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# Platia Magoula Zarkou
# The Neolithic Period

## Environment, Stratigraphy and Architecture, Chronology, Tools, Figurines and Ornaments

Eva Alram-Stern
Kostas Gallis
Giorgos Toufexis (Eds.)

AUSTRIAN
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OF SCIENCES
PRESS

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Platia Magoula Zarkou
The Neolithic Period

AUSTRIAN ACADEMY OF SCIENCES
Austrian Archaeological Institute
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Eva Alram-Stern – Kostas Gallis – Giorgos Toufexis (Eds.)

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PRESS

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# Preface by the Series Editor

The 23rd volume of the OREA series presents the Neolithic key site Platia Magoula Zarkou in Greek Thessaly. This multi-authored book demonstrates impressively the scientific value of well-excavated and contextualised archaeological data, which form the unique and primary source in studying past societies. The presented outcome is based on the excavations by Kostas Gallis conducted in the 1970s and 1980s. Basic research in archaeology is a long-term process and requires consistent, patient and persistent scholars, particularly when aiming at a final publication of archaeological fieldwork. It is to the excavators' credit that they developed the strategy for realising a publication by inviting Eva Alram-Stern, a well-known expert in our field not only for the scientific aspects of Neolithic Thessaly but also for her talent in dealing with and reliably publishing old excavation data. She designed and managed an FWF project by inviting participation from Greek and international well-known senior experts as well as early career researchers and PhD students, who contributed substantially to the interlinked approach of this publication project.

Studying, documenting and interpreting old excavation data can be a challenging and difficult task, but is definitely worth pursuing, as demonstrated in the present volume *Platia Magoula Zarkou. The Neolithic Period. Environment, Stratigraphy and Architecture, Chronology, Tools, Figurines and Ornaments,* edited by Eva Alram-Stern, Kostas Gallis and Giorgos Toufexis. The editors and authors created a combination of studying and presenting the main data and finds, partially integrated into an interdisciplinary approach and supplemented by new scientific and geo-archaeological investigations for a state-of-the-art environmental embedding of the tell. The volume offers detailed information on the excavations, stratigraphy, architectural remains and their absolute dating, all deriving from the one deep trench on the top of the tell and forming the scientific basis for the following core chapters. The detailed studies of the chipped stones are accompanied by new scientific analyses of their use wear as well as of the raw materials – both offer new and exciting insights into the function, source management and exchange networks of the agricultural communities in the 6th millennium calBC. The macrolithics, bone tools and textile production equipment demonstrate the variety, importance and quality of local production, as well as their integration into the wider late Neolithic (Greek) Aegean networks by means of skills, technologies, morphologies and styles.

Another core chapter is dedicated to the famous house model, not only studied and discussed for the first time with regard to many detailed aspects, but also re-evaluated and newly interpreted from ritual, gender and social perspectives. The Neolithic ornaments made of shell, bone, stone and clay are presented in detail, followed by a chapter on the faunal and floral remains, including some contextual and environmental interpretation, continued by a socio-cultural modelling of the site in its landscape discussed as physical and social Neolithic landscapes. The third core part of this volume successfully managed the synoptic combination of the experts' chapters into a summary of selected aspects of the late Neolithic community's life within an integrative and interpretative approach. The interested reader is offered new insights into household-based life, evidence of on-site activities, production and subsistence, the management of (lithic) sources and ritual practices at the late Neolithic Platia Magoula Zarkou.

Overall, I sincerely congratulate the authors and editors on realising this publication of the Platia Magoula Zarkou remains excavated half a century ago. This book represents a potential role model for comparable future attempts in dealing with unpublished excavations from the 20th century. The fruitful collaboration of the local authorities, Greek and international scientists, the combination of ECRs with senior archaeologists, as well as the integration of new

geo-archaeological fieldwork and scientific analyses, in my opinion demonstrate best-practice aspects. Not least, the initiative for this volume and the active engagement of the excavator Kostas Gallis in the publication process deserves the greatest respect.

The realisation of this book was possible due to the funding from the Austrian Science Fund (FWF) and plenty of support from the Department of Prehistory and West Asian/Northeast African Archaeology (former OREA institute) of the Austrian Archaeological Institute of the Austrian Academy of Sciences by means of technical, graphical, logistical, intellectual, financial and practical support from many members of our team. Additional funding was provided by several funding programmes of the Austrian Academy of Sciences. My sincere thanks are expressed to Ulrike Schuh for managing the publication and editing process and to Nicola Wood for the English editing. Finally, I thank the Austrian Academy of Sciences Press for the continuous high-quality publication of the OREA series, of which the present book represents the 23rd volume.

Barbara Horejs
Scientific Director of the Austrian Archaeological Institute
Vienna, 16 June 2022

# Preface

This book is the first volume of the final publication of the Neolithic contexts and finds from the tell site of Platia Magoula Zarkou in western Thessaly which was excavated by Kostas Gallis from 1976 till 1990. The aim of this excavation was to prove a new chronology of the Late Neolithic period which had been suggested by the synchronous appearance of pottery of the early Late Neolithic Tsangli phase and the 'final' Late Neolithic so-called Larissa phase found at the nearby cemetery of Platia Magoula Zarkou. To this end, Kostas Gallis established a deep trench on top of the tell. This trench not only proved the newly suggested chronology in the settlement based on its pottery, but also produced an uninterrupted sequence of strata and finds from the earlier phases of the Middle Neolithic to the earlier phases of the Late Neolithic period. Furthermore, an open house model including nine figurines and three miniature objects (one movable, two fixed) became one of the most prominent finds of the Thessalian Neolithic period.

During the following years, Kostas Gallis published a number of articles on the new chronology based on the pottery sequence as well as on the house model. Furthermore, he invited French archaeologists in the 'Mission Néolithique de Thessalie' and German specialists, namely Jean-Paul Demoule and Gerwulf Schneider, to study and present the pottery of the site as regards its technological and stylistic development and its relation to other regions of Thessaly.

However, neither the excavation nor its finds were ever presented extensively in a final publication. For this, Kostas Gallis, director emeritus of the Ephorate of Antiquities of Larissa, and its vice-director Giorgos Toufexis invited Eva Alram-Stern to develop a project for the study and publication of the stratigraphy and the finds. From the very beginning it became clear that only an international team of specialists would be able to study these rich and diverse groups of material. Therefore, Eva Alram-Stern – assisted by Areti Pentedeka – applied to the Austrian Science Fund for a stand-alone project in 2014 with the aim of presenting Platia Magoula Zarkou as a type site on the edge of the Western Thessalian Plain and demonstrating cultural change during the 6$^{th}$ millennium BC, i.e. the Middle Neolithic and Early Late Neolithic periods of Greece.

The project was accepted in the same year (FWF P27159), and housed at the Austrian Archaeological Institute, Department of Prehistory & West Asian/Northeast African Archaeology of the Austrian Academy of Sciences, with the Ephorate of Antiquities of Larissa – Diachronic Museum of Larissa as the international cooperation partner. So, based on this financial support and provided with a splendid infrastructure in the laboratories of the Diachronic Museum of Larissa by the Ephorate of Larissa, Kostas Gallis, Giorgos Toufexis and Eva Alram-Stern were able to invite a number of specialists who were familiar with Neolithic Thessaly, or even with the material of the site itself, to contribute to the publication.

The stratigraphy and architecture of the excavated trench was studied by Giorgos Toufexis, who, as a member of the excavation team, had already been responsible for the excavation in the last excavation campaigns, and by Christos Batzelas. For this, Kostas Gallis entrusted them with all the excavation archives. Giorgos Dallas scanned the photographs and took aerial photos of the site. For the processing of the data, Christoph Schwall provided advice in several cases. The results were particularly fruitfully discussed with Kostas Gallis, Anna Stroulia, Stella Souvatzi, Rozalia Christidou, Catherine Perlès as well as Agathe Reingruber and Stella Kyrillidou. Financed by the Holzhausen Legate of the Austrian Academy of Sciences, the editing of the plans for publication was undertaken by Anja Buhlke.

The pottery was studied by Areti Pentedeka who – through her petrographic expertise – was familiar with the material from her dissertation. In addition to this chemical and geological approach, pottery was also studied for its typology and its technology, creating an important backbone for the

publication. For drawings and photography, Areti Pentedeka was assisted by Ourania Exarhou, Sarah Eder and Stephanie Horwath (Austrian Archaeological Institute). The drawings were partly financed by the Stiftung der Familie Philipp Politzer (Foundation of the Family Philipp Politzer) of the Austrian Academy of Sciences. For the chemical analyses, she was supported by Gerwulf Schneider and Malgorzata Daskiewicz. Experimental firing of grey on grey ware was carried out by Loe F. H. C. Jacobs. Very soon it became clear that this part of the project was too large to be published together with the other finds and findings in one volume. Therefore, we decided to present it in a separate volume.

As to the tools, the chipped stone tools were analysed by Catherine Perlès (CNRS – Centre national de la recherche scientifique), who was already part of the French team which had studied the material in the 1980s, as well as by Lygeri Papagiannaki for use-wear analysis. Lygeri Papagiannaki's work in Larissa was supported by a grant from the UMR (unités mixtes de recherche) 7264 (CEPAM – Cultures et Environnements – Préhistoire, Antiquité, Moyen Âge). Catherine Perlès' stay in Larissa in 2016 was funded through the stand-alone project Platia Magoula Zarkou (PMZ) of the Austrian Academy of Sciences, while her trips in 2017 and 2018 were facilitated by grants from her laboratory, the UMR 7055. The respective laboratories supported not only the fieldwork, but also all the work done before and after this. Sylvie Beyries accepted to come to Larissa twice to discuss her determinations with Lygeri. Niccolò Mazzucco studied the materials with regard to their use as agricultural tools and most generously shared all his observations with the team. In addition, chemical analyses executed by Michael Brandl (Austrian Archaeological Institute) in cooperation with the University of Graz allowed a closer insight into the provenance of radiolarites.

The macrolithic (or ground stone) assemblage was analysed by Anna Stroulia with funding from the PMZ grant of the Austrian Academy of Sciences. Elsa Zilou expertly cleaned the surfaces of several tools and Rania Exarhou did the drawings. Vasilios and Margarita Melfos identified the macrolithic raw materials and addressed geology-related questions. Vasilios and Margarita Melfos, Michael Brandl, Giorgos Toufexis, Christos Batzelas, and Matina Karageorgiou participated in the raw material surveys. Giorgos Toufexis provided constructive feedback on earlier versions of the macrolithic chapter. Michael Strezewski helped with editing and offered technical support, while María Antonia Negrete Martínez put together the illustrations. Last but not least, Christos Batzelas ungrudgingly dealt with myriad stratigraphy-related questions and solved many practical problems.

The analysis of the bone artefacts was carried out by Rozalia Christidou at the Diachronic Museum of Larissa (2015 and 2017), and at the Wiener Laboratory of the American School of Classical Studies in Athens (2017 and 2019). Panagiotis Karkanas and Dimitris Michailidis provided access to and helped with the new Wiener Laboratory facilities.

The clay tools were studied by Eva Alram-Stern, and the textile tools were analysed in the course of a dissertation project by Christopher Britsch (Austrian Archaeological Institute). Much discussion on this subject came from Christoph Schwall (Austrian Archaeological Institute). The drawings and photos were arranged by María Antonia Negrete Martínez.

Eva Alram-Stern was privileged to be entrusted with the analysis of the figurines, including the house model. For this, she was supported by a digitised recording of the figurines made by Mario Börner (Austrian Archaeological Institute) on a portable 3D scanner. The drawings and photos were processed by Mario Börner and David Blattner and put together for publication by María Antonia Negrete Martínez. Argyris Fassoulas and Nektaria Alexiou shared their unpublished works on Thessalian Neolithic figurines, and Nancy Krahtopoulou (Ephorate of Karditsa) provided her with unpublished information on figurines from her surveys. Furthermore, Giorgos Toufexis, Catherine Perlès and Tracey Cullen discussed this chapter with her extensively and enabled her to take a fresh look at the material. Fruitful discussions about the house model and the architecture of the site inspired the Ephorate of Larissa to produce a short film disseminating a narrative on the making and interpretation of the house model. The film was awarded the First Prize in the international contest 'Museums in Short' 2020.

Nina Kyparissi, who had already included the ornaments in her dissertation, took responsibility for publication of the same. With the help of Giorgos Toufexis and Christos Batzelas, the ornaments were located in the plans and separated by phases. Additionally, Christos Batzelas produced drawings of the ornaments, and Rania Exarhou undertook their digital transformation. Giorgos Dallas, the photographer of the Ephorate of Larissa, photographed the ornaments with sensitivity and respect.

These studies were supplemented by summarising chapters by Paul Halstead on the economy and by Stella Souvatzi on the society of the site in relation to its surroundings.

Chronology is one of the backbones of this project. Consequently, the project was supplemented by radiocarbon dating of the stratigraphy of the site, financed by the Institute of Aegean Prehistory and the Dr. Anton Oelzelt-Newin'sche Foundation of the Austrian Academy of Sciences. The data were processed at the Klaus-Tschira-Archäometrie-Zentrum at the Curt-Engelhorn-Zentrum Archäometrie in Mannheim by Ronny Friedrich, and Bernhard Weninger processed them according to his Gaussian Monte Carlo Wiggle Matching program. In addition, Agathe Reingruber shared with us her results on the old data from the cores extracted in the course of the topographic studies by Tjeerd van Andel.

While the main aim of the Science Fund project was the publication of the finds, for the final publication, research was extended to the geological history of the area as well as to the topography of the area around the tell. The geology of the Peneiada was studied by Riccardo Caputo and his team. In order to improve our knowledge on the composition of the Peneiada plain, a 61m-deep bore hole was drilled close to the Peneios River, financed by the Dr. Emil Suess Legacy of the Austrian Academy of Sciences. The prehistoric topography of the tell had already been studied by Tjeerd van Andel in the 1990s. To gain a better insight into the activities around the tell, a geophysical prospection project was undertaken, directed by Apostolos Sarris (Digital Humanities GeoInformatics Lab, Archaeological Research Unit (ARU), Department of History and Archaeology, University of Cyprus), under the auspices of the Ephorate of Trikala and financed most generously by the Holzhausen Legacy of the Austrian Academy of Sciences. For this, we are most grateful to the Ephorate of Trikala and Ephor Krystallia Mantzana for the permit and her most generous help with the geophysical prospection.

In November 2017 the entire team met at the Austrian Archaeological Institute in Vienna and discussed their raw manuscripts. This workshop was the backbone for bringing together the data and results of the various specialists. We thank the Institute, especially Barbara Horejs, for hosting the publication team.

In consequence, our thanks go to the sponsors of this project, as well as all the collaborators on this project who made it possible to have this book published. Our special thanks go to the current director of the Ephorate of Antiquities of Larissa, Stavroula Sdrolia, and her predecessor, Anthi Batziou, for enabling this project in general and especially for providing us with a large working space in the restoration workshops of the Diachronic Museum of Larissa for the duration of the entire project.

Giorgos Toufexis was responsible for the administration of the project in Larissa, for the applications necessary for the various permits, and for the cooperation with the Ephorate. Christos Batzelas inventoried the finds and selected them for the specialists. Both of them were involved in any discussion of the finds as regards their stratigraphic or horizontal contextualization. Furthermore, they were the ones who gave constructive feedback to all the specialists and who helped with all their problems and questions. Christos Batzelas in particular was a constant help to all collaborators during the whole project, and without him the project would never have come to a successful end. Therefore, the whole team offers its warmest thanks. All of us appreciate what he did for the project and for us. In addition, we are most grateful to the excavation teams and the personnel of the Ephorate of Antiquities of Larissa, particularly the conservators and the guards of the Diachronic Museum.

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Vienna – Larissa, 1 June 2021

Eva Alram-Stern
Kostas Gallis
Giorgos Toufexis

Map 1 Map of Greece, showing the sites mentioned in the text (A. Buhlke)

1 Platia Magoula Zarkou/Pref. Trikala
2 Koutsaki Magoula/Pref. Trikala
3 Theopetra Cave/Pref. Trikala
4 Kephalovryso Magoula/Pref. Trikala
5 Damasi 4/Pref. Larissa
6 Argissa (Dendra 1)/Pref. Larissa
7 Otzaki (Dendra 2)/Pref. Larissa
8 Arapi (Giannouli 1)/Pref. Larissa
9 Mezourlo, Larissa/Pref. Larissa
10 Larissa 2 (Neraida)/Pref. Larissa
11 Souphli (Larissa 9)/Pref. Larissa
12 Makrychori 2/Pref. Larissa
13 Makrychori 1/Pref. Larissa
14 Rachmani (Makrychori 4)/ Pref. Larissa
15 Sykourion/Pref. Larissa
16 Deleria 1/Pref. Larissa
17 Ambelonas, Sofades/Pref. Karditsa
18 Ag. Sophia/Pref. Larissa
19 Domeniko 1/Pref. Larissa
20 Palaiochori Magoula/Pref. Karditsa
21 Votanikos Kipos/Lake Plastiras/ Pref. Karditsa
22 Zaimi/Pref. Karditsa
23 Agiopigi/Pref. Karditsa
24 Orgozinos/Pref. Karditsa
25 Prodromos 1/Pref. Karditsa
26 Prodromos 2/Pref. Karditsa
27 Prodromos 3/Pref. Karditsa
28 Makrychori/Kambos area/ Pref. Karditsa
29 Myrine-Ag. Varvara/Pref. Karditsa
30 Ag. Theodoros-Voulgarolakka/Pref. Karditsa
31 Paliouri/Pref. Karditsa
32 Mavrachades-Tataria/Pref. Karditsa
33 Mavrachades/Pref. Karditsa
34 Imvrou Pigadi Magoula/ Pref. Phthiotida
35 Koutroulou Magoula/Pref. Phthiotida
36 Theophani Magoula/Pref. Karditsa
37 Megalo Pazaraki/Pref. Karditsa
38 Margarita Magoula/Pref. Karditsa
39 Sofades/Pref. Karditsa
40 Tzani Magoula/Pref. Karditsa
41 Rizava Magoula/Pref. Karditsa
42 Tsangli/Pref. Larissa
43 Achilleion/Pref. Larissa
44 Vasilis/Pref. Larissa
45 Zoodochos Pigi/Pref. Larissa
46 Chalkiades 2/Pref. Larissa
47 Zappeio 5/Pref. Larissa
48 Astritsa/Pref. Karditsa
49 Sykeon Magoula/Pref. Karditsa
50 Aliphaka Magoula (Kastro 1)/ Pref. Larissa
51 Koilada 1/Pref. Larissa
52 Mandra/Pref. Larissa
53 Mesorachi 1/Pref. Larissa
54 Magoulitsa (Larissa 7)/Pref. Larissa
55 Galini 1/Pref. Larissa
56 Chalki 3/Pref. Larissa
57 Chalki 1/Pref. Larissa
58 Amygdali 1/Pref. Larissa
59 Palioskala/Pref. Larissa
60 Chatzimissiotiki (Stefanovikeio 5)/ Pref. Magnesia
61 Karamourlar Magoula (Stefanovikeio 2)/Pref. Magnesia
62 Rizomylos 2/Lake Karla/ Pref. Magnesia

Map 2 Map of Thessaly, showing the sites mentioned in the text (A. Buhlke)

63 Visviki Magoula (Velestino 4)/ Pref. Magnesia
64 Omvria, Velestino/Pref. Magnesia
65 Thermokipia, Mavrovouni/ Pref. Magnesia
66 Sesklo/Pref. Magnesia
67 Dimini/Pref. Magnesia
68 Kazanaki near Volos/Pref. Magnesia
69 Petromagoula/Pref. Magnesia
70 Pefkakia/Pref. Magnesia
71 Pyrasos/Pref. Magnesia
72 Belitsi Magoula/Pref. Magnesia
73 Perdika 1/Pref. Magnesia
74 Perdika 2/Pref. Magnesia
75 Karatsadagli/Pref. Magnesia
76 Zerelia/Pref. Magnesia
77 Almyros 2, Ambelia/Pref. Magnesia
78 Almyriotiki/Pref. Magnesia
79 Pournarolakka/Pref. Magnesia
80 Kamara/Pref. Magnesia
81 Stournareika/Koziakas Mountains/ Pref. Karditsa
84 Servia/western Macedonia
85 Nea Nikomedeia/western Macedonia
86 Mikro Nisi Akrinis/western Macedonia
87 Archontiko, Giannitsa/western Macedonia
88 Ag. Christophoros/western Macedonia
89 Kleitos I and II, Pref. Kozani/western Macedonia
90 Koromilia/western Macedonia
91 Kremasti Koilada (Toumba)/western Macedonia
92 Limnochori II/western Macedonia
93 Pontokomi-Souloukia/western Macedonia
94 Varemenoi Goulon/western Macedonia
95 Megalo Nisi Galanis/western Macedonia
96 Grevena region/western Macedonia
97 Piges Koromilias Cave (Kastoria)/ western Macedonia
98 Dispilio/western Macedonia
99 Paliambela/central Macedonia
100 Makriyalos/central Macedonia
101 Mesimeriani/central Macedonia
102 Angelochori/central Macedonia
103 Apsalos/central Macedonia
104 Avgi/central Macedonia
105 Koronia/central Macedonia
106 Olynthus/central Macedonia
107 Heliotopos, Langada/central Macedonia
108 Prophitis Langada/central Macedonia
109 Sosandra/central Macedonia
110 Stavroupoli, Thessaloniki/central Macedonia
111 Vasilika/central Macedonia
112 Toumba Thessalonikis/central Macedonia
113 Thermi B/central Macedonia
114 Dikili Tash/eastern Macedonia
115 Sitagroi/eastern Macedonia
116 Promachonas-Topolniča/eastern Macedonia
117 Makri/Thrace
118 Paradeisos/Thrace
119 Elateia/Phthiotida
120 Chaironeia/Boeotia
121 Ag. Petros/northern Sporades
122 Cyclops Cave/northern Sporades
123 Skoteini Cave, Tharrounia/Euboea
124 Saliagos near Antiparos/Cyclades
125 Zas Cave, Naxos/Cyclades
126 Ftelia, Mykonos/Cyclades
127 Akrotiri, Santorini/Cyclades
128 Yali/Dodecanese
129 Kitsos Cave/Attica
130 Ag. Kosmas/Attica
131 Aegina-Kolonna/Saronic Gulf
132 Corinth/Corinthia
133 Tsoungiza, Nemea/Corinthia
134 Franchthi Cave/Argolid
135 Asine/Argolid
136 Lerna/Argolid
137 Berbati-Limnes Survey Findspot 39/ Argolid
138 Mycenae/Argolid
139 Tiryns/Argolid
140 Klissoura Cave/Argolid
141 Ayioryitika/Arcadia
142 Limnes Cave/Arcadia
143 Kouphovouno/Laconia
144 Alepotrypa Cave/Laconia
145 Drakaina Cave/Kefallonia
146 Kastritsa/Epirus
147 Klithi, Vikos Gorge/Epirus
148 Boila, Vikos/Epirus
149 Knossos/Crete
150 Kommos/Crete
151 Mallia-Quartier Mu/Crete

# I. Introduction: Chronicle of Excavations and Research 1974–1990

*Kostas Gallis*

*As you set out for Ithaca*
*wish your journey to be a long one,*
*full of adventure, full of discovery.*

*Have Ithaca always in your mind,*
*arriving there you are destined for,*
*but do no hurry the journey at all.*

Ithaca, by K. P. Kavafis

## I.1. The History of the Excavations

As I start writing these lines, my mind goes to the phrase that "even the longest route always starts with a first step". So, the first step of the long route which was the adventure of the excavation at Platia Magoula Zarkou (PMZ) was taken on an early May afternoon in 1974, by spotting at the bottom of a newly opened irrigation canal, just 300m north of the prehistoric site of PMZ, some scanty sherds of Neolithic pottery and tiny burnt human bones. This was not an accidental find but the result of a long-lasting observation of the work of opening irrigation canals in various regions of the Thessalian plain within a project by the Greek Agricultural Service of redistribution of land and change of cultivation from the traditional crops (wheat) to more profitable ones (cotton and sugar beets). This observation was conducted during topographic research, in an effort to spot more prehistoric sites, which led to the compilation of the 'Atlas of the prehistoric sites of the Eastern Thessalian plain'.[1] It was not possible to spot Neolithic burials by only visual surface observation as there were no marks on the ground, such as we find for later times (Bronze Age and later), plus the fact that the surface of the plain has risen as a result of alluvial deposition since the Neolithic times. So, we thought that it might be possible to spot Neolithic cemeteries by watching the opening of irrigation canals where they passed near prehistoric sites (the magoules). This effort finally yielded results in two cases: at PMZ (30km west of Larissa), which concerns us here, and at Souphli Magoula (5km north of Larissa).

At PMZ a short three-day test excavation in May 1974 was initially undertaken which brought to light at the bottom of the irrigation canal urns containing burnt human bones, in some cases accompanied by a smaller pot which gave the impression that it was deposited as an offering. The systematic excavations, which followed in 1976, revealed part of a Neolithic cemetery, dated to the beginning of the Late Neolithic, situated 300m north-northeast of the settlement. It consisted exclusively of cremation burials in urns. In some cases the urns were accompanied by a smaller pot (an offering), in others, they were covered by another pot or buried upside down.[2]

[1] Gallis 1992a; see also Gallis 1975; Gallis 1992b; Gallis 1994.
[2] Gallis 1982; Gallis 1996c, 172–173; Gallis 1996d, 528–531.

At that time, i.e. during the 1960s and 1970s, there was a strong dispute about the dating of the black burnished pottery of the so-called Larissa Culture: the question was if this characteristic pottery style dated to the end of the Late Neolithic, as supported by Vladimir Milojčić, or to the beginning of the Late Neolithic, as was the view of Fritz Schachermeyr, to which chronological horizon (beginning of the Late Neolithic) the grey ware of Tsangli type had been assigned from the outset.[3] The finding, in the cremation cemetery, of pots belonging to both categories – sometimes in the same burial – showed that this problem could be solved by an excavation in the site itself. So, we started in the same excavation period of 1976 an excavation at the top of the magoula, scheduled from the beginning to be a stratigraphic one, by opening one single trench (Fig. I.1). We were optimistic that we would soon reach the Neolithic strata and solve the problem.

This first excavation on the magoula itself was short (02/06/1976 till 14/07/1976) and brought to light, immediately below the surface, disturbed habitation strata dated to the Early and Middle Helladic.

The stratigraphic excavation was resumed in 1981, because from 1977 till 1980 we were occupied with the study and preparation for publication of the cremation cemetery mentioned above, which was published in 1982.[4] During the subsequent period (17/08/1981 till 23/09/1981), Early and Middle Bronze Age habitation strata kept coming to light.

So this was the situation when we resumed excavation in 1983. In the trench, we had almost reached the level of the surface of the plain surrounding the magoula, without reaching any Neolithic strata. We thought that we were at nearly the same level as the Neolithic cemetery just 300m north of the settlement, without finding any trace of Neolithic. On the other hand, Early Helladic habitation strata continued to come to light at a depth lower than 4m, without us even being sure

Fig. I.1 Trench A (18.8.1981)

[3] Gallis 1992a, 49–65 for discussion and relative bibliography.
[4] Gallis 1982.

if we were in the beginning of the Early Helladic. We estimated that if the Late Neolithic sequence existed uninterrupted (i.e. Tsangli, Arapi, Otzaki, Classical Dimini phases), we would still need to excavate a considerable thickness of habitation levels before reaching the beginning of the Late Neolithic.

We started to wonder if the Neolithic habitation was perhaps located in some other spot of the magoula. So, on 23/6/1983, we opened a trial trench in the western foothills of the magoula (Trench B) and, on 5/7/1983, another one in its southeastern foothills (Trench C). In both trenches the surface layers were disturbed by ploughing, as the ploughing of the surrounding fields extended as far as the foothills of the magoula. The prevailing pottery here was also Early Helladic. In the summer of 1983 digging continued in parallel in all the three trenches (A, B and C). It was at this stage of the excavation when, on 30/6/1983, the digging brought to light, in the main original trench (Trench A), at a depth of 3.40–3.45m the first, Neolithic sherds. And they were grey pottery of the thin, very well-fired fabric of the Tsangli type, dating to the beginning of the Late Neolithic according to the hitherto prevailing view of Neolithic chronology.

Together with the Tsangli ware of all types (plain grey and grey on grey) we uncovered – but in much smaller quantities – black burnished pottery characteristic of the so-called Larissa Culture. These two categories of pottery (grey and black burnished, in all their varieties, coexisted in the subsequent levels to a depth of 5.30m). The grey ware was always found in more abundant quantities than the black pottery, thus strongly suggesting the existence of a centre of production of this characteristic pottery somewhere in western Thessaly.

Two years earlier (November 1981), similar observations had been made in a short stratigraphic excavation at Makrychori 2, in the Eastern Thessalian Plain, just 15km north of Larissa. There the coexistence of Tsangli grey ware with the black burnished pottery of the Larissa Culture was also confirmed.[5] In Makrychori 2 the excavation reached the sterile layer just below the Tsangli strata, but there this phase (Tsangli) was followed uninterruptedly by the pottery characteristic of the Arapi phase. In the case of Makrychori 2, in contrast to PMZ, the grey Tsangli pottery was very scarce, while the black burnished pottery was much more abundant, strongly suggesting the existence of a centre of production of the black burnished pottery in eastern Thessaly.

The coexistence of these two categories of pottery (Tsangli and Larissa) in the cemetery of PMZ (excavation periods 1974 and 1976), in the same stratigraphic horizon in Makrychori 2 (1981) and, finally, in the settlement of PMZ (1983) confirmed beyond any doubt that they were synchronous, belonging to the same chronological horizon of the beginning of Late Neolithic, hence named Tsangli-Larissa.

Once Neolithic strata started being revealed in Trench A, on 27/09/1983 we halted the excavation in the other two trenches (B and C) and continued the excavation only in the original main trench A.

## I.2. Pottery Analyses

Meanwhile, from 1979 on, an archaeometry programme in collaboration with the Institute of Inorganic Chemistry of the Free University of Berlin started (at that time Germany was still divided). In this institute its hardworking director, Heinrich Knoll, and his then assistant, Gerwulf Schneider, had organised a special workshop (Arbeitsgruppe Archäometrie) analysing archaeological artefacts of various periods from various parts of the world (Fig. I.2).

One of the objectives of the archaeometry programme was to try to spot possible places of production of characteristic categories of pottery, which it was apparent had been produced somewhere in Thessaly and dispersed to a wider area from these centres of production. The excavation of PMZ contributed a considerable bulk of well-stratified pottery (Middle Neolithic and beginning

[5] Gallis 1985a; Gallis 1987; Gallis 1996b, 121.

Fig. I.2 From left: Heinrich Knoll, Claude Björk, Gerwulf Schneider, Jean-Paul Demoule, Kostas Gallis and Giorgos Toufexis in the old laboratory of the Ephorate of Antiquities of Larissa (23/6/1992)

Fig. I.3 Karen Vitelli experimenting with scraped ware in the old laboratory of the Ephorate of Antiquities in Larissa (Summer 1988)

of the Late Neolithic), which was used in the aforementioned archaeometry programme.[6]

Two of the main elements which were taken into consideration in the relative analyses were chromium and nickel. The clay in the Thessalian plain is generally rich in chromium, which is washed down from the ophiolithic rocks of the surrounding mountains. By contrast, the clay of the characteristic grey Tsangli ware has a low percentage of chromium nickel. So, one of the first (striking) results coming out from the relative analyses was that – by an ironic coincidence – the characteristic grey Tsangli pottery was not produced in the homonymous site, as the clay in that region is rich in chromium nickel.

Actually, there are chromium mines in this spot, the modern name of Tsangli being Eretria. It was the digging for the construction of a line to connect the mines with the passing railway line, which cut the side of the magoula, which led Alan John Bayard Wace and Maurice S. Thompson to excavate at the site in 1910, producing, among other things, large quantities of the characteristic grey pottery.[7]

6 Schneider et al. 1991.

7 Wace – Thompson 1912, 86–149; Theocharis 1973, 79.

The stratigraphic excavation at PMZ showed very clearly that this grey pottery evolved from the Middle Neolithic linear 'scraped' ware, through a transitional phase with pottery that was grey inside (reducing atmosphere) and orange (scraped or linear decoration) outside (oxidising atmosphere), which can be called 'protogrey', and marks the even evolution from the Middle Neolithic to the Late Neolithic.[8] This evolution of the pottery was studied together with a team of archaeologists from Paris under the direction of Jean-Paul Demoule and Kostas Gallis.[9] Since the abundance of this ceramic style was first recognised in PMZ, we named this phase the 'Zarko Phase'.[10] We had been very puzzled, though, about the way 'scraped' ware was produced, and to clarify this we turned to Karen D. Vitelli of Indiana University, who carried out relevant experiments in the laboratories of the Ephorate of Antiquities (Fig. I.3). She reached the most interesting result that identical designs could be achieved either by removing paint (scraping technique) or by adding it.[11]

## I.3. The House Model

In the progress of the excavation, still in the excavation period 1983, in the undisturbed layers outside an Early Helladic 'bothros', near the eastern side of the trench, an unexpected find came to light: it was when we started to remove another 'floor of habitation' from the beginning of the Late Neolithic (Floor S16/22 of the excavation diary or Surface 22 in the present volume), that an unroofed house model with nine figurines and one movable miniature object inside started to come to light (Fig. I.4).[12]

The house model is like a real maquette of the house itself with its furniture and the persons in it: it is an unroofed house model with its entrance, a raised clay platform (bed) in the rear left corner and an oven, also in the rear wall, opposite the entrance. The oven has a protruding part in front of it ('parastia') like those found in Achilleion. Some tiny bits of red clay in the oven perhaps suggest fire. Between the oven and the raised clay platform there was an elongated object with grooves on its upper side, most probably representing a grinding stone.

The house model was found near a hearth, which constituted the most important spot ('hestia') in the house (Fig. I.5). It did not seem to be associated with any architectural structure; it was just in the 'debris' below the Surface S16/22 mentioned above. Its highest point was just below the 'floor' and at a depth of 5.16m from the surface of the magoula.

Its highest point was the protruding belly of the female figurine, the most bulky and most impressive of all, the 'Lady of the House'.[13]

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8 This protogrey ware was abundant in later Middle Neolithic strata of Building Phases Vd to VIb, which have been subsumed by Areti Pentedeka under Ceramic Horizons 3 and 4: Pentedeka in press; Pentedeka in preparation; for a first analysis: Demoule et al. 1988, 17–18, 51, fig. 27.

9 Demoule et al. 1988.

10 Gallis 1987, 153; Demoule et al. 1988, 50; Schneider et al. 1991, 3; Gallis 2006.

11 Vitelli 1989.

12 Gallis 1985b. In earlier publications of this find eight figurines are mentioned. We hesitated to consider a very small clay object near the oven of the house model as a figurine, thinking that it was perhaps an object associated with the oven. In the course of the time and with more careful study, we concluded that it depicts a baby (the youngest member of the family). This was actually our first impression, recorded in the excavation diary at that time (see excavation diary pp. 362–364), i.e. that there are, in all, nine figurines; this is also the view of Eva Alram-Stern, who studied in detail the house model for the publication, see Alram-Stern, this volume, 473.

13 Marija Gimbutas characterised the whole as a 'shrine model' when I first presented it at the Institute of Archaeology in UCLA (University of California, Los Angeles). The first presentation of this find was made there in April 1984, only a few months after its finding, in the Symposium 'Hleb I Vino', in the presence of Marija Gimbutas, Colin Renfrew, Jane Renfrew, Lloyd Cotsen, Ernestine Elster, Liz Carter, Joan Carothers, Mark Stefanovich, Karen Vitelli and others.

Fig. I.4 The Neolithic house model (in situ) (22/9/1983)

From the conditions of its finding, it may be concluded that it was put there either before laying the floor of the house or after laying the floor and digging a pit into which it was set as a 'foundation offering'.[14] This house model is, so far, unique in Greece, not only as regards its own merit (structure and contents), but especially for the data preserved for the condition of its burying and finding. It is really like a maquette of the house and the household during the construction of that Neolithic house. It depicts its inhabitants at the time of its construction: a traditional family such as could be found even now in a peasant village: an old couple ('grandfather' and 'grandmother'), a young couple with their child and their little baby – perhaps during whose time the house was constructed – and three younger members of the family. It can be deduced that three generations of the inhabitants of the house are represented. One could suggest that there is an effort to render even the atmosphere of this home, the most imposing figure, the 'grandmother', was lying in a prominent place, on the raised clay platform. Near her, the 'grandfather' was lying on the floor; the old couple is in a rather loose position, as they are the oldest members of the family. The young couple is in a tight position, like an embrace. It seems that the artist wanted to show the age of the persons, depicted by the size of the figurines.

The three younger members (two girls and probably a boy) are in the rear back corner near the oven, in a secure place within the house. One is tempted to suppose that the bigger female figurine with slightly protruding breasts is the older girl, the older sister of the other two.[15] That figurine of the young maiden was found with its head missing; we are not sure if it was originally deposited so or if this happened accidentally when it was spotted, as it was on top of the rest – as if protecting the other two younger children.

[14] See also Soudsky 1969; Makkay 1983.

[15] For a different interpretation of these figurines see Alram-Stern, this volume, 475–481.

Fig. I.5 From left: Christos Samaras (conservator), Maria Lakaki and Kostas Gallis around the Neolithic house model in Trench A (22/09/1983)

One wonders if the house model was made unroofed in order to show its interior with its inhabitants, which otherwise could not be seen. The impression is that the house model with the figurines was made 'to order', to be used for just this purpose i.e. as a foundation offering.[16] This is shown by the lower part of the house model which is thick to endure the pressure and with a rough surface, not so well finished as the interior and the contents. One is tempted to suggest that the house was probably the home of the potter who made the house model. The clay, the firing and the texture are very similar to the grey pottery of the Tsangli phase, which pottery also dates the house.[17]

It is obvious that the house model with its contents was intended to be viewed from its front, where the entrance is. It was deposited oriented towards the east, to be viewed from the east. The house floor where it was deposited extended to the east, beyond the side of the trench. If the excavation trench had been opened one metre to the west, we would have missed it. On the other hand, if the Early Helladic pit mentioned above, which reached to this depth, had been dug a little farther to the east, it would have destroyed it. Anyway, as it was buried immediately or very soon after being made, without being exposed, it was preserved nearly intact, with its interior as it was arranged by its Neolithic owners when it was deposited there c. 7600 years ago. It came to the light of the day again only during the excavation in 1983.[18]

16 For a different interpretation of the house model see Alram-Stern, this volume, 468–470.

17 Pentedeka in press; Pentedeka in preparation.

18 The house model has been included in many handbooks of archaeology and has been exhibited in many exhibitions at home and abroad. Now it is one of the highlights in the Diachronic Museum of Larissa.

## I.4. Continuation of the Excavations

As the excavation proceeded in 1983 the Middle Neolithic strata with all the characteristic varieties came to light: flame patterned, linear decoration, scraped decoration. Middle Neolithic pottery kept coming to light in deeper levels in the following excavation period in 1984 (21/5/1984 till 28/6/1984). As the objective of the excavation, which was the clarification of the stratigraphic/chronological position of the black burnished Larissa ware, was fulfilled, at the depth of 6m we limited the trench to half its original size (5m north to south × 4m east to west). Hearths and 'floors' of beaten earth still continued coming to light as well as stone tools, bone tools and animal bones.

In order to find out when the site was first inhabited, we decided to continue the excavation down to the sterile layer. We hoped that we would reach it soon, as it was apparent that in the trench we were already (at the depth of 6m) at a level lower than the surface of the plain around the magoula. Consequent habitation levels continued coming to light, with characteristic Middle Neolithic pottery, even to a depth lower than 7m (Fig. I.6). So, for economy of labour, at the depth of 7.40m on 05/06/1987, we decided to limit the dimensions of the trench even further, to half of the half (5m north to south × 2m east to west), always retaining the original width of 5m. Remains of walls kept coming to light at this depth, apparently well below the present surface of the ground around the magoula.

At the depth of 8.20m we reached the water table. The earth had turned to mud. It was impossible to continue. The workers assured us that in that region, when they opened wells, they reached water at this depth. So, in the excavation period 1987 (25/05/1987 till 11/06/1987), on

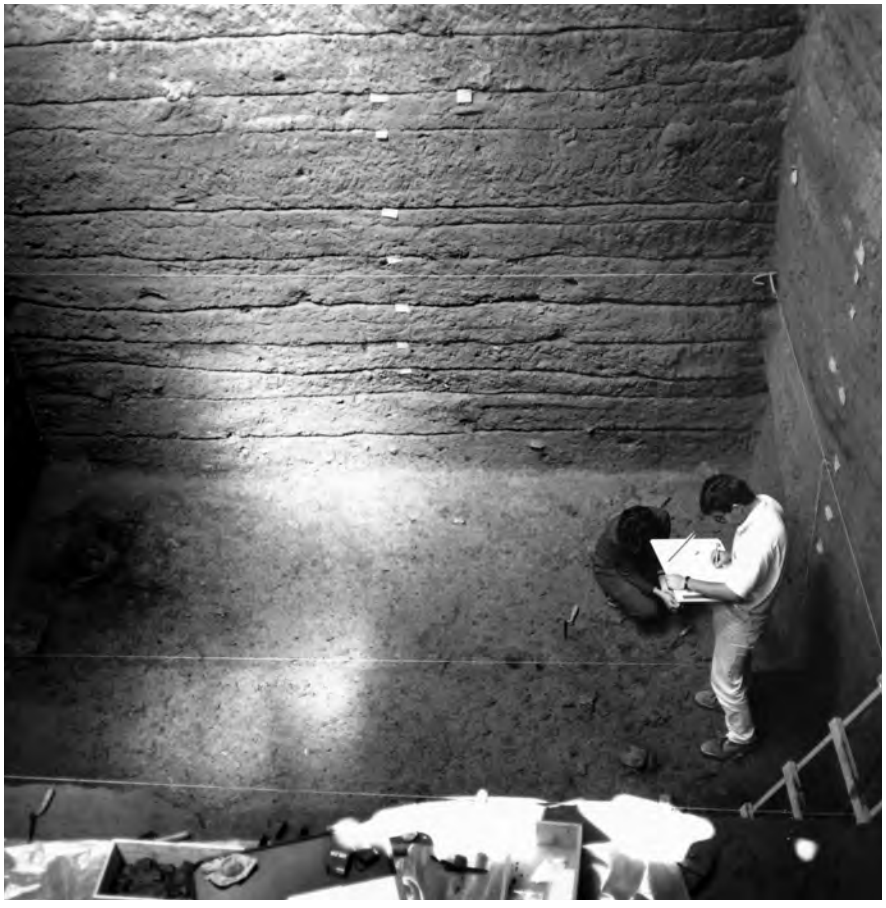

Fig. I.6 Trench A at 7.60m depth. On the right side, Giorgos Toufexis (05/06/1987)

Fig. I.7 Constructing a metal scaffold to protect the sides of Trench A (09/08/1990)

Fig. I.8 Protection panels along the sides of Trench A (16/08/1990)

11/06/1987, we had to halt the excavation, hoping for an opportunity to go deeper in the future, as it was obvious that the habitation layers continued further.

This opportunity came three years later, in 1990. It was a very dry year (according to the Institute Godart it was the driest year of the 20th century in Greece). The bottom of the trench was now completely dry. It was dangerous to work unprotected at a depth of 8.20m from the surface of the magoula. If a stone from the Bronze Age walls, in the top layers of the magoula, fell, it could be fatal. We built a metal scaffold and covered the upper part of the sides of the trench with styrofoam plates, in order to carry on the excavation at this depth in safety (Fig. I.7, Fig. I.8).

In the last excavation period (09/08/1990 till 28/09/1990) occupation deposits kept coming to light – like the stone foundations of walls as well as postholes until we reached the sterile layer at the depth of c. 10m. From the depth of 9.75m, as it became apparent that we were reaching the sterile layer, which consisted of pure clayey soil of greyish-greenish colour, we limited the excavation area once more, to 2 × 2m, in the northwestern corner of the original trench. Even in the lowest levels, characteristic Middle Neolithic pottery kept coming to light. We even dug for about one metre into the sterile layer to make sure that there were no farther traces of human activity. In the lowest part, in the very limited area of 2 × 2m, there came to light just a very short part of a ditch dug in the sterile soil.

Only a few weeks after the end of the excavation in September 1990, water started coming up in the bottom of the trench (Fig. I.9). The water table was rising again to its normal level for that region. There was a very serious danger of the trench collapsing at any time. So, urgent measures were taken to safeguard the lowest parts of the trench (the section 5 × 2m along the west side of the trench) by covering its sides with metal sheets, supported by metal rods across its width. This emergency work was supervised by Giorgos Toufexis, who had taken part in the excavation campaigns at PMZ since 1987.

After the end of the excavation, a metal pavilion was constructed above the trench to keep it dry and clean. So, one will be able to visit it in the future and see the stratigraphy (Fig. I.10, Fig. I.11).

Fig. I.9 The deepest part of Trench A flooded by aquifer waters (04/06/1991)

Fig. I.10 Metal pavilion above Trench A

Fig. I.11 Kostas Gallis and Marija Gimbutas (middle right side) in front of Trench A (16/9/1991)

## I.5. Geoarchaeological Investigation in the Area of the Site

We were puzzled that from the total thickness of 10m of the habitation levels at the site, only half of it was above the level of the surrounding plain and that the lower habitation strata extended so deep, even below the present water table. We had already, since 1976, had an indication from the excavation at the cemetery that the surface of the plain, at least in the region of the cemetery, had risen by 1m since the early Late Neolithic (Tsangli-Larissa phase). On the other hand, at the nearby Magoula Koutsaki, only 1.5km to the southeast of PMZ, Early and early Middle Neolithic sherds existed on the surface.

We discussed this question with Tjeerd van Andel, who at that time was in Thessaly, supervising the work of Ann Demitrack for her Ph.D. dissertation with the Stanford University.[19] He offered to investigate the area round PMZ by taking cores at the surrounding area and trying to see what the landscape was like in that region in Neolithic times. He hoped to furnish some answers to our questions about the habitation strata of PMZ in relation to the landscape. In collaboration with the Ephorate of Antiquities of Larissa, represented by the archaeologist G. Toufexis, he investigated the area from the Neolithic cremation cemetery to the north as far as the Peneios River to the south (Fig. I.12).[20]

The investigation pointed to a settlement that in Neolithic times lay at the side of some kind of flooded valley. While the habitation layers forming the magoula rose, the ground in the area was rising in parallel as a result of alluvial sedimentation. The Neolithic inhabitants of PMZ cultivated the land around their settlement, benefitting from the fertile soil from the alluvial deposits of the river. The investigation by van Andel laid the foundations for further investigation in that

[19] Demitrack 1986.
[20] Van Andel et al. 1995.

Fig. I.12 Geoarchaeological investigations in PMZ. Tjeerd van Andel doing field work (18/06/1991)

geoarchaeologically very interesting area and was advanced further by new research included in this publication.[21]

Looking back at this chronicle, I think that the excavation at PMZ is simply an example of the essence of scientific research, which is to ask questions and try to find the answers. During this process, new questions may arise, and one starts to find the answers to the new questions. Sometimes unexpected discoveries may occur, not scheduled from the beginning, which enrich our knowledge.

The excavation started by trying to answer the question of whether any organised cemeteries existed in Neolithic Thessaly, outside the settlements, and if they could be spotted. This question was answered by finding the first organised Neolithic cemetery (sixty cremation burials in urns), at a distance of 300m north of the site of PMZ.

The finding in the cemetery of urns belonging to two different ceramic categories (grey on grey Tsangli ware and black burnished Larissa ware) showed that it was possible to solve the problem of the stratigraphic position of the black burnished Larissa pottery, the chronological position of which was strong disputed at that time, as mentioned above. So the stratigraphic excavation at the site itself was begun, which clarified the chronological position of this characteristic black burnished pottery to the beginning of the Late Neolithic.

The existence, at this spot, of habitation levels well below the present surface of the plain, while Early and early Middle Neolithic finds were being found on the surface of the nearby Magoula Koutsaki, gave rise to the question of the geomorphological situation in that district in Neolithic times. This was illuminated by the research by T. van Andel and advanced by additional research carried out by Riccardo Caputo and Apostolos Sarris and their teams.[22]

[21] Caputo et al., this volume, 35–63.

[22] Caputo et al., this volume, 35–63; Sarris et al., this volume, 64–80.

## I.6. Radiocarbon Dates and Further Research on the Site

Particular provision was made during the excavation for systematic carbon sampling and today there is a good series of $^{14}C$ dates for most of the Neolithic strata. The first dates were published earlier and included in van Andel's investigation,[23] whilst they have also been re-examined by Agathe Reingruber and her colleagues.[24]

During the excavations, a large number of animal bones were collected, and eleven samples of charred plant remains were chosen for radiocarbon dating.[25] Another preliminary study was related to the chipped stone tool industry.[26]

## I.7. Conclusions

The rich data and the material of the excavations from 1976 till 1990 are the basis for this publication re-examining the architecture, stratigraphy and all finds from the tell. In addition, a geophysical survey in the area around the tell showed that the tell was encircled by a perimeter system and some areas below the tell were settled during the Bronze Age. In consequence, the rich data of PMZ may form the basis for organising a systematic excavation, particularly of the important, very well-preserved Early Helladic and Middle Helladic settlement which flourished in this strategic position, at the pass from the Western to the Eastern Thessalian Plain.

## I.8. Acknowledgements

Finishing this chronicle, my mind goes to the collaborators who took part at various stages of the long period of the excavation and the even longer period of the study of the finds and partial presentation of them in conferences and publications prior to this final publication. It is impossible to refer to all of them, covering a time span which started nearly half a century ago. They all knew how much I appreciated their help and how grateful I am to them for their contribution to the whole project.

I wish to address first wholehearted thanks to Giorgos Toufexis, archaeologist in the Ephorate of Antiquities of Larissa, who participated in the excavation of PMZ from 1987 on and over the course of the time evolved into a very efficient co-excavator. He offered precious help at various stages of the excavation and later in the study of the finds and the first publications. He also undertook all the administrative work demanded on the Greek side, for the publication project and the related fieldwork (geophysical and geological investigation) as well as for the study of the finds of the excavation by the various specialists. He even conducted additional investigations, in view of the present publication, where required.

I also express my warmest thanks to Christos Batzelas, who has been always very eager and, with immense patience, available to assist the various collaborators in their work with regard to the preparation of the present volume.

One of the oldest collaborators in the study of the finds of the excavation at PMZ is Ernestine Elster, who studied the flaked stone tools of the cremation cemetery and partially of the excavation in the settlement itself. I express my grateful thanks to her for her valuable help in presenting preliminary finds of the excavation (1984) and the final results (1991) at the Institute of Archaeology

[23] Gallis 1995, 214; van Andel et al. 1995,136; Gallis 1996d, 540, fig. 3.

[24] Reingruber et al. 2017, 44, fig. 13.

[25] Becker 1991; Jones – Halstead 1993; Becker 2000; re-evaluated by Halstead, this volume, 583–587.

[26] Elster 1994; published by Perlès-Papagiannaki, this volume 197–274. Also,Papagiannaki-Beyries, this volume, 275–288, Mazzucco, this volume, 289–290.

in UCLA (University of California, Los Angeles), for the warm hospitality in her beautiful, comfortable house facing the Pacific in Los Angeles during my lecture trips in the USA in 1984 and in 1991, and for her constant support and encouragement to pursue the publication of the excavation.

The study of the lithics was finally undertaken and completed for the final publication by Catherine Perlès. Beyond the thorough presentation of the flaked stone tools, Catherine Perlès with her expertise, offered invaluable help with her very useful discussions and suggestions, for the preparation of the present volume. I express to her also my grateful thanks.

Among the oldest collaborators, from the initial stages of the excavation, was the artist-conservator Christos Samaras, who offered invaluable help both at various stages of the excavation and later during the study of the finds for publication. Also, the archaeologist Maria Lakaki, who participated in the excavation at the period when the house model with the figurines inside came to light, stood out for her conscientious, careful and professional work. I owe to both of them special thanks.

One of the oldest collaborators is also Gerwulf Schneider (since 1979), who, under Heinrich Knoll, as mentioned above, undertook the great bulk of petrographic and chemical analyses of Neolithic pottery, work which was continued and will be presented in another volume of the PMZ publication. Also valuable has been the participation (since 1984) of Jean-Paul Demoule, assisted by Laurence Manolakakis, in the study of the pottery, particularly of the transitional period from the Middle to the Late Neolithic. A detailed examination of the pottery of this period from PMZ, with the use of the petrographic and chemical analyses, was made by Areti Pentedeka in her Ph.D. dissertation, who has undertaken the study of the pottery of PMZ for the final publication. I wish to stress at this point the very substantial contribution made by Karen Vitelli for understanding the technique of production of very special ceramic categories: scraped ware and grey ware (experimental archaeology). To all of them I express my warmest thanks.

Also, the work of Tjeerd van Andel and Curtis Runnels in the following year, after the end of the excavation, with the first $^{14}C$ dates appearing in it, laid the foundation for a very extensive geoarchaeological[27] and geophysical investigation[28] as well as an extended series of $^{14}C$ dates,[29] reports on which appear in the following chapters. I express to all of them my cordial thanks.

Finally, I express my grateful thanks to the Austrian Academy of Sciences and especially to dear Sigrid Jalkotzy (director emerita of the Mykenische Kommission of the Austrian Academy of Sciences), to Barbara Horejs (director of the Department of Prehistory & West Asian/Northeast African Archaeology of the Austrian Archaeological Institute, Austrian Academy of Sciences) and to Eva Alram-Stern (Department of Prehistory & West Asian/Northeast African Archaeology of the Austrian Archaeological Institute, Austrian Academy of Sciences) for undertaking the publication of the excavation of PMZ. In particular, I thank with all my heart Eva Alram-Stern who, responding to a proposal of mine, undertook the Heraclean task of organising the publication of the excavation: contacting and coordinating the colleagues who would study the various finds, organising and conducting additional research and investigations needed in view of the publication and finding the necessary funds for the whole task. It is difficult for me to find the appropriate words to thank her for the long and persistent work which was demanded, over the course of several years and sometimes in difficult and tiresome circumstances, bringing the whole task to a successful end. She even organised a very productive two-day workshop in the Austrian Academy of Science in Vienna, (on 9th–10th November 2017), where all the participants spoke about their contributions and discussed and exchanged ideas in view of the publication (Fig. I.13). I express my warmest thanks to all the contributors as an excavation is judged by its publication.

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27 Caputo et al., this volume, 35–63.

28 Sarris et al., this volume, 64–80.

29 Weninger et al., this volume, 183–195.

Fig. I.13 Participants of the conference on the results of the project 'Platia Magoula Zarkou in Thessaly/Greece. Cultural Change during the 6th Millennium BC', 9–10/11/2017 in Vienna. Left to right: Christoph Schwall, Anna Stroulia, Apostolos Sarris, Michael Brandl, Catherine Perlès, Gerwulf Schneider, Nina Kyparissi-Apostolika, Eva Alram-Stern, Loe Jacobs, Kostas Gallis, Giorgos Toufexis, Stella Souvatzi, Malgorzata Daszkiewicz, Christopher Britsch, Rozalia Christidou, Christos Batzelas, Riccardo Caputo, Bernhard Weninger (photo: F. Ostmann)

Closing this text, my mind goes to the person who has been steadily by my side throughout my entire archaeological career and beyond, to my wife Katerina. She shared my hopes and my anxieties and helped to overcome the various difficulties of my work; so, she was there right from the beginning of the excavation at PMZ. She was already at the excavation of the cremation cemetery, the publication of which I devoted to her. My mind goes also to my daughters Ioanna, a speech therapist; Irene, an archaeologist in the Greek Archaeological Service; and Eugenia, a dermatologist, in whose lives, during their childhood, they were deprived of time I should have devoted to them, being as I was, at times, almost totally absorbed by my work. I recall at this point a visit by Katerina and our daughters to Platia Magoula Zarkou at an early stage of the excavation. When we were leaving the site, a peasant, who was collecting watermelons in a nearby field, gave me a few watermelons. As I was putting them carefully in the car, my elder daughter Ioanna, at that time in primary school, commented, "Daddy's excavation has been fruitful".

# II. The Environment and its Evolution around the Tell

## II.1. The Latest Quaternary Evolution of the Peneiada Valley, Central Greece, and its Effects on Neolithic and Historical Settlement Distribution

*Riccardo Caputo – Bruno Helly – Dimitra Rapti – Sotiris Valkaniotis*

### II.1.1. Introduction

The major questions posed at the beginning of the present research which we attempted to answer were the following: firstly, explaining the Late Quaternary evolution of the Peneios River, especially along the reach interposed between the Karditsa and Larissa plains. In this regard, a major target was unravelling the crucial role played by the Peneiada Valley in the framework of the central Greece hydrographic network, and hence understanding the important geographic and environmental changes that occurred within the broader area up to historical times.

Second was the tentative reconstruction of the latest Pleistocene–Holocene palaeogeographic and palaeomorphological setting of the area, where several Neolithic communities were established including, above all, the PMZ settlement, the major and best-known archaeological site of its kind.[30]

In order to shed some light on the above issues, we investigated a much broader area, as the evolution of the PMZ site certainly depends on larger-scale natural phenomena mainly governed by the regional hydrographic network in all its aspects, for example the number, the dimension and the stability of the water courses; their water discharge and its seasonal variability; the occurrence and frequency of flooding events; and the extent of their effects on the surrounding plains, etc.

#### *Geological and Hydrographic Framework*

The present-day orographic texture of Thessaly and its broader surroundings is basically oriented NW-SE, which is the result, firstly, of the compressional phases building the Hellenides fold-and-thrust belt during the Oligocene–Miocene and, subsequently, of the Pliocene–Early Pleistocene tectonic inversion associated with a NE-SW crustal extension.[31] The overall result was a basin-and-range-like morphology alternating tectonic-topographic 'highs' (the Pindos Range, the Central Hills and the Olympos-Ossa-Pilion Range) and 'lows' (the Karditsa, Larissa and Thermaikos Basins).[32] However, since the Middle Pleistocene, the geodynamics of the Aegean region have changed abruptly, being characterised by a c. north-south-stretching direction and the formation of new, roughly east-west-trending structures, like the Tyrnavos Basin and Gonnoi Horst[33] or the Almyros and Vasilika Basins,[34] in northern and southern Thessaly, respectively. Most of these normal faults are still in an incipient stage,[35] and hence the cumulative displacements are relatively

[30] Gallis 1989; van Andel et al. 1995.
[31] Caputo 1990; Valkaniotis 2005.
[32] Caputo – Pavlides 1993.
[33] Caputo et al. 1994.
[34] Caputo 1990.
[35] Caputo 1995.

small. In any case, the cumulated crustal deformation has not yet been sufficient to have radically changed the inherited regional-scale morphology.

The present-day hydrographic network of the Peneios River, the longest in Greece (Fig. II.1.1a), is strongly influenced by these pre-existing and still dominating morphologies (i.e. the NW-SE-trending basins). This is particularly evident in the low-gradient sectors of the water courses crossing these areas, that is to say, downstream the exit of the mountain valleys (generally between 150 and 120m asl) of the numerous channels entrenching the Pindos Range, the Antichasia Mountains and the Othrys area (Fig. II.1.1). It is worth noting that along the path of the Peneios River we were able to distinguish two major reaches draining wide and flat alluvial areas. The western one is represented by the Karditsa Plain and it is characterised by numerous affluents, mainly on the right side of the main stream, the last of which is the Enipeas River, probably the most important for its water discharge contribution (Fig. II.1.1a).

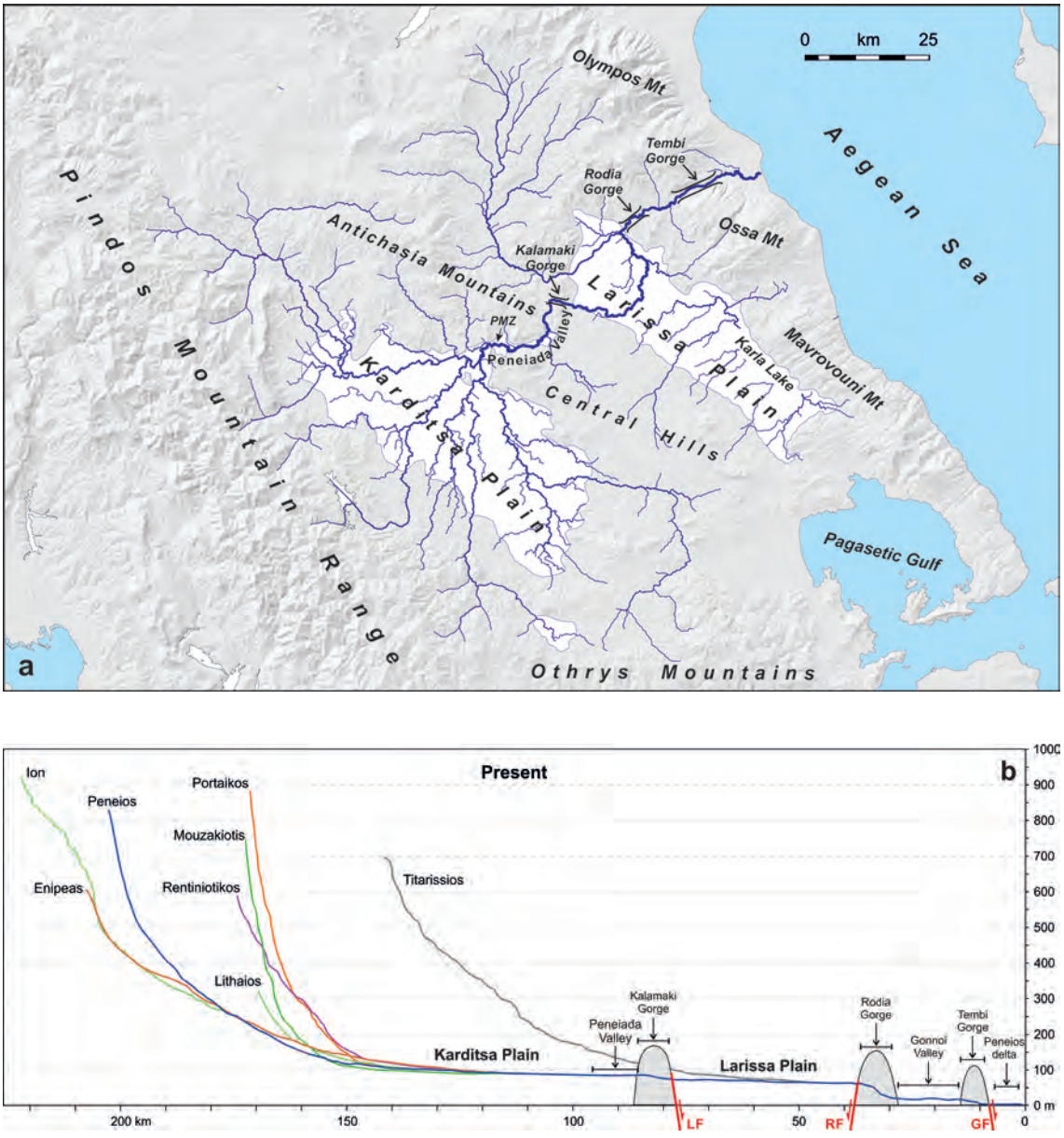


Fig. II.1.1 a. Hydrographic network of the Peneios River draining a large sector of central Greece. Note the morphological anomaly of the Peneiada Valley, investigated in the present research, separating the western Karditsa Plain from the eastern Larissa Plain; b. Present-day longitudinal profiles of the major rivers draining western Thessaly (R. Caputo)

The other major reach of the Peneios River, characterised by very low gradient flows across a flat alluvial area, is represented by the northern Larissa Plain, between the gorges of Kalamaki and Rodia (Fig. II.1.1a and b). In this case, however, the hydrography shows an anomaly because the river firstly flows ESE as far as the town of Larissa, where it abruptly turns northwards and then northwestwards before entering the Rodia Gorge. In this sector of the plain, a complex hydrographic evolution has been documented for the Holocene, with likely repeated natural attempts at deviation along the Asmaki channel towards the southeastern sector of the Larissa Plain.[36] This was due to a concomitant, though competing, role played by the major normal faults bordering the Tyrnavos Basin, the progressive sedimentary infilling and the hydrographic dynamics. Only anthropogenic activities carried out at the beginning of the 20th century impeded the definitive diversion of the Peneios waters into Lake Karla, and the consequent entrapment there due to the lower altitude of the southeastern Larissa Plain. Lake Karla was artificially drained during the 1960s and partially restored in recent years for environmental reasons.

Interposed between the two reaches that cross the wide Karditsa and Larissa plains, respectively, the Peneios River flows along a narrow alluvial plain, ranging from 0.5 to 3km in width, bordered by rocky mountain slopes. We refer to this morphological feature as the Peneiada Valley (from the small village on the left bank of the river; Fig. II.1.1a). This intermountain reach of the Peneios River is almost 30km long and the average slope of the alluvial plain is extremely low, corresponding to c. 0.5m/km (0.5‰; Fig. II.1.1b). The Peneiada Valley is characterised by numerous meanders, either active or abandoned ones (Fig. II.1.2).[37] Accordingly, the gradient of the water course is even lower, corresponding to an average of 0.3m/km (0.3‰). Based on the analysis of detailed topographic maps, cadastral maps and aerial imagery of different epochs, several overlapping meandering stages could be clearly recognised along the Peneiada Valley (Fig. II.1.2).

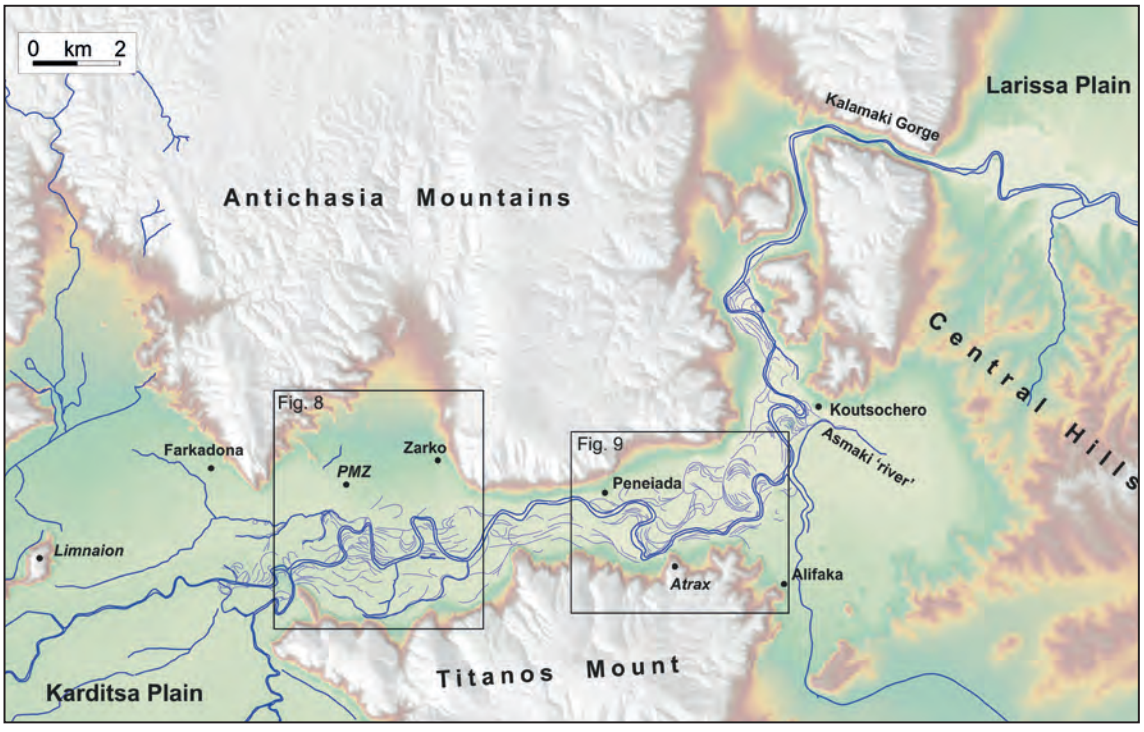


Fig. II.1.2 DEM of the Peneiada Valley showing the present-day Peneios River and the numerous meanders abandoned in historical times according to historical topographic maps (Heuzey – Daumet 1856; Nobile 1910; HAGS 1917). Boxes indicate the location of Figs. II.1.8, II.1.9 (R. Caputo)

36 Caputo et al. 1994.
37 Migiros et al. 2011.

## II.1.2. Late Quaternary Peneiada Valley Evolution

### *Valley Bottom Geometry and its Infilling*

A careful morphological analysis of the broader Peneiada Valley (Fig. II.1.2) suggests the presence of a marked hydrographic anomaly. In particular, following the present-day downstream path, the two valley flanks, consisting of rocky slopes and associated ejection cones descending the minor lateral valleys, get closer and closer. Indeed, the interposed alluvial plain is characterised by a progressive downstream narrowing, while the commonly inundated area during the periodical flooding events eventually disappears a few kilometres north of Kout-

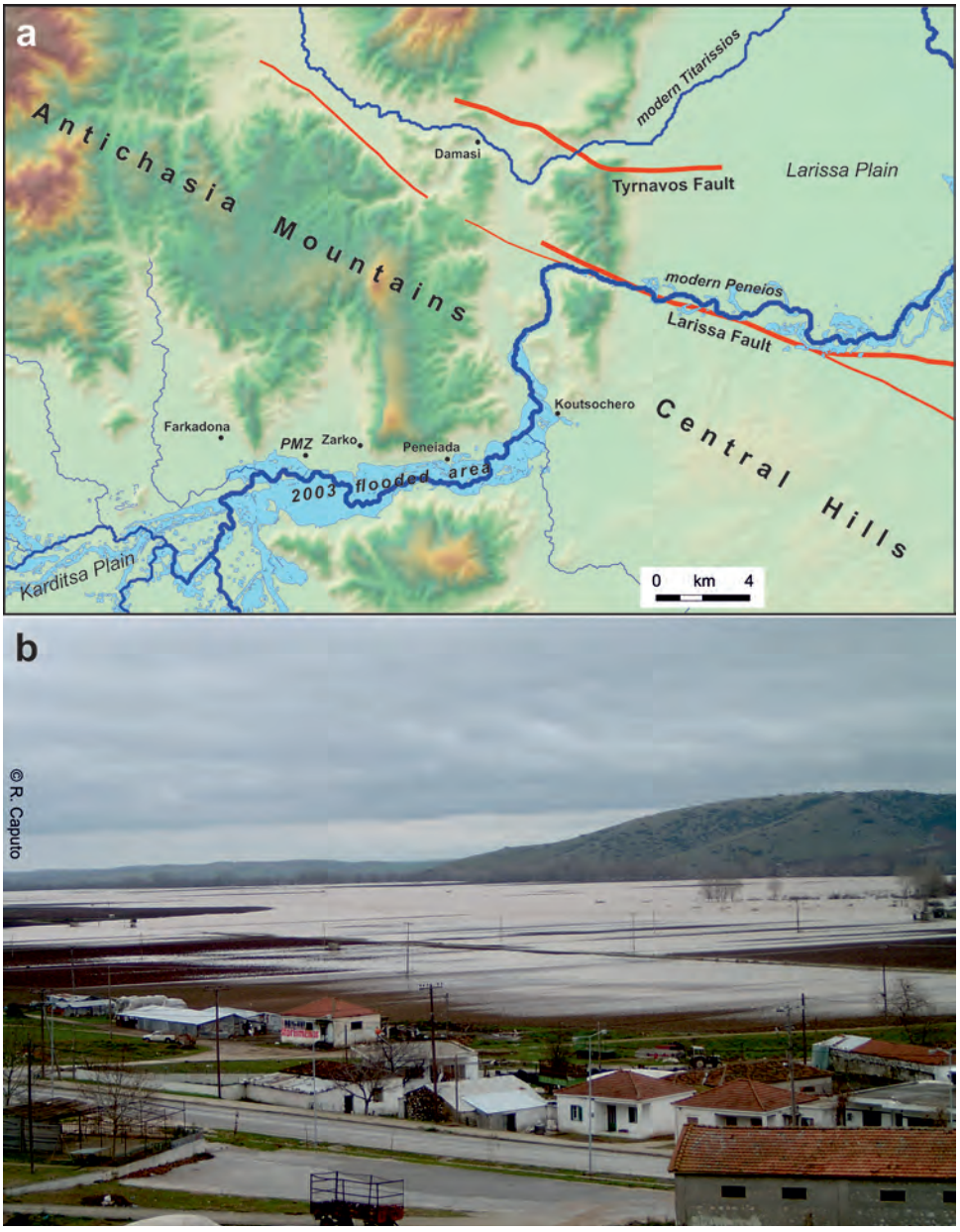


Fig. II.1.3 a. Extent of the flooded Peneiada Valley during the February 2003 event clearly showing that a large part of the alluvial plain is completely inundated up to few kilometres from the Kalamaki Gorge, where, instead, an entrenching process by the Peneios River dominates. In contrast, the upstream plain is continuously and repeatedly affected by fluvial deposition (viz. aggradation); b. Presence of the several metre-high water table that temporarily transformed the valley into a lake. Similar flooding events occur almost every year (R. Caputo)

sochero village (Fig. II.1.3). As a matter of fact, beyond this point, the Peneios River visibly entrenches its own bed, firstly affecting older fluvial deposits, then, the cemented lateral cones and, once in the Kalamaki Gorge, the Triassic bedrock itself. In summary, the morphological anomaly suggests a relatively recent and obviously still unbalanced natural process of path inversion of the water flow along a major reach (i.e. the Peneiada Valley).

Beyond the morphological evidence suggesting the inversion of the hydraulic (and topographic) gradient, a recent geophysical survey has reconstructed in detail the geometry of the basement underlying the recent fluvio-lacustrine deposits.[38] Although the absolute altimetric values of the reconstructed valley bottom have some minor uncertainties due to the simplified subsoil velocity model considered, the overall geometry of the palaeo-valley is well constrained and undoubtedly shows a regular south-and-westwards topographic gradient as represented in Fig. II.1.4. In other words, and neglecting any possible significant role of regional tilting by large-scale tectonic processes, any major water course flowing along the palaeo-Peneiada Valley was necessarily moving

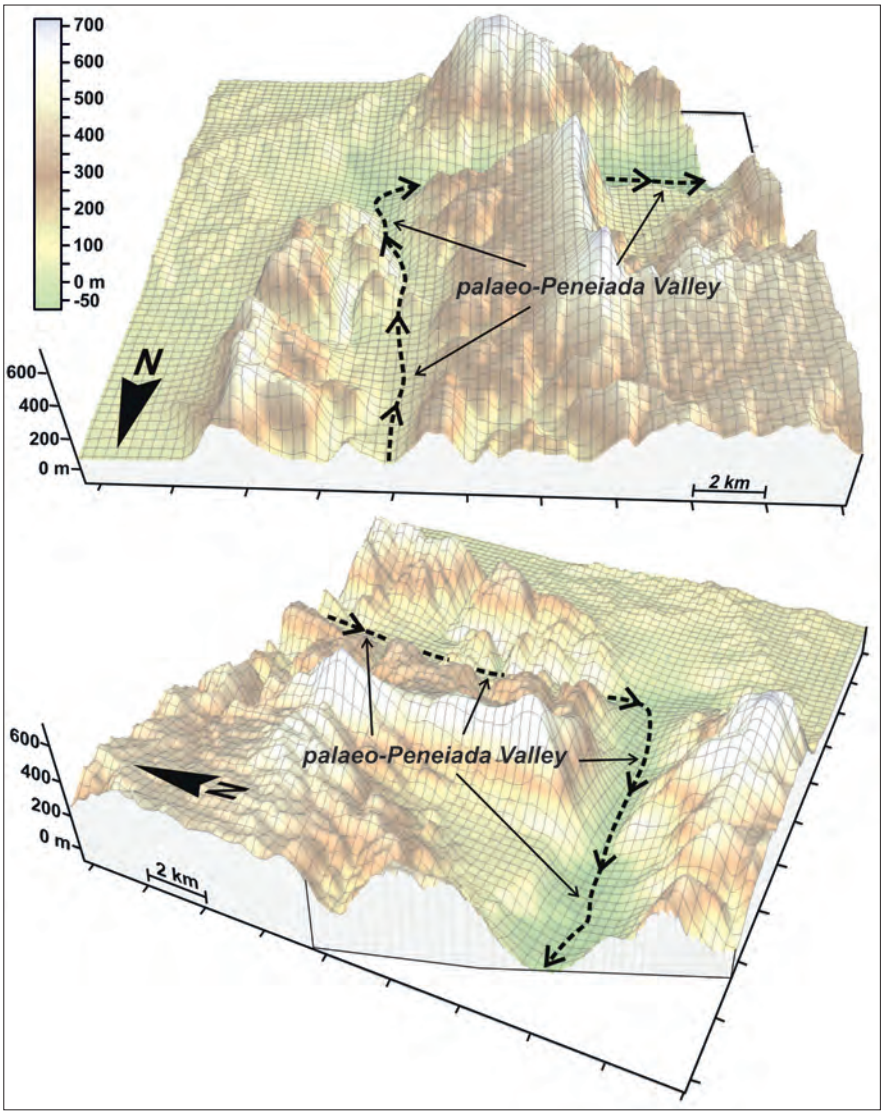


Fig. II.1.4 Three-dimensional model of the palaeo-Peneiada Valley as reconstructed by Mantovani et al. 2018 based on the results of a dedicated geophysical survey. Note that the slope along the bottom of the valley was towards the Karditsa area (R. Caputo)

[38] Mantovani et al. 2018.

in the opposite direction from the present-day Peneios River, which nowadays flows on top of the Holocene alluvial plain and drains the waters from western to eastern Thessaly (Fig. II.1.1a and b).

The geophysical survey, based on numerous microtremor measurements (seismic noise), was carried out all over the plain of the Peneiada Valley and it is well calibrated with the available stratigraphy from boreholes, allowing a two-step procedure for 3D interpolation.

Based on these geophysical results and the morphological evidence, it is also clear that the palaeo-Peneiada Valley could not be a secondary chorographic feature of the Thessaly region and was certainly characterised by a correspondingly wide hydrographic basin. By taking into account and carefully inspecting the present hydrographic network of the broader area (Fig. II.1.1a and b), and particularly the drainage area of the major water courses draining the mountains surrounding Thessaly (Fig. II.1.5), it is likely that the palaeo-Peneiada Valley was part of the Titarissios River, representing its lowest hydraulic and altimetric reach before flowing into the Karditsa 'area' (Figs. II.1.6a, II.1.7.a). The issue of a possible connection between the Titarissios and Peneios rivers was already raised by Horst Ernst Schneider and Michel Sivignon,[39] who, however, did not propose any solution to the question posed.

As a first substantial consequence of this reconstruction, the Karditsa 'area' was therefore characterised by an endorheic hydrographic pattern, where the Titarissios River was probably among the most important tributaries (at least considering the extension of the present-day hydrographic basins draining into western Thessaly; Fig. II.1.5). Accordingly, from an environmental point of view, the Karditsa 'area' at that time was certainly covered by a water table corresponding to a major lake or at least diffuse marshy zones; the permanence and the size of the inundated surface was obviously also a function of the climatic period (glacial versus interglacial stages) that, during the Quaternary, strongly modulated the regional precipitation regime[40] and therefore the overall water discharge of the several inlets and tributaries of the western Thessalian 'lowland'.

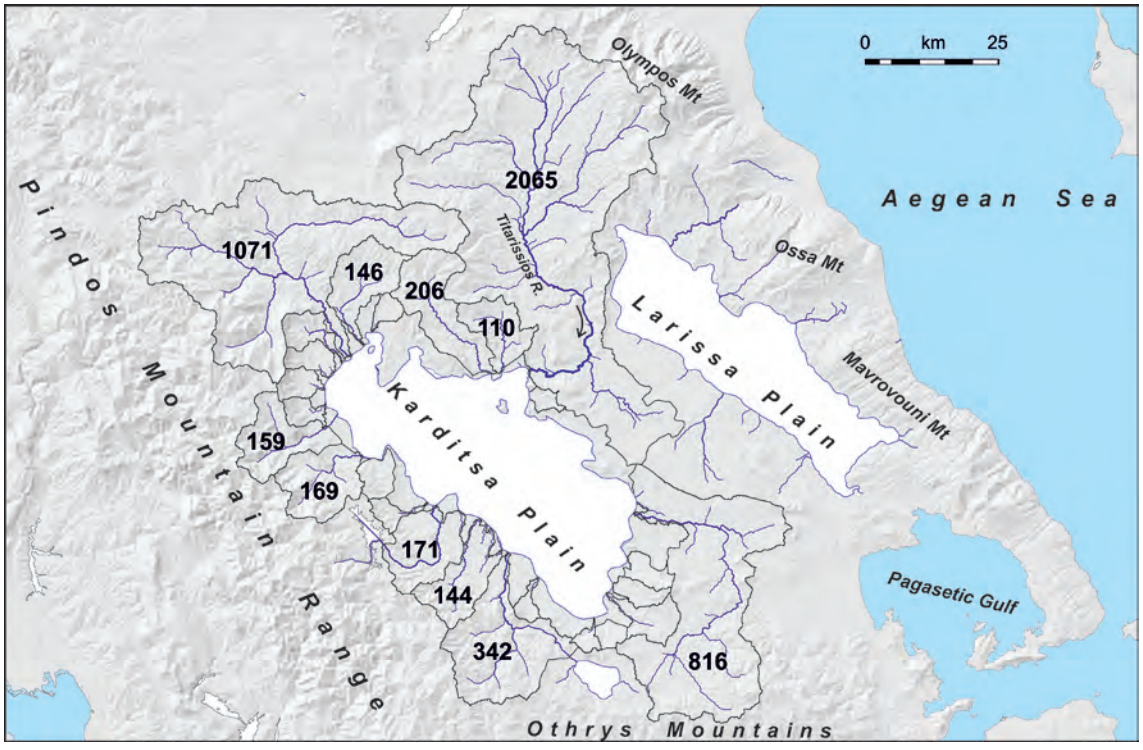


Fig. II.1.5 Hydrographic basins and corresponding areas in km² of the major inlets of the palaeo-Karditsa Lake (R. Caputo)

[39] Schneider 1968; Sivignon 1975.
[40] E.g. Dean et al. 2015.

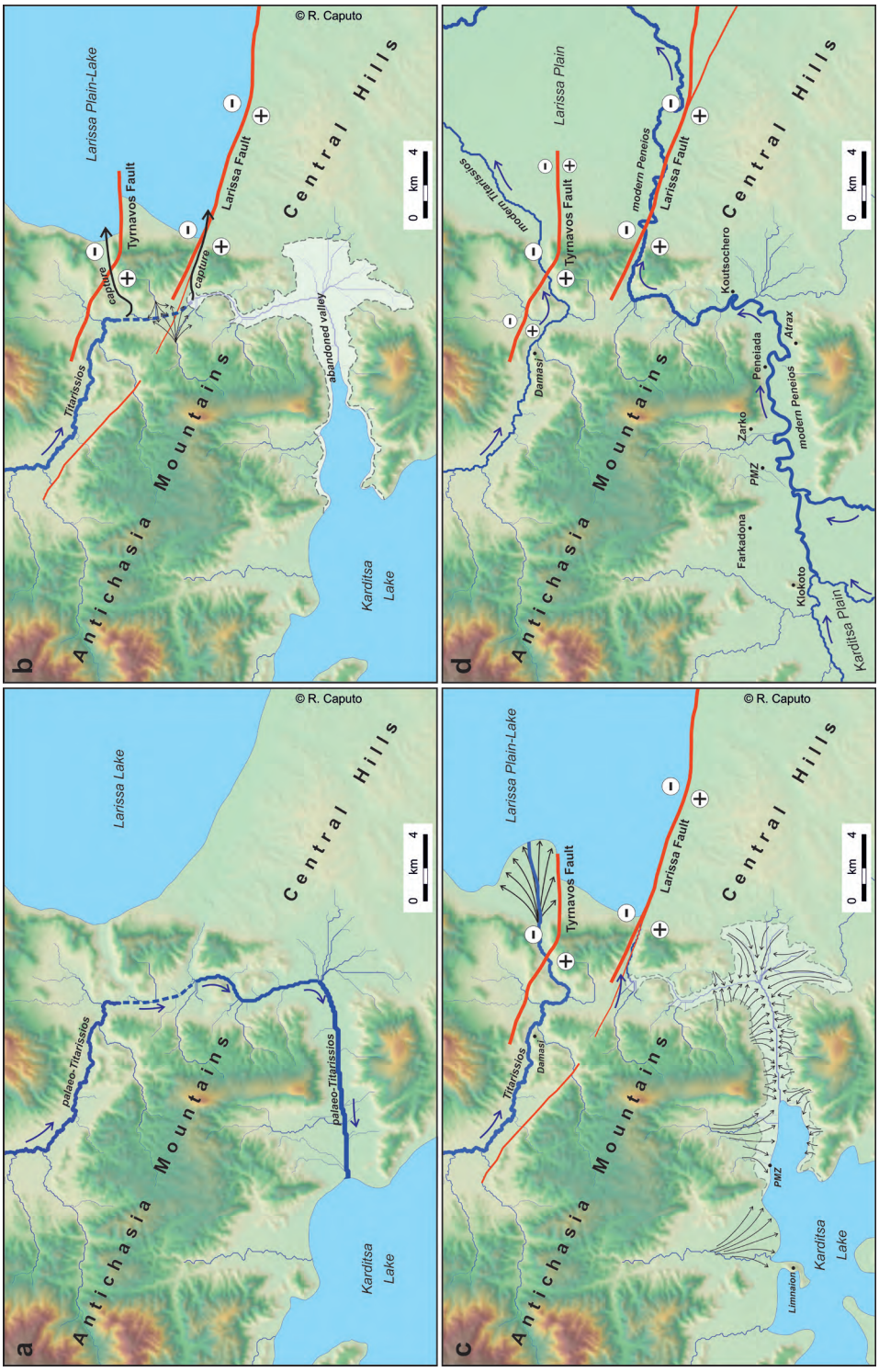


Fig. II.1.6 a. Tentative reconstruction of the main course of the Titarissios River flowing along the palaeo-Peneiada Valley and draining into the Karditsa Lake during the Late Pleistocene; b. Capture phases of the Titarissios River firstly in correspondence with, and due to, the Larissa Fault and subsequently by the Tyrnavos Fault, which definitely diverted the waters into the Larissa Lake. At this stage no major watercourse was flowing in the (abandoned) Peneiada Valley; c. In the meantime, the Karditsa Lake was progressively infilled by the sediments transported by the 'western' rivers (Fig. II.1.7). Once the progradation of the internal deltas and the level of the western plain reached the entrance of the abandoned Peneiada Valley the latter was affected by a very high aggradation rate and the consequent rapid inversion of the topographic gradient (thus becoming eastward dipping); d. therefore allowing the 'western' waters to definitely drain into the Larissa Plain sometime during the Holocene and likely in historical time (R. Caputo)

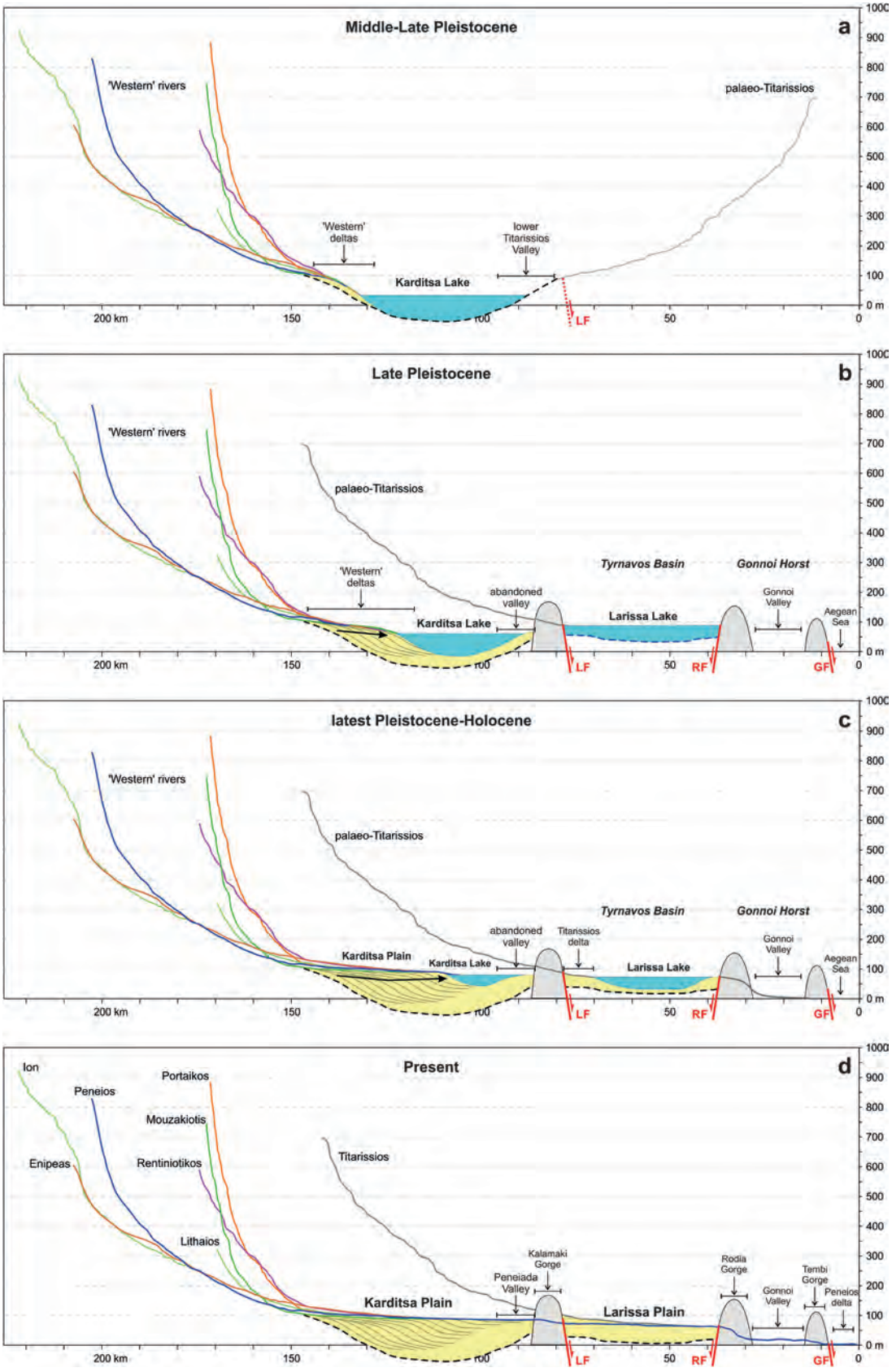


Fig. II.1.7 Evolution of the longitudinal profiles of the major rivers representing the hydrographic network of Thessaly since the Middle to Late Quaternary. The sketches show the progressive infilling of Karditsa Lake (a) by the 'western' rivers as well as the capture of the Titarissios River into the Larissa Lake/Plain (b) and the hydraulic inversion of the Peneiada Valley (d). See text for discussion (R. Caputo)

In this regard, it should be noted that for the eastern Thessalian sector too (Larissa 'area'), a prolonged stage with similar swampy and/or lacustrine conditions has been documented to have occurred during the Quaternary (the so called Villafranchian Thessalian lake).[41] But also later and up to the Holocene, the palaeogeography of eastern Thessaly was still highly dynamic, being governed by the competing roles of i) the active normal faults bordering the Tyrnavos Basin, ii) the fluvial sediment load, mainly the Titarissios and Peneios rivers, and iii) the climate.

*Tectonic Influence on the Recent Geomorphic Evolution*

Since the (Middle–)Late Quaternary, the broader Aegean region, including Thessaly, has been shaped by an important geodynamic rearrangement.[42] The new north-south direction of crustal stretching started affecting the pre-existing NW-SE-trending basin-and-range-like structure by creating new normal faults striking obliquely to the inherited ones and trending between east-west and ESE-WNW.[43] From a geographic, hydrographic and geomorphological point of view, the major consequence of the new tectonic regime was the progressive disappearance of the Villafranchian Thessalian lake,[44] which at that time covered most of the two largest basins (i.e. Karditsa and Larissa) and the lower parts of the interposed Central Hills. Coastal deposits (i.e. beach rocks) of this regional-scale Pliocene–Early Pleistocene lake have been largely mapped along the western reliefs of the Larissa Plain.[45] The present-day altitudes of these deposits are as high as 250–300m and therefore provide an approximate value for the maximum water level of the ancient lake.

As a consequence of this geodynamic rearrangement, in northern Thessaly an ESE-WNW-trending graben started developing (Tyrnavos Basin)[46] bordered by some (nowadays) major faults. Of particular interest for the present paper is the role played by the Tyrnavos and Larissa faults, strongly interfering with the hydrographic basin of the palaeo-Titarissios River and particularly the palaeo-Peneiada Valley (Fig. II.1.6b). Although the two faults are north-dipping, with normal dip-slip kinematics thus causing the uplift of the southern footwall blocks and the subsidence of the northern hanging-wall blocks, both faults had a different influence and they played different roles, both direct and indirect, on the fluvial diversion and the hydrographic changes that occurred during the Late Pleistocene.

Regarding the Larissa Fault, the repeated occurrence of linear morphogenic earthquakes[47] rapidly generated a scarp across the riverbed, locally inverting the downstream gradient and therefore gradually hampering the regular southward flow of the palaeo-Titarissios River. Additionally, the repeated coseismic fracturing along the WNW-ESE-trending damage zone of the Larissa Fault could have contributed to i) mechanically weakening the rock formations, ii) greatly increasing their erodibility and permeability and thus iii) concentrating the entrenchment process by channelised waters towards the east (Fig. II.1.6b). As a consequence of the local water accumulation (i.e. damming effect by the fault) and the fast regressive erosional phenomena ('climbing' from the Larissa lake) a proto-Kalamaki Gorge could have formed, possibly causing a first diversion event for the palaeo-Titarissios River.

On the other hand, the growing cumulative displacement on the contemporaneously forming Tyrnavos Fault had two major indirect effects. Firstly, the 3–4km-long reach of the Titarissios River flowing parallel to the fault trace on top of the continuously uplifted footwall block suffered a rapid decrease in its downstream gradient. Secondly, corresponding to the major tectonic

41 Caputo et al. 1994.
42 E.g. Mercier 1981; Mercier et al. 1989; Caputo – Pavlides 1993.
43 Caputo 1995.
44 Caputo et al. 1994.
45 Caputo 1990.
46 Caputo 1990; Caputo 1995.
47 Sensu Caputo 2005.

scarp induced by the Tyrnavos Fault, with a maximum effect in its central sector, the local north-eastwards topographic gradient was increasing together with the displacement accumulation and therefore the concentrated local energy of the surficial waters could have induced rapid regressive erosion, finally reaching, and thus capturing, the Titarissios River east of Damasi and thereby generating its present-day path and starting to form a rapidly prograding internal delta (Fig. II.1.6c).

We do not know the exact timing of this two-step capture process; however, the permanent diversion of the palaeo-Titarissios River towards the ENE, definitely draining its waters into the Larissa 'area' certainly occurred sometime during the Late Pleistocene. As a further consequence of either of these two major hydrographic changes, the lower reach of the palaeo-Titarissios River corresponding to the Peneiada Valley was then completely abandoned. Only a very local hydrographic network possibly exploited the valley at that time (Figs. II.1.6c, II.1.7b).

*Sedimentary Infilling of the Abandoned Valley*

From the geophysical investigations,[48] the deposits overlying the bedrock of the palaeo-valley have a maximum thickness of about 150m south of Farkadona, progressively decreasing towards Koutsochero and becoming nil west of the Kalamaki Gorge (Fig. II.1.4). The lower part of this sedimentary succession was possibly accumulated by the same palaeo-Titarissios River when it was contributing to the general infilling of the Karditsa Lake particularly during periods characterised by a higher base level likely corresponding to climatic wet stages. These lacustrine, fluvial and/or internal delta depositional conditions likely persisted through the Middle and Late Pleistocene.

However, once the definite diversion(s) occurred upstream and the Peneiada Valley was permanently abandoned by the Titarissios River, the depositional process likely suffered an important slowdown. Indeed, the major sedimentary contribution was only represented by the lateral ejection cones originating from, and descending the numerous minor valleys more or less deeply entrenched in the slopes of the Mesozoic carbonate massifs bordering the Peneiada Valley along its entire length (Fig. II.1.6c). On the other hand, the lack of a major water course flowing along the bottom of the valley could have had the effect of facilitating the growth of the ejection cones (viz. progradation) insofar as there was no longer sufficient energy to hydraulically remove from their toe the coarse-grained clasts, as otherwise regularly occurred during the flow of the palaeo-Titarissios River. During the Late Pleistocene glacial periods, these cones probably experienced their maximum development and progradation rate (Fig. II.1.6c).

In the meantime, the western rivers draining the Antichasia, Pindos and Othrys mountain ranges and cumulatively representing a very large drainage area (Fig. II.1.5) were causing a growing eastwards hydraulic and sedimentary 'pressure' in their search for an outlet towards the Aegean Sea (Fig. II.1.7b). This was due to the persisting continental collision along the western Hellenides and the consequent rapid uplift of the Greek mountain ranges, preventing a general drainage towards the Ionian Sea of the largely emerged areas of western Macedonia and Epirus. Depending on water discharge, which, conversely, was a direct function of climate, all these rivers mainly accumulated their sedimentary load within the Karditsa Basin, prevailingly in its southern, western and northern sectors (Fig. II.1.1a) producing coalescent internal deltas (Fig. II.1.7b) and thus generating a large scale mean gradient towards E-NE, still clearly visible in the digital elevation model (DEM) and in all profiles of the rivers flowing in the Karditsa Plain (Fig. II.1.1b). During the latest Quaternary, the western rivers progressively reached the entrance to the Peneiada Valley close to Farkadona (Fig. II.1.7c).

Following the diversion of the Titarissios River, the consequent lack of i) any counteracting westward flow, ii) any associated hydraulic gradient and iii) westward sediment transportation certainly facilitated and accelerated the very final infilling stages of the palaeo-Peneiada Valley

[48] Mantovani et al. 2018.

from the west towards the east (Fig. II.1.7d). Indeed, due to the limited width of the valley compared to the Karditsa Plain and to the huge sedimentary input of western provenance (Fig. II.1.5), this process likely occurred in an extremely rapid way. Once progradation and aggradation of the palaeo-Peneiada Valley floor reached the threshold altitude north of Koutsochero, the proto-Kalamaki Gorge that was likely already formed along the Larissa Fault during the Late Pleistocene (first Titarissios River diversion; Fig. II.1.6b) could have been exploited by the 'western' waters to establish a direct hydraulic connection with the Eastern Thessalian Plain (Fig. II.1.6d). With this last event, the flow direction along the Peneiada Valley was therefore definitely reversed (Fig. II.1.7d). This ultimate event occurred in (latest Pleistocene–)Holocene times, as will be discussed further in the following section. Only at this stage, did the Karditsa Plain and its entire hydrographic basin begin to drain permanently eastwards, as we see them today (Fig. II.1.1a). At that time, the Larissa Plain was probably already connected to the Aegean Sea across the Rodia Gorge and the Tembi Valley (Fig. II.1.7c),[49] thus setting up the entire path of what we today call the Peneios River.

The renewed water flow across the Kalamaki Gorge and the greatly increased water discharge along the very narrow valley consequently resumed entrenching and river regressive erosion, this time to facilitate the evacuation of the 'western' waters. Such erosion progressively shifted upstream the equilibrium point along the newly formed Peneios River. At present, the critical disequilibrium sector separating the upstream reach, where frequent flooding events still occur, contributing to a residual (though progressively disappearing) aggradation of the Peneiada Valley plain (Fig. II.1.3), and the downstream reach, where, instead, vertical entrenching by the riverbed started prevailing, is somewhere between Peneiada and Koutsochero villages. This is documented by the coexistence of persisting inundation periods and the riverbed being 5–8m deep relative to the surrounding alluvial plain.

### *Age of Ejection Cones*

Regarding the age of the late sediment infilling of the palaeo-Peneiada Valley and the final inversion of the water flow direction, no absolute ages are available at present. However, in this section we discuss some chronological constraints by analysing the ejection cones originating from the several minor lateral valleys (Fig. II.1.2). Their morphological analysis based on direct field observations and high resolution DEMs indicates that all these cones are characterised by a quite regular slope with typical fan geometry in map view and a smooth topographic surface uniformly sloping from the lateral valley mouth(s) in the bedrock towards the plain.

It should be noted that macroscopic differences exist between the ejection cones whose hydrographic basins consist exclusively of Mesozoic carbonate rocks, from those characterised by prevailing Palaeozoic metamorphic rocks, mainly schists and gneiss. Indeed, the degree of erodibility of these two lithologies is quite different, but in particular, the average dimensions of the clasts produced along the mountain slopes from the two source rocks is very different: the former generally coarse grained (with clasts up to some cm) and matrix-poor; the latter fine grained (with clasts of at most a few mm and generally much less) and matrix-rich. On the other hand, the different degree of erodibility caused the rocky slopes in the metamorphic basins to retreat much faster, therefore widening the corresponding secondary hydrographic networks and hence further increasing the amount of eroded material.

These differences, both in the granulometry and in the amount of clasts produced, as well as the overall textural features of the deposits, are obviously reflected in the slope angle of the associated cones: generally greater for carbonate-sourced fans (5°–10°) and smaller for the other ones (1°–2°); similarly, the overall size of the fans is much smaller for the former and wider for the latter ones.

[49] Caputo et al. 1994.

Also, the solute carbonate content in the water draining the 'carbonate' versus the 'metamorphic' hydrographic basins was markedly different, and this hydrochemical difference consequently induced a different degree of cementation for the two types of cones, especially during the glacial maxima, including the last one at c. 26.5–19.5ka BP. This is because the increased precipitation during these climatic peaks similarly increased the dissolution of the carbonate rocks uphill and hence the hydrochemistry of the fed aquifers, especially the shallow ones, was richer in solute calcium.

On top of the cones we nowadays observe a soil, generally 1–2m thick, with only a minor colluvial input. No active debris phenomena or scree deposits are observed on top of these surfaces. That is to say, the rocky slopes impending over the cones within the corresponding hydrographic basins at present do not produce clasts to be subsequently transported downhill and therefore they no longer contribute to the growth of the cones. In other words, and similar to most of the Aegean realm and other Mediterranean regions, the mountain slopes, especially the carbonate ones, have basically been stable since the fading of the last glacial maximum (LGM), say during the last 15–18ka. This is well documented in the literature and the late LGM topography is commonly exploited as a chronological marker in many morphotectonic and palaeoseismological investigations.[50] Similar cemented deposits in Thessaly characterising the upmost layers of the ejection cones provided $^{14}C$ ages of 19–23ka,[51] in perfect agreement with the age of the LGM. On the other hand, it should also be noted that the uniform granulometric and textural characteristics of the deposits as well as the morphological similarity of the different cones all along the Peneiada Valley, and in Thessaly more broadly, suggest a common genetic process and a common age formation.

Another crucial observation relative to the lateral ejection cones and their chronology is represented by their stratigraphic and geometric relationships with the fluvial-marsh deposits topping the Peneiada Valley plain. If we assume as a null hypothesis that both depositional environments (i.e. slope and flooding plain) were contemporaneously active, the two markedly different facies (ejection cones versus alluvial sediments) and the associated event layers should basically interfinger at the foot of the Peneiada Valley flanks where the progradation of the cones and the aggradation of the plain would compete and their effects would merge. As a consequence, on the topographic surface we should observe a sort of transition zone between the two sedimentary environments expressed in the topography by an interposed slope connecting the regularly dipping ejection cones (5°–10°) with the horizontal alluvial plain. In other words, at the toe of the cones we should systematically observe a belt characterised by a progressively decreasing gradient.

Contrary to the null hypothesis, this morphological feature is not observed at all along the Peneiada Valley's sides and the slope angle changes abruptly from that typical of the cones (i.e. 5°–10°) to the flat topography of the alluvial plain. To sum up, a first major conclusion we could infer is that the activity of the ejection cones clearly pre-dates the last infilling stage of the Peneiada Valley. As a consequence, and taking into account the fact that the cones largely completed their evolution during the LGM (c. 26.5–19.5ka BP), the final infilling phase and the ultimate progradation-aggradation event(s) within the alluvial plain that ultimately generated a stable, though subtle, eastward topographic gradient of the Peneiada Valley plain, mainly occurred during the Holocene (Fig. II.1.7d). Only at this stage, was a permanent hydraulic-hydrographic connection from the Karditsa Plain to the Larissa Plain established via a water course that we today call the Peneios River.

[50] Benedetti et al. 2002; Papanikolaou et al. 2005; Caputo et al. 2006; Caputo et al. 2010; Mason et al. 2016.
[51] Caputo – Helly 2007.

### II.1.3. Environmental Changes in the Post-Last Glacial Maximum Period

*Early Holocene Changes*

Immediately following the LGM, say for some/few thousands of years, the lack of, or the very reduced, vegetation cover had two major consequences. Firstly, large amounts of loose material were produced on the mountain slopes (i.e. in the upper parts of the drainage basins) and easily transported downstream through the hydrographic network. Secondly, due to the prevailing surface rilling and the poor underground infiltration along the slopes, most of the precipitation water was quickly transferred towards the lower hydrographic network, thereby increasing the water discharge in the channels and hence their energy. At the dawn of the post-LGM period, the combination of these two effects (high sediment load and high water discharge) probably found an equilibrium by transferring most of the sediment load down to the local base level, thereby building rapidly prograding internal deltas (Fig. II.1.7b–c).

Sometime later, the progressive climate change towards overall warmer conditions and the concurrent diffusion of the vegetation cover in the broader Mediterranean realm, and particularly in Greece, had some major consequences. Indeed, i) the water discharge in the lower channels (i.e. in the alluvial plains) experienced a slight reduction, ii) the production of clastic material in the mountain slopes was similarly reduced, but especially iii) large amounts of these materials were deposited in the wide alluvial cones/internal deltas starting to develop from the border of the Karditsa Plain and progressively prograding towards the Peneiada Valley entrance.

Due to the eastward restraining of the Peneiada Valley, the progressive alluvial infilling was even faster towards the Kalamaki Gorge with respect to the valley entrance close to Farkadona. In this regard, the occurrence of very rapidly prograding internal deltas has been well documented in the Po Plain, North Italy, associated with the large amount of material discharge caused by the Apennine tributaries.[52] For example, in historical times, local aggradation and progradation rates as high as 15cm/a and 500m/a, respectively, have been documented for the Reno River,[53] but similar ones could be inferred for other nearby Apennine rivers. Taking into account that the hydrographic basin of the Reno River is comparatively much smaller than the source area of the 'western' rivers at the entrance to the Peneiada Valley (Fig. II.1.5), during the post-LGM wet periods it is reasonable to assume comparable aggradation rates.

It should also be considered that the post-LGM period was also repeatedly affected by minor fluctuations of climatic conditions and particularly by several global cold epochs generally associated in central Greece with i) wetter conditions, ii) higher precipitation, iii) longer flooding periods, and iv) likely much more intense rainy events.[54] These conditions were favourable to more frequent and stronger exudation events and the consequent distribution and deposition of huge amounts of alluvial sediments in the surrounding flat topography. Insofar as the Peneiada Valley is particularly narrow, the infilling process and consequent aggradation of the valley floor could have been characterised by periods of accelerated sedimentation rates up to several mm/a (or even some cm/a).

*Neolithic Period*

Latest Palaeolithic and certainly Neolithic people lived in a rapidly changing environment. Indeed, that was the time span during which the Peneiada Valley was definitely infilled by progradation-aggradation, thus transforming from lacustrine-marshy conditions to the permanently established eastward water drainage. The latter stage is strictly associated with the formation of the modern

52 Amorosi et al. 2014; Caputo et al. 2016.
53 Bondesan 2001; Caputo et al. 2016.
54 Rossignol-Strick 1993; Kromer – Friedrich 2007; Ceraga et al. 2010; Dean et al. 2015.

Peneios River (Figs. II.1.1, II.1.5) transporting the 'western' water into the Larissa Plain and from there finally to the Aegean Sea, forming the present marine delta.

From a dynamic point of view, two distinct processes operated synergistically on the hydraulic-topographic gradient of the Peneiada Valley in order to facilitate the water flow from the Karditsa Plain towards the Larissa Plain. These processes were, firstly, the progressive regressive erosion along the Kalamaki Gorge (and subsequently the upstream reaches) and, secondly, the progressive progradation-aggradation within the Peneiada Valley from the west towards the east. As a consequence, once an eastward-dipping gradient was definitely established (Fig. II.1.7d), the seasonally and/or permanently flooded areas within the Peneiada Valley began to reduce together with the frequency of the exceptional flood events affecting the intermountain plain. In such newly evolving environmental conditions, contemporaneous people assisted a sort of regression of the lacustrine zone, a migration of the swamp area and a retreat of the associated 'coastline'.

Assuming as a preliminary and rough hypothesis that the amount of water seasonally flooding the Peneiada Valley plain during rainy periods and/or snow-melting periods was more or less constant during some generations of the Neolithic people, the inundated surface and the depth of the water could have been similar year on year. What changed progressively through generations, however, was the absolute altitude of the aggrading alluvial plain, consequently the extent of flood water and therefore the absolute altitude of the 'coastline' of the seasonally inundated areas. In other words, Neolithic people could have passively assisted a sort of swamp/lake transgression towards their villages and farmed areas.

Considering also annually variable floods and taking into account the 1-year, the 10-year and, for example, the 50-year water discharge maximum events, from the inhabitants' perspective it was like observing that exceptional inundation events, in terms of water extent, water current (viz. energy) and maximum water depth, were progressively increasing in frequency and magnitude during their lifetime. It is, therefore, obvious that in such conditions the most reasonable solution was to move their villages to a higher, safer and drier location, however still close to the seasonally fertilised farmed areas and the vital water supply.

This is what probably occurred sometime between the Early and the Middle Neolithic, say around 7.8ka BP (i.e. 5.8ka BC), when Magoula Koutsaki was abandoned[55] and PMZ was settled more or less contemporaneously. The detailed archaeological stratigraphy at this site documents that this settlement was characterised by a continuous occupation up to c. the end of the Middle Neolithic, when it seems it was suddenly abandoned until it was re-occupied during the Bronze Age.[56]

It is worth noting that PMZ is located at the toe of the widest ejection cone formed along the northern flank of the Peneiada Valley (Fig. II.1.8). As mentioned in a previous section, this is one of the cones of 'metamorphic' provenance consisting of matrix-rich, fine-grained (with clasts up to few millimetres in size) deposits mainly associated with debris-flow transport mechanisms. Such locations could be generally quite safe, especially if ditches and protection walls are installed;[57] however, in the case of exceptional events (e.g. flash floods) directed by natural fan channel migration and by chance straight towards the archaeological site, the destructive power of these natural phenomena could be locally catastrophic, generating a depositional strip several kilometres long, up to 1–2m thick and 100–200m wide. A similar morphological feature can be clearly observed nowadays south of Zarko village. Such an event could have potentially forced Neolithic people to move away from the site.

55 Giorgos Toufexis, personal communication.
56 Gallis 1989; Toufexis – Batzelas, this volume, 83, 125.
57 Souvatzi, this volume, 593–596.

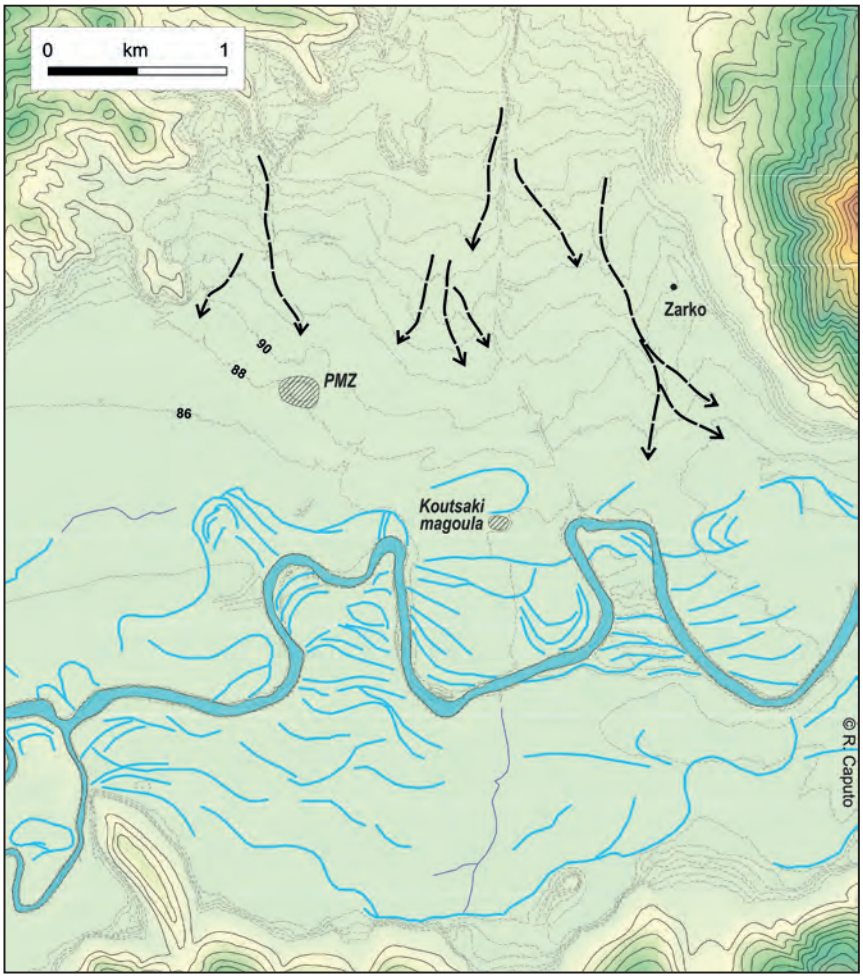


Fig. II.1.8 Map of the Zarko area showing the location of the Neolithic sites PMZ and Koutsaki Magoula. Blue lines represent palaeo-channels and point bars; dashed arrows indicate possible recent (Late Holocene?) flash floods. The altitude of selected contours is reported. Koutsaki Magoula and PMZ were both likely located close to the coastline of the palaeo-lake at different stages (viz. epochs). The former has been partially draped in historical time by the fluvial deposits of the modern Peneios River (R. Caputo)

### *River Dynamics Deduced from Historical Floodplain Features*

We have been able to identify late Holocene and modern fluvial features in the Peneiada reach floodplain (Fig. II.1.9). The three distinct units are the following: i) A first unit developed on the northern side of the Peneiada Plain may correspond to deposits originating from the northern slopes and reworked by water dynamics during the highest stage of the former lake. This unit may date back at the latest to the complete infilling of the lake by the eastward prograding internal delta; ii) An intermediate unit sloping to the east once the Kalambaki Gorge allowed regressive erosion westward into the Peneiada Valley floor. Unit 2 of the Peneios alluvial plain displays ancient oxbow lakes (cut-off and isolated) belonging to one or several meander belts of different ages on the northern margin of the alluvial plain; for example, oxbows near Peneiada have been documented on aerial photos.[58] The geographic isolation of palaeomeanders may have prevented the Peneios floods from completely filling them with sediment. The convex part of the meanders displays a series of arcuate scroll bars corresponding to a succession of meander shifting stages

[58] Tziafalias et al. 2016.

during flood episodes. West of Peneiada village, unit 2 is located south of the modern meander belt, while east of Peneiada, a stretch of meander pattern is located north of the modern meander belt. As a result, the shifting of meanders during the early Holocene would have released a considerable quantity of sediment towards the Kalambaki Gorge. The shifting of the meanders may have been all the more rapid as the river was not yet entrenched and the recent fluvio-lacustrine sediment was soft; iii) The present Peneios is an active incised river located in a meander belt, displaying compound meanders, discrete active features of lateral erosion and lateral features built up by the river lateral migration, like small bars (unit 3).

*Archaic to Roman Period*

A more recent archaeological site settled along the Peneiada Valley provides crucial information on the rapidly evolving hydrography and morphology of the area. It is represented by Atrax (Figs. II.1.2, II.1.9), one important town of the Thessalians from Archaic to Roman Thessaly (7th–2nd centuries B.C. ~2.7–2.1ka BP). The site was also occupied during Roman and early Byzantine times (till c. the 10th century) but its importance was clearly reduced. The site is located on the southern side of the valley and during its maximum expansion it occupied 90 hectares.[59] In particular, the core of the town (*acropolis*) was located in the lower sector of the bedrock slope of Mount Titanos, the more rural area (*katopolis*) extended over the lower part of the nearby ejection cone, while the farmed area was distributed in the contiguous alluvial plain just north of it (Fig. II.1.9).

A wall surrounding the city of Atrax was constructed with large quadrangular blocks; well shaped, they displayed corner rabbets. These features allow us to date the wall to the 4th century BC, a period during which Thessaly was allied (in fact submitted) to the Macedonian kings. In its NW corner, the wall extended down to the river channel. The stone structure has been interpreted as a large barbican ending with two square towers meant to impede access to the narrowest route down the hill and to ensure direct access to water. There it may have been the head of a wooden bridge, despite the fact that no remnant has been preserved on the opposite bank of the river.

At that time, the lake as a permanent water table had certainly already disappeared due to the establishment of stable drainage towards the Larissa Plain via the Kalamaki Gorge; nonetheless, seasonal flooding events affecting the Peneiada Valley bottom were relatively frequent (as they still occur today; Fig. II.1.3). If the urbanisation of the acropolis had mainly strategic reasons, the 'down-town' and agricultural areas were settled on a 'terraced' sector of the Peneiada Valley, and from this point of view, villagers were likely safe enough from major flooding events.

During Classical times, the necropoleis like those of Atrax, were commonly aligned along major roads and not grouped into cemeteries. In this regard, several tombs are more or less still at the surface around Atrax and well documented by archaeological surveys,[60] east, north, and west of the town, thus suggesting the existence of three roads, respectively (Fig. II.1.9). Two main sites of archaeological findings have been documented so far on the surface of the modern plain. Firstly, eight funeral steles with engraved epitaphs dated 4th–3rd centuries BC have been described at Lithodokia (the 'stones deposit'), between Peneiada and Koutsochero. These steles have been reused in a collective tomb dated to the Roman period thanks to the discovery of coins; the tomb could be posterior to the 1st century AD. Three corpses were present in the tomb.[61] On the occasion of the widening of the Larissa-Trikala road, 36 tombs were discovered at the same site, referred to as Palaiopigado, and described by Stella Katakouta.[62] These tombs of various types were dated as Hellenistic and Roman and included small vases and artefacts. This necropolis was probably connected with Atrax thanks to a road crossing the alluvial plain.

59 Tziafalias et al. 2016.
60 Chourmouziadis 1968; Tziafalias et al. 2016.
61 Gallis 1979a.
62 Katakouta 2001.

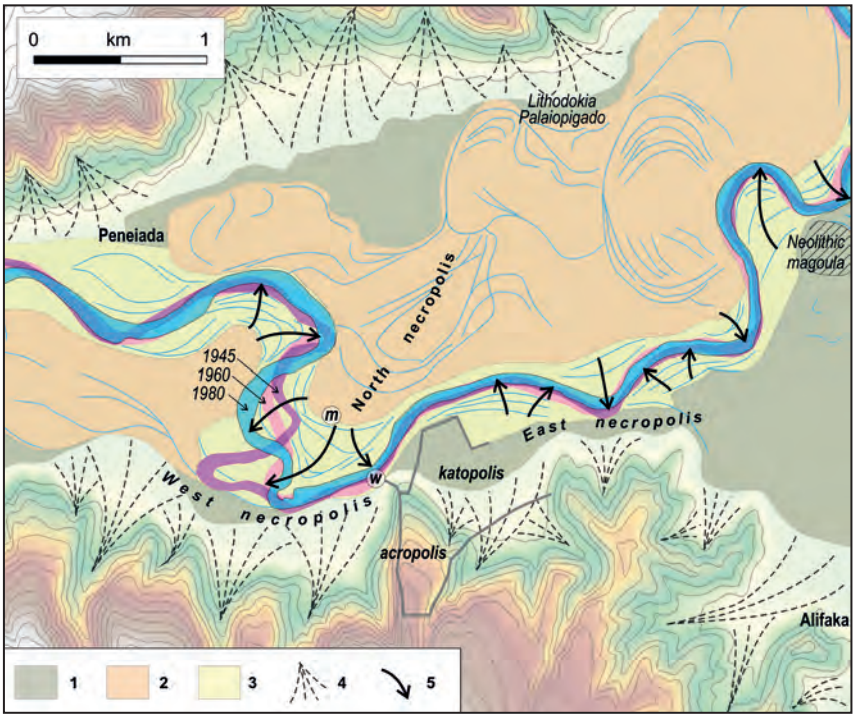


Fig. II.1.9 Map of the archaeological site of Atrax, southeast of Peneiada village, along the northern slope of the Titanos Mount, showing the location of the acropolis, the katopolis (downtown) and the necropoles surrounding thecity along the pathways to Trikala (West), Elassona (North) *and Larissa* (East). 1. highest terrace (Early to Mid Holocene); 2. intermediate terrace (prehistorical); 3. lowest terrace (historical); 4. ejection cones (LGM); 5. direction of historical meander shift. The different paths of the Peneios River are labelled by the year of the source topographic map (R. Caputo)

Secondly, the so-called North necropolis was discovered in 1972–1974 in a former channel visible in the cultivated alluvial plain north of Atrax, on the left bank of the modern Peneios (Fig. II.1.9). It may have been located along the road running from Atrax to Lithodokia. Before it was destroyed by farming, the necropolis yielded tombs and the large base of an equestrian statue,[63] with inscriptions related to a leading soldier and probably a citizen born in Atrax. This person had been a Thessalian strategist and a benefactor of the city; the statue was probably erected just after he left office, when he was still alive. The inscription may be dated to the 3rd century BC or more probably early 2nd century BC. The base of the statue stood at the same place until the late Roman period at least, as testified to by another inscription, a slave manumission act, dated mid-2nd century AD.[64]

Since then, the southwestwards lateral migration of the major meander located NW of the town (arrow from point *m* in Fig. II.1.9) has reworked the top 6–8m of sediments of this sector of the plain, thereby completely wiping out any possible trace of archaeological remains. As a consequence, some of the tombs from the northern and western necropoles have probably disappeared.

On the other hand, the surface location of the tombs suggests that sedimentation since then was quite limited. This observation and the fact that the present-day bed of the Peneios River in this sector of the Peneiada Valley is entrenched several metres in the alluvial plain suggest that regressive erosion from the Kalamaki Gorge has already affected this reach of the river, permitting a better and quicker drainage of the excess water during floods.

63 Tziafalias et al. 2016 (*I. Atrax*, no. 151).
64 Tziafalias et al. 2016 (*I. Atrax*, no. 48).

*Relationship between Fluvial Patterns and Historical Archaeological Sites*

The meandering process in this sector of the Peneiada Valley seems to have slowed down since at least the 3rd century BC as the necropoles established during the 4th century BC are still largely visible at the surface. Accordingly, most abandoned meanders and other hydrographic features associated with unit 2 are certainly older, while further meandering in the sector of the plain close to Atrax was quite reduced and limited to unit 3. Nevertheless, floods and some riverbed shifting have certainly destroyed the towers connected to the defence walls that collapsed into the rivers. In modern times, remaining blocks were possibly used to build a 'daliani', a V-shaped traditional structure which has been used for catching fish for centuries.[65]

The change in hydraulic behaviour during the last two millennia was also marked by a deep entrenching of the riverbed into its own alluvial deposits, likely a consequence of an excess of energy. Excess energy could be locally and/or temporarily available as a consequence of external (to the river) processes and phenomena, like changes in the climate and/or tectonic activity. Within the investigated area, this natural phenomenon was possibly triggered by the regressive upstream erosion that, starting from the Kalamaki Gorge several thousand years before, finally reached this sector of the plain, causing a relative increase in the slope and meander stability.

*Environmental History Deduced from Ancient Texts*

Although, from a geological point of view, the important environmental change from lacustrine-marshy to fluvial conditions was quite rapid, it certainly took place over a time span much longer than a single human generation. Nonetheless, the memory of such natural variations could have been fixed as an oral tradition, thus becoming a myth. For example, the historian Herodotus (5th century BC) reports the 'logos' that "Thessaly, as tradition has it, was in old times a lake enclosed all round by high mountains. On its eastern side it is fenced in by the joining of the lower parts of the mountains Pelion and Ossa, to the north by Olympus, to the west by Pindus, towards the south and the southerly wind by Othrys. In the middle, then, of this ring of mountains, lies the vale of Thessaly".[66] He also added that "[…] the Thessalians say that Poseidon made the passage by which the Peneus flows. This is reasonable, for whoever believes that Poseidon is the shaker of the earth and that rifts made by earthquakes are the work of that god will conclude, upon seeing that passage, that it is of Poseidon's making. It was manifest to me that it must have been an earthquake which forced the mountains apart".[67] As a good rationalist and beyond the reference of the Thessalians' myth, he interprets it by stating that an earthquake could have caused the breaking of the mountains surrounding Thessaly, therefore generating a gorge called Tembi and hence the emptying of the older lake.[68]

The same oral tradition is reported by the geographer Strabo (1st century BC) with the same explanation, while another historian, Baton of Sinope (late 3rd century BC) gives a more detailed account of this myth: "the Thessalians received this tradition from the mouth of a divine envoy, who informed the Thessalians that the history of their country is older than they think." In this regard, the author writes: "In the land of Haimon (prior name of Thessaly), following violent earthquakes, the mountain range called Tembi had been fractured and by this cutting had forcefully drained all the waters of the lake (which then occupied the country) in the direction of the course of Peneus (actual river); all the territory formerly lacustrine had been discovered and, thanks to the continuous drying up of the waters, it had become a plain of magnificent size and beauty".[69]

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65 Helly 1991; Helly 1999.
66 Herodotus, Histories 7.129.1.
67 Herodotus, Histories 7.129.4.
68 Helly 1987.
69 Fragment conserved by Athenaeus, Deipnosophistai 14.45.

The above citations make it clear that the Thessalians contemporaneous with the authors did not directly see the lake, nor its disruption by an earthquake, but the persistence of the myth on these issues up to the 5th–1st centuries BC confirms that the lake certainly was still clearly visible some generations before, possibly corresponding to some centuries, or at most a millennium. On the other hand, a large literature documents that tectonic activity affected Thessaly during the Holocene, with several major seismic events in historical times,[70] thus also confirming the myth.

An additional argument supporting a highly dynamic environment in historical times is the foundation at the beginning of the first millennium BC (i.e. c. 3.0ka BP) of a town called Limnaion, whose meaning in ancient Greek could be translated as 'lacustrine' or 'town on the lake'.[71] Based on the same narration by Livy, the broader location of this site could be constrained in the northeastern corner of the Karditsa Plain, close to the entrance of the Peneiada Valley, that is to say in the northeastern corner of the Karditsa Plain east of the major town of Pelinna. Following the proposed morphological and palaeogeographic evolution of the broader area during the Holocene, this is not a surprise and we tentatively correlate this historical town with the archaeological remains found on the hill above the Klokoto village near the modern Farkadona (Fig. II.1.6c–d).[72] Accordingly, it seems that up to historical times the entrance of the Peneiada Valley still represented, and caused, an overall 'dam effect' for the western waters in their attempt to reach the Aegean Sea, via the Larissa Plain, therefore locally and at least periodically accumulating in this sector of Thessaly to generate more or less wide lacustrine-to-marshy water tables.

*River Behaviour during the Ottoman Period*

With regard to modern times, we focus on two observations. Firstly, a detailed analysis of aerial photos and small-scale topographic maps (1:5,000) allows us to emphasise the occurrence of sand deposits in the internal part of some of the meanders, but especially the presence of small islands even in linear sectors of the riverbed. These sedimentary and morphological features could represent an incipient, though aborted, further transition of the river's behaviour from a meandering pattern towards a braided pattern (Fig. II.1.8). Indeed, in the present-day climatic conditions, such a perturbation of the hydrographic system could not be explained. We interpret it as a consequence of the Little Ice Age (14th–19th centuries) that likely caused initial forcing conditions, but whose duration was not sufficiently long to make this change complete and permanent.

A second observation is from the centre of the Koutsochero Basin NE of Alifaka village (Fig. II.1.2), where in the topographic maps of the Military Geographic Service (both 1:50,000 and 1:5,000 scale) the toponym 'Asmaki' is marked in correspondence with a geodetic point (quoted 82.45m) and the same name is applied to a small watercourse. It is worth noting that the very same word is also used in the Larissa Plain, NE of Larissa to indicate a 'recent' natural channel that was rapidly entrenching the Chasambali Bulge, which separates the so-called Nessonis Lake area from the Eleftherai Basin.[73] Although ephemeral, the critical role of the 'eastern' Asmaki River was a natural attempt at diverting the excess water during flooding periods of the Peneios River towards the southeastern sector of the Larissa Plain, potentially infilling Lake Karla, whose present-day altitude is 44–45m asl, that is, well below the 63–65m asl of the Chasambali Bulge as well as of the definitive exit of the Peneios River across the Rodia Gorge (c. 60m asl).

Although we do not know for sure, it is, however, likely that, based on ethnography, the same toponym in different localities describes the same topographic, morphological and/or hydrographic characteristics. Accordingly, during the Ottoman Empire occupation, local people likely identified the site Asmaki near Alifaka with the same geographic and hydraulic meaning it has

[70] Caputo 1995; Caputo et al. 2004; Caputo – Helly 2005a; Caputo – Helly 2005b; Caputo et al. 2011.
[71] Titus Livius 36.13.9.
[72] Decourt 1990.
[73] Caputo et al. 1994.

in the Larissa Plain. In other words, understanding and characterising this sector of the alluvial plain as a transfer zone or by-pass area of water during flooding events of the Peneios River in the Peneiada Valley.

If this is the case, the flat area south of Koutsochero represented a natural overflow basin, where both inflow and outflow probably occurred along the Asmaki watercourse up to modern times.

### II.1.4. Concluding Remarks

The results obtained within the framework of our investigations focused on reconstructing the morphological conditions and environmental evolution of the broader area surrounding the PMZ archaeological site and providing quite innovative and important information that goes well beyond, in both space and time, the initial target. They indeed contribute to unravelling the major hydrographic transformations that affected Thessaly during the latest Quaternary, allowing us to explain a major morphological anomaly in its central sector. In particular, we present and discuss evidence that the reach of the Peneios River presently flowing along the Peneiada Valley is very recent, certainly younger than the LGM period (c. 26.5–19.5ka BP) and possibly only definitively formed during the late Holocene. In this regard, on the basis of a systematic geophysical survey consisting of numerous horizontal to vertical spectral ratio (HVSR) measurements, Ambra Mantovani et al. have thoroughly documented that the bedrock underlying the recent loose deposits infilling the Peneiada Valley clearly deepens from ENE (Koutsochero area) towards the west (Zarko and Farkadona sector), where it reaches an estimated depth of about 150m from the surface (Fig. II.1.3).[74] A careful inspection and analysis of the entire Thessalian hydrographic network strongly suggest that in the past the Peneiada Valley represented the lower reach of the Titarissios River (Fig. II.1.6a), draining its waters into the western Thessalian 'lowland', at that time probably representing a wide lacustrine-to-marshy area (the so-called Karditsa Lake) fed by several independent hydrographic basins draining the Antichasia, Pindos and Othrys mountain ranges (Fig. II.1.5).

As a consequence of the tectonic activity that started generating the Tyrnavos and Larissa faults during the Late Pleistocene, the Titarissios River was diverted towards the eastern Thessalian Basin (Larissa area/lake), thus causing the abandonment of the Peneiada Valley, where only local deposition sourced from the valley flanks remained active (Fig. II.1.6b). On the other hand, due to the endorheic conditions characterising the western 'lowland', the Karditsa Lake was progressively infilled by fluvio-lacustrine deposits. The infilling process was highly asymmetric because the several internal deltas prograding from the western and the southern rivers were gradually merging towards the exit of the abandoned Peneiada Valley (i.e. the Farkadona area; Fig. II.1.7). Over time, this sedimentary process steadily reduced the size of the permanent water table, progressively shifting/delimiting the lacustrine area northeastwards.

Sometime after the LGM and likely during Holocene times, genuine fluvial-alluvial conditions reached the Peneiada Valley, thereby rapidly completing its infilling due to the locally and temporarily increased sedimentation rate as a consequence of the strongly reduced alluvial surface. The contextual aggradation and eastward progradation of internal deltas and the consequent development of a topographic gradient sloping eastwards (i.e. from Farkadona towards Koutsochero) ultimately allowed the altimetric threshold of the Kalamaki Gorge to be reached, there triggering an accelerated vertical entrenching from the gorge upstream. Once a permanent connection between the two major plains (Karditsa and Larissa) had been established, any major evidence of the western lake disappeared, leaving only local and temporary marshy areas, still marked in many historical geographic maps.[75]

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[74] Mantovani et al. 2018.

[75] Heuzey – Daumet 1876; Nobile 1910; Royal Hellenic Map Service 1909a; Royal Hellenic Map Service 1909b; Ministry of Agriculture 1928; Hellenic Army Geographical Service 2008.

It was in this rapidly changing geography and environmental conditions that Neolithic people lived, while some repercussions were probably still observed during antiquity and were handed down as a myth.

### II.1.5. Appendix: Description of the Peneiada Valley Project-1 Borehole

*Riccardo Caputo – Bruno Helly – Marco Stefani – George Syrides – Sotiris Valkaniotis – Alexandros Bellesis – Giorgos Toufexis*

#### *Geological and Geographic Settings*

The results of recent geological investigations made it clear that the sector of the Thessalian Plain surrounding PMZ witnessed important environmental changes during the Holocene.[76] Indeed, based on i) numerous geophysical measurements of the local seismic noise performed all along the alluvial plain of the valley, ii) the analysis of the horizontal to vertical spectral ratio (HVSR) at each site and iii) a careful estimate of the shear-wave velocities, the depth of the bedrock underlying the alluvial sediments of the Peneiada Valley was calculated and properly interpolated for obtaining a 3D model of the palaeo-topographic valley bottom. Accordingly, it was possible to document for the first time the occurrence of a geologically recent (latest Quaternary) inversion of the topographic gradient along the valley and therefore to establish that the 'ancient' river flowed westwards, in contrast to the present-day Peneios River (that flows in the opposite direction).

Beyond the regional hydrographic consequences, this latest Pleistocene–Holocene 'revolution' certainly induced some major environmental, morphological and geographical changes at the entrance of the Peneiada Valley (where PMZ is located). Indeed, local sedimentary conditions progressively changed from purely lacustrine, to marshy, and to purely fluvial ones, though alternating phases of dry and wet environmental conditions (and of a seasonal versus permanent water table at the surface) likely occurred several times as a consequence of the climate forcing and minor order climatic pulses. Accordingly, Neolithic people lived and farmed in natural conditions quite different from the present-day ones.

As a consequence of these new scientific findings and in order to chronologically constrain the palaeogeographic evolution of the broader area around the tell during the 6$^{th}$ to 2$^{nd}$ millennia BC, a new specific geological investigation close to the archaeological site was considered necessary.

Following the above premise, a dedicated subproject was set up within the framework of the major PMZ project in order to define more accurately the stratigraphy of the sedimentary succession infilling the Peneiada Valley and especially to chronologically constrain the palaeogeographic evolution of the broader area around the tell during the 6$^{th}$ to 2$^{nd}$ millennia BC. In order to achieve these goals, a borehole has been drilled for obtaining a continuous core of the latest Quaternary alluvial deposits. In particular, the target was twofold: firstly, a detailed analysis of the sedimentary log for distinguishing and characterising the superposed depositional (i.e. environmental) facies and their vertical variations; secondly, the core would have provided samples to be analysed with the radiocarbon technique for obtaining calibrated ages at different depths.

Accordingly, the major expected results from this project were i) the reconstruction of the palaeogeographic evolution of the area placing particular emphasis on the environmental characteristics and their influence on the prehistoric human settlements and possibly the farming behaviour of the local populations; ii) a chronological calibration of the sedimentary succession based on $^{14}C$ analyses of selected samples, thereby allowing us to reconstruct an exact chronostratigraphy for characterising the real environmental conditions during the different Neolithic stages and later.

[76] Mantovani et al. 2018.

*Methodology*

The exact location of the drilling site was carefully selected based on i) the 3D model of the palaeovalley bottom considering that the deeper the bedrock underlying the recent sedimentary infilling, the more complete and detailed the cored stratigraphic sequence could be;[77] ii) the need to focus on the latest Quaternary stratigraphic succession; iii) the available budget for drilling and sample dating and iv) trivial logistic issues (like the availability of water for the drilling operations, land ownership, distance from the cartway, etc.).

The drilling operation of borehole PVP-1 (Peneiada Valley Project 1) was successfully carried out between 29th and 31st October 2018, coring the alluvial plain close to the hydrographic left banks of the present-day Peneios River and next to a historically abandoned meander, 2km SW of Zarko, 1km SE of the PMZ site and 500m WSW of Koutsaki Magoula (Fig. II.1.10). Drilling was performed by the company GEODRILL with an Acker rotary rig and reached a maximum depth of 61.8m from the surface. Core sampling was realised with a single-wall core barrel sampler (1.50 and 3.00m long) with a diameter of 101mm. The use of external casing during coring avoided caving and side collapse and protected the sampled cores from possible mixing and contamination.

Based on the drilling procedure, the core was obviously extracted partitioned, but generally in good condition along the entire length. Soon after each extraction, the cored segment was photographed in detail with metre measuring tape alongside it. Taking into account the occurrence of some lost material (e.g. in the case of loose, coarse-grained clastic deposits) and the phenomenon of core lengthening (e.g. in clay-rich samples due to a 'toothpaste' effect), it should be noted that the recorded depth values could have vertical uncertainty of up to 5–10cm.

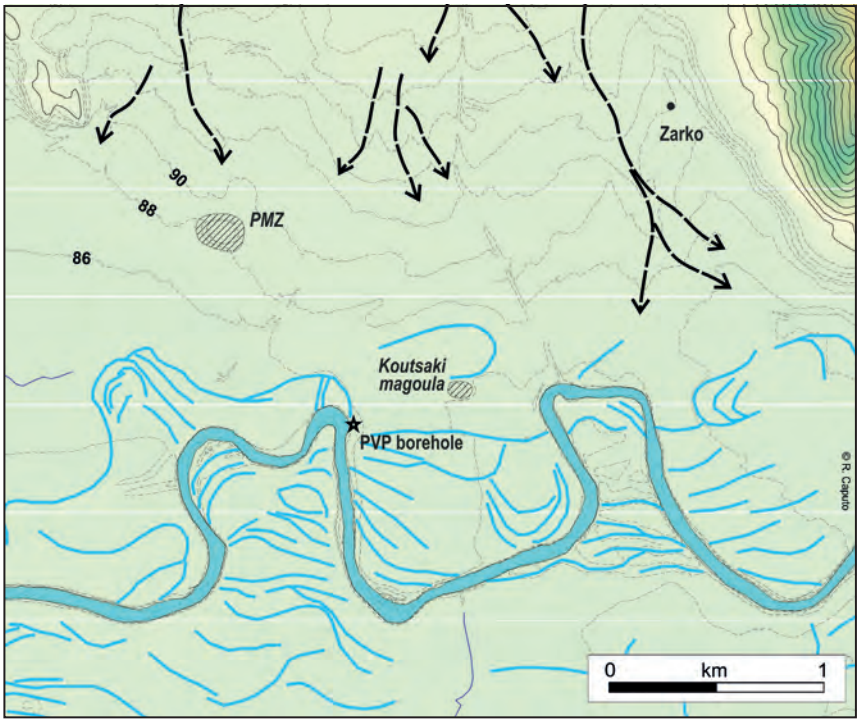



Fig. II.1.10 Topographic map of the western sector of the Peneiada Valley showing the present-day Peneios River and several historically abandoned meanders. Auxiliary contours are every 2m. Black dashed arrows indicate possible recent (Late Holocene?) flash floods that shaped the alluvial cone descending the northern slopes of the valley. The Neolithic sites of PMZ and Koutsaki Magoula and the modern Zarko village are represented. The star indicates the location of the borehole (R. Caputo)

[77] Mantovani et al. 2018.

During the field operations, a macroscopic lithological description was performed and the colour of the sedimentary material was determined using Munsell Soil Colour Charts. Numerous samples have also been collected for several purposes. Selected samples have been sent to a specialised laboratory (CEDAD – Centro Datazione e Diagnostica) at Salento University in Lecce, Italy, for radiocarbon analyses devoted to constraining the chronostratigraphy of (at least) the upper part of the core.

Several clay samples have been extracted as entire cylindrical portions of the core (10–15cm high) and provided to Areti Pentedeka to perform experimental archaeological tests consisting in the ceramic production of small artefacts to be petrographically compared with original ones. These samples have been collected at depths of 35.3, 41.3, 45.0, 49.0, 50.0, 53.5 and 55.9m.

In order to better understand the hydrographic-geological provenance of the sediments infilling the palaeo-Peneiada Valley, we also collected numerous samples of varying texture and granulometry for sedimentological-mineralogical analyses to be carried out within the framework of a dedicated investigation.

### *Lithostratigraphic Description*

As mentioned above, a detailed macroscopic description of the core was immediately realised in the field and initially reported at 1:20 scale. The lithostratigraphic description synthesised in Fig. II.1.11 and Tab. II.1.1 has been refined on the basis of a careful inspection of the photographic record and a preliminary samples review, while a preliminary depositional and palaeo-environmental interpretation is discussed in a subsequent section.

### *Fossil Content*

Some fossilised mollusc shells were observed during the extraction of the core from the core barrel sampler. Since the core samples were not elaborated, mollusc shells were observed only on the surface of the core samples as well as in the washed cuttings of the drilling, in the external casing, or in the washed residue on the top of each core sampling portion (Fig. II.1.12). The following genera were recognised:
Gastropods: *Planorbis planorbis*, *Theodoxus* sp., *Valvata* sp., Melanopsidae ind., Lymnaeidae ind.
Bivalvia: *Unio* sp.

All the above are freshwater molluscs and characterise aquatic environments with a permanent presence of water, thereby confirming the presence of lacustrine-marshy environmental conditions characterising the Peneiada Valley up to recent geological times before a permanent and clear hydrographic network was established.

### *Radiochronological Results*

Following the macroscopic analysis of the cored deposits, we collected all suitable samples for radiochronological laboratory analyses. They consist in the darker deposits, likely richer in organic material, vegetal fragments or turf layers and small shells. The CEDAD laboratory performed the radiocarbon analyses based on the high-resolution mass spectrometry technique (AMS) and following a several-step standard procedure (acid-alkaline-acid chemical attacks, 900°C burning, etc.). The radiocarbon ages provided are all calibrated based on the software OxCal Ver. 3.10 on the basis of atmospheric data.[78]

[78] Reimer et al. 2009.

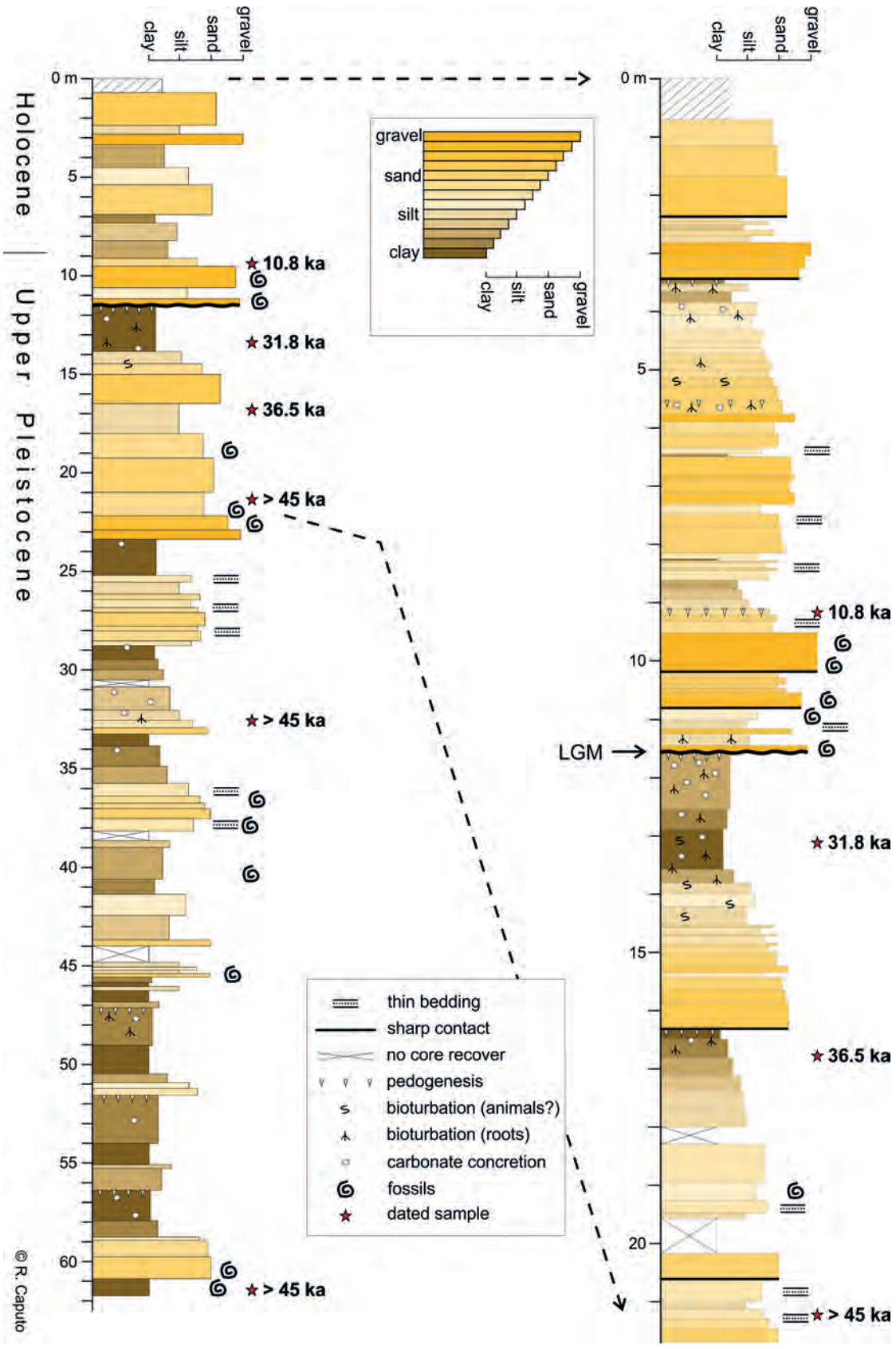



Fig. II.1.11 Complete lithostratigraphic column of the PVP borehole (left) and detail sketch of the uppermost 25m spanning the latest Pleistocene and Holocene deposits (right). Red stars indicate the dated samples with the AMS radiocarbon technique and corresponding calibrated ages (see also Tab. II.1.2). The paraconformity tentatively associated to the LGM likely corresponds to a sedimentary hiatus (R. Caputo, G. Syrides)

Tab. II.1.1 Lithological description of the Peneiada Valley Project 1 borehole (R. Caputo)

| Depth [m] | Short lithological description | Depositional facies |
|---|---|---|
| 0–0.7 | Sediments affected by anthropogenic reworking | Soil |
| 0.7–2.4 | Medium to coarse sand, fining upwards, meandering channel bar | Meander lateral bar and alluvial fan |
| 2.4–2.8 | Alternating fine sand, silty sand and silt | |
| 2.8–3.4 | Gravel, poor in matrix; a few centimetric clasts, very low maturity; metamorphic clasts and quartz; sharp base | |
| 3.4–4.3 | Silt, silty clay and clay alternating in centimetric layers, reddish, with prevailing herbaceous bioturbation, small pedogenetic carbonate concretions | Proximal alluvial plain |
| 4.3–4.5 | Thin intercalation of silty sand and fine-grained sand | |
| 4.5–5.9 | Fine to coarse sand, graded beds, often bioturbated, fining upwards unit; some root remains; gentle pedogenesis and some carbonate concretions (particularly at 5.60m) | |
| 5.9–6.3 | Medium-coarse sand disturbed by coring | |
| 6.3–6.5 | Fine-grained sand and silty sand, thin bedded lacking bioturbation | |
| 6.5–7.3 | Coarse-grained sand and mixed sand disturbed by coring (6.6–6.9m) | |
| 7.3–7.5 | Sand and silty-sand, thin bedded | |
| 7.5–8.1 | Medium sand, lacking matrix, partially disturbed by coring | |
| 8.1–8.6 | Fine sand and silt finely alternating, two graded sand beds (1.5cm thick); lack of bioturbation | |
| 8.6–9.1 | Silt and sandy silt, with traces of lamination and some organic content | Proximal alluvial plain, at the fringe of a locally fed alluvial fan |
| 9.1–9.2 | Palaeosol level; upper black organic-rich horizon, and a lower brownish level, with carbonate accumulation into altered sand; $^{14}C$ dated to calibrated 11,000 years BP | |
| 9.2–9.5 | Medium-to-fine sand, thinly bedded and lacking bioturbation | |
| 9.5–10.2 | Fine-grained gravel and coarse sand with muddy matrix, strongly disturbed by coring, with transported Melanopsidae fresh water gastropods | |
| 10.2–10.5 | Medium(-to-coarse) sand, with some gravel; graded beds and laminations | |
| 10.5–10.8 | Coarse sand-to-gravel, strongly disturbed and possibly displaced by coring | |
| 10.8–11.0 | Fine to medium sand, with some Bivalve bioclasts | |
| 11.0–11.3 | Silt, sandy silt and fine-grained sand, thinly bedded | |
| 11.3–11.5 | Dark grey coarse-grained sand and silt, with gastropods | |
| 11.5–11.6 | Gravel-coarse sand, very immature lithoclasts and freshwater gastropods | |
| 11.6 | Sharp, strongly diagenised surface, associated with a time gap | Associated with LGM |
| 11.6–12.6 | Grey bioturbated silty clay, strongly pedogenetic alteration, with diffuse calcareous concretions | Distal alluvial plain, with seasonal flooding and dry intervals |
| 12.6–13.7 | Bioturbated clay and silty clay, with a reduced degree of pedogenesis; $^{14}C$ dated to calibrated 31.8ka BP | |
| 13.7–14.5 | Bioturbated fine grained sand, silty sand and silt, yellowish and locally reddish | |

Tab. II.1.1 (continued)

| Depth [m] | Short lithological description | Depositional facies |
|---|---|---|
| 14.5–15.0 | Fine to medium sand, in several graded beds, with silty sand intercalation | Approaching river system with progradational cycles |
| 15.0–15.7 | Graded beds of coarse to medium sand, with some fine gravel grain, yellow | |
| 15.7–16.3 | Medium-coarse sand, lacking bioclasts and wood, disturbed by coring | |
| 16.3–16.5 | Centimetric alternation of coarse sand and fine silty sand; yellow colour | |
| 16.5–17.2 | Clay and silty clay, mottled by bioturbation, with root traces and carbonate nodules; $^{14}C$ dated to calibrated 36.5ka BP | |
| 17.2–18.0 | Fining upwards unit grading from sandy silt to silty clay, bioturbated | |
| 18.0–18.2 | No core recovery | |
| 18.2–19.6 | Alternation of silt, sandy silt and fine silty sand, fine graded beds and transported gastropods at the lower portion | |
| 19.6–20.2 | No core recovery, possibly sand | |
| 20.2–20.6 | Medium sand, probably graded, with a sharp base | |
| 20.6–21.0 | Fining upwards unit, grading from fine sand to sandy silt, poorly bioturbated and thus preserving fine horizontal graded beds; $^{14}C$ measured to be beyond the method limits | |

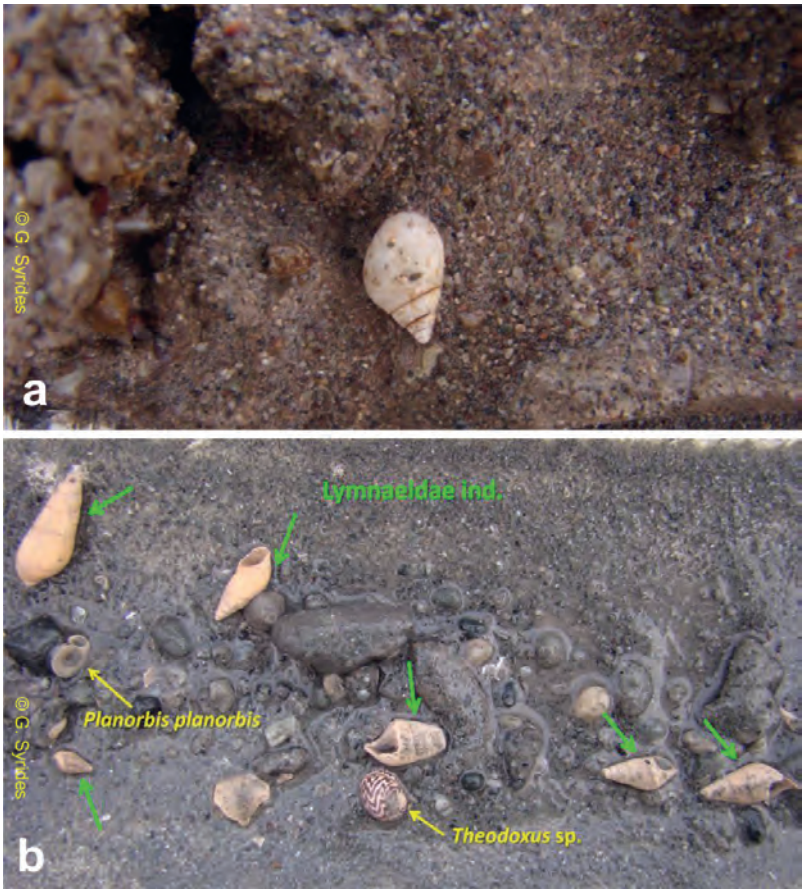



Fig. II.1.12 Examples of mollusc shells. a. Melanopsidae ind. Gastropod (10.12m); b. freshwater gastropods in the washed cuttings (~22.5m) (G. Syrides)

From the collected samples, we selected the most promising ones, also bearing in mind the overall target of the project, particularly devoted to constraining the chronostratigraphy of the Late Quaternary palaeo-Peneiada Valley infilling. Following this strategy, the deepest available sample (60.9m deep) and an intermediate one (32.5m) were preliminarily submitted to the laboratory, both, however, providing an age beyond the radiocarbon technique limits (i.e. >45ka). Even a shallower sample (21.3m deep) provided a similar Late Pleistocene age (Fig. II.1.11 and Tab. II.1.2). However, samples 008 and 002, collected at a depth of 16.7 and 13.3m, respectively, provided proper Late Pleistocene ages corresponding to 38.5 and 33.8ka BP (36510 ± 549 calBC 2σ – Tab. II.1.2). From these values, we could tentatively estimate a sedimentation rate of about 0.7mm/a in the latest Pleistocene, while the chronological constraint of sample 013 (>45ka BP) suggests this rate was previously slightly smaller. The inferred increase in time could be attributed to the growing clastic contribution due to the approaching internal deltas produced by the 'western' rivers progressively infilling the Karditsa Lake.[79]

The most important is sample 004, collected at a depth of 9.2m, that provided a calibrated age of 10829 ± 230 years BC, therefore basically pinpointing the Pleistocene-Holocene boundary. Although no laboratory ages are available in between samples 002 and 004, at a depth of 11.5m we observed a sharp, strongly diagenised surface, which is likely associated with a time gap caused by a strongly reduced sedimentation due to the paroxistic climatic conditions of the dry and cold last glacial maximum (LGM). Accordingly, this indurated surface could roughly represent the time period between 25 and 15ka BP.

*Environmental Evolution*

This section provides a preliminary interpretation of the environmental evolution recorded by the investigated core. The reconstruction is based on the sedimentological evidence and on the palaeoecological interpretation of the mollusc remains, framed within the chronological framework provided by $^{14}C$ dating and, for the uppermost portion, by archaeological and historiographic information. The provided reconstruction could be supported by further research, such as granulometry, morphometric, petrographic, palynology analyses. But even with the available data, the interpretation of the environmental evolution appears to be reliable.

The older portion of the analysed succession, below 45.5m in depth, clearly records low energy, continental marsh and lacustrine environments. Sometimes the deposits show poorly oxygenated conditions, associated with the preservation of organic material, while other beds suggest improved ecological conditions, allowing mollusc faunae. Granular sediment input was quite discontinuous and generally scanty in the deepest 15m. The water depth was comparatively limited and the water level fluctuations, likely associated with the frequent climatic changes characterising the Late Pleistocene, were therefore able to induce repeated episodes of temporary emersions, triggering incipient processes of pedogenesis. This is increasingly evident in the upper part of this interval, as documented by well-developed carbonate nodules and root bioturbation. The timing of this oldest drilled phase is not tightly constrained, since both radiochronological analyses from samples 048 (60.9m) and 016 (32.5m) indicate an age older than 45ka, that is to say, the methodological limit. However, if we tentatively consider the sedimentation rate provided by samples 002 (13.3m) and 008 (16.7m), corresponding to c. 0.72mm/a, at the bottom of the core we could estimate, as a very rough approximation, an age of 100ka that could be even somewhat older (150?ka) if the sedimentation rate was slightly lower.

The younger evolutionary phase (45.5–23.2m interval) experienced an increasing input of clastic material, mainly silt and fine silty sand, but sometimes also medium-coarse sand. These granular sediments were likely deposited within internal deltas and fluvial levee systems. Freshwater mollusc shells, particularly gastropods are frequent. Although bioturbation was common in

[79] See Caputo et al., this volume, 38–42.

Tab. II.1.2 Radiocarbon data from the Peneiada Valley Project 1 borehole (R. Caputo)

| Sample label (CEDAD code) | Depth [m] | Cal. age [years BC ± 2σ] |
|---|---|---|
| PVP-004 (LTL19022A) | 9.2 | 10829 ± 230 |
| PVP-002 (LTL19422A) | 13.3 | 31764 ± 246 |
| PVP-008 (LTL19423A) | 16.7 | 36510 ± 549 |
| PVP-013 (LTL19127A) | 21.3 | >45000 |
| PVP-016 (LTL18740A) | 32.5 | >45000 |
| PVP-048 (LTL18676A) | 60.9 | >45000 |

this period, at times the ecological conditions prevented the organism from bioturbating the sediment, therefore leaving well-preserved, fine-bedded, 20–50cm-thick successions, likely formed under subaqueous conditions. This unit was probably shallower relative to the lower one and chronologically spans younger Pleistocene times, though older than 45ka.

The analysis of the core allows us to identify a third depositional phase recorded at a depth between 23.2 and 14.5m. This time interval was characterised by the approaching river system, causing a significant clastic sediment input. Three possible metric-scale progradational (deltaic?) cycles could be tentatively inferred. The lack of wood fragments could suggest a seasonally dry environment (or other conditions unfavourable to the wood cover). The upper portion of this third unit, however, records in situ bioturbation by limivorous animals and bush vegetation. The prevailing subaerial condition facilitated the evolution of soils. Two radiochronological analyses have been performed in this core interval; the deeper sample (21.3m) was beyond the methodological limit (i.e. >45ka BP), while the upper one (16.7m) provided an age of c. 38.5ka, thus documenting the beginning of the Late Würmian glacial stage.

The dominant fine-grained sediments observed between 14.5 and 11.6m suggest that the area was subsequently characterised by a flat, distal alluvial plain environment, subject to prolonged seasonal flooding. The alternating drier periods were associated with a widespread and intense pedogenesis, leading to the extensive precipitation of diagenetic carbonate nodules, sometimes on vegetal root structures, significantly stiffing the mud sediment. A dated sample (002) collected at a depth of 13.3m provided an absolute age of 33.8ka (31764 ± 246 calBC 2σ), suggesting that this unit accumulated during the Late Würmian stage (pre-LGM). Soil alteration was particularly intense in the younger portion of this interval where the unit is capped by a sharp surface (palaeosol), recording deep pedogenesis alteration, developed during a comparatively long period of non-deposition, spent under subaerial conditions. This hiatus likely embraces, and is related to, the LGM climatic paroxism that in Greece likely represented a dry period.

Sedimentation restarted, only under changed climatic and environmental conditions, i.e. post-LGM and early Holocene times. This depositional phase is recorded by the core interval between 11.6 and 8.1m. Sand and silt accumulated into a topographically flat, proximal alluvial plain clearly interfingering with the lower fringe of an alluvial fan, fed by coarser-grained sediments, like fine gravel and coarse sand. The provenance of the latter material is undoubtedly from local metamorphic rocks, largely cropping out in a minor hydrographic basin north of the investigated site.[80] The increased precipitation washed out, with debris-flow mechanisms, the clasts formed and temporarily accumulated on the slopes during the former period. Seasonal(?) freshwater ponds were colonised by vegetation and gastropods. The laboratory age of 12.8ka BP provided by sample 004 collected at a depth of 9.2m is crucial and basically marks the Late Pleistocene–Holocene chronostratigraphic boundary.

[80] Caputo et al., this volume, 48–49.

From 8.1 to c. 3.4m, deposition of fine-grained sand and silt again prevailed in the area, documenting the restoration of a 'pure' alluvial plain fed by a major eastward flowing river. The fluvial channel itself did not reach the investigated area, where, instead, levee and distal interfluvial environments developed. Two further samples collected at 5.9 and 4.2m have been submitted to the laboratory for radiocarbon analyses, but the results are not yet available. They will contribute to refining the uppermost chronostratigraphy of the investigated core.

With the exception of the shallowest 0.7m, representing the present-day soil which consists of ploughed material, the uppermost portion of the core (3.4–0.7m) consists of gravel and sand, once again recording two distinct sediment sources, that is to say, local clastic contributions from the northern fan and the deposits transported by the Peneios River. At the drilling site, the river formed a shallow meander, documenting that the river bottom was at c. 2.3m from the topographic surface. This suggests a possible timing older than the historical entrenching phase that affected the Peneiada Valley plain.[81]

The present-day environment is heavily influenced by the hydraulic (irrigation and draining) work and by the widespread agricultural practices. Wide adjacent areas are, however, still subject to widespread flooding events during the moist seasons, reminiscent of the lacustrine and freshwater moist environments once so common in the research area.

### *Concluding Remarks*

Based on the detailed description and discussion of the drilling outcomes, we could safely state that the main anticipated results of this project have been achieved, but, above all, that the conceptual geological model is fully confirmed and, specifically, that a Late Quaternary lacustrine environment close to the PMZ site was progressively affected by the arrival of fluvial sedimentary conditions causing the final infilling of the palaeo-Peneiada Valley with the creation of the present-day hydrographic network flowing definitively eastwards. Accordingly, Neolithic people likely lived during the latest phases of this changing environment.

[81] Caputo et al., this volume, 38–43.

## II.2. Geophysical Investigations

*Apostolos Sarris – Tuna Kalayci – James Donati*

### II.2.1. Scope of the Survey and Previous Geological Studies

The geophysical prospection at the archaeological site of PMZ was carried out in December 2016 under the auspices of the Ephorate of Trikala and within the collaboration by the Foundation for Research and Technology, Hellas (F.O.R.T.H.) with Eva Alram-Stern (Austrian Archaeological Institute, Department of Prehistory & West Asian/Northeast African Archaeology) and Giorgos Toufexis (Ephorate of Antiquities of Larissa). The aim was to locate concentrations of human activities in the form of built environments as well as other habitation signatures around the tell. Survey areas were defined around the magoula with the intention of covering the largest area permitted by the ground conditions. The prospection was also accompanied by non-systematic reconnaissance surface collection for dating purposes in different sections of the site.

Previous geological studies in the area of PMZ included an evaluation of the soil deposits and the stratigraphy within and around the site, using an augering approach.[82] Eleven different cores (Fig. II.2.1) were collected around the magoula and one in the Late Neolithic cemetery that was discovered in 1974 at a distance of about 300m to the northeast of the magoula.[83] This particular campaign studied early Neolithic farming in the wider Thessalian river landscape. Tjeerd van Andel et al. concluded that despite the disadvantages of floodplain farming, some Early Neolithic

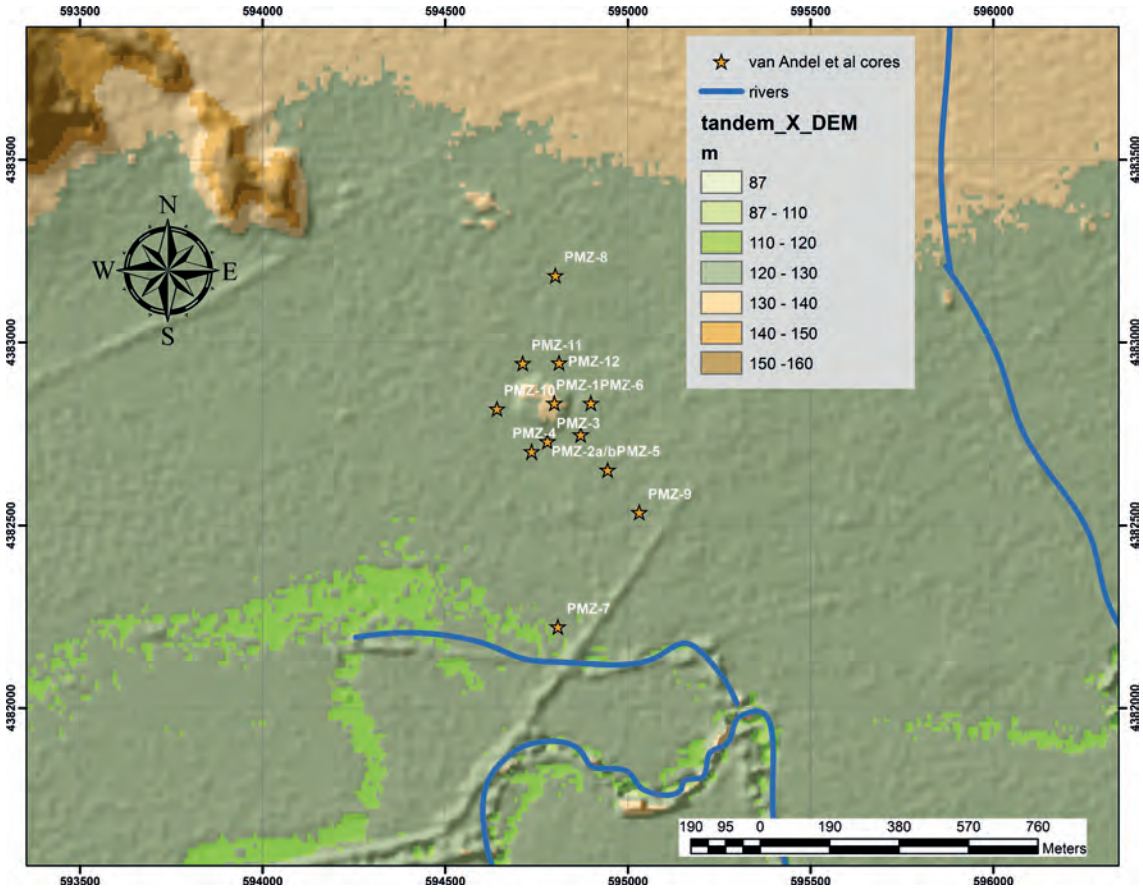



Fig. II.2.1 The location of the cores taken from van Andel et al. 1995 overlaid on the DEM and the hillshade of the area around PMZ. The DEM was created from data of the TanDEM-X radar satellite of DLR (A. Sarris)

82 Van Andel et al. 1995, 138–140.

83 Van Andel et al. 1995, 134.

communities established in silty soils made systematic use of it.[84] It has to be noted, however, that other archaeobotanical and zooarchaeological studies by Paul Halstead and Cornelia Becker came to different conclusions supporting rain-fed cultivation.[85]

### II.2.2. Geophysical Instrumentation and Methodology

Magnetic, soil resistance, ground penetrating radar (GPR) and electromagnetic induction (EMI) techniques were employed during the geophysical prospection campaign at PMZ recording anthropogenic residues around the tell. The specific techniques were chosen based on the needs of the research, the geomorphological characteristics of the site and the expected subsurface

Tab. II.2.1 Summary of the sampling and the area coverage of each geophysical technique (A. Sarris)

| Method | Δx [m] | Δy [m] | Area Coverage [m²] |
|---|---|---|---|
| **Magnetics** | 0.25 | Variable (<0.1) | 57,080 |
| **EM** | Variable (~1) | Variable (~0.2) | 47,208 |
| **Resistance** | 1 | 0.5 | 5,196 |
| **GPR** | 0.25 | 0.025 | 500 |

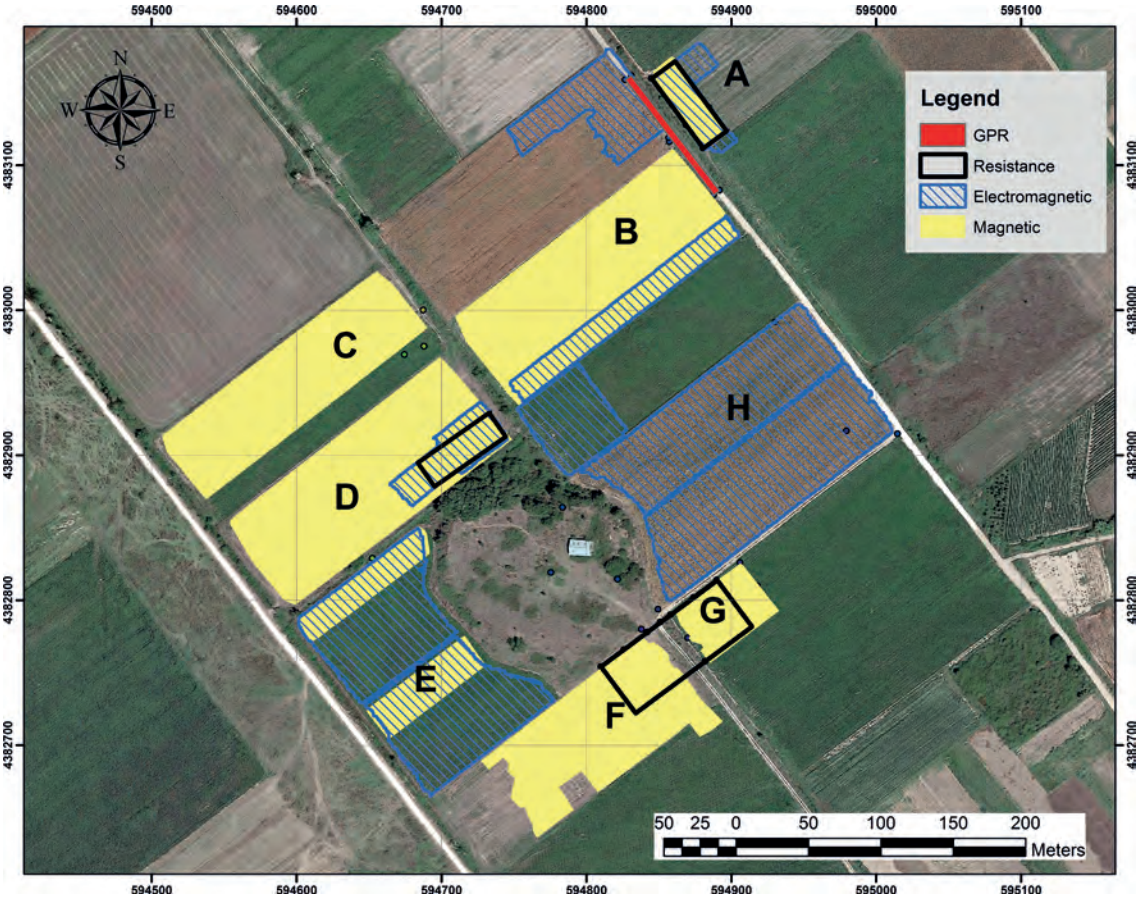



Fig. II.2.2 The map indicates the coverage of the RM85 resistance meter (~0.5ha), CMD EMI (~4.7ha), GPR (0.05ha) and SENSYS gradiometer (~5.7ha). The coding of the different sections of the site (A–H) that were surveyed are also indicated (A. Sarris)

84 Van Andel et al. 1995, 140.

85 Becker 1991; Becker 2000; Halstead, this volume, 585.

archaeological targets. The same integrated techniques proved to be extremely successful in mapping the environs of other Neolithic magoulas in Thessaly.[86] Tab. II.2.1 summarises the sampling and the area coverage of each technique and Fig. II.2.2. shows the extent of coverage of each prospection method.

Magnetic and EMI techniques were able to cover most of the area around the magoula. Soil resistance measurements were carried out only in specific sections to verify some of the suggested magnetic anomalies. Due to intense rainfall prior to the survey, the soil was extremely muddy; therefore, it was not possible to extensively scan the site with GPR other than a small section along a dirt road near the cemetery.

Magnetic measurements were collected using the multi-channel Sensorik & Systemtechnologie (SENSYS) MX Compact Survey System. SENSYS MX was equipped with eight FGM600 gradiometers and navigated through a differential GPS (dGPS). The gradiometer sensors were spaced 25cm apart and measurements were taken with a sampling of less than 10cm. MonMX 4.0 software was used for the communication of the MX compact box with the multi-channel system. The software interface allows the configuration and alignment of the sensors and the navigation within the landscape. A series of Matlab functions were used for further processing of data, including despiking and removal of overlapping data. The output processed data was imported to Surfer software, interpolated through a kriging algorithm, and finally converted into a raster map.[87]

The EMI data was collected with a CMD Mini Explorer unit by GF Instruments designed for multi-depth measurements. CMD Mini Explorer is used for the assessment of ground conductivity and of induced magnetic susceptibility using three dipole centre distances (0.2m, 1.71m, 1.18m) at a frequency of 30KHz, which correspond to 3 depth ranges (0.5/0.25m, 1.0/1.5m, 1.8/0.9m). The data was acquired using a dGPS and logged in a designated control unit. EMI measurements can change for each grid by an offset and a coefficient. Thus, unlike resistivity or magnetic data, EMI signals must be calibrated for further processing due to the sensitivity of the instrument (distortion, temperature change, etc.). As for the calibration, a vertical electrical sounding gives a first idea of the electrical resistivity distribution. Next, results are compared with EMI measurements collected at different heights. This comparison allows for the determination of the coefficient digit/ppm. The coefficient establishes the relationship between the instrumental response and the theoretical EMI response. Furthermore, it reveals the range of measurement for theoretical values (ppm) and the experimental values (digits). The range allows determination of the offset. To calculate the offset value for the in-phase part of the signal, a measurement is first made at a specific high height (equal to or more than 2m). For this measurement, the response induced by the susceptibility is null so that it is possible to calculate the offset for the susceptibility measurement. For processing the EMI data, it is assumed that the coefficient for the in-phase and quadrature are the same.[88]

Soil resistance mapping was conducted with a Geoscan Research RM85 instrument configured in a twin-probe electrode array. While 1m probe separation enabled deeper penetration of the current (in comparison to Dx=0.5m), a 0.5m sampling was carried out along parallel transects spaced 1m apart to ensure the collection of high-resolution data. Data sets were given the appropriate coordinates according to the position of the adjacent grids and an area code was given for each cluster of grids. A specific map coordinate system was chosen for each geophysical mosaic of grids, which was registered to the appropriate geodetic system of coordinates. Thus, based on georectified satellite images, it was possible to overlay the geophysical maps at their corresponding location. Statistical analysis of both the common rows and the calculation of the average level of adjacent grids was carried out in order to provide a correction factor for each grid. Despiking techniques were used to isolate the extreme values that masked the anomalies of interest and

[86] Simon et al. 2015a; Kalayci – Sarris 2016; Kalayci et al. 2017.
[87] Armstrong – Kalayci 2015, 1–12; Kalayci – Sarris 2016.
[88] Simon et al. 2015b.

Fig. II.2.3 Details from the geophysical work at PMZ during the 2016 field campaign. a. Soil resistance survey; b. EMI survey; c. Magnetometer survey (A. Sarris, photos: E. Alram-Stern)

selective compression of the dynamic range of values was used to enhance anomalies close to the background level. Finally, colour and greyscale geophysical maps were produced: hot colours (reddish colours) in colour maps and light (white) colours in greyscale maps represent high intensity values.

The Noggin Plus-Smart Cart (Sensors & Software) GPR with an antenna of 250MHz was employed sparingly because of adverse weather conditions. The effective penetration depth of the antennas can reach 3–4m below the surface, but due to the humidity/conductivity of the soil this was reduced to about 3m. Measurements were carried out along parallel transects 0.25m apart with a sampling of about 2.5cm along the transects. The transects that were derived from the GPR survey were processed using GFP Edit4 and EKKO Project 2 by Sensors & Software and Voxler. Processing methods were used to remove noise from the data and enhance the signal information that can lead to better representation of the subsoil. At first, the GPR sections were given the relative x- and y-coordinates according to a local reference system that was used for the site. Processing of the data included the application of correctional filters applied to each survey line, the extraction of slices that represent the distribution of the reflectors with increasing depth and the creation of the subsurface 3D model. In the first stage, trace repositioning was employed to correct for the position of and the extent of the GPR traces within each transect. Time zero correction, based on 10% of the absolute maximum value on a data trace, allowed estimation of the correct vertical position of the first pulse that left the antenna end entered the subsurface. Other filters, such as dewow (removal of low frequency noise), SEC (spreading & exponential compensation) gain and a background subtraction filter were used to enhance signals located at greater depths and reduce the background random noise. During the second stage, horizontal depth slices at different depth levels were created from the original vertical sections assuming a velocity for the electromagnetic waves equal to 0.1m/nsec. Then the 3D model was extracted and imported to Voxler software to visualise the subsurface.[89]

Details of the geophysical prospection work at PMZ are shown in Fig. II.2.3a–c.

## II.2.3. Geophysical Results

The areas of investigation around PMZ were divided into eight survey zones (Areas A–H) (see Fig. II.2.2). The locations and extent of these areas were selected based on ground surface conditions. In a number of cases, deep ploughing and standing vegetation (e.g. cotton) prevented more extensive magnetic and GPR surveying around the settlement. In all areas, the survey followed a NE to SW direction corresponding to the orientation of the ploughing lines.

### *Magnetic Survey*

Area A was established in order to investigate a potential burial ground, since it is located about 60m southeast of the excavated area of the Late Neolithic cemetery. The magnetic sensor array was set shorter (five sensors with 25cm separation) to overcome the challenging surface conditions. Nevertheless, no clear information was gathered with respect to potential urn burials (Fig. II.2.4a–b). Just a few isolated monopole anomalies with a diameter of ~1–1.5m were recognised (anomalies around A1) with a couple of larger features appearing in the southern section of Area A (features A2 and A3). It is hard to suggest that the specific anomalies can be related to urn burials,[90] due to their expected depths, which is at the limit of the investigation depth of the instrument (~1.5m from the upper horizon) according to the cores made by van Andel et al.[91] and the background noise due to the heavy ploughing of the site.

[89] Annan 2009; Manataki et al. 2015, 1–13.
[90] Gallis 1982, 77.
[91] Van Andel et al. 1995, 134.

Fig. II.2.4 a–b. Results of the magnetic survey near the Late Neolithic cemetery of PMZ in Area A. The yellow circles in the right-hand figure indicate the isolated monopole or dipole anomalies identified by the magnetometer survey. The Neolithic cemetery is also visible to the NW of the geophysical survey grid (A. Sarris)

North of the magoula, Areas B, C and D proved to be more revealing (Fig. II.2.5a–b). Area B (~80 × ~200m) exposed a series of linear anomalies criss-crossing each other. The main feature (B1) is a wide (~4m) lineament running NE-SW, while to the south (NE section of Area D) it appears to bisect the northern borders of the basin of the magoula. The lineament fades out rather abruptly within the bounds of the survey coverage. Nevertheless, recent satellite imagery (Fig. II.2.6) indicates that the feature continues further to the northeast with a slight turn to the north, a probable indication that the feature and others in Areas C and D are the remnants of past hydrological activity.

Area C is located ~100m to the NW of the site with dimensions of ~55 × ~200m. Like Area B, many lineaments (C1, C2 and C3) here are probably related to past hydrological activity. One notices that magnetic levels become higher closer to the magoula in contrast to the lower magnetic signals in the NW zone of Area C. These differences have also been noted in Area B, as well as Area D (see below), and they probably define the limits of anthropogenic activity around the magoula.

Area D (~75 × ~190m) abuts the settlement in the NW. There are numerous anomalies that require further attention. Prospection data revealed four large rectangular and highly magnetic features (D1, D2, D3 and D4), possibly of archaeological interest. These features appear to be aligned in the same direction NW-SE and have dimensions of about 9–12 × 12m. The northern feature (D1) clearly falls within two lineaments (D5) running in an east-west direction. This double lineament can also be traced on the satellite imagery towards the east. It would be tempting to suggest that the particular structures indicate residues of burnt houses.

A few more residues of architectural structures (D6) can be suggested on the northern fringes of the magoula, towards the southeastern zone of Area D. Three or more enclosed spaces are revealed in the immediate skirts of the settlement. They have northern orientations and are possibly surrounded by a thin enclosure wall or ditch. The dates of these structures cannot be determined

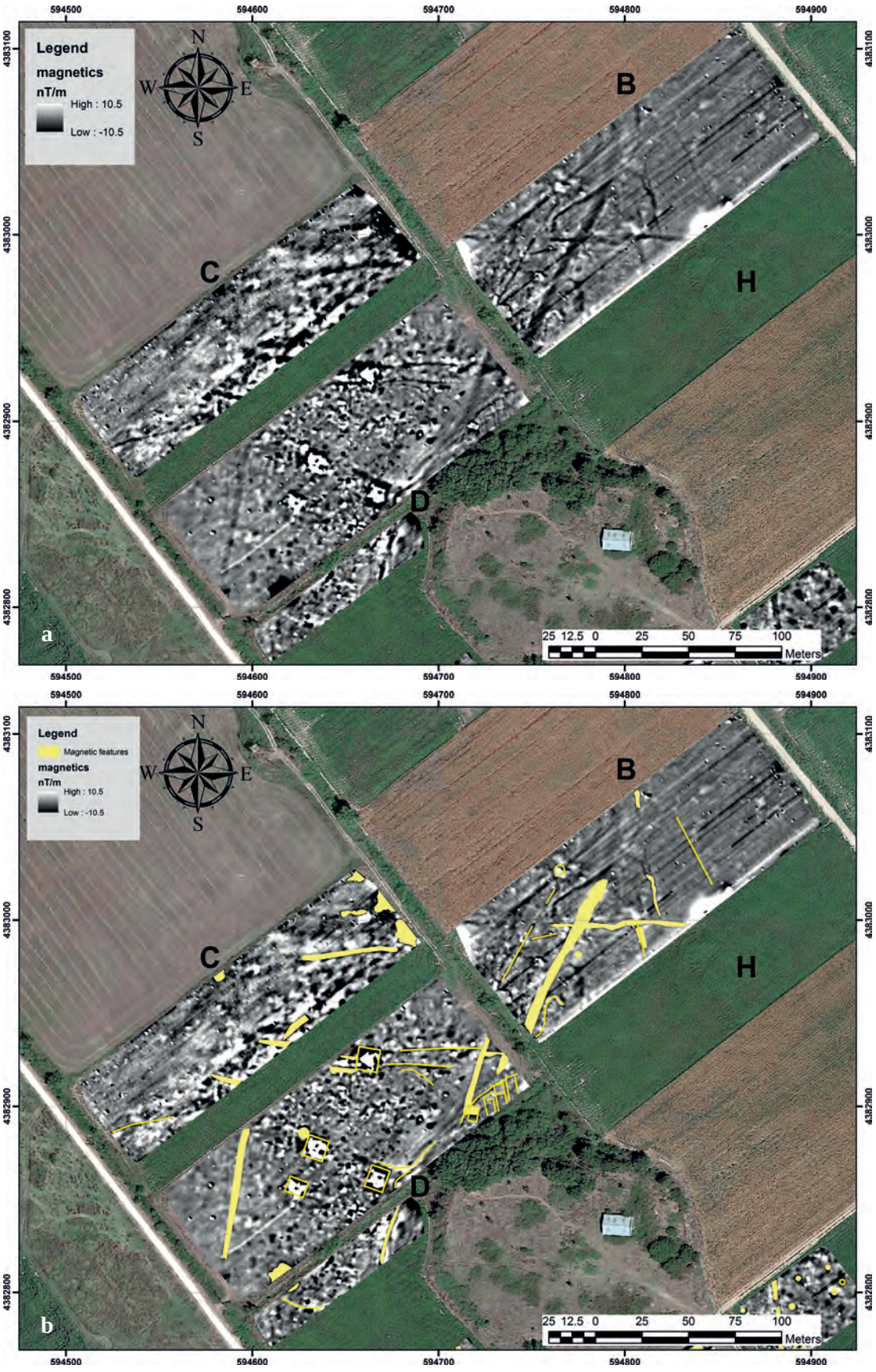



Fig. II.2.5 a. Results of the magnetic survey at PMZ in Areas B, C and D; b. Diagrammatic interpretation of the geomagnetic features (A. Sarris)

Fig. II.2.6 Satellite image extracted 4 May 2010 (GoogleEarth). The continuation of the intense magnetic feature is obvious in the satellite image and it turns to the north (A. Sarris)

through geophysics, but one could hypothesise that they constitute part of the furthest dwellings of the latest phase (Early Bronze Age?) of the settlement.

Area D expands further to the south with a narrow strip ~20 × ~105m. A long, linear modern ditch divides these two areas. Due to the constricted size, this portion did not provide as much information. However, the magnetic signature of the area indicates similar anthropogenic activity and land-use practices, modern or ancient. Of particular interest is the lineament (D7) located to the north of the survey area and running in a NW-SE direction. It is likely that this feature is the continuation of the single lineament in the NE. This particular anomaly also seems to coincide with a larger soil conductivity feature that runs further to the south (see EMI results below).

Area E is a small zone (~25 × ~85m) immediately west of the magoula (Fig. II.2.7a–b). Two (curvi-) linear features (E1 and E2) are immediately visible, running parallel to the curvature of the settlement. Despite their fragmentary nature, the projections of the two features to the northwest and southeast support the suggestion that these lineaments denote settlement enclosures, as do a couple of thinner curvilinear features (F1) in Area F (see below).

Area F is located to the south of the settlement, capturing the elevation rise to the southeast and the downwards slope towards the south. This division proved to be non-arbitrary as there is a clear geomagnetic difference based on the topographic imprint. The southwest section of the area is completely clear of anomalies, suggesting a lack of human interference. The only feature of interest is a circular lineament, F2 (with a concavity in the opposite direction of the magoula), which may not be of cultural origin. Another double linear feature (F3) runs in an east-west direction.

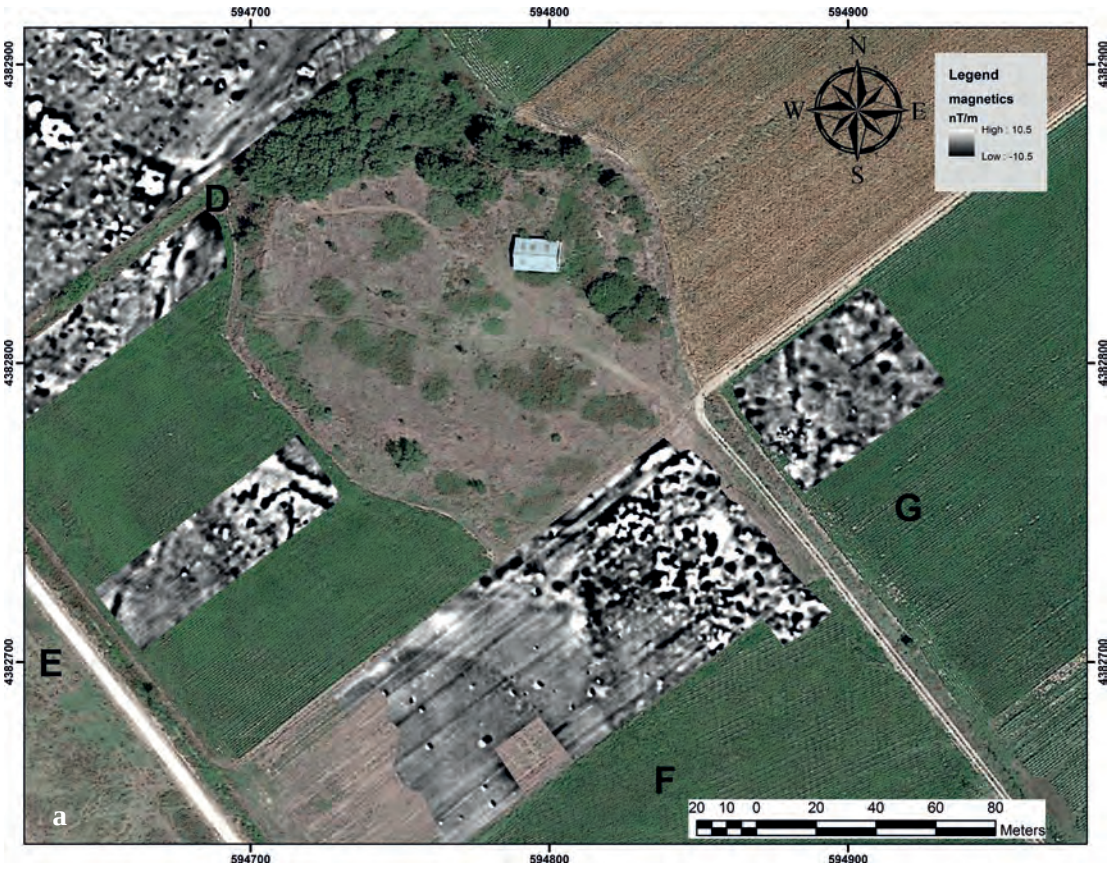



Fig. II.2.7a. Results of the magnetic survey at PMZ in Areas E, F and G (A. Sarris)

The eastern portion of Area F has a complex magnetic feature distribution (features around the vicinity of F4) and it is not possible to delineate features easily. Most of these features can be dated to past human activities, as the non-systematic archaeological survey indicated a dense scattering of Early Bronze Age to Middle Bronze Age sherds. Despite the complexity of the magnetic results, it seems that we are dealing with a dense distribution of structures, which provide evidence of an extensive Bronze Age (?) settlement that continues for more than 100m further to the east.

Area G is a smaller survey area (~45 × ~60m) located in the eastern section of the magoula. The distribution of the magnetic features does not have a pattern similar to Area F, even if it shows clear evidence of anthropogenic activity. A semicircular feature (G1) appears to the south of Area G. A few other features (G2) running in a north-south direction to the east of the magoula represent a continuation of low conductivity features running further to the north and may be residues of past hydrological activity (the east-running gully suggested by van Andel et al.).[92]

*Electromagnetic Induction (EMI) Survey*

Both magnetic susceptibility and soil conductivity data revealed patches and lineaments of highly susceptible and/or high conductivity soils (Fig. II.2.8a–c). The lineaments may be explained by modern agricultural activities where ploughing and differential treatment of soils provide patterns.

[92] Van Andel et al. 1995, 138.

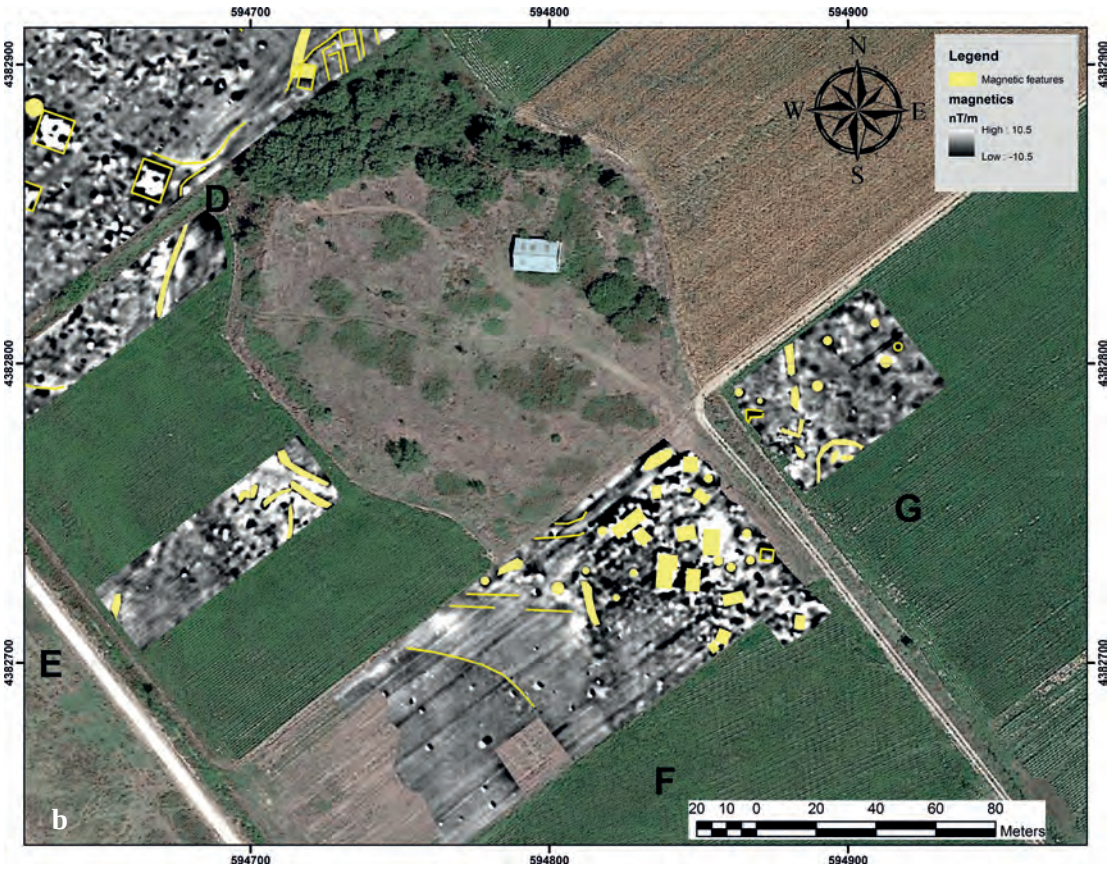



Fig. II.2.7b. Diagrammatic interpretation of the geomagnetic features (A. Sarris)

Clusters of highly magnetically susceptible/high conductivity areas may be indicative of concentrations of organic soils and/or human activity in the past. The images from both data sets provide slight evidence of curvilinear features from past hydrological activity or ditches that surround the magoula.

In the particular data set, the only immediately visible feature is a low-susceptibility curvilinear feature (E3) to the west of the settlement. It follows the contour of the magoula but fades away rather quickly. A few isolated high magnetic susceptibility anomalies are indicated within this circular feature. A few more features to the north of the magoula are at the same spot where the rectilinear structures (D6 in Fig. II.2.5b) on the fringes of the magoula were proposed by the magnetic data.

Similarly, low conductivity data indicate four distinct lineaments that require further discussion: a relatively resistive curvilinear feature (E4) to the west of the settlement runs closer in the north (similar trajectory to E3) and then diverts as it runs further to the SW. A relatively high resistivity anomaly (E5) runs even closer to the magoula to the west. Another curvilinear low conductivity feature (H1) runs parallel to the contour of the magoula at about 40m to the east. A low conductivity feature (D8) is located to the north of the settlement in close agreement with the soil resistance and magnetic measurements. Finally, a double faint linear feature (H2) shows up in the conductivity data further to the east and it is visible on some satellite imagery (e.g. 14 August 2013 on Google Earth).

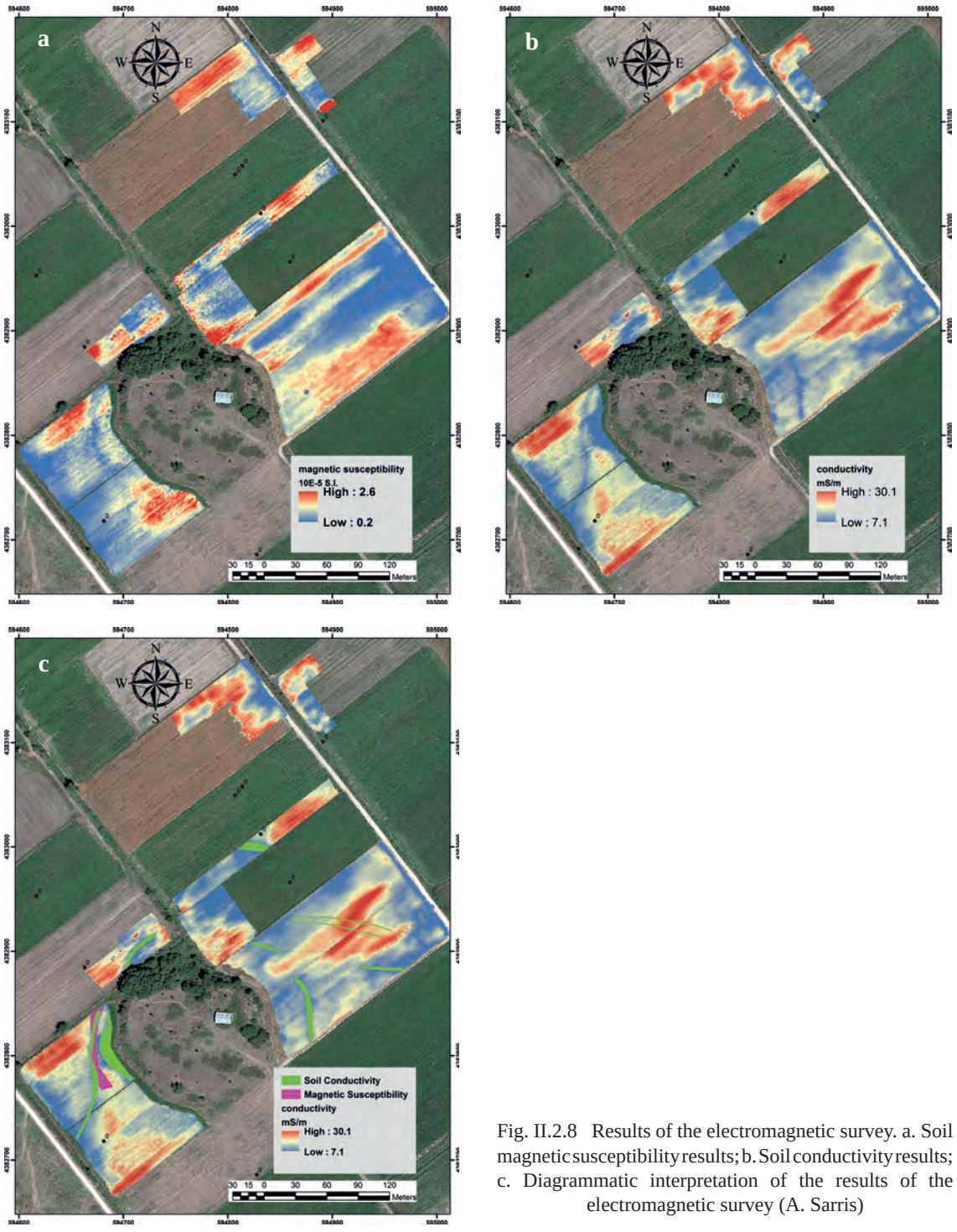



Fig. II.2.8 Results of the electromagnetic survey. a. Soil magnetic susceptibility results; b. Soil conductivity results; c. Diagrammatic interpretation of the results of the electromagnetic survey (A. Sarris)

*Soil Resistance*

Soil resistance data were collected from three regions: the area southeast of the cemetery excavations and a couple of areas to the north and south of the magoula. The individual sections were processed separately, and each final map was rectified and overlaid with satellite imagery (Fig. II.2.9a–b).

A number of linear anomalies were indicated in each section. To the south, two linear anomalies deserve attention. A faint high resistance anomaly (F5) seems to curve parallel to the shape of the magoula. A much higher resistance anomaly runs for about 50m in a similar way to the

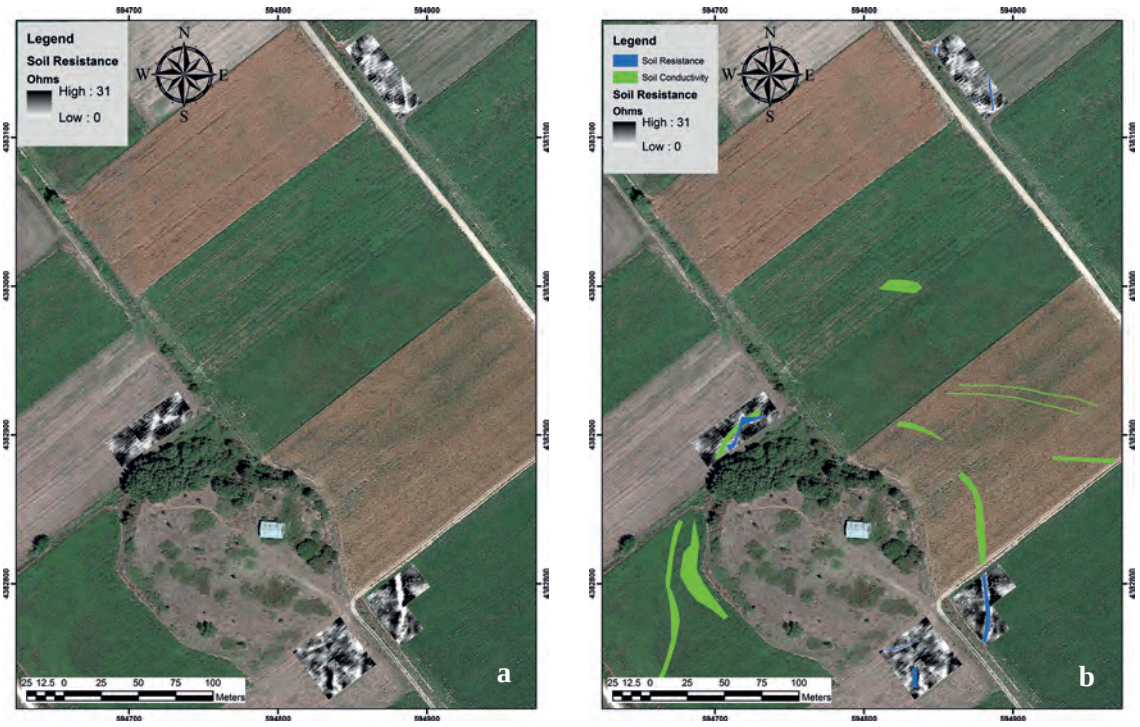



Fig. II.2.9 a. Results of the soil resistance survey; b. Diagrammatic interpretation (A. Sarris)

southeast (~40m away from the foot of the magoula) and coincides with the magnetic features (G2) at the same location. Interestingly, the continuation of this feature to the north is clearly pinpointed by the EMI measurements and it is manifested as a low conductivity anomaly (H1). Is it possible that the particular anomalies belong to a perimeter/fortification wall encircling the site?

To the north, a linear high resistance anomaly (D8) also coincides with the location of a highly magnetic and low conductivity anomaly. It is the one that encloses the structural remains (D6) at the north foot of the magoula.

On the other hand, not many features were suggested by the soil resistance measurements in the area of the cemetery, with the exception of a few isolated anomalies and a linear feature (A4) that runs in a north-south direction.

### *Ground Penetrating Radar (GPR)*

GPR measurements were carried out along the dirt road to the north, close to the cemetery. The individual radargrams indicate a geological interface to the north (in the beginning of each transect) of the surveyed area (Fig. II.2.10). Based on the individual radargrams and the time slices, it becomes obvious that we are dealing with a geological formation that appears around 2–2.5m below the current surface and which rises (to about 1m or less) towards the northeast (Fig. II.2.11a–b). The particular rise is seen in the individual radargrams of Fig. II.2.10. If this is the general tendency that we have further to the north, where the cemetery was brought to light, then it might be possible that the particular region constituted a low elevation rise, which may have been appropriate for the location of the cemetery, as it could have been relatively protected from frequent flooding episodes.[93]

[93] Discussed further by Caputo et al., this volume, 47–48.

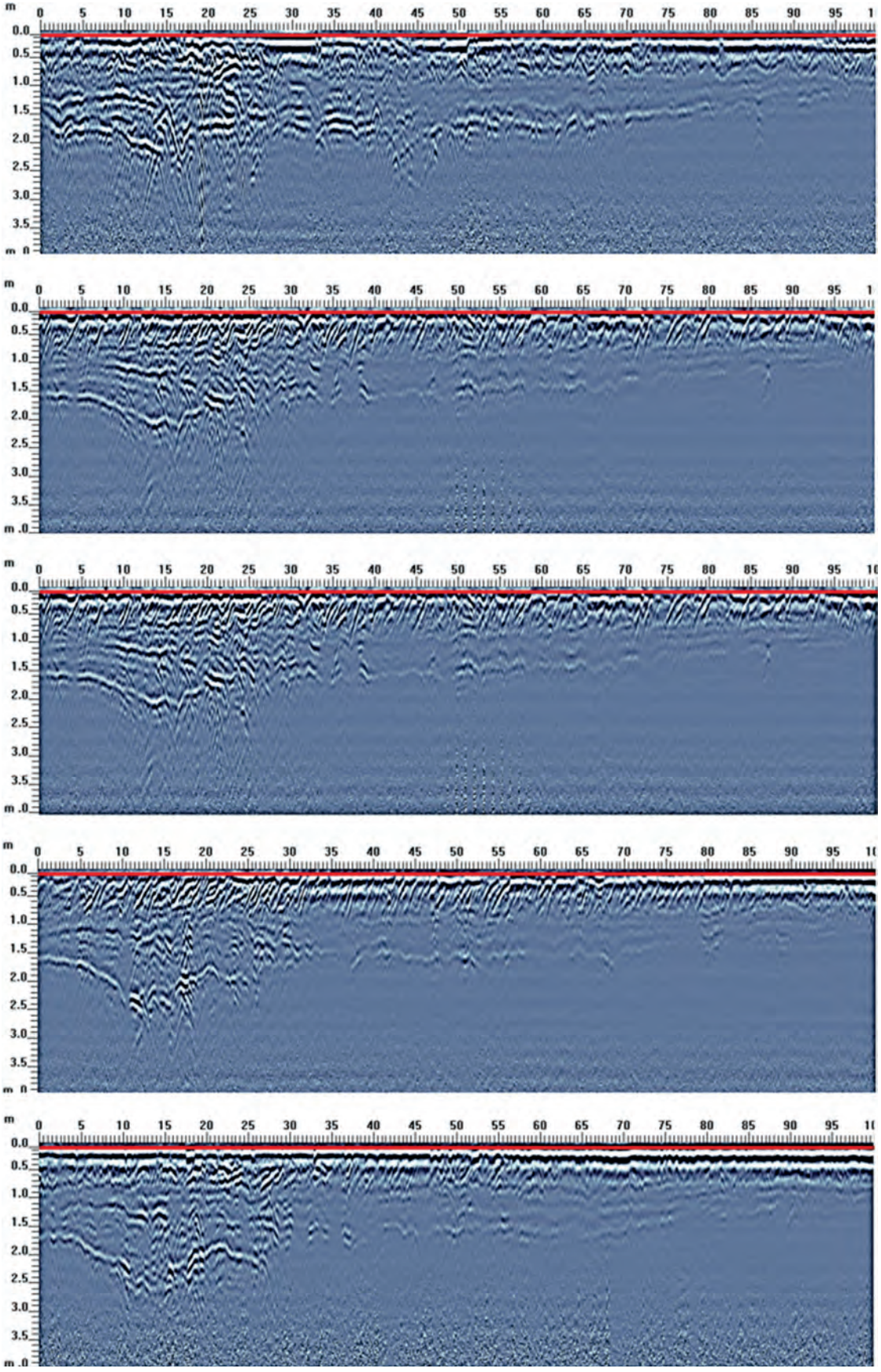


Fig. II.2.10 Radargrams of the GPR survey along the dirt road in the area of the cemetery. Radargrams represent the reflectors of the ground along parallel transects 1m apart (A. Sarris)

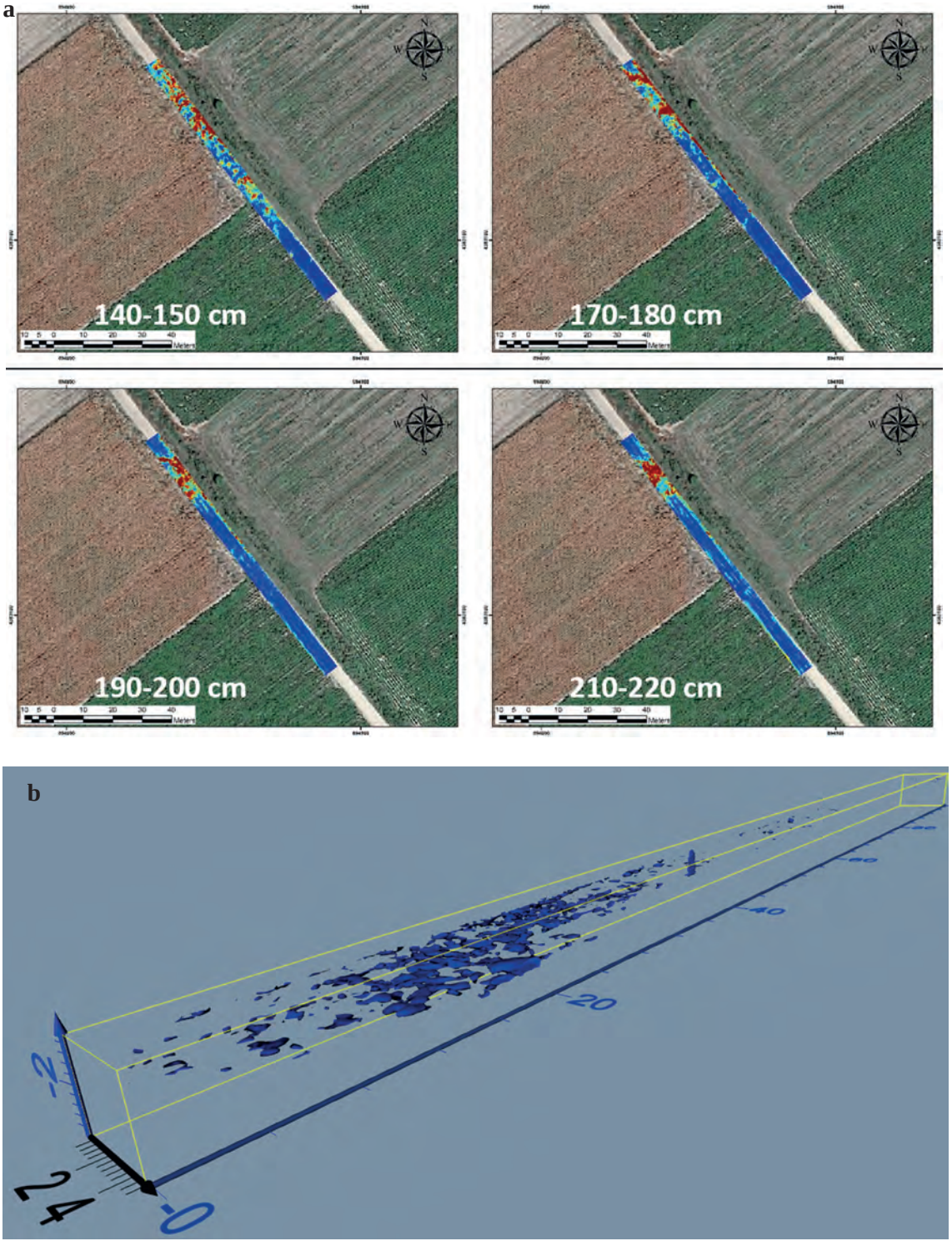



Fig. II.2.11 a. Selective geo-rectified GPR depth slices (for depths of 140–150cm, 170–180cm, 190–200cm and 210–220cm) along the road in the area of the cemetery; b. Volumetric representation of the GPR reflectors (A. Sarris)

## II.2.4. Integration of Geophysical Data and Discussion

The integrated interpretation of the geophysical survey measurements is shown in Fig. II.2.12. The potential burial grounds of Area A did not produce any kind of prominent features. The isolated magnetic anomalies and the linear high resistance feature to the south do not clarify the presence of structural remains even though some isolated anomalies may be related to burials.

On the other hand, GPR data shows that the area of the cemetery is located on top of a slightly elevated geological formation, which is relatively fragmented but rises towards the northeast. The particular formation may also correlate to laminations that have been created by episodic flooding and deposition observed by van Andel et al.[94] in a roadside ditch near the cemetery. If this is the case, which is also supported by the observations of Caputo et al. who mention a relatively constant seasonal flooding of the Peneiada Valley plain, the particular region of the cemetery was most probably located at the boundary of the flooding zone of the area around the magoula.[95]

According to van Andel et al.,[96] considering the cross sections connecting the soil cores, the top soil stratigraphic unit (Late Pleistocene Unit A) slopes in a SW direction. The soil analysis of the cores indicated the existence of a 75m-wide gully passing from the cemetery towards the eastern half of the mound (see black arrows on Fig. II.2.13). It seems that the particular feature is also visible on historical aerial photos passing to the west of PMZ-7 and most probably it was one of the creeks turning from the mountain range to the north towards the Peneios River south of the magoula (see Fig. II.2.1). Cores PMZ-2b, 4, 6 and 10, located close to the magoula, suggest that the occupation of the site during the Middle Neolithic period, which was confined to the west bank of the gully, continued despite the flooding episodes around the settlement. Even core PMZ-1 indicates that there may have been episodes of intense flooding that entered the settlement. If we assume that the flow of water continued periodically from the mountains together with the continuous growth of the magoula, it possibly followed two different paths (i.e. two

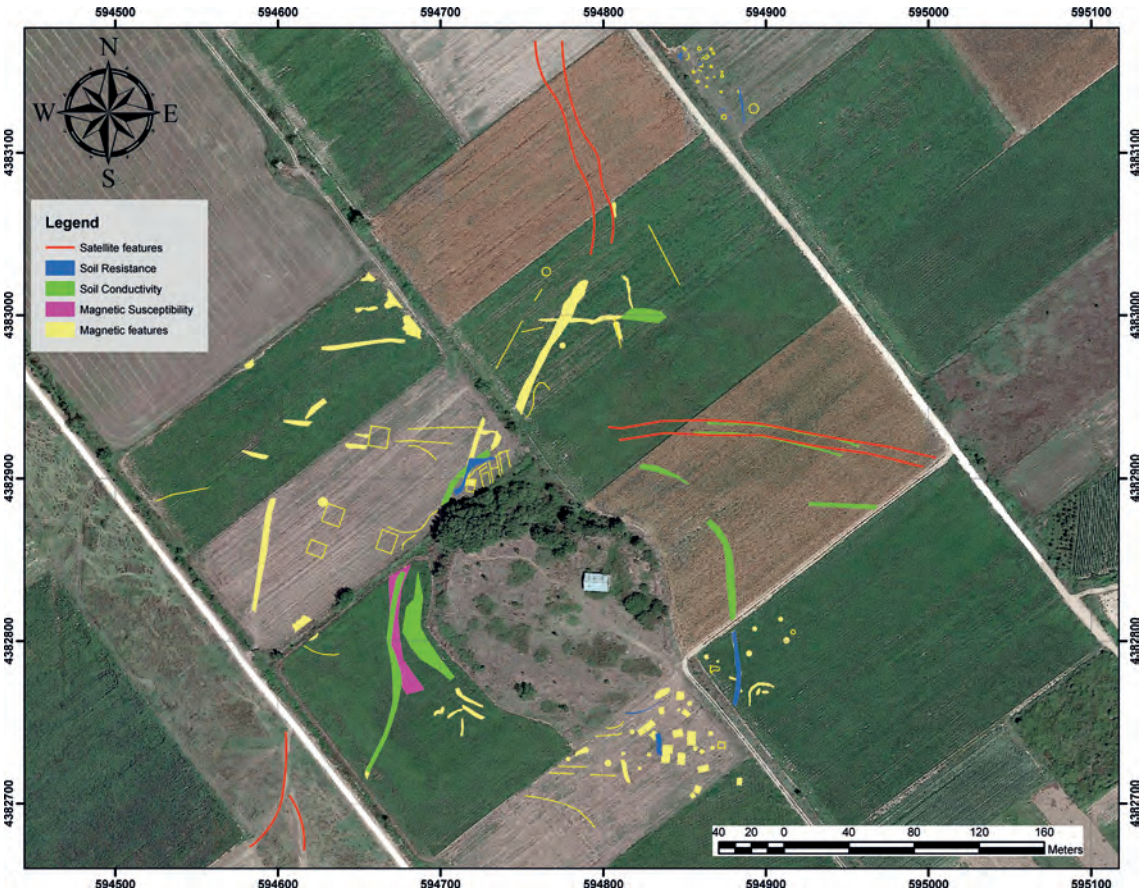



Fig. II.2.12 Integrated interpretation of the geophysical survey measurements at PMZ (A. Sarris)

94 Van Andel et al. 1995, 137.
95 Caputo et al., this volume, 48.
96 Van Andel et al. 1995, 138.

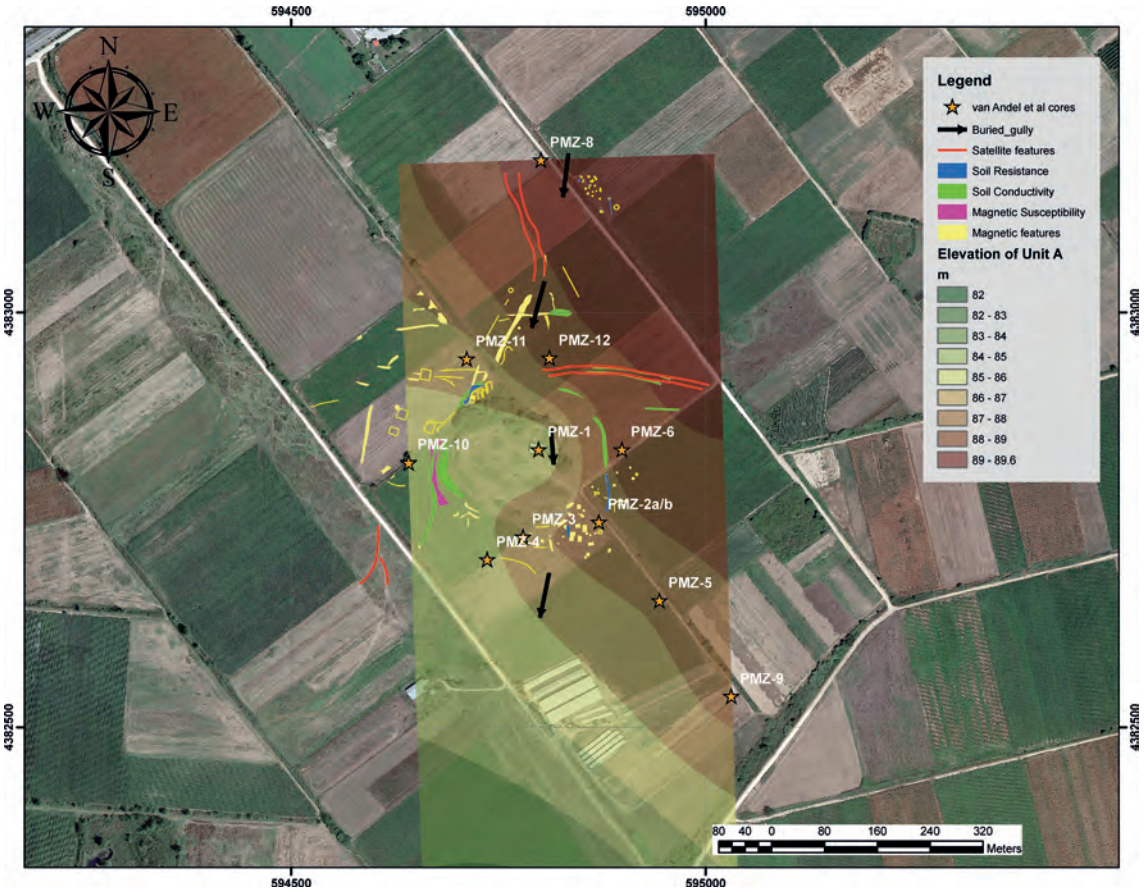



Fig. II.2.13 The interpolated surface of the top soil stratigraphic unit (Late Pleistocene Unit A) based on the soil cores of van Andel et al. 1995 superimposed on a satellite image of the area around PMZ and the features suggested by the geophysical survey. The black arrows show the flow of the eastern gully suggested by the above authors. It is possible to see the agreement of the north part of the flow of the gulley with the hydrological features suggested by the magnetic survey (A. Sarris)

different gullies) circulating around the magoula. This is actually confirmed by the geophysical data to the north of the mound, where elongated magnetic anomalies are probably related to past hydrological activity and/or a buried gully similar to the one described by van Andel et al.[97] Actually, the long high conductivity anomaly that appears to the SW, and extending further away from the mound toward the south, may represent the trace of this western gully. Similar hydrological features indicating the high energy of water flow were suggested in Area C.

Van Andel et al.[98] indicated that the cores PMZ-4 (to the south) and PMZ-10 (to the West) lack anthropogenic residues, suggesting that the particular core locations were outside the main habitation. Still their coring was not able to outline the borders of human occupation around the magoula. The geophysical measurements give a more precise picture about this issue. The quiet magnetic levels observed as we move further away from the magoula indicate the boundaries of anthropogenic activity in all surrounding sections. This is especially obvious to the west of Areas D and E, and to the SW of Area F in close agreement to the cores PMZ-4 and PMZ-10.

The areas to the NW and SE of the magoula disclosed the most important findings of the geophysical survey. Four large highly magnetic targets of archaeological interest, together with a few more structures on the northern fringes of the magoula were pinpointed to the NW (Area D).

97 Van Andel et al. 1995, fig. 10.
98 Van Andel et al. 1995, 137.

Similarly, occupation activity (mainly consisting of Early Bronze Age structures?) seems to be dense along the low elevation rise to the SE of the magoula (Area F), extending even further from the limits of the surveyed region (for more than 100m further to the SE of Area F).

The various data sets also suggest a number of enclosures. To the north, a thin enclosure wall seems to encircle the build ings at the periphery of the magoula. A couple of wider curvilinear features (a low-susceptibility and a low conductivity one) follow the contour of the magoula to the east and west. Traces of curvilinear features, located a little further away from the foot of the magoula, are also evident in all data sets (EMI, resistance and magnetic) to the east of the magoula. The low conductivity/high resistance/high magnetic signature of these features could designate perimeter/fortification wall/s or ditches described within a highly conductive soil background encircling the site. Still, we cannot ignore the hypothesis that some of these features may also be related to running gullies within a much more conductive soil context.

# III. Stratigraphy and Architecture

*Giorgos Toufexis – Christos Batzelas*

## III.1. The Excavations

PMZ is situated at the western exit of the Peneiada Valley which connects the eastern and western plains of Thessaly, approx. 800m north of the present route of the Peneios River (Fig. II.1.1a). As its name indicates, the settlement has the form of a large and prominent magoula (tell) with a broad and flat top 94.59m asl and steep slopes rising 5–6m above the surrounding plain (Fig. III. 1–2). It is almost circular in shape, 155m (NNW-south) × 135m (east-west) large, covering an extent of approx. 1.8 hectares, and constitutes an imposing landmark in the present local topography, clearly visible from a distance. The magoula consists of approx. 10m human deposits from the Middle Neolithic, early Late Neolithic, Early and Middle Bronze Age but the natural terrain in which it was founded is approx. 4–5m below the present surface of the plain.[99] Since then, the Neolithic deposits have been partly covered by alluvial aggregation around the magoula.[100]

Excavations were carried out in 1976–1990 in six short campaigns[101] and primarily aimed at the stratigraphic clarification of the so-called 'Larissa ware', for which ongoing evidence from the excavation of the cemetery of this site existed, suggesting that it appeared in the beginning of the Late Neolithic rather than at the end of it, contrary to what was believed until that time.[102] Black burnished cremation urns of 'Larissa ware' were found together with early Late Neolithic grey vessels of 'Tsangli ware' in the settlement's cemetery approx. 300m NNE of the magoula, indicating that both wares were coeval[103] and this led the excavator Kostas Gallis to the decision to start excavations in the settlement in order to clarify their stratigraphic order.[104] The excavations were confined to only one main trench, Trench A, located in the northeastern part of the top of the magoula, 22.5m NNE of the trigonometric point of the Hellenic Military Geographic Service (Fig. III.1). The appearance of prolific Bronze Age deposits in the uppermost stratum of Trench A which had been foreseen by the abundant surface collection of pottery on and around the magoula, led the excavator to the decision in 1983 to open two small trenches B and C in the northwestern and southern slopes of the tell respectively in order to reach the Neolithic deposits sooner and obtain additional stratigraphic evidence (Fig. III.1). Both trenches were 2 × 4m large but the excavation was short and stopped two years later in 1983 because no Neolithic deposits came to light, the Early Bronze Age layer instead still continuing further. The excavations in Trench B reached 3.45m in depth and in Trench C ~2m (Figs. III.1–2).

99 Gallis 1995, 213.

100 van Andel et al. 1995.

101 In the following periods: 2/6–14/7/1976, 17/8–23/9/1981, 7/5–29/9/1983, 21/5–28/6/1984, 3/3–11/6/1987 and 9/8–28/9/1990. Overall, the six excavations campaigns were equivalent to ten months' fieldwork.

102 Gallis, this volume, 20. The preliminary excavation reports mainly dealt with the pottery of the site and only rarely was a very brief mention of the architecture made: Gallis 1989, 201–202; Gallis 1995, 213; Gallis 1996d, 524.

103 Gallis 1982.

104 Gallis, this volume, 20.

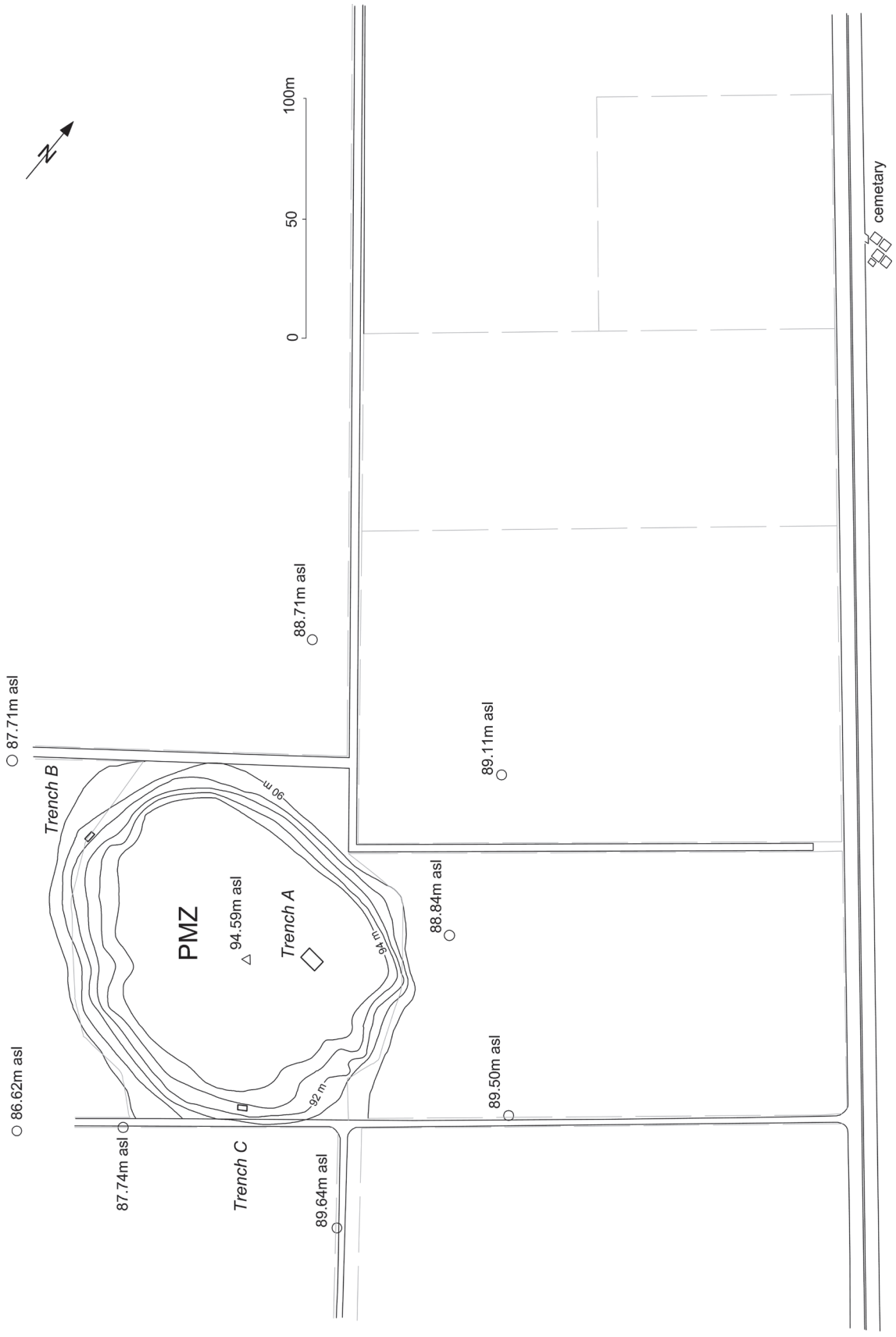



Fig. III.1 Topographic plan of the site and its wider area, also showing the location of the cemetery (edited by A. Buhlke)

Fig. III.2 The site from the east (aerial photo)

Trench A had a NNE-SSW orientation and was initially 4 (north-south) × 7m (east-west) large, but from the second excavation campaign in 1981 was enlarged to 5 (north-south) × 8m (east-west) owing to the collapse of its sides. From a depth of 3.40m downwards, a zone 1m large along the eastern side of the trench remained unexcavated, providing access to the trench through a staircase. From the depth of 6m on, the dimensions of the trench were gradually reduced as the excavation proceeded deeper. More precisely, from the depth of 6.00–7.40m the dimensions were 5 (north-south) × 4m (east-west), from 7.40–9.75m this became 5 (north-south) × 2m (east-west) and in the lowest part of the trench, from a depth of 9.75–10.70m, they were reduced to only 2 × 2m (Figs. III.3–4). Overall, a total amount of ~226m³ deposits were removed corresponding to ~107m³ deposits from the Bronze Age and ~119m³ deposits from the Middle and early Late Neolithic. The datum point (0.00m) was taken at the highest surface of the ground in the northern side of the trench, but its exact location and altitude were not specified.

As a rule, the excavation units were spits 0.10–0.12m thick and may have comprised one or more types of soils, each one consisting of a discrete stratigraphic unit (see also below). The starting and ending depths of each excavation unit were usually measured at only two points and had no exact coordinates so that limited accuracy could be achieved when projecting the excavation units onto the stratigraphic profiles of the trench (Pls. III.1–2). Consequently, for a number of small finds and pottery groups there was uncertainty in assigning them to the right stratigraphic unit (henceforth SU/SUs) especially when the excavation units in which they were found happened to consist of more than one SU. The excavation units were not given numbers during the excavation but only after the latter was completed, starting the counting from no. 175 from the bottom of the trench upwards until (henceforth EU/EUs) no. 302. After merging certain excavation units, in total 98 Neolithic excavation units were produced (EU 175–292). Almost half of them (47) originated from deposits between 4.18/4.25 and 5.73/5.77m depth when the eastern and western halves of the trench were excavated separately owing to a large Early Bronze Age pit found in the eastern half (Pl. III.1).[105] The EUs 175–189 in the deeper deposits of the trench were thicker because the underground aquifer made the soil muddy and almost impossible to excavate in thin spits.

[105] Overall, 19 excavation units (EU 245, 257, 266–277, 284, 288–291) belonged to this pit, which had disturbed the Neolithic deposits (see below).

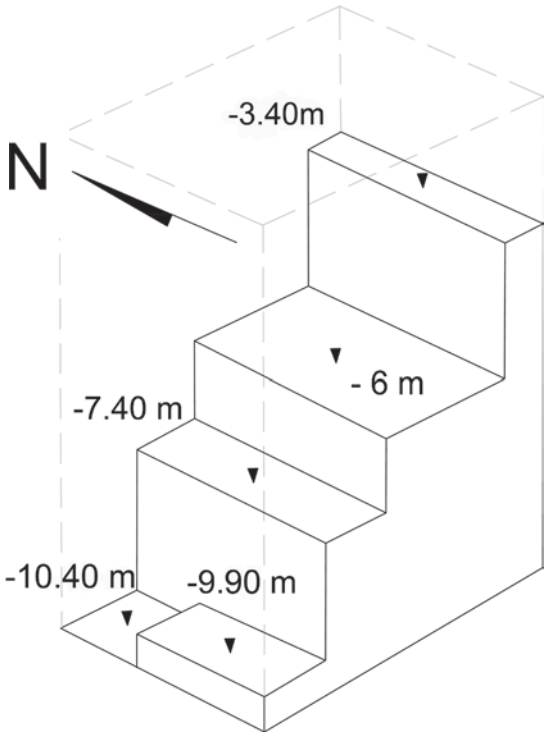



Fig. III.3 3-D diagram of Trench A (edited by A. Buhlke)

Pottery, bones and pieces of burnt clay were collected separately in each excavation unit, whereas dry sieving or flotation were not implemented at all. For the small finds and carbon samples for which there was uncertainty about which excavation unit they were found in, their attribution to excavation units was based only on their depth and coordinates and therefore is, to a certain degree, speculative. Furthermore, architectural details and soil descriptions were quite often given in an abbreviated form without being accompanied by detailed drawings and sufficient measurements as a result of the stratigraphic orientation and hasty proceeding of the excavation mentioned above. Nevertheless, based on the excavation diaries, sketches and photos, it was possible to produce schematic drawings for almost every building phase (Figs. III.5, III.8, III.10, III.12, III.15, III.17, III.19, III.21–27, III.29, III.32, III.34, III.37, III.39),[106] which are of considerable help for understanding the architecture, stratigraphy and distribution of the finds as well.

## III.2. Processing of the Stratigraphy

Of utmost importance for understanding the stratigraphic sequence, architecture and organisation of intra-settlement space, was the clarification of the definition of the 16 Neolithic 'floors' (F34–F19) identified in Trench A (Pl. III.1).

In the excavation diaries, those surfaces were generally considered 'floors' on which remnants of buildings, structures and pits or abundant small finds and pottery were found, even if they lacked any proper features justifying the term in regard of their construction or could not be assigned to indoor or outdoor areas. As the detailed analysis has shown, some of these surfaces could not be considered as house floors properly speaking but rather as activity areas. For this reason, every floor will henceforth be referred to more neutrally as 'surface', whereas the floors which undoubtedly were related to roofed areas are explained further. Yet, it appears that only a restricted number of floors formed 'closed units' with their associated layers laid immediately above them. This holds true for floors F32–31 (BSPh IVa–b), F25–24 (BSPh VIa–b) and F23–21 (BSPh VIIa–c), which were connected with conspicuous architecture and, based on the evidence, constituted interior areas (Pl. III.1). On the other hand, for a number of 'surfaces' there was compelling evidence that they were related to open/semi-open areas or yards and the intervening layers between them were probably formed by the activities that took place in them and refuse dumping as well as levelling works (see below, 135). For other 'surfaces', though, the identification was even more vague. The stratigraphy drawings depict these 'surfaces' as simple horizontal lines without connection to any other individual layers or further details (Pl. III.1–2). Nevertheless, on the northern side of the trench it was possible to project with sufficient accuracy the location of the majority of the small finds so that their relation to the 'surfaces' or intervening layers became more apparent.

[106] We thank Maria Dafoula, architect at the Ephorate of Antiquities of Larissa, Panagiotis Magalios and Alexandros Zouridakis for their help in the processing of the drawings.

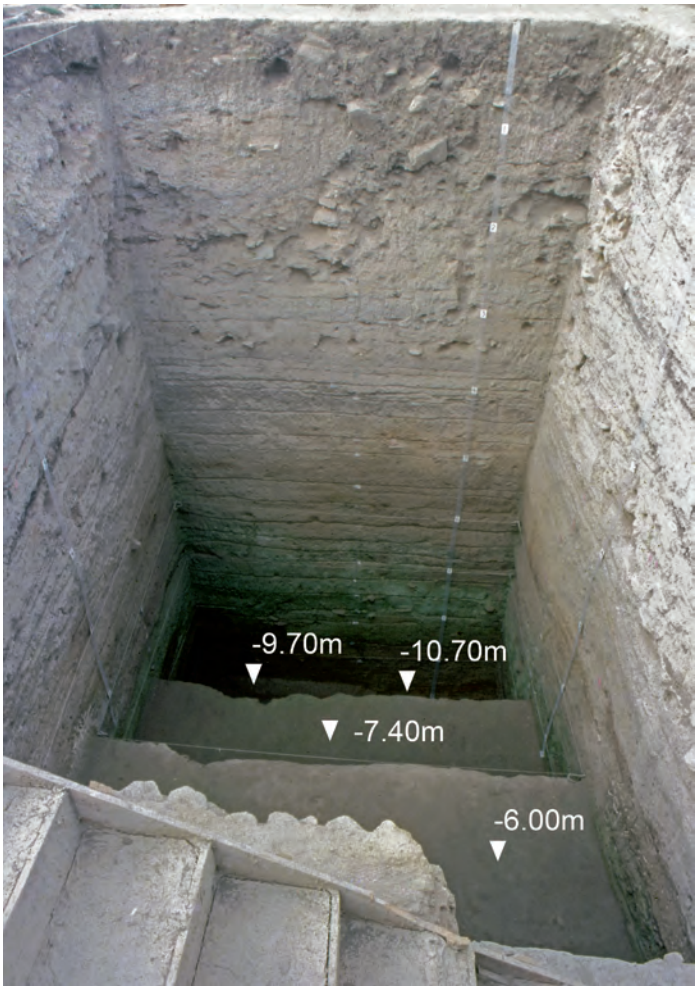



Fig. III.4 Trench A after the end of the excavations (edited by A. Buhlke)

The stratigraphy was analysed using the Harris matrix system, which underwent some adaptations since it was not implemented in the excavation (Pl. III.3).[107] In total, 186 stratigraphic units were identified and were given numbers, starting from the bottom of the trench upwards as is recommended for excavations in which no use of Harris matrix regulations was made (Pls. III.1, III.3).[108] The stratigraphic units include different types of soils, features (floors/'surfaces', walls and thermal structures), interface features (pits, postholes and ditches) as well as in situ concentrations of finds or certain distinctive finds. Ideally, each stratigraphic unit should contain only a well-defined type of soil with distinctive characteristics, but such highly accurate distinctions could hardly be achieved owing to insufficient documentation in the diaries. Consequently, some stratigraphic units might inevitably include more than one type of soil. The stratigraphic units so defined are linked together vertically and/or horizontally, although for a few of them the connection was uncertain. Every class of features was numbered separately, starting from the top downwards (Tab. III.1).

The Bronze Age and Neolithic floors/'surfaces' were the only features given numbers in the excavation but their counting started not from the first but the sixth 'surface' in the order of appearance, therefore, after their renumbering in accordance with the Harris matrix system, the uppermost Neolithic 'surface' corresponded to Surface F19 and the lowest to F34 (Pl. III.1).

[107] Harris 1989. We thank Christoph Schwall for his help and suggestions in the processing of the Harris matrix system.
[108] Harris 1989, 36, 111–112.

## III.3. Building Phases

Based on the retrieved stratigraphic and architectural evidence, nine building phases (henceforth BPh) I–IX have been identified, some having two to five individual subphases (henceforth BSPh) (Pl. III.3; Tab. III.1). Apart from BPh I and II, in which no 'surfaces' were found, each of the remaining building phases or subphases consisted of a 'surface' and the intervening layers between it and the next 'surface'. The stratigraphic sequence was continuous throughout the 5.80m-thick Neolithic deposits and no hiatus was observed, in compliance with pottery analysis, which points to a gradual and uninterrupted development.[109] The Building Phases corresponded to overall Ceramic Horizons 1–6 of MN I–III and LN I, according to the following table:

Chronological chart: relative and absolute chronology of the Neolithic building phases of PMZ

| **Neolithic periods in Thessaly according to Reingruber et al. 2017, tab. 5** | **Absolute dates according to Reingruber et al. 2017, tab. 5 (calBC 1σ rounded)** | **Absolute dates according to PMZ MAMS data (calBC 1σ rounded); see also Table X.3** | **Ceramic Horizon (CH)** | **Building Phases (BPh)/Building Subphases (BSPh)** |
|---|---|---|---|---|
| MN I | 5980–5750 | 5890–5760 | 1 | I–IVb |
| MN II | 5750–5600 | 5850–5750 | 2 | Va–c |
| | | 5770–5710 | 3 | Vd–e |
| MN III | 5600–5500 | 5770–5720 | 4 | VIa–b |
| Transition MN III–LN I | | | 5 | VIIa |
| LN I | 5500–5300 (early)<br>5300–5000 (late) | 5620–5480 | 6 | VIIb–c<br>VIII<br>IX |

### III.3.1. Building Phase I

Depth: ~9.88/9.93–10.30 / 10.70m; EU 175–177, SU 3–7.

Only a small part of a ditch 2.36m long was found in the initial habitation phase of the settlement (SU 3) (Figs. III.5–7, Pls. III.1, III.3).

The ditch was dug into the alluvial ground and had a slightly NNW-SE direction. It appeared at a depth of 10.00–10.20m as a broad strip of light brown soil, 0.66–0.96m wide. When the excavation was completed, the ditch was 0.75–1.00m wide (at the rim)/0.50–1.10m (at the bottom) and 0.40–0.60m deep and had an uneven u-shaped profile and a slight north-SSE slope. The fill of the ditch comprised several layers (SU 4–7) (Pls. III.1, III.3; Tab. III.1), the lowest of which, 0.40m thick (SU 4–5), consisted of a brown, sandy-loamy soil containing a small amount of pottery, bones, burnt pieces of clay, small finds and small field stones. The upper layers were 0.04–0.18m thick, having both east-west and north-SSE slopes (SU 6–7) and consisted of a brown soil quite similar to that found in the lower layers (SU 6). The ditch 'was sealed' by a thin layer of yellowish sand, 0.15–0.20m thick, getting very thin (0.02m) along the walls of the ditch (SU 7).

Overall, the ditch yielded a small amount of pottery, a few bones, three small finds (Pl. III.2; Fig. III.5; Tabs. III.2a–2b.1, 24–25), few and small field stones and pieces of burnt clay from

[109] Pentedeka in press; Toufexis et al. in press.

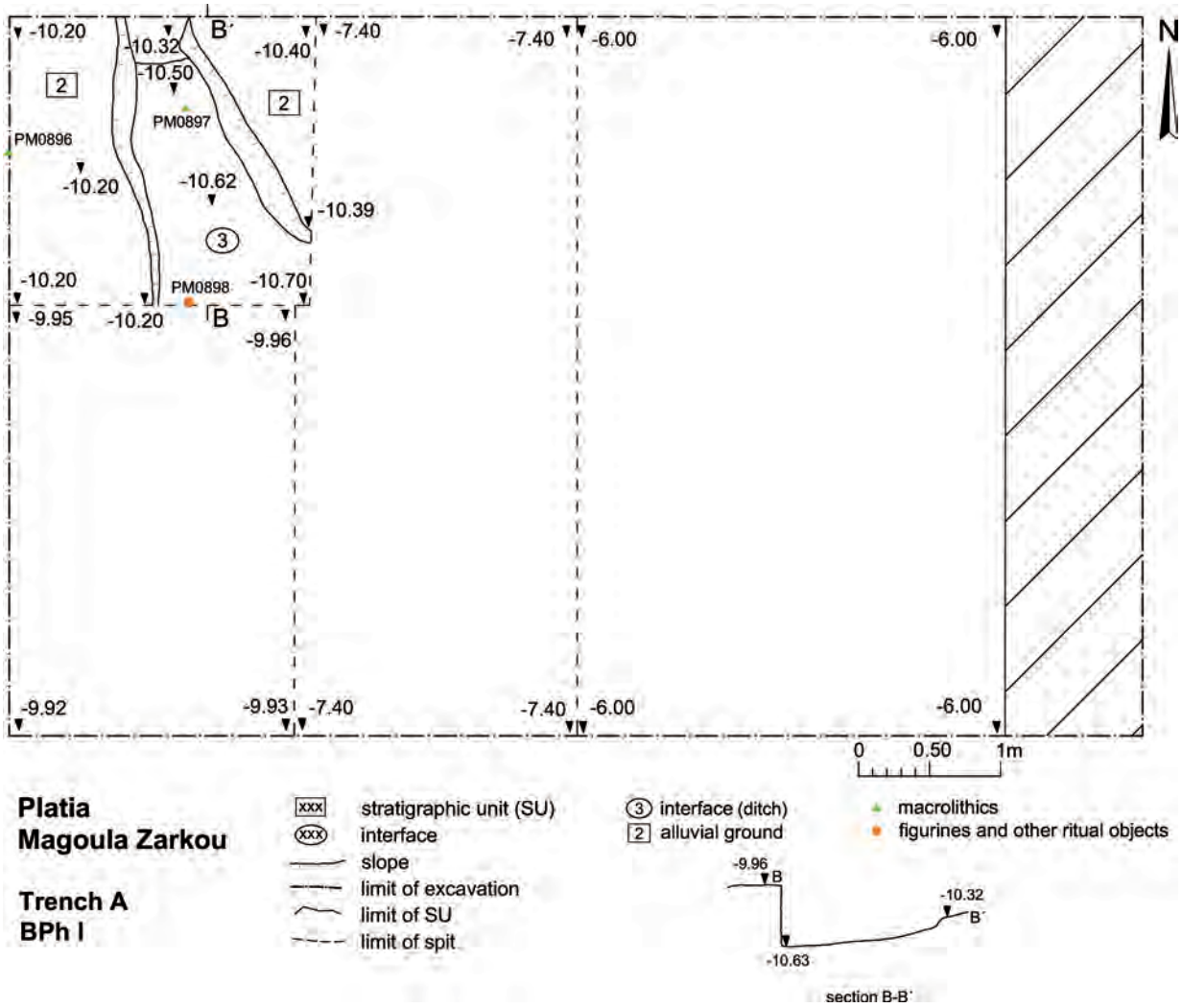



Fig. III.5 Plan of BPh I (edited by C. Batzelas, A. Buhlke)

thermal structures and buildings, some of which preserved prints of burnt timber (Figs. III.41.1–3, III.42.1; Tab. III.3).

The alluvial ground was hit at a depth of 10.00–10.20m, but was tentatively excavated further down to 10.70–11m at both sides of the ditch (SU 1–2). Its upper part, from a depth of 10.30/10.70–10.85m, had a yellowish/greenish-grey colour and contained very few sherds and patches of dissolved red clay as a result of meddling during the earliest occupation (SU 2: Figs. III.5–7; Pls. III.1, III.3; Tab. III.1). Further down the natural ground consisted of pure and coherent beige/dark-whitish clayey soil (SU 1: Pls. III.1–3; Tab. III.1).

From the bottom of the ditch the radiocarbon date on bone, MAMS-32133: 5843 ± 45 calBC (1σ), was obtained.[110]

[110] Alram-Stern – Toufexis, this volume, Tab. X.3; Weninger et al., this volume, 188.

Fig. III.6 BPh I. The ditch before excavation. View from the south (edited by A. Buhlke)

Fig. III.7 BPh I. Profile of the ditch on the north side of the trench (edited by A. Buhlke)

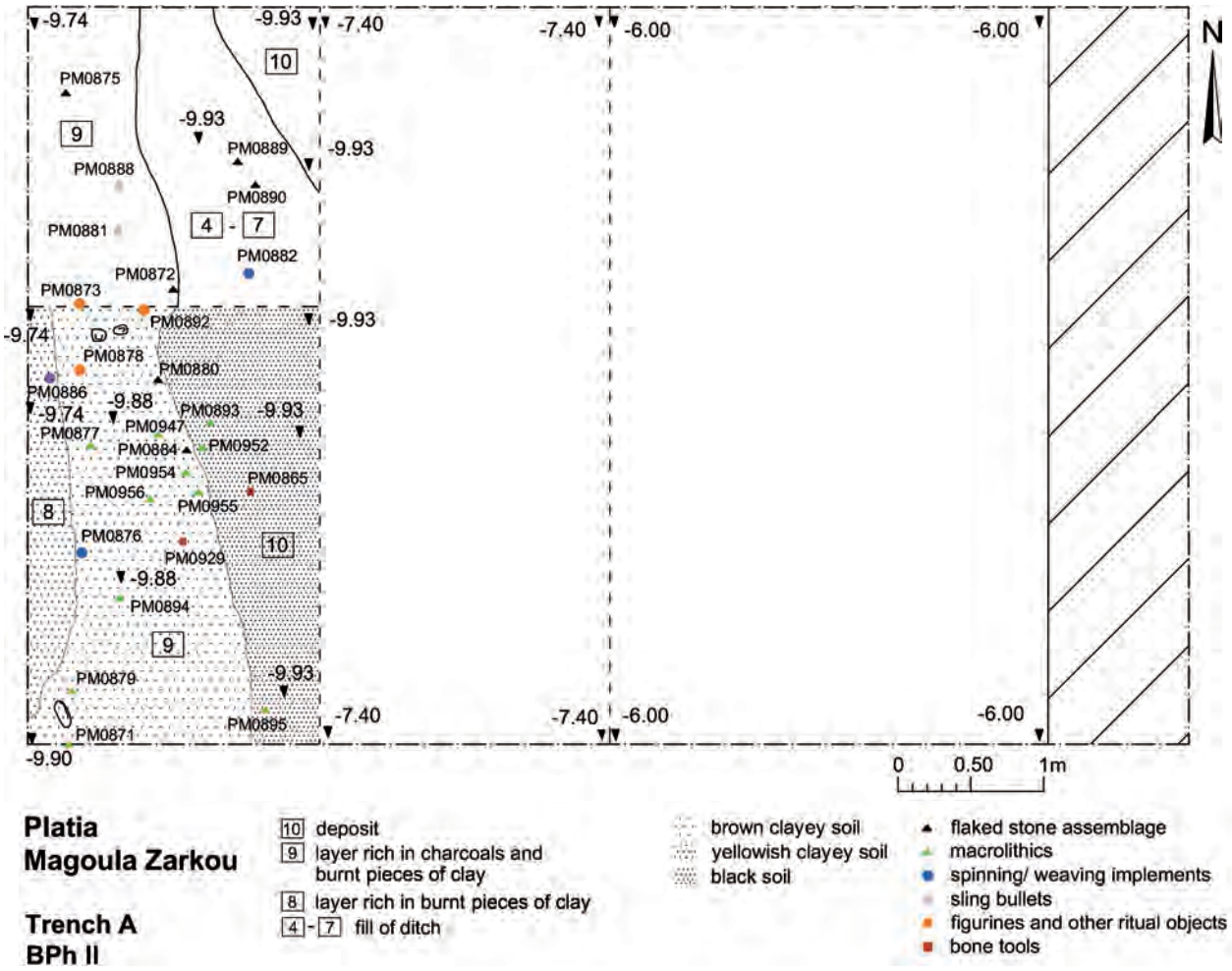



Fig. III.8 Plan of BPh I (northern part) and BPh II (southern part) (edited by C. Batzelas, A. Buhlke)

### III.3.2. Building Phase II

Depth: ~9.13 (west) / ~9.50m (east) – ~9.88 (west) / ~9.93m (east); EU 178–180, SU 8–19.

The overall 0.43–0.75m-thick deposits of this phase overlaid the alluvial ground and the ditch of BPh I (Figs. III.8–9; Pls. III.1, III.3; Tab. III.1). They consisted of thin greyish/grey-greenish clayey layers containing pottery, small finds and charcoals (SU 15, 17, 19) and of thin layers of ash and black soil 0.02–0.05m thick (exceptionally up to 0.12m thick), in places with one overlying the other (SU 9, 12).

A similar layer with ash and black soil yielding abundant tiny charcoal fragments and a few pieces of burnt clay spread over the fill of the ditch (SU 9) as well as a yellowish, sandy-loamy soil containing pieces of burnt clay in the western part of the trench (SU 8). In the layer SU 19 faint traces of potentially unburnt wood were reported, but the relevant samples were not found. The grey-greenish layers alternated with thin yellowish, sandy-loamy layers, yielding a few sherds and animal bones, a few small stones and some burnt pieces of clay (SU 10, 13, 14, 16, 18). The lowest of them in the western part of the trench also contained a few pieces of burnt clay and small field stones (Pl. III.1; Tab. III.1).

Apart from the lowest layer, the remainder presented a west-east and in places north-south inclination, more obvious in the uppermost layer, and were considerably thinner towards the east. The building phase yielded a fair amount of pottery, animal bones, some pieces of burnt clay and

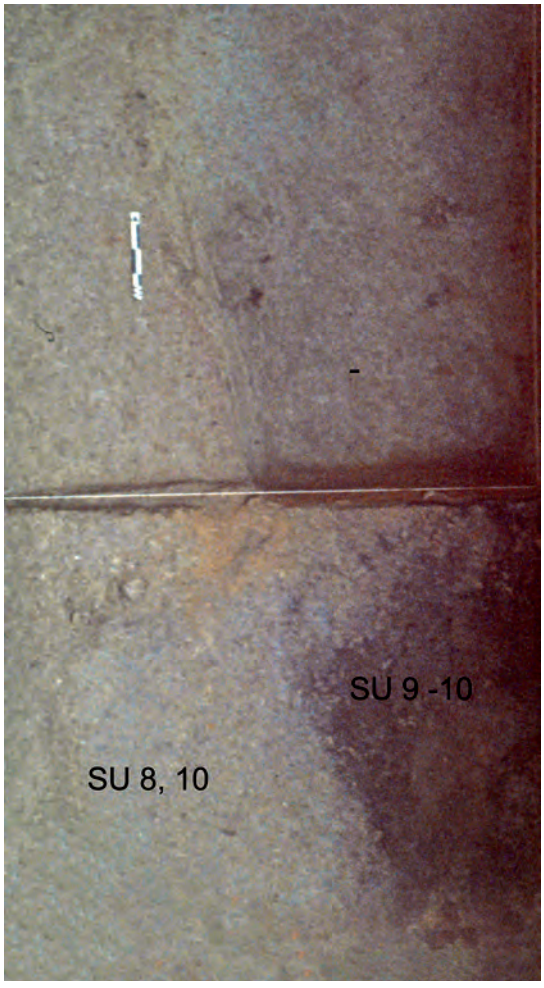



Fig. III.9 The ditch (northern part) and layers of BPh II (southern part). SU 9–10 show the continuation of the ditch to the south (edited by A. Buhlke)

27 small finds constituting 5% of the overall Neolithic finds from PMZ (Fig. III.8; Pl. III.2; Tabs. III.2a–2b.2, 24–25). They were encountered almost exclusively in the greyish/grey-greenish layers and included eleven macrolithics, six flaked stone tools and debris, two bone tools, three textile implements, two sling bullets and three anthropomorphic figurines. The burnt pieces of clay originated from thermal structures and buildings, whilst there were also 32 flat clay fragments (3410g) bearing decorative grooves (Figs. III.41.4–5, III.43a.1–3; Tab. III.3) (see below, 132). From a bone sample of this building phase, the radiocarbon date on bone, MAMS-32131: 5824 ± 46 calBC (1σ), was obtained.[111]

### III.3.3. Building Phase III

Depth: ~8.30–9.13 (west) / 9.50m (east); EU 181–186; SU 20–49, 170–174, 185.

This phase was distinguished on the basis of the so far first concrete architectural evidence comprising a wall built with posts and abundant clay (W39) that appeared in the beginning of the phase. Three building subphases were discerned (BSPh IIIa–c) equivalent to deposits 1.20m thick (Figs. III.10–16; Pls. III.1, III.3; Tab. III.1). As in BPh II, the layers continued to have a west-east inclination and were primarily made of grey-greenish/grey clayey soils, containing plenty of tiny charcoal fragments, pottery and small finds. The uppermost layer of this building phase was largely homogeneous (SU 49) and in places adjoined the wall W39 of the earliest BSPh IIIa (SU 172), except for the southern part of the trench, where the thin layers of BSPh IIIb intervened. The aforementioned discrete grey-greenish clayey layers were already present in BPh I and II, and they did not appear after the end of BPh III.

*Building Subphase IIIa*

Depth: ~8.96 (west) / 9.40m (east) – 9.13 (west) / ~9.50m (east); EU 181–183; SU 20–35, 170–172.

This building subphase comprised the destroyed wall W39 (SU 172), and probably a small pit (SU 170) and a potential posthole (SU 22). The wall had a north-south orientation and in all probability constituted the eastern exterior wall of a house which extended beyond the western side of the trench. The wall was built with posts and abundant clay which was preserved as a broad band of yellowish clay 0.40–0.60m wide and up to 0.40m thick, into which five postholes were set in a line at 0.62–1.02m intervals along the western side of the trench (SU 26–35) (Figs. III.10–11; Pls. III.1, III.3; Tab. III.1).

[111] Weninger et al., this volume, 188.

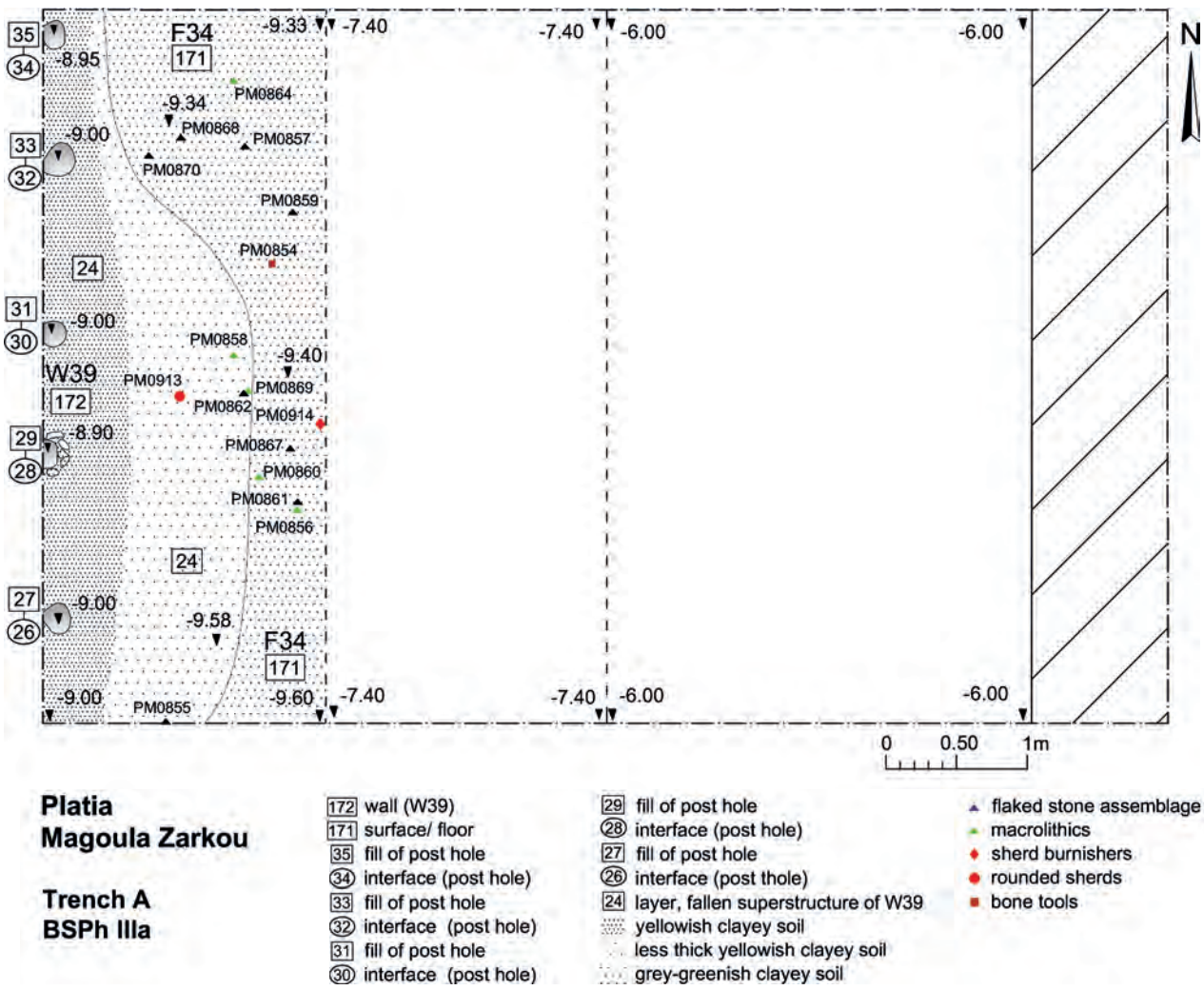



Fig. III.10 Plan of BSPh IIIa with wall W39 (edited by C. Batzelas, A. Buhlke)

Fig. III.11 BSPh IIIa. Wall W39. View from the east (edited by A. Buhlke)

The postholes were 0.18–0.22m in diameter and 0.12–0.42m deep and all but one had plastered walls with clay 0.02–0.03m thick admixed with pebbles or small stones, which prevented the wooden posts from rotting and receding. One posthole was funnel-shaped, whilst in the interior of another one scant traces of unburnt wood were reported. The wall was not affected by fire and the large amount of clay found in between and along the line of the postholes might lead to the suggestion that the wall was built with a combined timber and *pisé* technique[112] rather than with wattle and daub frames. Based on the evidence, the wall collapsed eastwards and the clay of its fallen superstructure spread with a west-east inclination to a distance of 0.25–0.90m from the wall line, whilst the thickness at the ends of its dispersion was only 0.04m.

Based on the evidence, a small pit found near the middle of the western side of the trench (SU 170) and a potential posthole near the southwestern corner (SU 23) should also be attributed to this phase. The pit contained yellowish and grey-greenish soil in the lower part and black soil in the upper (SU 20–21). The posthole differed from the postholes of the post-built wall W39 and contained dark grey soil with charcoals, a few small stones and probably traces of unburnt wood (SU 23).

The level on which the wall W39 and its fallen superstructure were encountered at a depth of ~9.13 (west) / ~9.50m (east) was numbered as Surface F34 (SU 171).

*Building Subphase IIIb*

Depth: ~8.55 (west) / 8.70m (east) – 8.96 (west) / 9.20m (east); EU 184–185; SU 36–43, 173, 185.

The overall ~0.50m-thick deposits comprised successive thin layers of black burnt soil and ashes that were mainly found in the central and southern parts of the trench and a small pit (SU 36). In places, these layers alternated with thin layers of yellow clay or of grey-greenish clayey soil admixed with ashes (SU 37–43) (Figs. III.12–14; Pls. III.1, III.3; Tab. III.1). The layers sloped eastwards as before and they were generally discontinuous, whilst in places their features were vague.

Three black layers that were more extensive and continuous than the remainder were considered by the excavators as floors, namely Surfaces F33a–c (SU 38, 40, 42), to which a fourth one should probably be added (F33d, SU 185) (Fig. III.14). Similar black layers were also found elsewhere in the trench, but they were considerably thinner and more restricted. The lowest of these 'surfaces' which was not numbered during the excavation was approx. 0.05m thick and extended in the eastern half of the trench. Between this 'surface' and the wall W39 of the underlying BSPh IIIa, another layer intervened, which comprised grey-greenish clayey soil (SU 37) (Pls. III.1, III.3; Tab. III.1). Surfaces F33a (SU 42) and F33b (SU 40) were observed in the southern part; the latter was found 0.08–0.15m underneath the former.

Surface F33c (SU 38) was probably an extension of Surface F33b to the north, near the northwest corner (Fig. III.12), although in places the two 'surfaces' did not form an even level but were laid one above the other, up to 0.13m. On Surface F33b ashes and some pieces of burnt clay were found, which most probably did not mark the location of an in situ structure in this area but were simply scattered there. In between Surfaces F33b and c, as well as underneath the latter, there were some discontinuous layers of ashes, up to 0.05m thick (SU 39) (Figs. III.13–14; Pls. III.1, III.3; Tab. III.1), which were covered by black burnt soil, whilst between Surfaces F33a and b an uneven layer of yellow clay intervened, with an overlying grey-greenish clayey soil yielding ashes and charcoal fragments (SU 41). BSPh IIIb was particularly rich in pottery and small finds that were mainly found in the admixed grey-greenish layers, in between Surfaces F33a–d (SU 37, 39, 41, 43). The numerous albeit fragmentarily preserved black layers that were described above indicate intense and continuous activity in this part of the settlement. However, without micromorphological analyses and sufficient documentation, their origin is hard to ascertain. The available data might indicate that they mostly originated from open fires set in this area in quite a

[112] Kloukinas 2017, 175.

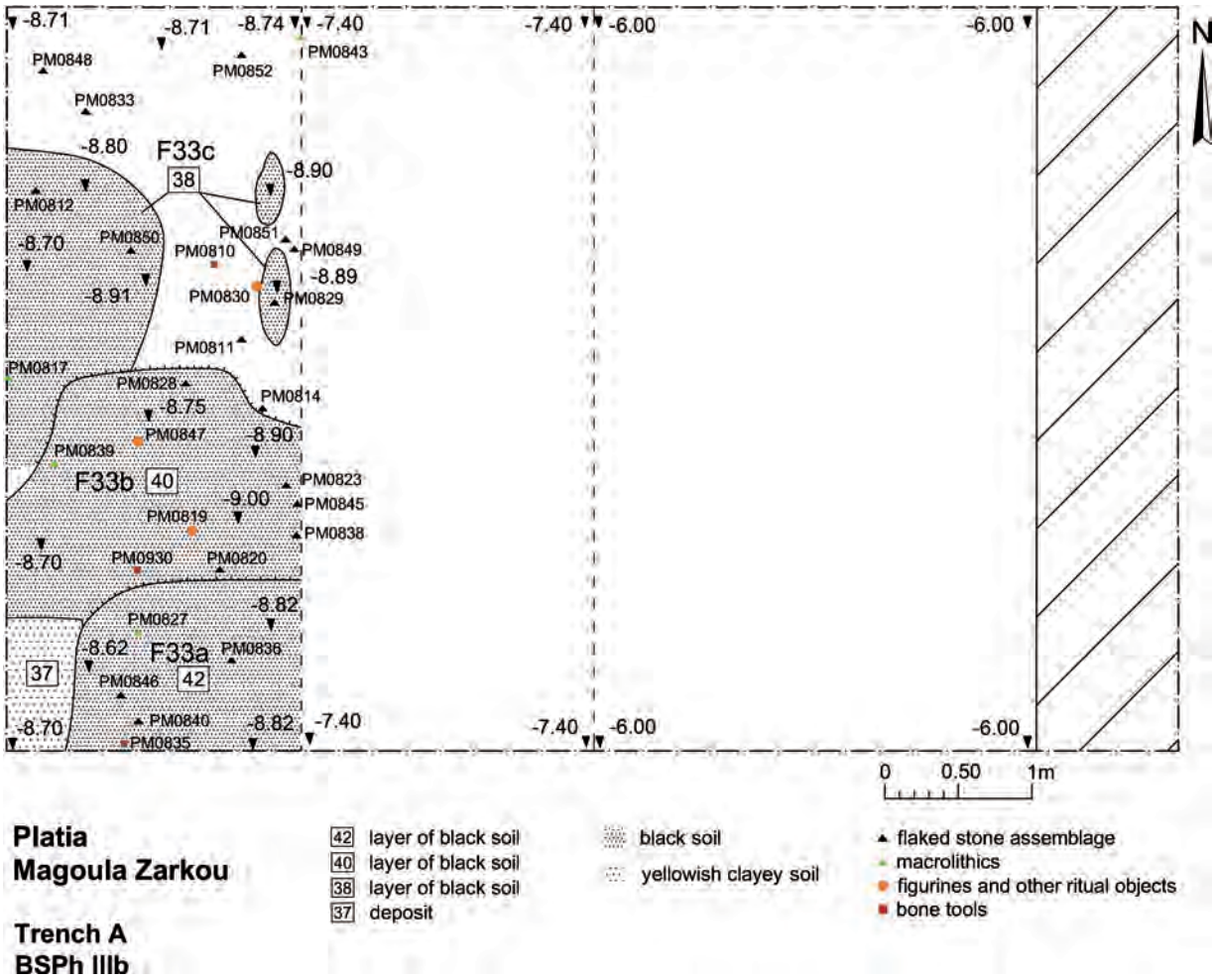



Fig. III.12 Plan of BSPh IIIb. Surfaces F33a–d (edited by C. Batzelas, A. Buhlke)

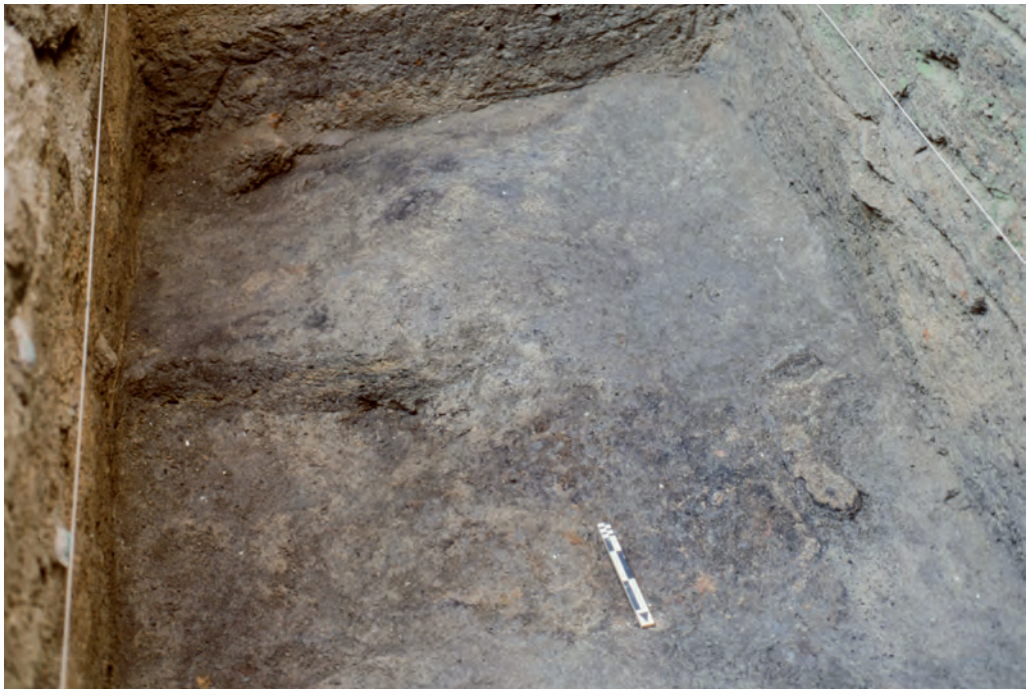


Fig. III.13 BSPh IIIb. Surfaces F33b–c on the southern side of the trench (edited by A. Buhlke)

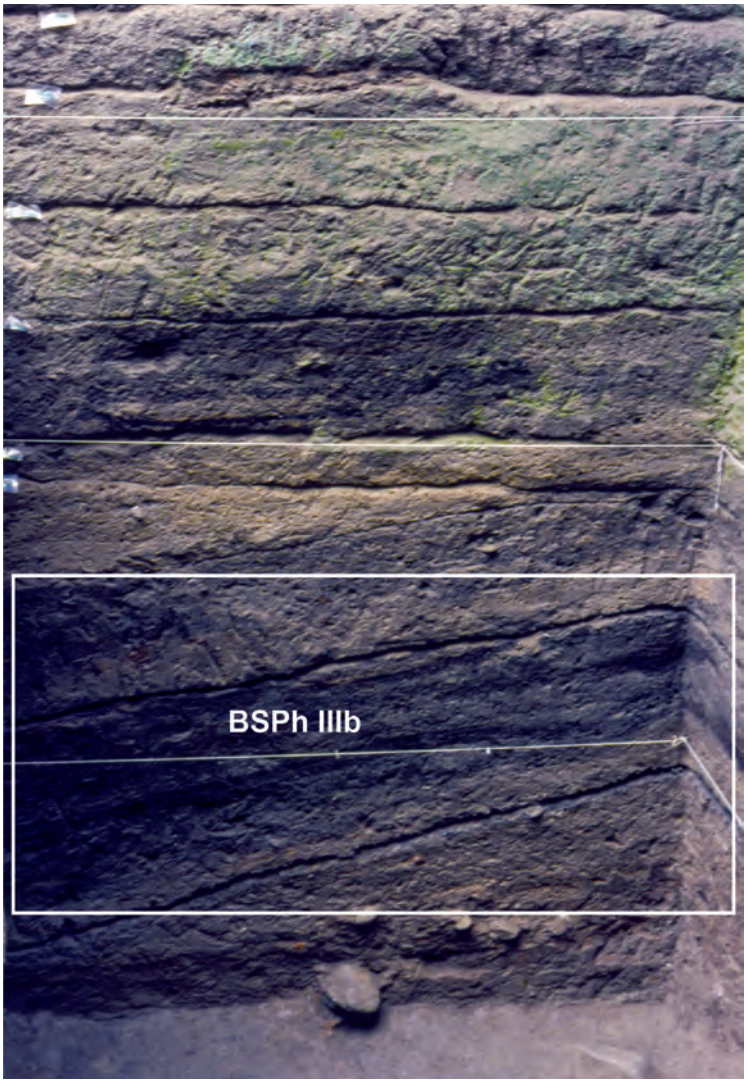



Fig. III.14 BSPh IIIb. Surfaces F33a, b and c on the southern side of the trench (edited by A. Buhlke)

short time and also from the dumping of fire refuse. The layers that intervened between the black layers were also too fragmentary to provide any clarification. The pit (SU 36) was found at a depth of 8.70m in the middle of the western side of the trench. It was 0.30m wide and filled with grey-greenish clayey soil rich in charcoal (SU 173).

*Building Subphase IIIc*

Depth: ~8.30–8.60m; EU 186; SU 44–49, 174.

To this building subphase were attributed, although not without reservations, some scanty building vestiges found in the southern part of the trench above the Surfaces F33a and b (Figs. III.15–16; Pls. III.1, III.3; Tab. III.1).

They comprised another potential 'surface' at a depth of ~8.55/8.57m (SU 174), a posthole (SU 44), a 0.90m-long and 0.56m-broad band of compact yellow clay in the southwestern corner of the trench (SU 45), and a layer of yellow clay, 0.05–0.16m thick, attached to it. The latter was visible along the southern side of the trench over Surface F33a of BSPh IIIb and yielded pottery and a few pieces of burnt clay, mainly near the southwestern corner (SU 174). All reservations considered, the broad clay band in the southwestern corner (SU 45) could probably correspond to the end of a clay wall in this area, and the clay layer (SU 174) to a floor; they both extended

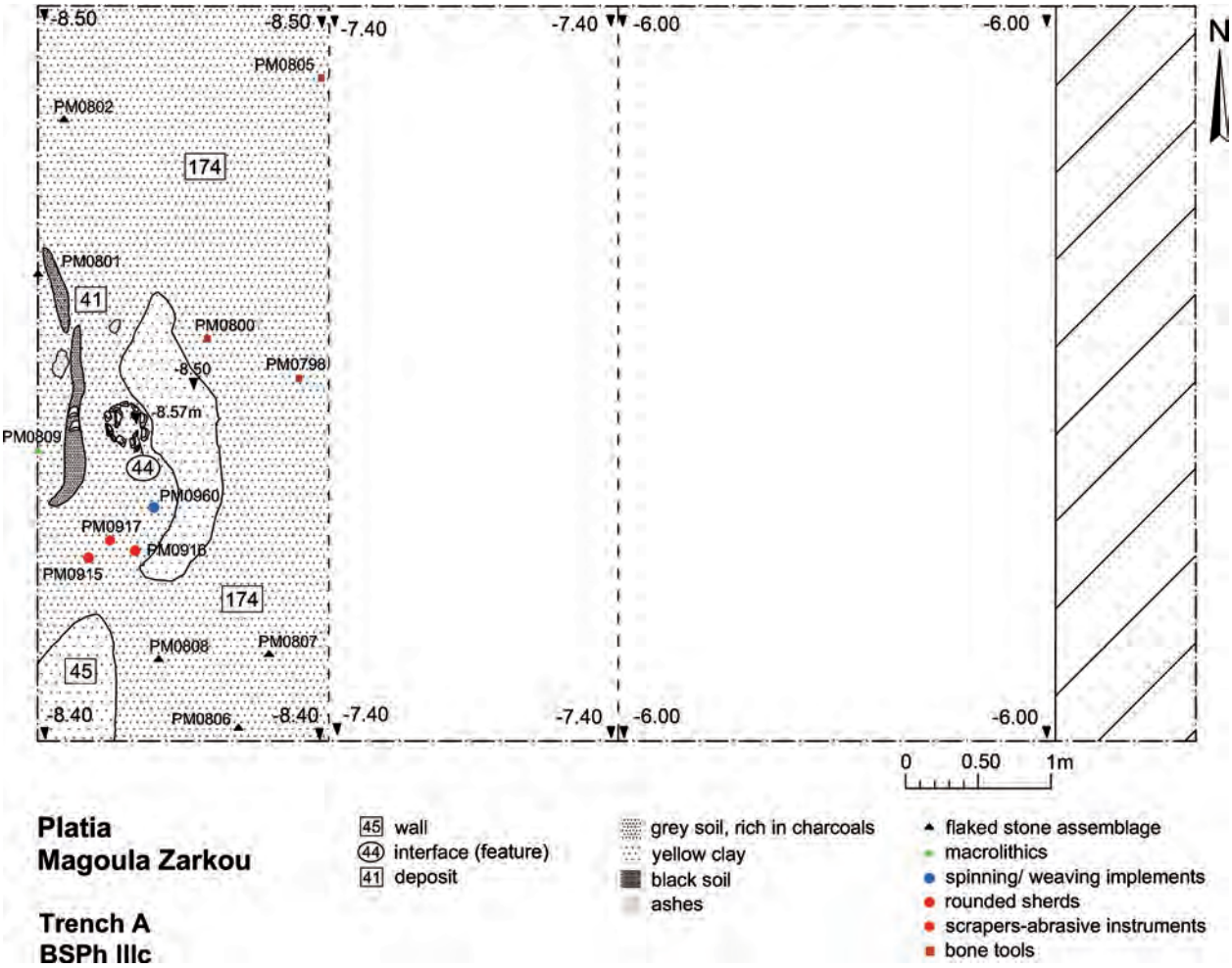



Fig. III.15 Plan of BSPh IIIc (edited by C. Batzelas, A. Buhlke)

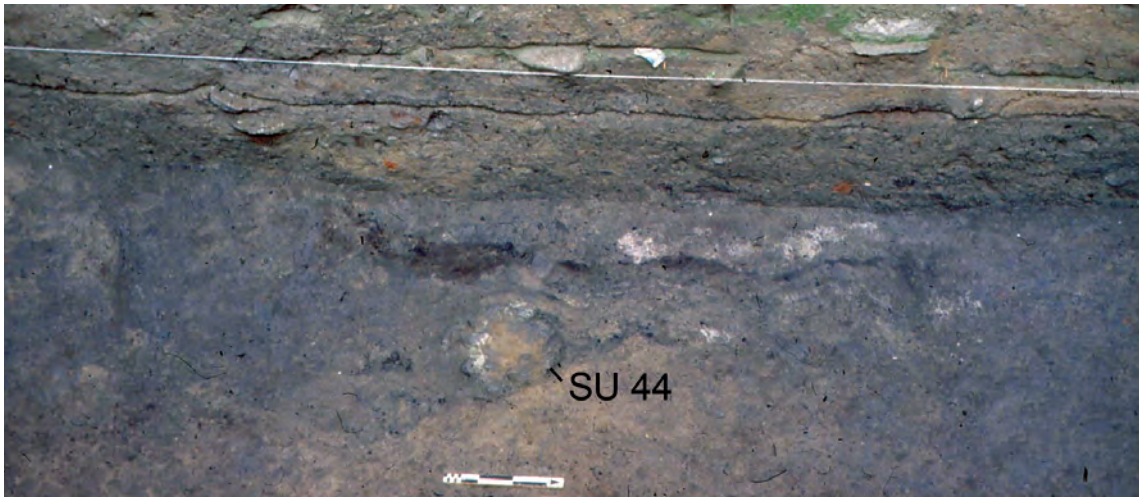



Fig. III.16 BSPh IIIc. Building remains (edited by A. Buhlke)

beyond the trench to the south. The posthole, (SU 44), was 0.30m in diameter and was lined in its perimeter with pebbles and small stones along with a broken grinding stone were found.

Above the potential 'surface' (SU 174) there were, in places, thin layers of grey-greenish soil, admixed with yellowish clayey soil and yellowish clayey soil alternating with layers of black soil (SU 46–48), whilst all over the trench there existed a grey-greenish clayey layer, plenty of pottery and tiny charcoal fragments but no architecture (SU 49).

On the whole, BPh III yielded abundant pottery, animal bones, pieces of burnt clay and 57 small finds which constituted 10% of the overall Neolithic assemblage of small finds. More precisely, 28 small finds were found in BSPh IIIb, 16 in IIIa and 13 in IIIc. They included thirty-one flaked stone tools and debris mostly found in BSPh IIIb, ten macrolithics, seven bone tools, one textile implement, one clay scraper, three rounded sherds, one sherd burnisher, and three fragments of anthropomorphic figurines, all encountered in BSPh IIIb (Figs. III.10, III.12, III.15; Pl. III.2; Tabs. III.2a–2b.3, 24–25). The burnt flat clay fragments with decorative patterns encountered in BPh II also continue in this phase, along with clay pieces from thermal structures and buildings (Figs. III.42.2, III.43a.4–8; Tab. III.3).

From BSPh IIIb two radiocarbon dates on bones are available, MAMS-32130: 5824 ± 46 calBC (1σ) and MAMS-32129: 5777 ± 41 calBC (1σ).[113]

### III.3.4. Building Phase IV

Depth: ~7.70–8.30m; EU 187a–d, 188–192; SU 50–71.

Two overlaid houses were attributed to this phase in contrast to the poor building remains of the preceding subphase and the, by contrast, unroofed spaces of the next phase. Two building subphases were discerned equivalent to ~0.60m-thick deposits (BSPh IVa and b), each one comprising the remains of a house (Figs. III.17–20a–c; Pls. III.1, III.3; Tab. III.1). From BSPh IVb onwards the west-east inclination observed in the layers of BPh II and III ceased and from now on the latter became noticeably horizontal throughout Trench A.

#### *Building Subphase IVa*

Depth: ~8.20–8.30m; EU 187a–d, 188; SU 50–60.

A small part of the interior of a house and a small part of its northern exterior wall (W38) were revealed (Figs. III.17–18; Pls. III.1, III.3; Tab. III.1). The house was built over the grey-greenish clayey soil that prevailed in BPh III (SU 49) and quite similar deposits from this phase (SU 50–51).

The wall W38 had an east-west orientation and a low stone foundation with field stones laid on a layer of yellowish clay mortar, which was also used as a bonding material for the stones. The latter were preserved only in the eastern half of the foundation, forming a line 1.16m long and 0.26–0.40m wide (SU 53), whilst they were missing in the western half (see also Fig. III.20a–c). What remained from the wall superstructure was a homogeneous mass of solid yellowish clay, 0.07–0.20m thick and 0.50–0.58m wide (Figs. III.17–18, III.20a–c). The wall was not affected by fire, therefore its superstructure could not be restored with certainty. According to the excavation archives, it was built with mudbricks, although a *pisé* superstructure should not be entirely ruled out (see discussion below).

The house floor Surface F32 (SU 52) was found at a depth of ~8.20m and was made of yellow compact clay. It was preserved in the largest part of the house interior, except for a large triangular area in the western part, where it was probably destroyed (SU 60:1), revealing underneath the aforementioned grey-greenish layer of BSPh IIIc (SU 49). However, in this area abundant pottery, small finds, animal bones and pieces of burnt clay were found which should be attributed to the house.

[113] Weninger et al., this volume, 188.

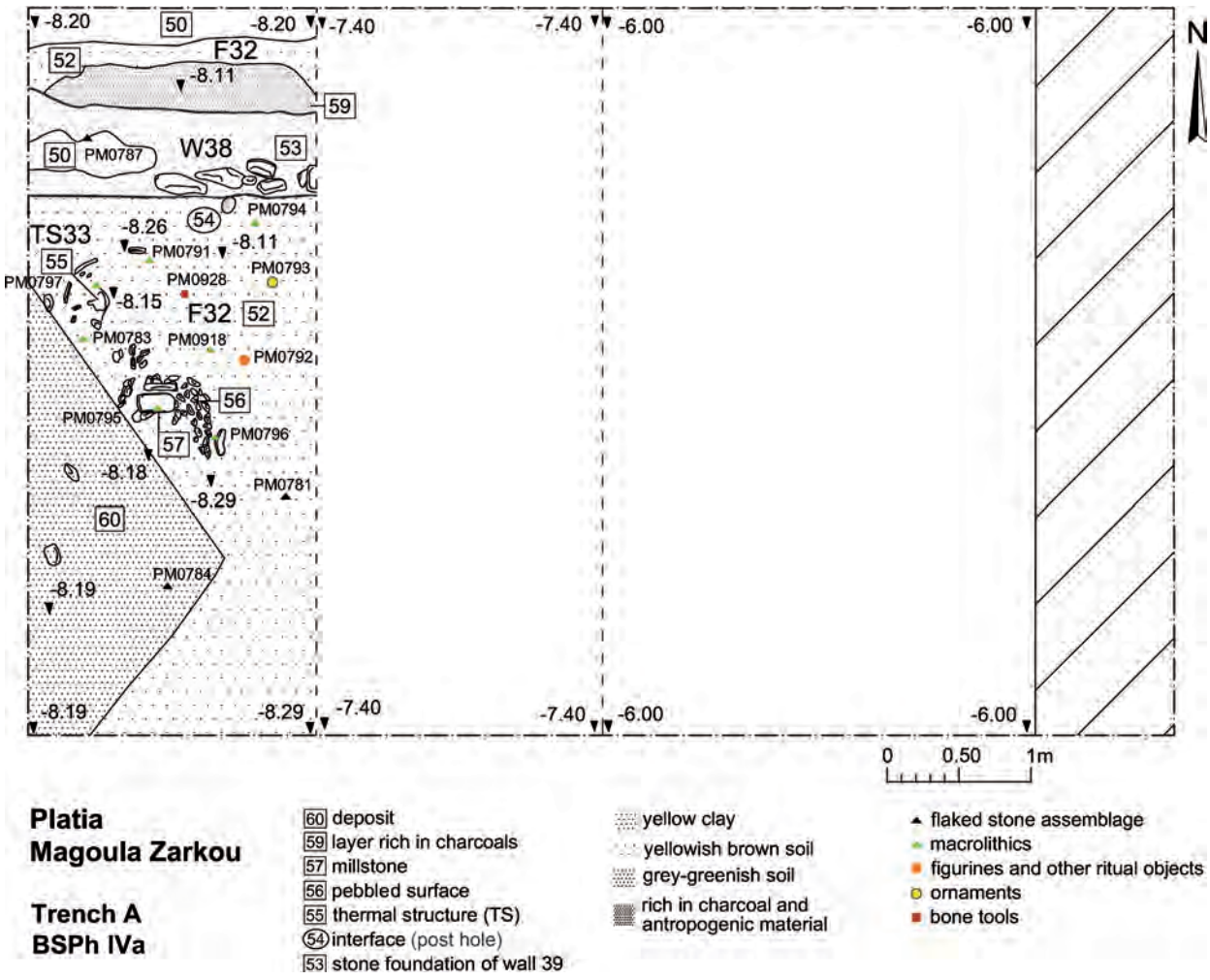



Fig. III.17 Plan of BSPh IVa (edited by C. Batzelas, A. Buhlke)

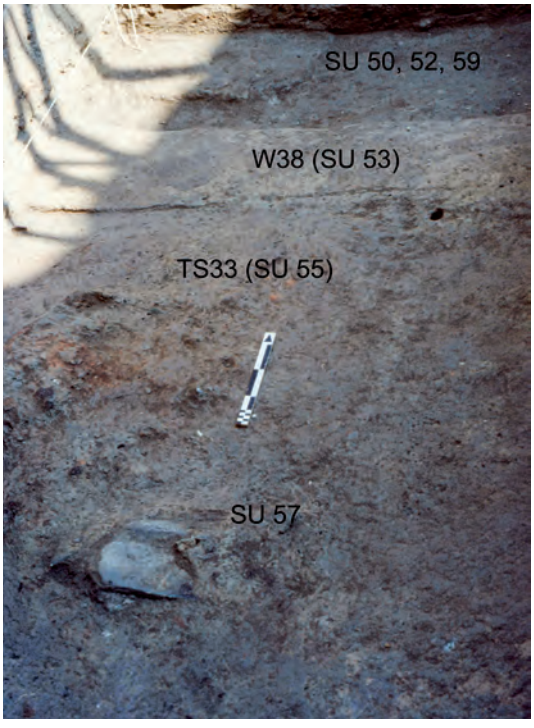



Fig. III.18 BSPh IVa. Part of a house with wall W38 (after removal of its stone foundation). View from the south (edited by A. Buhlke)

Yet, it seems that the house floor originally had the same gentle west-east inclination as the layers of the underlying building phases, although it disappeared over time, apparently through renewals.

Along the southern side of the trench a yellow clay layer was visible with a west-east inclination at its base, whilst its upper 'surface' was horizontal (SU 60:2). There was no evidence that this layer protruded into the interior of the house; it probably originated from the fallen clay walls of the house, which were then levelled so that the layer obtained an even, horizontal surface. The house was equipped with the thermal structure (oven) TS 33 (SU 55) found at a depth of 8.15m, close to the wall W38, as well as with a pebbled working surface SE of it (SU 56). The oven was found in a very fragmentary condition, preserving only small parts of its walls, 0.02–0.03m thick, and its clay floor with the substructure made of small stones (Tab. III.4). The relevant remains indicated that the oven was seemingly circular, approx. 0.60m in diameter, and its opening was probably set in its eastern side. The working surface was adjacent to the oven and consisted of a layer of pebbles 0.05m thick, which were preserved in an area 0.60 × 0.30m. The pebbles were 0.04–0.05m in size and were covered by a layer of yellow clay. At the western end of this 'surface', a quern (PM0795 / SU 57) was found and next to it a fragment of another one. Near the oven and the working surface and close to the interior façade of the wall W38, a small posthole was found which was 0.035m in diameter and 0.08m deep (SU 54). Over the floor there was a thin layer of yellowish-brown sandy loam, rich in pottery and other anthropogenic material (SU 58). Outside the house, to the north, the deposits consisted of greyish clayey soils containing tiny charcoal fragments (SU 50, 52, 59). The interior of the house differed from the area outside regarding the pottery and small finds. The house yielded a higher percentage of decorated pottery, with 'scraped' ware outnumbering the red monochrome, as well as few wasters,[114] and thirteen small finds, while none were finds discovered outside the house. However, this difference in the number of small finds may also be due to the restricted excavation surface outside the house. The small finds from this building subphase amounted to 2% of the overall Neolithic small finds and included six macrolithic tools, four flaked stone tools and debris, a bone tool, one leg of an anthropomorphic figurine and one ornament (Fig. III.17; Pl. III.2; Tabs. III.2a–2b.7, 24–25). Macrolithic tools were all found near oven TS 33 and its adjacent working surface and were apparently connected to food preparation and relevant activities that took place in this area.

*Building Subphase IVb*

Depth: ~7.70–8.14/8.23m; EU 189–193; SU 61–71.

In this phase a new house was erected exactly over the preceding house, sharing with it a common orientation and alignment (Figs. III.19–20a–c; Pls. III.1, III.3; Tab. III.1). Likewise, in BSPh IVa, only a small part of the interior of a house and its north external wall (W37) was revealed, whilst in the restricted area outside the house to the north the vestiges of a potential wall (W36, SU 70) were found.

The wall W37 (SU 62) followed the east-west alignment of the preceding wall W38, though it was built along the interior side of the latter. The wall foundation was 0.40–0.50m wide and was constructed with a single layer of field stones together with a few burnt pieces of clay used for this purpose, all held together by yellowish clay used as a bonding material. The wall superstructure was built in the same way as the wall W38. The house floor – Surface F31 (SU 61) – was made of yellow clay laid on the levelled ruins of the preceding house, only a few centimetres above its floor at a depth of 8.05/8.14m. Over the floor the deposits consisted of yellowish and grey sandy-loamy soils (SU 68) whilst a large area, 1.20 to 1.90m, north of the southern side of the trench was covered by a thin textured dark-greyish layer of burnt soil (SU 73). However, according to the evidence, this layer may not be related to the house, but it seemed to belong to the fill of a shallow pit dug from the overlying BSPh Va that penetrated the deposits of this building subphase (Pl. III.1) (see below).

[114] Pentedeka in press; Pentedeka in preparation.

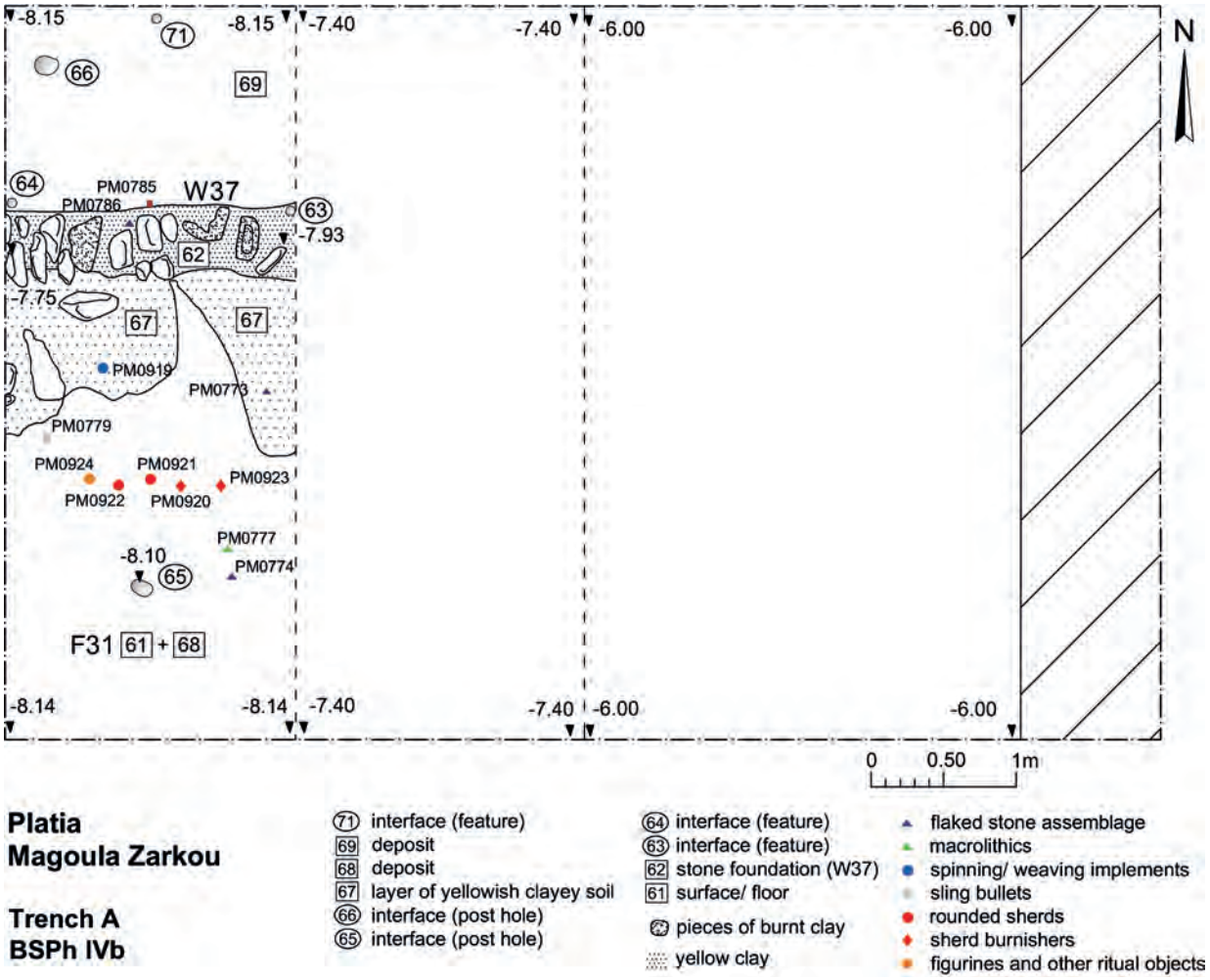



Fig. III.19 Plan of BSPh IVb (edited by C. Batzelas, A. Buhlke)

North of the house, a thin and narrow strip of yellow clay in a semicircular shape was reported, considered as another wall built with mudbricks (W36, SU 70), although the relevant documentation was poor. At least three layers were discerned in this area comprising light greyish and yellowish soils rich in charcoal (SU 69).

Inside the house ten small finds were found, contrasting with the area outside where two finds were encountered, a picture quite similar to that observed in the preceding house. The finds included one macrolithic and one bone tool, two flaked stone tools and one item of debris, two rounded sherds, two sherd burnishers, one clay sling bullet, one textile implement and one fragment of a figurine (Fig. III.19; Pl. III.2; Tab. III.2a–2b.7–9, 24–25). Five postholes were vaguely indicated on a sketch plan of this phase (SU 63–66, 71), without any specific details being given in the excavation diaries. The postholes were not, however, included in the complete plan of the house remains made during the excavation, while their association with this phase could not be ascertained.

Overall, BPh IV yielded a fairly large amount of pottery, animal bones, and 25 small finds almost equally allocated to BSPh IVa and IVb (13 and 12 small finds, respectively) (Figs. III.17, III.19; Pl. III.2; Tabs. III.2a–2b.7–9, 24–25). The burnt clay fragments continued to appear in modest quantities and mostly originated from buildings and thermal structures, whilst there were also flat clay pieces with decorative patterns as in BPh II and III (Figs. III.42.3–7, III.43a.9–10; Tab. III.3). From BSPh IVb the radiocarbon date on bone MAMS-32126: 5814 ± 46 calBC (1σ) is available.[115]

[115] Weninger et al., this volume, 188.

Fig. III.20 BSPh IVb. Part of a house with wall W37. a. Part of wall W38 of BSPh IVa is also visible. View from above; b. View from above; c. Part of wall W38 of BSPh IVa is also visible. View from the east (edited by A. Buhlke)

### III.3.5. Building Phase V

Depth: ~6.30–7.70m; EU 193–209; SU 72–112.

This phase consisted of overall ~1.40m-thick deposits, the thickest of all Neolithic building phases in the settlement. Contrary to the preceding phase, no secure house remains were identified, but instead an even succession of 'surfaces' was discerned. Five building subphases were distinguished (Va–e) corresponding to the Surfaces F30–26, respectively (Figs. III.21–25; Pls. III.1, III.3; Tab. III.1). Each of these building subphases comprised one 'surface' plus the layers intervening between it and the next 'surface' above it. Despite the fact that the excavation surface was enlarged to 20m², i.e. twice as large as in the preceding building phases, the architectural remains were scanty and included few thermal structures and scattered postholes. During excavation the 'surfaces' were not defined on the basis of specific characteristics relating to their construction but mostly whether any structures or stray postholes were encountered on them. The deposits in between the 'surfaces' were made of brown/brownish-grey sandy-loamy soils, which in places were admixed with fire refuse and yielded abundant pottery, animal bones and small finds. According to the available data, it is probable that the 'surfaces' of this building phase should not be considered as indoor floors but rather as open or semi-open areas between houses. Among other things, the coexistence of two or three adjacent thermal structures in BSPh Vb–Vd might further support this speculation.

#### *Building Subphase Va*

Depth: ~7.40–7.70m; EU 193–195; SU 72–84.

It comprised Surface F30 (SU 76) and at least two layers (SU 83–84) intervening between it and the overlying Surface F29 (Fig. III.21; Tab. III.1).

Surface F30 was delineated at a depth of ~7.50/7.60m above a layer of brown sandy soil (SU 72), and in the larger part of the trench mainly consisted of yellowish sandy-loamy soil scattered with fire refuse. Five postholes were found irregularly scattered throughout the trench (SU 78–82) as well as a few small stones and pieces of burnt clay in the northern part and two macrolithic tools. In the southern part of the trench, four overlaid dark greyish layers of fire refuse were found, with a total thickness of ~0.10m containing many tiny charcoal pieces (SU 73–75, 82), which were considered as two thermal structures on top of each other (TS 32, 32a). The uppermost layer was covered by burnt pieces of clay. Between the upper two layers a thin layer of soil, 0.04m thick, intervened, whereas between the lower two there was a thin layer with brown clayey soil (SU 74). A close examination of the stratigraphy of the southern and western sides of the trench might indicate that all these layers constituted the fill of a shallow fire pit which was dug into Surface F30 and extended almost as far as the underlying Surface F31 of BSPh IVb, as mentioned above (Fig. III.21; Pl. III.1). However, such a pit was not clearly recorded in the excavation archives and therefore its shape and dimensions could not be further specified. The upper and lowest of the three dark greyish layers (SU 82 and 73, respectively) covered a surface between 0.70m and 0.96m north of the southern side of the trench, respectively, whilst the middle layer was larger and extended up to 1.20 and 1.90m from this side. The consecutive layers of fire residues found inside the pit may indicate that the latter was used as a fire pit. No small finds were encountered inside this potential pit (Pls. III.1–2). The layers between Surface F30 and F29 of the overlying BSPh Vb consisted of greyish and brownish soils and yielded scattered fire residues throughout the trench, abundant pottery, small finds, animal bones and a few burnt pieces of clay (SU 83–84).

#### *Building Subphase Vb*

Depth: ~7.06/7.10/7.15–7.40m; EU 196–198; SU 85–90.

The delineation of Surface F29 of this building subphase at a depth of ~7.26 (north)/7.34m (south) was based solely on the depth at which the thermal structures TS 29–31 were found (Fig. III.22;

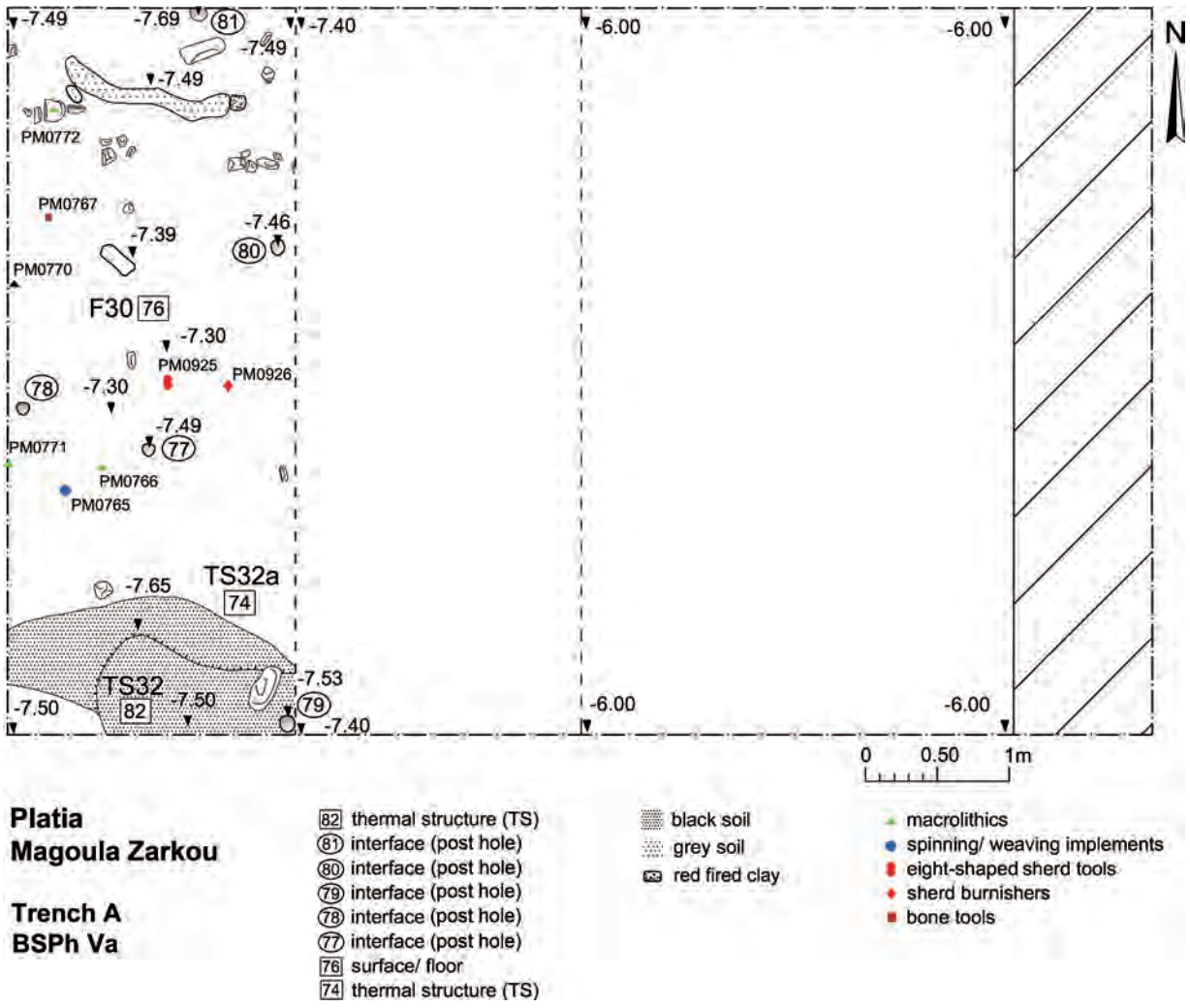



Fig. III.21 Plan of BSPh Va (edited by C. Batzelas, A. Buhlke)

Pls. III.1, III.3; Tab. III.1). The 'surface' consisted of yellowish sandy-loamy soil admixed with greyish soils (SU 85).

Thermal structures TS 29–31 (SU 88, 87 and 86, respectively) preserved only their substructures, made of a thin layer of clay with pebbles and a few sherds. Thermal structure TS 29 (SU 88) was found near the middle of the trench at a depth of 7.25m, close to a concentration of a few small stones. According to the evidence, it was ellipsoid in plan, measured approx. 0.30 × 0.50m and was covered by a thin black layer of fire residues. Thermal structures TS 30 (SU 87) and 31 (SU 86) were located in the southeastern part of the trench in close proximity to each other. They were circular with a diameter of approx. 0.40m and consisted of a blackened clay floor (Fig. III.22; Tab. III.4). Above the 'surface' and the thermal structures there was a greyish, in places yellowish, compact soil containing pottery and a few shells and animal bones (SU 89), as well as black soil in a small area along the western side of the trench (SU 90).

*Building Subphase Vc*

Depth: ~7.00–7.06/7.10/7.15m; EU 199; SU 91–100.

Surface F28 (SU 92), at a depth of ~6.98/7.00m, did not differ substantially from the preceding 'surface' as regards its construction (Fig. III.23; Pls. III.1, III.3; Tab. III.1). Underneath the 'surface' there was a greyish and, in places, yellowish soil with a few scattered field stones and

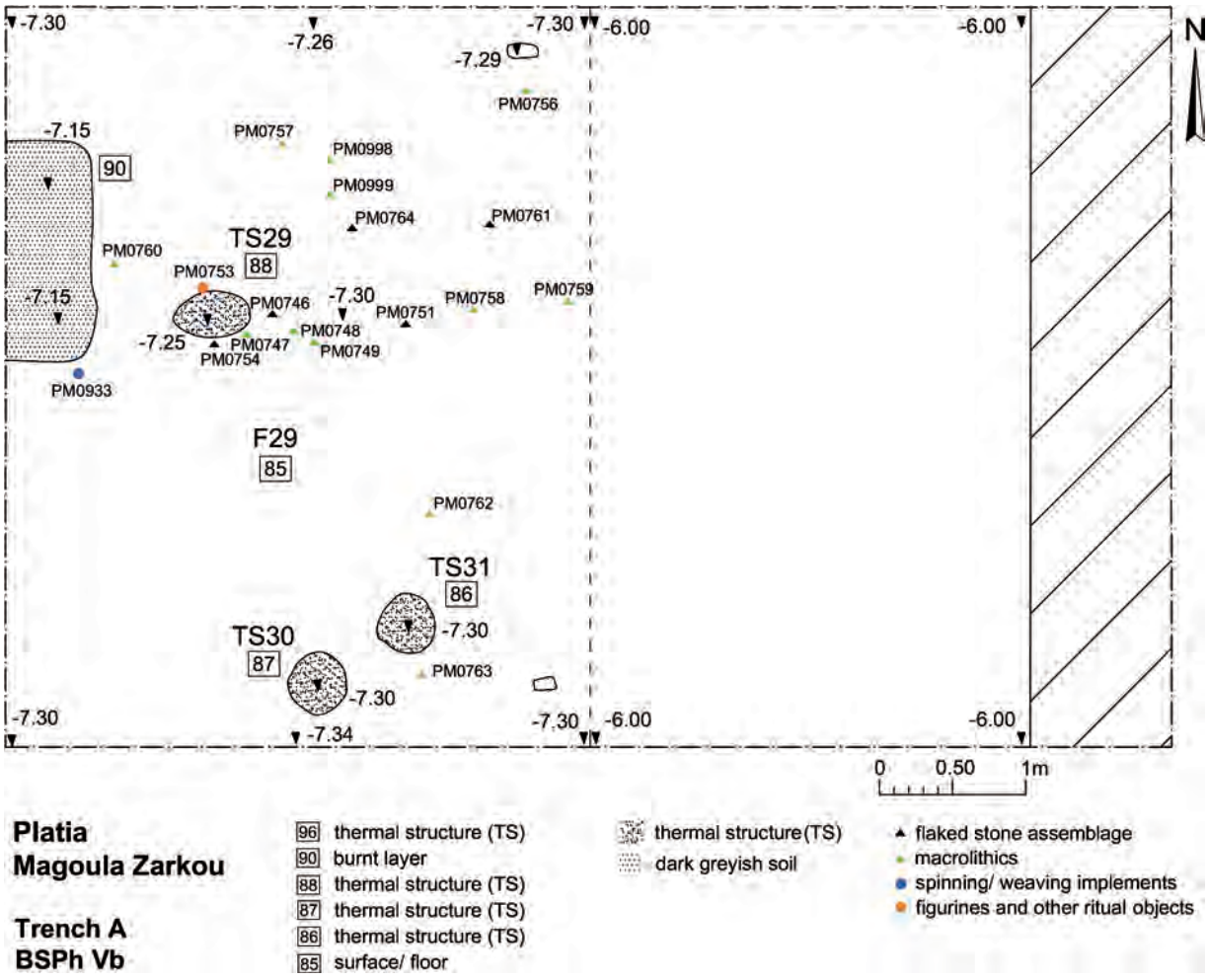



Fig. III.22 Plan of BSPh Vb (edited by C. Batzelas, A. Buhlke)

traces of fire (SU 91), whereas the subphase was sealed by a homogeneous yellowish-brown soil rich in pottery (SU 100).

Thermal structures TS 27 (SU 96), 28 (SU 95) and 28a–b (SU 94 and 93) and two isolated postholes found in the middle of the northern side and in the southeastern part of the trench (SU 98 and 99, respectively) were attributed to this building subphase (Fig. III.23; Tab. III.4). From thermal structure TS 27 at a depth of ~7.00m, only a layer of small stones with an overlying layer of black burnt soil of ellipsoid shape, 0.33 × 0.60m, and only 0.01m thick was preserved. Close to it, two fragmentary thin clay walls were found, perpendicular to each other, 0.65m (north-south) and 1.12m (east-west) long (SU 97), which probably belonged to a structure that existed in this place. Near the end of one wall a broken grinding stone was found. Thermal structures TS 28 (SU 95) and 28a–b (SU 94–93) were set one on top of the other in the southwestern corner of the trench but almost half of them extended beyond the southern side of the trench. The uppermost thermal structure TS 28 was found at a depth of ~7.00m and was probably circular, having a clay floor, 0.04m thick, hardened by fire, but only a small part of it was preserved. The underlying thermal structure TS 28b, at a depth of ~7.10m, was likewise circular with a diameter of more than 0.40m. Only its substructure was preserved, made of a clay layer with pebbles. Some thin and highly burnt clay pieces scattered around the structure floor apparently originated from its walls, indicating that it was an oven. Between the structures TS 28 and 28b, a layer of black burnt soil containing abundant tiny charcoals intervened, which was referred to as another thermal structure (TS 28a) in the

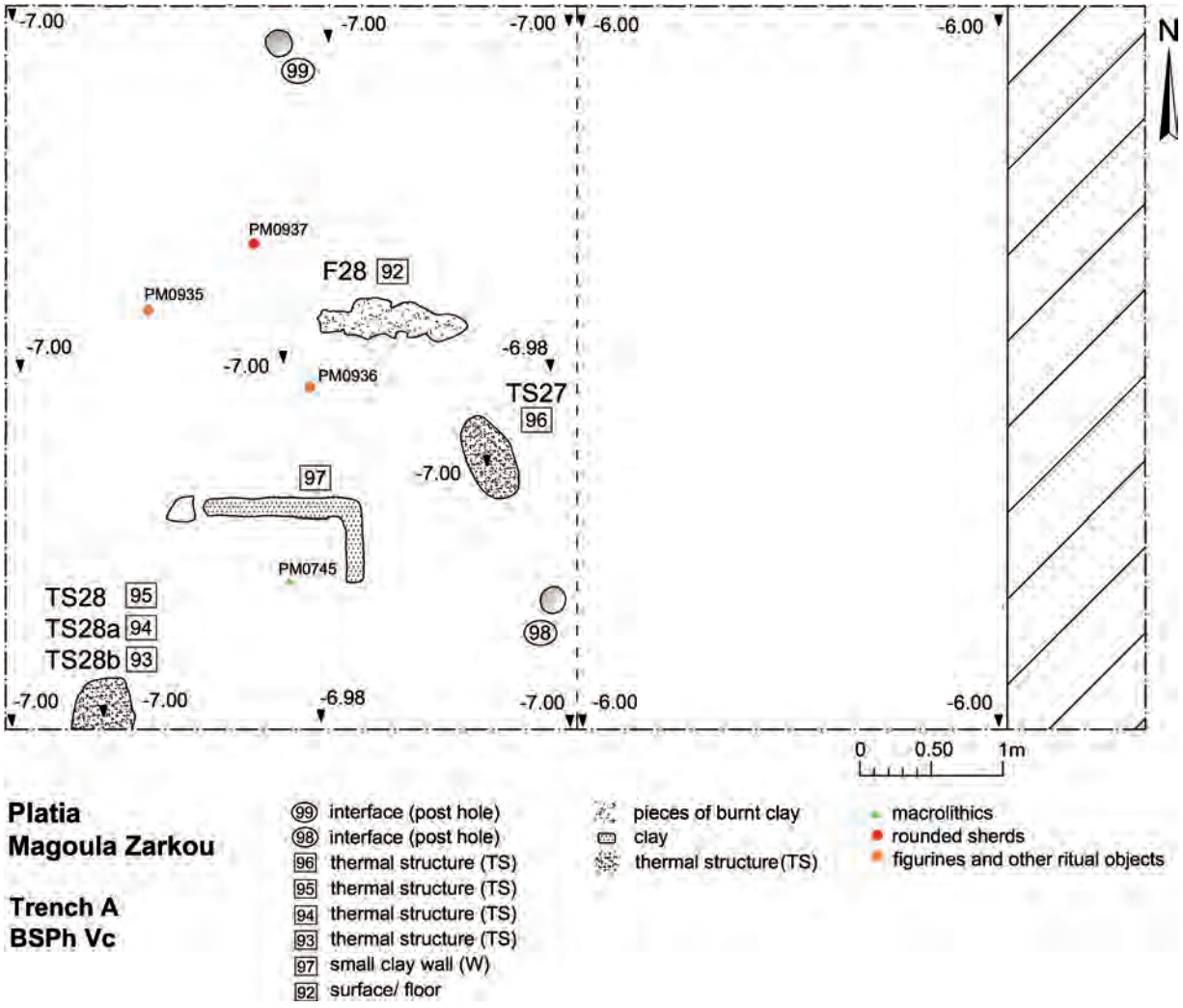



Fig. III.23 Plan of BSPh Vc (edited by C. Batzelas, A. Buhlke)

excavation diaries, but more likely it constituted the fire residues of TS 28b, left after its abandonment. Similar fire refuse was also found scattered widely around the two thermal structures.

*Building Subphase Vd*

Depth: ~6.50/6.60–7.00m; EU 200–204; SU 101–107.

On Surface F27, at a depth of ~6.80m (SU 101), two thermal structures were found near the middle of the trench (TS 25 and 26, SU 103 and 102, respectively) as well as two postholes (SU 105, 106) with fire remnants in between (SU 104) and in some places in the northern part of the trench as well (Fig. III.24; Pls. III.3, III.5; Tab. III.1). Like BSPh Vc, the subphase was topped by a homogeneous yellowish-brown sandy-loamy soil with abundant pottery (SU 107).

Surface 27 consisted of compact soil preserved in small areas near the middle of the eastern side and in the northeastern and southwestern corners of the trench. Two circular areas, ~0.80m in diameter, were observed in the northwestern corner but no further details were given. The thermal structures were probably circular with a diameter of 0.80m and were found in close proximity to each other at a depth of ~6.80m. Both of them shared certain common characteristics, like their clay floors having been renewed twice and their substructures constructed with pebbles (Fig. III.24; Tab. III.4). Near structure TS 26, a restricted surface with hard beaten soil was found which probably corresponded to a ‘use area’ in connection with the adjacent structure. The evidence for another thermal structure,

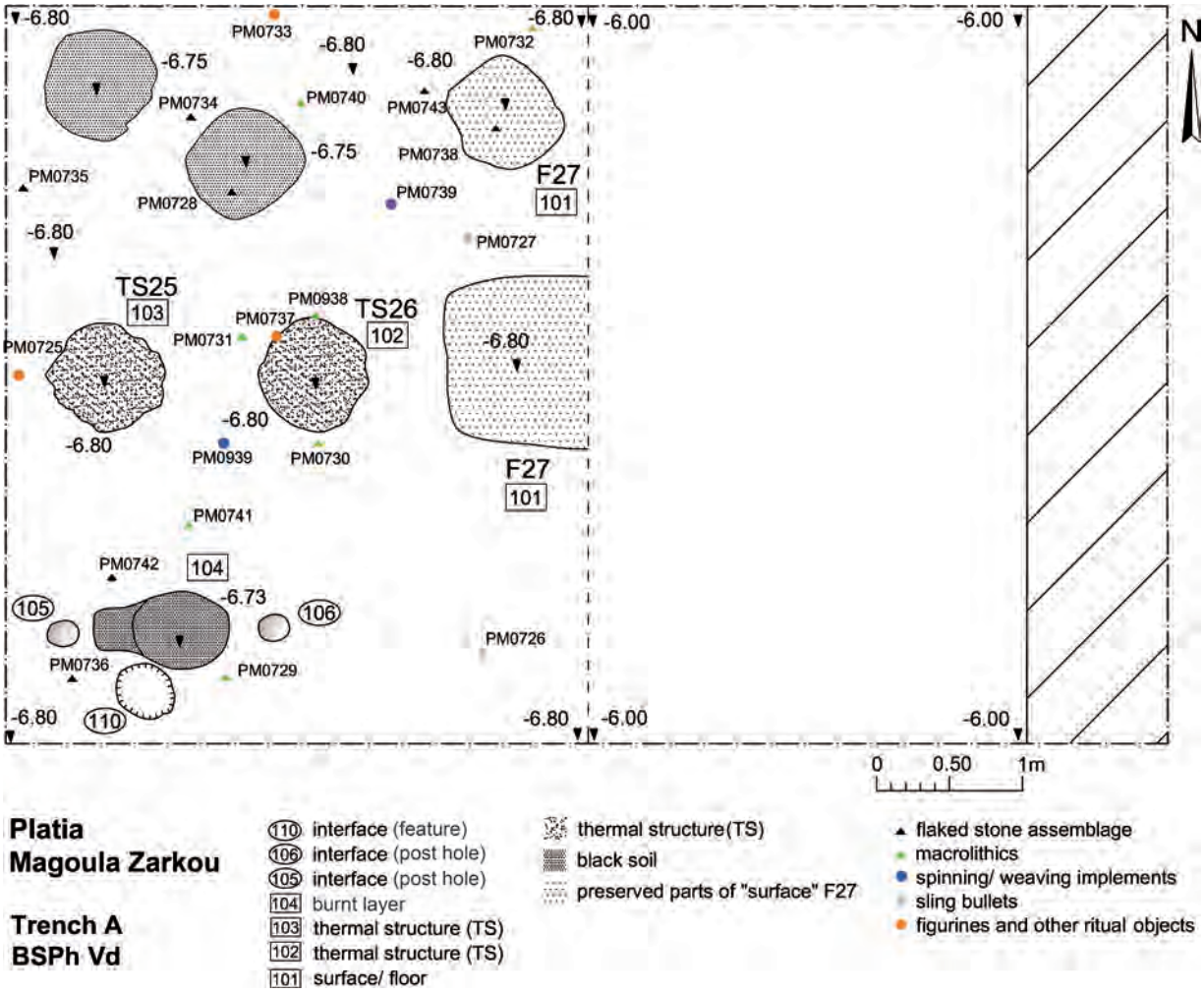



Fig. III.24 Plan of BSPh Vd (edited by C. Batzelas, A. Buhlke)

located at a depth of 6.73m in between the postholes mentioned above, was scarce and vague. It seems more probable that the black fired sediments in this place originated from simply discarding fire refuse there rather than from an in situ small open fire (SU 104). One of the postholes had its walls lined with small stones, and its bottom had a flat stone, preventing the post from decaying and receding (SU 105).

*Building Subphase Ve*

Depth: ~6.30–6.54m; EU 205–209; SU 108–112.

A 'surface' at a depth of ~6.40–6.42m (F26, SU 108), a thermal structure (TS 23, SU 109) and a small pit (SU 110–111) were attributed to this building subphase (Fig. III.25; Pls. III.1, III.3; Tab. III.1). The intervening layer between this and the overlying BPh VI consisted of a yellowish-brown sandy soil, rich in pottery and animal bones (SU 112).

Thermal structure TS 23 (SU 109) was an oven located near the middle of the trench and its rubble extended in an almost circular area, 0.80–0.90m in diameter, forming a layer 0.15m thick (Fig. III.25; Tab. III.4). The clay walls were 0.05–0.12m thick and were preserved only in places, whilst the clay floor was found at a depth of 6.30m and was slightly ellipsoid in shape at 0.53 × 0.74m. It was set on a durable substructure made of pebbles and was renewed three times, with the upper floor being blackened by fire. The oven was accompanied by a rectangular clay platform attached to it to the north on which a flat stone was found laid horizontally. Around the oven a few pieces of burnt clay were scattered,

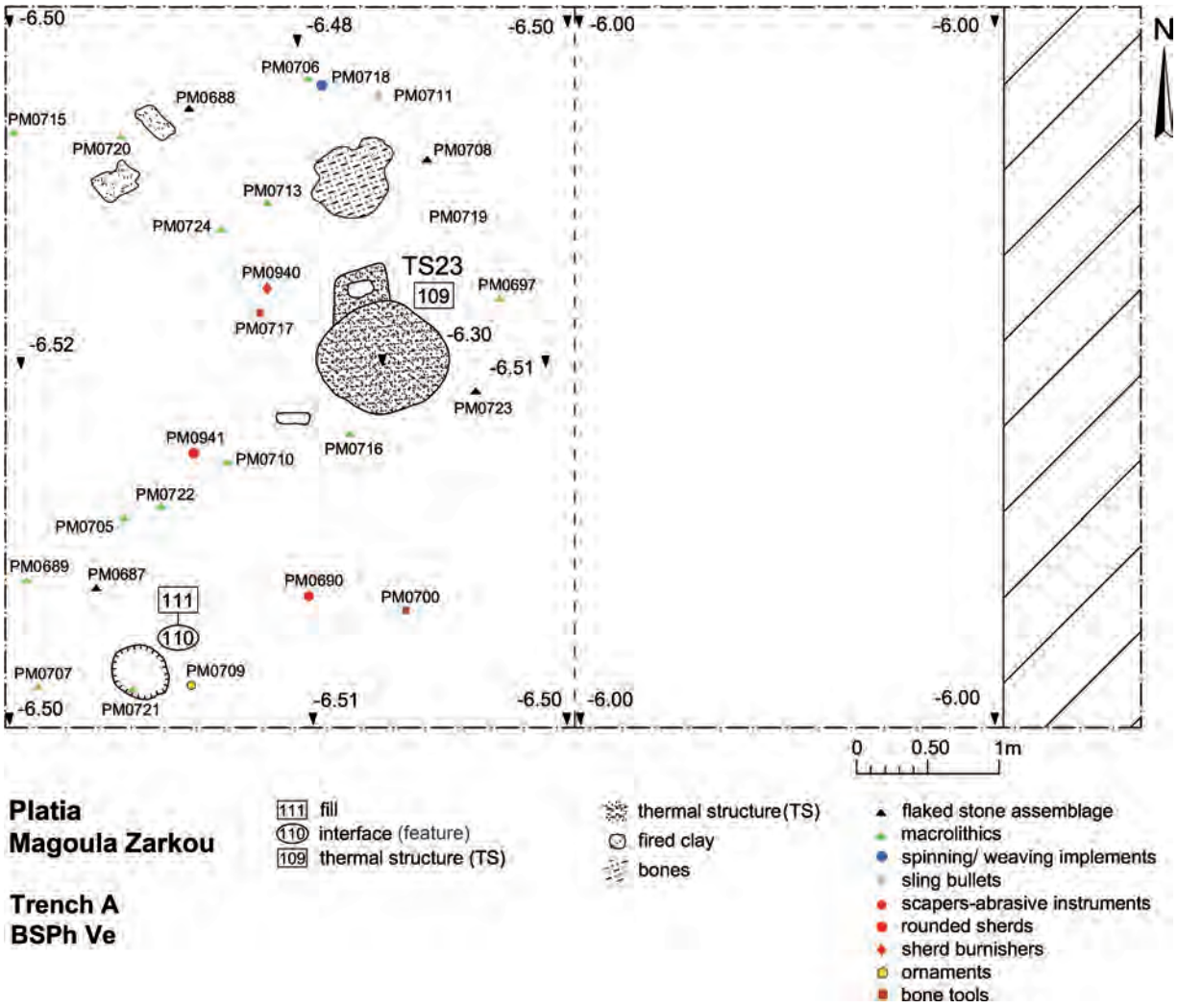



Fig. III.25 Plan of BSPh Ve (edited by C. Batzelas, A. Buhlke)

whilst near it, to the north, a broken grinding stone and a small concentration of animal bones were found. In the southwestern corner of the trench a small circular pit, 0.35m in diameter and 0.40m deep, was discovered (SU 110), which penetrated the floor of the preceding building subphase (SU 101). Its fill contained sherds, a few animal bones, tiny charcoal fragments and a broken grinding stone.

Overall, BPh V yielded 78 small finds, i.e. 13% of the entire Neolithic assemblage of finds (8 in BSPh Va, 19 in Vb, 4 in Vc, 21 in Vd and 26 in Ve), a rather restricted number considering the overall ~1.40m-thick deposits of this building phase (Figs. III.21–25; Pl. III.2; Tabs. III.2a–2b.10–15, 24–25). Half the number of the small finds were macrolithic tools (37 pieces) found near thermal structures as in BSPh Vb and Vd. There were also 17 flaked stone tools and debris, three bone tools, one clay scraper, two rounded sherds, one eight formed sherd tool, two sherd burnishers, five textile implements, three sling bullets, one ornament and six figurines. The burnt clay fragments were rather restricted in number and beside the pieces of clay from thermal structures and buildings, the peculiar pieces with decorative patterns were also found (Figs. III.41.6, III.42.8–12, III.43b.11–12; Tab. III.3).

Two radiocarbon dates on bones were obtained from BPh V, MAMS-32125: 5813 ± 49 calBC (1σ) [BSPh Va] and MAMS-32124: 5733 ± 34 calBC (1σ) [BSPh Vd].[116]

[116] Weninger et al., this volume, 188, Tab. IV.2.

### III.3.6. Building Phase VI

Depth: ~5.44/5.50 (west) – 5.46/5.52 (east) – 6.30m; EU 210–230; SU 113–126, 175–176, 186.

Overall, deposits ~0.86m thick were attributed to this phase. Two building subphases were discerned, BSPh VIa and b, with corresponding Surfaces F25 and F24, respectively (Figs. III.26–28; Pls. III.1, III.3; Tab. III.1). What further distinguishes this and the following phase from the preceding phases is the presence of destruction layers of burnt buildings forming 'closed units' and yielding an increased number of small finds in comparison with the preceding phases (Pl. III.2; Tabs. III.2a–b). The two building subphases of this phase shared similarities as regards the construction techniques and use of space. From BSPh VIb onwards, the excavation area was increased to 35m² (5m north-south × 7m east-west) (Figs. III.3–4).

#### *Building Subphase VIa*

Depth: ~6.00–6.30m; EU 210–211, 213–214, 216; SU 113–121, 175.

It comprised Surface F25, two thin clay walls (W34 and W35), two overlaid thermal structures (TS 22 and 22a) and two postholes (SU 118, 119). Surface F25 was found at a depth of ~6.20/6.25m (SU 113) and was made of brownish clay (Fig. III.26; Pls. III.1, III.3; Tab. III.1).

It extended over a large part of the trench and was bounded by the rudimentary clay walls W34 (SU 116) and W35 (SU 117) in the eastern and southern sides of the trench, respectively. The walls were preserved fragmentarily without details on their construction being given and it is therefore not certain what they looked like, nor the kind of the building they belonged to. Wall W34 was found close to the eastern side of the trench and was 2.20m long, 0.10m wide and 0.13m high, having a north-south orientation (SU 116). At its northern end and in contact with its inner façade, the lower part of a clay vessel was found, probably in situ (SU 175). In contact with the outer façade of the wall and 1m east of it, two postholes were found (SU 118, 119). The nearest posthole to the wall, SU 118, was circular, 0.20m in diameter and 0.20m deep, and its walls were plastered with clay admixed with pebbles, whilst a few pebbles and animal bones were found near its bottom. Despite its proximity to wall W34, it seems that it was not associated with the wall's construction, since no other postholes were found along the line of the wall. Conversely, together with posthole SU 119, which was of similar construction and of 0.19–0.23m in diameter, it seems to belong to another wall built with posts which continued into the non-excavated eastern half of the trench. There was not sufficient evidence to indicate whether the two walls were coeval and associated with each other, or more probably the post-built wall belonged to an earlier phase.

The wall W35 (SU 117), for which no dimensions were given, had an east-west orientation. A clay scraper (PM0698) was reported as being incorporated inside the wall, whilst at the western end of the wall and very close to its inner façade, a grinding stone was found (PM0691). A few macrolithic, flaked stone and clay tools were also found south of the wall. Near the middle of the western side of the trench two overlaid thermal structures were unearthed, namely ovens, at a depth of ~6.20m (TS 22 and TS22a). Oven TS 22a (SU 114), was somewhat ellipsoid in plan with dimensions 0.70 (north-south) × 0.60m (east-west) and had a plastered clay floor on a substructure with pebbles. Its walls were destroyed but their lines were clearly visible around the floor. By the side of the thermal structure a small concentration of animal bones and a large amount of charcoal and burnt clay from its walls were found. For the overlying thermal structure TS 22 (SU 115), it was reported that its shape and dimensions were similar to the preceding one and that its floor was blackened by fire.

The deposits overlying Surface F25 mainly consisted of brown sandy-loamy soil (SU 120, 121) and yielded abundant pottery and 40 small finds amounting to 7% of the total number of the overall Neolithic small finds. They included 21 macrolithic tools, ten flaked stone tools and debris, one bone tool, two sling bullets, one clay scraper, two rounded sherds, one sherd burnisher, one textile implement and one figurine (Pl. III.2; Tabs. III.2a–2b.16, 24–25).

Walls W34 and W35 were too thin and rudimentary to be considered as the exterior walls of a house. Their appearance might favour the suggestion that they confined a roofed area of a

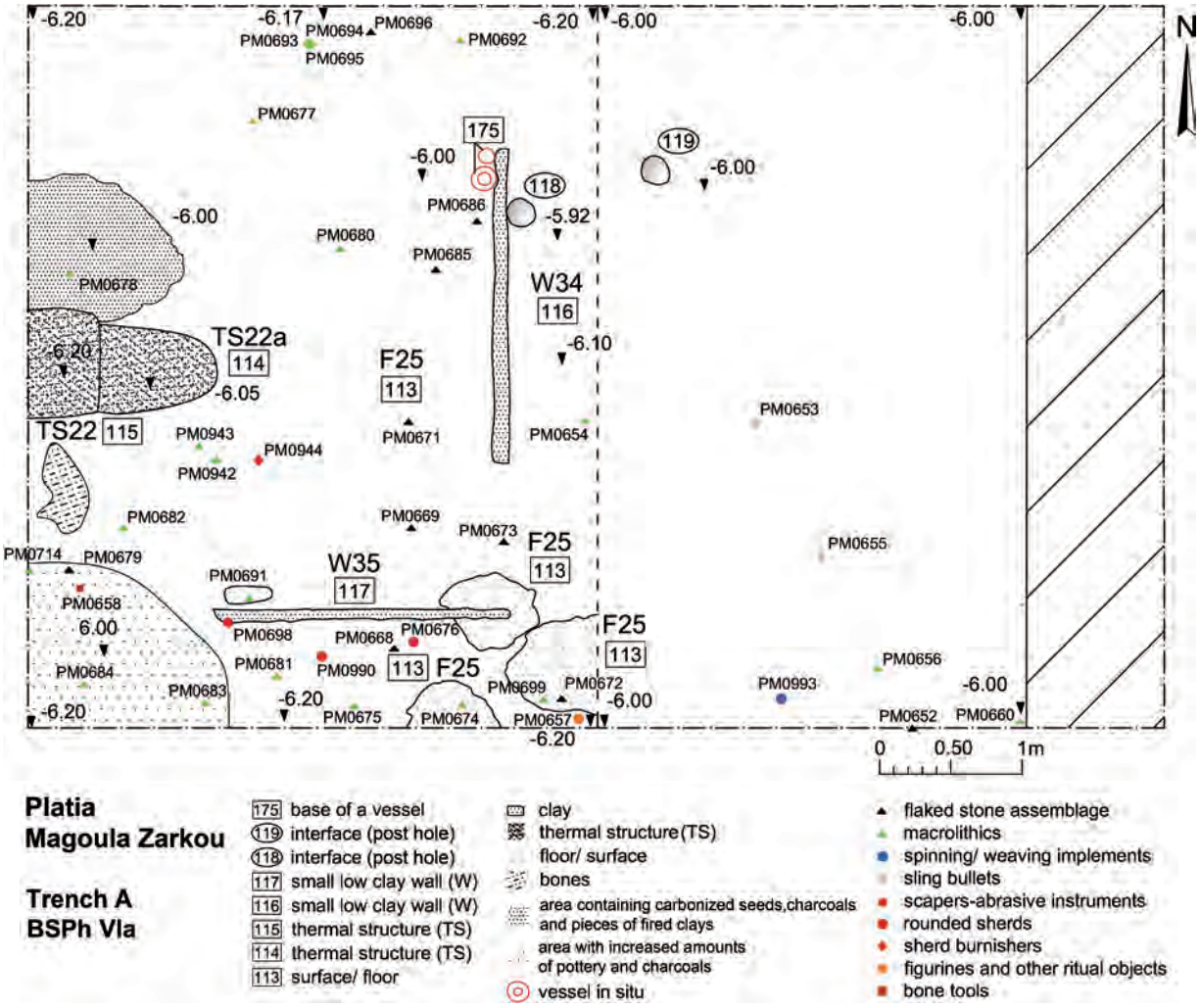



Fig. III.26 Plan of BSPh VIa (edited by C. Batzelas, A. Buhlke)

probable ancillary building of a house or, less probably, that they were partition walls of a larger building for which no further evidence existed in the trench. Whatever the case, the walls should probably be restored as low walls built with compact clay or with a wattle and daub superstructure. Inside the area they confined, food processing was undertaken, among other activities, as is shown by the presence of thermal structures and grinding stone tools.

*Building Subphase VIb*

Depth: ~5.68 (west) and 5.52/5.62 (east) – 6.00m; EU 217–230, 234–235; SU 122–126, 176, 186.

The vestiges of two rudimentary clay walls (W32 and W33, SU 123, 124, respectively), a 'surface' at a depth of 5.86/5.90 (east)/5.97m (west) (F24, SU 122), a thermal structure (TS 21, SU 125) and one posthole (SU 186) were ascribed to this building subphase (Figs. III.27–28; Pls. III.1, III.3; Tab. III.1).

The clay walls were found near the middle and the eastern side of the trench and had a north-south orientation. They were parallel to each other at a distance of 1.46m and were preserved as two thin stripes of burnt clay 'plaster', 0.03–0.07m thick and 0.05–0.09m high, mostly looking like coatings of wall façades from thoroughly destroyed walls. Their inclination westwards supports the speculation that the walls passed along their western side and that they probably constituted coatings of exterior wall façades.

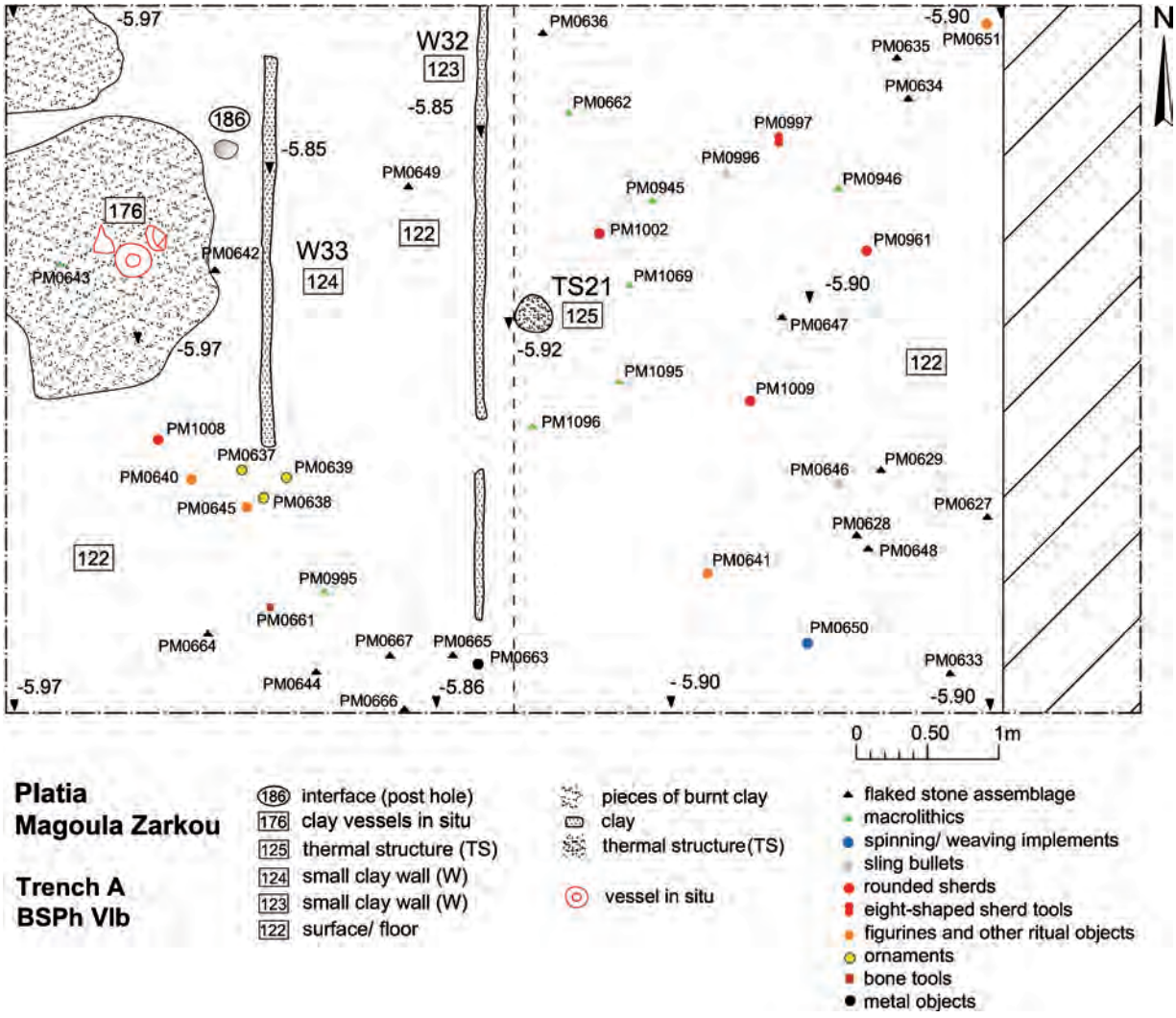



Fig. III.27 Plan of BSPh VIb (edited by C. Batzelas, A. Buhlke)

Fig. III.28 BSPh VIb. Surface F24 and wall plasters (W32–33). View from the south (edited by A. Buhlke)

Wall W32, to the east of wall W33, was 2.86m long but continued beyond the northern side of the trench. Wall W33 was preserved in a length of 2.72m, but a part of it, 1.10m long, near the middle, was found a little deeper, therefore not corresponding to an actual opening in the wall. Clay Surface F24 extended westwards from wall W32 to the west side of the trench and was mainly made of brown clay, getting hard in places (SU 122). Between the wall W33 and the western side of the trench it was greatly affected by fire, acquiring a brownish-red colour and becoming very compact. Near the middle, the lower part and two large fragments of clay vessels were found (SU 176) as well as a stone quern and near them a posthole 0.13–0.19m in diameter and 0.12m deep (SU 186) (Fig. III.27). Highly burnt pieces of clay were also found in abundance in this area throughout the deposits overlying the 'surface' (SU 126), according to the evidence, originating from the burnt building to which the walls W32 and W33 belonged.

The meticulously made Surface F24 apparently corresponded to an indoor floor area and the posthole mentioned above might indicate the need to support the roof of the building. On the other hand, the form of the walls W32 and W33 which confined the roofed area, at least from the eastern side, was difficult to restore since no proper evidence existed for their construction. Along the western sides of the preserved 'coatings' no postholes or fragments of mudbricks were found, thus making it less likely that a wall built with robust vertical posts or with a mudbrick or even *pisé* superstructure existed there. It seems most probable that these 'coatings' plastered a thin wattle and daub wall from which the clay fragments found bearing impressions of slender posts, branches or reeds originated. Like the walls of the previous phase, it was hard to conceive of them as the robust external walls of a house, but it seems more likely that they belonged to an 'auxiliary' room associated with or annexed to a house. The walls seemed to be coeval with each other, separating off the area between them from the rest of the room. There was no evidence for the use of this apparently roofed area, but storage might have been a potential use, among others, bearing in mind that baskets, sacks or storage containers made of perishable material hardly leave any relevant vestiges. Surface F24 is somehow reminiscent of the roofed area of the underlying building subphase, indicating a continuity in the use and organisation of space between the two subphases.

A short distance to the east of wall W32 the thermal structure TS 21 (SU 125) was found, probably a hearth, at a depth of 5.92m (Tab. III.4). Its plastered clay floor was heavily blackened by fire but only a limited part, 0.25m in diameter, was preserved.

Over the remaining part of the 'surface', east of wall W32, the deposits were rather homogeneous and consisted mainly of brownish soils. They yielded pottery, among them two clay vessels in situ (SU 176), some burnt pieces of clay found in sparse dispersion, animal bones and 41 small finds amounting to 7% of the total Neolithic finds (Fig. III.27; Pl. III.2; Tabs. III.2a–b.17, 24–25).[117] The latter included sixteen flaked stone tools and debris, eight macrolithic tools, one bone tool, one textile implement, two sling bullets, four rounded sherds, one eight formed sherd tool, three ornaments and four figurines, whilst a piece of a metal object was an intrusion from the Early Bronze Age strata.

Overall, BPh VI yielded 81 small finds, i.e. 14 % of the Neolithic assemblage of finds and its increased number was partly due to the enlarged excavation surface of the trench from the depth of 6m upwards. The finds included 29 macrolithics and 26 flaked stone tools and debris, five figurines, four sling bullets, two textile implements, two bone tools, three ornaments, one clay scraper, one sherd burnisher, six rounded sherds, one eight formed sherd tool and the aforementioned metal object (Figs. III.26–27; Pl. III.2; Tabs. III.2a–b.16–18, 24–25). Apart from the burnt clay fragments originating from thermal structures and walls, there were also 33 flat clay pieces with

[117] According to the evidence, a small copper sheet found in this subphase at a depth of 6m originated from a disturbance starting from the Early Bronze Age deposits. Further evidence of disturbance of some degree in this phase is also supported by a radiocarbon date on seed (MAMS-32122) falling into this period (see below).

decorative patterns of the type known from preceding phases (Figs. III.41.7–10, III.42.13–16, III.43b.15–16; Tab. III.3).

From BSPh VIb the radiocarbon date on bone MAMS-32123: 5751 ± 33 calBC (1σ) was obtained, whilst another one on seed, MAMS-32122: 2546–2351 calBC (1σ), was an outlier and incompatible with the Neolithic period at all.[118] Because the date falls outside the Neolithic data sequence, we have to be aware that Early Bronze Age contaminations may have existed from BSPh VIb onwards.

### III.3.7. Building Phase VII

Depth: ~4.82/4.84–5.56/5.60 (eastern half) / 5.65/5.68m (western half); EU 231, 233–244, 246–248, 250–253, 255–256; SU 127–152, 177–181.

Highly burnt pieces of clay from buildings and structures also continued to appear in this phase but no definite floor surfaces were discerned (Figs. III.29–36; Pls. III.1, III.3; Tab. III.1). In the eastern half of the trench, an Early Bronze Age pit destroyed a large part of the deposits of this as well as the overlying BPh VIII–IX.[119] Three building subphases (BSPh VIIa–c) and three 'surfaces' (F23–21, respectively) were distinguished, corresponding overall to ~0.80m-thick deposits and yielding a large amount of pottery and small finds as well as the known clay house model ascribed to BSPh VIIa. In BSPh VIIa–b the 'surfaces', albeit too fragmentary, extended mainly in the eastern half of the trench, indicating that the buildings were located in this area. In BSPh VIIc the picture was more homogeneous throughout the trench.

#### *Building Subphase VIIa*

Depth: ~5.18 (east half) / 5.15/5.17 (west half) – 5.56/5.60 (east half) / 5.65/5.68m (west half); EU 231, 233–243, 248, 250; SU 127–134, 177–179.

Surface F23 of this building subphase was found at a depth of ~5.40/5.47m but was preserved only in places in the eastern half of the trench (SU 127) (Fig. III.29; Pls. III.1, III.3; Tab. III.1).

It was made of yellowish compact clay and in the northeastern part was somewhat uneven with a slight inclination to the southwest. One definite and another possible thermal structure, a shallow pit in the northeastern corner, and two postholes in the southeastern one were related to this 'surface' (Fig. 29). From thermal structure TS 20 (SU 131) only a small part was revealed, 1.30 (east-west) × 0.50m (north-south) and 0.20–0.25m thick, along the northern side of the trench at a depth of 5.18m but the remainder expanded beyond the trench (Figs. III.29–30; Tab. III.4). It was seemingly quadrangular in plan and its floor was made of compact clay over a robust substructure 0.20–0.25m thick. The latter consisted of three overlaid layers of coarse sherds and pebbles at the bottom, smaller stones and clayey soil in the middle and a thin clay coat on the top, onto which the structure's clay plaster floor was laid. Beside the structure, in the northeastern corner of the trench, a rubbish pit was found, 0.70m in diameter and 0.10m deep, yielding large sherds, a few stones and animal bones, whilst it was reported that a piece of flaked stone debris and two broken macrolithic tools were also found (SU 130) (Figs. III.29–30). It seems that a floor made of hard clay on a substructure with pebbles in front of the preceding structure could belong to another

[118] Weninger et al., this volume, 188.

[119] The Early Bronze Age pit referred to as 'vothros' in the diaries was slightly ellipsoid in plan with a diameter of 2.50–3.80m (rim)/1.80–2.10m (bottom) and 1.23m deep (SU 167). It started at a depth of 4.00–4.10m and penetrated the deposits of the underlying BPh VII–IX down to a depth of 5.33m. Its fill consisted of light-brownish, fine-grained sandy soil and, in the deeper part, of yellowish, soft sandy-loamy soil and contained a few field stones, mudbricks, animal bones and pottery (SU 168). Near the bottom the soil was loose, containing ashes and black burnt residues considered as fire refuse from thermal structures discarded in the pit (SU 133, 134). However, it should not be immediately ruled out that these black layers were probably related to the Neolithic layers overlying Surface F23 of BSPh VIIa right underneath the bottom of the pit and that they have been disturbed by the pit.

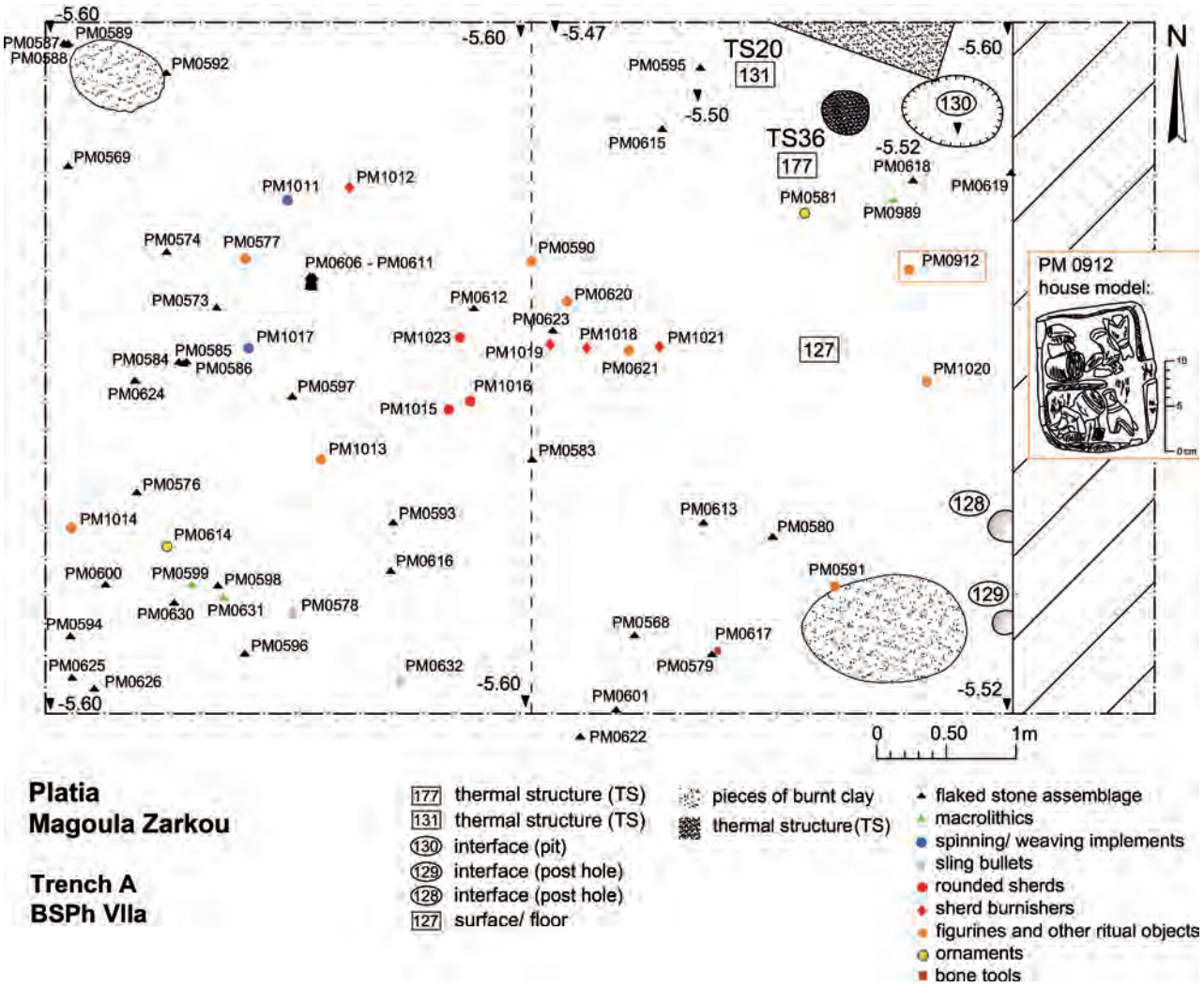



Fig. III.29 Plan of BSPh VIIa (edited by C. Batzelas, A. Buhlke)

Fig. III.30 BSPh VIIa. Thermal structures TS 20 and 36. View from the south (edited by A. Buhlke)

thermal structure that was probably constructed when the former ceased to be used and the adjacent pit was filled (TS 36, SU 177) (Fig. III.29). It also appears that a little above this potential thermal structure, a circular concentration of sherds belonging to a storage vessel which originally stood in this place was found (SU 178) (Fig. III.33c), although the contemporaneity between the two was difficult to ascertain. Over Surface F23 in the western part of the trench there was brown sandy-loamy soil (SU 132), whilst in the eastern half lay a destruction layer with black burnt soil and above it highly burnt pieces of clay, many of which preserved impressions of burnt timber from walls or roofs (SU 133–134).

In the upper part of this destruction layer and by the east side of the trench the well-known clay house model was found at a depth of 5.17m (SU 179, PM0912) amidst highly burnt pieces of red clay, some of which preserved impressions left by burnt slender posts and branches, a few sherds and charcoals and some pebbles and stones, whilst beside the house model there was a small, flat whitish stone. At a distance of 0.20–0.30m east of the model there were traces of black burnt soil in a restricted area (Fig. III.31a–c). According to the excavator, the house model was found 0.16m below Surface F22 from the overlying BSPh VIIb (see below), inside a small pit, 0.25m deep, dug into the rubble of the destruction layer, and it was covered by loose dark-brown earth and burnt pieces of clay above.[120] The excavator also argues that the pit was dug during the construction of the house of the subsequent BSPh VIIb, 0.35m north of its thermal structure TS 19 (see below). The pit was considered as sacrificial and the house model as a foundation offering, securing the well-being of the new house, whose occupants might have been represented by the figurines inside the house model.[121] However, it seems more likely that the house model should be associated with the burnt rubble of BSPh VIIa in which it was found and consequently, in this analysis, it was ascribed to this phase. The excavation archives do not shed much light on the aforementioned pit,[122] while the present analysis rather leads to the conclusion that the house model was deposited on the uppermost part of the loose and uniformly formed rubble of the burnt house of BSPh VIIa.[123] The horizontal placement of the house model with the figurines neatly arranged inside proves that it was meticulously deposited there, ritually closing the life cycle of the burnt house of BSPh VIIa and blessing the erection of the new house in the subsequent BSPh VIIb. It should also be noted that in the upper part of the destruction layer of BSPh VIIa, and at a distance of 0.78m northeast of the house model, a large bead made of *Spondylus gaederopus* (PM0581) was found, and it is tempting to assume that it was devoted to the burnt house in the same way as the house model.

On the other hand, the close proximity of the house model to thermal structures of both BSPh VIIa and VIIb highlights the significance these structures had in the daily life of the households (Fig. III.31a–c).

Near the southeastern corner of the trench, a restricted circular concentration of burnt pieces of clay and black soil was found, indicating another potential thermal structure in this place, and near it, two postholes, 0.17 (SU 128) and 0.10–0.16m in diameter (SU 129) and 0.08m deep (SU 128) (Fig. III.29).

Apart from the house model, 71 small finds were found in this subphase, constituting in total 12% of the overall Neolithic small finds (Fig. III.29; Pl. III.2; Tabs. III.2a–2b.19, 24–25). They comprised 45 flaked stone tools and debris, nine fragmentary anthropomorphic figurines besides the figurines inside the house model, three rounded sherds, three macrolithic tools, two textile implements, two sling bullets, one bone tool, two ornaments and three sherd burnishers.[124] There were also burnt clay fragments with impressions left by burnt timber from houses as well as

[120] Gallis 1985b, 20; Gallis 1989, 201–202; Gallis 1996a, 65.
[121] Gallis 1985b, 23.
[122] Any information regarding the shape, dimensions and construction of a pit is lacking in the diaries.
[123] See also Alram-Stern, this volume, 468–469.
[124] A small bronze nodule similar to that found in BSPh VIb should likewise be attributed to Early Bronze Age disturbance, though not mentioned in the diaries.

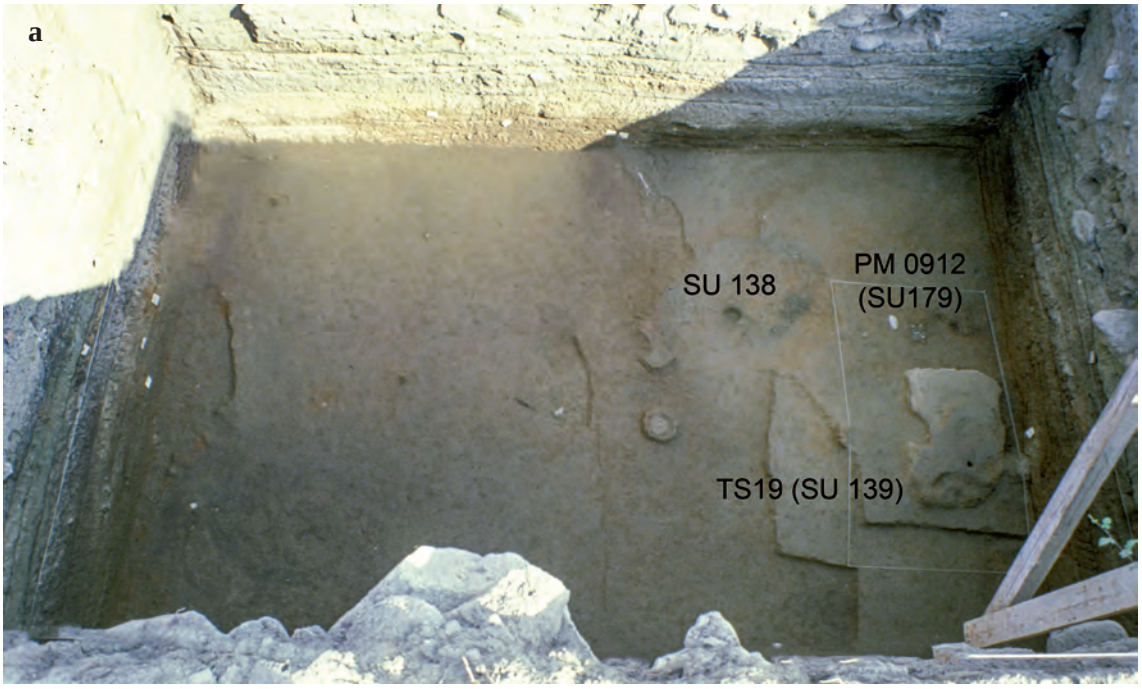


Fig. III.31a–b BSPh VIIa and VIIb. The clay house model of BSPh VIIa (SU 179) is shown close to thermal structure TS 19 of VIIb. a. View from the south; b. View from the north (edited by A. Buhlke)

Fig. III.31c BSPh VIIa and VIIb. The clay house model of BSPh VIIa (SU 179) is shown close to thermal structure TS 19 of VIIb. View from the east (edited by A. Buhlke)

thermal structures and 26 clay pieces with decorative motifs of the type also found in preceding phases (Figs. III.41.11–16, III.42.17–18, III.43c.17–20; Tab. III.3).

*Building Subphase VIIb*

Depth: ~5.04/5.06–5.18/5.20 (east half) / 5.26/5.30m (west half); EU 244, 246a, 246b, 249, 249a, 251, 252; SU 135–141.

The architectural evidence for this phase included Surface F22, thermal structure TS 19 and two postholes. Surface F22 (SU 136) was clearly visible at a depth of ~5.11/5.12m in restricted areas in the northeastern and southeastern corners of the trench (Figs. III.31a–c, III.32, III.33a–d; Tab. III.1) whilst in the remainder it seemed to be lacking discrete features.

It consisted of yellowish clayey soil with small pebbles in places, making it hard and compact (SU 136). In the middle of the eastern side, hearth TS 19 was found preserved in an exceptionally good condition for this site (SU 139) (Figs. III.31a–c, III.33a–d; Pls. III.1, III.3; Tabs. III.1, III.4). As was mentioned above, the thermal structure was built over the burnt rubble of the preceding BSPh VIIa.

It was slightly rectangular in plan, 1.25 (north-south) × 0.80m (east-west) and 0.20m thick, with a robust and elaborate substructure (Figs. III.32, III.33a–d; Tab. III.4) which consisted of small flat stones, a few large sherds and burnt pieces of clay and was covered by a thin clay layer of 0.03m in thickness. The northern vertical front of the substructure was plastered with clay. The hearth's floor was renewed three times with clay plaster 0.01–0.04m thick, blackened by fire, but the upper two renewals were less well preserved.

In the middle of the thermal structure there was a circular hole with a diameter of 0.15m (SU 180), seemingly corresponding to the end of a posthole of the overlying BSPh VIIc and cutting through the thermal structure (Fig. III.33c–d). There were no indications of walls and it seems that the hearth was probably of the same type as the hearth TS 20 of the preceding BSPh VIIa and slightly raised above Surface F22. Two postholes were found at some distance west of the hearth, one of which, 0.15m in diameter and 0.05m deep, contained ashes (SU 137) and the other one, 0.19m in diameter, had plastered walls (SU 138) (Figs. III.31a–b, III.32, III.33c; Pls. III.1, III.3; Tab. III.1). On Surface F22 lay a light brown sandy-loamy soil including sparse tiny charcoal fragments and burnt clay fragments (SU 140). North of the thermal structure and near the

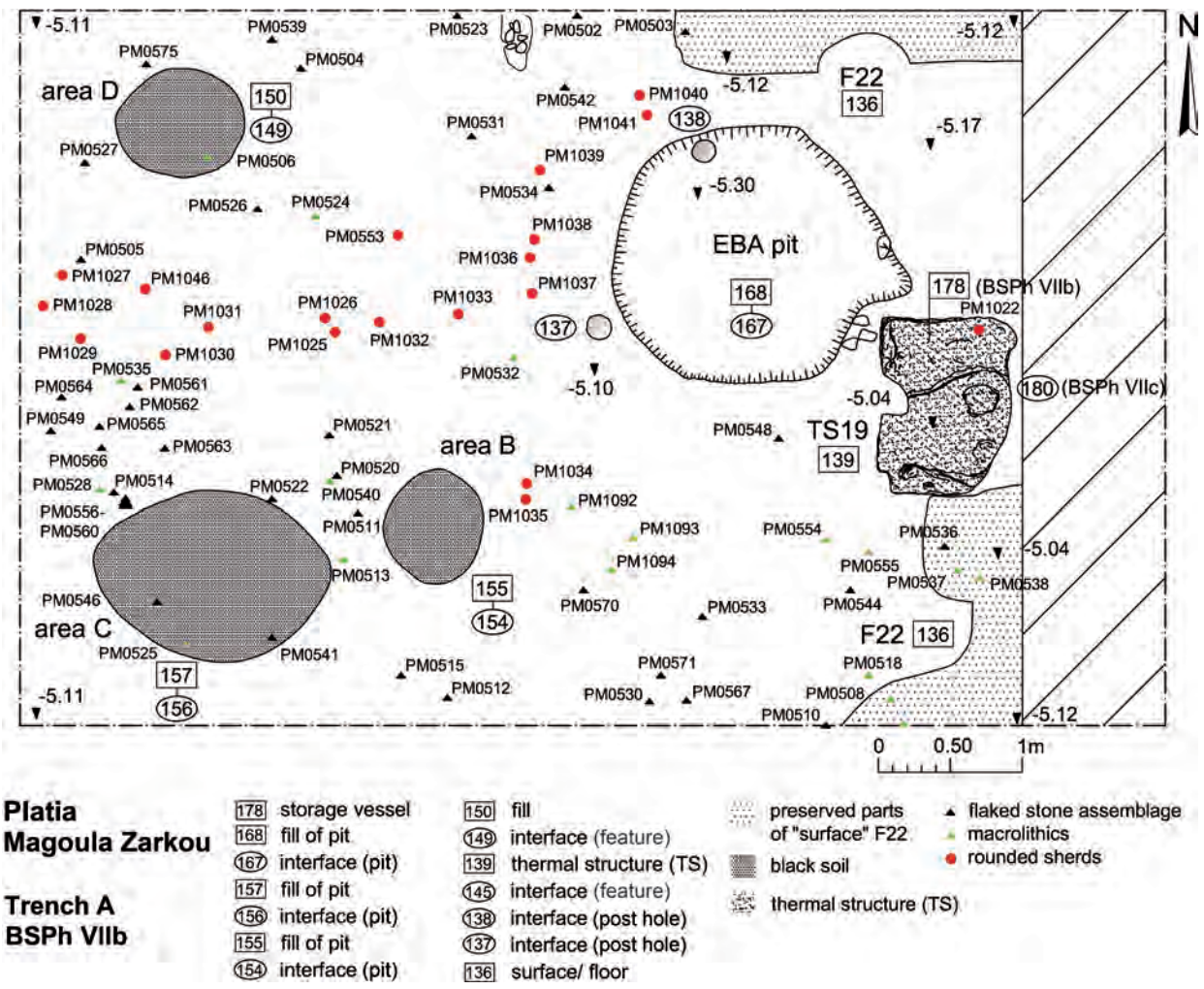
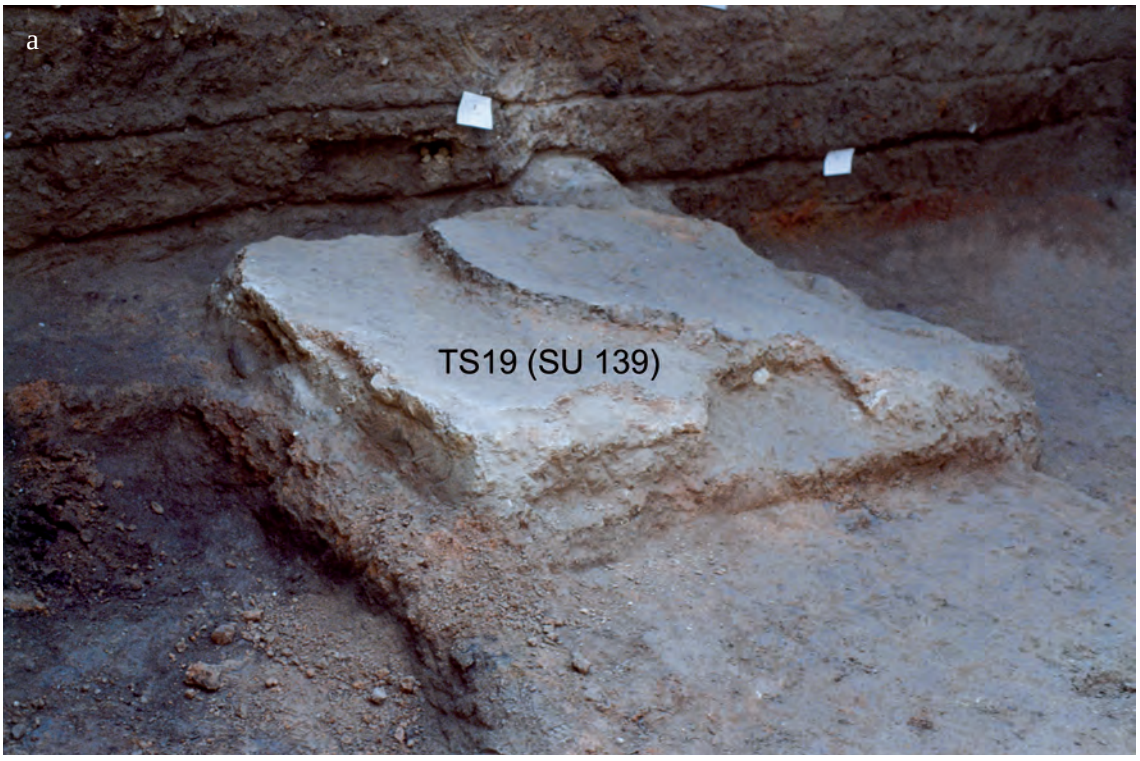



Fig. III.32 Plan of BSPh VIIb, including SU 154–157 of BPh VIII (edited by C. Batzelas, A. Buhlke)

northeastern corner of the trench, a probable mudbrick wall, seen only on the profile of the eastern side of the trench, is reported in the diaries. According to the excavator, the wall confined from the north the area where the house model was found, but on a profile sketch it is shown as being based on Surface F21 from the preceding BSPh VIIa. Unfortunately, no further details were given for this potential wall, nor were any traces of it observed inside the trench in this or the preceding building subphase. Contrary to the eastern half of the trench, Surface F22 was not traceable in the western half, where architecture seemed to be lacking. The deposits in this area were made of brown, sandy-loamy soil with sparse burnt clay pieces and, in places, with fire remnants, abundant pottery and small finds (SU 135, 141). The available evidence might indicate that an open-air area or yard existed in this area next to a building in the eastern half of the trench.

This building subphase yielded 79 small finds i.e. 13% of the total assemblage of Neolithic finds. There were 42 flaked stone tools and debris, 20 rounded sherds – an increasingly high number in relation to those found in the preceding phases – and 17 macrolithic tools (Fig. III.32; Pl. III.2; Tabs. III.2a–2b.20, 24–25). Burnt clay fragments have receded in number and mostly originated from thermal structures, whilst no flat clay pieces with decorative patterns were encountered (Fig. III.42.19–21; Tab. III.3).



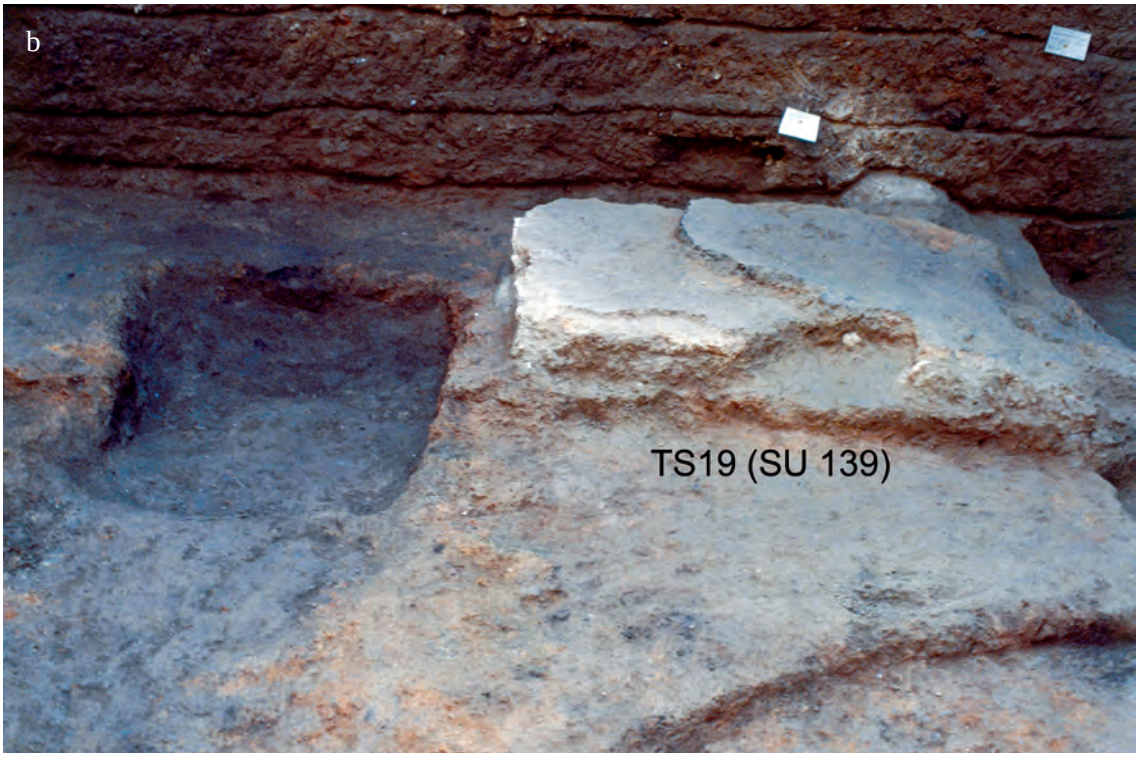
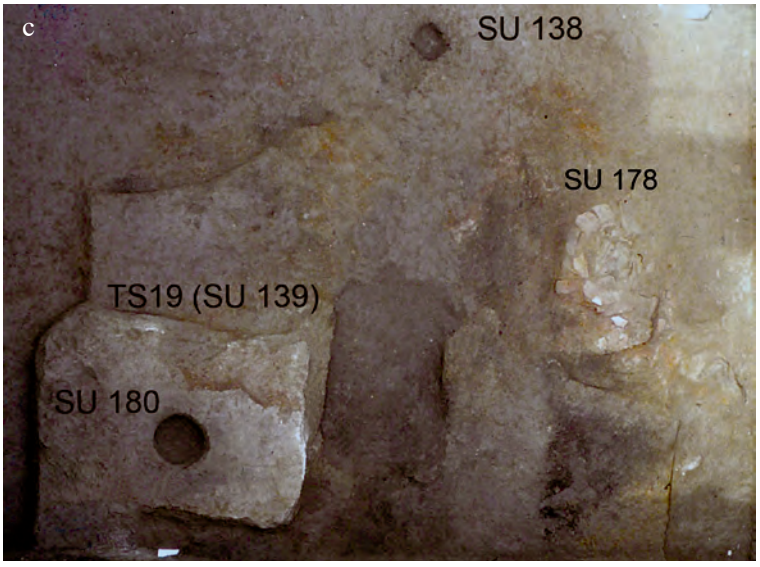




Fig. III.33a–b BSPh VIIb. Thermal structure TS 19. a. View from the west; b. View from the west (edited by A. Buhlke)



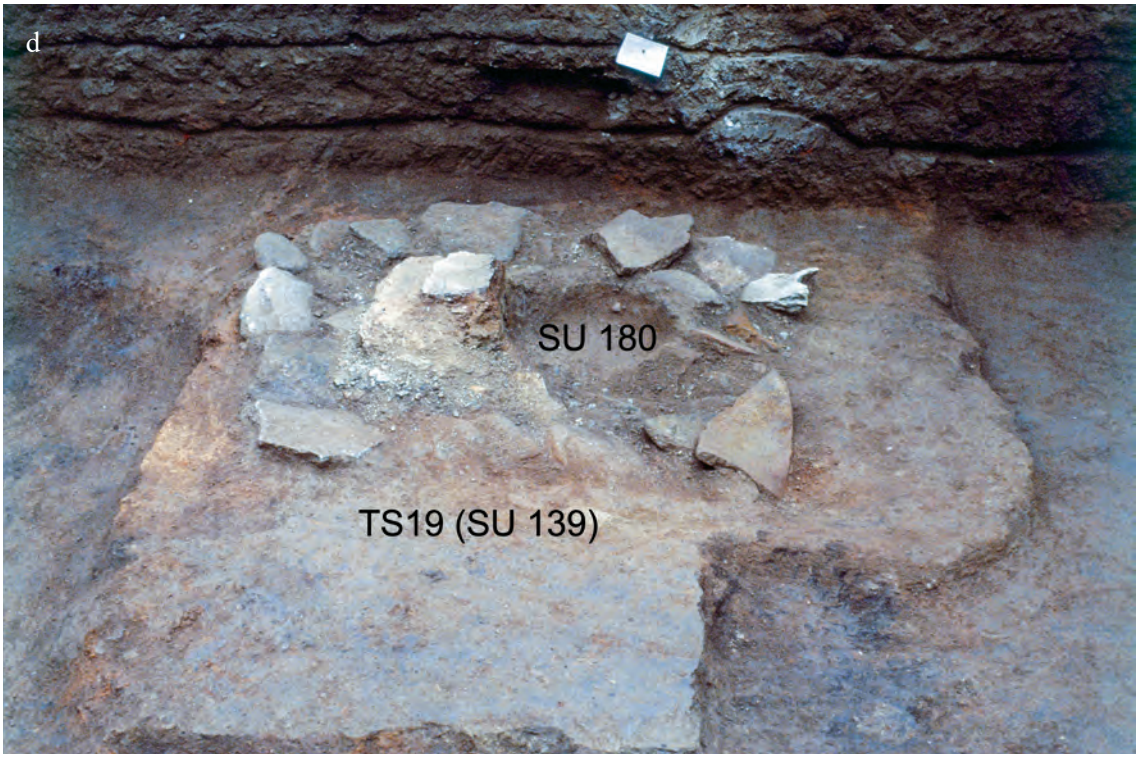




Fig. III.33c–d BSPh VIIb. Thermal structure TS 19. c. View from above. SU 178 of VIIb is also shown; d. Substructure of thermal structure TS 19. View from the west (edited by A. Buhlke)

*Building Subphase VIIc*

Depth: ~4.82/4.84 – 5.04/5.06 (west half) / 5.20m (east half); EU 247, 253, 255, 256; SU 142–150, 180–182.

As in the preceding phase, the archaeological evidence was scarce. It included Surface F21, probably part of a post-built wall, two shallow pits and one probable posthole. Surface F21 (SU 142) was fragmentarily preserved and dispersed in restricted areas considered to belong to the same 'surface' in the middle and close to the eastern side, as well as near the corners of the trench, except from the northwestern corner (Fig. III.34; Pls. III.1, III.3; Tab. III.1). These areas similarly consisted of hard compact clay occasionally admixed with small pebbles (SU 142).

Near the northwestern corner a shallow circular pit, 0.86m in diameter and filled with black burnt soil, was found (SU 149, 150). Beside it, to the east, was another quadrangular pit, 0.38 × 0.62m large, yielding ten flaked stone tools (SU 147, 148, 181), and next to it, another ellipsoid shallow pit, 0.70 × 1.20m large, whose fill consisted of black burnt soil and contained a few carbonized seeds (SU 145, 146). Near the middle of the northern side of the trench a small concentration of animal bones was reported, and, likewise, a small clay vessel in the northwestern part of the trench (SU 182). Within the narrow stripe of clay in the southeastern corner of the trench, two adjacent postholes were found, 0.18–0.21m in diameter and 0.11–0.15m deep, preserving rings of compact clay around them and with their walls lined with clay plaster, as well as having a few small stones in their bottoms (SU 143, 144) (Figs. III.34–36). This narrow band of clay was considered in the diaries as another disconnected area of Surface F21 but it is more likely that it corresponded to a poorly preserved post-built wall.

Based on the evidence, the posthole (SU 180), 0.20m in diameter and 0.15m deep, which penetrated the floor of the TS 19 of the preceding BSPh VIIb mentioned above, should be assigned to this building subphase.

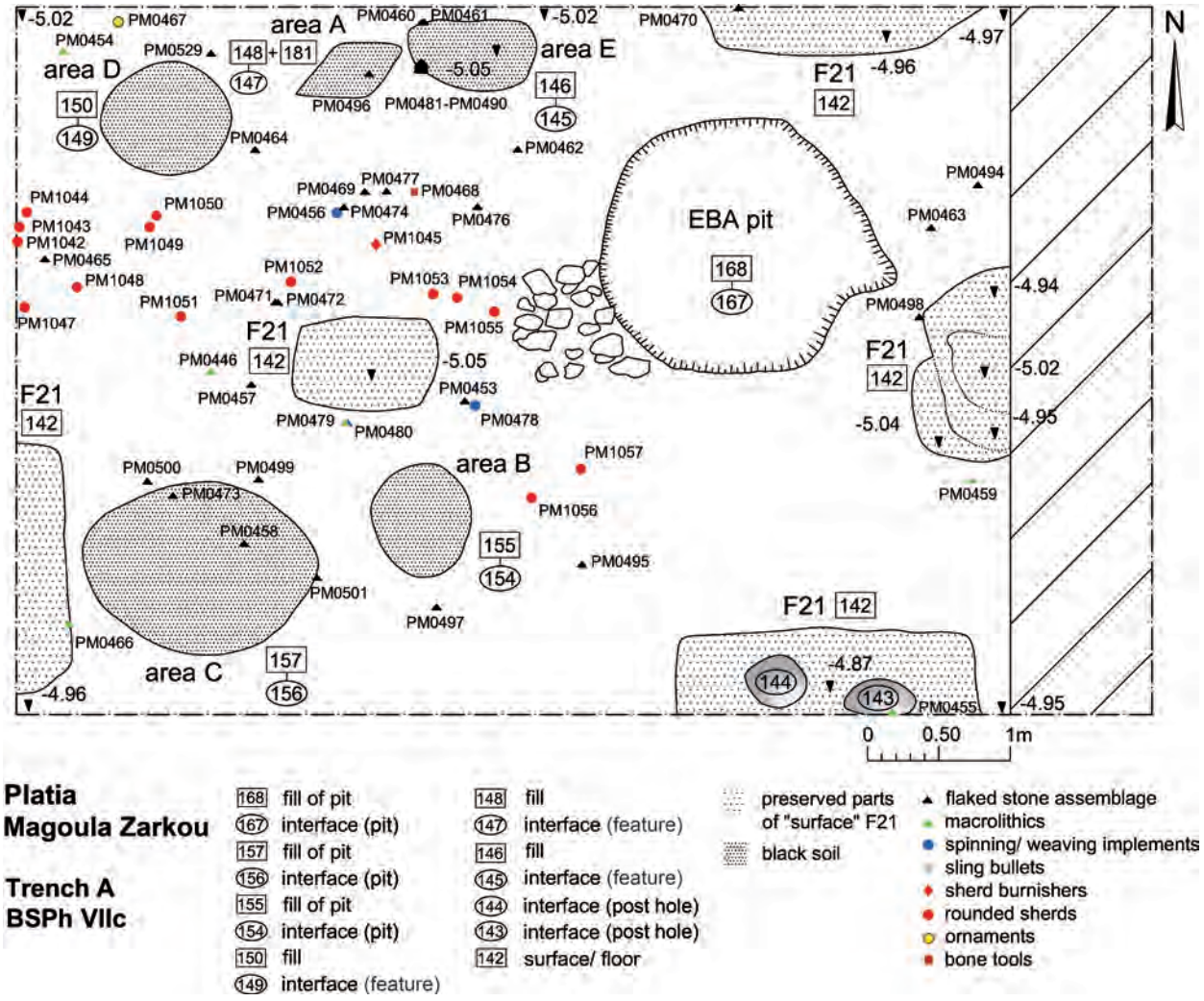



Fig. III.34 Plan of BSPh VIIc, including SU 154–157 of BPh VIII (edited by C. Batzelas, A. Buhlke)

Fig. III.35 BSPh VIIc. View from the north (edited by A. Buhlke)

In the western part of the trench the outlines of two pits were observed (SU 154–157), which were not coeval with this phase but dug from the overlying BPh VIII (see below). The deposits over Surface F21(SU 151–152) were made of dark brown, sandy-loamy soil and yielded a few burnt pieces of clay, burnt soil and ashes in places, a few stones, abundant pottery and 62 small finds, accounting for 10% of the entire Neolithic assemblage of finds (Fig. III.34; Pl. III.2; Tabs. III.2a–2b.21, 24–25). There were 37 flaked stone tools and debris, six macrolithic tools, 14 rounded sherds, one bone tool, two textile implements, one sherd burnisher and one ornament. The burnt clay fragments appeared in a modest amount, like in BSPh VIIb, and mainly derived from buildings (Fig. III.42.22–24; Tab. III.3).

Overall, BPh VII yielded 212 small finds, i.e. 35% of the total Neolithic assemblage of finds, the largest quantity from any Neolithic building phase (Figs. III.29, III.32, III.34; Pl. III.2; Tabs. III.2a–2b.19–22, 24–25), but it should be taken into account that from BSPh VIb onwards, the excavation area acquired its largest extent of 5 × 7m (Figs. III.3–4). Most of the finds were found in the western half of the trench, but this difference might be partly due to the destruction of the deposits in the eastern half caused by the construction of the large Early Bronze Age pit mentioned above. The small finds included 124 flaked stone tools and debris, 26 macrolithic tools, two bone tools, four textile implements, 37 rounded sherds, two sling bullets, four sherd burnishers, three ornaments and nine figurines, all of them found in BSPh VIIa, likewise the house model. BPh VII also yielded the largest amount of burnt clay fragments (279 pieces/10644g) owing to the wide presence of fire destruction strata in all its subphases (Tab. III.3). They partly originated from building walls or roofs and partly from thermal structures (Figs. III.41.11–16, III.42.17–24; Tab. III.3). The flat decorated clay pieces that first appeared in BPh II were found in increasing numbers in this phase (31 pieces/4226g), but no information is given in the diaries regarding their accurate location (Fig. III.43c.17–21; Tab. III.3). One of them, made of highly burnt thick clay tempered with abundant chaff and vegetal material, was found in BSPh VIIa and had a relatively

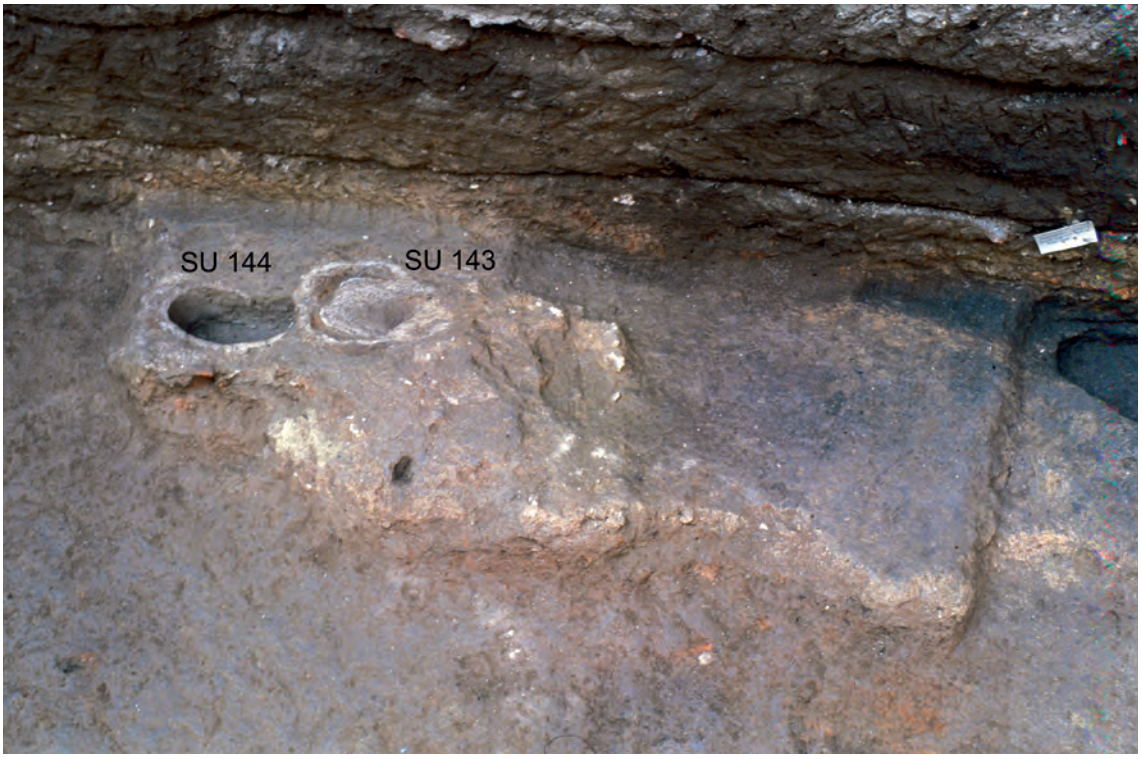



Fig. III.36 BSPh VIIc. Postholes (SU 143–144). View from the north (edited A. Buhlke)

smooth outer surface with a large handle on it and a less even underside, whilst a few smaller fragments might also belong to the same object (Fig. III.43c.19). Its function is not certain, but it is argued that it might have been connected with thermal structures.[125]

From BSPh VIIb and VIIc two radiocarbon dates on bones were obtained, MAMS-32120: 5583 ± 32 calBC (1σ) and MAMS-32119: 5502± 24 calBC (1σ). A third radiocarbon date on seed, MAMS-32121: 2487-2350 calBC (1σ), was an outlier and points to intrusions from Bronze Age layers.[126]

### III.3.8. Building Phase VIII

Depth: ~4.23 (west half) / 4.28/4.30 (east half) – 4.83 (west half) / 4.82m (east half); EU 258–261, 263–265, 278–279, 281–283, 285–287; SU 153–165, 183–184.

To this building phase were attributed ~0.65m-thick deposits. The archaeological evidence included Surface F20 (SU 159), two adjacent pits found in the southwestern part of the trench (SU 154–157) and a thermal structure near the middle (TS 18) (Figs. III.37–38; Pls. III.1, III.3; Tab. III.1).

In comparison to the preceding BPhs VI and VII the architecture was scarce and no burnt buildings were found apart from a restricted amount of burnt pieces of clay. Surface F20 had no discrete features regarding its construction and did not differ clearly from the remainder of the deposits over it (SU 160–164). The latter were mainly made of brown and brownish-grey soil and were largely homogeneous throughout the trench (SU 159–165). They yielded abundant pottery

[125] See discussion, 129.
[126] Weninger et al., this volume, 188.

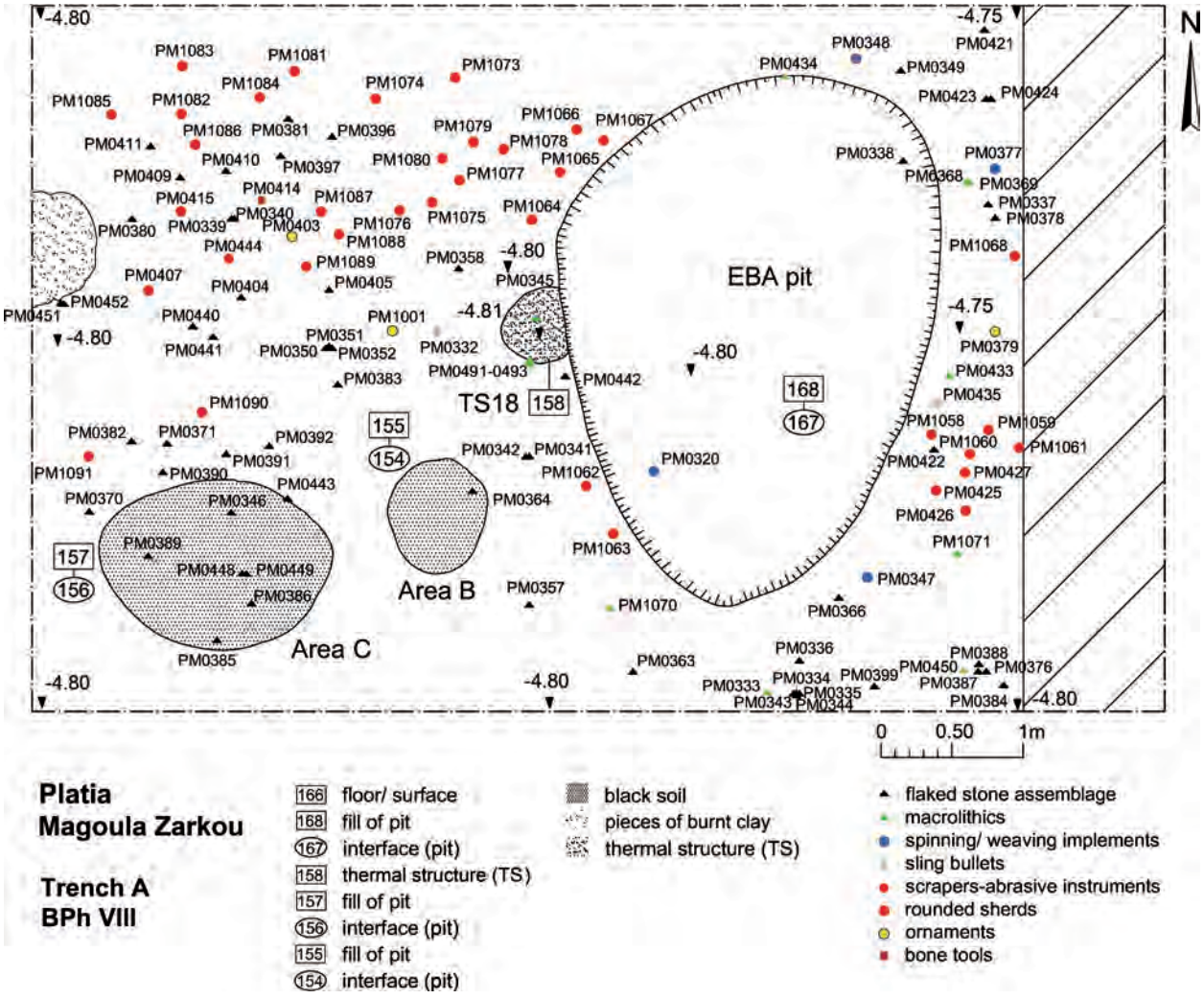



Fig. III.37 Plan of BPh VIII (edited by C. Batzelas, A. Buhlke)

and small finds, some animal bones, a very few burnt pieces of clay and a few carbonised seeds found near the middle of the trench.

The two pits were found in the southwestern part or the trench and proceeded further down to Surface F21 of the underlying BSPh VIIc. They were circular in shape with a diameter of 0.80m and 1.46m and their fill consisted of black burnt soil (SU 154–157) containing a few sherds and pieces of burnt clay and a few animal bones. The thermal structure TS 18 in the middle of the trench (SU 158) preserved a large part of its clay floor, having a diameter of 0.60m and a substructure made of clayey soil admixed with pebbles and small stones along with three broken grinding stones (SU 183) (Fig. III.37; Tab. III.4). Near the middle of the eastern side of the trench unburnt bones of a human skull were reported (SU 184), which, however, were not found during the processing of the excavation finds.[127]

This building phase yielded 116 small finds, constituting 19% of the total Neolithic assemblage and coming mainly from the western part of the trench, as also happened in the preceding phase (Fig. III.37; Pl. III.2; Tabs. III.2a–2b.23–25). They included 58 flaked stone tools and debris, twelve

[127] The available documentation in the archives was very poor on this issue. Consequently, a differentiation in burial practices comprising inhumations inside the settlement and cremation burials outside it in the cemetery is only speculative.

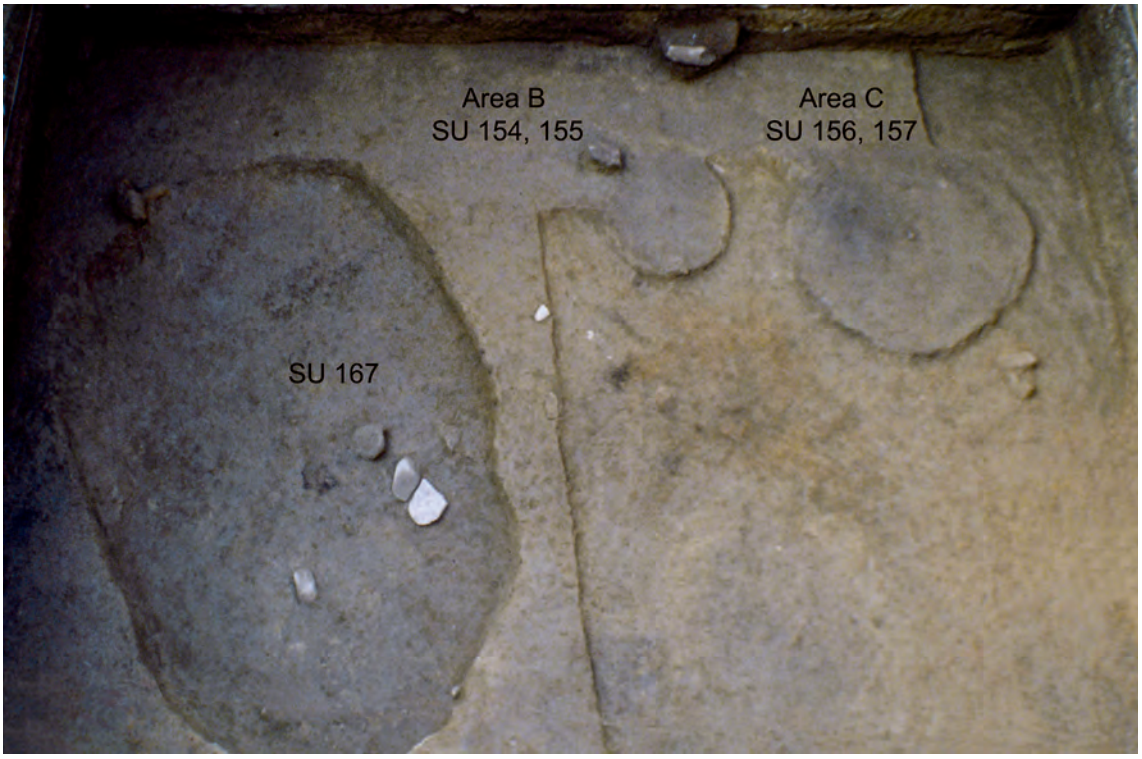



Fig. III.38 BPh VIII. View from the north (edited by A. Buhlke)

macrolithics, one bone tool and four clay textile implements, three ornaments, two clay sling bullets, one scraper and 35 rounded sherds, being almost equal in number as in the preceding building phase. Burnt clay pieces were found in a modest quantity (252 pieces/7963g) and originated from thermal structures and buildings (Fig. III.42.25–28; Tab. III.3), whilst a few flat clay fragments of the type having decorative patterns still continue to appear, albeit in a very restricted number.

In general, the presence of pits as well as the lack of obvious architecture throughout the trench indicated that Surface F20 probably corresponded to an unroofed area wherein some household activities took place, evidenced by the thermal structure TS 18. The largely homogeneous deposits of noticeable thickness overlying Surface F20 could have accumulated through the dumping of refuse and levelling works that took place as part of the wider arrangements in the organisation of the intra-settlement space in this area.

The radiocarbon date on a carbonised seed MAMS-32118: 2448–2234 calBC (1σ) was incompatible with the Neolithic period and, likewise MAMS 32121 of BSPh VIIa mentioned above, shows disturbances from Early Bronze Age layers.

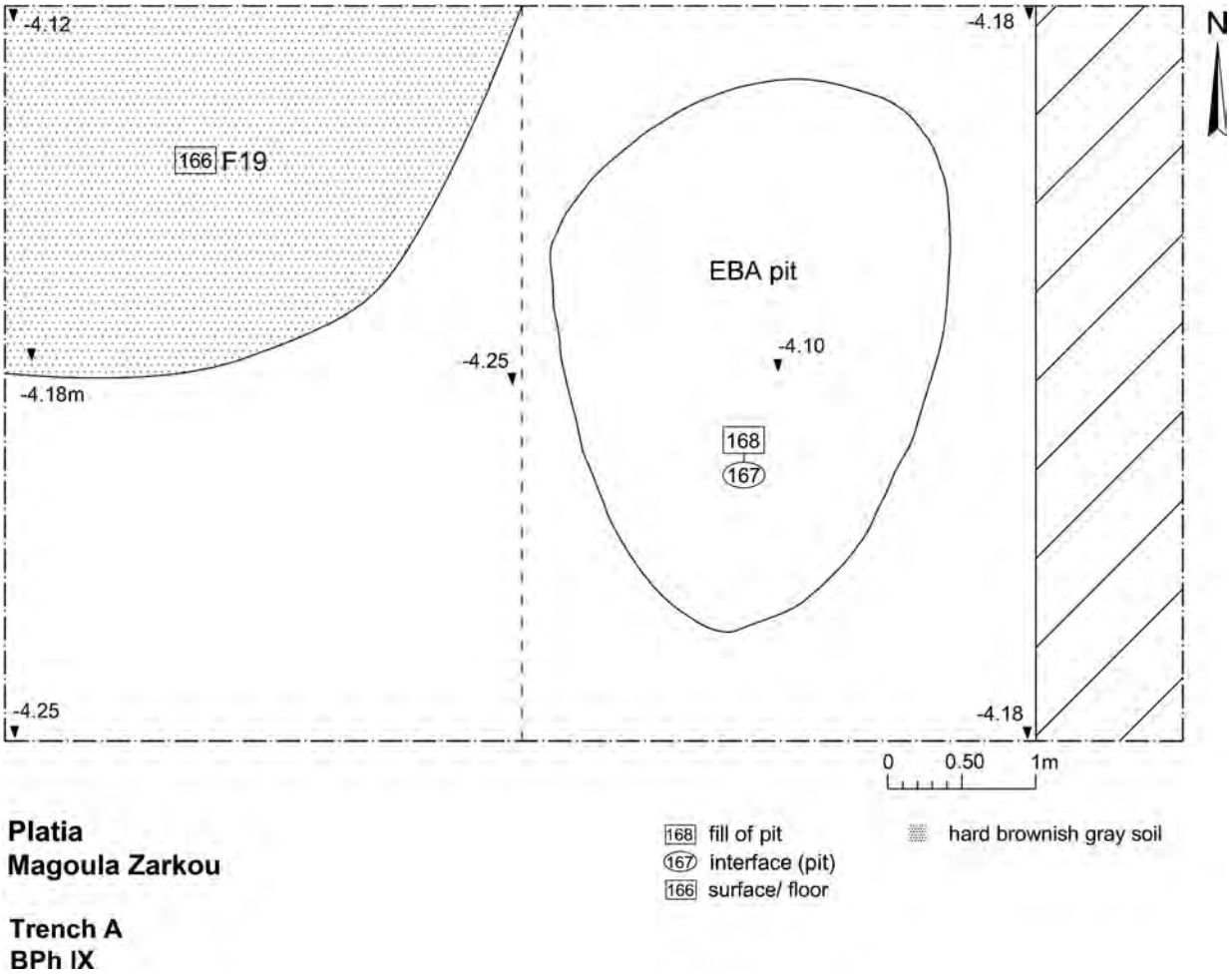



Fig. III.39 Plan of BPh IX (edited by C. Batzelas, A. Buhlke)

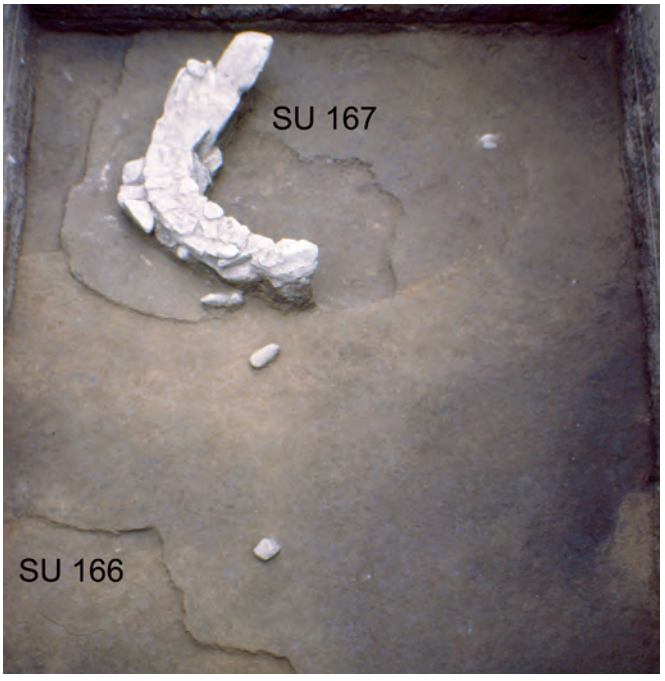



Fig. III.40 BPh IX. View from the west. The stone-built wall W31 and the pit SU 167 are from the Early Bronze Age (edited by A. Buhlke)

### III.3.9. Building Phase IX

Depth: ~4.18/4.25–4.22/4.25m; EU 292; SU 166.

Only Surface F19 (SU 166) at a depth of ~4.18/4.25m was attributed to this building phase (Figs. III.39–40; Pls. III.1, III.3; Tab. III.1). It was preserved only in places in the northwestern part of the trench and its features were far from clear.

It consisted of hard brownish-grey soil, occasionally containing pebbles up to 0.05m in size. No small finds were encountered in this phase apart from nine pieces of burnt clay and three flat pieces of clay with decorative patterns.

According to the available data, the layers overlying this building phase are dated to the Early Bronze Age, but no study of the findings of this period has been carried out so far. The excavator, Kostas Gallis, has referred to a layer approx. 0.20m thick that followed the Neolithic occupation, which yielded only a few finds and probably corresponded to an abandonment layer between the two periods.[128] Although the available evidence is not sufficient to allow a discussion on the transition between two such remote periods, some preliminary observations indicate that levelling works and similar works were also carried out when the occupation resumed at this settlement in the Early Bronze Age.

## III.4. Discussion

The restricted excavation surface and stratigraphic orientation of the overall research in the PMZ settlement has inevitably imposed significant constraints in attempting a reconstruction of the habitation activity of the settlement. We should always bear in mind that we were able to see only a very small portion of the whole.

### III.4.1. The Ditch

As was mentioned above, the shallow ditch was the only architectural evidence preserved in the initial BPh I. The ditch was filled in a short time due to its shallow depth and was sealed by a thin layer of yellowish sand apparently accumulated through natural processes. Due to the limited part unearthed, it was not possible to ascertain whether the ditch was constructed as a continuous line and not by connecting and unifying adjacent pits in a chain-like order, a construction manner not observed so far in Thessaly[129] nor whether there was a dump, wall or wooden palisade along its banks. However, such types of constructions are known from certain sites in Thessaly as in Early/Middle Neolithic Makrychori 1,[130] Late Neolithic Mandra II,[131] Late and Final Neolithic Otzaki[132] and Middle Neolithic Myrine-Ag. Varvara,[133] as well as in settlements in northern Greece.[134] Ditches or other types of enclosures constitute a significant component in a settlement's organisation, defining its external boundaries or dividing its intra-settlement space. They had a wide spatial and temporal distribution throughout the Neolithic period and appeared in Thessaly already in the Early Neolithic in Larissa (Neraida),[135] Souphli Magoula[136] and in Makrychori 1 in the Early/Middle Neolithic.[137] Ditches in particular could combine a wide spectrum of functions, besides

[128] Gallis 1989, 201.
[129] Toufexis 2017, 313; Pappa 2020, 105–108, 126–128, 144–145.
[130] Toufexis 2017, 177–178, 317.
[131] Toufexis 2017, 99–100, 104.
[132] Milojčić 1983a, 12, 22–23, 28–29, 32–35.
[133] Krahtopoulou 2019b, 720–721.
[134] See briefly Toufexis 2017, 311–312.
[135] Anetakis 2020, 1435; Alexiou et al. in press.
[136] Gallis 1982, 47.
[137] Toufexis 2017, 168–171, 177–178.

ensuring the physical and symbolic protection of settlements also being used as drainage or irrigation canals or providing clay for the construction of buildings or space for burials etc.[138] Among their various potential functions, drainage played a major role when it comes to settlements located in floodplain environments like many settlements in Thessaly and certainly PMZ. However, in PMZ it was not certain whether the ditch constituted the external boundary of the initial settlement or divided its intra-settlement space.[139] In the former case the settlement should have been slightly offset towards the west in comparison to the subsequent building phases which overlaid the ditch and also extended to the east, in compliance with the form of the developed tell. On the other hand, geophysical inspection indicates that other Neolithic ditches also existed around the tell, but it is difficult to ascertain whether they are contemporaneous to the ditch found in the trench in BPh I.[140]

### III.4.2. Building Remains

The building practices analysed above showed differentiation and variability also observed in other Middle Neolithic tells in Thessaly, among which Achilleion is a good example,[141] although to what extent this occurred in every building phase is hard to estimate based on the available evidence. The most obvious changes were encountered in Middle Neolithic I, where the houses of BSPh IIIa and BPh IV were built with different building techniques. In BSPh IIIa the wall was built with posts and a large amount of thick and solid clay, probably in a combined *pisé* and timber technique[142] rather that with mudbricks[143] nor according to the wattle and daub building method[144] for which the amount of clay found might seem rather superfluous. It is doubtful, however, whether real *pisé* technique ever existed in the Neolithic period or if the so called *pisé* walls were built with packed lumps of clay[145] (see below). By contrast, the houses of the subsequent BPh IV were built with the 'stone and mud/mudbrick' technique,[146] which is generally considered more characteristic for Thessaly.[147] The stone socles of the walls were of the 'simplest' type, comprising only a single row of medium-sized field stones laid on the ground and bonded with clay mortar. Although in some preliminary reports and also in excavation archives the house walls were referred to as being built with mudbricks,[148] a *pisé* superstructure should not entirely be ruled out, despite the uncertainty

138 Chondrogianni-Metoki 2009, 526–537; Toufexis 2017, 319–332; Pappa 2020, 267–269; Souvatzi, this volume, 594–596.

139 See also Souvatzi, this volume, 593.

140 Sarris et al., this volume, 68–80; Souvatzi, this volume, 594.

141 Winn – Shimabuku 1989a.

142 Kloukinas 2017, 175.

143 However, walls built with mudbricks and posts are also known as in Nea Makri in the Middle Neolithic (Pantelidou-Gofa 1991, 162–164; see also Elia 1982, 260; Treuil 1983, 253; Gallis 1996a, 64), but it was suggested that in such walls the vertical posts were normally not necessary, see Perlès 2001, 188.

144 Gallis 1995, 213. Post-built houses with wattle and daub frames are widely spread in Thessaly anyway and many examples are reported, mainly from Early and Middle Neolithic/early Late Neolithic settlements, particularly in western Thessaly. They are reported from Kephalovryso (Chourmouziadis 1969, 300), Sykeon (Chatziaggelakis 2012a, 75), Prodromos 2 (Chourmouziadis 1971, 174; Chourmouziadis 1977, 394), probably Prodromos 3 (Karagiannopoulos 2016, 391–392), Agiopigi (Chatziaggelakis 2011a, 568), Artesiano (Gallis 1979b, 568), Makrychori [Karditsa] (Gallis 1979b, 568–569), Zaimi (Chatziaggelakis 1998, 243–244), Astritsa (Chatziaggelakis 2011b, 568), Magoulitsa (Papadopoulou 1958, 40), Orgozinos (Nikolaou et al. 2008, 388), Achilleion (Winn – Shimabuku 1989a, 36–40, 46, 50–53, 66–68), Magoula Belitsi (Vouzaxakis 2007, 85–88), Kamara (Rondiri 2009, 67), Pournarolakka (Kalogianni et al. 2007, 63), Pyrasos (Theocharis 1959, 38), Makrychori 1 [Larissa] (Toufexis 2017, 140–142, 144–145), Souphli (Gallis 1982, 47) or from more regional sites like Votanikos Kipos on Lake Plastiras (Kyparissi-Apostolika et al. 2012, 98; Apostolikas 2013, 188, 231–232).

145 Treuil 1983, 260–261; Perlès 2001, 190.

146 Kloukinas 2017, 174.

147 Elia 1982, 362, 365; Gallis 1996a, 64; Kloukinas 2017, 174. It has been suggested that the prevalence of the mudbrick technique in Thessaly marks a local development from the wattle and daub and then *pisé* building methods (Elia 1982, 365) but, based on the existing evidence, this does not entirely hold true.

148 Gallis 1995, 213.

concerning its identification mentioned above.[149] Besides, walls built with *pisé* and timber are reported in Early Neolithic Sesklo[150] and the *pisé* technique is also mentioned in the construction of partition walls in Early Neolithic Prodromos 2,[151] in Middle Neolithic Makrychori 1[152] and in Imvrou Pigadi,[153] while in Early and Middle Neolithic Achilleion the *pisé* walls also had stone foundations.[154] Similarly, mudbrick walls, usually having stone foundations, became customary throughout Thessaly in the Middle and Late Neolithic.[155] They are known already in the Early Neolithic in Sesklo,[156] Magoulitsa[157] and Otzaki but without a stone socle.[158] In the Middle Neolithic, mudbrick walls with or without stone foundations are known[159] in Sesklo,[160] Thermokipia,[161] Omvria – where they were accompanied by foundation trenches –,[162] Zerelia,[163] Tsangli,[164] Magoula Imvrou Pigadi,[165] Magoula Koutroulou,[166] Sykeon,[167] Otzaki[168] – where they continued to be built without stone foundations – and Makrychori 1.[169] The stone foundations differ regarding their construction, height and whether or not they were associated with foundation trenches.[170]

In MN II, BPh V produced very poor architecture despite having thicker deposits than any other Neolithic phase and its excavation surface being almost twice as large as before. The scarce postholes in BSPh Va, Vc and Vd did not point to any compelling house plan, nor were there any reliable indications for the presence of indoor floors. This seems to hold true also for BSPh Vb and Ve, where no postholes were reported, indicating that either the buildings were entirely destroyed and left no vestiges behind or, most probably, the 'surfaces' in these phases corresponded to open/semi-open areas or yards. The few and scarce postholes found in BSPh Va, Vc and Vd could be attributed to light wooden structures like fences, pavilions etc. that existed in yards or semi-open areas near houses. Some examples could be called on from Sesklo (*acropolis*), where House 11–12 (11A) seemed to have a light portico with posts along its western side open to a small yard,[171] and from Magoula Koutroulou, where some postholes were associated with a paved and partly roofed yard surrounded by houses.[172]

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149 If the *pisé* technique entailed the use of packed clay lumps, as was suggested (Perlès 2001, 190), it might be of some relevance to mention here that in the modern village of Nesson situated in the basin of Sykourion in eastern Thessaly some old buildings with walls that were built with large lumps of clay resembling very large and shapeless mudbricks set in roughly horizontal lines and stone socles are still standing (Skafida 1994, 183, fig. 7). The abundant clay originated from the rich clayey sediments of the nearby small lake that existed until recently in the basin: Reingruber et al. in press.

150 Andreou et al. 2001, 262; Souvatzi 2008, 79.

151 Chourmouziadis 1977, 394.

152 Toufexis 2017, 158, 192.

153 Kyparissi-Apostolika 2009, 843; Kyparissi-Apostolika 2012, 434.

154 Winn – Shimabuku 1989a, 34, 60, 66, 68.

155 Elia 1982, 362, 365; Treuil 1983, 261–268; Gallis 1996a, 64.

156 Andreou et al. 2001, 262; Souvatzi 2008, 78.

157 Papadopoulou 1958, 40.

158 Elia 1982, 162, 167; Treuil 1983, 264; Gallis 1996a, 63.

159 Only sites are mentioned in which mudbrick walls are clearly reported by their excavators. Therefore, their number is only indicative since this building technique was evidently practised in other sites too.

160 Andreou et al. 2001, 263; Souvatzi 2008, 81.

161 Adrymi-Sismani 2013a, 494; Adrymi-Sismani 2013b, 51–62.

162 Almatzi 2012, 129.

163 Wace – Thompson 1912, 161.

164 Wace – Thompson 1912, 115.

165 Kyparissi-Apostolika 2009, 840.

166 Hamilakis et al. 2017, 84.

167 Chatziaggelakis 2012a, 75.

168 Milojčić 1983b.

169 Toufexis 2017, 164–165.

170 Elia 1982, 259.

171 Theocharis 1980, 12; Souvatzi 2008, 85.

172 Hamilakis et al. 2017, 85.

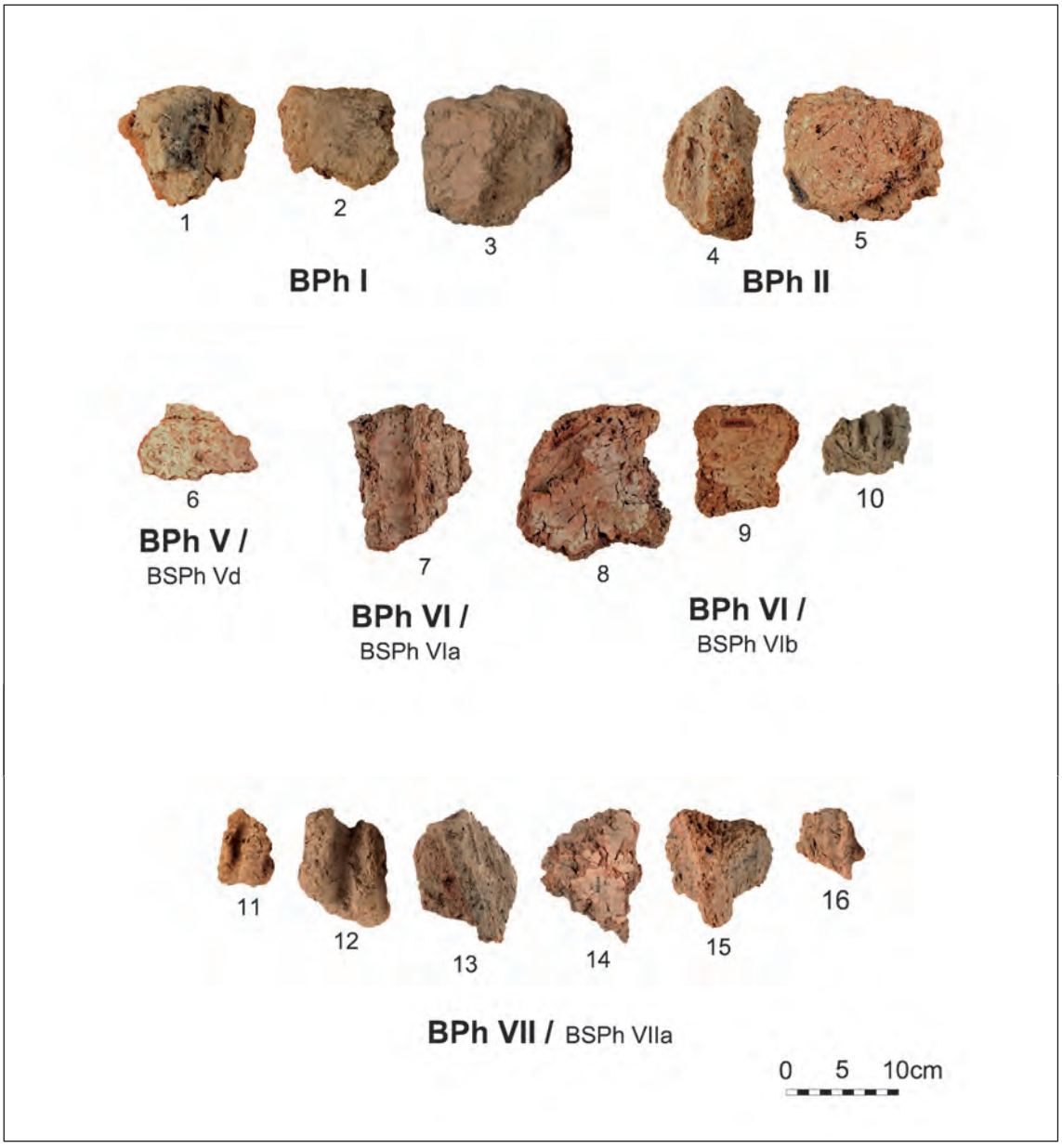


Fig. III.41 Burnt pieces of clay (photos: G. Dallas)

In MN III the walls W32–33 in BPh VI were tentatively restored as being built with the wattle and daub technique, while the walls W34–35 were thin, low clay walls, probably with a light wattle and daub superstructure too. A certain amount of burnt clay bearing impressions of beams, reeds or branches may have originated from these walls or even the roofs of the buildings they belonged to. However, they were all too thin to be considered as external walls of a house, nor was there any evidence that they belonged to an interior room of a house since the area outside them to the south and east was devoid of coherent building remains. It was thus suggested that they might have belonged to small auxiliary buildings associated with and/or annexed to houses which might even have been built differently.[173] However, the meticulously made postholes found

[173] It is worth mentioning here that in Middle Neolithic Otzaki two coeval buildings but with different uses were built with entirely different techniques: a post-built building stood next to a mudbrick house: Milojčić 1983b, 8.

near the potential auxiliary buildings in BPh VI together with relevant evidence from BSPh VIIc shows that post-built houses constituted a rather common type in MN III and LN I and probably in MN II, as also in a large number of sites of this period mentioned above.

Overall, the burnt clay fragments originated from buildings and structures and were found throughout all the building phases, being more abundant in BPh VI and VII where the burnt buildings were encountered (Fig. III.41, III.42, III.43a–c; Tab. III.3). Nevertheless, the totality of these clay fragments weighs only 59.624kg, a certainly restricted assemblage considering the overall Neolithic deposits and the fact that a considerable part of them – c. 14.200kg, i.e. 24% of the total amount – originated from thermal structures or their equipment.

There is a certain amount of burnt pieces of clay, generally of small size, preserving impressions of timber such as slender posts, branches or reeds, whereas there are also pieces which might even point to the use of planks or plank-shaped timber. They were made of porous and gritty clay tempered with abundant straw, chaff and other vegetal material and were well burnt, acquiring a brown to orange-reddish colour.

Based on the evidence, they could originate from post-built walls or roofs of buildings, while some thin pieces up to ~0.03m thick, one side of which is more or less smooth while the other bears impressions of thin branches or reeds, probably plastered walls built with the wattle and daub technique. There were also some slender pieces made of similar clay, albeit less tempered, without bearing impressions of timber in which one side is relatively smooth while the other is rough, for which it cannot be said with certainty whether they were wall plasters or originated from domed ovens. Their surfaces varied from light beige or yellowish to grey, red and dark reddish-brown (10YR 6/3, 7/4, 7/2, 2.5Y 6/2).

Floors in roofed areas were made of compact clay (BPh IV and VI) but there were also indoor and probably outdoor clay floors admixed with sparse small pebbles (BSPh VIIb–c and BPh VIII). Indications for recycling building materials were very restricted. The few burnt pieces of clay found built in the foundation of wall W37 in BSPh IVb did not point to a systematic reuse of burnt pieces of clay in wall construction. It is worth mentioning here that house conflagrations could provide recycling building material for the new houses,[174] but this practice was not developed in PMZ, nor apparently in other Neolithic settlements of Thessaly.[175] On the other hand, stones might have been reused and it was argued that the stones from the foundation of wall W38 in BSPh IVa were probably reused for the construction of the foundation of wall W37 of the overlying BSPh IVb. As elsewhere, small-scale recycling of other materials, e.g. sherds or broken macrolithic tools, was also attested in the construction of floor substructures of thermal structures and occasionally in postholes in BSPh IIIa and c.

### III.4.3. Thermal Structures

Overall 20 thermal structures were found,[176] a considerable number indeed if one considers the restricted excavation surface in the site. For many of them there was insufficient documentation and their restoration was based exclusively on short descriptions or rough sketches that appeared in the diaries. Consequently, for certain structures, their identification as hearths or ovens should be considered speculative. In general, all thermal structures were of types known in Neolithic Greece,[177] and, taking all reservations into account, could correspond to nine hearths (TS 18, 19, 20, 21, 27, 29, 30, 31, 36), eight ovens (TS 22a, 22, 23, 25, 26, 28b, 28, 33) and two fire pits

[174] Shaffer 1993, 73.

[175] It was, however, evidenced in Middle Neolithic Makrychori 1, where burnt clay pieces from destroyed thermal structures and probably walls were used for the construction of a wall foundation: Toufexis 2017, 165.

[176] In the excavation diaries three more potential thermal structures were reported. According to the analysis undertaken though, it seems that that two of them probably corresponded to postholes and one merely constituted a layer of clay. Also, thermal structure TS 36 was identified afterwards, during the processing of the diaries.

[177] Prévost-Dermarkar 2002; Kalogiropoulou 2013, 76–79. See also Treuil 1983, 330–335.

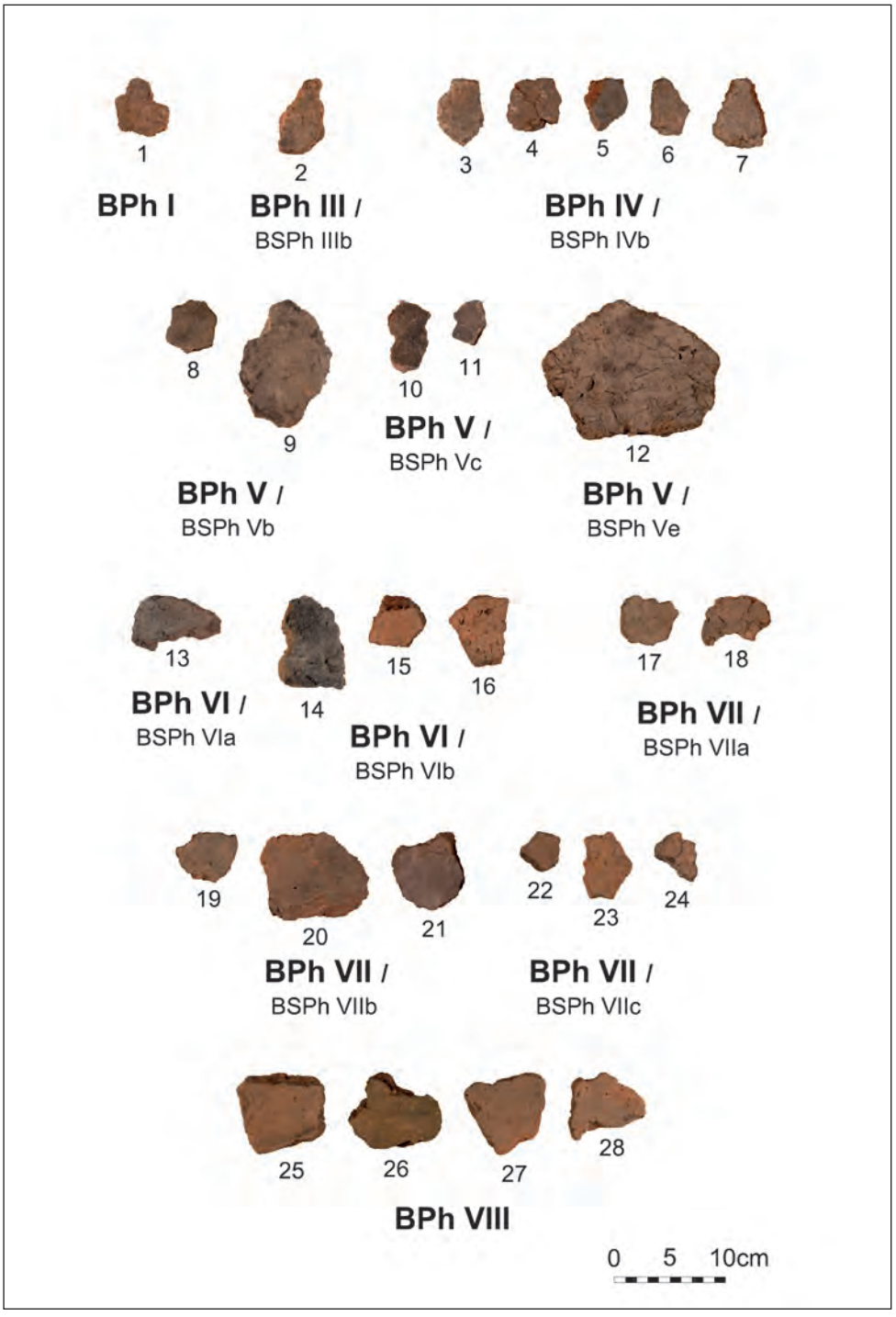


Fig. III.42 Pieces of clay floors from thermal structures (photos: G. Dallas)

(TS 32a, 32) whilst one remained unspecified (TS 28a) (Tab. III.4). They appear interspersed in BPh IV–VIII as follows: one in IV, twelve in V, three in VI, three in VII and one in VIII. The absence of thermal structures in BPh I–III should be attributed to the restricted excavation surface of the trench, since throughout the trench scattered burnt pieces of clay from the walls and floors of thermal structures were found.

The hearths had a plastered clay floor (Fig. III.42) on a substructure made of clay admixed with pebbles (TS 19, 20, 25, 26) or only a layer of pebbles.

Hearths TS 29–31 were reported as having consisted of only a clay layer with pebbles and a few sherds and unless their floors were entirely destroyed they could be considered as hearths without identifiable clay floor. The rectangular hearths TS 19 and 20 in BSPh VIIa and VIIb differed regarding their form and meticulous construction not encountered in other building phases.

Ovens only seldom preserved the lowest parts of their walls around the floor (TS 33, TS 25). In BSPh Ve the oven TS 23 had a clay platform, probably at the front, while in the oven represented in the house model of the site a narrow platform protrudes slightly in front of its opening. More or less similar ovens are known from Early and Middle Neolithic Achilleion (phases IIa and IIIb, IVa middle, respectively).[178] In particular, the oven from Middle Neolithic phase IVa middle of that site had a clay platform in front like the oven TS 23 in PMZ, but in the former the platform was round and larger and not rectangular as in the oven of the PMZ model.

On the other hand, the use of fire pits was restricted since only two were found. In the fire pit of BSPh Va three potential successive fire episodes were discerned (TS 32, 32a–b) but otherwise the dimensions and the shape of the pit are not reported in the diaries.

Thermal structures were found inside both houses and potential auxiliary buildings connected to them (BSPh IVa, VIa and VIIa–b) and in open/semi-open areas or yards where there was no compelling evidence of roofed architecture. In BSPh IVa the placement of oven TS 33 close to a wall inside the house recalls the location of the oven in the house model of the site and if a restoration could be made based on the house model, the wall behind oven TS 33 could correspond to the rear wall of the house opposite the entrance.

Building phase V yielded the majority of thermal structures (12 out of the overall 20 Neolithic thermal structures of the settlement) forming small clusters of two in BSPh Vb and Vd (TS 30–31 and TS 25–26, respectively). The large number of thermal structures in this phase supports the interpretation given to its 'surfaces' as being associated with open/semi-open areas or yards where thermal structures are commonly found in Thessaly and elsewhere.[179] In Early and Middle Neolithic Sesklo open spaces were used for food preparation,[180] in Early and Middle Neolithic Achilleion (phases IIa–b, IIIb early and late, IVa early and middle) thermal structures were found inside houses but mainly in courtyards whilst in the same site some structures in phases IIb, IIIb early and IIIb late could have been used communally.[181] In Middle Neolithic/early Late Neolithic Makrychori 1 all but one thermal structure were seemingly located in open spaces,[182] and like Achilleion, some of them could have been available for use by several households.

Some thermal structures were rebuilt vertically, one on top of the other (TS 22–22a, 28a–28b), or in adjacent locations in successive building phases (Vb–c, Vd–e, VIIa–b) or their floors have been renewed, (TS 25 and 26) implying an effort for stability and continuity in the use of intra-settlement space.

The overall thermal structures in PMZ seemed to have been used primarily for cooking inside and outside houses, encouraging sharing among households and the esteem of social cohesion and communality in social life.[183] On the other hand, no contextual evidence existed of ovens being used as pottery kilns. The latter have, however, recently been found in Middle Neolithic Magoula Koutroulou[184] and Magoula Rizava in the Western Thessalian Plain.[185] Both these sites were considered as regional pottery production centres and the kilns under discussion were found in clusters between clay walls and shared morphological features. Some of the kilns of these sites, like oven O1 in Magoula Rizava, could be compared regarding their form to the oven in the PMZ house model.

178 Winn – Shimabuku 1989a, 37, 40, 47–49, 61–62.
179 Kalogiropoulou 2012, 365–369; Kalogiropoulou 2013.
180 Theocharis 1980; Kotsakis 1996, 49; Souvatzi 2008, 85.
181 Winn – Shimabuku 1989a, 40, 46, 51.
182 Toufexis 2017, 276.
183 Kalogiropoulou 2012, 369.
184 Kyparissi-Apostolika 2012.
185 Krahtopoulou et al. 2018.

### III.4.4. Burnt Pieces of Clay with Decorative Elements

As is mentioned above, a group of burnt pieces of clay was very distinctive as they bear decorative elements on one side (Fig. III.43a–c). They have the form of almost flat and thin plaques, one side of which is even and smooth and bears decorative elements, while the other is rough but flattened. Although fragmentarily preserved, some of them seem to be discoid in shape with a diameter of 0.22–0.38m, getting thinner towards their ends, where plain or oblique rims are

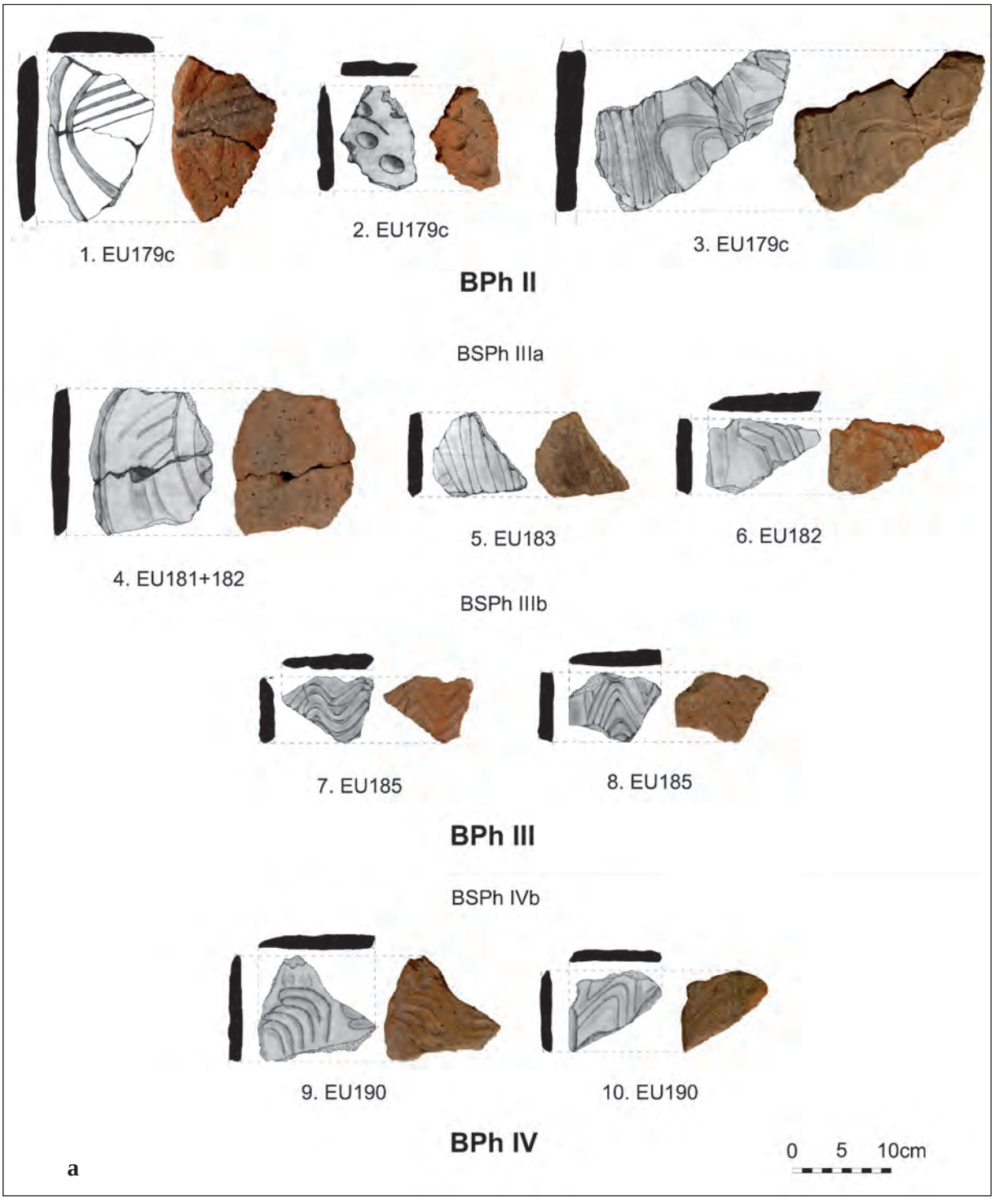


Fig. III.43a Burnt pieces of clay with decorative elements (drawings: C. Batzelas, photos: G. Dallas)

formed, while sometimes their ends are hardly terminated in rudimentary rims. Usually, they were 0.01–0.025m thick and tempered with chaff and vegetal material and well fired, acquiring a light brown/brown-reddish-colour (10YR 7/2, 7/3, 5YR 5/8, 7.5YR 7/4, 6/6, 7/6) while sometimes they were, in places, slightly smoked.

The decoration consists of shallow grooves, some of which were apparently finger-made, or less often of oval impressions or broad incisions. The grooves are usually arranged in bundles forming wavy or concentric patterns, sometimes around the rim, or curvilinear and angular or less clearly defined patterns. These pieces were omnipresent in every building phase except BPh VIII where their number decreases considerably. There was no evidence to clarify whether they were associated with any particular structure, as they were found just scattered in the layers.

A particular piece found in BSPh VIIa differed from the others in that it was made of thicker and more tempered clay with chaff and vegetal material and had a large handle on one side where part of a groove of the type mentioned above was also preserved (Fig. III.43c.19). Its

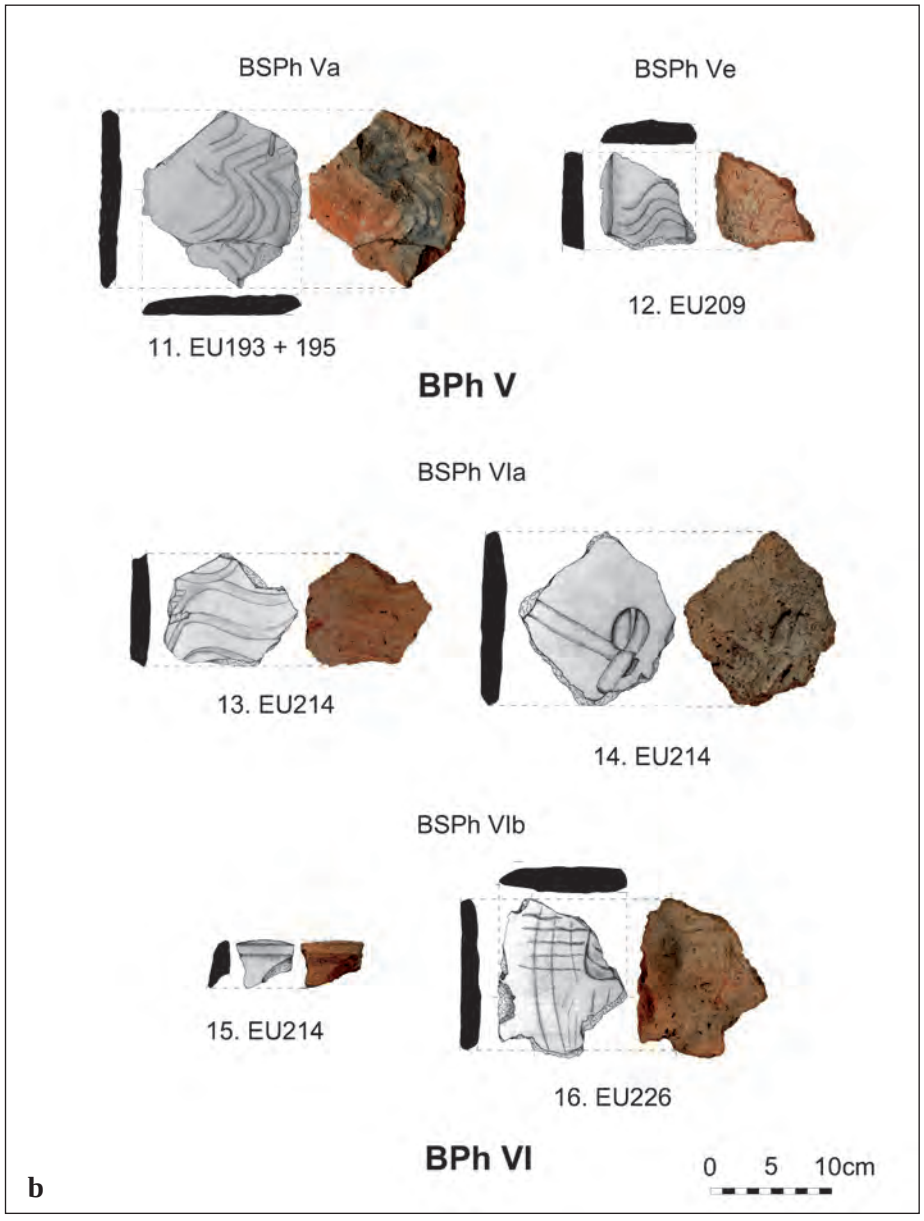


Fig. III.43b Burnt pieces of clay with decorative elements (drawings: C. Batzelas, photos: G. Dallas)

initial shape and the dimensions of the type of vessel this piece belonged to are not known nor is the way it was used. All reservations considered, the durable construction of this piece of clay together with the high firing and presence of the handle might suggest that it probably served as a lid in thermal structures, a hypothesis that needs to be tested further. On the other hand, it is not certain whether the other decorated pieces of clay mentioned above could constitute wall or structure plasters not unknown in Neolithic houses, or could have been used as lids or belonged to other types of vessels.[186] In any case, the appearance of pieces of clay of this type in almost all the Neolithic layers reflects a sense of continuity and bonding with traditional techniques and styles.

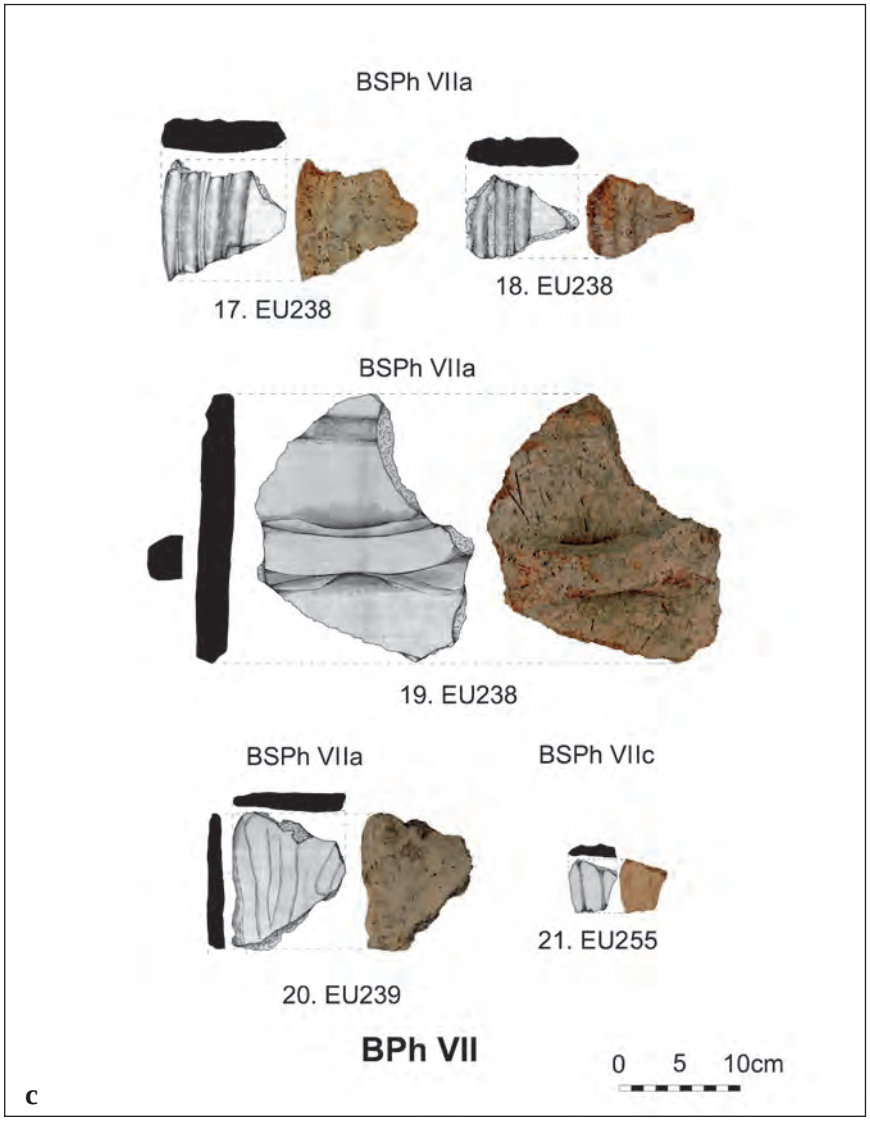


Fig. III.43c Burnt pieces of clay with decorative elements and a large handle of vessel (no. 19) (drawings: C. Batzelas, photos: G. Dallas)

[186] Stratouli 2004, 11–12; Kyparissi-Apostolika 2009, 841; Aslanis 2010, 41; Ziota 2014, 323; Toufexis in press. We thank Georgia Stratouli, Christina Ziota and Dimitris Kloukinas for sharing with us their opinion on the decorated pieces of clay discussed in this chapter.

### III.4.5. Tell Formation and Use of Domestic Space

*Levelling Activities*

Apart from the initial and early building phases I–IVa, whose layers displayed a gentle west-east inclination,[187] the remaining layers intervening between the 'surfaces' were noticeably horizontal and generally thin, with the exception of the ~0.60m-thick deposits in BPh VIII, where only one 'surface' was observed. On the other hand, the accumulations of burnt pieces of clay found over burnt buildings were limited and this, in turn, indicates that levelling works were systematically carried out in the settlement in order to provide adequate space for the new buildings or yards, taking into account the lack of unrestricted space the tell type settlements were facing.

*Open and Roofed Spaces*

As far as one can proceed to some generalisations based on the restricted data of Trench A, it seems that management of the domestic space in PMZ was characterised both by variability and differentiation as well as stability and continuity, as shown by the alternation of built and open/semi-open areas observed in certain building phases and by the tendency for maintaining similar uses of space in some others. In BSPh IIIb a seemingly open-air area, in which open fires were repeatedly set, appeared in a location previously occupied by a house in BSPh IIIa. Similarly, the house of BSPh IVa was erected in an area hardly occupied by a building in the underlying BSPh IIIc, whilst in BPh V it seemed that open or semi-open-air areas or yards existed in an area occupied by houses in both the underlying and overlying phases. Their noticeable continuation throughout the BSPh Va–e indicates stability and duration in the use of space. Besides, the largely homogeneous BPh VIII, in which no buildings were found, succeeded the burnt buildings of BPh VII and probably indicated major changes in the organisation of the domestic space, at least in some parts of the settlement. Analogous examples are also encountered in other Neolithic tells in Thessaly. In Early and Middle Neolithic Achilleion (phases IIa, b and IIIa, b, IVa–late, respectively) yards or large unbuilt areas appeared in areas previously occupied by buildings.[188] The shifting of houses to nearby locations might have been necessitated by a number of reasons such as the natural decay of houses or accumulation of refuse inside or around houses, and ethnographically it is often connected with post-built houses.[189] In Middle Neolithic Sesklo, open or semi-open areas or more 'private' yards expanded the domestic space of houses or were associated with community spaces/'squares' between clusters of houses.[190] In early Late Neolithic Makrychori 1, open areas or yards were common in the 'habitation periphery' of the tell.[191] They also existed in Middle Neolithic Magoula Koutroulou,[192] whilst in the Middle Neolithic Thermokipia, Building A was connected with a large yard confined by a stone enclosure.[193] However, it should be taken into account that the density of occupation in tells can be low,[194] as this is further indicated by the results of the large-scale geophysical survey carried out by the Institute of Mediterranean Studies and the Greek Archaeological Service in several Neolithic tells in the southern part of the Eastern Thessalian Plain and Almyros Basin. Although the relevant results should be treated with caution due to the multiple phases represented in some tells, a picture is emerging indicating that open

[187] According to van Andel et al. 1995, 134, this inclination indicates that the settlement was founded either on the slope of a terrain rise or on the bank of a gully running east of the site.
[188] Winn – Shimabuku 1989a, 66–68.
[189] Winn – Shimabuku 1989a, 37, 46, 57.
[190] Theocharis 1973, 68; Theocharis 1980; Kotsakis 1999, 70; Kotsakis 2006, 213; Souvatzi 2008, 81, 85, 95.
[191] Toufexis 2017, 192–193.
[192] Hamilakis et al. 2017, 85.
[193] Adrymi-Sismani 2013b, 51–55; Adrymi-Sismani 2014, 674–675.
[194] Kotsakis 1999, 71; Souvatzi 2020, 127–128.

areas surrounded individual houses or clusters of houses[195] and that they played a major role in structuring the domestic space.[196]

On the other hand, the vertical rebuilding of houses observed in BPh IV and VI of PMZ testifies to continuity in the use of the domestic phase, a fundamental characteristic of the tell settlements together with their long-term occupation and the abundant use of clay for the construction of houses.[197] In the Middle Neolithic in Thessaly this has been best exemplified in Sesklo (*acropolis*),[198] Tsangli,[199] Koutroulou Magoula[200] and Otzaki, where the superimposed houses were associated with claims of private property.[201] This practice also facilitated the foundation of the new houses over the stable rubble of the older ones[202] and contributed to the regulation of vital open space between buildings.

BPh VI and VII were distinctive in that their buildings were burnt, contrary to BPh III and IV whose houses seemed hardly affected by fire, if at all. Burnt houses are often considered the result of intentional conflagrations, *domithanasia* in Tringham's words,[203] appearing in Anatolia and southeast Europe by the middle of the 7th millennium BC.[204] They might have signified in a ritual manner the end of the life cycle of houses and ensured continuity in habitation, preservation of social memory and links with the ancestors. At the same time, they facilitated the rapid building up of tells through the accumulation of the rubble of burnt houses,[205] whereas it has also been suggested that they might even be related to the death of a household's head or the community's leader.[206] Regarding PMZ, the deposition of the house model in the burnt rubble of a house in BSPh VIIa might equally be related to at least some of the symbolic aspects mentioned above.[207]

With the exception of certain 'closed units' comprising roofed 'surfaces' and the layers corresponding to their interiors, the origin of the intervening layers between 'surfaces' which is considered to correspond to open/semi-open areas or yards, was less certain. It seems that these layers originated from a variety of activities such as food preparation and cooking, setting open fires, refuse dumping and levelling works affecting wider areas around the buildings. It is indicative that only in the 'closed units' of BSPh IVa and VIIc was there enough evidence that the flaked stone tools were probably found in situ, while in the remainder of the site tools of this kind were considered as being redeposited.[208] Besides, only 19 out of 133 macrolithics were found on floor surfaces in BSPh Vc, Vd, VIb, VIIb and VIIc, although it is impossible to tell whether they were actually used in these spaces.[209]

It has been suggested above that in BPh VI of PMZ external 'auxiliary' buildings associated with or annexed to houses appeared, which served, among other things, for cooking (BSPh VIa) or probably storage (BSPh VIb). Indeed, such buildings are also reported from other Neolithic sites in Thessaly. In Middle Neolithic Otzaki a building considered to be a stable stood next to a house.[210] In Sesklo (*polis*) the houses were associated with secondary auxiliary buildings, the 'outhouses',[211] whereas evidence for such buildings was also reported from the Middle Neolithic settlement in Kazanaki near Volos.[212]

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195 Sarris et al. 2017b.
196 Souvatzi 2020, 130.
197 Kotsakis 1999, 68.
198 Theocharis 1973, 65, 66–67; Kotsakis 1994, 126; Kotsakis 1999, 70; Kotsakis 2006, 209, 218.
199 Wace – Thompson 1912, 115–121.
200 Hamilakis et al. 2017, 81.
201 Milojčić 1960, 12; Gallis 1996a, 63; Souvatzi 2020, 131.
202 Kotsakis 2011, 4.
203 Tringham 2005, 106–108; Tringham 2013, 99.
204 Tringham 2013; Brami 2014, 163–166.
205 Stevanović 1997, 387–388; Kotsakis 1999, 209–210; Tringham 2005, 104–108; Gheorghiu 2008; Kotsakis 2011, 4; Tringham 2013; contra Lichter 2016.
206 Chapman 1999, 123.
207 Gallis 1985b; Alram-Stern, this volume, 469–470, 474–481.
208 Perlès – Papagiannaki, this volume, 223, 247.
209 Stroulia, this volume, 343–344.
210 Milojčić 1960, 12.
211 Theocharis 1973, 65; Theocharis 1980; Kotsakis 2006, 213.
212 Alexandrou 2014, 551.

Tells are considered typical for Thessaly, whilst other habitation types like tells with a 'habitation periphery' and flat sites also existed.[213] Tells were widespread from the Near East and Anatolia to southeastern Europe, constituting monumental landmarks in space, and multiple aspects concerning their formation and interpretation have being discussed at length.[214] In a wider perspective, however, PMZ and *magoules* of Thessaly generally differ from the tells in Anatolia and the Balkans, among other things, in that they lack the austere organisation of intra-settlement space and uniformity of house plans which only seldom underwent minor changes.[215]

*The Issue of Potential Flooding and the Stratigraphic Evidence*

In the overall stratigraphic sequence of the main excavation trench A no 'sterile' layers were found indicating abandonment(s) of the settlement due to flooding.[216] Such layers were reported in a 3m drill hole (PMZ-1) opened inside the main trench from a depth of 7.30m downwards. More precisely, 'sterile' layers 0.40m and 0.25m thick were reported at approx. depths of 8m and 9m, respectively, with intervening occupation deposits.[217] However, the analysis of the stratigraphy and processing of the finds indicated that no such 'sterile' layers were found in the excavated part of the trench nor did the finds originating from the deposits at the same depth as the 'sterile' layers appear unusually worn in comparison to those from the underlying or overlying deposits. Unless these 'sterile' layers did not extend further beyond or vanished due to occupation activities, the stratigraphic sequence in Trench A seemed, from an archaeological point of view, 'uninterrupted'. This could probably lead to the assumption that whenever exceptional flood events occurred, the occupants of the settlement were able to tackle the damage inside their settlement through repairs and that they were probably only seldom forced to abandon their homes and move to a nearby area for a rather short period of time until the floods receded. Around the settlement, ditches,[218] and probably also dams, could counteract the impacts of flooding to a certain extent. We also argue that PMZ's villagers chose their farming land in secure regions north, northeast and northwest of the settlement, which were kept dry and out of the reach of floods.[219] After all, the 'uninterrupted' Neolithic sequence in Trench A testifies to the determination of PMZ's villagers to prolong their occupation in this site, taking advantage of its location in a very dynamic environment.[220]

## III.5. Epilogue

Despite the restrictions often mentioned above, the preceding analysis has presented evidence that houses in PMZ were subjected to change, at least in the way they were built, as has been suggested for Greek Neolithic houses in general,[221] and that a number of differences and analogies have been discerned between PMZ and its coeval Thessalian settlements regarding the architecture and use of intra-settlement space. There is hope that the analysis could cast light on the way this settlement formed its identity in relation to its near and distant neighbours through a well-developed exchange network seen in other classes of material culture.

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213 Toufexis 2017, 26–30.

214 From a Greek perspective and for further bibliography, see briefly Grammenos 1996, 42–43; Kotsakis 1999; Kotsakis 2006; Nanoglou 2008; Souvatzi 2008; Chondrogianni-Metoki 2009, 5–8; Kalogiropoulou 2013, 16–35; Toufexis 2017, 53, 101, 102, 200–201, 333–342; Souvatzi 2020. For a wider perspective, see briefly Whittle 1996a; Chapman 1997, 151–154; Bailey 1999; Bailey 2000; Blanco-González – Kienlin 2020.

215 Bailey 2000, 159; Kotsakis 2006, 209–210; Toufexis 2017, 339.

216 Van Andel et al. 1995, 138–140.

217 Van Andel et al. 1995, 138.

218 Sarris et al., this volume, 68–80.

219 For further discussion, see Halstead, this volume, 584–586; Caputo et al., this volume, 47–49.

220 Van Andel et al. 1995; Caputo et al., this volume, 47–49.

221 Souvatzi 2013b.

Tab. III.1 List of the stratigraphic units (SU) in the Harris matrix (G. Toufexis, C. Batzelas)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Alluvial ground (lower part) | Light brown/whitish clayey soil | Entire trench | 10.85–11.70 | 2 × 2 | 2–3 | – | – | Alluvial ground | |
| 2 | Alluvial ground (upper part) | Grey-yellowish to greenish clayey soil containing diluted red clays, scarce charcoal fragments and a few sherds as a result of meddling during the earliest occupation | Entire trench | 10.30/10.70–10.85 | | 1; 3 | 175 (part) | – | | |
| 3 | Interface feature | Part of the ditch dug into the alluvial ground. Orientation: N/NW–SE, U-profile. 2.36 (L) × 0.75–1 (rim) / 0.50–1.10 (bottom) (W) × 0.40–0.60m (D) | | 9.90–10.30/10.32 (N) / 10.70 (S) | 2 × 2 | 2–7 | 175–177 | PM0896; PM0897; PM0898 | I | 1 |
| 4 | Fill of interface feature SU 3 (ditch) | Brown sandy loam, containing a few small stones, small quantity of pottery, a few animal bones and burnt pieces of clay. 0.40m thick (together with SU 5) | Lowest part of the fill in ditch, S part of the ditch (SU 3) | 10.40–10.70 | | 3–7 | 175 (part) | see SU 3 | | |
| 5 | Fill of interface feature SU 3 (ditch) | Brown sandy loam containing a few small stones, small quantity of pottery, a few animal bones and burnt pieces of clay. 0.40m thick (together with SU 4) | Part of the fill in ditch (SU 3) | 10.05/10.25–10.40 | | 3–7 | 175 (part); 176 (part) | see SU 3 | | |
| 6 | Fill of interface feature SU 3 (ditch) | Fine brown sandy soil containing burnt pieces of clay | Upper part of the fill in ditch (SU 3) | 9.90–10.05/10.25 | | 3–5; 7 | 175 (part); 176 (part); 177 (part) | see SU 3 | | |
| 7 | Fill of interface feature SU 3 (ditch) | Yellow fine sand, E–W and N–S/SE inclination, 0.15–0.20m thick | Uppermost part of the fill in ditch (SU 3) | 10.00 (W) / 10.05 (E) –10.09 (W) / 10.14 (E) | | 3–6 | 176 (part); 177 (part) | see SU 3 | | |
| 8 | Layer directly above interface feature SU 3 (ditch) | Yellowish sandy loam soil containing burnt pieces of clay | W part of the trench | 9.75–9.90 | 5 × 2 | 3; 7; 9–11 | 177 (part); 178 (part) | PM0890; PM0892; PM0893; PM0894; PM0895 | II | |
| 9 | Layer directly above interface feature SU 3 (ditch) | Black burnt soil with ash, abundant tiny charcoal fragments and a few pieces of burnt clay | E part of the trench | 9.75–9.90 | | 3; 7–8; 10–11 | 177 (part); 178 (part) | see SU 8 | | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | Deposit above interface feature (ditch) SU 3 | It consists of two different soils: 1) dark brown, sandy loam, without pottery along the W side and in NE corner and 2) yellowish, sandy loam in N area | Entire trench | 9.60–9.75 | 5 × 2 | 3; 8–9; 11–13 | 179 (part) | PM0879; PM0880; PM0881; PM0882; PM0884; PM0886; PM0888; PM0889; PM0929; PM0947; PM0952; PM0954; PM0955; PM0956 | II | 1 |
| 11 | Layer of burnt pieces of clay | Accumulation of burnt pieces of clay | NW corner of the trench | 9.73–9.77 | | 8; 10; 12–13 | 178 (part); 179 (part) | see SU 10 | | |
| 12 | Deposit above interface feature SU 3 (ditch) | Two or three thin overlying layers consisting of black burnt soil containing ashes, alternating with layers of yellowish sandy loam | Small area in the SW corner of the trench | 9.57–9.67 | | 8–11; 13–15 | 179 (part) | see SU 10 | | |
| 13 | Deposit above interface feature SU 3 (ditch) | Yellowish sandy loam containing a few sherds | Entire trench | 9.50/9.55–9.65/9.70 | | 10–12; 14–15 | 180 (part) | see SU 10 | | |
| 14 | Deposit above interface feature SU 3 (ditch) | In places yellowish or dark-brown sandy loam containing burnt pieces of clays, a few stones, animal bones and pottery | W part of the trench. At the same level as SU 15 | 9.35–9.55 | | 8–13; 15–16 | 180 (part) | PM0865; PM0871; PM0872; PM0873; PM0875; PM0876; PM0877; PM0878 | | |
| 15 | Deposit above interface feature SU 3 (ditch) | Grey-greenish soil containing charcoal fragments, pottery and a few animal bones. Same level as SU 14 | E part of the trench. At the same level as SU 14 | 9.35–9.55 | | 14; 8–13; 16 | 180 (part) | see SU 14 | | |
| 16 | Layer above interface feature SU 3 (ditch) | Yellowish sandy loam sloping eastwards | Entire trench | 9.31 (W) / 9.68 (E) – 9.34 (W) / 9.71 (E) | | 14–15; 17; 8–13 | 179 (part); 180 (part) | see SU 14 | | |
| 17 | Layer above interface feature SU 3 (ditch) | Grey-greenish soil rich in charcoal fragments and pottery, sloping eastwards | Entire trench | 9.21/9.23 (W) / 9.65 (E) – 9.31 (W) / 9.68 (E) | | 16; 18; 8–15 | 179 (part); 180 (part) | see SU 14 | | |
| 18 | Layer above interface feature SU 3 (ditch) | Yellowish sandy loam | Entire trench | 8.95/9.05 (W) / 9.16 (NW corner) / 9.57 (E) – 9.21/923 (W) / 9.65 (E) | | 16–17; 19; 8–15 | 179 (part); 180 (part) | see SU 14 | | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/ BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 19 | Layer above interface feature SU 3 (ditch) | Grey-greenish sandy loam containing charcoal fragments, pottery, a few animal bones and probably residues of unburnt timber | Entire trench | 8.93 (SW) / 9.06 (NW) / 9.55 (SE) – 8.95/9.05 (W) / 9.16 (NW corner) / 9.57 (E) | 5 × 2 | 18; 8–17 | 179 (part); 180 (part) | see SU 14 | II | 1 |
| 20 | Fill of interface feature SU 170 | Lower fill of the pit (SU 170) consisting of mixed yellowish and grey-greenish, clayey soil | 1.20m (N–S), middle of W side, underneath SU 21 | 9.13–9.22 | 5 × 2 | 19; 170; 21; 22 | 180 (part); 181 (part) | see SU 171 | IIIa | |
| 21 | Fill of interface feature SU 170 | Upper fill of the pit (SU 170) consisting of black soil | 1.20m (N–S), middle of the W side, underneath SU 21 | 9.05–9.13 | | 20; 19; 22; 23 | 180 (part); 181 (part) | see SU 171 | | |
| 22 | Interface feature | Probable posthole, below SU 18–19. Two pebbles embedded into its bottom | SW corner (its centre 2.56m from the S and 0.09m from the W side), 0.10m E of the third (SU 30) of the five postholes (SU 26, 28, 30, 32, 34) consisting the W39 (SU 172) | 9.13–9.19 | | 23; 19–22 | 180 (part); 181 (part) | see SU 171 | | |
| 23 | Fill of interface feature SU 22 | Grey soil containing many charcoal fragments, a few small stones and probably residues of unburnt wood | SW corner (its centre 2.56m from the E and 0.09m from the W side), 0.10m E of the third (SU 30) of the five postholes (SU 26, 28, 30, 32, 34) consisting the W39 (SU 172) | 9.13–9.19 | | 19–22 | 180 (part) | see SU 171 | | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/ BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 24 | Clay layer associated with wall W39 (SU 172) | Yellowish clayey soil attributed to the fallen superstructure of wall W39 (SU 172), along the W side of the trench, 0.40–0.60m wide and 0.40m thick. Association with five postholes (SU 26, 28, 30, 32, 34) | The largest part of the trench | 8.78 or 8.70 (W) / 9.58 or 9.50 (E) – 9.13 (W) / 9.50 (E) | 5 × 2 | 172; 25–35, 171 | 181 (part); 182 (part); 183 (part); 184 (part) | PM0854; PM0855; PM0856; PM0857; PM0858; PM0859; PM0913; PM0914 | IIIa | 1 |
| 25 | Layer above wall W39 (SU 172) | Thin layer of black soft soil directly above wall W39 (SU 172) | The largest part of the trench | 8.73 (W) / 9.54 (E) – 8.78 or 8.70 (E) / 9.58 or 9.50 (W) | | 172; 24; 26–35; 171 | 181 (part); 182 (part); 183 (part); 184 (part) | see SU 24 | | |
| 26 | Interface feature | Posthole of wall W39 (SU 172). Walls plastered with clay admixed with stones, 0.18 (Diam.) × 0.22m (Diam.) | 0.66m from SW corner, adjacent to W side | 8.78–9.00 | | 172; 24–25; 27–35; 171 | 181 (part); 182 (part); 183 (part); 184 (part) | – | | |
| 27 | Fill of interface feature SU 26 | Black soft soil | 0.66m from SW corner, adjacent to W side | 8.78–9.00 | | 172; 24–26; 28–35; 171 | 181 (part); 182 (part); 183 (part); 184 (part) | – | | |
| 28 | Interface feature | Posthole of wall W39 (SU 172). Its rim was outlined with stones, 0.20 (Diam.) × 0.17m (D) | 1.82m from SW corner, adjacent to W side | 8.78–8.95 | | 172; 24–25; 29; 26– 27; 30–35; 171 | 182 (part); 183 (part); 184 (part) | – | | |
| 29 | Fill of interface feature SU 28 | Black soft soil containing residues of wood, burnt pieces of clay and a small sherd | 1.82m from SW corner, adjacent to W side | 8.78–8.95 | | 172; 24–25; 28; 26–27; 30–35; 171 | 182 (part); 183 (part); 184 (part) | – | | |
| 30 | Interface feature | Posthole of wall W39 (SU 172). 0.26 (top Diam.) / 0.12 (bottom Diam.) × 0.42m (D) | 2.70m from SW corner, adjacent to W side | 8.78–9.20 | | 172; 24–25; 31; 26–29; 32–35; 171 | 181 (part); 182 (part); 183 (part); 184 (part) | – | | |
| 31 | Fill of interface feature SU 30 | Black soft soil | 2.70m from SW corner, adjacent to W side | 8.78–9.20 | | 172; 24–25; 30; 26–29; 32–35; 171 | 181 (part); 182 (part); 183 (part); 184 (part) | – | | |
| 32 | Interface feature | Posthole of wall W39 (SU 172), 0.22m (preserved D) | 3.98m from SW corner, adjacent to W side | 8.78–9.20 | | 172; 24–25; 33; 26–30; 34–35; 171 | 181 (part); 182 (part); 183 (part); 184 (part) | – | | |
| 33 | Fill of interface feature SU 32 | Black soft soil | 3.98m from SW corner, adjacent to W side | 8.78–9.00 | | 172; 24–25; 32; 26–31; 34– 35; 171 | 181 (part); 182 (part); 183 (part); 184 (part) | – | | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/ BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 34 | Interface feature | Posthole of wall W39 (SU 172), 0.22m (preserved D) | NW corner | 8.78–9.00 | 5 × 2 | 172; 24–25; 35; 26–33; 171 | 181 (part); 182 (part); 183 (part); 184 (part) | – | IIIa | 1 |
| 35 | Fill of interface feature SU 32 | Black soft soil | NW corner | 8.78–9.00 | | 172; 24–25; 34; 26–33; 171 | 181 (part); 182 (part); 183 (part); 184 (part) | – | | |
| 36 | Interface feature | Small pit. 0.30m (Diam.) | Visible in the W side, 2.50m from the SW corner cutting part of SU 24 | 8.70 | 5 × 2 | 173; 172; 24; 37 | 181 (part); 182 (part); 183 (part) | – | IIIb | |
| 37 | Deposit directly above wall W39 (SU 172) | It consists of: 1) grey-greenish clayey soil rich in charcoal fragments, pottery and residues of unburnt wood, 2) thin layers of ash and black soil and 3) yellowish clayey soil with less pottery | Entire trench | 8.70 (W) / 8.90 (E) – 8.73 (W) / 9.54 (E) | | 38; 172 | 181 (part); 182 (part); 183 (part); 184 (part) | PM0836; PM0838, PM0839; PM0840; PM0843; PM0845, PM0846; PM0847; PM0848; PM0849; PM0850; PM0851; PM0852; PM0930 | | |
| 38 | Thin layer of black burnt soil Surface F33c | Black burnt soil with ashes, sloping eastwards | 1.10 (E–W)×2.20m (N–S), S/ SW part of the trench | 8.70 (W) / 8.88–8.90 (E) – 8.70 (W) / 8.90 (E) | | 37; 39; 40–43 | 185 (part); 184 (part) | PM0817 | | |
| 39 | Thin deposit between Surfaces F33c (SU 38) and F33b (SU 40) | Greyish clayey soil, in places, admixed with yellowish clayey soil clay and ashes, abundant charcoals, sloping eastwards | 1.10 (E–W)×2.20 m (N–S), S/ SW part of the trench | 8.68 (W) / 8.92 (E) – 8.70 (W) / 8.90–8.91 (E) | | 38; 40; 37; 41–43 | 185 (part) | PM0823 | | |
| 40 | Thin layer of black burnt Surface F33b | Black burnt soil with ashes, sloping eastwards. Preserved in a small part of the trench. Similar to SU 38 and SU 42 | S half of the trench | 8.66 (W) / 8.90 (E) – 8.68 (W) / 8.92 (E) | | 39; 41; 37–38; 42–43 | 185 (part) | see SU 38 | | |
| 41 | Thin deposit between Surface F33b (SU 40) and the overlaid Surface-F33a (SU 43) | It consists of 1) a layer of yellowish-brown clayey soil with fore residues directly above F33b and 2) an overlying layer of grey-greenish clayey soil with ashes, rich in charcoals and pottery, both sloping eastwards | Almost the entire trench | 8.63 (W) – 8.84 (E) – 8.66 (W) / 8.90 (E) | | 40; 42; 37–39; 43 | 185 (part) | see SU 37 | | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/ BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 42 | Thin layer of black burnt soil Surface F33a | Black burnt soil with ashes | 1.60 (E–W) × 1.16m (N–S) S/SE part of the trench, sloping eastwards | 8.62 (W) / 8.82 (E) – 8.63 (W) – 8.84 (E) | 5 × 2 | 41; 43; 37–40 | 185 (part) | PM0819; PM0827; PM0828; PM0829; PM0830; PM0833; PM0835 | IIIb | 1 |
| 43 | Layer directly above Surface F33a | Yellowish clayey soil | Almost the entire trench | 8.55 (W) / 8.79 (E) – 8.62 (W) / 8.82 (E) | | 42; 174 | 185 (part) | PM0810; PM0811; PM0812; PM0814; PM0820 | | |
| 44 | Interface feature | Posthole related to Surface (SU 174) | Approx. middle of the trench | 8.55/8.57 | 5 × 2 | 174; 43; 45–49 | 186 (part) | – | IIIc | |
| 45 | Thin layer of black burnt soil Surface F33a | Layer of yellowish clayey soil | SW corner of the trench | 8.55/8.57 | | 174; 43–44; 46–49 | 186 (part) | – | | |
| 46 | Layer directly above Surface SU 174 | Grey-greenish soil admixed with yellowish clayey soil, rich in pottery, bones and burnt pieces of clay, mainly in W side of the trench | Entire trench | 8.40–8.55 | | 174; 44–45; 47–49 | 186 (part) | PM0798; PM0800; PM0801; PM0802; PM0805; PM0806; PM0807; PM0808; PM0809; PM0915; PM0916; PM0917 | | |
| 47 | Thin layers | Thin layers of yellowish clayey soil alternating with thin layers of black soil | SW corner of the trench | 8.40–8.57 | | 46; 174; 48–49 | 186 (part) | see SU 46 | | |
| 48 | Thin layer | Yellowish clayey soil | Mainly in W and NW part of the trench | 8.30–8.60 | | 47; 49; 46; 174 | 186 (part) | see SU 46 | | |
| 49 | Layer between BSPh IIIc and IVa | Grey-greenish clayey soil | Entire trench | 8.30–8.40 (W) / 8.75 (E) | | 48; 50; 47; 174 | 186 (part); 187 (part) | PM0960 and see also SU 46 | | |
| 50 | Layer directly below Surface F32 (SU 52) | Grey-greenish clayey soil rich in charcoal fragments, in places, admixed with yellowish clayey soil | N of W38 (SU 53) | 8.20–8.30 | 5 × 2 | 49; 51–53 | 187; 188 (part) | PM0787; PM0928 | IVa | |
| 51 | Layer directly below Surface F32 (SU 52) | Compact yellowish clayey soil with a few charcoal fragments and grey-greenish soil with burnt pieces of clay containing many charcoal fragments spread in an almost triangular area | S of W38 (SU 53) | 8.20–8.30 | | 50; 52–53 | 187; 188 (part) | PM0781; PM0784; PM0791; PM0794; PM0795; PM0796; PM0792; PM0793; PM0797 | | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 52 | Surface F32 | Compact yellowish-brown soil | Entire trench, N and S of wall W38 (SU 52) | 8.20–8.30 | 5 × 2 | 50–51; 53–60 | 187 (part); 188 | – | IVa | 1 |
| 53 | Wall W38 | Between E and W sides of the trench, almost E–W orientation. Built according to the mud/mud-brick on stone foundation technique, 2 (L) × 0.50 / 0.58 (W) × 0.07–0.20m (H) | N part of the trench | 8.05–8.20 | | 52; 54–60 | 187 (part) | – | | |
| 54 | Interface feature | Posthole related to Surface F32 (SU 52) and wall W38 (SU 53), 0.35 (Diam.) × 0.08m (D) | Close to inner facade of wall W38 (SU 53) | 8.20–8.28 | | 52–53; 55–60 | 187 (part) | – | | |
| 55 | Thermal structure TS33 | Probably an oven, related to Surface F32 (SU 52) and wall W38 (SU 53). Fragmentary preservation, apparently circular | 0.50m S of wall W38 (SU 53), 0.47m from W side | 8.15–8.20 | | 56–57; 52–54; 58–60 | 187 (part) | PM0783 | | |
| 56 | Pebble-paved surface related to TS33 (SU 55) | It consists of a layer of pebbles 0.05m thick, covered by a layer of yellow clay | 0.60 (N–S) × 0.30m (E–W), SE of TS 33 (SU 55) | 8.25 | | 55; 57; 52–54; 58–60 | part of 189 (and 188) | – | | |
| 57 | In situ quern | In close relation to TS 33 (SU 55), on Surface F32 (SU 52) | 0.90 (W) × 2.28m (S) | 8.18 | | 55–56; 52–54; 58–60 | 187 | – | | |
| 58 | Layer above wall W38 (SU 53) | Yellowish-brown, sandy loam rich in pottery and bones, some charcoal fragments and burnt pieces of clay | Entire trench | 8.05/8.14–8.14/8.23 | | 59–60; 52–57 | 188 (part); 189 (part) | PM0918 | | |
| 59 | Layer between Surfaces F32 (SU 52) and 31 (SU 61), N of wall W38 (SU 53) | Greyish clayey soil rich in charcoals and anthropogenic material | N of W38 (SU 53) | 8.05/8.14–8.20 | | 58; 60; 52–57 | 190 (part) | – | | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 60 | Layer between Surfaces F32 and 31 (SU 61), S of wall W38 (SU 53) | Consisting of 2 different soils: 1) a grey-greenish soil in a triangular area in the W part, S of W38 (SU 53) and 2) yellowish soil in the remaining part S of W38 (SU 53) | S of W38 (SU 53) | 8.05/8.14–8.20 | 5 × 2 | 58–59; 52–57 | 190 (part) | – | IVa | 1 |
| 61 | Surface F31 | Yellowish clayey soil | Entire trench N and S of wall W37 (SU 62) | 8.05/8.14–8.23 | 5 × 2 | 58–60; 62–69 | 190 | PM0785; PM0786 | IVb | |
| 62 | Wall W37 | Between E and W sides of the trench, almost E–W alignment, built along the inner side of wall W38 (SU 53), according to the mud/mudbrick on stone foundation technique, 2 (L) × 0.40/0.50 (W) × ~0.35m (H). Clay from the superstructure spread in a band 1m wide | N area, parallel and slightly S to wall W38 | 7.70–8.05/8.10 | | 61; 63–69 | 189 (part); 190–192 | – | | |
| 63 | Interface feature | Posthole | Near eastern end of wall W37 (SU 62) | 7.70 | | 64; 62; 61; 65–69 | 191 (part); 192 (part) | – | | |
| 64 | Interface feature | Posthole | Near western end of wall W37 (SU 62) | 7.70 | | 63; 62; 61; 65–69 | 191 (part); 192 (part) | – | | |
| 65 | Interface feature | Posthole | SE corner, approx. 1.05m from S and E sides | 8.10 | | 66; 61–64; 67–69 | 189 (part); 190 (part) | – | | |
| 66 | Interface feature | Posthole | NW corner, 0.45m from N and 0.27m from W sides | 8.10 | | 65; 61–64; 67–69 | 189 (part); 190 (part) | – | | |
| 67 | Layer of yellow clay alongside wall W37 (SU 62) | Yellowish clayey soil | N and S of wall W37 (SU 62), originating from its fallen superstructure | 7.60–8.05/8.14 | | 62–66; 68–69 | 191 (part); 192 (part); 193 (part) | – | | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 68 | Deposit above Surface F31 (SU 61), S of wall W37 (SU 62) | Greyish soil sandy loam, ~0.10m thick, containing charcoal fragments and more finds than the quite similar deposit at the same level N of wall W37 (SU 69) | S of wall W37 (SU 62) | 7.60–8.05/8.14 | 5 × 2 | 67; 69; 61–66 | 191 (part); 192 (part); 193 (part) | PM0773; PM0774; PM0777; PM0779; PM0919 | IVb | 1 |
| 69 | Deposit above Surface F31 (SU 61), N of wall W37 (SU 62) | It consists of at least 3 quite similar sandy loamy soils:1) greyish soil rich in charcoal fragments, 2) yellowish-brown soil, rich in charcoal fragments, mostly near to N side and 3) yellowish soil | N of wall W37 (SU 62) | 7.50–8.05/8.14 | | 68; 67; 70–71; 61–66 | 190 (part); 191 (part) | PM0920; PM0921; PM0922; PM0923; PM0924 | | |
| 70 | Wall W36 | Preserved as a semicircular narrow strip of yellowish clay | N area | 7.70 | | 69; 71; 67–68; 61–66 | 190 (part); 191 (part); 192 (part); 193 (part) | – | | |
| 71 | Interface feature | Posthole related to SU 69, close to N side | NW area | 7.61 | | 70; 69; 68; 67; 61–66 | 193 (part) | – | | |
| 72 | Layer directly below Surface F30 (SU 76) | Thin layer of brown soil | S and central area | 7.55/7.56–7.65 | 5 × 2 | 67–71 | 193 (part) | – | Va | 2 |
| 73 | Layer with fire residues | Thin layer of dark-greyish/blackish soil containing fire residues, rich in charcoal fragments, probably the lowest fill of a potential fire pit | S and central area | 7.55/7.61–7.65/7.66 | | 72; 74–76; 82 | 193 (part) | PM0925; PM0926 | | |
| 74 | Thin layer | Thin layer of orange-yellowish clayey soil, between SU 73 and 75 | Mainly S area | 7.50–7.54/7.55 | | 73; 75; 72; 76; 82 | 193 (part) | – | | |
| 75 | Layer with fire residues (thermal structure TS 32a) | Thin layer of dark-greyish/blackish soil containing fire residues, rich in charcoals, probably fill of a potential fire pit | S area | 7.54/7.55–7.55/7.56 | | 74; 76; 73; 72; 82 | 193 (part) | – | | |
| 76 | Surface F30 | Yellowish clayey soil scattered with fire refuse | Entire trench | 7.50 or 7.60 | 5 × 4 | 77–84; 75; 74; 73; 72 | 193 (part); 194 (part) | – | | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 77 | Interface feature | Posthole related to Surface F30 (SU 76), 0.12–0.14m (Diam.) | Approx. middle of the trench | 7.35 | 5 × 2 | 76; 78–84; 75; 74; 73; 72 | 194 (part); 195 (part) | – | Va | 2 |
| 78 | Interface feature | Posthole related to Surface F30 (SU 76), 0.08–0.10m (Diam.) | Close to W side | 7.44 | | 76–77; 79–84; 75; 74; 73; 72 | 195 (part) | – | | |
| 79 | Interface feature | Posthole related to Surface F30 (SU 76), ~0.10m (Diam.) | SE corner | 7.40 | | 76–78; 80–84; 75; 74; 73; 72 | 195 (part); 196 (part) | – | | |
| 80 | Interface feature | Posthole related to Surface F30 (SU 76), ~0.10m (Diam.) | Middle of the E side | 7.35 | | 76–79; 81–84; 75; 74; 73; 72 | 195 (part); 196 (part) | – | | |
| 81 | Interface feature | Posthole related to Surface F30 (SU 76), 0.10–0.12m (Diam.) | N area | 7.60 | | 76–80; 82–84; 75; 74; 73; 72 | 195 (part); 196 (part) | – | | |
| 82 | Layer with fire residues thermal structure TS 32 | Thin layer of burning directly above F30 (SU 76) | Along S side | 7.52/7.55–7.59 | | 75; 74; 73; 72; 76; 77; 78–81; 83; 84 | 194 (part); 195 (part) | – | | |
| 83 | Layer directly above Surface F30 (SU 76) | In places, bright greyish soil with traces of burning and scattered stones or greyish-brown sandy soil with sporadic traces of burning, rich in pottery, bones, small finds and pieces of burnt clay | Entire trench | 7.45–7.50 or 7.60 | | 84; 76–82 | 194 (part); 195 (part) | PM0765 | | |
| 84 | Layer directly below Surface F29 (SU 85) | Yellowish-brown sandy soil with sporadic traces of burning, rich in pottery, animal bones, small finds and pieces of burnt clay | Entire trench | 7.40–7.45 | | 83; 76–82 | 195 (part); 196 (part); 197 (part) | PM0766; PM0767; PM0770; PM0771; PM0772 | | |
| 85 | Surface F29 | Yellowish sandy loamy soil admixed with greyish soil | Entire trench | 7.26 (N) / 7.34 (S) – 7.40 | 5 × 4 | 86–90 | 196 (part) | PM0756; PM0759; PM0760; PM0761; PM0762; PM0763; PM0764 | Vb | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/ BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 86 | Thermal structure TS 31 | Circular, consisting of a blackened surface on a substructure of pebbles, sherds and clay | SE area, NE of TS 30 (SU 87) | 7.30 | 5 × 4 | 85; 87–90 | 196 (part) | – | Vb | 2 |
| 87 | Thermal structure TS 29 | Small circular, similar to TS 28b (SU 93) | Middle of the S side | 7.30 | | 85–86; 88–90 | 196 (part) | – | | |
| 88 | Thermal structure TS 29 | Somewhat elliptical in shape. Only its substructure was preserved consisting of a thin layer of clay with pebbles and a few sherds and covered by a thin black layer of fire residues with pebbles and sherds, Dim.: 0.50 × 0.30m | NW corner | 7.25 | | 85–87; 89; 90 | 197 (part); 198 (part) | PM0753; PM0754 | | |
| 89 | Deposit above Surface F29 (SU 85) | Greyish and yellowish more compact soil. It contained pottery, some animal bones and a few shells | Entire trench | 7.09/7.18–7.26 (N) / 7.34 (S) | | 85–88; 90 | 197 (part); 198 (part) | PM0746; PM0747; PM0748; PM0749; PM0751; PM0757; PM0758; PM0933; PM0998; PM0999 | | |
| 90 | Layer of black soil | Grey to black, soft soil | Along W side of the trench, 1.50 (N–S) × ~0.60m (E–W) | 7.21–7.25 | | 85–89 | 197 (part) | see SU 89 | | |
| 91 | Layer directly below Surface F28 (SU 92) | Greyish, in places yellowish and more compact soil, with traces of fire and a few scattered stones | W and N sides | 7.06/7.10–7.09/7.18 | 5 × 4 | 92–100 | 198 (part); 199 (part) | – | Vc | |
| 92 | Surface F28 | Yellowish clayey soil, in places greyish, with charcoal fragments and scattered fire refuse | Entire trench | 6.98/7.00–7.06/7.10 | | 93–100 | 199 (part); 200 (part) | PM0935; PM0936; PM0937 | | |
| 93 | Thermal structure TS 28b | Circular, only the substructure was preserved, made of a clay layer with pebbles with an earthen floor on a substructure with pebbles | SW corner, directly below TS 28a (SU 94), 0.30m from E and 0.85m from W sides | 7.10 | | 91–92; 94–100 | 198 (part) | – | | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 94 | Thermal structure TS 28a | Circular, consisting of a layer of black burnt soil with abundant tiny charcoals. Most likely not a thermal structure but a layer corresponding to fire refuse above TS 28b (SU 93) | SW corner, directly above TS 28b (SU 93) | 7.05–7.10 | 5 × 4 | 91–93; 95–100 | 198 (part) | – | Vc | 2 |
| 95 | Thermal structure TS 28 | Circular, consisting of a layer of black burnt soil with abundant tiny charcoals. | SW corner | 7.00–7.05 | | 92–94; 96–100 | 199 (part); 200 (part) | – | | |
| 96 | Thermal structure TS 27 | Somewhat elliptical. Black burnt soil as a floor ~0.01m thick, a layer of small stones as substructure, 0.60 (N–S) × 0.33m (E–W) | SE area, 1.90m from S and 0.60m from E side | 7.00–7.05 | | 92–95; 97–100 | 199 (part); 200 (part) | – | | |
| 97 | Thin clay walls close to TS 27 (SU 96) | Two fragmentary thin clay walls perpendicular to each other, probably belonging to a destroyed structure. 1.12 (E–W) × 0.65m (N–S) (preserved Dim.). A broken grinding stone (PM0745) at the W end of one wall | SE area of the trench | 7.00 | | 92–96; 98–100 | 199 (part); 200 (part) | PM0745 | | |
| 98 | Interface feature | Posthole related to Surface F28 (SU 92) | Close to SE corner | 7.00 | | 99; 92–97; 100 | 199 (part); 200 (part) | – | | |
| 99 | Interface feature | Posthole related to Surface F28 (SU 92) | Middle of the N side | 7.00 | | 98; 92–97; 100 | 198 (part); 199 (part) | – | | |
| 100 | Deposit above Surface F28 (SU 92) | Yellowish-brown soil rich in pottery | Entire trench | 6.75/6.80–6.80/6.85 | | 92–99 | 201; 202; 203 (part) | – | | |
| 101 | Surface F27 | Compact soil. Two circular areas (Diam.: approx. 0.80m) with different (probably burnt) soil near NW corner | Entire trench. Best preserved in a small area ~1.00m long in middle of the E side and in SW and NE corners | 6.75/6.80–6.80/6.85 | 5 × 4 | 102–107 | 201 (part); 202 (part); 203 | PM0735; PM0736; PM0737; PM0738; PM0739; PM0740; PM0741; PM0742; PM0743; PM0938 | Vd | 3 |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 102 | Thermal structure TS 26 | Circular, two renewals of the floor, substructure made with pebbles. ~0.80m (preserved Diam.) | Middle of the trench, E of TS 25 (SU 103) | 6.80 | 5 × 4 | 103–104; 101; 105–107 | 201; 202 | – | Vd | 3 |
| 103 | Thermal structure TS 25 | Adjacent to and very similar to TS 26 (SU 102), two renewals of the floor, substructure made with pebbles. ~0.80m (preserved Diam.) | Near middle of the W side | 6.80 | | 102; 104; 101; 105–107 | 201; 202 | – | | |
| 104 | Layer of fire refuse | Black fire refuse in between two postholes (SU 105 and 106) | SW corner | 6.73 | | 103; 102; 101; 105–107 | 203 | – | | |
| 105 | Interface feature | Posthole, walls lined with small stones, flat stone in the bottom | SW corner | 6.80 | | 106; 101–104; 107 | 201 (part); 202 (part); 203 (part) | – | | |
| 106 | Interface feature | Posthole near posthole (SU 105) | Directly E of TS 24 | 6.80 | | 105; 101–104; 107 | 201 (part); 202 (part); 203 (part) | – | | |
| 107 | Deposit above Surface F27 (SU 101) | Yellowish brown sandy loam, rich in pottery | Entire trench | 6.50/6.55–6.75/6.80 | | 101–106 | 203 (part); 204; 205 (part); 206 | PM0725; PM0726; PM0727; PM0728; PM0729; PM0730; PM0731; PM0732; PM0733; PM0734; PM0939 | | |
| 108 | Surface F26 | Compact soil | Entire trench | 6.40/6.52–6.55 | 5 × 4 | 109–112 | 205; 208 (part) | PM0715; PM0716; PM0717; PM0718; PM0719; PM0720; PM0722; PM0723; PM0724 | Ve | |
| 109 | Thermal structure TS 23 | Somewhat elliptical, three renewals of the floor, substructure ~0.10m thick with pebbles. Upper floor blackened. Walls 0.05–0.12m thick preserved only in places. A rectangular clay platform attached to N, a flat stone on the platform. Dim: 0.53 (E–W) × 0.74m (N–S) | 2.40 (N) × 1.26m façade, near TS 22a (SU 114) | 6.30–6.45 | | 108; 110–112 | 209 | – | | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/ BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 110 | Interface feature | Small pit, 0.35 (Diam.) × 0.40m (Depth) | SW corner | 6.42–6.82 | 5 × 4 | 108–109; 111–112 | 205 (part) | – | Ve | 3 |
| 111 | Fill of interface feature SU 110 | It contained sherds, a few animal bones, tiny charcoal fragments and a broken grinding stone | SW corner | 6.42–6.82 | | 108–110; 112 | 205 (part) | PM0721 | | |
| 112 | Deposit between Surface F26 (SU 108) and F25 (SU 113) | Yellowish-brown sandy loam rich in pottery and animal bones | Entire trench | 6.30–6.40/6.52 | | 108–111 | 208 (part); 209; 210; 211 (part) | PM0687; PM0688; PM0689; PM0690; PM0697; PM0700; PM0705; PM0706, PM0707; PM0708; PM0709; PM0710; PM0711; PM0713; PM0940; PM0941 | | |
| 113 | Surface F25 | Brownish clayey soil | Entire trench | 6.10 (E) / 6.17 (N) / 6.22 (W) / 6.20 (S) – 6.30 | 5 × 4 | 114–119; 175; 120 | 210; 211 (part) | PM0691; PM0698 and see also SU 120 | VIa | 4 |
| 114 | Thermal structure TS 22a | Somewhat ellipsoid, clay floor on a substructure with small pebbles, walls clearly visible around the floor 0.70 (N–S) × 0.60m (E–W) | Close to middle of the W side, directly below TS 22 (SU 115) | 6.25 | | 115; 113; 116–119; 175; 120–121 | 210 (part) | – | | |
| 115 | Thermal structure TS 22 | Somewhat ellipsoid, clay floor blackened by fire | Close to middle of the W side, directly above TS 22 (SU 114) | 6.20 | | 114; 113; 116–119; 175; 120–121 | 210 | – | | |
| 116 | Wall W34 | Preserved as a hard-fired thin and low clay strip, 2.20m long and 0.10m (wide), N–S orientation. Similar construction to W35 (SU 117) | Close and parallel to E side | 6.00 | | 117; 113–115; 175; 118–121 | 213 (part); 214 (part) | – | | |
| 117 | Wall W35 | Preserved as a hard-fired thin and low clay strip, 2.08m long, 0.10m (wide), and 0.13m tall. E–W orientation with a southwards inclination. Similar construction to W34 (SU 116) | SE area | 6.00–6.13 | | 116; 113–115; 118–119; 175; 120–121 | 213 (part); 214 (part) | – | | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/ BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 118 | Interface feature | Posthole, circular, plastered walls with clay admixed with pebbles, a few pebbles and animal bones inside. 0.20 (Diam.), 0.20m (D) | Close to N end of wall W34, in contact with its inner side, 1.45m from N and 3.40m from W side | 5.92 | 5 × 4 | 175; 119; 113–117; 120–121 | 213 (part); 214 (part); 217 (part) | – | VIa | 4 |
| 119 | Interface feature | Posthole, filled with clay, small stones and gravel. 0.29 (Diam.), ~0.20m (D) | 1.00m E/NE of the posthole (SU 118) | 5.92 | | 118; 175; 116; 113–115; 117; 120–121 | 213 (part); 214 (part); 218 (part) | – | | |
| 120 | Deposit above Surface F25 (SU 113) | Brown, sandy loam, rich in pottery, small finds, animal bones and charcoal fragments | Entire trench | 6.15/6.20 – 6.10 (E) / 6.17 (N) / 6.22 (W) / 6.20 (S) | 5 × 7 | 121; 113–117; 175; 118– 119 | 213 (part); 214 (part) | PM0668; PM0669; PM0671; PM0672; PM0673; PM0674; PM0675; PM0676; PM0677; PM0678; PM0679; PM0680; PM0681; PM0682; PM0683; PM0684; PM0685; PM0686; PM0692; PM0693; PM0694; PM0695; PM0696; PM0699; PM0714; PM0942; PM0943; PM0944 | | |
| 121 | Deposit below Surface F24 (SU 122) | It consists of: 1) greyish-brown, sandy loam with burnt pieces of clay in NW corner, and compact yellowish soil, in places. Few carbonised seeds and charcoals in W part (at ~6.00m D). Rich in pottery, burnt pieces of clay, 2) Yellowish sandy soil, poor in pottery | Entire trench | 5.92 (E) and 5.98/6.00 (W) – 6.15/6.20 | | 120; 113–118; 175; 119 | 214; 216; 217 (part); 218 (part); 219 (part) | PM0652; PM0653; PM0654; PM0655; PM0656; PM0657; PM0658; PM0660; PM0990; PM0993 | | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 122 | Surface F24 | Brown-yellowish clay, in places, hard | Entire trench | 5.86/5.90 (E) / 5.97 (W) – 5.92 (E) / 5.98/6.00 (W) | 5 × 7 | 121; 123–125; 175; 126 | part of 217; 218; 219 (or part of 221+222 and 223+224) | PM0649; PM0650; PM0651; PM0661; PM0662; PM0663; PM0664; PM0665; PM0666; PM0667; PM0995 | VIb | 4 |
| 123 | Wall W32 | Preserved as thin and low clay strip, mostly looking like a coating of a façade, N–S orientation, westwards inclination, similar construction and parallel to wall W33 (SU 116) to W, 2.86 (L) × 0.03–0.07 (W) × 0.05–0.09m (H) | Near middle of the trench, 3.20–3.30m from W side | 5.86–5.95 | | 124; 122; 125; 175; 126 | 217 (part) | – | | |
| 124 | Wall W33 | Preserved as thin and low clay strip, mostly looking like a coating of a façade, N–S orientation, westwards inclination, similar construction and parallel to wall W32 (SU 123) to E | 1.76m from W side | 5.86 | | 123; 122; 176; 125–126 | 217 (part); 218 (part); 221 (part) | – | | |
| 125 | Thermal structure TS 21 | Circular, plastered clay floor blackened by fire, preserved Diam.: 0.25m | Central area of the trench, very close to W32 (SU 123) Entire trench | 5.92–5.99/6.00 | | 22; 123; 176; 124; 126 | 214 (part); 218 (part); 219 (part) | – | | |
| 126 | Deposit between Surfaces F23 (SU 127) and F24 (SU 122) | It consists of three different layers. Very rich in pottery and, in places, residues of fire | Entire trench | 5.45/5.55/5.60–5.86/5.90 (central and E area) and 5.97 (W) | | 122–123; 176; 124–125 | 223; 225; 226; 228–230; 231 (part); 234 (part); 235 (part) | PM0627; PM0628; PM0629; PM0633; PM0634; PM0635; PM0636; PM0637; PM0638; PM0639; PM0640; PM0641; PM0642; PM0643; PM0644; PM0645; PM0646; PM0647; PM0648; PM0945; PM0946; PM0961; PM0996; PM0997; PM1002; PM1008; PM1009; PM1069; PM1095; PM1096 | | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 127 | Surface F23 | Yellowish compact clay, slightly uneven in NW corner, slight inclination to SW | Preserved only in places, mainly in E half | 5.40/5.48 (N/NE) / 5.57/5.60 (S/SW) – 5.45/5.55/5.60 | 5 × 7 | 128–134; 177 | 231 (part); 232 (part); 236 | PM0613; PM0614; PM0615; PM0617; PM0618; PM0619; PM0620; PM0621; PM0622; PM0623; PM0624; PM0625; PM0626; PM0630; PM0631; PM0632; PM1011; PM1012; PM1013; PM1014; PM1015; PM1016; PM1017; PM1018; PM1019; PM1020 | VIIa | 5 |
| 128 | Interface feature | Posthole, almost circular. 0.17 (Diam.) × 0.08m (D) | SE area | 5.52–5.60 | | 129; 130; 127; 131–134; 177 | 226 (part); 228; 229 | – | | |
| 129 | Interface feature | Posthole, almost circular. Walls lined with large sherds. Compact yellowish clay around it. 0.10–0.16m (Diam.) | SE corner | 5.52 | | 128; 130; 127; 131–134; 177 | 229 (part) | – | | |
| 130 | Interface feature | Pit. Its fill contained small and large coarse sherds. 0.70 (Diam.), 0.10m (Depth) | NE corner, beside TS 20 (SU 131) | 5.52–5.62 | | 128–129; 127; 131–134; 177 | 230; 229 | – | | |
| 131 | Thermal structure TS 20 | Along N side of the trench. Quadrangular, floor made of compact clay, robust substructure 0.20–0.25m thick, with three overlaid layers of sherds and pebbles at its bottom, clay and smaller stones in middle and thin clay plaster on the top. Preserved dim.: 1.30 (E–W) × 0.50m (N–S) | NE corner | 5.18–5.38 | | 127–130; 132–134; 177 | 231 (part); 233 | – | | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 132 | Layer directly above Surface F23 (SU 127) | Dark- or light-brown sandy loam soil, in places, containing burnt pieces of clay and occasionally fire residues | Largest part of the W half of the trench | 5.30–5.40/5.48 (N/NE) / 5.57/5.60 (S/SW) | 5 × 7 | 133–134; 177; 127–131 | 234; 235; 237; 240 | PM0583; PM0584; PM0585; PM0586; PM0587; PM0588; PM0589; PM0590; PM0591; PM0592; PM0593; PM0594; PM0596; PM0597; PM0598; PM0599; PM0600; PM0602; PM0603; PM0604; PM0605; PM0606; PM0607; PM0608; PM0609; PM0610; PM0611; PM0612; PM1021; PM1023 | VIIa | 5 |
| 133 | Layer of black burnt soil, above Surface F23 (SU 127) | Black burnt and loose soil, containing ashes. Part of destruction stratum (with layer SU 134), above Surface F23 (SU 127) | Mainly E and partly W half of the trench | 5.30–5.40/5.48 (N/NE) / 5.57/5.60 (S/SW) | | 132; 134; 177; 127–131 | 236 (part); 238 | PM0616 | | |
| 134 | Layer of burnt pieces of clay, above layer SU 133 | It contains highly burnt pieces of clay bearing impressions of burnt timber | E half of the trench | 5.15–5.30 | | 133; 132; 177; 127–131 | 242; 243; 246 (part); 248–250 | PM0568; PM0569; PM0573; PM0574; PM0576; PM0577; PM0578; PM0579; PM0580; PM0581; PM0595; PM0601; PM0912; PM0989 | | |
| 135 | Deposit approx. at the level of Surface F22 (SU 136) | Brown, sandy loam containing sparse burnt pieces of clay and, in places, fire residues, rich in pottery and finds | W half of the trench | 5.15–5.30 | 5 × 7 | 136–139; 178; 140–141 | 244; 241 (part); 251; 252 | PM0539; PM0540; PM0541; PM0542; PM0546; PM0549; PM0553; PM0556; PM0557; PM0558; PM0559; PM0560 | VIIb | 6 |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 136 | Surface F22 | Yellowish compact clay with small pebbles | E half of the trench | 5.11/512–5.15 | 5 × 7 | 135; 134; 137–139; 177–178; 140–141 | 246b | PM0536; PM0537; PM0538; PM0544; PM0548; PM0554; PM0555; PM0567; PM0570; PM0571; PM0575; PM1022; PM1025; PM1026; PM1027 | VIIb | 6 |
| 137 | Interface feature | Posthole containing ashes, 0.15 (Diam.) × 0.05m (D) | Middle of the trench, near W rim of the EBA pit (SU 167) | 5.12 | | 138; 136; 135; 139; 177–178; 140–141 | 246b | – | | |
| 138 | Interface feature | Posthole, plastered walls with clay. 0.19m (Diam.) | E half of the trench, at the bottom of the EBA pit (SU 167), 1.60m W of the house model (SU 179/PM0912) | 5.30 | | 137; 136; 135; 139; 177–178; 140–141 | 246b | – | | |
| 139 | Thermal structure TS 19 | Rectangular, three renewals of the clay floor, elaborate substructure consisted of a layer of small flat stones, a layer of few large sherds and layer of burnt pieces of clay, covered by a thin clay layer 0.03m thick. Its northern side plastered with clay. 1.15 (N–S) × 0.80 (E–W) × 0.10/0.11m (H) | Approx. middle of the E side | 5.04–5.25 | | 136; 135; 137–138; 177–178; 140–141 | 249a | PM1092; PM1093; PM1094 | | |
| 140 | Deposit above Surface F22 (SU 136) | Light brown sandy loam containing sparse tiny charcoals and burnt pieces of clay | E half of the trench | 5.00–5.11/5.12m | | 141; 135–139; 177–178 | 247; 249a; 256 (part) | PM0508; PM0510; PM0518; PM0530; PM0533; PM0534 | | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/ BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 141 | Deposit between Surfaces F22 (SU 136) and 21, W half of the trench | Brown, sandy loam containing sparse burnt pieces of clay and, in places, fire residues and a few stones, particularly in the middle of the trench, rich in pottery and finds | W half of the trench | 5.00–5.10 | 5 × 7 | 140; 139; 135–139; 177–178 | 251 (part); 252 (part); 253 (part); 254 (part) | PM0502; PM0503; PM0504; PM0505; PM0506; PM0511; PM0512; PM0513; PM0514; PM0515; PM0520; PM0521; PM0522; PM0523; PM0524; PM0525; PM0526; PM0527; PM0528; PM0531; PM0532; PM0535; PM0561; PM0562; PM0563; PM0564; PM0565; PM0566; PM1028; PM1029; PM1030; PM1031; PM1032; PM1033; PM1034; PM1035; PM1036; PM1037; PM1038; PM1039; PM1040; PM1041; PM1046 | VIIb | 6 |
| 142 | Surface F21 | Hard compact clay, in places admixed with small pebbles, preserved only in places | Preserved in an area 0.86 (E–W) × 0.55m (N–S), in contact with S side of the trench, in restricted areas in the middle and close to the E side and near corners except from NW corner. Largely destroyed by an EBA pit (SU 167) | 4.94/4.97–5.00 | 5 × 7 | 142–150; 179–180; 151–152 | 253; 254 | PM0476; PM0477; PM0478; PM0479; PM0480; PM0494; PM0495; PM0496; PM0497; PM0498; PM0499; PM0500; PM0501; PM0529; PM1042; PM1043; PM1044; PM1045 | VIIc | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/ BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 143 | Interface feature | Posthole, elliptical, adjacent and similar to posthole SU 144. Walls plastered with clay, a few small stones in the bottom. 0.21 × 0.11m (Dim.) | SE corner | 4.87 | 5 × 7 | 144–145; 147; 149; 146; 148; 150; 142; 179–180; 151–152 | 253 (part); 254 (part) | – | VIIc | 6 |
| 144 | Interface feature | Posthole, elliptical, adjacent and similar to posthole SU 143. Walls plastered with clay, a few small stones in the bottom. 0.18 × 0.15m (Dim.) | SE corner | 4.87 | | 143; 145; 147; 149; 146; 148; 150; 142; 179–180; 151–152 | 253 (part); 254 (part) | – | | |
| 145 | Interface feature | Small elliptical shallow pit 1.20 (E–W) × 0.70m (N–S) | N part of the trench (Area E) | 4.94–5.05 | | 143; 144; 147; 149; 146; 148; 150; 142; 179–180; 151–152 | 253 (part); 254 (part) | – | | |
| 146 | Fill of the interface feature SU 145 | Black burnt soft soil, with carbonised seeds | N part of the trench | 4.94–5.05 | | 148; 150; 143–145; 147; 149; 142; 179–180; 151–152 | 253 (part); 254 (part) | – | | |
| 147 | Interface feature | Small and shallow quadrangular pit, 0.62 (NE–SW) × 0.38m (NW–SE) | NW corner (Area A) | 4.82–5.08 | | 145; 149; 143–144; 146; 148; 150; 142; 179–180; 151–152 | 253 (part); 254 (part) | – | | |
| 148 | Fill of interface feature SU 147 | Black burnt soil containing 10 flaked stone tools | NW corner | 4.82–5.08 | | 147; 179; 146; 150; 145; 149; 143–144; 142; 180; 151–152 | 253 (part); 254 (part) | PM0481; PM0482; PM0483; PM0484; PM0485; PM0486; PM0487; PM0488; PM0489; PM0490 | | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/ BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 149 | Interface feature | Small shallow circular pit. Diam.: 0.86–0.88m | NW corner (Area D) | 4.96–5.01 | 5 × 7 | 150; 145; 147; 146; 148; 143–144; 142; 179–180; 151–152 | 253 (part); 254 (part) | – | VIIc | 6 |
| 150 | Fill of interface feature SU 149 | Black burnt soft soil | NW corner | 4.96–5.01 | | 149; 148; 146; 145; 147; 143–144; 142; 179–180; 151–152 | 253 (part); 254 (part) | – | | |
| 151 | Deposit between Surfaces F21 (SU 142) and F20 (SU 153) | Dark-brown sandy loam soil with scattered small stones | E half of the trench | 4.82/4.84 (W) / 4.82 (E) – 4.94/4.97 | | 152; 142–148; 179–180; 149–150 | 256 | PM0455; PM0459; PM0462; PM0463; PM0470; PM1056; PM1057 | | |
| 152 | Deposit between Surfaces F21 (SU 142) and F20 (SU 153) | Soft soil, in places, bright grey or blackened (SW corner), with scattered ashes, small stones, charcoals, few bones, burnt pieces of clay, mainly in middle of the trench | W half of the trench | 4.82/4.84 (W) / 4.82 (E) – 4.97/5.03 | | 151; 142–148; 179–180; 149–150 | 255 | PM0446; PM0450; PM0453; PM0454; PM0456; PM0457; PM1058; PM1059; PM0460; PM0461; PM0464; PM0465; PM0466; PM0467; PM0468; PM0469; PM0471; PM0472; PM0473; PM0474; PM1047; PM1048; PM1049; PM1050; PM1051; PM1052; PM1053; PM1054; PM1055 | | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/ BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 153 | Surface F20 | Compact yellowish-grey clayey soil | Entire trench | 4.75 (E) / 4.80 (W) – 4.82/4.84 (W) / 4.82 (E) | 5 × 7 | 154–158; 181; 159–165 | 258, 260 | PM0440; PM0441; PM0442; PM1058; PM1059; PM1060; PM1061; PM1062; PM1063; PM1071; PM1073; PM1074 | VIII | 6 |
| 154 | Interface feature | Small, almost circular pit. Diam.: 0.72/0.80m | S–SW area (Area B) | 4.70–4.92 | | 155–157; 153; 158; 181; 159–165 | 258; 255 (part); 259 (part) | – | | |
| 155 | Fill of interface feature SU 154 | Black burnt soil with few bones and sherds and some burnt pieces of clay | S–SW area | 4.70–4.92 | | 154; 156–157; 153; 158; 181; 159–165 | 258; 255 (part); 259 (part) | PM0444; PM0451; PM0452 | | |
| 156 | Interface feature | Small circular pit (area C). Diam.: 1.40/1.48m | SW area | 4.70–4.98 | | 157; 154–155; 153; 158; 181; 159–165 | 258; 255 (part); 259 (part) | – | | |
| 157 | Fill of interface feature SU 156 | Black soft soil with few bones and sherds and some burnt pieces of clay | SW area | 4.70–4.98 | | 156; 154–155; 153; 158; 181; 159–165 | 258; 255 (part); 259 (part) | PM0443; PM0448; PM0449 | | |
| 158 | Thermal structure TS18 | Irregularly circular, partly destroyed by an EBA pit (SU 167). Compact clay floor, substructure with clay admixed with pebbles and small stones along with three broken grinding stones (PM0491; PM0492; PM0493) Diam.: 0.50–0.65m | Middle of the trench | 4.81 | | 181; 153–157; 159–165 | 259, 260 | PM0491; PM0492; PM0493 | | |
| 159 | Accumulation of burnt pieces of clay, above Surface F20 (SU 153) | Small accumulation of burnt pieces of clay | Middle of the W side | 4.70–4.80 | | 160–165; 153–158; 181 | 263 (part) | – | | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 160 | Deposit directly above Surface F20 (SU 153) | Hard, dark-brown soil | E half of the trench | 4.45/4.47–4.70/4.75 | 5 × 7 | 159; 161–165; 153–158; 181 | 261 (part); 264; 279 | PM0363; PM0366; PM0368; PM0369; PM0376; PM0377; PM0378; PM0379; PM0384; PM0387; PM0399; PM0421; PM0422; PM0423; PM0424; PM0425; PM0426; PM0427; PM0433; PM0434; PM0435 | VIII | 6 |
| 161 | Deposit above Surface F20 (SU 153) | Greyish-brown soil, very compact and dark-brown in SW area | W half of the trench | 4.45/4.47–4.70/4.75 | | 160; 159; 162–165; 153–158; 181 | 263 (part); 265 (part); 278 (part) | PM0364; PM0370; PM0371; PM0380; PM0381; PM0382; PM0383; PM0385; PM0386; PM0389; PM0390; PM0391; PM0392; PM0396; PM0397; PM0403; PM0404; PM0405; PM0407; PM0409; PM0410; PM0411; PM0414; PM0415; PM1001; PM1064; PM1065; PM1066; PM1067; PM1068; PM1075; PM1076; PM1077; PM1078; PM1079; PM1080; PM1081; PM1082; PM1083; PM1084; PM1085; PM1086; PM1087; PM1088; PM1089; PM1090; PM1091 | | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 162 | Layer with intense traces of fire | Yellowish and reddish soil, in places very compact, containing some bones and some carbonised seeds | Middle of the trench | 4.45/4.47–4.62/4.66 | 5 × 7 | 161; 160; 159; 163–165; 153–158; 181 | 279 (part); 281; 283 | see SU 161 | VIII | 6 |
| 163 | Deposit in between Surfaces F20 and 19 (SU 166) | Homogeneous, dark brown, soil | E half of the trench | 4.17/4.22–4.50 | | 182; 162; 164–165; 161; 160; 159; 153–158; 181 | 282; 286 | PM0320; PM0333; PM0334; PM0335; PM0336; PM0337; PM0338; PM0343; PM0344; PM0347; PM0348; PM0349; PM1070 | | |
| 164 | Deposit in between Surfaces F20 and 19 (SU 166) | Very soft and loose yellowish-brown soil with some burnt pieces of clay and fire residues | W half of the trench | 4.20–4.50 | | 165; 163; 162; 161; 160; 182; 159; 153–158; 181 | 283 (part); 285; 287 | PM0332; PM0339; PM0340; PM0341; PM0342; PM0345; PM0346; PM0350; PM0351; PM0352; PM0357; PM0358 | | |
| 165 | Deposit in between Surfaces F20 and 19 (SU 166) | Soft black soil | NW area | 4.17/4.22–4.25 | | 164; 163; 162; 161; 160; 182; 159; 153–158; 181 | 293 (part) | – | | |
| 166 | Surface F19 | Hard brownish-grey soil, occasionally containing small pebbles | W half of the trench, mainly in NW area | 4.12 (N) / 4.17 (NW) / 4.25 (S/SW) | 5 × 7 | – | 292 | PM0321; PM0322; PM0323 | IX | |
| 167 | Interface feature | Slightly elliptical in shape pit of EBA. Walls slightly narrowing in the bottom 2.70–3.80 (Dim.), 1.23m (D) | E half of the trench | 4.10–5.33 (max) | 5 × 7 | 168–169 | see SU 168 | see SU 168 | EBA pit | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/ BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 168 | Fill of interface feature SU 167 | Several layers containing almost exclusively coarse monochrome pottery | E half of the trench | 4.10–5.33 (max) | 5 × 7 | 167; 169 | 245; 257; 266–277; 284; 288–291 | PM0324; PM0325; PM0326; PM0327; PM0328; PM0329; PM0330; PM0331; PM0353; PM0354; PM0355; PM0356; PM0359; PM0360; PM0361; PM0365; PM0372; PM0373; PM0374; PM0375; PM0393; PM0394; PM0395; PM0398; PM0400; PM0401; PM0402; PM0408; PM0412; PM0413; PM0417; PM0418; PM0419; PM0420; PM0428; PM0429; PM0430; PM0439; PM0445; PM0516; PM0517; PM0550; PM0551; PM0552; PM0908; PM0909 | EBA pit | |
| 169 | Wall W31 | Curved stone wall built over EBA pit (SU 167–168). 4.00 (L) ×~0.40 (W) × 0.10–0.30m (H) | NE area | 4.00 / 4.10–4.30 | 5 × 7 | 167–168 | 290 | EBA | – | |
| 170 | Interface feature | Small pit (its fill corresponds to SU 20 and 21) | 1.20m (N–S) middle of the W side of the trench | 9.05–9.22 | 5 × 2 | 19–22 | 179 (part); 180 (part) | see SU 171 | IIIa | 1 |
| 171 | Surface F34 | The surface onto which wall W39 (SU 172) was laid | Entire trench | 9.13 (W) / 9.50 (E) | | 22–23; 172; 24–36 | 181 | PM0860; PM0861; PM0862; PM0864; PM0867; PM0868; PM0869; PM0870 | IIIa | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/ BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 172 | Wall W39 | Built with posts and abundant clay. Preserved as a broad band of yellowish clay 0.40–0.60m wide and up to 0.40m thick. Five postholes in a line along the W side of the trench set at 0.62–1.02m intervals (SU 26–35). The fallen superstructure shows a W–E slope (SU 24–25) | The fallen superstructure occupied a large part of the trench and sloped strongly eastwards to a distance of 0.25–0.90m from the wall line | 8.78 or 8.70 (W) / 9.58 or 9.50 (E) – 9.13 (W) / 9.50 (E) | 5 × 2 | 171; 24–36 | 181 (part); 182 (part); 183 (part); 184 (part) | see SU 171 | IIIa | 1 |
| 173 | Fill of interface feature (pit) SU 36 | Grey-greenish clayey soil rich in charcoals | In contact with W side, 2.50m from SW, cutting part of the superstructure (SU 24) of wall W39 (SU 172) | 8.70–8.85 | | 36; 172; 24; 37 | 181 (part); 182 (part); 183 (part) | – | IIIb | |
| 174 | Surface F34 | Potential 'surface' of compact soil | Entire trench | 8.55/8.57 | | 43–49 | 186 (part) | – | IIIc | |
| 175 | Vessel in situ | Base of a vessel in situ | N end of wall W34 (SU 116), close to its W side | 6.20 | 5 × 4 | 116–118; 113–115; 119–121 | 213 (part); 214 (part) | – | VIa | 4 |
| 176 | Vessels in situ | The lower part and two large fragments of clay vessels | On Surface F 24 (SU 122), between wall W33 (SU 123) and W side | 5.97 | 5 × 7 | 123; 122; 124–126 | 220 (part) | – | VIb | |
| 177 | Thermal structure TS 36 | Only the circular substructure was preserved with a layer of large coarse sherds | N/NW of TS 19 (SU 139), over a pit (SU 130) | 5.20–5.34 | | 139; 177; 135–141 | wb38 | – | VIIa | 5 |
| 178 | Circular accumulation of sherds of a storage vessel | Almost circular accumulation of sherds of a storage vessel, very close to TS 20 (SU 171 and 36 (SU 177), Diam.: 0.20–0.30m | NE corner of the trench | 5.25–5.30 | | 177; 130; 127; 133; 134; 136 | 236; 238; 239; 242; 243 | – | VIIa | |
| 179 | Clay house model containing figurines (PM0912) | | E half of the trench, 0.35m N of TS 19 (SU 139) of BSPh VIIb | 5.17 (upper part) / 5.19 (bottom) | | 134; 133; 132; 127–131 | 245; 246; 248; 249; 242; 238 | – | VIIa | |

Tab. III.1 (continued)

| SU-No. | Character | Description | Area | Depth [m] | Trench size [m] | Correlated SU | Correspondence to EU | Small finds | BPh/ BSPh | Ceramic Phase |
|---|---|---|---|---|---|---|---|---|---|---|
| 180 | Interface feature | Posthole penetrating TS 19 of BSPh VIIb, almost circular, 0.20–0.25 (Dim.) | Middle of the E side | 5.04 | 5 × 7 | 139; 142–144 | 249a; 251 | – | VIIc | 6 |
| 181 | Accumulation of 10 flaked stone tools in fill (SU 148) of pit (SU 147) | It comprises the tools: PM0481; PM0482; PM0483; PM0484; PM0485; PM0486; PM0487; PM0488; PM0489 and PM0490 | NW corner | 4.82–5.08 | | 148; 147; 146; 150; 143–145; 149; 142; 180; 151–152 | 253 (part); 254 (part) | – | VIIc | |
| 182 | Vessel in situ | Small open clay vessel | NW part of the trench, on Surface F21 (SU 142) | 4.97 | | 142–148; 179; 149–152 | 253 (part); 254 (part) | – | VIIc | |
| 183 | Small finds in situ | Three broken grinding stones (PM0491, PM0492, PM0493), in substructure of TS 18 (SU 158) | Almost in the middle of the trench, near the W rim of the EBA pit (SU 167) | 4.86–4.91 | | 158; 153–157; 159–165 | 255 (part); 259 (part) | – | VIII | |
| 184 | Human bones (skull) | Human bones (skull) | Middle of the E side | 4.60–4.63 | | 160–165; 159; 153–158; 181 | 279 | – | VIII | |
| 185 | Thin layer of black burnt Surface F 33d | Black burnt soil 0.05m thick containing ashes and fire residues sloping eastwards | S part of the trench | 8.70 (W) / 8.88 (E) – 8.70 (W) / 8.90 (E) | 5 × 2 | 37–43 | 185 (part); 184 (part) | – | IIIb | 1 |
| 186 | Interface feature | Posthole, 0.13–0.19 (Diam.), 0.12m (D) | On Surface F24 (SU 122), between wall W33 (SU 124) and W side of the trench | 5.97–6.09 | 5 × 7 | 123; 122; 124–126; 176 | 220 (part) | – | VIb | 4 |

Tab. III.2a The various categories of small finds per Building Phase (BPh) (G. Toufexis, C. Batzelas)

| BPh/ BSPh | EU | SU | Depth (m) | Flaked stone assemblage | | Macrolithics | | Bone tools | | Clay and sherd tools | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Textile imple-ments | | Sling bullets | |
| I | 175–177 | 3–7 | ~9.88/9.93 –10.30/10.70 | PM0896 | | PM0897 | | 0 | | 0 | | 0 | |
| | | | | 1 | | 1 | | | | | | | |
| II | 178–180 | 8–19 | ~9.13 (W) / ~9.50 (E) – ~9.88 (W) / ~9.93 (E) | PM0872; PM0875; PM0880; PM0884; PM0889; PM0890 | | PM0871; PM0877; PM0879; PM0893; PM0894; PM0895; PM0947; PM0952; PM0954; PM0955; PM0956 | | PM0865; PM0929 | | PM0876; PM0882; PM0886 | | PM0881; PM0888 | |
| | | | | 6 | | 11 | | 2 | | 3 | | 2 | |
| IIIa | 181–183 | 20–35; 170–172 | ~8.96 (W) / 9.40 (E) – 9.13 (W) / ~9.50 (E) | 8 | PM0855; PM0857; PM0859; PM0861; PM0862; PM0867; PM0868; PM0870 | 5 | PM0856; PM0858; PM0860; PM0864; PM0869 | 1 | PM0854 | 0 | | 0 | |
| IIIb | 184; 185 | 36–43; 173; 185 | ~8.55 (W) / 8.70 (E) – 8.96 (W) / 9.20 (E) | 18 | PM0811; PM0812; PM0814; PM0820; PM0823; PM0828; PM0829; PM0833; PM0836; PM0838; PM0840; PM0845; PM0846; PM0848; PM0849; PM0850; PM0851; PM0852 | 4 | PM0817; PM0827; PM0839; PM0843 | 3 | PM0810; PM0835; PM0930 | 0 | | 0 | |
| IIIc | 186 | 174; 44–49 | ~8.30–8.60 | 5 | PM0801; PM0802; PM0806; PM0807; PM0808 | 1 | PM0809 | 3 | PM0798; PM0800; PM0805 | 1 | PM0960 | 0 | |
| III | 181–186 | 20–49; 170–174; 185 | ~8.30–9.13 (W) / ~9.50 (E) | 31 | | 10 | | 7 | | 1 | | 0 | |
| IVa | 187; 188 | 50–60 | ~8.20–8.30 | 4 | PM0781; PM0784; PM0787; PM0797 | 6 | PM0783; PM0791; PM0794; PM0795; PM0796; PM0918 | 1 | PM0928 | 0 | | 0 | |
| IVb | 189–192 | 61–71 | ~7.70–8.14/8.23 | 3 | PM0773; PM0774; PM0786 | 1 | PM0777 | 1 | PM0785 | 1 | PM0919 | 1 | PM0779 |
| IV | 187–192 | 50–71 | ~7.70–8.30 | 7 | | 7 | | 2 | | 1 | | 1 | |
| Va | 193–195 | 72–84 | ~7.40–7.70 | 1 | PM0770 | 3 | PM0766; PM0771; PM0772 | 1 | PM0767 | 1 | PM0765 | 0 | |
| Vb | 196–198 | 85–90 | ~7.06/7.10/ 7.15–7.40 | 5 | PM0746; PM0751; PM0754; PM0761; PM0764 | 12 | PM0747; PM0748; PM0749; PM0756; PM0757; PM0758; PM0759; PM0760; PM0762; PM0763; PM0998; PM0999 | 0 | | 1 | PM0933 | 0 | |

| Clay and sherd tools | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Scrapers/ abrasive instruments | | Rounded sherds | | Eight-shaped sherd tools | | Sherd burnishers | | Figurines and other ritual objects | | Ornaments | | Metal objects | Totals per BPh/BSPh | Percentage (%) per BPh/BSPh |
| 0 | | 0 | | 0 | | 0 | | PM0898<br>1 | | 0 | | 0 | 3 | 0% |
| 0 | | 0 | | 0 | | 0 | | PM0873; PM0878; PM0892<br>3 | | 0 | | 0 | 27 | 5% |
| 0 | | 1 | PM0913 | 0 | | 1 | PM0914 | 0 | | 0 | | 0 | 16 | 3% |
| 0 | | 0 | | 0 | | 0 | | 3 | PM0819; PM0830; PM0847 | 0 | | 0 | 28 | 5% |
| 1 | PM0917 | 2 | PM0915; PM0916 | 0 | | 0 | | 0 | | 0 | | 0 | 13 | 2% |
| 1 | | 3 | | 0 | | 1 | | 3 | | 0 | | 0 | 57 | 10% |
| 0 | | 0 | | 0 | | 0 | | 1 | PM0792 | 1 | PM0793 | 0 | 13 | 2% |
| 0 | | 2 | PM0921; PM0922 | 0 | | 2 | PM0920; PM0923 | 1 | PM0924 | 0 | | 0 | 12 | 2% |
| 0 | | 2 | | 0 | | 2 | | 2 | | 1 | | 0 | 25 | 4% |
| 0 | | 0 | | 1 | PM0925 | 1 | PM00926 | 0 | | 0 | | 0 | 8 | 1% |
| 0 | | 0 | | 0 | | 0 | | 1 | PM0753 | 0 | | 0 | 19 | 3% |

Tab. III.2a (continued)

| BPh/ BSPh | EU | SU | Depth (m) | Flaked stone assemblage | | Macrolithics | | Bone tools | | Clay and sherd tools | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Textile imple-ments | | Sling bullets | |
| **Vc** | 199 | 91–100 | ~7.00–7.06/7.10/7.15 | 0 | | 1 | PM0745 | 0 | | 0 | | 0 | |
| **Vd** | 200–204 | 101–107 | ~6.50/6.60–7.00 | 7 | PM0728; PM0734; PM0735; PM0736; PM0738; PM0742; PM0743 | 7 | PM0729; PM0730; PM0731; PM0732; PM0740; PM0741; PM0938 | 0 | | 2 | PM0739; PM0939 | 2 | PM0726; PM0727 |
| **Ve** | 205–209 | 108–112 | ~6.30–6.54 | 4 | PM0687; PM0688; PM0708; PM0723 | 14 | PM0689; PM0697; PM0705; PM0706; PM0707; PM0710; PM0713; PM0715; PM0716; PM0719; PM0720; PM0721; PM0722; PM0724 | 2 | PM0700; PM0717 | 1 | PM0718 | 1 | PM0711 |
| **V** | 193–209 | 72–112 | ~6.30–7.70 | 17 | | 37 | | 3 | | 5 | | 3 | |
| **VIa** | 210–214; 216 | 113–121; 175 | ~6.00–6.30 | 10 | PM0652; PM0668; PM0669; PM0671; PM0672; PM0673; PM0679; PM0685; PM0686; PM0696 | 21 | PM0654; PM0656; PM0660; PM0674; PM0675; PM0677; PM0678; PM0680; PM0681; PM0682; PM0683; PM0684; PM0691; PM0692; PM0693; PM0694; PM0695; PM0699; PM0714; PM0942; PM0943 | 1 | PM0658 | 1 | PM0993 | 2 | PM0653; PM0655 |
| **VIb** | 217–221; 223; 225–230 | 122–126; 176; 186 | ~5.68 (W) / 5.52/5.62 (E) – 6.00 | 16 | PM0627; PM0628; PM0629; PM0633; PM0634; PM0635; PM0636; PM0642; PM0644; PM0647; PM0648; PM0649; PM0664; PM0665; PM0666; PM0667 | 8 | PM0643; PM0662; PM0945; PM0946; PM0995; PM1069; PM1095; PM1096 | 1 | PM0661 | 1 | PM0650 | 2 | PM0646; PM0996 |

| Clay and sherd tools | | | | | | | | | | | | | | | | | | Figurines and other ritual objects | | Ornaments | | Metal objects | | Totals per BPh/BSPh | Percent-ages (%) per BPh/ BSPh |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Scrapers/ abrasive instruments | | Rounded sherds | | | | Eight-shaped sherd tools | | | | Sherd burnishers | | | | | | | | | | | | | | | |
| 0 | | 1 | PM0937 | | | 0 | | | | 0 | | | | | | | | 2 | PM0935; PM0936 | 0 | | 0 | | 4 | 1% |
| 0 | | 0 | | | | 0 | | | | 0 | | | | | | | | 3 | PM0725; PM0733; PM0737 | 0 | | 0 | | 21 | 4% |
| 1 | PM0690 | 1 | PM0941 | | | 0 | | | | 1 | PM00940 | | | | | | | 0 | | 1 | PM0709 | 0 | | 26 | 4% |
| 1 | | 2 | | | | 1 | | | | 2 | | | | | | | | 6 | | 1 | | 0 | | 78 | 13% |
| 1 | PM0698 | 2 | PM0676; PM0990 | | | 0 | | | | 1 | PM0944 | | | | | | | 1 | PM0657 | 0 | | 0 | | 40 | 7% |
| 0 | | 4 | PM0961; PM1002; PM1008; PM1009 | 1 | PM0997 | | | | | 0 | | | | | | | | 4 | PM0640; PM0641; PM0645; PM0651 | 3 | PM 0637; PM0638; PM0639 | 1 | PM0663 | 41 | 7% |

Tab. III.2a (continued)

| BPh/ BSPh | EU | SU | Depth (m) | Flaked stone assemblage | | Macrolithics | | Bone tools | | Clay and sherd tools | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Textile imple-ments | | Sling bullets | |
| **VI** | 210–230 | 113–126; 175–176; 186 | ~5.68 (W) 5.52/5.62 (E) – 6.30 | 26 | | 29 | | 2 | | 2 | | 4 | |
| **VIIa** | 231; 233–243; 248; 250 | 127–134; 177–179 | ~5.18 (E half) / 5.15/5.17 (W half) – 5.56/5.60 (E half) / 5.65/5.68 (W half) | 45 | PM0568; PM0569; PM0573; PM0574; PM0576; PM0579; PM0580; PM0583; PM0584; PM0585; PM0586; PM0587; PM0588; PM0589; PM0592; PM0593; PM0594; PM0595; PM0596; PM0597; PM0598; PM0600; PM0601; PM0602; PM0603; PM0604; PM0605; PM0606; PM0607; PM0608; PM0609; PM0610; PM0611; PM0612; PM0613; PM0615; PM0616; PM0618; PM0619; PM0622; PM0623; PM0624; PM0625; PM0626; PM0630 | 3 | PM0599; PM0631; PM0989 | 1 | PM0617 | 2 | PM1011; PM1017 | 2 | PM0578; PM0632 |
| **VIIb** | 244; 246a; 246b; 249; 249a; 251; 252 | 135–141 | ~5.04/5.06–5.18/5.20 (E half) / 5.26/5.30 (W half) | 42 | PM0502; PM0503; PM0504; PM0505; PM0510; PM0511; PM0512; PM0514; PM0515; PM0520; PM0521; PM0522; PM0523; PM0526; PM0527; PM0530; PM0531; PM0533; PM0534; PM0536; PM0539; PM0541; PM0542; PM0544; PM0546; PM0548; PM0549; PM0556; PM0557; PM0558; PM0559; PM0560; PM0561; PM0562; PM0563; PM0564; PM0565; PM0566; PM0567; PM0570; PM0571; PM0575 | 17 | PM0506; PM0508; PM0513; PM0518; PM0524; PM0525; PM0528; PM0532; PM0535; PM0537; PM0538; PM0540; PM0554; PM0555; PM1092; PM1093; PM1094 | 0 | | 0 | | 0 | |

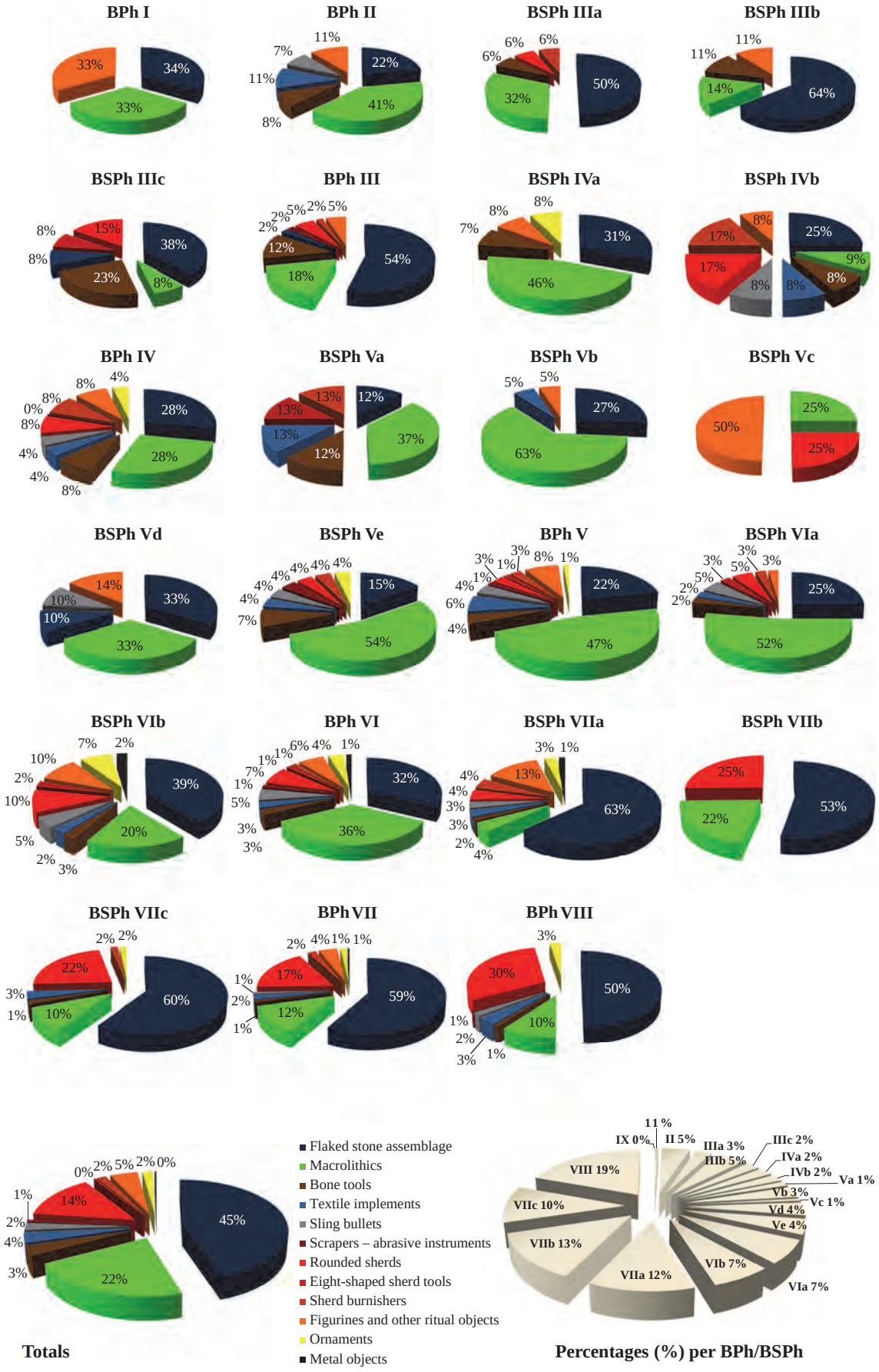
| Clay and sherd tools | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Scrapers/ abrasive instruments | Rounded sherds | | Eight-shaped sherd tools | Sherd burnishers | | Figurines and other ritual objects | | Ornaments | | Metal objects | | Totals per BPh/BSPh | Percent-ages (%) per BPh/ BSPh |
| 1 | 6 | | 1 | 1 | | 5 | | 3 | | 1 | | 81 | 14% |
| 0 | 3 | PM1015; PM1016; PM1023 | 0 | 3 | PM1012; PM1018; PM1021 | 9 | PM0577; PM0590; PM0591; PM0620; PM0621; PM0912; PM1013; PM1014; PM1020 | 2 | PM0581; PM0614 | 1 | PM1019 | 71 | 12% |
| 0 | 20 | PM0553; PM1022; PM1025; PM1026; PM1027; PM1028; PM1029; PM1030; PM1031; PM1032; PM1033; PM1034; PM1035; PM1036; PM1037; PM1038; PM1039; PM1040; PM1041; PM1046 | 0 | 0 | | 0 | | 0 | | 0 | | 79 | 13% |

Tab. III.2a (continued)

| BPh/ BSPh | EU | SU | Depth (m) | Flaked stone assemblage | | Macrolithics | | Bone tools | | Clay and sherd tools | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Textile imple-ments | | Sling bullets |
| **VIIc** | 247; 253; 255; 256 | 142–152; 180–182 | ~4.82/4.84 – 5.04/5.06 (W half) /5.20 (E half) | 37 | PM0453; PM0457; PM0458; PM0460; PM0461; PM0462; PM0463; PM0464; PM0465; PM0469; PM0470; PM0471; PM0472; PM0473; PM0474; PM0476; PM0477; PM0480; PM0481; PM0482; PM0483; PM0484; PM0485; PM0486; PM0487; PM0488; PM0489; PM0490; PM0494; PM0495; PM0496; PM0497; PM0498; PM0499; PM0500; PM0501; PM0529 | 6 | PM0446; PM0454; PM0455; PM0459; PM0466; PM0479 | 1 | PM0468 | 2 | PM0456; PM0478 | 0 |
| **VII** | 231; 233–244; 246–248; 250–253; 255–256 | 127–152; 177–181 | ~4.82/4.84–5.56/5.60 (E half) / 5.65/5.68m (W half) | 124 | | 26 | | 2 | | 4 | | 2 |
| **VIII** | 258–261; 263–265; 278; 279; 281–283; 285–287 | 153–165; 183–184 | ~4.23 (W half) / 4.28/4.30 (E half) – 4.83 (W half) / 4.82 (E half) | 58 | PM0334; PM0335; PM0336; PM0337; PM0338; PM0339; PM0340; PM0341; PM0342; PM0343; PM0344; PM0346; PM0349; PM0350; PM0351; PM0352; PM0357; PM0358; PM0363; PM0364; PM0366; PM0370; PM0371; PM0376; PM0378; PM0380; PM0381; PM0382; PM0383; PM0384; PM0385; PM0386; PM0387; PM0388; PM0389; PM0390; PM0391; PM0392; PM0396; PM0397; PM0399; PM0404; PM0405; PM0409; PM0410; PM0411; PM0421; PM0422; PM0423; PM0424; PM0440; PM0441; PM0442; PM0443; PM0448; PM0449; PM0451; PM0452 | 12 | PM0333; PM0345; PM0368; PM0369; PM0433; PM0434; PM0450; PM0491; PM0492; PM0493; PM1070; PM1071 | 1 | PM0414 | 4 | PM0320; PM0347; PM0348; PM0377 | 2 | PM0332; PM0435 |
| | | | | 58 | | 12 | | 1 | | 4 | | 2 |
| **IX** | 292; 294 | 166 | ~4.18/4.25–4.22/4.25 | 0 | | 0 | | 0 | | 0 | | 0 |
| **Total number per small finds category** | | | | **270** | | **133** | | **19** | | **20** | | **14** |
| **Percentage of each small finds category** | | | | **45%** | | **22%** | | **3%** | | **4%** | | **2%** |

| Clay and sherd tools | | | | | | | | Figurines and other ritual objects | | Ornaments | | Metal objects | Totals per BPh/BSPh | Percent-ages (%) per BPh/ BSPh |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Scrapers/ abrasive instruments | | Rounded sherds | | Eight-shaped sherd tools | Sherd burnishers | | | | | | | | | |
| 0 | | 14 | PM1042; PM1043; PM1044; PM1047; PM1048; PM1049; PM1050; PM1051; PM1052; PM1053; PM1054; PM1055; PM1056; PM1057 | 0 | 1 | PM1045 | | 0 | | 1 | PM0467 | 0 | 62 | 10% |
| 0 | | 37 | | 0 | 4 | | | 9 | | 3 | | 1 | 212 | 35% |
| 1 | PM0444 | 35 | PM0407; PM0415; PM0425; PM0426; PM0427; PM1058; PM1059; PM1060; PM1061; PM1062; PM1063; PM1064; PM1065; PM1066; PM1067; PM1068; PM1073; PM1074; PM1075; PM1076; PM1077; PM1078; PM1079; PM1080; PM1081; PM1082; PM1083; PM1084; PM1085; PM1086; PM1087; PM1088; PM1089; PM1090; PM1091 | 0 | 0 | | | 0 | | 3 | PM0379; PM0403; PM1001 | 0 | 116 | 19% |
| 1 | | 35 | | | | 3 | | | | | | | | |
| 0 | | 0 | | 0 | 0 | | | 0 | | 0 | | 0 | 0 | 0% |
| **4** | | **85** | | **2** | **10** | | | **29** | | **11** | | **2** | **599** | **100%** |
| **1%** | | **14%** | | **0%** | **2%** | | | **5%** | | **2%** | | **0%** | **100%** | |

Tab. III.2b Pie charts showing the percentages of the various categories of small finds per building phase (BPh) (G. Toufexis, C. Batzelas)



Tab. III.3 Burnt pieces of clay per Building Phase (BPh) (G. Toufexis, C. Batzelas)

| BPh/ BSPh | Depth [m] | EU | Burnt pieces of clays | | | | | | | | | | Number of pieces per EU | Weight per EU [g] | Number of pieces per BPh/ BSPh | Weight per BPh/ BSPh [g] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Parts of thermal structures or of wall plasters | | Parts of floors of thermal structures | | Wasters | | Pieces with decorative elements (grooves) | | Unidentified | | | | | |
| | | | Pieces | Weight [g] | Pieces | Weight [g] | Pieces | Weight [g] | Pieces | Weight [g] | Pieces | Weight [g] | | | | |
| **I** | ~9.88 (W) / 9.93 (E) – 10.30 (N) / 10.70 (S) | 175 | 2 | 108 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 108 | **33** | **4919** |
| | | 176 | 12 | 2477 | 1 | 49 | 0 | 0 | 0 | 0 | 4 | 120 | 17 | 2646 | | |
| | | 177 | 11 | 1522 | 1 | 135 | 1 | 486 | 0 | 0 | 1 | 22 | 14 | 2165 | | |
| **II** | 9.13 (W) / ~9.50 (E) – ~9.88 (W) / ~9.93 (E) | 178 | 10 | 1790 | 0 | 0 | 0 | 0 | 7 | 530 | 7 | 53 | 24 | 2373 | **129** | **10153** |
| | | 179 | 37 | 1704 | 3 | 1366 | 0 | 0 | 19 | 2520 | 6 | 222 | 65 | 5812 | | |
| | | 180 | 23 | 949 | 0 | 0 | 0 | 0 | 6 | 360 | 11 | 659 | 40 | 1968 | | |
| **IIIa** | 8.96 (W) / 9.40 (E) – 9.13 (W) / ~9.50 (E) | 181 | 2 | 62 | 1 | 106 | 0 | 0 | 1 | 415 | 0 | 0 | 4 | 583 | **21** | **1861** |
| | | 182 | 8 | 795 | 0 | 0 | 0 | 0 | 1 | 142 | 0 | 0 | 9 | 937 | | |
| | | 183 | 3 | 88 | 2 | 46 | 0 | 0 | 3 | 207 | 0 | 0 | 8 | 341 | | |
| **IIIb** | 8.55 (W) / 8.70 (E) – 8.96 (W) / 9.20 (E) | 184 | 6 | 71 | 0 | 0 | 0 | 0 | 8 | 354 | 5 | 126 | 19 | 551 | **46** | **1321** |
| | | 185 | 15 | 376 | 2 | 75 | 0 | 0 | 5 | 272 | 5 | 47 | 27 | 770 | | |
| **IIIc** | 8.30–8.60 | 186 | 10 | 247 | 5 | 331 | 0 | 0 | 6 | 195 | 3 | 79 | 24 | 852 | **24** | **852** |

Tab. III.3 (continued)

| BPh/ BSPh | Depth [m] | EU | Burnt pieces of clays | | | | | | | | | | Number of pieces per EU | Weight per EU [g] | Number of pieces per BPh/ BSPh | Weight per BPh/ BSPh [g] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Parts of thermal structures or of wall plasters | | Parts of floors of thermal structures | | Wasters | | Pieces with decorative elements (grooves) | | Unidentified | | | | | |
| | | | Pieces | Weight [g] | Pieces | Weight [g] | Pieces | Weight [g] | Pieces | Weight [g] | Pieces | Weight [g] | | | | |
| **IVa** | 8.20–8.30 | 187 | 10 | 291 | 5 | 213 | 0 | 0 | 2 | 79 | 3 | 57 | 20 | 640 | **27** | **715** |
| | | 188 | 4 | 29 | 1 | 23 | 0 | 0 | 0 | 0 | 2 | 23 | 7 | 75 | | |
| **IVb** | 7.57/ 7.61–8.14/ 8.23 | 189 | 3 | 223 | 1 | 47 | 0 | 0 | 0 | 0 | 2 | 12 | 6 | 282 | **61** | **2427** |
| | | 190 | 4 | 96 | 3 | 207 | 0 | 0 | 4 | 437 | 0 | 0 | 11 | 740 | | |
| | | 191 | 2 | 67 | 2 | 66 | 0 | 0 | 3 | 275 | 2 | 35 | 9 | 443 | | |
| | | 192 | 7 | 196 | 2 | 64 | 0 | 0 | 3 | 94 | 2 | 42 | 14 | 396 | | |
| | | 193 | 11 | 268 | 2 | 30 | 0 | 0 | 2 | 139 | 6 | 129 | 21 | 566 | | |
| **Va** | 7.30–7.57/7.61 | 194 | 3 | 140 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 140 | **43** | **1795** |
| | | 195 | 8 | 252 | 2 | 87 | 0 | 0 | 2 | 319 | 4 | 360 | 16 | 1018 | | |
| | | 196 | 8 | 350 | 8 | 209 | 0 | 0 | 0 | 0 | 8 | 78 | 24 | 637 | | |
| **Vb** | 7.06/ 7.10/ 7.15–7.30 | 197 | 25 | 672 | 6 | 596 | 0 | 0 | 0 | 0 | 22 | 370 | 53 | 1638 | **67** | **1890** |
| | | 198 | 10 | 125 | 2 | 53 | 0 | 0 | 0 | 0 | 2 | 74 | 14 | 252 | | |
| **Vc** | 7.00–7.06/ 7.10/ 7.15 | 199 | 7 | 42 | 3 | 69 | 0 | 0 | 0 | 0 | 2 | 35 | 12 | 146 | **12** | **146** |

Tab. III.3 (continued)

| BPh/ BSPh | Depth [m] | EU | Burnt pieces of clays | | | | | | | | | | Number of pieces per EU | Weight per EU [g] | Number of pieces per BPh/ BSPh | Weight per BPh/ BSPh [g] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Parts of thermal structures or of wall plasters | | Parts of floors of thermal structures | | Wasters | | Pieces with decorative elements (grooves) | | Unidentified | | | | | |
| | | | Pieces | Weight [g] | Pieces | Weight [g] | Pieces | Weight [g] | Pieces | Weight [g] | Pieces | Weight [g] | | | | |
| **Vd** | 6.50/ 6.60–7.00 | 200 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **35** | **561** |
| | | 201 | 11 | 186 | 1 | 32 | 0 | 0 | 0 | 0 | 0 | 0 | 12 | 218 | | |
| | | 202 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | | 203 | 1 | 27 | 5 | 42 | 0 | 0 | 0 | 0 | 2 | 78 | 8 | 147 | | |
| | | 204 | 10 | 106 | 1 | 48 | 0 | 0 | 0 | 0 | 4 | 42 | 15 | 196 | | |
| **Ve** | 6.30–6.54 | 205 | 5 | 205 | 1 | 13 | 0 | 0 | 2 | 270 | 0 | 0 | 8 | 488 | **29** | **2116** |
| | | 206 | 0 | 0 | 2 | 205 | 0 | 0 | 0 | 0 | 1 | 4 | 3 | 209 | | |
| | | 207 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | | 208 | 8 | 254 | 1 | 592 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 846 | | |
| | | 209 | 5 | 78 | 0 | 0 | 0 | 0 | 3 | 491 | 1 | 4 | 9 | 573 | | |
| **VIa** | 5.92–6.30 | 210 | 5 | 162 | 1 | 98 | 0 | 0 | 0 | 0 | 2 | 22 | 8 | 282 | **62** | **2920** |
| | | 211 | 6 | 134 | 0 | 0 | 0 | 0 | 3 | 150 | 0 | 0 | 9 | 284 | | |
| | | 213 | 6 | 195 | 0 | 0 | 0 | 0 | 2 | 209 | 0 | 0 | 8 | 404 | | |
| | | 214 | 21 | 812 | 0 | 0 | 0 | 0 | 3 | 427 | 5 | 79 | 29 | 1318 | | |
| | | 216 | 2 | 30 | 0 | 0 | 0 | 0 | 6 | 602 | 0 | 0 | 8 | 632 | | |

Tab. III.3 (continued)

| BPh/ BSPh | Depth [m] | EU | Burnt pieces of clays | | | | | | | | | | Number of pieces per EU | Weight per EU [g] | Number of pieces per BPh/ BSPh | Weight per BPh/ BSPh [g] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Parts of thermal structures or of wall plasters | | Parts of floors of thermal structures | | Wasters | | Pieces with decorative elements (grooves) | | Unidentified | | | | | |
| | | | Pieces | Weight [g] | Pieces | Weight [g] | Pieces | Weight [g] | Pieces | Weight [g] | Pieces | Weight [g] | | | | |
| **VIb** | 5.44/5.50 (W) / 5.46/5.52 (E) – 5.95 | 217 | 18 | 898 | 0 | 0 | 0 | 0 | 1 | 50 | 0 | 0 | 19 | 948 | **147** | **5376** |
| | | 218 | 11 | 116 | 1 | 53 | 0 | 0 | 1 | 19 | 0 | 0 | 13 | 188 | | |
| | | 219 | 5 | 228 | 0 | 0 | 0 | 0 | 2 | 92 | 2 | 67 | 9 | 387 | | |
| | | 220 | 2 | 43 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 43 | | |
| | | 221 | 20 | 471 | 1 | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 21 | 490 | | |
| | | 223 | 6 | 166 | 1 | 105 | 1 | 85 | 0 | 0 | 1 | 22 | 9 | 378 | | |
| | | 225 | 10 | 257 | 3 | 210 | 0 | 0 | 4 | 94 | 6 | 48 | 23 | 609 | | |
| | | 226 | 10 | 205 | 0 | 0 | 0 | 0 | 7 | 592 | 0 | 0 | 17 | 797 | | |
| | | 227 | 2 | 320 | 0 | 0 | 0 | 0 | 1 | 19 | 1 | 18 | 4 | 357 | | |
| | | 228 | 10 | 450 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 50 | 16 | 500 | | |
| | | 229 | 7 | 249 | 2 | 30 | 0 | 0 | 3 | 295 | 0 | 0 | 12 | 574 | | |
| | | 230 | 1 | 87 | 1 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 105 | | |
| **VIIa** | 5.18 (E half) / 5.15/5.17 (W half) – 5.56/5.60 (E half) / 5.65/5.68 (W half) | 231 | 3 | 80 | 0 | 0 | 0 | 0 | 3 | 93 | 2 | 20 | 8 | 193 | **279** | **10644** |
| | | 232 | 1 | 101 | 0 | 0 | 0 | 0 | 4 | 114 | 3 | 51 | 8 | 266 | | |
| | | 233 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 155 | 0 | 0 | 3 | 155 | | |
| | | 234 | 14 | 690 | 1 | 35 | 1 | 6 | 0 | 0 | 4 | 20 | 20 | 751 | | |
| | | 235 | 2 | 237 | 0 | 0 | 1 | 102 | 0 | 0 | 3 | 38 | 6 | 377 | | |
| | | 236 | 4 | 188 | 2 | 137 | 0 | 0 | 0 | 0 | 5 | 104 | 11 | 429 | | |
| | | 237 | 13 | 360 | 2 | 69 | 0 | 0 | 1 | 82 | 5 | 85 | 21 | 596 | | |
| | | 238 | 27 | 1199 | 2 | 349 | 0 | 0 | 7 | 1864 | 16 | 89 | 52 | 3501 | | |

Tab. III.3 (continued)

| BPh/ BSPh | Depth [m] | EU | Burnt pieces of clays | | | | | | | | | | Number of pieces per EU | Weight per EU [g] | Number of pieces per BPh/ BSPh | Weight per BPh/ BSPh [g] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Parts of thermal structures or of wall plasters | | Parts of floors of thermal structures | | Wasters | | Pieces with decorative elements (grooves) | | Unidentified | | | | | |
| | | | Pieces | Weight [g] | Pieces | Weight [g] | Pieces | Weight [g] | Pieces | Weight [g] | Pieces | Weight [g] | | | | |
| VIIa | 5.18 (E half) / 5.15/5.17 (W half) – 5.56/5.60 (E half) / 5.65/5.68 (W half) | 239 | 12 | 300 | 3 | 19 | 3 | 70 | 0 | 0 | 4 | 31 | 22 | 420 | 279 | 10644 |
| | | 240 | 10 | 185 | 5 | 158 | 1 | 40 | 2 | 67 | 4 | 18 | 22 | 468 | | |
| | | 241 | 6 | 93 | 1 | 4 | 0 | 0 | 0 | 0 | 4 | 22 | 11 | 119 | | |
| | | 242 | 10 | 153 | 0 | 0 | 1 | 251 | 1 | 84 | 1 | 32 | 13 | 520 | | |
| | | 248 | 5 | 296 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 15 | 10 | 311 | | |
| | | 249b | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 1484 | 0 | 0 | 5 | 1484 | | |
| | | 250 | 50 | 914 | 6 | 50 | 0 | 0 | 0 | 0 | 11 | 90 | 67 | 1054 | | |
| VIIb | 5.04/ 5.06–5.18/ 5.20 (E half) / 5.26/5.30 (W half) | 244 | 7 | 146 | 0 | 0 | 1 | 44 | 0 | 0 | 6 | 48 | 14 | 238 | 141 | 2561 |
| | | 246a | 3 | 45 | 0 | 0 | 1 | 21 | 2 | 84 | 4 | 33 | 10 | 183 | | |
| | | 246b | 6 | 90 | 3 | 68 | 0 | 0 | 0 | 0 | 1 | 4 | 10 | 162 | | |
| | | 249a, c | 25 | 844 | 40 | 219 | 0 | 0 | 1 | 79 | 0 | 0 | 66 | 1142 | | |
| | | 251 | 6 | 115 | 10 | 324 | 1 | 21 | 0 | 0 | 6 | 38 | 23 | 498 | | |
| | | 252 | 9 | 87 | 5 | 122 | 2 | 115 | 0 | 0 | 2 | 14 | 18 | 338 | | |
| VIIc | 4.82/ 4.84–5.04/ 5.06 (W half or the entire trench) / 5.20 (E half) | 247 | 2 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 16 | 77 | 1267 |
| | | 253 | 21 | 249 | 7 | 145 | 3 | 52 | 1 | 105 | 11 | 48 | 43 | 599 | | |
| | | 255 | 9 | 328 | 5 | 50 | 0 | 0 | 1 | 15 | 6 | 23 | 21 | 416 | | |
| | | 256 | 4 | 114 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 122 | 11 | 236 | | |

Tab. III.3 (continued)

| BPh/ BSPh | Depth [m] | EU | Burnt pieces of clays | | | | | | | | | | Number of pieces per EU | Weight per EU [g] | Number of pieces per BPh/ BSPh | Weight per BPh/ BSPh [g] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Parts of thermal structures or of wall plasters | | Parts of floors of thermal structures | | Wasters | | Pieces with decorative elements (grooves) | | Unidentified | | | | | |
| | | | Pieces | Weight [g] | Pieces | Weight [g] | Pieces | Weight [g] | Pieces | Weight [g] | Pieces | Weight [g] | | | | |
| **VIII** | ~4.23 (W half) / 4.28/4.30 (E half)– 4.83 (W half) / 4.82 (E half) | 258 | 0 | 0 | 1 | 32 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 32 | **252** | **7963** |
| | | 259 | 17 | 1721 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 23 | 19 | 1744 | | |
| | | 260 | 6 | 81 | 1 | 49 | 0 | 0 | 1 | 16 | 7 | 120 | 15 | 266 | | |
| | | 261 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | | 263 | 0 | 0 | 0 | 0 | 1 | 17 | 0 | 0 | 0 | 0 | 1 | 17 | | |
| | | 264 | 6 | 242 | 1 | 14 | 0 | 0 | 0 | 0 | 11 | 72 | 18 | 328 | | |
| | | 265 | 2 | 99 | 1 | 10 | 0 | 0 | 1 | 23 | 3 | 20 | 7 | 152 | | |
| | | 278 | 12 | 546 | 6 | 107 | 1 | 13 | 0 | 0 | 11 | 58 | 30 | 724 | | |
| | | 279 | 23 | 580 | 4 | 147 | 0 | 0 | 0 | 0 | 6 | 17 | 33 | 744 | | |
| | | 281 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | | 282 | 24 | 571 | 1 | 63 | 2 | 47 | 0 | 0 | 9 | 234 | 36 | 915 | | |
| | | 283 | 24 | 631 | 1 | 54 | 2 | 72 | 1 | 164 | 3 | 132 | 31 | 1053 | | |
| | | 285 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | | 286 | 9 | 261 | 7 | 571 | 1 | 12 | 0 | 0 | 0 | 0 | 17 | 844 | | |
| | | 287 | 20 | 504 | 6 | 234 | 5 | 217 | 0 | 0 | 13 | 189 | 44 | 1144 | | |
| **IX** | 4.18/ 4.25– 4.22/ 4.25 | 292 | 4 | 47 | 0 | 0 | 0 | 0 | 3 | 123 | 2 | 48 | 9 | 218 | 9 | 218 |
| **Totals** | | | 819 | 30732 | 194 | 8267 | 29 | 1671 | 147 | 14200 | 305 | 4835 | 1494 | 59705 | 1494 | 59705 |

Tab. III.4 Thermal structures per building phase (BPh) (G. Toufexis, C. Batzelas)

| | TS-Nos. | BPh/BSPh | SU | Area | Depth [m] | Type | | | | Shape | | | | Size [m] | Floor | | | Substructure | | | | Period |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Hearth | Oven | Fire pit | Unidentified | Circular | Elliptical | Quadrangular | Unidentified | | Clay | Burnt soil | Unidentified | Stones and/or sherds | Sand and/or pebbles | Unidentified | No substructure | |
| 1 | 33 | IVa | 55 | W | 8.15 | | ● | | | | | | ● | 0.60 × 0.40 | ● | | | | ● | | | MN I |
| 2 | 32a | Va | 73 | W | 7.55/7.60 | | | ● | | | | | ● | ~0.90 × 2 | | | ● | | | | ● | MN II |
| 3 | 32 | Va | 82 | W | ~7.52/7.55 | | | ● | | | | | ● | ~0.90 × 2 | | | ● | | | | ● | MN II |
| 4 | 31 | Vb | 86 | SE | ~7.30 | ● | | | | ● | | | | ~0.40 | | ● | | | ● | | | MN II |
| 5 | 30 | Vb | 87 | S | ~7.30 | ● | | | | ● | | | | ~0.40 | | ● | | | | | | MN II |
| 6 | 29 | Vb | 88 | middle | 7.25 | ● | | | | | ● | | | 0.50 × 0.30 | | | | | ● | | | MN II |
| 7 | 28b | Vc | 93 | SW | 7.10 | | ● | | | ● | | | | ~0.40 | | ● | | ● | | | | MN II |
| 8 | 28a | Vc | 94 | SW | ~7.05 | | | | ● | ● | | | | ~0.40 | | ● | | | ● | | | MN II |
| 9 | 28 | Vc | 95 | SW | ~7.00 | | ● | | | ● | | | | ~0.40 | | ● | | | ● | | | MN II |
| 10 | 27 | Vc | 96 | SE | ~7.00 | ● | | | | | ● | | | 0.60 × 0.33 | | ● | | | ● | | | MN II |
| 11 | 26 | Vd | 102 | middle | ~6.80 | | ● | | | ● | | | | ~0.80 | ● | | | | ● | | | MN II |
| 12 | 25 | Vd | 103 | W | ~6.80 | | ● | | | ● | | | | ~0.80 | ● | | | | ● | | | MN II |
| 13 | 23 | Ve | 109 | middle | 6.30 | | ● | | | | ● | | | 0.90 × 0.80 | ● | | | | ● | | | MN II |
| 14 | 22a | VIa | 114 | W | ~6.25 | | ● | | | | ● | | | 0.70 × 0.64 | ● | | | | ● | | | MN III |
| 15 | 22 | VIa | 115 | W | 6.20 | | ● | | | | ● | | | 0.70 × 0.64 | ● | | | | ● | | | MN III |
| 16 | 21 | VIb | 125 | W | 5.92 | ● | | | | ● | | | | 0.25 | ● | | | | | ● | | MN III |
| 17 | 20 | VIIa | 131 | NE corner | 5.18 | ● | | | | | | ● | | 1.35 × 0.50 × 0.25 | ● | | | ● | | | | MN III–LN I |
| 18 | 36 | VIIa | 177 | NE | ~5.50 | ● | | | | ● | | | | ~0.80 | ● | | | ● | | | | LN I |
| 19 | 19 | VIIb | 139 | E | 5.04 | ● | | | | | | ● | | 1.25 × 0.80 × 0.20 | ● | | | ● | | | | LN I |
| 20 | 18 | VIII | 158 | middle | 4.81 | ● | | | | ● | | | | 0.60 | ● | | | | ● | | | LN I |

# IV. The Absolute Chronology of the Excavations: Radiocarbon Dating and Stratigraphic Age Modelling

*Bernhard Weninger – Giorgos Toufexis – Christos Batzelas*

## IV.1. Introduction

To establish an absolute timescale for the Neolithic stratigraphy of PMZ we have at our disposal altogether ten $^{14}C$ ages on short-lived animal bones (Tab. IV.1). The $^{14}C$ measurements were processed in 2017 at the $^{14}C$-AMS laboratory of the Klaus Tschira Archaeometry Centre of the University of Heidelberg under the direction of Ronny Friedrich. The majority of $^{14}C$ ages have standard deviations of ±30 BP or better. During sampling, great care was taken to avoid any kind of 'old carbon' effect due to old wood (inner tree rings), or recycled old wood (secondary use, etc.).

## IV.2. The $^{14}C$ Database

The data table begins with a serial number (ID1 to ID10) which is to be used below to simplify the identification of the samples (e.g. ID1=MAMS-32119). Then follows the laboratory number (MAMS Labcode) and corresponding conventional $^{14}C$ age. In accordance with the advice given in the MAMS $^{14}C$ data sheets, in Tab. IV.1 we do not provide the values measured for the $\delta^{13}C$ fractionation of the samples, which are machine-specific values (they describe the AMS beam). The next columns show the dated material (bone), the carbon content (%), the measured C/N (carbon/nitrogen) relation, and the collagen content (%). According to the information provided by the Mannheim laboratory, the collagen was extracted using a weak acid dissolution, followed by ultrafiltration and separation of the fraction >30kD. The extracted organic carbon was then dry-frozen and burnt in an elemental analyser to produce $CO_2$ which was further catalysed to produce graphite.

According to the laboratory, the measured values for carbon content, C/N relation, and collagen content are all within the ranges to be expected for well-preserved collagen (C/N: 2.6–3.2, collagen content >1%). The comment that the conspicuously low collagen content of ID10 (MAMS-32133) might be due to the higher wet acidity of the settlement ditch from which the bone derives, compared to the apparently drier house sediments from whence the other samples derive, is our own observation, albeit hypothetical. Altogether, despite some exceptions, the collagen preservation appears to be better for the stratigraphically higher samples. The following columns named 'Trench, Unit', 'Depth [cm]', 'Phase', and 'Context', contain the archaeological information that we have used for the stratigraphic (age-depth) modelling. The final column of Tab. IV.1 shows the calibrated ages for the single $^{14}C$ measurements, as referenced to the calBC-scale, with calibrated dating uncertainties given at 68% confidence. These calibrated ages were derived by using CalPal software (Version 2009.5) and the IntCal13 calibration curve.[222]

[222] Reimer et al. 2013. We have resisted the temptation of updating the PMZ-chronology to IntCal20. For the interval 5900–5450 calBC the calculated change in the chronology of PMZ would have amounted to - 0.1 ± 2.7 BP (i.e.one $^{14}C$-month). For a preliminary presentation of the radiocarbon dates of the site see Toufexis et al. in press.

Tab. IV.1 Radiocarbon ages (N=10) from PMZ, arranged according to MAMS LabCode (Mannheim $^{14}$C-AMS) (B. Weninger)

| ID | Lab-Code | $^{14}$C Age [BP, 68%] | Material | C [%] | C/N | Collagen [%] | Trench, EU | Depth [cm] | BPh/ BSPh | Context | Calendric Age [calBC, 68%] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | MAMS-32119 | 6538 ± 27 | Bone | 27.5 | 3.2 | 3.1 | A, 255 | 491 | VIIc | Below Surface F20 | 5502 ± 24 |
| 2 | MAMS-32120 | 6651 ± 28 | Bone | 22.6 | 3.2 | 1.1 | A, 244 | 522 | VIIb | Established via depth | 5583 ± 32 |
| 3 | MAMS-32123 | 6870 ± 27 | Bone | 23.5 | 2.8 | 5.4 | A, 219 | 591 | VIb | From Surface F24 | 5751 ± 33 |
| 4 | MAMS-32124 | 6855 ± 30 | Bone | 22.9 | 2.8 | 2.0 | A, 204 | 657 | Vd | Below Surface F26 | 5733 ± 34 |
| 5 | MAMS-32125 | 6935 ± 36 | Bone | 18.3 | 2.7 | 1.1 | A, 195 | 745 | Va | Below Surface F29 | 5813 ± 49 |
| 6 | MAMS-32126 | 6938 ± 30 | Bone | 18.0 | 2.7 | 3.7 | A, 192 | 775 | IVb | Below Surface F30 | 5814 ± 46 |
| 7 | MAMS-32129 | 6892 ± 33 | Bone | 15.0 | 2.8 | 1.9 | A, 185 | 876 | IIIb | Between Surfaces F33a-d | 5777 ± 41 |
| 8 | MAMS-32130 | 6948 ± 29 | Bone | 20.0 | 3.2 | 1.5 | A, 184 | 894 | IIIb | Between Surfaces F33a-d | 5824 ± 46 |
| 9 | MAMS-32131 | 6948 ± 29 | Bone | 24.1 | 3.2 | 0.8 | A, 179 | 967 | II | Below Surface F34 | 5824 ± 46 |
| 10 | MAMS-32133 | 6965 ± 28 | Bone | 24.2 | 3.2 | 0.4 | A, 176 | 1022 | I | Ditch | 5843 ± 45 |

We note in advance that, in our discussion of the PMZ chronology, the only use made of the (unmodelled) single-sample calibrated ages shown numerically in Tab. IV.1, and graphically in Fig. IV.3, is to demonstrate the existence of some strong, artificial chronological distortion (order of magnitude ~100yrs). This age distortion, which is mainly relevant for the youngest PMZ phases, would be immediately introduced into any chronology that is based on the single-sample calibrated ages. This kind of age distortion is not new, but its existence is not widely acknowledged. It can be understood as due to systematic lock-in effects of the multiple $^{14}$C readings on the wiggles of the calibration curve.[223] An elementary description of this effect would be that, since there is a higher number of $^{14}$C-scale readings on the temporally extended wiggles or plateaus of the calibration curve, there is an a priori higher probability that the plateau readings become integrated in our archaeological chronology. This applies, whether or not the plateau readings represent the true sample ages. From a more fundamental mathematical perspective, the age distortion is methodologically preordained (i.e. mathematically inevitable) due to the generally (variable) non-commutative algebraic structure of the calibration curve. In the case of PMZ data, the age distortion is strongest for the two youngest single ages. It exists naturally for all age considerations (i.e. not only for explicitly undertaken age modelling) that are based on calibrated single ages, but can be easily avoided, by use of the chronological results obtained from linear stratigraphic (metric) age-depth modelling, as described below (Fig. IV.5). Application of this linear age model would, strictly speaking, require some independent demonstration that the sediment deposition at PMZ is both continuous and without occupation gaps. Only then could we expect that the PMZ tell growth can be adequately described as resulting from sedimentation processes that add up to

[223] Weninger et al. 2011; Weninger et al. 2015.

produce a time-constant accumulation rate. In effect, although intended to overcome the fallacies associated with naïve application of calibrated single ages, the applied stratigraphic age-depth modelling would itself require further studies, since it would otherwise be founded on similarly undemonstrated assumptions as are associated with the use of single calibration ages. Although lacking these studies, the application of an explicit age-depth model at PMZ nevertheless has a major advantage over single-age dating in that the achieved site chronology, once established, immediately becomes testable. Although the explicitly formulated model assumptions may, indeed, be faulty, they are transparent and open to discussion. A further advantage of explicit age modelling is the possibility to identify potential outliers, both in terms of erratic $^{14}$C measurements and of archaeologically misaligned samples. Yet, we state this as a methodological caveat not only as regards many published $^{14}$C-based archaeological studies but also for our own results, mentioning at the same time that we are not alone. The point hereby is that, in our view, so-called 'archaeological age modelling' of archaeological $^{14}$C dates – although widely applied – is still very much in its infancy. In published studies to date, the main (and often only) component of archaeological age modelling under study is the mathematical one (most often Bayesian). In other words, the large majority of presently so-called 'archaeological age models' are, in actual fact, most often little more than 'statistical descriptions of the available $^{14}$C-data.

Now, as for the archaeological component of stratigraphic age-depth modelling, what we presently know from experience (without modelling) is that the majority of $^{14}$C-dated tell mounds in Anatolia and southeast Europe have an average sediment accumulation rate of ~1cm/yr, with uncertainty in the order of ±20%. This is presently little more than an empirical rule-of-thumb, awaiting further confirmation and, in particular, awaiting further quantitative sedimentological description. Nevertheless, it can be used for the purposes of forecasting. With around 5m of Neolithic sediments at PMZ, what we may therefore expect is an overall time-depth of 500 ±100yrs. Looking ahead, this forecasting is once again confirmed, when based on the tabled values for the single ages (cf. Tab. IV.1 and Fig. IV.3). The more refined modelling result, namely that some 350yrs of sediment accumulation are observable in PMZ, represents a value on the 'faster-than-average accumulation side' of the forecasting. In addition, given that PMZ has altogether 19 $^{14}$C-dated building phases and building subphases, and given that the average phase length is calculated as 20 years, we also find that the calculated average phase length corresponds neatly with the expected time span of one human generation. In other words, the above-mentioned rule-of-thumb apparently also applies to the promising possibility of using measured tell-heights, beyond first-order dating, for the purpose of demographic forecasting (based on e.g. estimated 3D sediment volumes).

## IV.3. Data Processing and Calibration Software

The present analysis is based on application of the $^{14}$C age calibration software CalPal (Version 2019.5). CalPal software is written in Fortran 95 using Intel® Visual Fortran XE Compiler XE with integrated IMSL®6.0 Numerical Libraries by RogueWare®. The WinOS interface is provided by Winteracter® version 12.0e. For purposes of high-resolution $^{14}$C age modelling, which occasionally requires Monte Carlo runtimes in the order of 10–20 hrs, CalPal-software is equipped with runtime forecasting time/date Fortran routines that were developed by QTSoftware®. CalPal is installed on a Celsius W530® workstation with a Xeon E3-1281v3® 3.7 GHz CPU with 61cm display. The majority of CalPal routines are otherwise designed for PC desktop and notebook use (with minimum 12" display). The CalPal package is equipped with a number of import/export interfaces, also written in Fortran 95, and that support data flow with the following external (commercial) programs: Excel© ($^{14}$C database management), Globalmapper© (archaeological site mapping with 30" SRTM© data), and Un-Scan-IT© (automated graphic digitisation of climate records).

Important for the present Gaussian Monte Carlo Wiggle Matching (GMCWM) application is the introduction (in CalPal Version 2017.1) of some more flexible Fortran 95 subroutines for calculation of the best-fitting Chi-squared probabilities. These new routines support calculation of so-called non-central chi-square probability distributions, which enable a more sensitive adjustment of the statistical variables used in GMCWM. From literature we know that the non-central chi-square distribution is well adapted to cases where the distribution function is a mixture of random variables, but for which a small amount of bias cannot be excluded, if only due to limited data availability. This would appear sensible in our context, since archaeological and calibration-curve $^{14}C$ data sets typically contain measurements that have generally small but in any case unknown variability in terms of e.g. interlaboratory offsets, local $^{14}C$ reservoir effects, sequence-internal bias etc. Conveniently, for the purposes of CalPal Fortran programming, the required subroutines are implemented ready-for-use in the IMSL® 6.0 libraries, whereby CalPal makes specific use of the routine called CSNDF, which allows the passing of a (variable) non-centrality parameter λ. In the CalPal GMCWM dialogue, this passing of the variable λ from the screen to the CSNDF routine is implemented by a trackbar. Furthermore, when the non-central chi-squared functionality

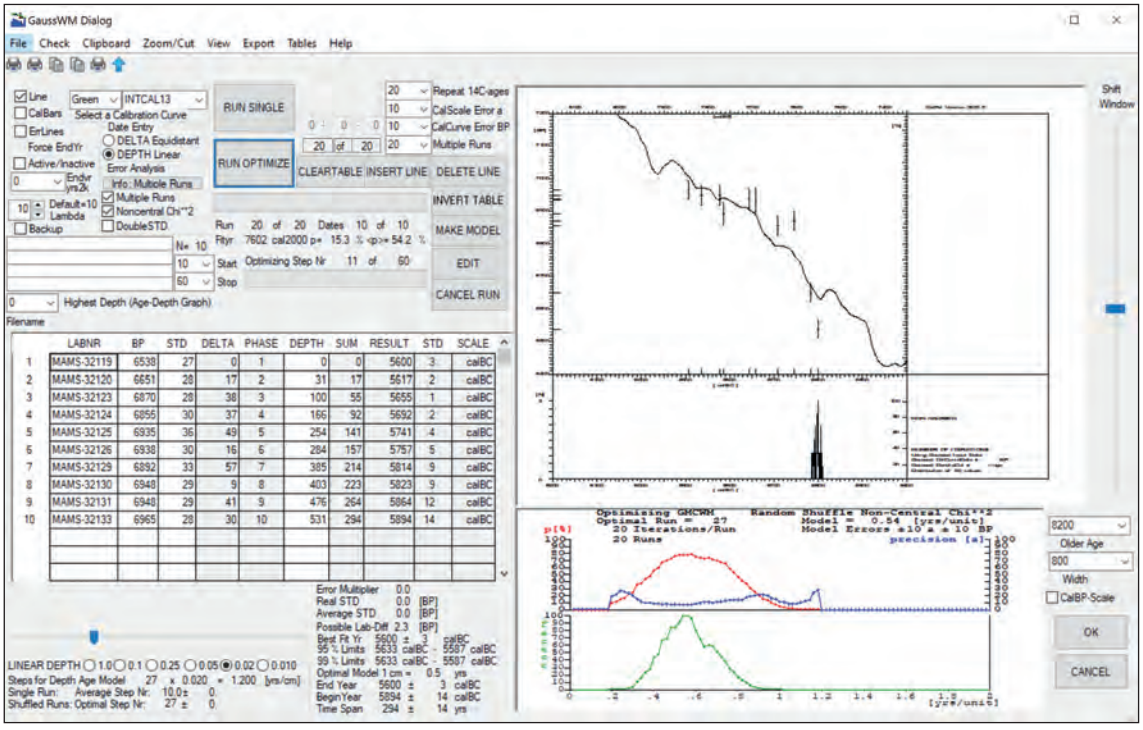



Fig. IV.1 Screenshot of GaussWM dialogue (CalPal Version 2021.6) to illustrate the application of GMCWM to PMZ data. Following import of GaussWM data from an Excel-format file, the study data is shown in stratigraphic order in the spreadsheet, with associated depth values given in the column with heading DEPTH. During the runtime the sequence of $^{14}C$-ages is expanded stepwise, with the best-fitting results at each step shown in the upper graph, and corresponding statistical parameters shown in the lower graph (red=probability, blue=dating precision, green=optimisation factor=probability/precision). Following selection of age-model and runtime parameters, the GaussWM analysis is started with the button RUN OPTIMIZE. During the runtime the developing results are shown (animated) in graphic windows (right) and in spreadsheet rows DELTA, SUM RESULT, STD. Final results are stored to numeric (ASCII, xls-format) and graphic files (selectable format). At the end of the runtime, the overall best-fitting sequence is derived by numeric analysis of the stored sets of statistical variables, the best-fitting graph is established, and corresponding statistical variables are stored to file. The dialogue (above) shows in the upper graph the age-position of the PMZ study data (error bars) in relation to the calibration curve (green line: IntCal13 calibration curve). For purposes of final, visual quality control of the achieved results, a separate dialogue (not shown, cf. Weninger 2017, Appendix) allows joint graphic projection of the GaussWM results with the raw data sets of the laboratories involved in the construction of the high-precision calibration curve (present study: QL-Seattle, UB-Belfast, Hd-Heidelberg) (B. Weninger)

is chosen (by checkbox), the GMCWM dialogue will respond with the proposal to use λ=10 as the default value, whereby the user is provided with the information that λ=0 corresponds to traditional chi-squared analyses. For explorative purposes in the application of GaussWM, other λ values can be entered into a spin-down integer field named *Lambda* (Fig. IV.1). Finally, we have checked that $^{14}$C-age calibrations and, in particular, the GaussWM results described in the following (based on Intcal13 and CalPal Version 2017.5) can be accurately reproduced by application of recent updates to Intcal20 and CalPal Version 2021.6, with max. deviations in the order of numeric rounding (±5 yrs, 95%).

## IV.4. Single-Age $^{14}$C Age Calibration

### IV.4.1. Overview: Dispersion Calibration

Fig. IV.2. provides an overview of the radiocarbon ages from PMZ (Tab. IV.2). It shows the $^{14}$C-scale histogram and summed calibrated $^{14}$C age probability distribution for all PMZ data (N=10). For this kind of data representation, it is important to note that the BarCode ages (small vertical lines on the calendric time-scale) – defined as central values of 95%-confidence intervals – are often strongly age-distorted (centennial-scale), due to the non-commutative (age-folding) properties of the $^{14}$C age calibration curve. However, in the case of the present PMZ data, such age distortion apparently applies mainly to the two youngest dates (ID1 and ID2), both of which have calibrated median values that are centred inside the two V-shaped re-entry wiggles at around 5600 and 5500 calBC, respectively. Due to the strongly non-commutative character of the underlying probabilistic calibration algebra, at these positions we can therefore immediately suspect the possible existence of some particularly strong age distortion. Closer inspection of the internal time structure of the two wiggles allows us to estimate the potential magnitude of the age distortion as (max.) approx. 100–120yrs, whereby the actually occurring age distortion in the PMZ age model will be dependent on a number of parameters and, in particular, on the quality of the applied IntCal13 calibration curve. As it turns out (compare Fig. IV.3 and Fig. IV.5), the calibration-induced distortion of the age model based on single dates is ~100yrs, i.e. close to the theoretically possible local maximum. This is a quite extraordinary finding. It can be explained as due to a chance combination of the measured $^{14}$C-age (ID1) with the structure of the (potentially non-ideal) calibration curve in the region of 5500 calBC. At this critical point, as can be seen from Fig. IV.2, it is conspicuous that the wiggle in the IntCal13 curve at around 5600 calBC is constructed such that all (N=6) available high-precision laboratory tree-ring measurements in the near (decadal) vicinity of this wiggle are all situated below the calibration curve, whereas all (N=4) of the next younger high-precision calibration ages are situated above the IntCal13 curve. Finally, the strong downward bend of the IntCal13 curve between 5670 and 5600 calBC (and which is so clearly evident not only in PMZ, but also in the IntCal20-update), provides some quite compelling support for the PMZ age model.

Interestingly, and now excluding ID1, for all other PMZ dates, on average, the calibrated single-age values are already in approximately correct stratigraphic order, even for the otherwise so often problematic method of dispersion calibration (Fig. IV.2). This property of PMZ data is altogether promising, in terms of the possibility of constructing a high-resolution archaeological chronology, when based on quantitative (metric) age-depth modelling.

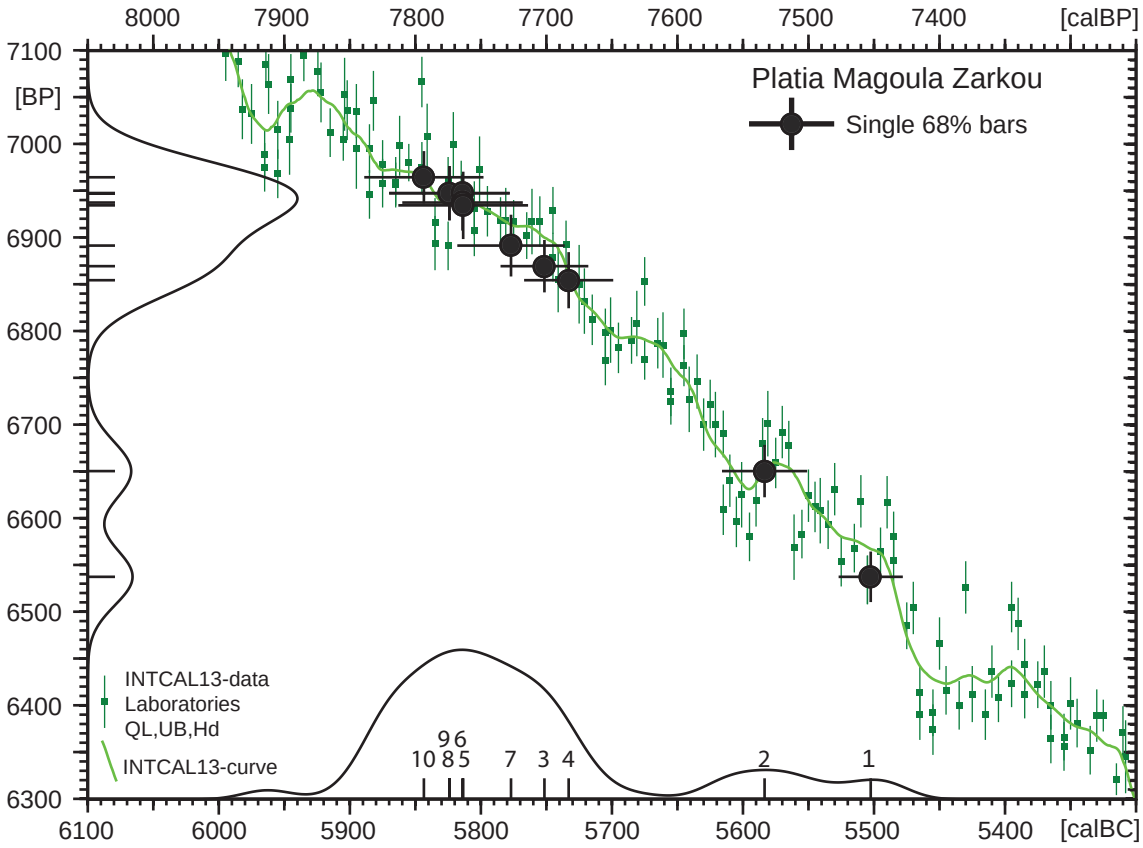



Fig. IV.2 Overview of radiocarbon ages from PMZ (N=10; Tab. IV.2.1), showing the summed calibrated $^{14}C$ age probability distribution of total data. Calibrated median values of the single $^{14}C$ ages are shown in BarCode representation (small vertical lines). It is important to note that BarCode ages (defined as central values of 95%-confidence intervals) are (otherwise) quite often strongly age-distorted (centennial-scale). This would be due to the non-commutative (age-folding) properties of the $^{14}C$ age calibration curve. However, in the case of the present PMZ-data, such age distortion apparently only applies to the second-youngest date (No. 2), for which the calibrated median value is centred inside the V-shaped wiggle at around 5580 calBC. For all other dates, on average, the calibrated age values are in at least approximately correct stratigraphic order. This property of PMZ data is promising, in terms of the possibility of constructing a high-resolution archaeological chronology, based on quantitative age-depth modelling (B. Weninger)

Tab. IV.2 Input stratigraphic age-model and output GaussWM-derived calendric ages for PMZ data, with (approx.) PMZ-phases assigned to sampling depths (B. Weninger)

| Nr | LabCode | $^{14}C$-Age [BP, 68%] | BestFit [calBC, 95%] | Depth Tell | [cm] Δ | BPh/BSPh |
|---|---|---|---|---|---|---|
| 1 | MAMS-32119 | 6538 ± 27 | 5601 ± 4 | 491 | 0 | VIIc |
| 2 | MAMS-32120 | 6651 ± 28 | 5619 ± 2 | 522 | 31 | VIIb |
| 3 | MAMS-32123 | 6870 ± 28 | 5657 ± 1 | 591 | 100 | VIb |
| 4 | MAMS-32124 | 6855 ± 30 | 5693 ± 2 | 657 | 166 | Vd |
| 5 | MAMS-32125 | 6935 ± 36 | 5742 ± 4 | 745 | 254 | Va |
| 6 | MAMS-32126 | 6938 ± 30 | 5759 ± 4 | 775 | 284 | IVb |
| 7 | MAMS-32129 | 6892 ± 33 | 5815 ± 8 | 876 | 385 | IIIb |
| 8 | MAMS-32130 | 6948 ± 29 | 5825 ± 8 | 894 | 403 | IIIb |
| 9 | MAMS-32131 | 6948 ± 29 | 5865 ± 12 | 967 | 476 | II |
| 10 | MAMS-32133 | 6965 ± 28 | 5896 ± 14 | 1022 | 531 | I ditch |

### IV.4.2. Single-Date Age-Depth Model

As already indicated, the main aim of the present stratigraphic $^{14}C$ analysis of PMZ data by application of GMCWM is to construct an age-depth model of the Middle and Late Neolithic deposits of PMZ, such that i) each of the nine building phases (BPh I–IX) is assigned a calendar age and its associated dating uncertainty; ii) similarly, each of the alternatively defined 19 subphases (I, II, IIIa–c, IVa–b, Va–e, VIa–b, VIIa–c, VIII, IX) requires an assigned calendar age and dating uncertainty, and finally iii), what is also required is a graph (and corresponding numeric equation) from which the calendric age of any tell deposit can be calculated, together with an estimate of the achieved dating precision, provided that its stratigraphic depth (cm) is given.

To achieve this goal, let us now test whether this chronology can be achieved simply by constructing a graph that shows the calibrated ages versus the stratigraphic depth from which the dated (bone) samples were taken. To be sure, such an approach represents the currently most widely applied method for construction of age-depth models in many disciplines e.g. in geomorphology, marine geology, as well in archaeological research. A graphic representation of the results achieved by this uncomplicated, unpretentious and, indeed, seemingly natural manner of age-depth representation of the PMZ data is shown in Fig. IV.3. This figure also provides the table (Tab. IV.2) of the numeric values and archaeological variables used in the chronology construction ($^{14}C$ age, calibrated age, sample depth (absolute scale [cm]), sample depth (relative scale [cm], rescaled with the depth of the youngest dated sample set to $\Delta$=0 [cm]), sample phase and subphase assignment).

Put differently, for PMZ date MAMS-32119 (ID1), the (vertically) oversmoothed construction of IntCal13 leads to a (horizontal) age distortion of around 100 yrs, such that the calculated calibrated $^{14}C$ age of 5502 ±24 calBC is around 100 yrs too young. Given that this age distortion is statistically significant, it is no wonder that the single-age-based age model shows an unexpectedly strong bend away from the initial linearity 5850–5700 calBC, at around 5700 calBC and for younger ages (Fig. IV.3).

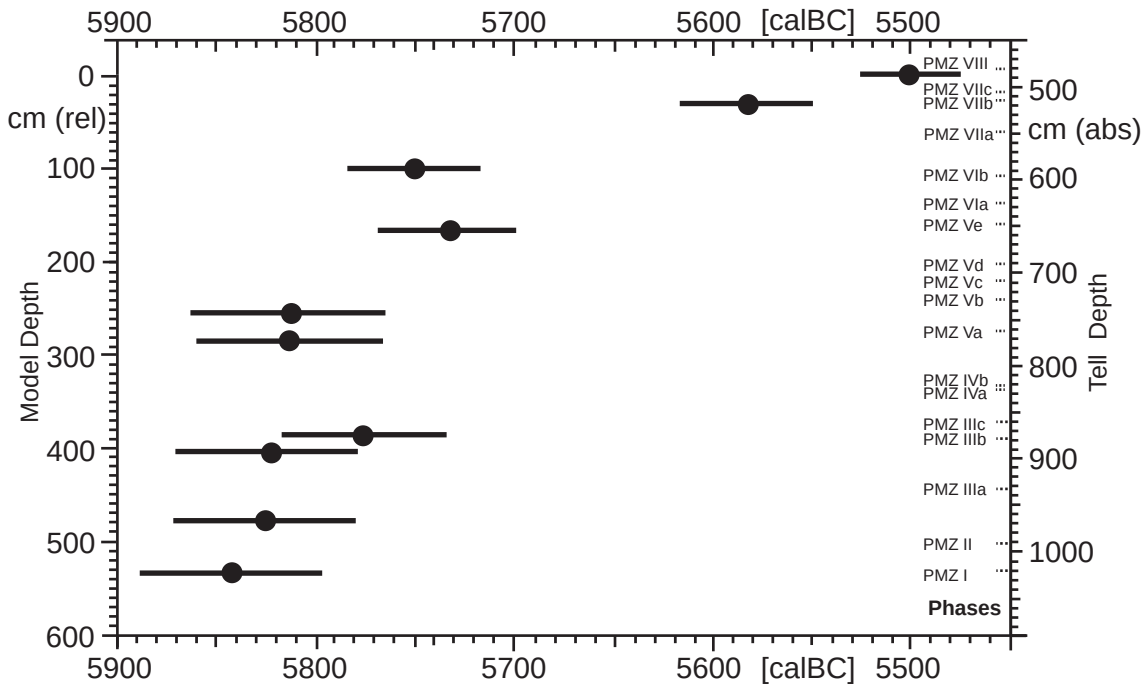



Fig. IV.3 PMZ age-depth model based on calibrated single dates (Tab. IV.2.3). Note the strongly age-distorted shape of the age-depth relationship, but which is simply due to the non-linear character (in this case: 'bent shape') of the underlying $^{14}C$ age calibration curve, in combination with one by chance badly designed wiggle at around 5600 calBC (cf. text) (B. Weninger)

## IV.5. Gaussian Monte Carlo Wiggle Matching

### IV.5.1. Methodology

Gaussian Monte Carlo Wiggle Matching is an extension of the wiggle-matching method that was first developed for dendrochronological applications by G.W. Pearson.[224] The method was generalised by Bernhard Weninger for archaeological studies.[225] In both cases, the basic approach is to fit a given sequence of $^{14}C$ ages to the calibration curve by minimising the summed and squared differences between the $^{14}C$ data (of unknown calendric age) and the calibration data (known calendric age). The calendric age that belongs to the calculated chi-squared minimum can then be taken as representing the statistically best-fitting calendric age. Whereas for tree-ring data with annual growth the sample distances on the calendric time-scale can be derived by direct counting of the growth rings, archaeological application is technically more complicated since it requires modelling of the age distances between the sequential variables (for example: stratified sediment layers or architectural phases of a tell site). What is invariably more demanding than the actual age modelling is, in particular, the derivation of realistic estimates for the age model certainties and to this end, the software realisation of the wiggle-matching procedure – depending on application – requires a quite large number of additional input/output procedures. The user dialogue for the presently applied method of optimising GMCWM is illustrated in Fig. IV.1. To begin, in both cases described above (dendrochronological and archaeological wiggle matching), the approach is similar in that a chi-squared distribution is fitted to the data whereby the weighted sum of squares for the two $^{14}C$ data sets (known and unknown calendric ages) is used to calculate the probability of the best-fitting calendric age for the study data. What complicates matters is that, due to the non-linearity of the calibration curve, there is not always a unique solution. On this specific point, in recent years it has become increasingly apparent that GMCWM results (and presumably also the results of Bayesian sequencing), even of larger data sets, may exhibit chronological quantisation similar to that of single $^{14}C$ ages. The existence of multiple solutions for large data sets would represent the mathematical generalisation of the multiple readings observed for single $^{14}C$ ages. Further, we may theoretically expect a rapid increase in the number of solutions in parallel to an increase in dating precision. This forecasting is the actual reason for our recent introduction, as mentioned above, of the more flexible non-central chi-square probability function. This problem is addressed in more detail by Weninger,[226] but does not require further mediation for the PMZ data, which – interestingly – do not show such multiple best-fit solutions. The reason for this is presumably the relatively straightforward structure of the calibration curve in the time window under study (6000–5400 calBC), with an extended more or less linear section 5950–5650 calBC and an s-shaped wiggle at ~5600 calBC, followed by a set of rather wobbly data 5550–5450 calBC. What we consequently observe (as shown below: Fig. IV.4), is that the relative amplitudes of the higher-order solutions (although presumably existing) are so small that they cannot be distinguished from the statistical noise. Further methodological refinements, prior to the introduction of noncentral chi-square analysis, were already implemented in earlier versions of CalPal.[227] These program developments, in combination, today allow utilisation of a variety of technical, graphical, and statistical structures (e.g. Excel-format data import/export, semi-automated construction of archaeological models, calculation of conditional and marginal probabilities, phase boundaries, analysis with/without sample order randomisation, and others), depending on the specific application.

[224] Pearson 1986.
[225] Weninger 1986.
[226] Weninger et al. 2018.
[227] E.g. Weninger 1986; Bronk Ramsey et al. 2001; Benz et al. 2012; Horejs et al. 2015; Jung – Weninger 2015; Krauß et al. 2017.

### IV.5.2. Results of Gaussian Monte Carlo Wiggle Matching Application to Platia Magoula Zarkou-Data

In the present study we have used the GMCWM method as implemented in CalPal (Version 2019.5) to derive a best-fitting age-depth model for the PMZ data. As it turned out, the GMCWM-application for the PMZ data was unusually straightforward (i.e. there was no need for complex sample order randomisation, or for calibration curve correction studies, or for otherwise typically necessary outlier analysis). The necessary model construction was achieved, in an uncomplicated manner, by data entry into a standardised (CalPal-format) Excel file, wherein the required variables are listed as LabCode (character field), $^{14}$C age (numeric field, BP scale), standard deviation (numeric field, BP scale), and stratigraphic depth (numeric field, cm scale), along with an associated list of incrementally increasing integer values (ID1–10) to encode the lack of need for sample position randomisation during the Monte Carlo processing. This file was then read into CalPal via the ODBC interface, to produce an input/output table, with structure as illustrated in Tab. IV.2. Following some preliminary runs, needed to establish the appropriate case-specific runtime parameters and settings (e.g. time windows, uncertainty parameters, choice of linear age-depth modelling, choice of non-centrality value λ), the final results were achieved for an extended (typical) runtime of 10 hrs. The statistical parameters for this run are provided in the caption to Fig. IV.4, with numeric results given in Tab. IV.2.

The input/output table with GMCWM results (Tab. IV.2) contains a stratigraphically ordered list (from young to old) of model-input $^{14}$C ages and corresponding metric depth. The youngest sample depth value is referenced to Δ=0cm (compare the two columns with headings 'Δ[cm]' and 'Depth Tell [cm]'). The column with the heading 'BestFit' contains the final numeric results, achieved by statistical processing in combination with a number of mathematical measures and visual-based decisions, all aimed at data reduction of the three basic statistical curves shown in Fig. IV.4. It is interesting, indeed methodologically entrancing, to note the unusually small size of the statistical uncertainties (noted at 95% confidence in the BestFit column). These uncertainties have values ranging from (min.) ±1 yr (for ID3) to (max.) ±14yrs (for ID10), with the smallest values in the sequenced centre (c. ID3–7), and the largest values for the outer (oldest/youngest) regions in the sequence (ID1 and ID10). This is the natural result of the applied modelling procedure, which is based on systematic (stepwise) expansion of the data set along the calendric time-scale, such that, as a result of statistical optimisation, the possible 'wobbling' of the data set is at a maximum for the sequence beginning/end and is at its lowest for the central sample positions. Put differently, due to the sandwich structure of the data set, the inner dates are 'held fast' by the outer dates. This structure is quite acceptable, and is, indeed, an immediate consequence of the GMCWM approach. En passant, we note that such a 'sandwich-structure' of modelling uncertainties, with smallest values achieved in the model-centre and largest values at its begin and end, is also observable for Bayesian sequencing. Although seldom commented on by authors, the existence of such quasi inbuilt (i.e. fundamental) error-structures is easily recognised in many published OxCal-graphs.

An open question is then, of course, whether the small size of the statistical errors is indeed acceptable, and what do such small values mean? To begin, and given that similarly small errors are also observed for studies that apply the Bayesian sequencing method,[228] the problem is apparently not specific to GMCWM, but has a more general character. In effect, so it seems, what both methods are measuring cannot be uncritically interpreted as immediately real 'dating uncertainties' or 'errors', with traditional (probabilistic) meaning. It appears that these uncertainties (derived as they are from millions of model comparisons) have a rather more *conditional* meaning, less in terms of achieved (numeric) dating precision, and more in terms of what might better be called (semi-quantitative) 'model robustness'. In this respect, the title of the paper by

[228] E.g. Sevink et al. 2011.

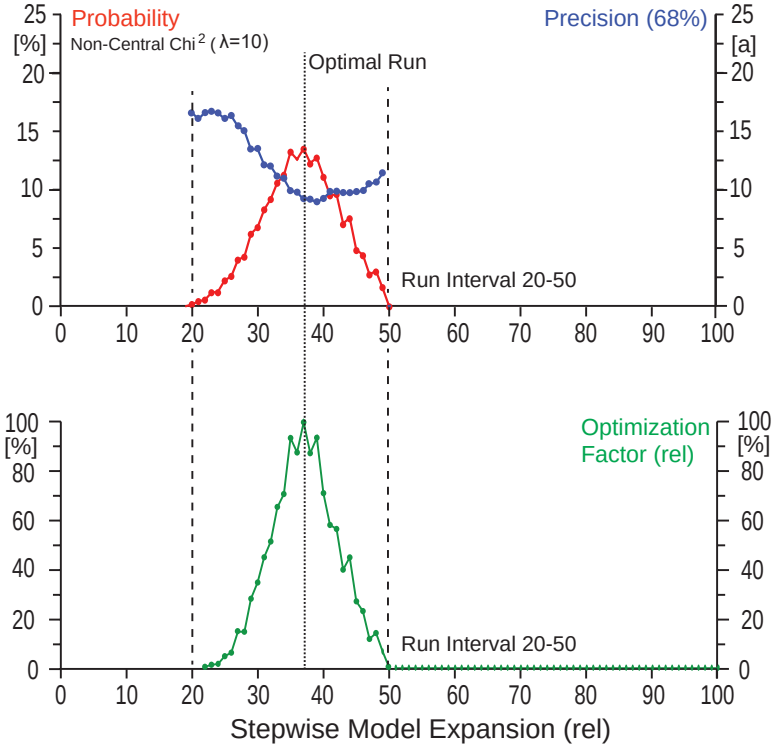



Fig. IV.4 Statistical results for GMCWM analysis of PMZ data. Upper graph: Dating probability (red) and dating precision (blue). Lower graph: Probability/precision (B. Weninger)

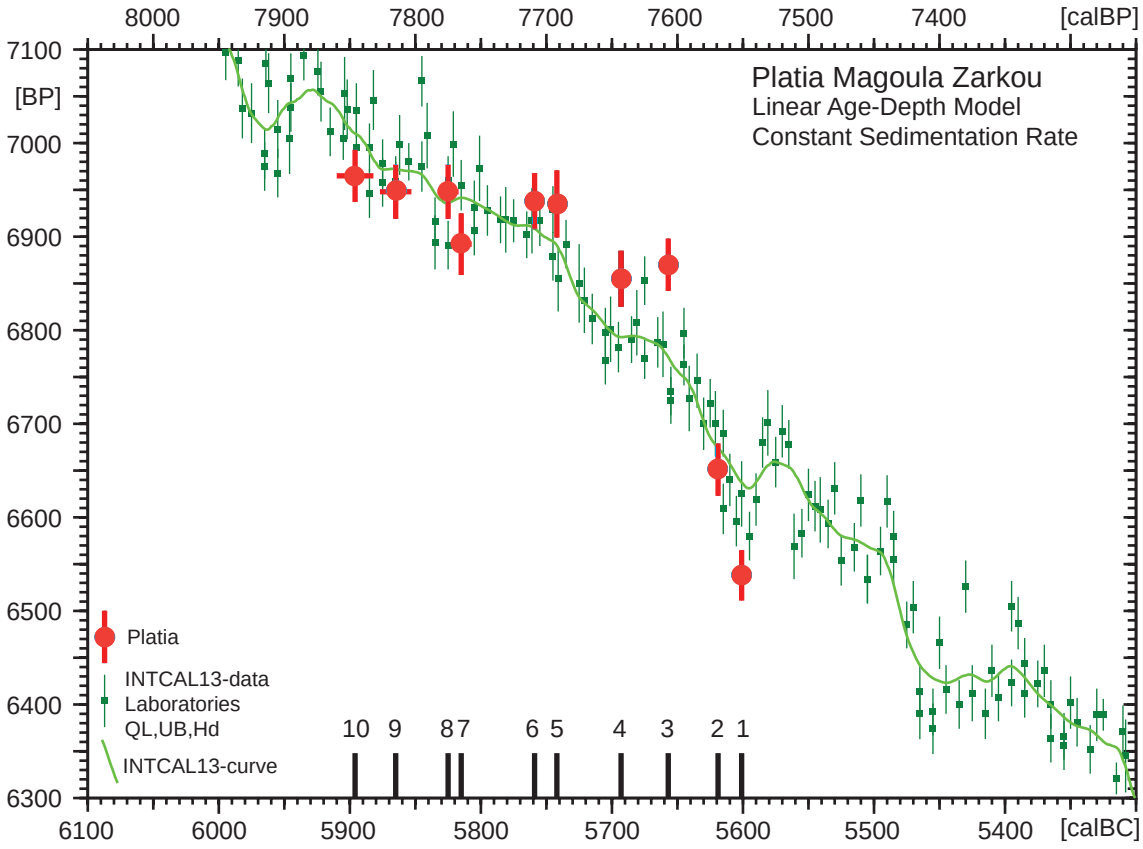



Fig. IV.5 Final GMCWM linear age-depth model with a focus on showing the relationship between the calibrated data (dots with 68%-error bars) and the tree-ring calibration curve (IntCal13, green line. ID numbers (1–10) represent dated bone samples according to Tab. IV.2.2 (B. Weninger)

Jan Sevink et al. 2011, 'Robust date for the Bronze Age Avellino eruption (Somma-Vesuvius): 3945 ±10 calBP (1995 ±10 calBC)' is well chosen, even though the actual meaning of the acclaimed dating precision of 10yrs itself remains to be clarified. From what is presently clear, given that such exaggeration of dating precision accords with widespread archaeological praxis in error notation, we cannot rely on the expectation that the (otherwise: nominally) standardised '±' character is an abbreviation for reproducible dating uncertainty at 68% confidence. A solution to the vexing problem of how to realistically quantify the dating uncertainties that are associated with calibrated $^{14}$C ages – even when derived from advanced statistical studies, e.g. via GMCWM or by Bayesian modelling – in our view represents one of the presently most important and still unresolved enigmas of archaeological $^{14}$C analysis. We will return to this question in Chapter IV.6 (Discussion). Let us first take a look at the statistical properties of the GMCWM results.

The set of three graphs (Fig. IV.4: which we regularly call the 'GMCWM statistics box') shows the statistical functions that contribute to the final (numerically abbreviated) dating results (data input: Tab. IV.2). The technical procedures applied in deriving these functions are as follows. Following selection of an appropriate scaling factor (with the dimension cm/yr), the GMCWM algorithm expands the sample sequence (internally scaled to cm/yr) stepwise along the calendric scale, whereby at each step the corresponding probability of the age model is calculated and stored to file. As can be seen from Fig. IV.4, the stepwise model expansion is based on a fixed number of max. 100 steps (both graphs have x-axes scaled to the same 0–100 steps). In the present study, only steps 20–50 were required to achieve a useful time window, and this limitation of the time window was happily chosen to achieve a major (70%) reduction in runtime. In parallel to the width of the best-fitting calendric-scale histogram (calculated at each step by repeating the fitting process for an (optional) number of times, here: N=100) under different conditions (here: Gaussian CalScale distance error of 10 [a]; Gaussian CalCurve remeasurement per point of ±10 [BP], 68% confidence). The entire procedure was repeated for an (optionally) large number of times (here: 1000 runs), with a total runtime of 10 hrs.

The finally achieved age-depth model for the PMZ data is shown in Fig. IV.5, with numeric 'Best Fit' results provided in Tab. IV.2 (above).

## IV.6. Discussion

As it turns out, the calculated best-fitting calendric ages for each of the sample positions within the sequence are so highly reproducible ('robustness'= ±10yrs, 95% confidence) that, already above, we have expressed some reservations about the meaning of these values. In addition, we have also indicated above that the underlying puzzle has little to do with any specific properties of the applied GMCWM method. Namely, similarly small values (±10yrs) are obtained, as exemplified in the study by Sevink et al. 2011 that is based on Bayesian sequencing of some few (N=9) dates, for the Bronze Age eruption of the Avellino volcano. Note that, of the nine dated samples, only one is short-lived (leaves) and the remaining eight $^{14}$C ages were processed on peat and wood.[229] This is not a unique result: the application of Bayesian sequencing is often claimed to be capable of deriving dating uncertainties with magnitudes in the order of some very few decades.[230] The reality of this acclaimed precision (or rather: its interpretation) is not immediately plausible given the many accompanying uncertainties in archaeological age models, the present need to calibrate annual-width samples on low-density and mostly decadal-scale calibration curves, the often observed over-smoothing of these calibration curves, the unexplored questions of geographic variability in carbon reservoirs, and other remaining unresolved technical aspects of $^{14}$C dating, e.g.

[229] Sevink et al. 2011.
[230] E.g. Bayliss 2009; Blockley – Housley 2009.

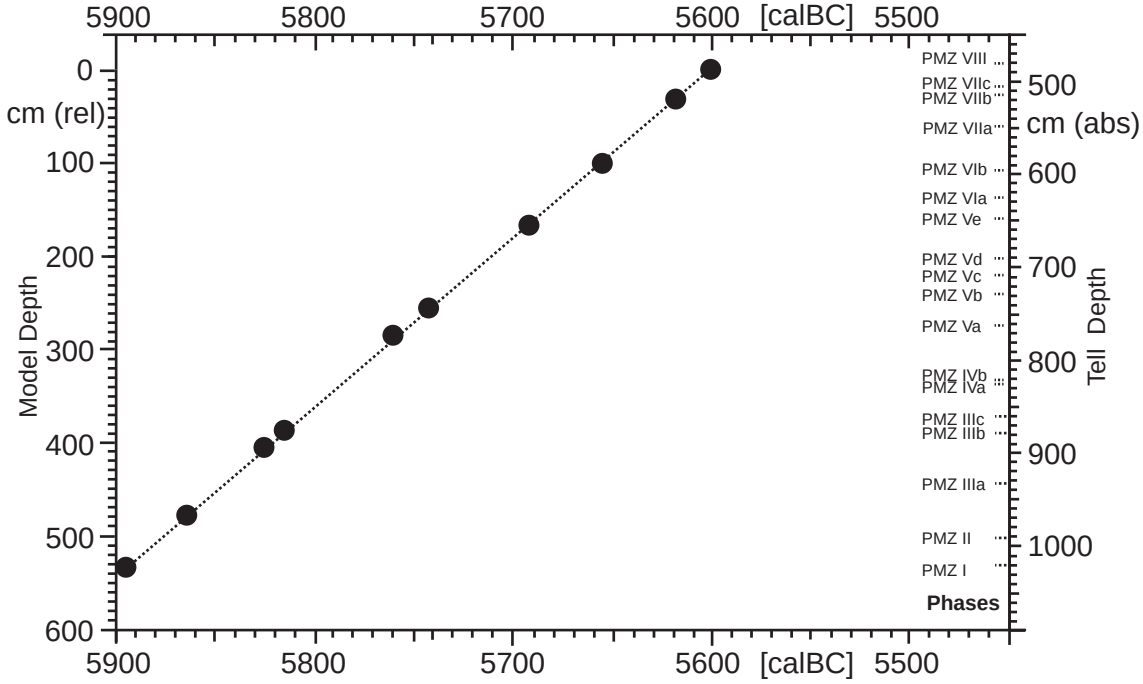



Fig. IV.6 Final GMCWM linear age-depth model with a focus on showing the age-depth-phase relationship of PMZ-stratigraphy. Modelled ages are shown as dots, representative for the respective calibrated central values of 95% intervals (cf. Tab. IV.2.2). ID numbers (1–10) represent dated bone samples (cf. Tab. IV.2.2). The statistically optimised best-fitting linear curve (dotted line) that connects the calibrated sample ages and their respective stratigraphic depth is so precise that, for simplicity, it is drawn by hand (B. Weninger)

the precision and accuracy of interlaboratory calibration. A solution is, perhaps, to simultaneously keep in mind both the technical sources of the measuring uncertainties, and their deployment in the specific scientific framework under study. Since these two contexts can be different, they can also be related to different meanings, e.g. for our understanding, use, and, in particular, our inferential application of the corresponding chronology.

In conclusion, a possible resolution to the puzzle under study is to differentiate (more clearly than is often advocated) between dating uncertainties that arise as a result of comparing the archaeological $^{14}C$ data under study with a theoretical model, and the dating uncertainties that exist in the archaeological reality. In the present case, what we have achieved is to demonstrate (no more than) the existence (sensu strictu) of a linear age-depth model for the PMZ stratigraphy, and further that – with minimal (10-hour) statistical manipulation – the PMZ data are shown to be in near-perfect agreement with this model. All these nice properties (of the model) are advocated in Figs. IV.5 and IV.6. Unfortunately, what we have not yet shown is that the model really does agree (in detail) with the actual stratigraphy of PMZ, nor have we derived estimates of the amounts, sources, location, and presumable relocation of the sediments that are used in the PMZ buildings. In direct analogy, and although we have no reason to doubt the usefulness and typically enhanced quality of $^{14}C$-based age modelling, seldom is archaeological justification provided to conclude a posteriori why the achieved numeric precision of modelling studies should be immediately valid (beyond its theoretical justification) for the archaeological realities under study. This justification, quite generally, would require a variety of further, independent studies, but would take us into research projects presently largely beyond the reach of contemporary statistical modelling.[231] In

[231] E.g. Pettitt – Zilhão 2015.

effect, understanding our often highly simplified theoretical hopes and guesses is something very different to understanding the complexity of the real world, out there. As for the present PMZ analysis, the reconstructed extremely small variability of the sediment accumulation apparently does not correlate, at least not to any large extent, with the archaeologically defined sequence of periods and phases. Instead, the tell apparently just keeps on growing, and growing..., with an average but entirely constant accumulation rate in the order of 1 cm/yr throughout all its many periods and phases, for some overall 300 yrs. This applies, at least, as observed in the $^{14}$C-sampled Trench A. More generally, for the present generation of dates and archaeological models, in particular concerning tell stratigraphies, although the calculated errors of GMCWM and Bayesian sequencing are typically in the range of a few years/decades, the underlying real dating uncertainties are presumably much larger, in the order of decades/centuries. Whether these uncertainties can be reduced through the development of more realistic and archaeo-bio-physically motivated theories of tell development, is a seemingly natural expectation, the validity of which nevertheless awaits detailed verification.

## IV.7. Conclusions

PMZ contains ~5m of Neolithic sediments, to which 9 periods and 19 subphases have been assigned based on architectural and pottery-style analysis. In the present chapter, based on a set of N=10 $^{14}$C measurements provided by the Mannheim AMS laboratory for stratified bone samples (Tab. IV.1), we have constructed, with high numeric dating precision, a linear age-depth model for the Neolithic layers The method applied in age-depth modelling is Gaussian Monte Carlo Wiggle Matching. The results are provided in two graphs (Figs. IV.5–6), whereby Fig. IV.5 focuses on comparing the mathematically constructed optimal age-depth model with the tree-ring calibration curve IntCal13, and Fig. IV.6 demonstrates the achieved high quality of the best-fitting linear age-depth model. In Fig. IV.6 the calculated (model-based) optimal calendar age of each of the $^{14}$C-dated bone samples is represented by a dot with assigned calendric-scale age uncertainty, whereby the error bar length is mostly too small to be recognisable. This age model is the result of applying a (largely standardised) Monte Carlo statistical optimisation to the PMZ data, which required some 10 hours of runtime on a standard PC, and which results in such small dating errors (often < 10 yrs, 68% confidence), that we have reason to doubt their reality. It is pointed out, finally, that an important methodological difference exists between such calculated model uncertainties and the true (but largely unknown) dating errors of the archaeological object, whereby the differences between the two dating concepts are often neglected. For the PMZ data, the calculated dating uncertainties based on extensive (empirical) Monte Carlo modelling are in the range of 1–14yrs (95% confidence; Tab. IV.2). The true (real) dating errors are likely to be in the order of 20–50yrs (95% confidence).

In a nutshell, the Neolithic tell at PMZ (depth: 500 cm) is continuously occupied from 5900 to 5600 calBC.[232] During its Neolithic occupation (length: 300 yrs) the average growth rate of the tell is 1.67 cm/yr (500 cm / 300 yrs), with overall quite small growth variability (e.g. from one phase to the next) estimated to be smaller than ±5 %. When calculated from cultural/demographic perspective, each of the stratigraphically discernible 19 subphases covers 17 ±1 yrs.

Hence, as illustrated in Fig. IV.6, assuming for convenience that the depth of the highest Neolithic Phase VIII is set to Zero [cm], the following age/depth formula can be used to achieve a first order estimate of the calendric age for all single finds (left scale) and/or PMZ phases (right scale):

Calendric Age (PMZ depth) = 0.55 * depth [cm] + 5600 ±20 [calBC, 68%].

[232] For a start of the PMZ sequence see also Reingruber et al. 2017, 44; Alram-Stern – Toufexis, this volume, 615–617.

# V. The Tools

## V.1. The Flaked Stone Assemblages

*Catherine Perlès – Lygeri Papagiannaki*

### V.1.1. Introduction

Despite the abundance of Middle Neolithic sites in Thessaly, the flaked stone tools remain insufficiently documented, especially when compared with the pottery. Several sites yielded very small collections, and aside from Achilleion, the most comprehensive studies have remained unpublished.[233] Consequently, regional and diachronic variation in characteristic tool types, raw material procurement, techniques and methods of production remain difficult to establish. PMZ will be one of the few assemblages to be fully published[234] and should constitute an important reference collection to define the characteristics of Middle Neolithic and early Late Neolithic Thessalian flaked stones assemblages.

*The Potential for Refined Diachronic Approaches*

The several metres-deep Middle Neolithic sequence at PMZ will allow us to define not only the main features of the Middle Neolithic flaked stone assemblages as a whole, but also to investigate for the first time in Thessaly, diachronic variation within the Middle Neolithic. In particular, a late Middle Neolithic phase, called the 'Zarko phase', was defined in the original publication on the basis of the pottery assemblages.[235] Can we document parallel transformations in the flaked stone assemblages and individualise this phase? PMZ is also one of the very few sites where the Middle Neolithic/Late Neolithic transition can be observed, and this was originally presented as an instance of local, gradual transformation. Is the transition to the Late Neolithic also gradual with the lithics, or, as occurs in other regions,[236] do we witness breaks in raw material procurement, flaking techniques and tool typology? Defining the technological and typological characteristics of the flaked stone assemblages, their transformation throughout the sequence, the lithic phases and their correlation – or absence thereof – with the pottery phases will thus be a major goal of the present analysis.

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233 Moundrea-Agrafioti 1981; Karimali 1994.

234 The flaked stone assemblages from PMZ were initially entrusted to Ernestine Elster, who published two short reports (Elster – Duricic 1982; Elster 1994). Catherine Perlès studied the collection at Larissa in 1984–1986 in the framework of the French 'Mission Néolithique de Thessalie' with Jean-Paul Demoule (Perlès 1994a). They were later also studied by Evangelia Karimali for her dissertation (Karimali 1994) and referred to in several important papers on lithic trade networks (Karimali 2000; Karimali 2009).

235 Demoule et al. 1988. The final results of the reanalysis of the pottery by Areti Pentedeka were not available at the time of writing.

236 At Franchthi, for instance, see Perlès 2004. Antikleia Moundrea-Agrafioti also notes important differences between the Middle and Late Neolithic assemblages in Thessaly, but her sample only included the LN II subphase from Dimini and no early Late Neolithic: Moundrea-Agrafioti 1981, 159–163.

*Phasing the Flaked Stone Assemblages*

The samples from each excavation unit being too small for valid comparisons, our unit of analysis has been the 'building phase' or 'building subphase', as defined by G. Toufexis and C. Batzelas.[237] The earliest two phases (BPh I and II) refer to the basal ditch and the overlying sediments. The later building phases were defined by the presence of 'surfaces' (F33 to F20), usually associated with architectural remains, hearths, postholes or pits. BPh and BSPh III to IX thus consists of a 'surface', its associated features and the sediments interstratified between this surface and the overlying one (possibly destruction strata). Ideally, the lithic chronostratigraphy should have been established solely on the basis of the most secure contexts with in situ deposition ('surfaces', 'floors', 'pits'). Unfortunately, the number of significant artefacts from these secure contexts is far too small to do this. Consequently, we had to take into consideration all the artefacts from each architectural phase, including those coming from the deposits between two surfaces, and possibly redeposited.

From the base of the excavation on the sterile soil, up to the uppermost Neolithic deposits, we defined five 'lithic phases' on the basis of the stratigraphy and intrinsic characters of the flaked stone assemblages: raw materials, products, techniques of production and tool types.

Two important points must be made concerning this phasing:

i) Each lithic phase differs from the others by *statistically* significant variation in the proportion of raw materials, and/or of blades and flakes, and/or of retouched tools. Nevertheless, considering the very small size of each sample, random spatial variation must be expected. Consequently, these variations may not all be *archaeologically* significant, especially when the tool types show no differences. This will lead us to suggest an alternate chronostratigraphic scheme based on tool types only, and restricted to three lithic phases.[238]

ii) The fact that the material from the deposits overlying each 'surface' was included in the samples for each building phase may create artificial continuity between the lithic phases. Indeed, most of this material, as we shall argue below, is redeposited rather than in its original use or discard context. Some, at least, of this material may come from earlier contexts. There is therefore a distinct possibility that regular reworking of earlier material and its incorporation into later assemblages create spurious continuity. This point will be discussed in the conclusion, on the basis of the more securely dated subsamples.

*Technology and Traceology: An Integrated Approach*

The PMZ assemblages are also the first in Thessaly to be studied simultaneously from a techno-typological perspective (Catherine Perlès = C. P.) and a functional perspective (Lygeri Papagiannaki = L. P.). The initial aim of the technological approach was to reconstruct the major characteristics of the *chaînes opératoires*, from the acquisition of the raw material to the discarding of the tools, and to address questions about the techno-economic organisation of raw material acquisition and tool production. In particular, we sought to establish whether the raw materials were procured from primary or secondary sources, whether they were obtained through direct procurement or exchange, at what stage of exploitation they were introduced into the settlement, which techniques of production were implemented, and the degree of specialisation this required. All the artefacts were individually recorded, sketched and described. Most were also photographed with a Lumix TZ6 camera. Michèle Ballinger produced the publication drawings of the most significant artefacts.

As a complement and prolongation of the technological studies, the functional analyses investigated the nature of the activities involving flaked stone tools at or around PMZ, their relative

[237] Toufexis – Batzelas, this volume, chapter III.
[238] Below, 269.

importance, the choice of blanks for specific activities and the conception of the tool as a whole. In this perspective, we hoped that a comparison between tool conception and use in the Middle and Late Neolithic would contribute to the debate on continuity and discontinuities between the two periods.

L. P. examined 45 pieces – roughly half of the retouched tools and some unretouched blanks – in order to specify the mode of hafting of the tools, the materials worked, the gestures, and the life history of each tool.[239] Systematic macroscopic and microscopic observation of the blunting, removals, polishes, striations and residues[240] were conducted under a Euromex StereoBlue binocular and an Olympus BH2-Umex microscope, fitted with a Tucson TSview camera. Additionally, Niccolò Mazzucco examined all the sickle inserts within the framework of a large comparative study of Neolithic Mediterranean sickle elements.[241] His observations will be included in the present study to complement Papagiannaki's.[242]

Besides insights on the use of flaked stone tools at PMZ, the joint technological and functional approaches will allow us to test the validity of the traditional pseudo-functional typological denominations (e.g. 'end-scraper', 'borer', 'point'). It will clearly reveal, in particular, the difficulty for the technologist in differentiating a retouch meant to shape the handhold or hafted part of the tool from a retouch meant to modify the working edge of the tool.

### *Spatial Analyses*

PMZ is also one of the few sites excavated decades ago where the three-dimensional position of each flaked stone artefact was recorded. This proved essential in order to discriminate between artefacts more securely associated with a stratified surface, and artefacts found in intermediary deposits and potentially redeposited. We also hoped to find a significant association of tools on identified 'surfaces' so as to define activity areas. As mentioned above, however, the majority of the artefacts come from the deposits interstratified between the 'surfaces', and these analyses turned out to be rather disappointing.

### *Platia Magoula Zarkou and Thessalian Lithic Trade Networks*

Finally, the position of PMZ on the main axis that links the Western and Eastern Thessalian Plains sets it a priori in an ideal nodal position in exchange networks. Areti Pentedeka has already shown the site to be a 'source' for three exchange networks in pottery, in both the Middle Neolithic and the Late Neolithic, and, to a lesser extent, a recipient site in two other networks linking it to eastern Thessaly.[243] On the other hand, Evangelia Karimali underlined that PMZ was characterised by a massive dominance of 'chocolate flint' and a low proportion of obsidian that clearly aligned it with the settlements of the Western Thessalian Plain.[244] With more detailed technological and functional analyses and a refined chronostratigraphic framework, can we now shed more light on the position of PMZ within these lithic networks and document, as is the case with pottery, diachronic changes in raw material procurement strategies and participation in trade networks?

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239 The functional analyses were the subject of an M2 thesis at the University of Nice by Lygeri Papagiannaki. The documentation and interpretation of each artefact studied was discussed at the Larissa Museum with Sylvie Beyries, Directeur de Recherches, CEPAM (Cultures et Environnements – Préhistoire, Antiquité, Moyen Âge), CNRS-University of Nice, and supervisor of the master. The interpretation of the traces was based on the reference collection of the CEPAM.

240 Semenov 1964; Mansur 1982; González Urquijo – Ibáñez Estevez 1994.

241 Project 'Nea-Innova: The diffusion of Neolithic in the central-west Mediterranean: agriculture, innovations and radiocarbon dating', PI: J. F. Gibaja (HAR2016-75201-P).

242 We warmly thank Niccolò Mazzucco for sharing his observations and for fruitful discussions on the material.

243 Pentedeka 2011.

244 Karimali 2009.

These questions drove our analyses of the material and defined the main axes of enquiry. However, archaeology is not a predictive science, and the study of the material led to some frustration: for the most part, the *chaînes opératoires* are so patchily represented that it is impossible to reconstruct them in their entirety, and often likewise impossible to assess the extent of local manufacturing versus the importation of finished blanks or tools. On the other hand, these analyses also led us to unexpected and interesting results: compared with other sites,[245] PMZ presents many idiosyncratic features, absent or only rarely documented elsewhere in Thessaly and in southern Greece. For instance, the density of flaked stones is particularly low, the position of PMZ within trade networks appears singular, and several technical choices and tool types are unique.

Significantly, one of the most conspicuous idiosyncratic traits, the scarcity of flaked stone artefacts, holds true in both the Middle Neolithic and the Late Neolithic and has immediate bearing on all subsequent analyses. We shall therefore discuss this problem and the related issue of raw material procurement before embracing a diachronic perspective.

### *Why Are There So Few Flaked Stone Tools at Platia Magoula Zarkou?*

A total of 270 artefacts (including debris) were attributed to the Neolithic deposits from Platia Magoula Zarkou for a volume of sediment estimated at 119m$^3$.[246] The overall ratio is thus 2.3 artefacts per m$^3$. Although it varies somewhat from phase to phase, it always remains low. By comparison, the Neolithic trenches FAN and FAS at Franchthi yielded a total of 1916 artefacts for a volume of ca. 20 m$^3$,[247] i.e. a ratio of 96 flaked stones per m$^3$.

Obviously, the two sites differ in two major respects. First, the majority of excavation units in the two Franchthi trenches were water-sieved, and the remaining were dry-sieved down to a mesh of 5mm. By contrast, no sieving was undertaken at PMZ. Recovery procedures must therefore have played a role and led to losses at PMZ. There are, however, reasons to argue that this is only part of the problem. The excavation was indeed careful and recovered very small chips of 10mm or less. Even more significantly, obsidian, although the most conspicuous and 'precious' raw material for the excavator in view of its exogenous origin, is always scarce.

We could consequently attribute the scarcity of flaked stones to an uneven spatial distribution of flaking remains: the excavation would have concerned sectors where flaking activities rarely took place, and where tools were occasionally utilised, but not produced. Such sampling biases are always possible on large tell settlements that were only very partially excavated, and it must account in part for the very fragmented aspects of the *chaînes opératoires*. However, the nature of the excavated areas and deposits varies through time,[248] whereas the scarcity of flaked stones is a constant. It thus seems unlikely that excavation at PMZ systematically concerned areas devoid of flaking activities and where there was little use for flaked stone tools.

The second major difference between Franchthi and PMZ is the scarcity of obsidian. Franchthi is a southern coastal site, and clearly had easier access to obsidian exchange networks than did PMZ. Antikleia Moundrea-Agrafioti specifically noted that Thessalian sites with restricted access to obsidian tended to be altogether poor in flaked stone tools.[249] At PMZ, no locally available raw

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245 Data on flaked stone assemblages contemporaneous with PMZ are available for the following Thessalian sites: Achilleion, dated to the Early Neolithic/Middle Neolithic transition, MN I and MN III (Elster 1989); Sesklo B, dated to the MN II and III and Magoula Karamourlar (Moundrea-Agrafioti 1981); Otzaki (Mottier 1981) and Ag. Petros in the nearby Sporades dated to the MN II (Moundrea-Agrafioti 1981). Unfortunately, neither the Middle Neolithic nor the early Late Neolithic at Magoula Visviki yielded any retouched tool (Bergner 2015a). The assemblages from Magoula Koutroulou and Magoula Imvrou Pigadi are currently being studied and little information is available. The attribution of these sites to subphases of the Middle Neolithic is based on Reingruber et al. 2017.

246 Toufexis – Batzelas, this volume, 83.

247 Farrand 2000.

248 Souvatzi, this volume, chapter IX; Toufexis – Batzelas, this volume, 137.

249 Oral communication 7/16.

materials could replace obsidian, and our technological and functional analyses suggest that the settlement had only limited access to regional raw materials, such as radiolarite. The proportion of retouched tools is indeed unusually high, and the tools, especially in the earlier Middle Neolithic, show an equally unusual degree of curation. It appears that, if the flaked stone are so scarce at PMZ, it is mainly because the settlement had no easy access to sources of raw materials. More generally, and probably for the same reasons, the scarcity of flaked stone tools appears to be characteristic of many Thessalian settlements: Karimali provides even lower figures for Dimini, Ag. Sophia and Pefkakia.[250]

### V.1.2. An Overview of Raw Materials Exploitation

The raw materials from PMZ were initially identified according to criteria commonly used by lithic technologists, and, in the present case, a lithic technologist of French training: texture, inclusions, and translucency. Most were initially identified as radiolarites and diagenetically transformed radiolarites, i.e. 'jaspers'. Both raw materials are also commonly found in the literature under the name of 'chocolate flint'.[251] The identification of 'radiolarites' and derived 'jaspers' was based on comparative samples collected from the Portaikos River and at primary sources in the Pindos (Koziakas Range), which were identified in the 1980s by the French specialist of radiolarites in Greece, P. de Wever.

For the present publication, raw material determinations within the 'chert group' (or silicites) were revised by mineralogist Michael Brandl, according to the recommendations of the 2010 International Mineralogical Association in Budapest.[252] As shown by Tab. V.1.1 ('original determination'), this nomenclature differs significantly from the nomenclatures used by flaked stone specialists. In particular, within this new system of classification, jaspers are considered completely unrelated, by their formation, to radiolarites.

The problems, however, are not only terminological. The samples sent to Brandl for petrographic determination and geochemical analyses revealed important discrepancies between the original, macroscopic identification, and the microscopic identification. On the whole, the identification of light-coloured translucent raw materials as 'chert' was confirmed. By contrast, several specimens identified as 'jasper' or 'radiolarite' on the basis of their fine grain, texture and absence of translucency, contained too few radiolarians to be considered as radiolarite and were therefore reclassified as cherts (Tab. V.1.1). Their geochemical composition is nevertheless identical to that of true radiolarites and indicates a similar source area.[253] Since it was not possible for the entire collection to be re-examined by a specialist, we shall thus group all the brown-red, non-translucent specimens initially classified as radiolarites or 'jaspers' under the heading of 'radiolarite/chocolate chert' (henceforth R/CC).

Another difficulty pertains to the fact that the group of 'cherts' now contains both the dark-coloured, non-translucent material similar to radiolarites, and the light-coloured, translucent materials, most probably of different origins. In order to distinguish the two varieties, we shall call the second group 'translucent chert', with a special mention for the well-known 'honey flint', here called 'honey chert'.

*Radiolarites/Chocolate Cherts* are by far the most abundant in the PMZ Neolithic collection (72%), as already noted by Karimali.[254] They can be divided into very fine-grained ones (51% of total) and the coarser ones (20.6%). Despite the fineness of the grain of the majority of the radiolarites, their flaking qualities are not always optimal: besides the small size of the pebbles,

[250] Karimali 1994, 291.
[251] The Greek 'chocolate flint' is completely unrelated to the Polish 'chocolate flint' (or 'chocolate silicites') from the Holy Cross Mountains: Brandl et al. 2016.
[252] See Brandl 2013/2014; Brandl et al., this volume, 291–292.
[253] Brandl et al., this volume, 302.
[254] See 'chocolate flint' in Karimali 2009.

when they were collected as such, they often present inner faults that render the control of flaking hazardous or react to percussion with marked undulations.

Some R/CC are extremely lustrous and evoke heat-treated raw materials, as was also the case at Achilleion.[255] In some cases small thermal cracks confirmed the presence of heat alteration, but we found no definite evidence for intentional heat treatment, such as lustrous retouch negatives contrasting with the matte original flaked surfaces.[256] Most pieces must have accidentally come into contact with a fire, but natural processes, such as heating during a metamorphic process, could also be envisioned.

*Obsidian* amounts to 11.4% of the raw materials.[257] It has not been analysed, but its texture and colour is entirely compatible with a Melian origin.[258]

*Translucent cherts*, of various textures and colours but always somehow translucent, amount to 11.7% of the raw materials. This group is anything but homogeneous and the flaking qualities vary. Included in this category are eight specimens (3% of total) of the diagnostic 'honey cherts', here mostly honey or rose in colour, translucent and homogeneous. As with radiolarites, the pink hue made us suspect heat treatment, but this could not be established. Noteworthy is the absence of a green-brown very homogeneous chert, well represented at Achilleion by pressure-flaked blades, imported as finished blanks. This high-quality raw material was seemingly unavailable to the inhabitants of PMZ.

*Quartz* flakes are scarce: eight specimens, or 3% of the total. Some are clearly intentional, non-cortical flakes. Others consist of cortical flakes and debris that may be unrelated to the flaked stone industry and may have been accidentally produced during the percussive use of a quartz pebble.

### *Acquisition of the Raw Materials*

The presence of cortical and neocortical flakes demonstrates that some of the R/CC were picked up as river pebbles and not at the original sources. However, according to Riccardo Caputo, the flysch and marble hills on each side of the valley near PMZ do not contain radiolarites and could not have provided local pebbles.[259] Consequently, all the R/CC derived from the Pindos Mountains, more precisely the Koziakas Range, where these materials are common. It is easy to find large and good-quality pebbles in the Peneios near the foot of the mountains,[260] but the Peneios could not have had the carrying capacity to transport pebbles down to PMZ through the flat Trikala Basin. The surveys undertaken in the framework of the present project confirmed that R/CC pebbles were virtually absent in the riverbeds a few kilometres from the mountains and that the nearest exploitable sources were located 40km away from the settlement, as the crow flies.[261] With one exception, the ten Neolithic samples analysed all corresponded to locations sampled along the Portaikos and the Peneios, up to 50km from the site: PMZ 2, 4, 5 and 8. With five specimens identified, location PMZ 8, on the Peneios,[262] appears to have been favoured, but the sample is small. It is clear, anyway, that R/CC pebbles must be considered as a regional, not a local resource, either collected during specific expeditions, or exchanged with groups living nearer to the mountains.

Most of the pebbles flaked at PMZ were too small to produce the good-quality and often wide R/CC blades and other sources must have been exploited. Some artefacts indeed present a fresh

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255 Personal observation C. P.

256 Inizan et al. 1976; Domanski – Webb 2007; Schmidt et al. 2012.

257 The figure given by Karimali (8.4%) was clearly based on a subsample of the collection since she quotes six pieces whereas we have 31 obsidian artefacts for the Neolithic strata: Karimali 2009, fig. 1.

258 With one possible exception: the flake PM0567 in Lithic Phase 4.

259 Caputo et al., this volume, chapter II.1.

260 Personal observation 1986.

261 Brandl et al., this volume, 294.

262 See Brandl et al., this volume, Fig. V.1.21.

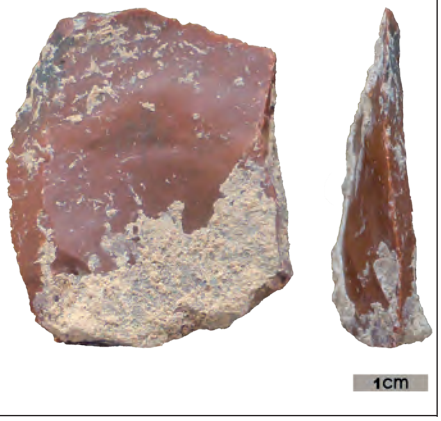
cortex that indicates a collection of raw material at or near the sources, in the Pindos. One of them was analysed and does correspond, by its geochemical composition, to source PMZ 5, characterised as a primary/residual outcrop. Core-shaping flakes and under-crest bladelets suggest that some of the laminar were produced at the site, either from traded cores or by itinerant specialists. It seems probable, however, that the best-quality blades, each unique as regards the characteristics of its raw material, were imported as already flaked blanks.[263]

This also applies to the honey chert blades: the only honey chert flake found at PMZ is a secondary flake extracted from a blade, and honey chert (or 'honey flint') blades always circulate as such in eastern and southern Greece. Their precise origins remain unknown.[264] Bulgaria can be excluded for the vast majority of honey chert blades south of Macedonia and a western origin, in Greece or Albania, appears the most plausible.

Obsidian was imported from Melos. The assemblage comprises both flakes and bladelets. Some, but not all bladelets were pressure flaked. The presence of rejuvenation flakes and irregular bladelets suggests in situ flaking of already prepared or already partially flaked cores, a usual pattern with obsidian.[265] However, the low proportion of obsidian and small absolute number of pieces clearly shows that PMZ had limited access to obsidian trade networks.

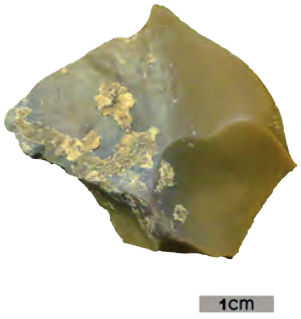
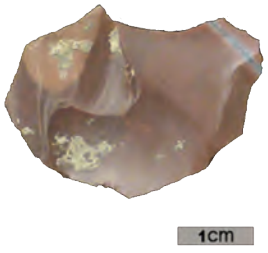
The only raw material that can be considered potentially local is quartz, but its use at PMZ is anecdotal. While the procurement of R/CC pebbles remains debatable since both direct procurement and exchange can be envisioned, there is no doubt that most of the sources of raw materials, in particular the raw materials related to the production of blades, were too far away for direct procurement at the sources. The PMZ inhabitants were thus largely, or perhaps entirely, dependant on exchange for their flaked stone tools. The dependence upon traded raw materials and blanks is frequent in central and southern Greece during the Neolithic, even when local raw materials were available. What is more unusual is that all the trade networks appear to have provided PMZ with very limited quantities of nodules and blanks.

Tab. V.1.1 Raw materials used at PMZ and results of microscopic and geochemical analyses. Microscopic and geochemical groups, see Brandl et al., this volume (C. Perlès)

| PMZ number | Description | Original determination | Petrographic determination | Photograph |
|---|---|---|---|---|
| PM0078 Unretouched flake (Helladic) | Medium-grained, matte, non-translucent, red with dark spots | Matt red jasper (= chocolate flint) | Radiolarite (radiolarians) Microscopic group 1 Geochemical group 1, Source 8 |   |

[263] Below, e.g. 207.
[264] There are indeed many varieties in the group of 'honey flints' and certainly multiple sources: Perlès in preparation.
[265] Perlès 1990; Karimali 2009.

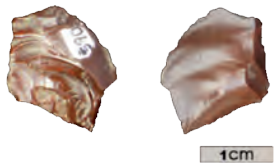
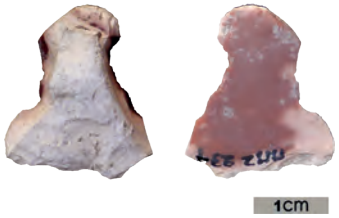
Tab. V.1.1 (continued)

| PMZ number | Description | Original determination | Petrographic determination | Photograph |
|---|---|---|---|---|
| PM0108 Unretouched flake (Helladic) | Fine-grained, homogeneous, lustrous, non-translucent, pale chocolate colour | Lustrous chocolate jasper (= chocolate flint) | Radiolarite (radiolarians) Pebble Microscopic group 1 Geochemical group 1, Source 8 | |
| PM0380 Unretouched flake (Lithic Phase 5) | Fine-grained, homogeneous, non-translucent, chocolate and beige colour | Chocolate and beige jasper (= chocolate flint) | Radiolarite (radiolarians) Microscopic group 1 Geochemical group 1, Source 8 | |
| PM0404 Unretouched flake (Lithic Phase 5) | Medium-grained, non-translucent, dark brown colour | Dark-brown radiolarite | Radiolarite (radiolarians) Microscopic group 2 Geochemical group 1, Source 2 | |
| PM0449 Unretouched flake (Lithic Phase 5) | Fine-grained, homogeneous, non-translucent, brown to olive-green with blue passes | Brown–olive-green jasper | Olive-green radiolarite (dissolved radiolarians) Pebble Microscopic group 3 Geochemical group 1, Source 8 |   |
| PM0448 Unretouched flake (Lithic Phase 5) | Fine-grained, homogeneous, non-translucent, chocolate colour with dark pink stain and a translucent band | Chocolate jasper (= chocolate flint) | Radiolarite (radiolarians) Slight fire influence Microscopic group 1 Geochemical group 1, Source 8 |   |

Tab. V.1.1 (continued)

| PMZ number | Description | Original determination | Petrographic determination | Photograph |
|---|---|---|---|---|
| PM0568 Unretouched flake, cortical (Lithic Phase 4) | Fine-grained, homogeneous, non-translucent, brown-red with pink cortex | Red-brown jasper with cortex (= chocolate flint) | Radiolarite (dissolved radiolarians) with sub-cortex Microscopic group 1 Geochemical group 1, Source 2 | |
| PM0868 Waste (Lithic Phase 1) | Very lustrous, brown-red with darker spots, rolled outer surface | Brown-red jasper, lustrous (= chocolate flint) | Radiolarite Medium fire influence Gravel Microscopic group 5 Geochemical group undetermined | |
| PM0884 Unretouched flake (Lithic Phase 1) | Medium-grained olive-green jasper passing to brown | Medium-grained radiolarite | Radiolarite (radiolarians) Microscopic group 2 Geochemical group 1, Source 8 | |
| PM0461 Unretouched flake (Lithic Phase 4) | Fine-grained, slightly translucent on edges, texture of a radiolarite, green with white fresh cortex | Cortical radiolarite or chert? | Radiolarite (heavily dissolved radiolarians) Primary source Microscopic group 3 Geochemical group 1, Source 2 | |
| PM0248 Unretouched flake (Helladic) | Fine-grained, homogeneous, lustrous, non-translucent, chocolate colour | Jasper (= chocolate flint) | Chert (very few radiolarians) Microscopic group 6 Geochemical group 1, Source 8 | |
| PM0299 Unretouched flake (Helladic) | Fine-grained, homogeneous, lustrous, non-translucent, chocolate colour | Very lustrous red jasper | Chert (very few radiolarians) Microscopic group 6 Geochemical group 1, Source 5 | |

Tab. V.1.1 (continued)

| PMZ number | Description | Original determination | Petrographic determination | Photograph |
|---|---|---|---|---|
| PM0870<br>Unretouched flake<br>(Lithic Phase 1) | Very lustrous dark-brown flake, with thermal removal on dorsal face and a matter surface, heated | Lustrous radiolarite, heated (heat-treatment?) | Chert (very few radiolarians)<br>Burnt<br>Microscopic group 6<br>Geochemical group 1 |  |
| PM0471<br>Primary flake<br>(Lithic Phase 4) | Fine-grained, homogeneous, non-translucent, red with light spots, white fresh cortex | Cortical radiolarite from primary source | Chert (very few radiolarians)<br>Primary source<br>Microscopic group 6<br>Geochemical group 1,<br>Source 5 |  |
| PM0252<br>Unretouched laminar flake<br>(Helladic) | Fine-grained, translucent, beige-pink with lighter passes | Chert (= silex) | Pelmicritic Chert (peloids)<br>Possibly heated<br>Microscopic group 8<br>Geochemical group 3,<br>Source undetermined | |
| PM0580<br>Unretouched flake<br>(Lithic Phase 3) | Fine-grained, translucent, very small white spots | Chert (flint) or calcedony | Chert<br>Few intraclasts, some marine detritus<br>Microscopic group 7<br>Geochemical group 2,<br>Source 4 | |
| PM0811<br>Unretouched flake<br>(Lithic Phase 1) | Fine-grained, red with grey veins | Chert (= silex) | Radiolarite, radiolarians, chalcedony veins<br>Microscopic group 4<br>Geochemical group 1,<br>Source 8 | |

Tab. V.1.1 (continued)

| PMZ number | Description | Original determination | Petrographic determination | Photograph |
|---|---|---|---|---|
| PM0671 Unretouched blade (Lithic Phase 2) | Medium-grained, very slightly translucent on edges, texture of radiolarite beige-green | Yellowish radiolarite? Chert? | Not analysed | |
| PM0348 Non-intentional blade (Lithic Phase 5) | Fine-grained, translucent, beige and blue, spotted, white cortex and blue under-cortical zone | Chert (= silex) | Not analysed | |
| PM0838 Reflaked honey-flint blade (Lithic Phase 1) | Fine-grained, homogeneous, translucent, dark honey colour | Honey flint | Not analysed | |
| PM0802 Bladelet (Lithic Phase 1) | Black, glassy, brilliant, homogeneous | Obsidian | Not analysed | |
| PM0797 Unretouched flake (Lithic Phase 1) | Saccharoid, irregular texture, translucent, yellowish colour | Quartz | Not analysed | |
| PM0636 (Lithic Phase 3) | Translucent, glassy, white | Quartz | Not analysed | |

## V.1.3. Lithic Phase 1 – Building Phases I–V

### *Characterisation*

Lithic Phase 1 encompasses BPh I–V (EU 177–206) and constitutes a relatively small but very homogeneous and characteristic assemblage. No differences could be perceived throughout this sequence. Lithic Phase 1 is characterised by an intentional production of flakes, by the scarcity of bladelets, the scarcity of unretouched blades, a high ratio of retouched tools, the predominance of sickle inserts in the toolkit and the predominance of flakes over blades for the latter. Lithic Phase 1 is radiocarbon dated by several samples (Chapter IV) to ca. 5900–5700 calBC (2σ), i.e. mostly to the MN I Thessalian Neolithic.[266]

### *Raw Materials*

The Lithic Phase 1 assemblage comprises 58 artefacts and 5 debris (Tab. V.1.2). The vast majority of the flaked stones are made in R/CC: 53 pieces out of a total of 63 (88%). Five pieces are made in obsidian, one in quartz, one in honey flint, and one in a light-coloured translucent chert. As explained above, all but perhaps the quartz flake are exogenous.

Natural surfaces – cortex or neocortex – are rarely preserved, even on R/CC flakes or blades (n=7). The proportion (13%) is much lower than at Achilleion, where cortex is present on 37% of the 'red jaspers' and 11% of the 'grey-green jaspers'[267] and closer to the proportions found in eastern Thessaly (ca. 5%),[268] further away from the Pindos sources. This suggests that at PMZ a fair number of artefacts were obtained by exchange as already flaked blanks.

Different sources were exploited. Two primary flakes show that some of the R/CC were procured, directly or indirectly, as water-rolled river pebbles (Fig. V.1.1a). The geochemical analyses confirmed that two flakes from Lithic Phase 1 corresponded to location PMZ 8, on the Peneios River.[269] One small flake, from BPh V, bears a relatively fresh cortex, partially removed by thermal flakes (Fig. V.1.1c). It must have been collected at or near a source. The only light chert bladelet also preserved some primary, unrolled cortex on the butt, indicating procurement at or near the source (Fig. V.1.1d). The single honey flint blade must have been imported, as usual, as an already flaked blank.

Tab. V.1.2 Composition of the flaked stone assemblage from Lithic Phase 1 (C. Perlès)

| | R/CC | Chert | Obsidian | Honey chert | Quartz |
|---|---|---|---|---|---|
| **Debris** | 5 | | | | |
| **Cores** | 1 | | | | |
| **Flakes** | 19 | 1 | 1 | | 1 |
| **Blades** | 1 | 1 | | | |
| **Bladelets** | 3 | | 1 | | |
| **Retouched flakes** | 9 | | 2 | | |
| **Retouched blades** | 13 | | 1 | 1 | |
| **Retouched bladelets** | 2 | | 1 | | |
| **Total** | 53 | 2 | 6 | 1 | 1 |

266 Reingruber et al. 2017.
267 Radiolarites at least are locally available at Achilleion (Geological Map of Greece, IGME, Pharsala Sheet): Elster 1989, tab. 10.1.
268 Moundrea-Agrafioti 1981, 68.
269 Brandl et al., this volume, 296.

Obsidian is conspicuously scarce. It amounts to 8% of the raw materials, as opposed to 28.8% at Achilleion (Phase IV)[270] and more than 50% at Magoula Koutroulou[271] in western Thessaly. In eastern Thessaly and at Ag. Petros, the percentages range from 47 to 70%.[272] Figures as low as that of PMZ Lithic Phase 1 are found only much further inland, in sites such as Theopetra and Magoulitsa.[273] The obsidian artefacts show no natural surfaces: they were imported as finished pieces, or flaked in situ from already prepared cores.

*The Production*

The radiolarite/chocolate cherts (R/CC) sample comprises 5 debris, 1 core, 1 undetermined blank, 34 flakes, 1 fine bladelet, 2 possible bladelets and 17 blades, mostly fragmented. The grain varies from coarse to extremely fine (Fig. V.1.1a–c, e–j). Some, at least, of the blocks were locally worked: the relatively high number of debris[274] of fine-grained chocolate R/CC, fractured along natural clivage facets and without any evidence of water abrasion, is a good indicator of local flaking activities. The exploitation of R/CC aimed at the production of both flakes and blades. There is no evidence of a distinct bladelet production, and the few specimens must have been produced alongside the production of blades.

A flat, centripetal discoid flake core, of dark radiolarite (Figs. V.1.1b, V.1.3i), and several flakes with characteristic bulbs of percussion (cf. Fig. V.1.1e) testify to in situ production of flakes with a hard stone hammer, which accords with the relative abundance of debris in this phase. This unskilled production does not present the characteristics of waste from apprenticeship: there are no multiple misplaced incipient conoids, hinged fractures are not especially abundant, and the blanks are utilised for tools, which is normally not the case when only practice is involved.[275] Nor does it correspond to the production of specific tool types:[276] it must therefore be considered as a local response by unskilled knappers to a shortage of more formal blanks. Similarly, the quartz laminar flake (Tab. V.1.1, PM0797) is made in coarse, granular quartz and was probably produced with a hard hammer (the proximal end is broken). This local production explains the relatively high proportion of flakes (58% of the blanks), which sets PMZ Lithic Phase I apart from contemporaneous settlements. In the obsidian-rich assemblages from Ag. Petros, Magoula Karamourlar and Sesklo B, blades represent, respectively, 55%, 68% and 77% of the blanks.[277] The situation is comparable at Otzaki (Planum 15 and 16), with 70% blades.[278] At Achilleion, where an exploitation of local raw materials was more important, blades still represent 50% of the blanks in Phase III and 55% in Phase IV.[279] Even when radiolarite/cherts only are considered at Sesklo B and Magoula Karamourlar, blades are more abundant than flakes.[280]

Other radiolarite/chocolate chert flakes, more regular and thinner, were detached by the more elaborate technique of indirect percussion, as indicated by their wide-angled, flat butt without conoid (Fig. V.1.1f–i). This suggests that they were intended to shape cores for the production of blades rather than as final products per se. All the blades that bear diagnostic criteria were indeed produced by indirect percussion (Fig. V.1.2a–g): large contact zone of the punch, thick butts

270 Elster 1989, tab. 10.1 (the figure was calculated without 'missing inf').
271 Hamilakis et al. 2017.
272 Moundrea-Agrafioti 1981, tab. 1.
273 Karimali 2009, tab. 1.
274 See Inizan et al. 1999, 34: "Debris: applies to any shapeless fragment, when the means by which it was fractured cannot be identified."
275 Klaric 2018.
276 As is the case, for instance, with the production of drills in the Early Neolithic at Franchthi: Perlès 2004.
277 Moundrea-Agrafioti 1981, 61, tab. 2.
278 Personal observation, C. P.
279 Elster 1989, tab. 10.11.
280 Moundrea-Agrafioti 1981, tab. 8. The information is not available for Achilleion.

when flat – or even concave – with a characteristic angle of ca. 90°; blades more curved than by pressure, with frequent waves, ripples or irregularities on the ventral surface; arrises less parallel and regular than with pressure.[281] Of the six blades that preserved their proximal end, all show a flat butt, either prepared or natural. In three cases, the overhang of previous scars had been suppressed by short removals on the dorsal face. In the absence of blade cores, of crested blades and of characteristic rejuvenation flakes (*cintrage*[282] and *carénage*[283] of blade cores), the volumetric and technical characteristics of the cores cannot be assessed.

The fine R/CC bladelet PM0688 (Figs. V.1.1j, V.1.3j) is unique among the R/CC artefacts. It was detached either by indirect percussion, or possibly by pressure with a short shoulder crutch.[284] There may be doubt, however, about its chronostratigraphic position: it was found just 2cm below surface F25, and could actually belong to Lithic Phase 2.

Even if a number of flakes suggest in situ blade production, the variation in raw materials makes it impossible to match any of the shaping flakes to any of the blades: they are all different in the details of the texture and colours. Each piece belongs to a different *chaîne opératoire*, represented by a single element. We are thus dealing with only extremely partial remnants of the *chaînes opératoires* that were implemented, either locally or elsewhere (Tab. V.1.3).

Pressure flaking is only securely attested in this lithic phase on obsidian and honey chert. The obsidian artefacts comprise three pressure-flaked bladelets. One is a fine mesial fragment, very regular (Fig. V.1.1k); the second a small proximal fragment with a retouched notch (Fig. V.1.1l). The butt is punctiform, with preparation of the removal on the dorsal face, a typical Middle Neolithic method.[285] The last obsidian bladelet is a rather irregular distal fragment from a pyramidal core (Fig. V.1.1m). The two other pieces are irregular flakes coming from early phases of the debitage, detached by indirect percussion (Fig. V.1.1n–o). They may indicate in situ debitage of already prepared cores,[286] but this cannot be ascertained given the small number of artefacts. Trade of second-choice artefacts alongside the bladelets can also be envisioned.

The honey chert blade (Fig. V.1.1p) is a large, sturdy blade with very rectilinear arrises and a straight profile that indicates pressure flaking. Its original width must have exceeded 2.2cm, as for a majority of honey chert blades of the Middle Neolithic, thus requiring the use of a lever to detach the blades.[287] It was reflaked after initial use in order to extract one bladelet, and then crudely reflaked from the other fracture to extract splintered flakes. The bladelet and flakes extracted from this blade have not been recovered in the excavation.

This observation, together with the impossibility of matching the R/CC flakes and blades, confirm that we are mostly dealing with redeposited material and that the waste from local production is to be found in unexcavated areas of the site. However, with such a fragmented image of the individual *chaînes opératoires*, it is impossible to assess the extent of in situ production, in particular for the blades. The small number of flakes where indirect percussion could be securely identified (n=6), as well as the importance of retouch and curation, suggests that blanks were scarce and that many may have been imported as such, as is the case in most Thessalian Middle Neolithic sites.[288]

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281 Pelegrin 1994.

282 See Inizan et al. 1999, 136: "Literally 'centering' in architecture. The term refers to the transversal convexity of the debitage surfaces of a blade core (perpendicular to the ridges)."

283 See Inizan et al. 1999, 136: "The term refers to the longitudinal convexity of the debitage surfaces of a core, which is best represented on cores with a single striking platform."

284 Pelegrin 2012.

285 Perlès 2004.

286 Perlès 1990; 'Table 5' after Reingruber et al. 2017, tab. 5

287 Pelegrin 2004; Pelegrin 2012; Perlès in preparation.

288 Moundrea-Agrafioti 1981, 74; Karimali 2009.

Fig. V.1.1 Lithic Phase 1. a, c–i, n: unretouched flakes, b: flake core, d, j–m: bladelets, o: laterally retouched flake, p–q: reflaked blades (pseudo-burins), r: micro end-scraper, s: end-scraper, t–u: laterally retouched blades, v: microfoliate point. All in R/CC except d in light-coloured chert, k–o in obsidian, p in honey chert. a: PM0801, b: PM0846, c: PM0687, d: PM0784, e: PM0849, f: PM0884, g: PM0870, h: PM0872, i: PM0896, j: PM0688, k: PM0738, l: PM0802, m: PM0774, n: PM0820, o: PM0781, p: PM0838, q: PM0855, r: PM0723, s: PM0742, t: PM0840, u: PM0773, v: PM0848 (C. Perlès)

Tab. V.1.3 Relevant dimensions for the Lithic Phase 1 assemblage. When the functional orientation differs from the technological orientation – i.e. according to the direction of the percussion, with proximal end at the bottom – the measurements are given according to the functional orientation (C. Perlès)

| **PMZ number** | **Determination** | **Dimensions** [cm] |
|---|---|---|
| PM0846 | Flake core | 2.7 × 3.6 × 0.7 |
| PM0735 | Primary R/CC flake | 2.7 × 3.83 × 1.52 |
| PM0862 | Core preparation R/CC flake | 2.12 × 1.5 × 0.43 |
| PM0787 | Core preparation R/CC flake | 2.93 × 1.4 × 0.59 |
| PM0884 | Core preparation R/CC flake | 3.25 × 3.1 × 0.6 |
| PM0814 | Obsidian rejuvenation flake | 1.8 × 1 × 0.28 |
| PM0797 | Distal frag. of quartz laminar flake | 2.7 × 1.57 × 0.7 |
| PM0784 | Proximal frag. of chert bladelet | 2.04 × 1.2 × 0.4 |
| PM0738 | Mesial frag. of obsidian bladelet | 1.78 × 0.9 × 0.19 |
| PM0774 | Distal frag. of obsidian bladelet | 3.31 × 1.18 × 0.25 |
| PM0802 | Proximal frag. of notched obsidian bladelet | 1.64 × 0.79 × 0.3 |
| PM0852 | Mesial frag. of utilised R/CC blade | 1.6 × 1.55 × 0.31 |
| PM0773 | Mesial frag. of retouched R/CC blade | 2.7 × 1.14 × 0.7 |
| PM0840 | Mesial frag. of retouched R/CC blade | 3.03 × 1.7 × 0.42 |
| PM0855 | Proximal frag. of retouched R/CC blade | 2.24 × 1.55 × 0.37 |
| PM0871 | Retouched obsidian flake | 1.88 × 2.2 × 0.49 |
| PM0820 | Retouched obsidian flake | 2.69 × 1.37 × 0.35 |
| PM0833 | Sickle insert on R/CC blade | 5 × 1.5 × 0.65 |
| PM0736 | Sickle insert on R/CC blade | 3.6 × 1.45 × 0.5 |
| PM0875 | Sickle insert on mesial frag. of R/CC blade | 3.53 × 1.33 × 0.48 |
| PM0743 | Sickle insert on mesial frag. of R/CC blade | 2.71 × 1.2 × 0.59 |
| PM0808 | Sickle insert on proximal frag. of R/CC blade | 2.26 × 1.65 × 0.51 |
| PM0751 | Sickle insert on proximal frag. of R/CC blade | 2.9 × 1.64 × 0.64 |
| PM0746 | Sickle insert on R/CC blade | 2.88 × 1.77 × 0.55 |
| PM0764 | Sickle insert on R/CC blade | 3.3 × 1.61 × 0.53 |
| PM0836 | Sickle insert on R/CC flake | 2.7 × 1.7 × 0.62 |
| PM0734 | Sickle insert on R/CC flake | 2 × 1.3 × 0.34 |
| PM0867 | Sickle insert on R/CC flake | 2.8 × 1.56 × 0.68 |
| PM0845 | Sickle insert on R/CC flake | 2.1 × 1 × 0.82 |
| PM0812 | Sickle insert on R/CC flake | 2.68 × 1.47 × 0.57 |
| PM0849 | Sickle insert on R/CC flake | 3.1 × 2 × 0.72 |
| PM0728 | Sickle insert on R/CC flake | 2.9 × 1.34 × 0.35 |
| PM0770 | Sickle insert on R/CC flake | 2.6 × 1.68 × 0.78 |
| PM0742 | End-scraper on R/CC blade | 3.21 × 2.09 × 0.63 |
| PM0723 | Frag. of micro end-scraper | 0.9 × 0.7 × 0.23 |
| PM0848 | Microfoliate R/CC point | 2.06 × 0.98 × 0.35 |
| PM0823 | Splintered R/CC flake | 1.13 × 2 × 0.6 |
| PM0838 | Mesial frag. of retouched honey chert blade | 3.58 × 1.8 × 0.86 |

*The Retouched Toolkit*

If one leaves aside the debris and the core, 29 out of a total of 56 pieces are retouched, i.e. more than half. This ratio is higher than in any Middle Neolithic Thessalian site where the information is available. At Achilleion Early Neolithic/Middle Neolithic and Middle Neolithic, one obtains a ratio of 13.7% retouched pieces in Phase III and 13.8% in Phase IV by combining tables 10.4 and 10.3.[289] At Otzaki[290] the ratio is 27% for Planum 15 and 16, dated to an early Middle Neolithic. Ag. Petros, Sesklo B and Magoula Karamourlar show rates of 36.1%, 31.5% and 33.1%, respectively, for the Middle Neolithic as a whole.[291] These ratios are comparable to the ratio of retouched pieces in the Middle Neolithic at Franchthi.[292] The unusually high ratio at PMZ, together with the use of informal flakes, confirms that raw materials and available blanks were severely lacking.

From a typological viewpoint, the comparison between the classic technomorphological classification and the results of the functional analysis reveals interesting discrepancies. Well-developed cereal gloss had been recognised during the technological analysis, and the artefacts accordingly classified as sickle inserts on blades or flakes. On several sickle inserts, however, the polish that started to develop after rejuvenation of the edge was not visible macroscopically, so they had been considered as sickle inserts transformed into 'retouched blades'. Similarly, the exact extension of the polish on the distal edge of the inserts could not always be assessed, leading to misidentifications: two 'end-scrapers on sickle blades', for instance, were functionally complete inserts with an 'end-scraper front' to shape the distal end. Another short 'end-scraper on flake' was in fact used to cut cereals with the 'end-scraper' front. Microscopic examination was also necessary to detect minute traces of residues from hafting[293] and to show that several retouched edges were not secondary transformations of sickle inserts, but a deliberate shaping of the edge for hafting.

Unless a well-developed cereal gloss covers the working edge(s), the main difficulty for the technologist is to differentiate a retouch intended to shape the piece for manual prehension or for hafting from a retouch intended to modify the characteristics of the working edge. Most of the discrepancies observed between the classical typological classification and the results of the microscopic studies arose from this difficulty.

Functional analyses also proved decisive for understanding the sickle inserts on flakes. Poorly developed polish on unusual blanks, such as informal flakes, had not always been recognised and the artefacts had been classified in a different typological category (see 'little tranchet', Tab. V.1.4). More generally, functional analyses allowed us to make some sense of the whole class of sickle inserts on flakes, which, when oriented according to a technological orientation – along the flaking axis – appeared all different: one had to understand that the users of the inserts, contrary to the technologist, did not care about a strict technological orientation! Traditional typologies and strict classificatory principles are clearly ill adapted when, as is the case here, the artisans or the users did not have a strict technomorphological template in mind for their tools.

Tab. V.1.4 lists the retouched pieces from Lithic Phase 1 (by building phase) and underlines, by means of italics, discrepancies between the original typological determination and the functional determination.

In the following presentation, the tools will be classified according to the results of the functional analysis, when available. The largest group by far consists of flakes and blades bearing cereal polish, i.e. sickle inserts (16 out of 28). The other tool types are mostly represented by single artefacts: end-scraper, micro end-scraper, 'burin', notched bladelet, microfoliate, retouched flakes and blades. The absence of projectile points and geometrics should be noted, but this may be due to the small size of the sample.

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289 Elster 1989.
290 Mottier 1981 and personal observation C. P.
291 Moundrea-Agrafioti 1981, tab. 10.
292 Perlès 2004, docs. 8.1 and 8.2.
293 These residues have not been analysed.

Tab. V.1.4 Retouched tools from Lithic Phase 1. Italics denote discrepancies between the technomorphological and functional identifications (C. Perlès)

| PMZ number | BPh/ BSPh | Figure | Raw material | Technomorphological classification | Functional classification |
|---|---|---|---|---|---|
| PM0875 | II | V.1.2.c, V.1.4.c | Burnt R/CC | *End-scraper on sickle blade* | *Sickle insert on blade, reused for another task* |
| PM0867 | IIIa | V.1.2.n, V.1.4.m | R/CC | Denticulated sickle insert on flake | Sickle insert on flake |
| PM0855 | IIIa | V.1.1.q | R/CC | Pseudo 'burin' | n/a |
| PM0849 | IIIb | V.1.2.m, V.1.4.l | R/CC | Denticulated sickle insert on flake | Denticulated sickle insert on flake |
| PM0848 | IIIb | V.1.1.v, V.1.3.h | R/CC | Microfoliate point | Utilised tool, undetermined use |
| PM0852 | IIIb | V.1.3.e | R/CC | Blade with use wear | Blade used on hard or semi-hard material |
| PM0838 | IIIb | V.1.1.p, V.1.3.d | Honey chert | Retouched and reflaked blade | Retouched blade, used on wood, reflaked |
| PM0823 | IIIb | – | R/CC | Splintered piece | n/a |
| PM0840 | IIIb | V.1.1.t | R/CC | Retouched blade | Retouched, utilised blade, undetermined use |
| PM0845 | IIIb | V.1.2.o, V.1.4.n | R/CC | *Secondary flake from sickle blade* | *Sickle insert on flake* |
| PM0833 | IIIb | V.1.2.a, V.1.4.a | R/CC | Transformed sickle blade | *Sickle insert on blade* |
| PM0836 | IIIb | V.1.2.j, V.1.4.j | R/CC | *Little tranchet* | *Sickle insert on flake* |
| PM0812 | IIIb | V.1.2.i | R/CC | Retouched sickle insert on flake | Retouched sickle insert on flake |
| PM0820 | IIIb | V.1.1.n, V.1.3.f | Obsidian | Notched flake | n/a |
| PM0802 | IIIc | V.1.1.l | Obsidian | Notched bladelet | n/a |
| PM0808 | IIIc | V.1.2.l, V.1.4.k | R/CC | *End-scraper on sickle blade* | *Sickle insert on blade* |
| PM0781 | IVa | V.1.1.o | Obsidian | Retouched flake | n/a |
| PM0773 | IVb | V.1.1.u, V.1.3.c | R/CC | Retouched blade | Scraper used on skin |
| PM0770 | Va | V.1.2.h, V.1.4.i | R/CC | *Retouched flake* | *Sickle insert on flake* |
| PM0764 | Va | V.1.2.e, V.1.4.e | R/CC | Sickle blade | Sickle insert on blade |
| PM0751 | Vb | V.1.2.f, V.1.4.f | R/CC | *Sickle blade transformed into denticulated blade* | *Sickle insert on blade* |
| PM0746 | Vb | V.1.2.d, V.1.4.d | R/CC | *Transformed sickle blade* | *Sickle insert on blade* |
| PM0742 | Vd | V.1.1.s, V.1.3.a | R/CC | Proximal end-scraper | End-scraper used on skin or hide |
| PM0743 | Vd | V.1.2.k, V.1.4.h | R/CC | *Sickle blade transformed into denticulated blade* | *Sickle insert on blade* |
| PM0736 | Vd | V.1.2.b, V.1.4.b | R/CC | Sickle blade transformed into denticulated blade | Sickle blade reused for another task |
| PM0734 | Vd | – | R/CC | Sickle insert on flake | n/a |
| PM0728 | Vd | V.1.2.g, V.1.4.g | R/CC | *Sickle insert transformed into point* | *Sickle insert* |
| PM0723 | Ve | V.1.1.r, V.1.3.b | R/CC | Micro end-scraper | Micro end-scraper |

Sickle Inserts (n=16)

The rather unusual characteristic of the sickle inserts in Lithic Phase 1 is the variety of blanks utilised. Several groups can be distinguished: sickle inserts on regular blades, sickle inserts on backed flakes, and sickle inserts on informal flakes.

Classical 'sickle blades' are surprisingly few in this assemblage. They are made on blades of variable flaking quality, all probably produced by indirect percussion, and characterised by a frequent bilateral use and oblique hafting.

PM0833 (Figs. V.1.2a, V.1.4a) stands out by its dimensions: made in a dark-brown, spotted R/CC, it measures 5cm long for a present width of 1.5cm, despite important lateral rejuvenation. The linear butt is preserved and the distal end was intentionally broken to reduce its length. According to L. P., the insert is functionally complete with cereal polish on the distal fracture and on both edges (see V.1.9. Appendix for a detailed description of the wear traces). It was first used on one edge, then turned over and used on the other edge. Both edges were rejuvenated, by a short denticulated abrupt retouch on the left edge, and a longer, subparallel, ¾ abrupt denticulated retouch on the right edge. Both edges were re-used to cut cereals for a short while after rejuvenation. It would thus belong to the small subset of Thessalian inserts that Moundrea-Agrafioti defined as '*lames-faucilles*',[294] as opposed to the more common '*éléments de faucille*', usually between 2.6 and 3cm long. However, Mazzucco found it too altered to confirm its use.

PM0736 (Figs. V.1.2b, V.1.4b) is made on a regular blade of fine-grained chocolate R/CC with a flat butt and preparation on the dorsal face. It is functionally complete, with cereal polish on the two extremities. The distal end was intentionally broken to reduce it to a module of 3.6cm for a width of 1.45cm. It was inserted obliquely, turned over after the initial use and re-used to cut cereals. The left edge was then denticulated by ¾ abrupt retouch with no polish, while the right edge bears an alternating use retouch due to the re-use of the insert for another task.[295] The secondary retouch of the left edge may thus be related to the rehafting of the tool when re-used.

PM0875 (Figs. V.1.2c, V.1.4c) was initially classified as an end-scraper on a sickle blade. Microscopic examination showed that cereal polish extended over the right side of the 'end-scraper' and that the latter was meant to shape the tool to a module of ca. 3.5cm. Similarly shaped sickle inserts are known in other Thessalian sites, but rare.[296] Like the previous one, PM0875 was inserted obliquely, used on cereals, turned over and re-used. It was then retouched on both edges by a slightly denticulated ¾ abrupt retouch and used for another task.[297]

PM0746 is a mesial fragment of blade that bears cereal polish on both fractures and is therefore functionally complete (Figs. V.1.2d, V.1.4d). The left proximal part was shaped for hafting by a short inverse retouch. The right edge was used to cut cereal, rejuvenated by denticulated ½ abrupt retouch, and used again for the same task. Remains of polish obliterated by thermal fractures are possible on the left edge.[298]

PM0764 (Figs. V.1.2e, V.1.4e) is probably functionally complete, shortened by fracture on the proximal extremity to fit the module of ca. 3.5cm. It was used to cut cereals with the right edge, and bears traces of resin on the hafted left edge. The working edge was extensively rejuvenated and used again for the same task.[299]

The following pieces constitute a second and numerically dominant group of inserts, made on flakes or laminar flakes. As mentioned above, when oriented along the technological axis, this group appeared heterogeneous by the shape of the blanks, the position of the working edge and the characteristics of the opposite edge. Its coherence is revealed when the artefacts are oriented

[294] Moundrea-Agrafioti 1981, 119.
[295] Observation N. Mazzucco.
[296] Moundrea-Agrafioti 1981, 117.
[297] Observation N. Mazzucco.
[298] Observation N. Mazzucco.
[299] Observation N. Mazzucco.

along the longest morphological axis: these inserts are all characterised by small dimensions, by the use of one edge only to cut cereals, by a thick opposite hafted edge, and by an only slightly oblique insertion into the haft.

Like PM0875, PM0751 (Figs. V.1.2f, V.1.4f) was initially classified as an end-scraper. Microscopic examination revealed a functionally complete sickle insert. The left edge bears a short inverse retouch on the proximal end, comparable to that of PM0764, and an irregular direct retouch on the mesial and distal parts. There is no use-wear on this edge and the retouch must have been intended to shape the insert for hafting. The piece was inserted slightly obliquely and used with the right edge. The polish is cut by a short ½ abrupt retouch that bears no traces of cereal polish or of use on another material.

PM0728 (Figs. V.1.2g, V.1.4g), initially classified as a sickle insert reshaped into a pseudo-point, is, in fact, a functionally complete sickle insert that bears cereal polish on the two extremities. It fits within the shorter module of less than 3cm. The left edge was shaped for hafting by inverse ½ abrupt retouch and preserves traces of resin. It was inserted very slightly obliquely into the haft. The right working edge bears an irregular direct abrupt retouch, possibly from its use when cutting cereals.[300] It is close, morphologically and technically, to PM0770 (Fig. V.1.2h), which is made on a fragmentary flake but probably functionally complete. The right edge was shaped for hafting by ½ abrupt inverse retouch and inserted slightly obliquely into the haft. The left edge was used to cut cereals and bears an inverse discontinuous low-angle retouch that corresponds to light rejuvenation. The insert was not used for long after rejuvenation. PM0812 (Fig. V.1.2i) is morphologically very similar to PM0770 but the 'backed' hafted edge to the right is prepared by an oblique inverse abrupt truncation. The poorly developed polish on the mesial part of the left edge was interpreted differently by the two specialists of traceology: L. P. suggests it results from the working of reeds, while Mazzucco considers it as resulting from brief work on cereals. Though slightly different, with its quadrangular morphology, PM0836 also belongs to the group of inserts on backed flakes. The cereal polish was not initially identified and the piece was described as a 'little tranchet', or bitruncation (Figs. V.1.2j, V.1.4j). The original proximal end was truncated by direct retouch; the original distal edge bears a continuous ½ direct retouch, while the original right edge is backed by inverse abrupt retouch. The results of the functional analysis demonstrate that it was, in fact, shaped to be a sickle insert, with the left edge hafted, and the right edge used on cereals. The polish extends over the distal truncation and the insertion in the haft appears to have been slightly more oblique than with the previous pieces.

PM0743 has been so intensely rejuvenated that it now presents an unusual elongated and narrow shape. The distal end is broken. The right edge was backed in order to be inserted in the haft, by large, denticulated ½ abrupt direct retouch (Figs. V.1.2k, V.1.4h). Like the previous pieces, it was inserted with a very slight angle into the haft. The left edge was used to cut cereals, rejuvenated – probably several times – and used again for the same task.[301]

PM0808 (Figs. V.1.2l, V.1.4k) was initially interpreted as an end-scraper manufactured on a flake extracted from a sickle blade by bipolar percussion. Only one facet of the original blank is preserved, and it bears a well-developed, macroscopically visible, cereal polish. However, microscopic examination also revealed cereal polish on the 'end-scraper' front. This piece is thus another example of a thick-backed sickle insert on an unusual flake blank. Finally, PM0734 shaped on a hinged flake – possibly from bipolar percussion – is the smallest example of inserts on backed flakes. The right edge was backed by short abrupt retouch, the left edge bears a light cereal polish.[302]

The remaining three inserts, also on flakes, have different and very unusual shapes for sickle inserts but they share one characteristic: a very large butt that renders the insert very thick.

[300] Observation N. Mazzucco.
[301] Observation N. Mazzucco and L. P.
[302] This piece had been examined in 1990 by C. P., but was not recovered during the recent studies.

Fig. V.1.2 Lithic Phase 1. Sickle inserts on blades and flakes. All in R/CC. a: PM0833, b: PM0736, c: PM0875, d: PM0746, e: PM0764, f: PM0751, g: PM0728, h: PM0770, i: PM0812, j: PM0836, k: PM0743, l: PM0808, m: PM0849, n: PM0867, o: PM0845 (C. Perlès)

PM0849 (Figs. V.1.2m, V.1.4l) was awkwardly produced with a hard hammer. Since, functionally speaking, the resulting thick butt constitutes the right edge of the insert, this piece belongs to the group of inserts with a thick hafted back. It differs, however, by its denticulated, convex working edge, shaped on the distal edge by low-angled retouch and bearing a well-developed cereal polish. Despite these unusual characteristics, the polish is absolutely similar to the other inserts, and shows that the flake was used to cut cereals.[303] PM0867 (Figs. V.1.2n, V.1.4m) was also struck with a hard hammer and used on its left edge. The active edge bears a denticulated low-angled retouch, polished, but the denticulation is less pronounced than on the previous piece. After being used as a sickle insert, the flake was re-used by the distal end to scrape dry skin. The last sickle insert, PM0845, probably presents the most unusual morphology, with its narrow triangular shape and thick triangular section (Figs. V.1.2o, V.1.4n). Like the two previous ones, it presents a very large butt and was struck with a hard hammer. It was inserted diagonally, and the well-developed cereal polish on the right edge extends over the butt. Important striations and soil polish over the cereal polish indicate contact with the ground.[304]

### ‘Burin’ (n=1)

PM0855 (Fig. V.1.1q) is made on a unique light-beige R/CC with brown spots. Before the breakage of the proximal extremity, a strongly hinged bladelet, similar to a burin spall, was extracted on the left edge. Real burins, i.e. tools used on the angle or edge of the spall removal, are virtually non-existent in Greek Middle Neolithic assemblages. By contrast, the reflaking of large blades to obtain smaller blanks is a common practice.[305] This piece should thus more probably be considered as a burin-like core.

### End-scrapers (n=2)

The only two end-scrapers are morphologically very different from one another and they were used differently. PM0742 (Figs. V.1.1s, V.1.3a) is a proximal end-scraper made on a wide, hinged R/CC blade or laminar flake. Both edges bear a large ¾ direct continuous retouch. The end-scraper front is ½ circular and was shaped by ½ abrupt regular retouch. Microscopic examination confirms that it was used as an end-scraper on hide, held at a high angle, with a transverse movement. PM0723 (Figs. V.1.1r, V.1.3b) is, by contrast, a fragment of a very small micro ‘end-scraper’, made on a bladelet or small flake. A convex front was prepared on the distal part, adjacent to an inverse retouch on the left edge. The tool was not used on the whole scraper front but only on a localised segment of the left distal extremity, with a transversal gesture on vegetal material that could not be identified.

### Laterally Retouched Blades (n=3)

PM0840 (Fig. V.1.1t) is a proximal fragment of an R/CC blade with a punctiform butt, flaked by indirect percussion. It bears a bilateral low-angle retouch and was utilised on the right edge, as shown by the blunting and polish. The material worked could not be identified. PM0773 (Figs. V.1.1u, V.1.3c) is a narrow, dark-brown, matte R/CC mesial fragment of blade. Both edges were backed by a direct ¾ retouch, irregularly denticulate and used with a transversal movement on a semi-hard material, such as fresh skin.

PM0838 is the only artefact made of honey chert in this phase. As stated above, it is a typical blade made by pressure flaking with a lever (Figs. V.1.1p, V.1.3d). Possible remnants of cereal

[303] Observation N. Mazzucco.
[304] According to Mazzucco, this volume, 289–290 this could be a threshing sledge insert.
[305] Perlès 2004.

polish on the right arris suggest it may have initially been used as a sickle blade, but this has not been confirmed. The left original edge is partly preserved and bears a low-angle direct retouch. It was used with a transverse action on hard or semi-hard material such as wood. A bladelet was then extracted on the right edge from the distal fracture. After the removal of this bladelet, the newly created edge was also used to work wood. Finally, the blade was splintered by bipolar percussion from the proximal extremity (or fracture).

Utilised Blade (n=1)

PM0852 is a short mesial fragment of a regular R/CC blade with use retouch. Microscopic examination showed that the left edge was used transversally on an undetermined hard or semi-hard material (Fig. V.1.3e).

Notched Flake and Bladelet (n=2)

The only two notched pieces are both in obsidian. PM0802 (Fig. V.1.1l) is made on the smallest obsidian bladelet. A small notch was retouched on the proximal part of the left edge. PM0820 (Figs. V.1.1n, V.1.3f), flaked on the lateral side of an obsidian core by indirect percussion, was modified by a short ¾ abrupt retouch that created two shallow notches on the right edge.

Retouched Flakes (n=1)

The second obsidian flake, PM0781 (Fig. V.1.1o), was also flaked by indirect percussion. It bears a regular direct ½ abrupt retouch on the left edge.

'Microfoliate' (n=1)

PM0848 (Figs. V.1.1v, V.1.3h) is a most unusual tool in a Middle Neolithic context; it has no equivalent that we know of, and constitutes a real 'typological puzzle': should it be considered as a microfoliate point or, if one reverses the axis, as a very narrow transverse arrowhead? Made on a R/CC bladelet or flake, PM0848 has been nearly entirely shaped by bilateral, bifacial, low-angle covering retouch. Like on the large Final Neolithic/Early Bronze Age foliate points, the bevelled base was shaped by axial retouch. Microscopic examination revealed blunting and polish on the point, but neither the gesture nor the material worked could be identified.

Splintered Piece (n=1)

PM0823 is a thick R/CC flake that bears two negatives on the ventral face. It may correspond to the very initial phase of use of a splintered blade.

*The PMZ Lithic Phase 1 in the Thessalian Context*

Apart from the sickle inserts, few formal tool types are represented in this small assemblage. In terms of activities identified, the harvest of cereals is largely predominant. Domestic crafts – woodworking, hide working, bone tool and ornament manufacturing – and food preparation, such as meat cutting, are either absent or conspicuously underrepresented.

The importance of sickle inserts is not specific to PMZ Lithic Phase 1: it holds true in all our Middle Neolithic Thessalian reference collections, Achilleion, Ag. Petros, Sesklo B, Magoula Karamourlar and Otzaki. Their percentage in the toolkits is usually lower than at PMZ, in particular because splintered pieces are abundant, while splintered pieces are conspicuously rare or even absent at PMZ in Phase 1. When splintered pieces are removed, the proportions become comparable, slightly above 50% of the retouched tools. On the other hand, the PMZ assemblage differs

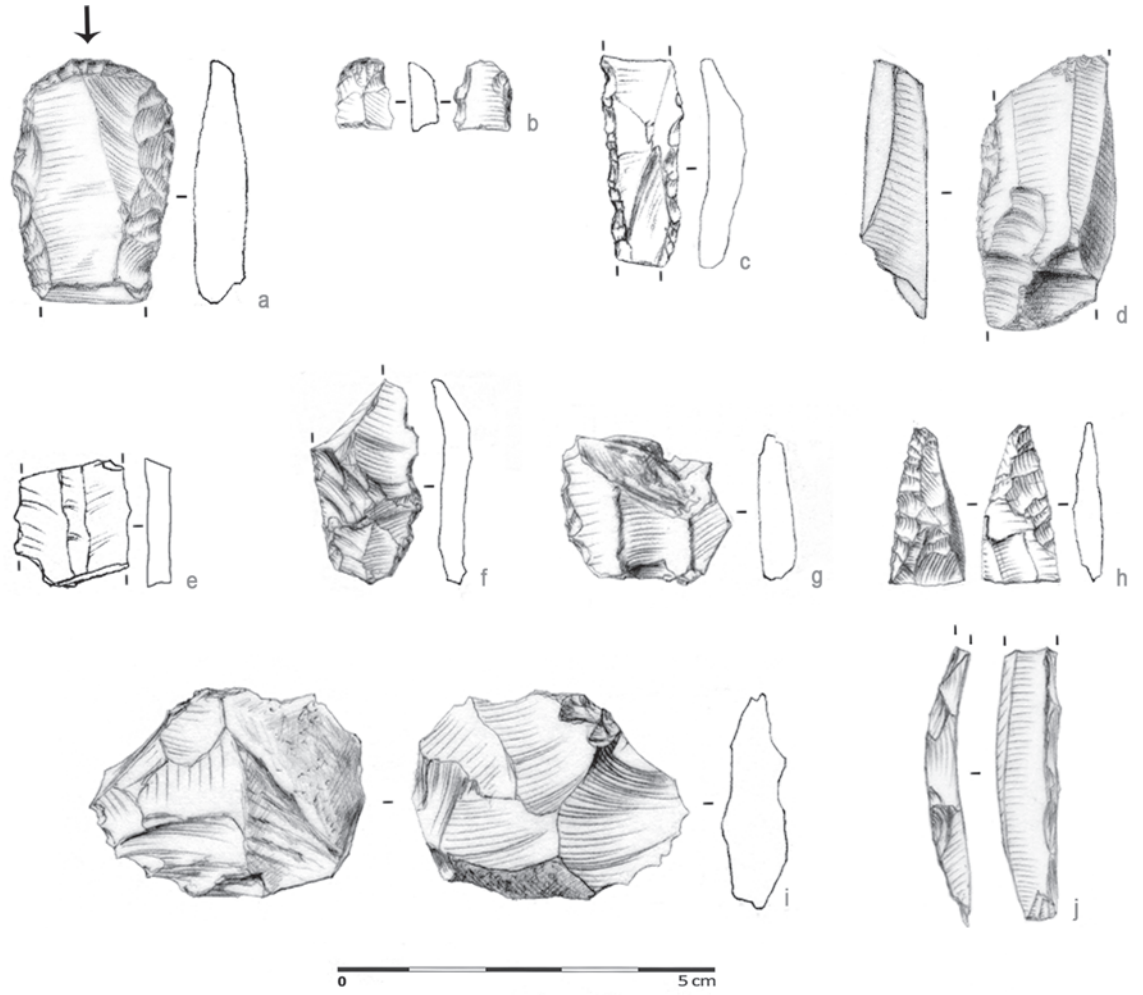


Fig. V.1.3 Lithic Phase 1. a: proximal R/CC end-scraper (PM0742), b: micro R/CC end-scraper (PM0723), c: laterally retouched R/CC blade (PM0773), d: retouched and reflaked honey chert blade (PM0838), e: utilised R/CC blade fragment (PM0852), f: notched obsidian bladelet (PM0820), g: retouched obsidian flake (PM0781), h: R/CC microfoliate point (PM0848), i: R/CC flake core (PM0846), j: R/CC lateral bladelet (PM0688) (C. Perlès, drawings: M. Ballinger)

from all others by the nature of the sickle inserts and the predominance of thick-backed flakes. Sickle inserts on flakes, and in particular on thick-backed flakes, are present in other series, where they constitute a clearly distinct type, but they are a minority: 1 out of 12 at Otzaki[306] and barely 8% in the Thessalian sites studied by Moundrea-Agrafioti.[307] At Achilleion (Early Neolithic and Middle Neolithic), C. P. counted 16 backed flakes with cereal polish for 67 sickle blades among the blanks that could be identified. In addition, sickle inserts on backed flakes at Achilleion tend to be more regular than at PMZ: they are made on laminar flakes, the functional axis corresponds to the technological axis and they do not have especially thick butts.[308]

Since many of the blades used as sickle inserts in eastern Thessalian sites were imported as already prepared blanks,[309] as shown by the relative scarcity of flakes, we suggested that the predominance of sickle inserts on flakes at PMZ was due to difficulties in obtaining adequate blades through trade. However, the inserts on flakes are not, or not always, a shorter version of

306 See Mottier 1981, pl. 72.3 for an unusually large example.
307 Moundrea-Agrafioti 1983, 203.
308 Few are depicted in the publication, but see Elster 1989, fig. 109.4, nos. 6 and 8.
309 Moundrea-Agrafioti 1981, 102.

inserts on blades. The 'sickle blades' were intended to be used on both sides, and both edges were consequently left sharp. Some of the inserts on flakes at Achilleion were used on both edges, and can be considered as a shorter version of the same type.[310] Conversely, most of the sickle inserts on flakes from PMZ present a thick hafted edge, either natural or intentionally backed, and were used unilaterally. They also seem to have been hafted more parallel in the haft than blades and may thus correspond to two different types of sickles, both used to cut cereals. For functional or traditional reasons, the farmers of PMZ Lithic Phase 1 may have preferred this second type of sickle. It remains possible, nevertheless, that it was 'preferred' at PMZ precisely because regular blades were too scarce.

The few other retouched tools are common tool types in Middle Neolithic assemblages: retouched flakes and blades, end-scrapers, notched pieces. There are two exceptions: the micro end-scraper and the microfoliate point, both unique not only for Thessaly, but, as far as we know, for Greece in general. Altogether, the retouched toolkit from Lithic Phase 1 presents many idiosyncratic features: a predominance of thick-backed sickle inserts on flakes, a quasi-absence of splintered pieces, an absence of borers and geometrics, the presence of unique tool types. None of these features are found in the other Middle Neolithic assemblages published. Nor do they evoke earlier, Early Neolithic characteristics: Thessalian Early Neolithic assemblages are actually very similar to Middle Neolithic ones. They must rather be understood as a temporary answer to local conditions and the scarcity of blades.

### *Stratigraphic Distribution and Contexts*

The stratigraphic distribution of the flaked stones of Lithic Phase 1 is uneven throughout the sequence. The basal ditch (BPh I) yielded only one R/CC unretouched flake. BPh II comprises the sediments overlying the ditch, where no architectural remains were preserved. They yielded six R/CC pieces, spread over the whole excavation surface (Fig. III.8): two debris, three unretouched flakes and the sickle blade PM0875 (Fig. V.1.2c). Considering its stratigraphic position, this bilaterally retouched sickle blade shaped with an 'end-scraper front' thus defines a type that can securely be considered early Middle Neolithic.

Five R/CC pieces are associated with the level of the collapsed wall W39 (BSPh IIIa, Fig. III.10): two debris, two unretouched flakes, and the sickle insert on denticulated flake PM0867 (Fig. V.1.2n). Even if this insert was incorporated into the wall from earlier sediments, it confirms that sickle inserts on both blades and flakes were in use simultaneously in the earliest phases of occupation. The burin-like blade PM0855 (Fig. V.1.1q) was recovered in the burnt layer directly overlying W39, together with two unretouched flakes.

BSPh IIIb comprises surfaces F33a–d (Fig. III.12), described as intermingled remnants of fires and dissolved clay from building materials.[311] Despite evidence for repeated firing, only one piece is clearly burnt. It thus appears doubtful that they were deposited on the original surfaces before the firing episodes. Altogether, the three surfaces and interstratified deposits yielded a richer assemblage: 18 pieces, including the first two obsidian elements and the first honey chert blade. The flake core PM0846 (Figs. V.1.1b, V.1.3j) was associated with the lowermost of these surfaces. However, none of the corresponding flakes were recovered, and it cannot be surmised that it was worked there rather than redeposited. Retouched pieces are numerous: four sickle inserts on flakes (PM0812, PM0836, PM0849, PM0845, Figs. V.1.2i–j, m, o, V.1.4i–j, l, n), one sickle insert on blade (PM0833, Figs. V.1.2a, V.1.4a), the honey chert blade PM0838 (Figs. V.1.1p, V.1.3d), a retouched R/CC blade (PM0840, Fig. V.1.1t), one obsidian retouched flake (PM0820, Fig. V.1.1n) and the microfoliate point (PM0848, Figs. V.1.1v, V.1.3h). Again, all can be considered as representative of the lithic tools of the earliest phases of occupation, even if it cannot be proven that they were strictly in situ.

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[310] See for instance at Achilleion: Elster 1989, fig. 10.3, no. 2.

[311] Toufexis – Batzelas, this volume, 92.

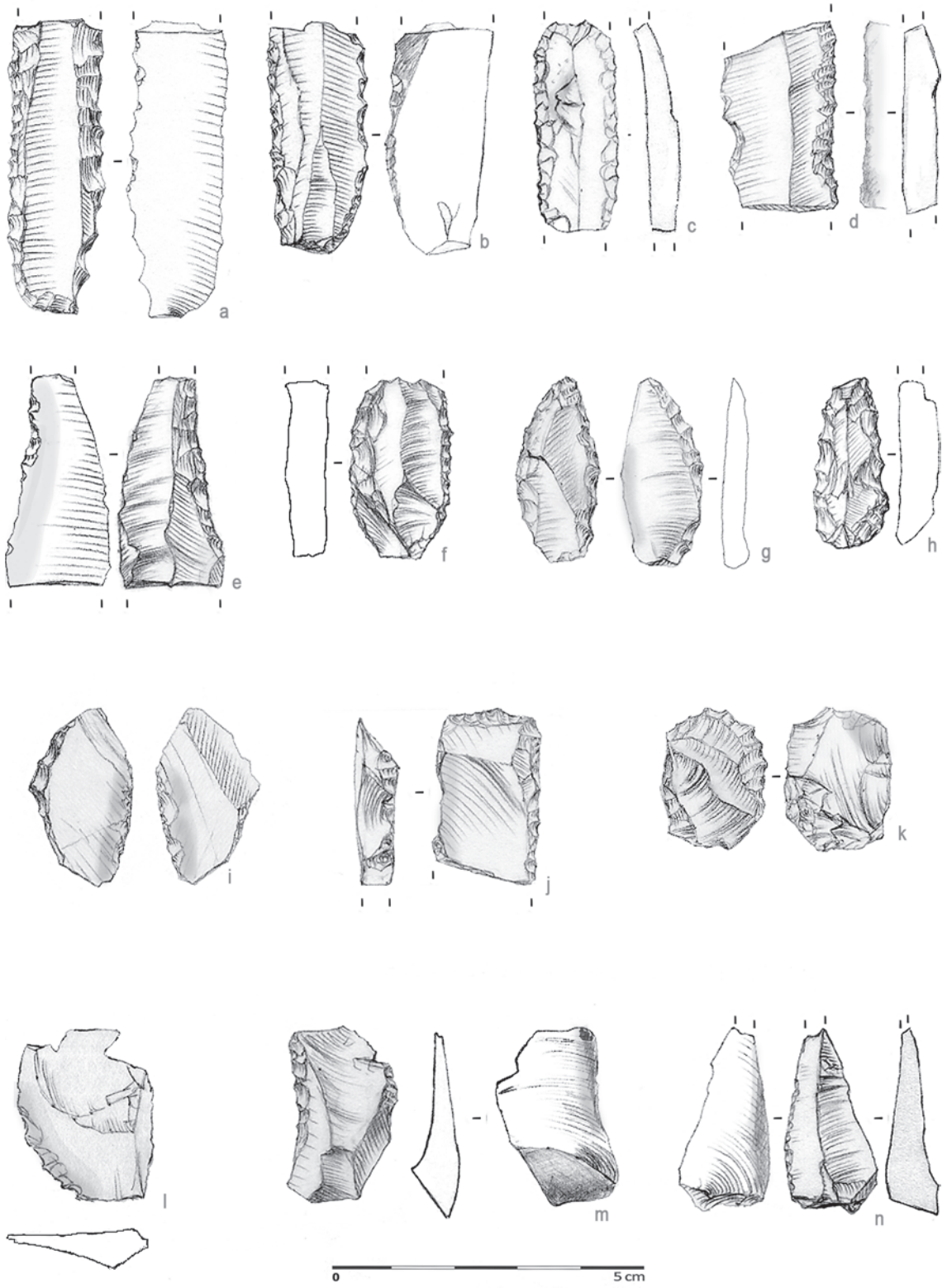


Fig. V.1.4 Lithic Phase 1. Sickle inserts on blades and flakes. All in in R/CC. a: PM0833, b: PM0736, c: PM0875, d: PM0746, e: PM0764, f: PM0751, g: PM0728, h: PM0743, i: PM0812, j: PM0836, k: PM0808, l: PM0849, m: PM0867: n: PM0845 (C. Perlès, drawings: M. Ballinger)

In terms of technical activities, this represents five tools used to cut cereals, one tool used to scrape wood, and four pieces of indeterminate use. The sickle inserts were clearly not used in situ, but may have been de-hafted around the hearths. The other pieces may, conversely, have been used where they were discarded. If they were, however, their small number and diversity testifies to episodic, short-term technical activities rather than real production workshops.

Five pieces were associated with the surface uncovered in BSPh IIIc (Fig. III.15): one obsidian bladelet, one R/CC fragmentary burnt blade and three R/CC flakes, including two which were accidentally burnt. Since no hearths were noted on this surface, the burnt pieces must have been redeposited from elsewhere and this casts doubts for the other pieces as well: they may all derive from earlier contexts. The only retouched piece is the obsidian bladelet (PM0802, Fig. V.1.1l), but its use has not been investigated.

BSPh IVa corresponds to another surface (F32) with remnants of a wall, a thermal structure and possible postholes (Fig. III.17). Despite this architectural richness, it yielded only five flaked stones: an obsidian flake, the quartz laminar flake, a light chert bladelet, a R/CC debris and a R/CC flake. The obsidian flake is retouched (PM0781, Fig. V.1.1o) but its use has not been investigated. These artefacts must be in situ, but are unfortunately not informative in terms of chronotypology or activities.

No flaked stone was directly associated with surface 31 and its architectural features (BSPh IVb, Fig. III.19). This is all the more unfortunate in that F31 is considered to be the internal floor of a house limited by the wall W37. The two pieces attributed to this building phase come from the destruction deposits above the floor: an obsidian bladelet (PM0774, Fig. V.1.1m) and a retouched R/CC blade PM0773 (Figs. V.1.1u, V.1.3c) used to scrape skin, most certainly redeposited here and not used in situ. Similarly, no flaked stone artefacts are associated with surface F30, despite the presence of postholes that suggest a living floor (Fig. III.21). PM0770, a thick-backed sickle insert (Fig. V.1.2h), was found above F30 and just below the next surface, F29, but no data allows us to say whether it was in situ or redeposited. Conversely, PM0764, a sickle insert on blade (Fig. V.1.2e) was uncovered during the excavation of earthen floor F29, and can be presumed to be in situ.

The three artefacts attributed to BSPh Vb were found in the deposits above surface F29 and hearths TS 29–31 (Fig. III.22). They again consist of three R/CC sickle blades (PM0746, PM0751 and PM0745, Figs. V.1.2d, f, o, V.1.4d, f, n). Four more were uncovered in BSPh Vd[312] (Fig. III.24): PM0728, PM0734 and PM0743, three sickle inserts on flakes, and PM0736, a sickle insert on a blade (Figs. V.1.2b, g, k, V.1.4b, g–h). From the same building phase come the large proximal end-scraper (PM0742, Figs. V.1.1s, V.1.3a), a utilised bladelet and an unretouched flake. Despite the presence of thermal structure TS 26, no piece is burnt. Unfortunately, it is unclear whether these artefacts were found directly on surface F27 or between F26 and F27.[313] They suggest, however, that both types of sickle insert as well as end-scrapers on large blades persisted throughout the early Middle Neolithic phases.

Finally, the micro end-scraper (PM0723, Figs. V.1.1r, V.1.3b) was found on surface F26 in BSPh Ve (Fig. III.25), together with two unretouched R/CC flakes, a retouched one (PM0607) and the bladelet PM0688 (Fig. V.1.1j, V.1.3j) found just below surface F25 from BPh VI. The micro end-scraper is thus also characteristic of the early Middle Neolithic phases from PMZ.

The concentration in BSPh Va–e of retouched and utilised artefacts, and the quasi-absence of unretouched pieces is puzzling. Surfaces F26, F27 and F28 are described as activity areas with well-built hearths and remnants of walls. We can thus suggest that flaking stone was avoided in this activity area, that a few tools were used for technical tasks and that the sickle inserts, which

[312] There are no flaked artefacts in BSPh Vc.

[313] These pieces are attributed to SU 100–101. SU 100 corresponds to the deposits above surface F28, whereas SU 101 corresponds to surface F27.

are dominant, were de-hafted and replaced. None, however, was found in direct spatial association with a hearth.

On the whole, very few artefacts from Lithic Phase 1 are directly related to floors, hearths and architectural features. No in situ knapping is firmly evidenced, and there is no proof that the artefacts were used where they were found, especially considering the predominance of sickle inserts. To what extent the typological similarities of the flaked stone assemblages from BPh I to V are due to reworking of earlier material, or reflect an archaeological reality, is difficult to assess. Nevertheless, these deposits appear to have accumulated very quickly,[314] which reinforces the plausibility of technological and typological homogeneity. In particular, the predominance of sickle inserts and the presence of inserts on both flakes and blades in BSPh Vd and Ve align them with the earlier levels. There is no argument in the lithic assemblage to confirm the break between BSPh Vc and Vd that is observed in the pottery assemblages.[315]

### V.1.4. Lithic Phase 2 – Building Phase VI

*Characterisation*

The small assemblage from Lithic Phase 2 (n=27) (EU 211–234) shows indisputable elements of continuity with Lithic Phase 1, but equally marked changes in the proportions of the different classes of artefacts. Radiolarite/chocolate cherts are less predominant in the raw materials, obsidian correlatively better represented, radiolarite blades become rare and flakes relatively more abundant, and the proportion of retouched pieces is lower. This phase also presents the first instance of percussion with a soft stone hammer. Apart from one aberrant date (MAMS 32122), Lithic Phase 2 was dated to 5837–5681calBC 2σ (MAMS 32123), i.e. within the chronological range of Lithic Phase 1, but with a best fit at 5657 ± 1 (Chapter IV).

*Raw Materials*

The range of raw materials is identical to Lithic Phase 1: radiolarites/chocolate cherts (n=13), non-chocolate cherts (n=2), obsidian (n=6), honey chert (n=3), undetermined (n=2) and quartz (n=1), but the proportions differ significantly (Tab. V.1.5).[316] Cortical and neo-cortical pieces are better represented than in Lithic Phase 1 (about ⅕), but the proportion remains much lower than at Achilleion.[317] The raw materials were mostly procured as water-rolled pebbles: a few flakes were extracted from a core on a R/CC pebble that rapidly split (Figs. V.1.5a, V.1.6a); two primary R/CC flakes, the quartz flake and the large chert blade, were also flaked from water-rolled pebbles (Fig. V.1.5b–d, h). No artefact bears fresh cortex.

*The Production*

The radiolarite/chocolate chert sample comprises 2 debris, 1 core, 9 flakes and 1 blade. The high proportion of flakes versus blades was already noted as a specificity of PMZ.[318] This is even more pronounced in Lithic Phase 2, whether one considers the R/CC artefacts only or the whole assemblage (Tab. V.1.5). Again, the procurement of blades, or of raw material adequate to produce blades, appears to have been difficult.

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314 Weninger et al., this volume, Tab. IV. 1.
315 Pentedeka in press; Pentedeka in preparation.
316 $\chi^2$=10.8, df = 4, $p < 0.05$.
317 Elster 1989, tab. 10.15.
318 See above, 209.

Tab. V.1.5 Composition of the flaked stone assemblage from Lithic Phase 2 (C. Perlès)

| | R/CC | Chert | Obsidian | Honey chert | Quartz | Undetermined |
|---|---|---|---|---|---|---|
| **Debris** | 2 | | | | | |
| **Cores** | 1 | | | | | |
| **Flakes** | 6 | | 2 | | 1 | 1 |
| **Blades** | | | | | | 1 |
| **Bladelets** | | | 3 | | | |
| **Retouched flakes** | 3 | 1 | 1 | 1 | | |
| **Retouched blades** | 1 | 1 | | 2 | | |
| **Retouched bladelets** | | | | | | |
| **Total** | 13 | 2 | 6 | 3 | 1 | 2 |

In situ production of R/CC flakes with a hard stone hammer on flat striking platforms is again attested by the core and a few non-matching flakes struck with a hard stone hammer. A few other flakes, produced by indirect percussion, can be attributed to the shaping of blade cores, despite the rarity of blades in the assemblage (Fig. V.1.6d). Yet, one large flake and the only two R/CC blades present the characteristics of soft stone hammer percussion;[319] a large flat butt with a marked angle towards the ventral face, but a more diffuse bulb of percussion than with a hard stone hammer (Fig. V.1.5e–f). In turn, a large fragmentary blade made on variegated chert with rectilinear arrises (Fig. V.1.5h) suggests the use of indirect percussion, but the proximal end is broken and this cannot be ascertained.

Indirect percussion was used to detach two of the three obsidian bladelets (Figs. V.1.5i, k, V.1.6b), whereas the third was produced by pressure flaking (Fig. V.1.5j). The butts are flat or linear, with preparation for the detachment on the dorsal face, a normal Middle Neolithic procedure. The obsidian sample also comprises two lateral core preparation flakes (Fig. V.1.5l), and a very small flake that could correspond to the rejuvenation of a striking platform. The presence of this flake, too small to be used (Tab. V.1.6), suggests that obsidian was at least partially worked on the site.

The two honey chert blades were produced by pressure flaking. Even before rejuvenation, their width must have been under 2cm, so that the use of a lever was not necessary. A long standing-crutch would have nevertheless been required, at least for PM0696 (Figs. V.1.5n, V.1.6c).[320] The third honey chert artefact is a flake extracted from a retouched blade, a practice already observed in Lithic Phase 1 and current on Middle Neolithic honey cherts blades.[321] The flaking technique of the quartz flake remains undetermined.

As in Lithic Phase 1, details of raw material show that every piece comes from a different core, and every *chaîne opératoire* is represented by a single piece. While the local production of R/CC flakes can be considered certain and the flaking of obsidian probable, it is impossible to determine whether the few R/CC blades and bladelets were produced in situ or imported as already flaked blanks. As usual, the honey chert blades must have been introduced into the settlement as already flaked blanks.

[319] Pelegrin 2000.
[320] Pelegrin 2012.
[321] Perlès 2004.

Tab. V.1.6 Relevant dimensions for the Lithic Phase 2 assemblage (C. Perlès)

| PMZ number | Determination | Dimensions [cm] |
|---|---|---|
| PM0613 | Distal frag. of obsidian bladelet | 1.15 × 1.1 × 0.21 |
| PM0815 | Proximal frag. of obsidian bladelet | 2.36 × 0.86 × 0.29 |
| PM0634 | Proximal frag. of obsidian bladelet | 1.92 × 0.64 × 0.21 |
| PM0696 | Sickle insert on blade | 3.7 × 1.38 × 0.62 |
| PM0652 | Sickle insert on flake | 3.06 × 1.86 × 0.51 |
| PM0644 | Sickle insert on obsidian flake | 2.25 × 1.6 × 0.43 |
| PM0686 | Retouched honey chert blade | 3.08 × 1.14 × 0.25 |
| PM0635 | Retouched and blunted blade | 3.3 × 1.18 × 0.52 |
| PM0642 | Retouched chert flake | 4.1 × 2.33 × 0.7 |
| PM0649 | Beak | 3.24 × 1.9 × 0.67 |
| PM0685 | Splintered flake | 2.9 × 2.1 × 0.85 |

### *The Retouched Toolkit*

The proportion of retouched tools is lower than in Lithic Phase 1: nine pieces out of a total of 24, excluding the core and debris.[322] This proportion becomes comparable to that of eastern Thessalian sites (and Franchthi) and remains much higher than at Achilleion.[323] Of the four artefacts that were examined for use-wear traces, one only was misidentified macroscopically: a presumed sickle blade that was actually used to work hides (Tab. V.1.7). Nevertheless, sickle inserts are still the best-represented category of tools, but in a lower proportion than before. As a consequence, they are now less abundant than in our reference assemblages, where they represent ca. 50% of the retouched tools, splintered pieces excepted.[324] The absence of classical tool types such as end-scrapers cannot be considered significant given the small size of the sample.

### Sickle Inserts (n=3)

Even in this very small sample, the peculiarity of the early Middle Neolithic assemblages at PMZ remains observable: of the three sickle inserts, two are made on flakes. As previously noted,[325] sickle inserts on flakes usually represent less than 10% of the sickle inserts in Thessaly.[326] Even more surprising, and apparently unique in Thessalian assemblages, one of them is an obsidian flake.

PM0696 is the only sickle insert on blade, a large, pressure-flaked honey chert blade. It has a long biography: it was first shaped as a long sickle insert with a casually manufactured inverse distal truncation (Figs. V.1.5n, V.1.6c). Both edges were successively used to cut cereals. The proximal part of the blade was then broken, the left edge entirely retouched by ½ abrupt to ¾ abrupt direct retouch, the right edge by subparallel, very regular direct ½ retouch. The tool was then used on the distal edge, left edge and distal half of the right edge on dry hide, with an angle of ca. 75°. A similar re-use of honey chert sickle blades on hide had already been observed in the Middle Neolithic at Franchthi.[327]

322 The difference from Lithic Phase 1 is not statistically significant.
323 See above, 209.
324 See above, 209.
325 See above, 220.
326 Moundrea-Agrafioti 1983, 203.
327 Perlès – Vaughan 1983.

Tab. V.1.7 Retouched tools from Lithic Phase 2, by architectural subphase. Italics denote discrepancies between the technomorphological and functional identifications (C. Perlès)

| PMZ number | BPh/ BSPh | Figure | Raw material | Technomorphological classification | Functional classification |
|---|---|---|---|---|---|
| PM0679 | VIa | – | Honey chert | Flake from a retouched blade | n/a |
| PM0685 | VIa | – | R/CC | Splintered flake | n/a |
| PM0686 | VIa | V.1.5.p, V.1.6.e | Honey chert | *Sickle blade* | *Blade used on skin* |
| PM0696 | VIa | V.1.5.n, V.1.6.c | Honey chert | Transformed sickle blade | Transformed sickle blade |
| PM0652 | VIb | V.1.5.o, V.1.6.d | R/CC | Retouched sickle insert on flake | Sickle insert |
| PM0635 | VIb | V.1.6.g | R/CC | Retouched and blunted blade | n/a |
| PM0642 | VIb | V.1.5.e, V.1.6.i | Chert, burnt? | Retouched flake | n/a |
| PM0644 | VIb | V.1.5.m, V.1.6.f | Obsidian | Blunted sickle insert | Sickle insert |
| PM0649 | VIb | V.1.5.h, V.1.6.h | Chert | Unretouched beak | n/a |

PM0652 (Figs. V.1.5o, V.1.6d) is a fine example of a sickle insert on a large thick-backed flake. Made on an elongated lateral core preparation flake, it was backed on the right side by ¾ abrupt retouch and inserted slightly obliquely into the haft. The working edge, to the left, was shaped by short inverse retouch and was used to cut cereals.

PM0644 is a smaller insert, also made on a lateral core preparation flake but of obsidian. Whereas obsidian sickle blades are not uncommon in Thessaly where they amount to ca. 15% of all sickle blades,[328] or in the Peloponnese (25% of the sickle inserts at Franchthi),[329] this is the first insert on an obsidian flake we have encountered. The piece is functionally intact and both edges show a marked blunting, over an unretouched edge to the right, over an inverse retouch on the left (Figs. V.1.5m, V.1.6f). Microscopic examination shows that it was used as the other sickle inserts, but for a short while.[330]

### Laterally Retouched Blades and Flakes (n=3 + 1)

PM0686, the second honey chert blade, is a mesial fragment with two straight fractures (Figs. V.1.5p, V.1.6e). It was first used on both edges on a semi-hard to hard animal material such as hide, with an open angle. Both edges were then rejuvenated or transformed by regular subparallel ¾ abrupt retouch, but the retouch bears no discernible use-wear traces.

The three other laterally retouched artefacts were not examined microscopically and their function is unknown. PM0635, a R/CC irregular blade, bears a continuous inverse retouch of the right edge, overlaid by a pronounced blunting (Fig. V.1.6g). PM0642 is a large foliate flake of coarse chert (Tab. V.1.6) with a short continuous direct retouch on the right edge (Figs. V.1.5e, V.1.6i). PM0679 is not a retouched flake per se: it is a secondary flake that was extracted from a honey flint blade with bilateral direct retouch. The blade itself has not been recovered.

[328] Moundrea-Agrafioti 1983.
[329] Perlès 2004.
[330] Observation N. Mazzucco.

Fig. V.1.5 Lithic Phase 2. a: flake core, b–f, i–l: unretouched flakes and bladelets, h: unretouched, heavily used borer, g: inversely retouched R/CC bladelet, m, o: sickle inserts on flakes, n: sickle insert on blade, p: bilaterally retouched blade. a–c, e–g, o: R/CC. d: quartz. i–m: obsidian. n, p: honey chert. a: PM0667, b: PM0633, c: PM0673, d: PM0636, e: PM0642, f: PM0671, g: PM0635, h: PM0649, i: PM0615, j: PM0634, k: PM0613, l: PM0672, m: PM0644, n: PM0696, o: PM0652, p: PM0686 (C. Perlès)

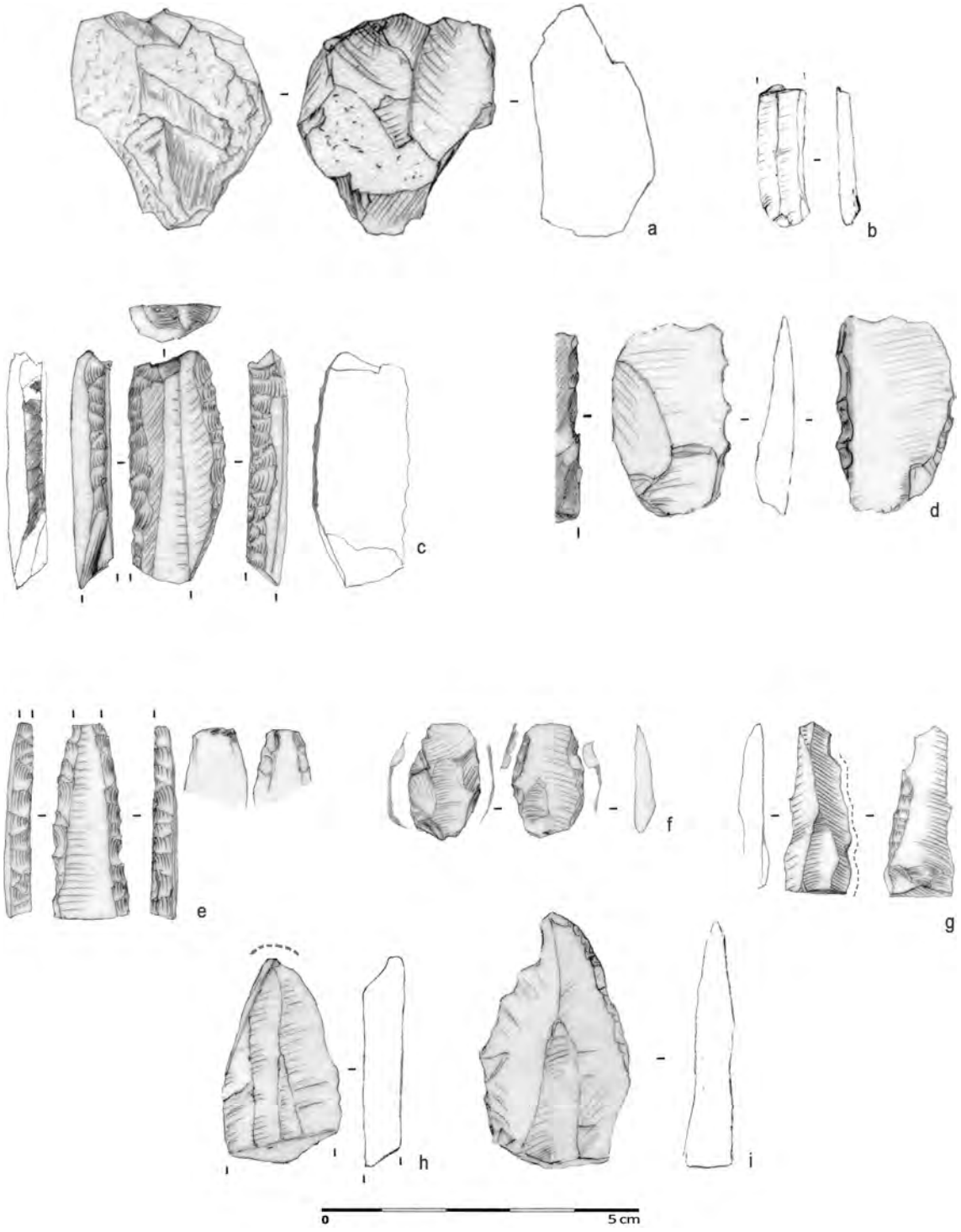


Fig. V.1.6 Lithic Phase 2. a: R/CC flake core (PM0667), b: obsidian bladelet (PM0615), c: R/CC sickle insert on blade (PM0696), d: R/CC sickle insert on flake (PM0652), e: retouched honey chert blade (PM0686), f: sickle insert on obsidian flake (PM0644), g: retouched R/CC bladelet (PM0635), h: unretouched R/CC beak (PM0649) (C. Perlès, drawings: M. Ballinger)

Beak (n=1)

The distal extremity of PM0649 presented a triangular shape due to the convergence of the right edge with an abrupt natural facet on the left edge. This sturdy point, now heavily blunted, was used directly without retouching in a rotary or semi-rotary motion (Figs. V.1.5h, V.1.6h). Although the tool has not been examined under a microscope, its use to bore mending holes on pottery appears plausible.

Splintered Flake (n=1)

Splintered pieces are again conspicuously rare in this assemblage. PM0685 is a primary R/CC flake reflaked by bipolar percussion, either during use as an intermediate piece or to try and extract a few more very small flakes.

*Contexts and Stratigraphic Distribution*

The composition of the Lithic Phase 2 assemblage differed from the Lithic Phase 1 assemblage in several quantitative aspects. Nevertheless, both samples are small: the differences may reflect actual changes, but they may also be due to random spatial variation. Indeed, from a typological and functional viewpoint, this very small assemblage is similar to the retouched toolkit of Lithic Phase 1. The activities identified through microscopic examination are the same, i.e. harvesting cereals and preparing hides, although other tools were probably involved in different activities. The specificity of PMZ within the Thessalian context is confirmed, with two of the three sickle inserts made on flakes and splintered pieces conspicuously rare.

However, what is probably the most striking feature of Lithic Phase 2 is how few artefacts and retouched tools were recovered. BSPh VIa and VIb correspond to two surfaces (F25 and F24, Figs. III.26–27) with remains of walls and hearths. Even if the surface was reduced while excavating phase VIb, the excavation still covered 20m². Yet only eleven artefacts were recovered in phase VIa, none of which can be attributed with certainty to 'Floor F25' and associated structures rather than to the overlying deposits. The honey flint blade PM0686 (Figs. V.1.5n, V.1.6c) and the splintered flake PM0687 were found 'directly above F25'. It is therefore possible that this blade was in situ, confirming the continuous presence of honey chert sickle blades in Lithic Phase 2. Six other artefacts from BSPh VIa, none of which were retouched, were found in the yellowish sandy soil between F25 and F24.

In BSPh VIb, a debris, two R/CC flakes and the flake core PM0667 (Figs. V.1.5a, V.1.6a) were found in the destruction layer just below F24, and are probably not in situ. Conversely, the sickle insert on flake PM0652 (Figs. V.1.5o, V.1.5d) was found during the excavation of Floor F24: it confirms that sickle inserts on flakes were still in use during Lithic Phase 2 and do not come – or do not come solely – from the reworking of older material. All the other artefacts attributed to BSPh VIb (n=11) were found in the overlying deposits, between F24 and F23, so that their precise original context is unknown.

### V.1.5. Lithic Phase 3 – Building Subphase VIIa

*Characterisation*

Lithic Phase 3 (EU 231, 233, 236–243) is again a small assemblage (n=44). It is characterised by a statistically significant drop in the proportion of retouched tools, a relative increase of radiolarites/chocolate cherts, the presence of the first arrowheads and the first geometric tool. The only $^{14}C$ sample analysed gave an aberrant date (MAMS 32121).

Tab. V.1.8 Composition of the flaked stone assemblage from Lithic Phase 3 (C. Perlès)

| | R/CC | Chert | Obsidian | Honey chert | Quartz | Undetermined |
|---|---|---|---|---|---|---|
| **Debris** | 1 | | | | | |
| **Cores** | 2 | | | | | |
| **Flakes** | 15 | 4 | 2 | | 1 | 1 |
| **Blades** | 3 | | 1 | | | |
| **Bladelets** | 6 | 1 | 3 | | | |
| **Retouched flakes** | 1 | | | | | |
| **Retouched blades** | 2 | | | 1 | | 1 |
| **Retouched bladelets** | | | | | | |
| **Total** | 30 | 5 | 6 | 1 | 0 | 2 |

*Raw Materials*

Raw materials are less diversified than in Lithic Phase 2 since quartz is absent. Radiolarites/chocolate cherts predominate with 30 artefacts, followed by obsidian (n=6), light-coloured cherts (n=5), honey chert (n=1) and two undetermined raw materials.[331] Cortical pieces are extremely rare (n=3) and the cortical surfaces are very small. This very low rate of cortical pieces now aligns PMZ with eastern Thessalian sites where few blocks of raw materials were introduced as such in the settlements.[332] The use of river pebbles remains probable, but a small R/CC cortical flake with a fresh pink cortex indicates procurement at or near the source. The dimension and quality of bladelet PM0576 (Figs. V.1.7f, V.1.8b), as well as the presence of a tiny patch of pink cortex on the distal extremity, seemingly unrolled, similarly points towards procurement at a primary source. As before, we cannot ascertain whether the procurement was direct or indirect, but the very low proportion of cortex suggests indirect procurement of already prepared cores and finished blanks. Among the translucent cherts, the composition of PM0580 (Fig. V.1.7e) matches with location PM 4, high up the Portaikos.

*The Production*

The Lithic Phase 3 assemblage comprises 2 cores, 23 flakes, 4 blades, 12 bladelets, 2 undetermined blanks and 1 debris (Tab. V.1.8). Although flakes still predominate, the proportion of laminar blanks is higher than in the two earlier lithic phases and becomes more comparable to other Thessalian assemblages, especially Achilleion (50% in Phase III and 55% in phase IV).[333] However, the high proportion of small bladelets rather than blades still sets PMZ apart.

The proportion of flakes nevertheless remains high, and this is due to a local production of flakes. The R/CC flake core testifies again to unskilled hard hammer percussion (Fig. V.1.7a). Local flaking is also exemplified by two 'handfuls' of flakes in the western part of the trench, many of which are too small to be used and therefore unlikely to have been traded.

Struck in a concave facet of a 'flat' or dihedral butt with a lip on the ventral surface, three larger R/CC flakes were detached by indirect percussion and would instead correspond to crest preparation for blade cores (Fig. V.1.7b–c). Neither the cores nor the corresponding blades/bladelets have been recovered. Yet, the assemblage comprises several very regular bladelets on homogeneous,

[331] Compared with Lithic Phase 2, the difference is not significant at $p < 0.05$.
[332] Moundrea-Agrafioti 1981, 68.
[333] See Elster 1989, tab. 10.11.

fine-grained R/CC. The exceptionally long PM0576 presents a dihedral butt with concave facets, a marked lip as well as undulations on the ventral face and the arrises, which indicate that it was detached by very well-mastered indirect percussion (Figs. V.1.7f, V.1.8b). The much smaller PM0594 was detached by indirect percussion on a concave flat butt with removal of the overhang on the dorsal face (Fig. V.1.7g). Both indirect percussion and pressure flaking are possible for the small mesial fragment PM0612 (Fig. V.1.7i) and for two even smaller bladelets (Tab. V.1.9; Figs. V.1.7h, V.1.8d).

The three obsidian bladelets, one of them transformed into a trapeze, show the characteristic straight profile and rectilinear arrises of pressure flaking (Fig. V.1.7j–k). The other three obsidian artefacts are very small flakes. One of them is less than 1cm long, showing the high standard of recovery during excavation, and again suggesting local flaking of obsidian.

Some translucent cherts were probably also worked in situ, since two preparation flakes by indirect percussion have been recovered. Both PM0630, in a brown chert with translucent veins (Fig. V.1.7d) and PM0580 (Figs. V.1.7e, V.1.8a) in a light translucent chert, have a facetted butt characteristic of bilateral crests in the shaping of blade or bladelet cores.

The honey flint blade was pressure flaked (PM0623, Figs. V.1.7o, V.1.8e). Its original width, before reduction by retouch, can be estimated at around 2cm, therefore around the limit between standing pressure flaking and lever pressure flaking.[334]

The situation is thus comparable to the previous lithic phases: a local production of flakes is assured, some local working of obsidian, radiolarite/cherts and translucent chert is probable, but, given the patchiness of the *chaînes opératoires*, it cannot be ascertained whether all the blanks were locally produced or whether some were imported.

### *The Retouched Toolkit*

The low proportion of retouched pieces (n=6) is the most striking characteristic of Lithic Phase 3. Compared with Lithic Phase 2, the difference is statistically significant.[335] The proportion is now close to the figure calculated for Achilleion (ca. 13%) but much lower than in eastern Thessalian sites, where retouched pieces reach around 30%.[336]

Despite their small number, four of the retouched pieces represent new types in the PMZ assemblages: a truncated blade, a trapeze and two transverse arrowheads. Given their absence in the richer retouched toolkits from Lithic Phases 1 and 2, their presence here constitutes a significant novelty. Would these types appear in Thessaly only in a relatively late phase of the Middle Neolithic, rather than at its beginning? The answer to this question cannot be provided by Thessalian lithic assemblages, which either lack these types or have not been subphased within the Middle Neolithic. Franchthi, however, does give some support to the hypothesis of a later introduction of transverse arrowheads in Middle Neolithic assemblages,[337] but not of trapezes and truncations.[338]

PM0575 is a small trapeze on a pressure-flaked obsidian bladelet (Figs. V.1.7k, V.1.8g).[339] The oblique proximal truncation is direct and abrupt, the distal one ¾ abrupt and less oblique. The left lateral edge is broken. Trapezes are seemingly very rare in Thessaly: they are not mentioned or illustrated at Achilleion and Otzaki,[340] and Moundrea-Agrafioti only found Middle Neolithic trapezes at Ag. Petros in the Sporades – one of them in obsidian – and none in eastern Thessaly.

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334 Pelegrin 2012.

335 $\chi^2 = 3.9$, $p < 0.05$, df = 1.

336 See above, 213.

337 Perlès 2004, Doc. 4.47.

338 Perlès 2004, Docs. 4.46 and 4.71.

339 The exact stratigraphic position of this piece has long remained uncertain and it may belong to BSPh VIIb. The marked typological similarity between Lithic Phases 3 and 4 does not allow us to discriminate on this basis.

340 Elster 1989; Mottier 1981.

Tab. V.1.9 Relevant dimensions for Lithic Phase 3 (C. Perlès)

| PMZ number | Determination | Dimensions [cm] |
|---|---|---|
| PM0593 | R/CC flake core | 2.9 × 2.1 × 1.3 |
| PM0580 | Light chert crest preparation flake | 2.46 × 2.16 × 0.35 |
| PM0605 | Proximal frag. of R/CC blade | 1.48 × 1.5 × 0.41 |
| PM0576 | R/CC bladelet | 5.09 × 1.01 × 0.28 |
| PM0594 | R/CC bladelet | 2.68 × 1.2 × 2.02 |
| PM0609 | Mesial frag. of R/CC bladelet | 1.16 × 1.17 × 0.25 |
| PM0611 | Distal frag. of R/CC bladelet | 1.4 × 1.1 × 0.25 |
| PM0612 | Mesial frag. of R/CC bladelet | 1.52 × 0.97 × 0.27 |
| PM0569 | Proximal frag. of light chert (?) bladelet | 1.3 × 1 × 1.19 |
| PM0585 | R/CC microbladelet | 1.38 × 0.51 × 0.19 |
| PM0610 | R/CC microbladelet | 1.5 × 1.3 × 0.17 |
| PM0588 | Obsidian rejuvenation flake | 0.59 × 0.9 × 0.2 |
| PM0587 | Mesial frag. of obsidian bladelet | 1.18 × 0.7 × 0.16 |
| PM0595 | Mesial frag. of obsidian bladelet | 1.4 × 0.9 × 0.24 |
| PM0627 | Mesial frag. of obsidian bladelet | 1.76 × 0.81 × 1.75 |
| PM0623 | Honey chert sickle blade | 4 × 1.62 × 0.52 |
| PM0592 | End-scraper on glossed R/CC flake | 4.4 × 2.6 × 0.68 |
| PM0622 | Truncated R/CC blade | 3.64 × 1.5 × 0.63 |
| PM0616 | R/CC transverse arrowhead | 1.75 × 1.86 × 0.41 |
| PM0626 | R/CC transverse arrowhead | 1.64 × 1.31 × 0.31 |
| PM0575 | Trapeze on obsidian bladelet | 1.07 × 1.18 × 0.3 |

Tab. V.1.10 Retouched tools from Lithic Phase 3 (C. Perlès)

| PMZ number | BPh/ BSPh | Figure | Raw material | Technomorphological classification | Functional classification |
|---|---|---|---|---|---|
| PM0575 | VIIa | V.1.7.k, V.1.8.g | Obsidian | Trapeze | n/a |
| PM0592 | VIIa | V.1.7.p, V.1.8.f | R/CC | Sickle insert on flake | n/a |
| PM0616 | VIIa | V.1.7.l, V.1.8.h | R/CC | Transverse arrowhead | n/a |
| PM0626 | VIIa | V.1.7.m, V.1.8.i | R/CC | Transverse arrowhead | n/a |
| PM0622 | VIIa | V.1.7.n | R/CC | Truncated blade | n/a |
| PM0623 | VIIa | V.1.7.o, V.1.8.e | Honey chert | Sickle blade | Sickle blade, re-used |

[341] Some, however, were recovered in earlier assemblages (Sesklo C), but trapezes have a long chronological distribution: the presence of this trapeze at PMZ in Lithic Phase 3 cannot be taken as evidence for an Early Neolithic occupation.

Trapezes are usually considered as a type of transverse arrowheads[342] despite the occurrence of the two types in the same assemblages.[343] The two following artefacts can actually be considered as technically intermediate between typical bitruncated trapezes and axial transverse arrowheads. Morphologically, PM0616 is an axial transverse arrowhead of small size, in radiolarite/chocolate chert (Fig. V.1.7l, V.1.8h). Technically, it is an interesting intermediate between a trapeze and an axial transverse arrowhead. It is manufactured on a flake, probably struck from a river pebble. It was shaped by ½ abrupt proximal and distal direct truncations,[344] but also bears a direct subparallel retouch of low angle on the left edge, more characteristic of true transverse arrowheads. The left angle is broken by a deep impact fracture. PM0626 is another intermediate between the two types: it was shaped by bitruncating a very regular R/CC blade, as for trapezes, but by bifacial ½ abrupt retouch, a technique characteristic of transverse arrowheads (Figs. V.1.7m, V.1.8i). These two pieces, are, to our knowledge, the first transverse arrowheads published from Thessalian collections.[345] They are abundant further south at Franchthi, where they are clearly associated with the Middle Neolithic, and with the Middle Neolithic only.[346] To the west, conversely, bifacially worked transverse arrowheads, of a shape different from ours, are present in small numbers in Late Neolithic contexts at Drakaina Cave.[347]

The truncated blade PM0622 also constitutes a novelty in the assemblage. Made on a very regular R/CC blade, flaked by expert indirect percussion or possibly pressure, it bears a short, direct, abrupt truncation on the distal end (Fig. V.1.7n). Despite a proximal fracture, it is sufficiently well preserved to ascertain that it is not a fragmentary geometric microlith or a sickle insert.

The last two retouched artefacts, conversely, establish a typological and functional link with the previous lithic phases. PM0623 is another illustration of the long use life of many honey chert sickle blades (Figs. V.1.7o, V.1.8e). It was reduced to a module of 4cm by two fractures – the proximal one with traces of cereal polish – and hafted by the right edge, which preserved microscopic residues of resin. It was used to cut cereals with the left edge, and rejuvenated several times until the edge was so abrupt it could no longer function. The right edge was then used in turn, on a semi-hard/hard vegetal material, and also briefly, with an oblique gesture, on a hard, possibly osseous material. Finally, the distal fracture shows a rugged polish and traces of a colouring matter, and may have been used to process a mineral matter such as ochre.

PM0592 appears to be a sickle insert on a large flake, but the piece has not been examined microscopically and the nature of the polish, limited to the mesial segment of the left edge and of marginal extension, has not been verified. This large flake (Figs. V.1.7p, V.1.8f) is badly burnt and broken in two. The distal end bears an end-scraper made by direct ¾ abrupt retouch. We do not know whether the end-scraper was functional, or whether it was meant to shape the tool.

### *A Small but Original Assemblage*

The Lithic Phase 3 assemblage differs from the preceding ones by the higher proportion of bladelets as a whole, and the quality of the R/CC bladelets. Compared with other Thessalian sites, it alternately aligns with eastern and western Thessalian sites, depending on whether one considers the ratio of cortical pieces or the ratio of retouched pieces. However, the assemblage

[341] Moundrea-Agrafioti 1981, 155.
[342] Rozoy 1978. But see Gurova 2017 for other uses as well.
[343] Perlès 2004, Docs. 4.46 and 4.47.
[344] Which appear as the right and left edges on the illustration due to a functional orientation of the piece.
[345] Nevertheless, they occur in Thessaly: C. P. has seen transverse arrowheads in unpublished surface collections.
[346] Perlès 2004.
[347] Stratouli – Metaxas 2009.

Fig. V.1.7 Lithic Phase 3. a–j: unretouched flakes and bladelets, k–m: trapezes/transverse arrowheads, n: truncated blade, o: sickle insert on blade, p: sickle insert on flake. a–c, f–I, n: R/CC, d–e, p: light-coloured cherts, j–k: obsidian, o: honey chert. a: PM0593, b: PM0598, c: PM0596, d: PM0630, e: PM0580, f: PM0576, g: PM0594, h: PM0585, i: PM0612, j: PM0627, k: PM0575, l: PM0616, m: PM0626, n: PM0622, o: PM0623, p: PM0592 (C. Perlès)

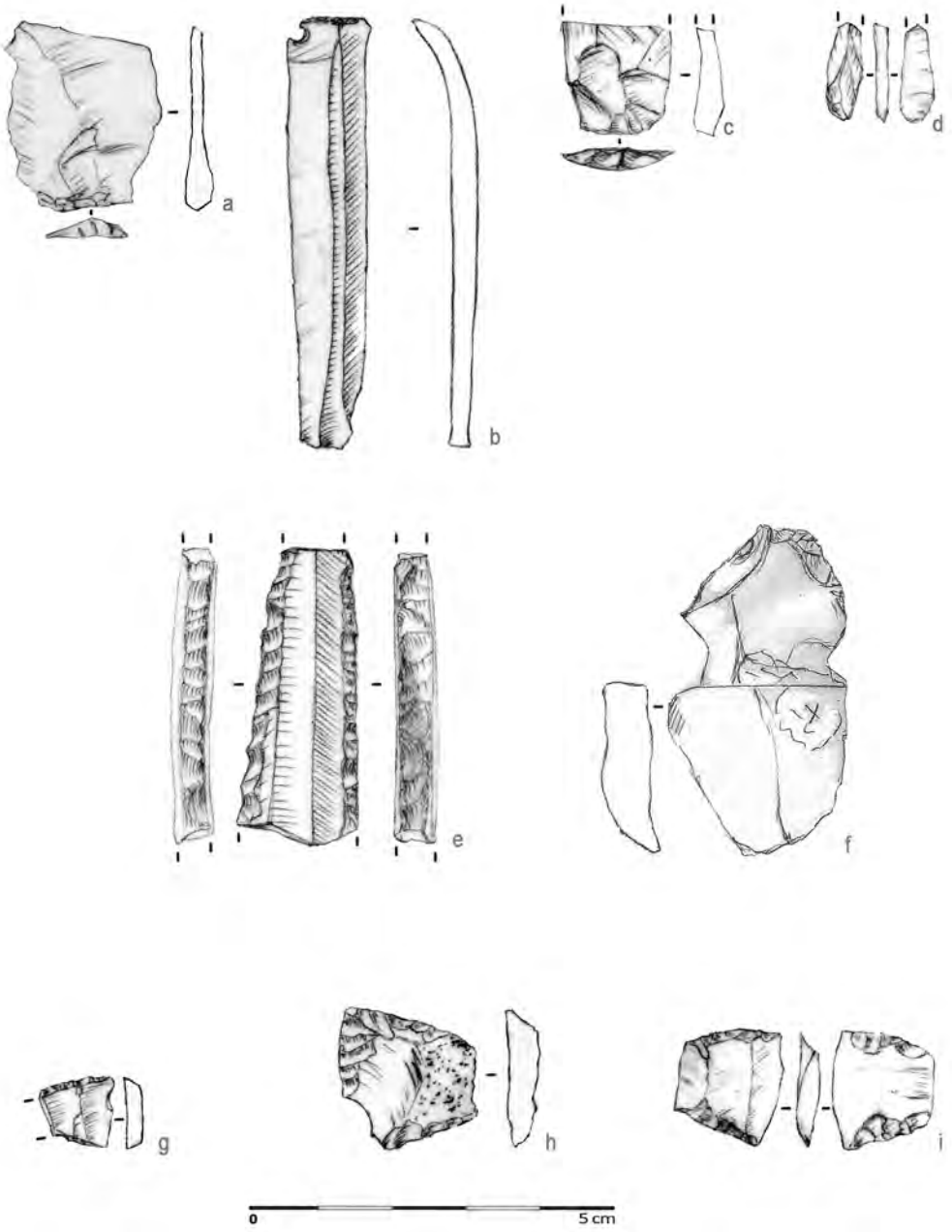


Fig. V.1.8 Lithic Phase 3. a: crest preparation flake, translucent chert (PM0580), b: R/CC bladelet (PM0576), c: proximal fragment of R/CC blade (PM0605), d: R/CC bladelet (PM0585), e: honey chert sickle blade (PM0623), f: burnt R/CC flake with gloss (PM0592), g: obsidian trapeze (PM0852), h–i: R/CC transverse arrowheads (PM0616 and PM0626) (C. Perlès, drawings: M. Ballinger)

is very small and the figures are to be treated with caution. Conversely, the very small size of the retouched assemblage makes the presence of new types, which constitute two-thirds of the retouched tools, all the more significant. Lithic Phase 3 indeed differs from almost all other Thessalian assemblages by the presence of a trapeze and two transverse arrowheads, unknown in almost all other sites. For the same reasons, it differs from the preceding phases, where these types were absent despite larger toolkits. In spite of the indisputable element of continuity introduced by the honey chert blade PM0623 (Fig. V.1.7o), if a break had to be established within the Middle Neolithic sequence on the basis of the flaked tools, it would be with Lithic Phase 3.

*Contexts*

The distribution of flaked stone artefacts in Lithic Phase 3 differs from the preceding ones. This phase corresponds to BSPh VIIa (Fig. III.29), which comprises the surface F23 and few structures: two postholes, a thermal structure (TS 20) and probably a second one (TS 36) as well as a pit (SU 130). Only two artefacts are directly associated with Surface F23: a small splinter and a flake heavily covered with concretions, both in radiolarite/chocolate chert. No flaked stone was associated with the other structures and all the remaining ones come from the deposits above Surface F23. Nevertheless, two concentrations of flaked stones were uncovered in the western half of the trench, in the deposits immediately overlying F23 (SU 132). The smallest one consisted of a small fragment of R/CC flake, barely 1cm long, the microbladelet PM0585 (Figs. V.1.7h, V.1.8d) and a small fragmentary obsidian flake. The largest concentration numbered ten artefacts, all in radiolarite/chocolate chert: four flakes or fragments of flakes, three fragmentary blades, one bladelet and two undetermined fragmentary blanks. Their size ranges from 1.2 to 2.5cm. None are retouched. What these concentrations represent is unclear: the raw materials differ in nature or texture, thus they cannot be the remnants of the flaking of a core or two; several artefacts appear too small to be used, so that caches of blanks appear unlikely; yet they were dropped or deposited together, in between two recognised surfaces. The only interpretation we can suggest is that a living floor or work area was cleared, and handfuls of waste discarded further away, where no activity was taking place.

Above the deposits immediately overlying F23 (SU 132) a thin fire-destruction stratum intervened between surfaces F23 and F22 (SU 133–134). The clay house model[348] was uncovered in this stratum, which also yielded nine lithic artefacts: the transverse arrowhead PM0616 (Fig. V.1.7l), five flakes and three bladelets, all unretouched but two of which were burnt. The deposition of exceptional flaked tools in or near hearths has been identified in sites such as Kitsos or Tharrounia[349] and it was tempting to hypothesise that this could also be the case at PMZ. Unfortunately, these artefacts were found neither near the house model nor grouped together, but instead widely dispersed over the southern and western parts of the trench. Additionally, none can be considered 'exceptional'. There is no argument to suggest intentional deposition, even less ritual deposition.

### V.1.6. Lithic Phase 4 – Building Subphases VIIb and VIIc

*Characterisation*

Lithic Phase 4 encompasses BSPh VIIb and VIIc (EU 244, 246a, 247, 251, 252, 253, 255, 256). The assemblages from these two phases showed absolutely no technological, typological or statistical differences, and were consequently grouped together as Lithic Phase 4. This similarity is surprising since the dates of these two subphases hardly overlap: 5629–5531 calBC 2σ (MAMS-32120, BSPh VIIb) and 5545–5472 calBC 2σ (MAMS-32119, BSPh VIIc).[350]

Once again, the contrasts between Lithic Phases 3 and 4 pertain less to the typology of the tools than to a statistically significant difference in the proportion of flakes, blades and bladelets, and a highly significant difference in the ratio of retouched tools. If flakes remain predominant,

[348] Alram-Stern, this volume, chapter VI.3; Toufexis – Batzelas, this volume, 113.

[349] Perlès 1981; Perlès 1994b.

[350] However, when calibrated with IntCal20 rather than CalPal (V.2019.5) as used here, there is substantial overlap between the two dates: respectively 5630–5485 and 5611–5412 calBC. We thank an anonymous reviewer for pointing this out and resolving the apparent discrepancy.

blades are now twice as abundant as bladelets[351] and retouched tools again represent a third of the assemblage.[352]

*Raw Materials*

The assemblage is larger than in the preceding phases (n=79), but the raw materials do not differ qualitatively or quantitatively from Lithic Phase 3. Radiolarite/chocolate cherts still predominate with 57 specimens. The proportion of cortical or neo-cortical pieces is slightly higher than in the preceding phase, but remains low (8.8%) and again suggests the introduction of already prepared cores or finished blanks. A primary flake with rolled neo-cortex shows that river pebbles were still exploited. However, most of the seven cortical pieces show a rather fresh cortex that indicates procurement at or near the source (Figs. V.1.9a–b, r, V.1.11a). A shift in procurement strategies can be suspected, with a higher incidence of exchange with groups located nearer to the sources. The results of the geochemical analyses on PM0471 (Fig. V.1.9b) confirm this hypothesis, since it corresponds to location PM 5, a primary source along the Portaikos. Obsidian is represented by eleven pieces, none of which bears any cortex, as usual. Similarly, none of the eight translucent cherts, nor the two honey chert blades, bear any cortical facet. Importation as finished blades is the most likely for the last two blades, as in all Neolithic sites from Greece.

*The Production*

The Lithic Phase 4 assemblage altogether comprises 3 debris, 47 flakes, 14 blades, 11 bladelets, 1 core and 3 undetermined blanks (Tab. V.1.11). The high proportion of flakes, a characteristic of the PMZ assemblages,[353] still holds true in the later Middle Neolithic. The intentional production of R/CC flakes by hard hammer percussion is still documented (Fig. V.1.9d–e), but most of the diagnostic R/CC flakes were now produced by indirect percussion and correspond to the shaping (Figs. V.1.9c, f–g, V.1.11b–d) and rejuvenation (Fig. V.1.9h–i) of blade cores. As usual, we do not have the corresponding cores and blades of precisely the same variety of R/CC, but the relatively high number of shaping and rejuvenation flakes suggests that some, at least, of the blades were produced locally.

The R/CC blades are, on the whole, wide (1.5–2cm), relatively flat, very regular, with butts at an angle of about 90° (Tab. V.1.12). They testify to skilled craftsmanship in the use of indirect percussion (see Fig. V.1.10a–b, g). The production of such blades required high-quality, homogeneous raw materials and this correlates with the suspected shift in raw material procurement towards primary sources. The cores were prepared with crests, as shown by a fragmentary blade that removed part of an anterior crest (Fig. V.1.9j); secondary crests were occasionally manufactured to restore the axial convexity ('*carénage*') of the core, as shown by PM0534 (Figs. V.1.9k, V.1.12e).

The large module of the blades contrasts with the module of the R/CC bladelets, often under a centimetre wide (Tab. V.1.12). Bladelets were a distinct objective of the production and show more varied modes of production than blades. Some of the larger ones were produced by indirect percussion and probably correspond to the final stage of blade cores exploitation. This applies to PM0499, which, despite its extreme thinness, shows ripples on the ventral surface hardly compatible with pressure flaking (Fig. V.1.9m, V.1.11g). It is also the case for the already mentioned secondary crested blade PM0534 (Fig. V.1.9k).

Interestingly this same blade, with several – hardly successful – attempts at extracting microbladelets from the distal extremity, illustrates a second method of production, on pseudo-burins.

[351] The difference in the distribution of flakes, blades and bladelets is significant at $p < 0.05$ ($\chi^2 = 6.8$, df = 2).
[352] The difference in the ratio of retouched tools is significant at $p < 0.02$ ($\chi^2 = 6.3$, df = 1).
[353] See above, 209, 225.

Tab. V.1.11 Composition of the flaked stone assemblage from Lithic Phase 4 (C. Perlès)

| | R/CC | Chert | Obsidian | Honey chert | Quartz | Undetermined |
|---|---|---|---|---|---|---|
| **Debris** | 2 | 2 | | | | 1 |
| **Cores** | 1 | | | | | |
| **Flakes** | 33 | 3 | 4 | | | |
| **Blades** | 3 | | | | | |
| **Bladelets** | 5 | | 1 | | | |
| **Undetermined** | | 1 | | | | |
| **Retouched flakes** | 3 | 2 | 2 | | | |
| **Retouched blades** | 6 | | 3 | 2 | | |
| **Retouched bladelets** | 3 | 2 | | | | |
| **Undetermined retouched** | 1 | | 1 | | | |
| **Total** | 57 | 8 | 11 | 2 | | 1 |

This method was also implemented on PM0531, a larger blade that bears the negatives of three bladelets, the last one strongly hinged (Fig. V.1.9l).

Other R/CC bladelets were produced by pressure flaking, and a fragmentary core shows that some, at least, of this production was local. This microcore was conical or cylindrical, and was rejuvenated by a platform tablet at least once (Figs. V.1.9n, V.1.11h). While none of the bladelets recovered comes from this core, several confirm the use of pressure flaking for small modules, a technique already suspected in Lithic Phase 3 (Figs. V.1.9o, V.1.10r, V.1.11i–j). Given the width of the bladelets, pressure with the hand or a shoulder crutch (modes 1 and 2) would have sufficed.[354]

The rather heterogeneous set of obsidian artefacts also shows varied techniques of production. The proximal part is only preserved on one of the seven flakes,[355] which was flaked by indirect percussion (Fig. V.1.9p). Of the two blades, one was flaked by indirect percussion (Figs. V.1.10l, V.1.12b), the other, as well as two bladelets, by pressure flaking (Figs. V.1.9q, V.1.10p). These blades and bladelets are larger than the R/CC pressure-flaked ones, and would have required a short crutch in a sitting position (mode 3). The pressure-flaked bladelet that preserved its proximal part shows the characteristics of a Middle Neolithic method of preparation, with suppression of the overhang on the dorsal and a small linear butt.

Among the six artefacts attributed to the category of light or translucent cherts, four artefacts suggest local chert workmanship: a platform rejuvenation flake (Figs. V.1.9s), a retouched proximal fragment of a large anterior crested blade with a large flat butt (Figs. V.1.10j, V.1.12d), a very small flake, too small to have been traded, and an undetermined fragment. The other artefacts comprise two fragmentary retouched blades in very different cherts, one of which is of high craftsmanship (Figs. V.1.10o, V.1.12m). Their flaking technique cannot be identified.

The technique of flaking of the honey chert blade PM0489, a distal fragment, cannot be determined (Figs. V.1.10i, V.1.12g). The second blade, PM0495 (Figs. V.1.10e, V.1.11l), a long and well-preserved mesial fragment, presents wavy arrises on the dorsal surface and ripples on the

[354] Pelegrin 2012.

[355] One of these obsidian flakes (PM0567) is on a very black, very glossy obsidian, somehow more ‘plastic’ than ‘glassy’, which does not look typically Melian.

Fig. V.1.9 Lithic Phase 4. a–j, m, p–s: unretouched flakes and bladelets, k–l: reflaked blades, n: pressure-flaked micro-core, o: pressure-flaked bladelet. a: PM0568, b: PM0471, c: PM0520, d: PM0460, e: PM0558; f: PM0463, g: PM0473, h: PM0477, i: PM0557, j: PM0462, k: PM0534, l: PM0531; m: PM0499, n: PM0487, o: PM0536, p: PM0497, q: PM0470, r: PM0461, s: PM0511 (C. Perlès)

Tab. V.1.12 Relevant dimensions for Lithic Phase 4 (C. Perlès)

| PMZ number | Determination | Dimensions [cm] |
|---|---|---|
| PM0487 | R/CC bladelet microcore frag. | 1 × 1.11 × 0.77 |
| PM0463 | Large crest preparation R/CC flake | 3.41 × 2.7 × 0.45 |
| PM0473 | R/CC core preparation flake | 2.1 × 1.5 × 0.5 |
| PM0500 | Platform rejuvenation flake | 1.06 × 1.63 × 0.18 |
| PM0477 | Platform rejuvenation flake | 1.84 × 2.4 × 0.35 |
| PM0499 | Distal frag. of R/CC bladelet | 2.34 × 0.96 × 0.17 |
| PM0465 | Platform rejuvenation R/CC flake | 1.61 × 2.39 × 0.47 |
| PM0560 | Mesial frag. of R/CC bladelet | 0.8 × 0.6 × 0.11 |
| PM0488 | Distal frag. of R/CC bladelet | 1.3 × 0.7 × 0.32 |
| PM0560 | Mesial frag. of R/CC bladelet | 0.8 × 0.6 × 0.11 |
| PM0470 | Mesial frag. of obsidian bladelet | 1.8 × 1.18 × 0.32 |
| PM0531 | Reflaked R/CC blade frag. | 2.2 × 1.5 × 0.63 |
| PM0526 | R/CC utilised bladelet | 1.8 × 0.78 × 0.28 |
| PM0462 | Mesial frag. of R/CC crested blade | 1.8 × 1.4 × 0.46 |
| PM0541 | Proximal frag. of chert blade | 2.5 × 1.87 × 0.86 |
| PM0472 | Distal frag. of R/CC blade | 3.5 × 1.4 × 0.54 |
| PM0529 | R/CC blade | 3.27 × 1.6 × 0.41 |
| PM0497 | Retouched obsidian flake | 1.9 × 2.4 × 0.39 |
| PM0469 | Retouched chert flake | 2.28 × 2.13 × 0.63 |
| PM0523 | Retouched R/CC laminar flake | 3.7 × 1.96 × 0.72 |
| PM0556 | Truncated R/CC flake | 2.7 × 1.6 × 0.37 |
| PM0457 | Obsidian splintered piece | 2.3 × 2.6 × 0.5 |
| PM0515 | Chert retouched crested blade | 3.26 × 2.1 × 1.15 |
| PM0534 | Reflaked retouched R/CC crested blade | 3.47 × 0.96 × 0.67 |
| PM0549 | Proximal frag. of retouched obsidian bladelet | 2.2 × 1.16 × 0.38 |
| PM0476 | Frag. obsidian transverse arrowhead | 1.17 × 1.42 × 0.25 |
| PM0512 | R/CC transverse arrowhead | 1.75 × 1.8 × 0.47 |
| PM0502 | Distal frag. truncated chert blade | 1.4 × 2.35 × 0.33 |
| PM0527 | Distal frag. of truncated obsidian blade | 1.7 × 1.26 × 0.24 |
| PM0505 | End-scraper on obsidian blade | 5 × 1.36 × 0.5 |
| PM0514 | R/CC end-scraper | 2.51 × 1.81 × 0.45 |
| PM0495 | Honey chert sickle blade | 5.5 × 1.4 × 0.6 |
| PM0489 | Frag. of honey flint sickle blade | 2.05 × 1.15 × 0.46 |
| PM0503 | R/CC Sickle blade/end-scraper | 2.8 × 1.93 × 0.41 |
| PM0530 | Distal frag. of R/CC sickle blade | 0.91 × 1.3 × 0.42 |
| PM0453 | Frag. R/CC sickle blade | 2.37 × 1.8 × 0.35 |
| PM0498 | Frag. of R/CC sickle bladelet | 2.77 × 1.16 × 0.65 |

ventral face that exclude pressure flaking. It constitutes a rare example of the use of indirect percussion on typical honey chert.

With a larger proportion of wide and regular blades, the Lithic Phase 4 assemblage differs from the preceding phases and undoubtedly resembles more the 'classic' Thessalian Middle Neolithic assemblages from Achilleion, Sesklo B, Ag. Petros, Otzaki and Magoula Karamourlar. Nevertheless, the local production of flakes and their overall abundance continue to set PMZ apart, and to suggest that blades, or their raw material, were still too scarce to answer all the needs of the community.

*The Retouched Toolkit*

Retouched tools again become proportionally abundant: debris and core apart, they represent 24 artefacts out of a total of 75, i.e. one third. This ratio again aligns PMZ with the eastern Thessalian sites, where all the raw materials had to be imported, in contrast to Achilleion located near radiolarite sources and where the ratio is much lower.[356] Despite the long-term trend of a decrease in the proportion of sickle inserts in general, and of sickle inserts on flakes in particular, clear elements of continuity with the preceding phases can be perceived within the toolkit. However, sickle inserts being less abundant, the toolkit is more diversified than in most preceding phases.

The confrontation between the technomorphological typology and the results of the wear-trace analyses again brought some surprises (Tab. V.1.13). In two cases, the end-scrapers on sickle blades were not a secondary transformation but part of the shaping of the sickle insert, although in another case the end-scraper may indeed have been used to scrape hides. Another end-scraper was not used to work skin or hides, but on a mineral material. One of the presumed sickle blades was not used to cut cereals, but an undetermined material. Finally, two retouched tools showed no wear traces. As previously, the classification of the tools will follow the results of the use-wear analysis when available.

Sickle Inserts (n=5)

The progressive diminution of the proportion of sickle inserts in the toolkit since Lithic Phase 1 is confirmed in Lithic Phase 4, even if sickle inserts remain the best-represented tool type. Significantly, all are now made on blades, thus corresponding better to the usual standards in Thessalian (and Greek) Middle Neolithic assemblages. Their modules, however, are surprisingly different.

PM0503 (Figs. V.1.10a., V.1.11m) had a long and diversified use-life. It was manufactured on a wide R/CC blade of the highest quality. The butt is long and narrow, with a lip on the ventral face. It was probably detached by indirect percussion. Both edges were first used extensively to cut cereals and rejuvenated for the same task, with an insertion parallel to the haft for the right edge and slightly more oblique for the left. The sickle blade was then transformed: an end-scraper was manufactured on the distal end and used on hide, while the two edges, modified by bilateral ¾ abrupt retouch, were used on an undetermined material.[357]

The similar-looking PM0453 (Figs. V.1.10b, V.1.11n) was also manufactured on fine, homogeneous R/CC and on a large regular blade. Despite the technomorphological resemblance, its biography is very different. Like PM0503 it bears an 'end-scraper' on the distal edge, but traces of cereal polish extend over the retouch: the end-scraper was therefore part of the initial shaping of the insert. The insert was not used for long – possibly because the proximal end broke – and only on the left edge. The polish is too limited to determine how the insert was hafted.

PM0498 (Figs. V.1.10d, V.1.11o), also on chocolate R/CC, is of a much smaller module, possibly pressure flaked. The proximal extremity bears what was initially interpreted as an oblique

[356] See above, 213.
[357] Observation L. P. and N. Mazzucco.

Tab. V.1.13 Retouched tools from Lithic Phase 4. Italics denote discrepancies between the technomorphological and functional identifications (C. Perlès)

| PMZ number | BPh/ BSPh | Figure | Raw material | Technomorphological classification | Functional classification |
|---|---|---|---|---|---|
| PM0556 | VIIb | 4.1.10.q, 4.1.12.m | R/CC | *Obliquely truncated flake* | Flake used on fresh skin by the unretouched edge |
| PM0549 | VIIb | 4.1.10.l | Obsidian | Denticulated blade | n/a |
| PM0541 | VIIb | 4.1.10.k, 4.1.12.g | Burnt translucent chert | *Retouched blade* | Not utilised |
| PM0536 | VIIb | 4.1.9.o, 4.1.11.i | R/CC | Retouched bladelet | n/a |
| PM0534 | VIIb | 4.1.9.k, 4.1.12.e | R/CC | Retouched and reflaked bladelet | n/a |
| PM0531 | VIIb | 4.1.9.l | R/CC | Reflaked blade (‘burin’) | n/a |
| PM0530 | VIIb | 4.1.10.c | R/CC | *End-scraper on sickle blade* | *Sickle blade* |
| PM0527 | VIIb | 4.1.10.p | Obsidian | Truncated blade | n/a |
| PM0523 | VIIb | 4.1.10.h, 4.1.12.c | R/CC | *End-scraper on laminar flake* | *Edge used on mineral material* |
| PM0515 | VIIb | 4.1.10.j, 4.1.12.d | Light chert | Retouched crested blade | n/a |
| PM0514 | VIIb | 4.1.10.g 4.1.12.a | R/CC | End-scraper on blade | End-scraper (hide) |
| PM0512 | VIIb | 4.1.10.m, 4.1.12.k | Burnt R/CC | Transverse arrowhead | n/a |
| PM0510 | VIIb | – | R/CC | Splintered flake | n/a |
| PM0505 | VIIb | 4.1.10.f, 4.1.12.b | Obsidian | End-scraper on retouched blade | n/a |
| PM0503 | VIIb | 4.1.10.a, 4.1.11.m | R/CC | End-scraper on sickle blade | End-scraper on sickle blade |
| PM0502 | VIIb | 4.1.10.o, 4.1.12.l | Light varie-gated chert | Truncated blade | Not utilised |
| PM0498 | VIIc | 4.1.10.d, 4.1.11.o | R/CC | *End-scraper on sickle bladelet* | *Sickle insert* |
| PM0497 | VIIc | 4.1.9.p, 4.1.12.i | Obsidian | Retouched flake | n/a |
| PM0495 | VIIc | 4.1.10.e, 4.1.11.l | Honey chert | Transformed sickle blade | Transformed (?) sickle blade |
| PM0490 | VIIc | 4.1.10.r, 4.1.12.n | R/CC | *Arched backed bladelet* | *Utilised point* |
| PM0489 | VIIc | 4.1.10.i, 4.1.12.f | Honey chert | *Sickle blade* | *Used, not on cereals* |
| PM0476 | VIIc | 4.1.10.n, 4.1.12.j | Obsidian | Frag. of transverse arrowhead | n/a |
| PM0469 | VIIc | 4.1.12.h | Light chert | Retouched flake | n/a |
| PM0457 | VIIc | 4.1.10.s | Obsidian | Splintered flake | n/a |
| PM0453 | VIIc | 4.1.10.b, 4.1.11.n | R/CC | *Proximal end-scraper on sickle* | *Sickle blade* |

abrupt 'end-scraper', but it showed no traces of use and must again be part of the shaping of the insert.[358] The tool was inserted parallel to the haft, and the left edge bears a well-developed cereal polish, rejuvenated by inverse scalariform retouch, partially polished. This insert constitutes the first instance of deliberate rejuvenation on the ventral face, rather than the dorsal face.

PM0530 (Fig. V.1.10c) is a very small distal fragment of a sickle insert on an R/CC blade of medium width, which also bears an abrupt end-scraper front. The blade was inserted parallel to the haft by the right edge. The left edge bears a well-developed cereal polish and was rejuvenated, but not used for long afterwards since the retouch scars show only limited polish. A distal 'end-scraper' was then manufactured, but it bears no traces of use and its significance is unclear.

PM0495, a honey chert blade, presents a pinkish hue that may indicate that the chert has been heated (Figs. V.1.10e, V.1.11l). The blade was extracted from the side of the core and the left edge is almost abrupt. This edge was consequently not used and bears wear and possible residues related to hafting. The distribution of the cereal polish on the right edge, extensive on the proximal end and absent on the distal end, suggests an oblique hafting. This sickle blade was used extensively and rejuvenated several times by ¾ direct abrupt retouch until it was no longer functional. The left edge was subsequently modified by a low-angle retouch, and used on a different material, possibly hide.

### End-scrapers

From a classical typological viewpoint, seven artefacts would have been classified as end-scrapers, and they would have constituted the best-represented typological group. However, four were manufactured on sickle blades (see above, 242, 244) and their actual use as an end-scraper was only confirmed for one of them (PM0503, above, 242).

Of the three remaining potential candidates, one only, PM0514, has been confirmed as a classic end-scraper used to work hide (Figs. V.1.10g, V.1.12a). It is a short end-scraper on a regular blade produced by indirect percussion. It was certainly rejuvenated several times, given its present length. The working front is wide and bears a regular subparallel direct retouch. Wear traces indicate a transversal movement on hide.

Typologically, PM0505 is a narrow end-scraper on a retouched, irregular obsidian blade flaked by indirect percussion on a facetted platform. It bears a very short ½ abrupt direct retouch on the right edge and a narrow direct end-scraper. It has not been examined microscopically and its use cannot be confirmed (Figs. V.1.10f, V.1.12b). Finally, PM0523 was utilised not by its distal, retouched front, but by the lateral edges and will therefore be classified as a side-scraper.

### Side-scraper (n=1)

PM0523 was manufactured on a laminar R/CC flake produced during the lateral shaping of a core (Figs. V.1.10h, V.1.12c). As mentioned above, the distal 'end-scraper' is part of the shaping of the tool, as the wear traces extend slightly on its left side. The left edge was regularised by ½ abrupt retouch and the tool used by its left distal part on a mineral matter.

### Laterally Retouched Blades and Bladelets (n=6)

The retouched blades and bladelets constitute a heterogeneous group, differing by their dimensions, the location and nature of the retouch. The most unusual tool is PM0515, the fragment of the large, crested blade in blue-grey chert with white spots (Figs. V.1.10j, V.1.12d). The left edge bears a large and regular low-angle inverse retouch and is completely blunted, indicating use on hard material. A few discontinuous direct retouch scars on the right edge suggest that it was also

[358] Observation N. Mazzucco.

Fig. V.1.10 Lithic Phase 4. a: sickle insert with an end-scraper, b–e: sickle inserts on blades, f–g: end-scraper on blades, h: side-scraper, i: bitruncated blade, j: inversely retouched crested blade, k: inversely retouched flake, l: bilaterally retouched blade, m–n: transverse arrowheads, o–p: truncated blades, q: obliquely truncated flake, r: arched backed bladelet, s: splintered piece. a–d, g–h, m, p–r: R/CC. e, i: honey chert. f, k, o: light-coloured cherts. l, n, p: obsidian. a: PM0503, b: PM0453, c: PM0530, d: PM0498, e: PM0495, f: PM0505, g: PM0514, h: PM0523, i: PM0489, j: PM0515, k: PM0490, l: PM0549, m: PM0512, n: PM0476, o: PM0502, p: PM0527, q: PM0556, r: PM0490, s: PM0457 (C. Perlès)

utilised. Of a very different module, PM0536 (Figs. V.1.9o, V.1.11i), a pressure-flaked bladelet on good quality R/CC, shows a short ½ abrupt retouch on the left edge, adjacent to the fracture. This retouch is possibly accidental. PM0534 (Figs. V.1.9k, V.1.12e), already mentioned as a reflaked secondary crested blade, was retouched on the proximal half of the right edge by direct low-angle retouch on a ½ abrupt edge.

The small honey chert blade PM0489 (Figs. V.1.10i, V.1.12f) was initially identified as a sickle insert because some polish could be observed on the right edge. The tool was cursorily truncated at both extremities and lightly retouched on the dorsal face of both edges. Some microscopic residues and blunting on the left edge must be related to the hafting of the tool. It was then used with a bidirectional movement, for cutting or sawing wood, not for cutting cereals.

PM0541, a proximal fragment on burnt translucent chert, was retouched on the left edge by large ½ abrupt retouch. On the ventral face, a large, splintered retouch scar is visible next to a thermal scar (Figs. V.1.10k, V.1.12g). This piece was examined microscopically but bore no wear traces.

The single retouched obsidian bladelet, PM0549 (Fig. V.1.10l) was modified on both edges by short abrupt retouch. The right edge is denticulated, the left one rectilinear. There are no use-wear data for this tool.

### Retouched Flakes (n=2)

PM0469 (Fig. V.1.12h), made on a coarse-grained, dark-pink chert with black spots, presented an abrupt distal edge that bears a direct low-angle retouch. It was examined microscopically, but showed no wear traces. The second retouched flake, PM0497, on obsidian, shows a short, direct, ½ abrupt retouch on the proximal half of the right edge (Figs. V.1.9p, V.1.12i).

### Transverse Arrowheads (n=2)

PM0512 (Figs. V.1.10m, V.1.12k), on burnt R/CC, is morphologically very similar to the first transverse arrowheads encountered in Lithic Phase 3 and of similar – small – dimensions (Fig. V.1.7l). The four sides of the arrowhead were shaped by various combinations of retouch: large bifacial low-angle retouch on the distal edge, inverse low-angle retouch on the left and right edges, and a direct abrupt truncation on the proximal edge.

The typological determination of the second piece is more uncertain since part of the base and left edge are broken. PM0476 (Figs. V.1.10n, V.1.12j) is manufactured on a small obsidian flake and of roughly quadrangular shape. The distal end was inversely truncated, then retouched on the dorsal face by regular ½ abrupt subparallel retouch. The small part of the proximal end that is preserved shows an inverse low-angle retouch. As stated earlier, the presence of radiolarite and obsidian transverse arrowheads in the same assemblages is frequent.

### Truncated Blades (n=2)

PM0502, made on a very unusual, fine-grained, beige and red translucent chert, is unfortunately preserved only by its distal section (Figs. V.1.10o, V.1.12l). The blade was wide and flat, with regular arrises, possibly pressure flaked. The distal extremity is truncated by regular direct subparallel retouch. Microscopic examination revealed no wear traces. The second truncated blade, PM0527, is made on obsidian, and shows a similar direct truncation but was not examined for wear traces (Fig. V.1.10p).

We mentioned that truncated blades, as individual tools, are very rare in the Thessalian Middle Neolithic,[359] but truncations are used to calibrate sickle inserts and, more rarely, to manufacture

[359] Moundrea-Agrafioti 1981, 148.

trapezes. PM0502 could thus possibly be a distal fragment of a sickle blade. PM0527 is better preserved and this use can be excluded. It is also too long to be a fragmentary trapeze and can thus be considered as a true truncated blade, comparable to the blade found in Lithic Phase 3.[360]

Obliquely Truncated Flake (n=1)

Manufactured on good quality R/CC the elongated flake PM0556 was probably extracted, by indirect percussion, at the end of a phase of blade production. The right edge was then obliquely truncated by short direct abrupt retouch. Despite the pointed shape created by this retouch, the point was not used and the retouch was probably intended to facilitate hafting. The left edge was used unretouched with a wide angle on fresh hide (Figs. V.1.10q, V.1.12m).

Arched Backed Bladelet (n=1)

PM0490 represents an unusual type in a Greek Middle Neolithic assemblage. This R/CC pressure-flaked bladelet was backed and obliquely truncated by a short abrupt retouch on the distal half of the right edge and shaped into a narrow point (Figs. V.1.10r, V.1.12n). In contrast to the previous truncated flake, the point was the active zone on PM0490, but the material worked could not be determined.

Splintered Pieces (n=2)

Splintered pieces are still surprisingly rare, if not absent at PMZ in the late Middle Neolithic. The two artefacts presented here do not correspond to the usual standards of splintered pieces. PM0457 is made on a thick flake or fragment of obsidian core (Fig. V.1.10s) awkwardly flaked by bipolar percussion and partly split. Was it a last attempt to extract a few obsidian flakes, or a beginner's practice? Similarly, PM0510, a thick flake on mediocre-quality R/CC, was splintered by bipolar percussion on the ventral face. It may have been used briefly as a wedge.

'Burin' (n=1)

Typologically, PM0531 should be called a burin, with several bladelets extracted from a proximal fracture (Fig. V.1.9l). We have already presented it as a burin-like core rather than a tool: true burins are indeed absent from Greek Middle Neolithic assemblages, whereas the reflaking of blades is a common practice.[361]

*Contexts and Chronological Attribution*

BSPh VIIb comprises Surface F22, a fragmentary floor that overlaid the fire destruction stratum where the house model was deposited (Fig. III.32). It was only preserved around the Early Bronze Age pit in the eastern half of the trench. A large hearth (TS 19) and two postholes were associated with F22. The four artefacts found directly on Surface F22, a burnt debris, two R/CC and an obsidian flake, were dispersed in the southern part of the trench and were not associated with any recognised structure. A 'handful' of flaked stones, similar to those from BSPh VIIa, was uncovered precisely at the limit between these BSPh VIIa and VIIb (SU 135), again in the western half of the trench. It consists of a microbladelet of red R/CC with white and green spots, the crest preparation flake PM0557, the obliquely truncated flake PM0556 in homogeneous chocolate R/CC (Fig. V.1.10q), the small flake PM0558 in a darker R/CC (Fig. V.1.9e) and a small R/CC

[360] See above, 234.
[361] Perlès 2004.

splinter. Like the earlier ones, this small group does not correspond to a flaking sequence, cannot be considered as a cache of blanks, includes at least one piece that we would not call 'waste' and remains unexplained.

Surface F21 (BSPh VIIc, Fig. III.34) included a compacted yellowish clayish soil (SU 144) at a depth of 4.94 to 4.95m. This floor was recognised as small patches over the whole trench, the Early Bronze Age pit excepted. The only flaked stone directly associated with the floor was the small sickle insert PM0498 (Figs. V.1.10d, V.1.11o). A quadrangular pit, 0.62 × 0.38m, unconnected with the remnants of the floor, was uncovered in the northwest area of the trench, filled with black burnt soil (see Fig. III.34, area A). This context can thus be considered a secure, 'closed context'. It contained ten flaked stone artefacts: the small bladelet microcore PM0584 (Figs. V.1.9n, V.1.11h), five fragmentary R/CC flakes, a fragmentary R/CC bladelet, a R/CC splinter, but also the honey chert blade PM0495 (Figs. V.1.10e, V.1.11l) and the arched bladelet PM0490 (Figs. V.1.10r, V.1.12n). This group of artefacts is even more puzzling than the above-mentioned one: most are broken, half of them are heated or burnt but not the others; several are too small to be of any use, with a maximum length under 1.5cm. And yet, they are associated with two perfectly preserved tools.

Fifteen other flaked artefacts were found dispersed over the entire Surface F21, outside the floor patches. None was heated or burnt. Besides fragmentary R/CC flakes, they include six retouched tools: the obsidian end-scraper on blade (PM0505, Figs. V.1.10f, V.1.12b), the obsidian transverse arrowhead (PM0476, Fig. V.1.12j), the retouched obsidian flake (PM0497, Figs. V.1.9p, V.1.12l), the fragment of chert truncated blade (PM0502, Figs. V.1.10o, V.1.12m), and two sickle inserts (PM0503 and PM0498, Figs. V.1.10a, d, V.1.11m, o). Even though they are not associated with the yellow clay soil, there is no indication that these artefacts were redeposited. Finally, fourteen other pieces were found in the deposits – destruction layer – between surfaces F21 and F20, also spread over the entire preserved Neolithic surface of the trench. Their original context and date is more uncertain.

The tool types from BSPh VIIb and VIIc present striking similarities. It was previously thought that Surface F22 (BSPh VIIb) was the last Middle Neolithic surface, and Surface F21 (BSPh VIIc) the first Late Neolithic surface. However, several tools found on F21, in particular the long honey flint sickle blade PM0495 (Fig. V.1.10e), the small insert PM0498 (Fig. V.1.10c) and the transverse arrowhead PM0476 (Fig. V.1.12j), have their exact correspondence in earlier phases. Since there is no indication that these artefacts were redeposited from earlier contexts, in terms of flaked stone assemblages, both the assemblages from BSPh VIIb and VIIc belong to the Middle Neolithic and show close correspondences with Lithic Phase 3.

The activities represented by these tools are the same as before – harvesting cereals and working hide – with one exception: PM0523 (Figs. V.1.10h, V.1.12c) that worked a mineral matter. With sickle inserts as the predominant tool type, and with all sickle inserts made on blades, the assemblage from Lithic Phase 4 presents clear analogies with other Thessalian Middle Neolithic assemblages. Nevertheless, the proportion of sickle inserts – one fifth of the retouched tools – is now clearly lower than in other sites, where sickle inserts represent about 50% of the toolkit, splintered pieces excepted. The Lithic Phase 4 assemblage also differs from the assemblages from Achilleion, Sesklo B, Magoula Karamourlar or Ag. Petros in the importance of flakes in the debitage, the quasi-absence of splintered blades and the presence of tool types rare or absent elsewhere: truncated blades and transverse arrowheads.

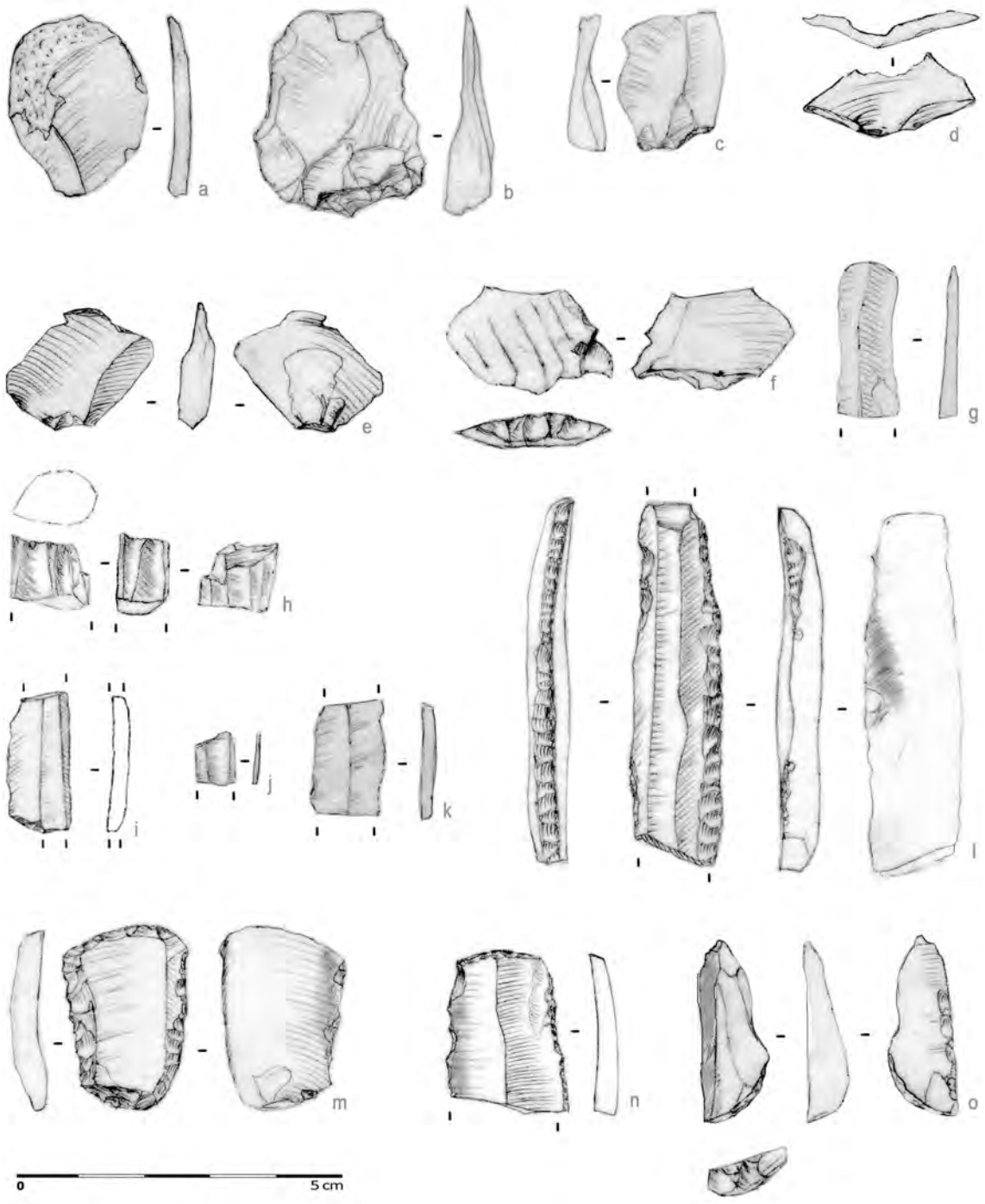


Fig. V.1.11 Lithic Phase 4. a–f: trimming and preparation flakes, g, i–k: bladelets (i with proximal retouch), h: pressure-flaked microcore, l: sickle blade, m: end-scraper on sickle blade, n: sickle insert on blade, o: sickle insert on bladelet. All in R/CC except l in honey chert. a: PM0568, b: PM0463, c: PM0473, d: PM0511, e: PM0477, f: PM0465, g: PM0499, h: PM0487, i: PM0536, j: PM0556, k: PM0470, l: PM0495, m: PM0503, n: PM0453, o: PM0498 (C. Perlès, drawings: M. Ballinger)

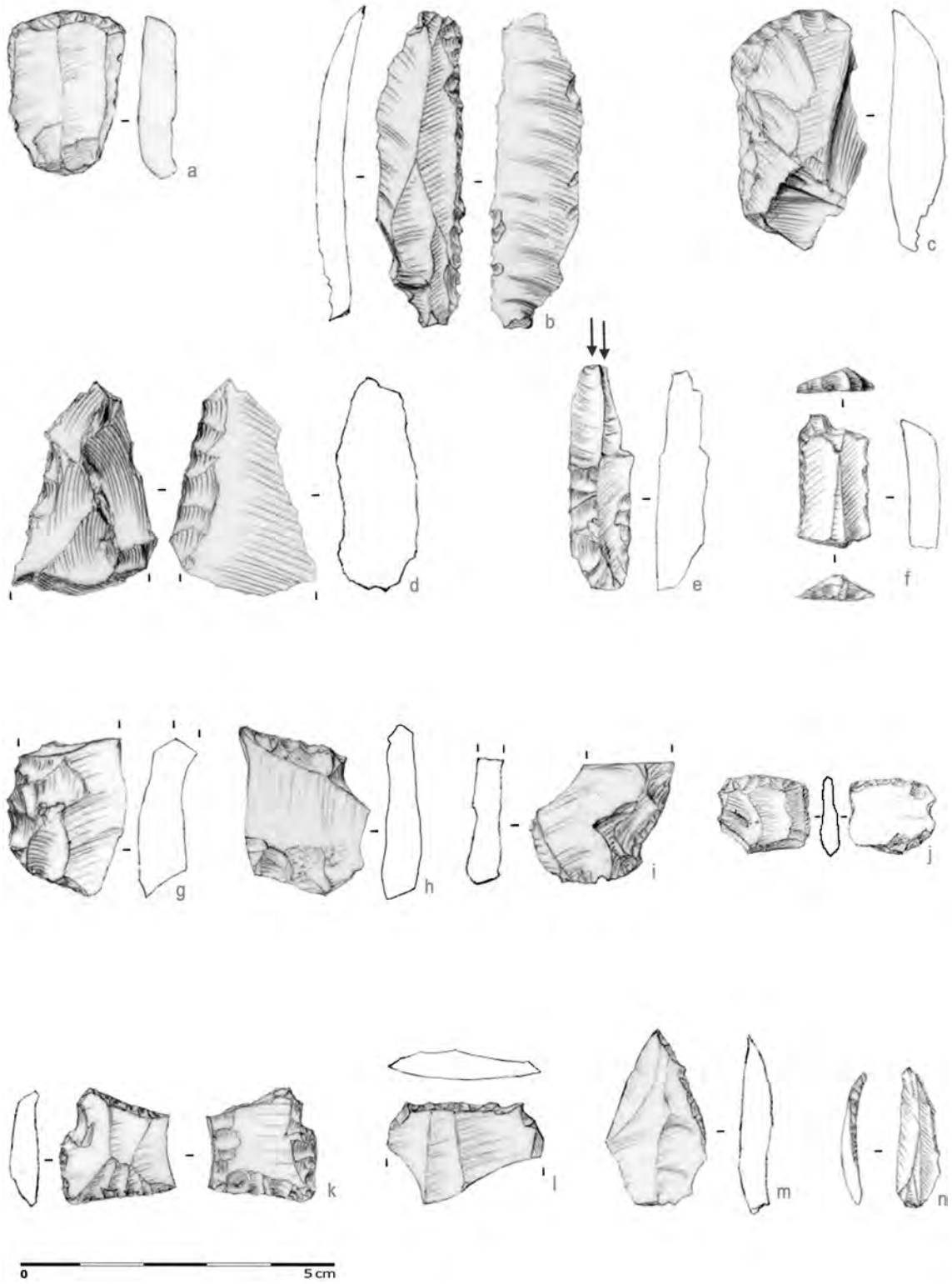


Fig. V.1.12 Lithic Phase 4. a–b: end-scraper on blades, c: side-scraper on flake, d: inversely retouched crested blade, e: reflaked secondary crested blade, f: bitruncated blade, g: retouched blade, h–i: retouched flakes, j–k: transverse arrowheads, l: truncated blade, m: obliquely truncated flake, n: arched backed bladelet. a, c, e, k, m–n in R/CC, b, i–j in obsidian, d, g–h, l in translucent cherts, f in honey chert. a: PM0514, b: PM0505, c: PM0523, d: PM0515, e: PM0534, f: PM0489, g: PM0541, h: PM0468, i: PM0497, j: PM0476, k: PM0512, l: PM0502, m: PM0556, n: PM0556 (C. Perlès, drawings: M. Ballinger)

## V.1.7. Lithic Phase 5 – Building Phase VIII[362]

### *Characterisation*

Contrary to what occurred with the previous lithic phases, Lithic Phase 5 (EU 258–260, 264–265, 278–279, 281–283, 285–286) differs from the preceding ones less by quantitative criteria than by qualitative criteria: a more systematic choice of high-quality R/CC, the appearance of pressure-flaked R/CC blades, and new tool types, in particular perforating tools ('*mèches*'). Conversely, the heavily retouched sickle blades, present in all phases up to now, are now absent. Some quantitative changes can nevertheless be observed: a higher proportion of unretouched bladelets, and, especially, a significant drop in the proportion of obsidian. The microscopic examination also reveals an increase of activities related to plant processing and of versatile tools used on several different materials.

### *Raw Materials*

Of a total of 58 artefacts, R/CC amount to 45 specimens, obsidian 2, translucent cherts 4, quartz 3, and honey chert 1. Three specimens were not identified.[363] Many of the R/CC are of a high, homogeneous quality, and bear very well their usual denomination of 'chocolate flint' or 'chocolate jasper'. Of special interest is an irregular flake that shows that both light-red matte and dark, lustrous chocolate radiolarite/chert can be found in the same block of raw material (Fig. V.1.13a). Many other R/CC pieces have a lustrous surface, but associated with evidence of thermal alteration. As before, we suspected heat treatment, but found no definite evidence. The pink hue of the honey chert blade fragment PM0384 (Fig. V.1.13s) is also probably due to heating. The fact that the fracture is more lustrous than the surfaces again suggests intentional heat treatment, but this cannot be ascertained on such a small fragment.

Among the R/CC, several bear surfaces corresponding to cleavage planes, but only three show true cortex or neo-cortex: As in the earlier phases, they attest to both procurement in the river and at or near the source (Figs. V.1.13b, n). The results of the geochemical analyses confirm the exploitation of secondary sources both on the Peneios (PM 8) and the Portaikos (PM 2).

With only two pieces, obsidian is rarer in this Lithic Phase V than it has ever been and, since none of them comes from a secure context,[364] the possibility of redeposition from earlier contexts cannot be ruled out. Whichever the case, the scarcity or absence of obsidian is unexpected. There are no Thessalian flaked stone assemblages of the earliest Late Neolithic to compare PMZ with,[365] but, at Ag. Petros in the Sporades, the early Late Neolithic assemblage comprised 70% obsidian.[366] At Tharrounia and Sarakenos Cave (LN Ia) obsidian reached 95%,[367] and it constituted 63% of the assemblage in Lithic Phase III at Franchthi.[368] Later Late Neolithic eastern Thessalian

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362 BPh IX should belong to this lithic phase, but it yielded no flaked stones.

363 Compared with Lithic Phase 4, the difference in distribution of raw materials is significant at $p = 0.56$.

364 Below, 260, 262.

365 Visviki Magoula and Arapi are the only other published sites from Thessaly with Tsangli-Larissa occupations. Unfortunately, the Tsangli-Larissa deposits from Magoula Visviki, found at the bottom of Trench B, yielded no retouched artefacts (Bergner 2015a, 385) and the lithics from Arapi have not been published (Hauptmann – Milojčić 1969). Orgozinos, in western Thessaly, with only 3% obsidian (Karimali 2009) compares well with PMZ in this respect, but we do not know which phase of the Late Neolithic is represented. Potential elements of comparison will therefore have to be sought either further away (Ag. Petros in the Sporades, the Sarakenos Cave in Boeotia, Tharrounia in Euboea, Kitsos in Attica, Franchthi in the Argolid) or in later Thessalian Late Neolithic sites (Ag. Sophia, Dimini).

366 Moundrea-Agrafioti 1981, tab. 1.

367 Perlès 1994b, tab. 2.

368 Perlès 2004, tab. 5.1.

Tab. V.1.14 Composition of the flaked stone assemblage from Lithic Phase 5 (C. Perlès)

| | R/CC | Chert | Obsidian | Honey chert | Quartz | Undetermined |
|---|---|---|---|---|---|---|
| **Debris** | 3 | | | | 1 | |
| **Cores** | 1 | | | | | |
| **Flakes** | 16 | 1 | 1 | | 2 | 2 |
| **Blades** | 1 | | | 1 | | |
| **Bladelets** | 8 | 2 | 1 | | | |
| **Retouched flakes** | | | | | | 1 |
| **Retouched blades** | 5 | 1 | | | | |
| **Retouched bladelets** | 7 | | | | | |
| **Total** | 45 | 4 | 2 | 1 | 3 | 3 |

assemblages yielded up to 85% obsidian. PMZ always had limited access to obsidian trade networks, but the situation seems to have worsened in the Tsangli-Larissa phase.

Finally, three pieces are made on quartz. One was lost and could not be examined. The other two consist of a cortical flake and a debris and may have been produced during the use of a quartz pebble as a percussive tool (Tab. V.1.14).

*The Production*

One cortical and two non-cortical flakes struck with a hard hammer suggest that an independent production of flakes was still taking place, but probably on a modest scale (Figs. V.1.13c–d, V.1.14c). Most of the flakes were produced by indirect percussion and probably correspond to the shaping of blade or bladelet cores (Fig. V.1.13e–g). PM0831, for instance, removed the side or the back of a core shaped with two crests (Fig. V.1.13g). Crest preparation is also attested by two bladelets that bear traces of antero-lateral crests (Figs. V.1.13i–j, V.1.15b–c). However, the volumetric conception of the cores, in particular the initial number of crests, remains undetermined: the only blade or bladelet core is residual, with a few flakes removed by indirect percussion at the end of the exploitation (Figs. V.1.13h, V.1.15a).

Most of the R/CC blades and bladelets were flaked by indirect percussion (e.g. Fig. V.1.13k–l), with a linear butt and suppression of the overhang. This was also the technique used on the translucent chert blade PM0382 (Figs. V.1.13m, V.1.15i). However, a remarkable feature of Lithic Phase 5 is the presence of several unretouched R/CC pressure-flaked blades and bladelets (Figs. V.1.13n–r and possibly j, V.1.15d–g). Assuming that the R/CC react as chert,[369] the R/CC bladelets securely identified as pressure-flaked in the previous phase were small enough to be produced by 'mode 2', with a shoulder crutch, while the bladelets from Lithic Phase 5 would have required at least a 'mode 3' flaking, with a short crutch held while seated.[370] In turn, PM0391, nearly 1.4cm wide would have required 'mode 4', with a long crutch held while standing (Figs. V.1.13o, V.1.15g). PM0342 was possibly also pressure flaked and would have required the same device (Figs. V.1.14a, V.1.16a). Of the three bladelets that preserved their proximal part, two present a facetted butt, the third a linear butt, without removal of the overhang on the dorsal face (Figs. V.1.13n, q–r, V.1.15d–f). The differences in flaking techniques and modes of preparation of the detachment of the bladelets suggest they were produced by knappers with different technical traditions or abilities.

[369] Which seems to be the case, according to the experiment conducted by J. Pelegrin on a R/CC pebble collected in the Peneios by C. P.

[370] Pelegrin 2012, fig. 18.12.

Fig. V.1.13 Lithic Phase 5. a–g: unretouched flakes, h: bladelet core, i–j: secondary crested bladelets, k–s, u: unretouched blades and bladelets, t: core rejuvenation flake. a–l, n, r: R/CC. m, p–q: light coloured cherts. s: honey chert. t–u: obsidian. a: PM0384, b: PM0390, c: PM0449, d: PM0380, e: PM0448, f: PM0389, g: PM0381, h: PM0378, i: PM0440, j: PM0397, k: PM0351, l: PM0448, m: PM0382, n: PM0363, o: PM0391, p: PM0422, q: PM0385, r: PM0357, s: PM0384, t: PM0405, u: PM0334 (C. Perlès)

Tab. V.1.15 Relevant dimensions for Lithic Phase 5 (C. Perlès)

| PMZ number | Determination | Dimensions [cm] |
|---|---|---|
| PM0378 | R/CC residual core | 2.71 × 2.82 × 2.04 |
| PM0380 | R/CC hard hammer flake | 3.1 × 4.56 × 1.23 |
| PM0449 | R/CC hard hammer flake | 3.23 × 3.8 × 1.03 |
| PM0381 | R/CC core shaping flake | 3.23 × 2.35 × 0.51 |
| PM0389 | R/CC core shaping flake | 3.8 × 1.8 × 0.42 |
| PM0397 | R/CC under-crest bladelet (frag.) | 2.33 × 1.13 × 0.3 |
| PM0440 | R/CC under-crest bladelet (frag.) | 2.1 × 1.04 × 0.48 |
| PM0363 | R/CC bladelet | 2.9 × 1.14 × 0.33 |
| PM0385 | R/CC utilised bladelet | 3.14 × 0.71 × 0.13 |
| PM0350 | Distal frag. of R/CC bladelet | 1.69 × 0.99 × 0.25 |
| PM0391 | Mesial frag. of utilised R/CC blade | 2.76 × 1.35 × 0.27 |
| PM0392 | Proximal frag. of R/CC blade | 1.73 × 1.9 × 0.35 |
| PM0339 | Proximal frag. of obsidian blade | 1.44 × 1.30 × 0.22 |
| PM0405 | Obsidian rejuvenation flake | 1.9 × 0.9 × 0.31 |
| PM0384 | Proximal frag. of honey chert blade | 1.7 × 1.8 × 0.39 |
| PM0382 | Translucent chert bladelet | 4.83 × 1.19 × 0.24 |
| PM0422 | Translucent chert bladelet | 4 × 0.91 × 0.27 |
| PM0342 | Sickle insert on blade (frag.) | 2.2 × 1.45 × 0.55 |
| PM0351 | Sickle insert on bladelet (frag.) | 1.32 × 1 × 0.26 |
| PM0441 | Sickle insert on flake | 3.4 × 1.8 × 0.66 |
| PM0399 | Beak | 2.20 × 1.04 × 0.33 |
| PM0366 | Beak/borer | 3 × 1.16 × 0.45 |
| PM0334 | Beak/borer | 2.41 × 0.65 × 0.38 |
| PM0340 | Borer | 1.92 × 0.9 × 0.4 |
| PM0338 | End-scraper on frag. blade | 1.7 × 1.7 × 0.39 |
| PM0386 | Bitruncated triangle | 1.06 × 2.02 × 0.3 |
| PM0358 | Retouched R/CC blade (frag.) | 1.9 × 1.61 × 0.54 |
| PM0452 | Retouched R/CC blade (frag.) | 2.7 × 1.51 × 0.33 |
| PM0421 | Retouched flake | 2.4 × 2.23 × 1.02 |
| PM0364 | Retouched flake | 1.5 × 1.6 |
| PM0404 | Splintered piece? | 1.72 × 1.9 × 0.47 |
| PM0337 | Splintered piece | 3.03 × 2.06 × 0.77 |
| PM0341 | Utilised laminar flake | 2.79 × 1.02 × 0.56 |
| PM0451 | Utilised laminar flake | 3 × 1.88 × 0.7 |

The two obsidian artefacts consist of one small rejuvenation flake (Fig. V.1.13t) and a single fragmentary obsidian blade (Fig. V.1.13u). The latter presents a linear butt with suppression of the overhang on the dorsal face, a typical Middle Neolithic method of preparation for the detachment;[371] this is a further argument to suspect a redeposition from an earlier context.

Whichever the raw material, blades and bladelets still constitute two distinct objectives in the production: the width of the bladelets varies from 0.7 to 1.19cm, while the width of the blades ranges from 1.3 to 1.8cm, with a majority over 1.45cm (Tab. V.1.15). Like in the previous phases, however, the extent of local production versus imported blanks is difficult to assess. If the very small obsidian rejuvenation flake actually belongs to this phase, it would testify that obsidian, as in the preceding phases, was at least partially worked in situ. The presence of two R/CC undercrest bladelets, of a possible core pyramidion, and, even more significant, of a platform rejuvenation R/CC flake, suggests a local production of blades and bladelets. This, however, does not preclude the importation, in parallel, of already flaked blanks.

### *Utilised and Retouched Tools*

With only 16 specimens from a total of 58, the retouched toolkit is proportionally slightly smaller than in the preceding phase.[372] This renders the presence of three retouched perforating tools, the first in the PMZ assemblages, all the more significant. In addition, at least four bladelets and flakes were utilised and, in one case at least, hafted without retouch. This may possibly be a new feature,[373] related to the lighter module of the blades and bladelets, which could not undergo important retouching.

Among the retouched tools examined under microscope, one or two were misidentified: PM0399, identified as a beak/borer (with a broken point) was actually used bilaterally on the proximal half. However, since the point is broken, the former use cannot be entirely excluded. PM0351 was classified as a sickle insert transformed into a small end-scraper: once again, microscopic examination revealed it was not a transformation but part of the original shaping of the insert.

### Sickle Inserts (n=3)

Already rare in the previous phase, sickle inserts remain few in number and constitute a thoroughly heterogeneous group.

PM0342 is a sickle insert made on a pressure-flaked R/CC blade, broken after use on both extremities (Figs. V.1.14a, V.1.16a). It was inserted parallel to the haft without any modification of the hafted edge, and used on its right edge only. This edge was damaged – possibly by a pick during excavation – but was otherwise left unretouched, with a few use-scars creating a very small denticulation. Unretouched but slightly denticulated working edges may be characteristic of the Late Neolithic since several instances were recorded at Ag. Sophia.[374]

PM0351 is a very small and narrow insert on a R/CC bladelet (Figs. V.1.14b, V.1.16b). It was shaped before use by an 'end-scraper front', inserted into the haft by the right edge and used to cut cereals with the left edge. The edge was rejuvenated by short abrupt retouch and the piece re-used for the same task. A very short final retouch – from use? – removed the blunting of the edge.[375] Several sickle inserts shaped for hafting with an 'end-scraper' front were present in the

371 Perlès 2004; Kourtessi-Philippakis et al. 2008.
372 The difference is not statistically significant.
373 Unretouched blades and bladelets have not been systematically examined for wear traces.
374 Observation C. P.
375 Observation N. Mazzucco.

Tab. V.1.16 Retouched and utilised artefacts from Lithic Phase 5 (C. Perlès)

| PMZ number | BPh | Figure | Raw material | Technomorphological classification | Functional classification |
|---|---|---|---|---|---|
| PM0342 | VIII | V.1.14.a, V.1.16.a | R/CC | Sickle insert on blade | Sickle insert |
| PM0351 | VIII | V.1.14.b, V.1.16.b | R/CC | *End-scraper on sickle bladelet (frag.)* | *Sickle insert* |
| PM0441 | VIII | V.1.14.c, V.1.16.c | R/CC | Sickle insert on flake | Sickle insert |
| PM0399 | VIII | V.1.14.g, V.1.16.g | R/CC | *Beak* | *Tool used laterally on hide or vegetal matter* |
| PM0366 | VIII | V.1.14.d, V.1.16.d | R/CC | Beak/borer | Borer used on wood |
| PM0334 | VIII | V.1.14.e, V.1.16.e | R/CC | Beak/borer | Borer used on skin and wood |
| PM0340 | VIII | V.1.14.f, V.1.16.f | R/CC | Borer | n/a |
| PM0338 | VIII | V.1.14.j, V.1.16.i | Heated or burnt R/CC | End-scraper on blade | End-scraper used on skin |
| PM0386 | VIII | V.1.14.n, V.1.16.o | R/CC | Bitruncated triangle | n/a |
| PM0358 | VIII | V.1.14.i, V.1.16.h | R/CC | Retouched blade (frag.) | n/a |
| PM0452 | VIII | V.1.14.h | R/CC | Retouched blade (frag.) | n/a |
| PM0364 | VIII | V.1.16.j | R/CC | Retouched flake | n/a |
| PM0421 | VIII | V.1.16.k | R/CC | Retouched flake/splintered piece | n/a |
| PM0404 | VIII | V.1.14.m, V.1.16.n | R/CC | Splintered piece? | n/a |
| PM0346 | VIII | V.1.14.l, V.1.16.l | R/CC | Split splintered piece | n/a |
| PM0337 | VIII | V.1.14.k, V.1.16.m | Heated or burnt R/CC | Splintered piece | n/a |
| PM0391 | VIII | V.1.13.o, V.1.15.g | R/CC | Utilised blade | Blade utilised on hide |
| PM0451 | VIII | V.1.14.p | R/CC | Utilised flake | n/a |
| PM0341 | VIII | V.1.14.o | Burnt chert ? | Utilised flake | n/a |
| PM0385 | VIII | V.1.13.q, V.1.15.f | R/CC | Utilised bladelet | Bladelet utilised on skin and wood |
| PM0422 | VIII | V.1.13.p, V.1.15.j | Radiolarite or chert | Utilised bladelet | Bladelet utilised on plants |

earlier PMZ phases, but they are also known in Late Neolithic contexts,[376] though mostly on larger blades.

The third insert, PM0441 is a sickle insert on a large flake. With its bifacial retouch and serrated working edge, it evokes Helladic inserts[377] (or even *tribulum* inserts[378]) rather than Middle Neolithic ones. The hafted right edge was mostly shaped by direct retouch, the left edge was shaped by bifacial retouch (Figs. V.1.14c, V.1.16c). It was used to cut cereals with the left edge, rejuvenated several times, then re-used for another task on both edges.[379] We know of no equivalent sickle insert in Late Neolithic assemblages.

### Perforating Tools (n=3)

The presence of three retouched perforating tools (borers or '*mèches*') constitutes an innovation in the PMZ toolkit: none had been identified previously, even in larger assemblages. PM0366 was manufactured on a R/CC blade by regular bilateral ¾ abrupt retouch converging to shape a sturdy beak. Microscopic examination showed the point was used in a rotary motion on dry wood (Figs. V.1.14d, V.1.16d). PM0334 was similarly manufactured on a R/CC bladelet by direct abrupt retouch of the left edge and the distal half of the right edge (Figs. V.1.14e, V.1.16e). The point was used on both hide and wood, either successively or, perhaps, by perforating a hide set on a wooden stand. The point of PM0340 is broken and its use cannot be confirmed, but the similarity of the shaping technique with the two preceding artefacts, by bilateral abrupt retouch, makes its use as a borer very likely (Figs. V.1.14f, V.1.16f). Similar perforating tools, shaped by direct bilateral retouch, were uncovered in the Late Neolithic levels from Ag. Petros,[380] Tharrounia,[381] Kitsos[382] and Ag. Sophia.[383] They thus appear to represent a typical Late Neolithic type of perforating tool.

### Retouched Blades (n=3)

This set of three artefacts does not constitute a homogeneous category. If all had been analysed for wear traces, very different uses would undoubtedly have been documented. PM0399, made on a regular R/CC blade, was shaped by direct bilateral abrupt retouch, but shorter than on the three preceding artefacts (Figs. V.1.14g, V.1.16g). The distal extremity is broken, and it was initially classified as a broken perforating tool, which remains a possibility. However, microscopic examination showed it was used on the proximal part of both the right and left edges, either on a soft vegetal matter or on fresh hide, with a transversal gesture. The fragmentary blade or laminar flake of homogeneous R/CC PM0452 was not examined for wear traces, but the very different retouch makes a similar use unlikely. Both edges bear a very short irregular direct retouch, continuous on the left edge and limited to the mesial part on the right edge (Fig. V.1.14h). Conversely, the proximal blade fragment PM0358 presents a steep-backed right edge, opposed to a naturally abrupt left edge (Figs. V.1.14i, V.1.16h).

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376 E.g. Moundrea-Agrafioti 1981, 125 (Dimini); Perlès 1994b, pl. 7.4–6 (Tharrounia); Kourtessi-Philippakis et al. 2008, pl. 4.57.

377 However, given its stratigraphic position on Surface F20 and its coordinates, a contamination from Helladic levels can be ruled out. This is one of the few securely dated Late Neolithic artefacts, see below, 260.

378 See N. Mazzucco, this volume, 289–290.

379 Observation L. P. and N. Mazzucco.

380 Moundrea-Agrafioti 1981, pl. 5.7.

381 Perlès 1994b, pl. 12.1–2.

382 Perlès 1981, fig. 112.4.

383 Milojčić et al. 1976, pl. 22.9.

Fig. V.1.14 Lithic Phase 5. a–c: sickle inserts, d–f: borers, g–i: laterally retouched blades, j: end-scraper, k–m: splintered pieces, n: bitruncated triangle, o–p: utilised bladelet and flake. All in R/CC cherts except o, light-coloured chert. a: PM0342, b: PM0351, c: PM0441, d: PM0366, e: PM0334, f: PM0340, g: PM0399, h: PM0452, i: PM0358, j: PM0338, k: PM0337, l: PM0346, m: PM0404, n: PM0386, o: PM0341, p: PM0451 (C. Perlès)

## End-scraper (n=1)

True end-scrapers are generally rare in Neolithic Thessalian assemblages[384] and PMZ Late Neolithic is no exception. This single specimen, PM0338, made on an unretouched R/CC blade, was used briefly with a transverse movement on fresh or dry hide. Compared with the Middle Neolithic end-scrapers from PMZ, it is made on a distinctly narrower and flatter blade, with a lower

[384] Moundrea-Agrafioti 1981, 153.

and very regularly shaped working front (Figs. V.1.14j, V.1.16i). These traits are characteristic of one type of Late Neolithic end-scrapers.[385]

Retouched Flakes (n=2)

The two retouched flakes have little in common. PM0364 (Fig. V.1.16j) is a small, fragmentary platform rejuvenation flake with a short regular abrupt inverse retouch on the left edge, a style of retouch that is frequent in Late Neolithic assemblages.[386] PM0421 (Fig. V.1.16k) is, conversely, a thick flake that may be the pyramidion of an irregular pyramidal core. It bears a direct denticulated retouch on two segments of the periphery, and was later re-used as a splintered piece.

Splintered Pieces (n=3 + 1?)

Besides the above-mentioned piece, splintered pieces are represented by a split fragment ('*bâtonnet de pièce esquillée*') in R/CC (PM0346, Figs. V.1.14l, V.1.16l) and a large, burnt, splintered blade or laminar flake with neo-cortex (PM0337, Figs. V.1.14k, V.1.16m). PM0404 (Figs. V.1.14m, V.1.16n) is more ambiguous since one modified edge only bears unifacial retouch and the removals are not really 'splintered'. It could correspond to a very brief use as a splintered piece, or to a failed attempt at manufacturing a bifacial tool. Whichever the case, the presence of at least three splintered pieces in this small series is important, since we repeatedly noticed their unexpected absence in the previous phases.

Bitruncated Triangle (n=1)

PM0386 is an unusual bitruncated triangle in R/CC, manufactured on a wide blade by two direct ¾ abrupt truncations (Figs. V.1.14n, V.1.16o). It may be considered as a variant of a trapeze. Geometrics are never abundant in Greek Neolithic assemblages, but they can occur in all chronological phases. Four were uncovered in Late Neolithic assemblages at Kitsos,[387] one in Phase III at Sitagroi.[388]

Utilised Blanks

As mentioned above, several blanks were utilised without any modification of the working edge. Despite its apparent brittleness, PM0385 (Figs. V.1.13q, V.1.15f) was utilised by the left edge on a supple or semi-hard vegetal matter (wood) with a longitudinal movement, and by the right edge on fresh hide, with a transversal movement. PM0391 (Figs. V.1.13o, V.1.15g) was used with the right edge on dry hide, again with a transversal movement. PM0397 (Figs. V.1.13j, V.1.15c) was also examined under the microscope but did not reveal any wear traces. Conversely, the laminar flakes PM0341 and PM0351 (Fig. V.1.14o–p), not examined under the microscope, bear clear use retouch.

*Contexts*

Surface F20, tentatively identified as a floor by the excavator, defines the base of BPh VIII (Fig. III.37). F20 consisted in a 4cm-thick surface of compacted yellowish, clayish earth covering the entire surface of the excavation (Early Bronze Age pit excepted). Hearth TS 18 was found on this surface. Eight artefacts were directly associated with F20, all in R/CC. These artefacts can thus be securely dated to the early Late Neolithic (Tsangli-Larissa phase) but, aside from a sickle

385 See Milojčić et al. 1976, pl. 23; Perlès 1994b, pl. 8; Kourtessi-Philippakis et al. 2008, pl. 4.
386 Perlès 1994b, pl. 6.
387 Perlès 1981, pl. VII.5–6.
388 Tringham 2003, fig. 4.3z.

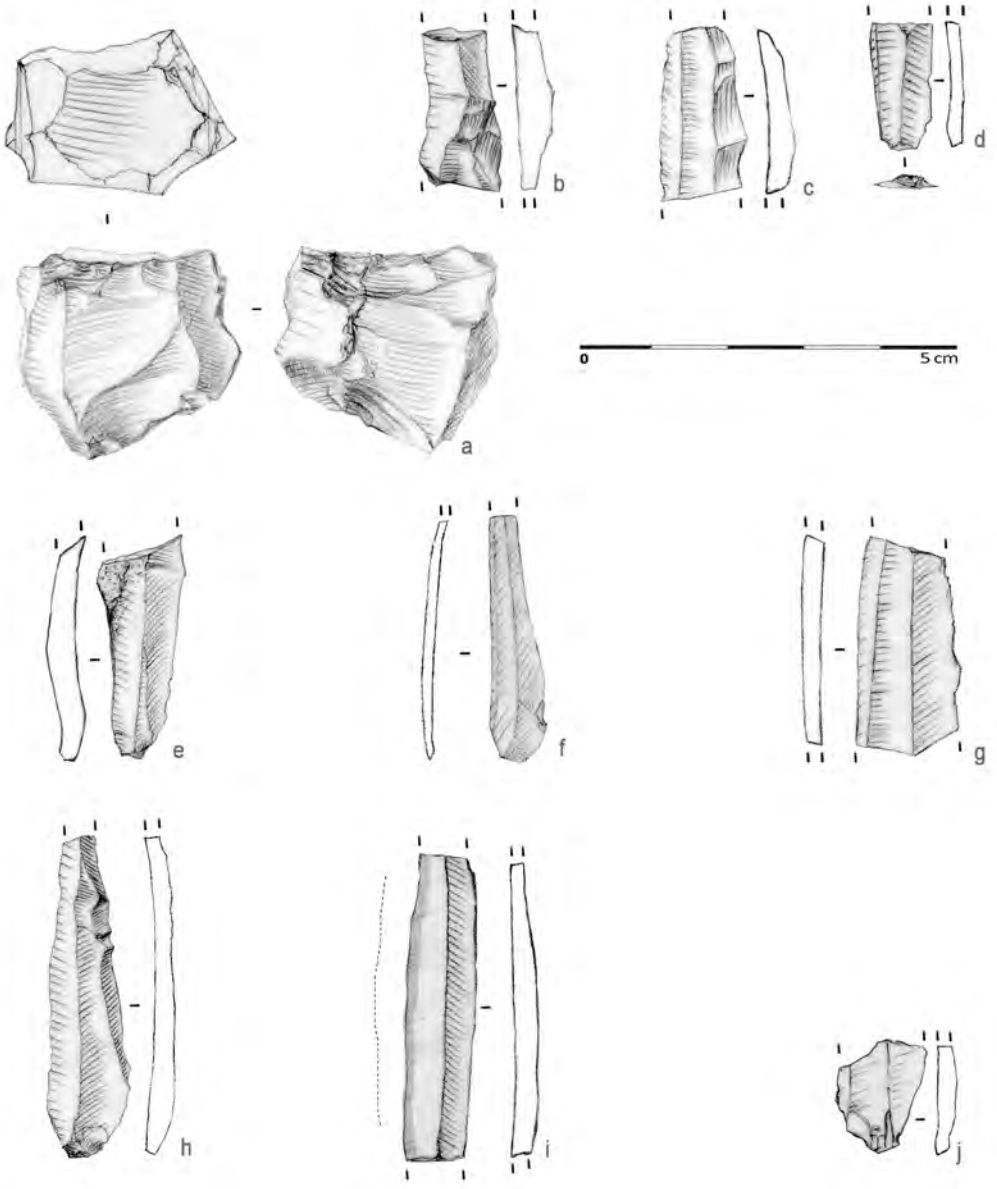


Fig. V.1.15 Lithic Phase 5. a: exhausted flake and bladelet core, b–c: secondary crested blades, d–g: pressure-flaked bladelets and blade, h–i: indirect percussion bladelet and blade, k: proximal fragment of obsidian blade. All in R/CC except i–j in translucent chert and k in obsidian. a: PM0378, b: PM0440, c: PM0397, d: PM0357, e: PM0363, f: PM0385, g: PM0391, h: PM0392, i: PM0382, j: PM0422, k: PM0339 (C. Perlès, drawings: M. Ballinger)

insert, they are not very informative. A fragmentary under-crest bladelet (PM0440, Figs. V.1.13i, V.1.15b) was found very close to the sickle insert on flake (PM0441, Figs. V.1.14c, V.1.16c) in the western part of the trench. PM0442, a debris, was found on the same surface, close to the Early Bronze Age pit. Two unretouched flakes and a fragmentary bladelet (PM0443, PM0448–9) were found in 'a small pit on F20' in the south-western part of the trench, while two flakes, including the retouched flake PM0452 (Fig. V.1.14h) were found together in the centre of the western part.

A quartz debris was uncovered immediately above F20, but the vast majority of flaked artefacts from Lithic Phase 5 come from the thick deposits (± 0.6m) overlying F20, where no surface, floor, hearth or other feature was identified.[389] Among the 48 artefacts recovered from these

[389] Toufexis – Batzelas, this volume, 123.

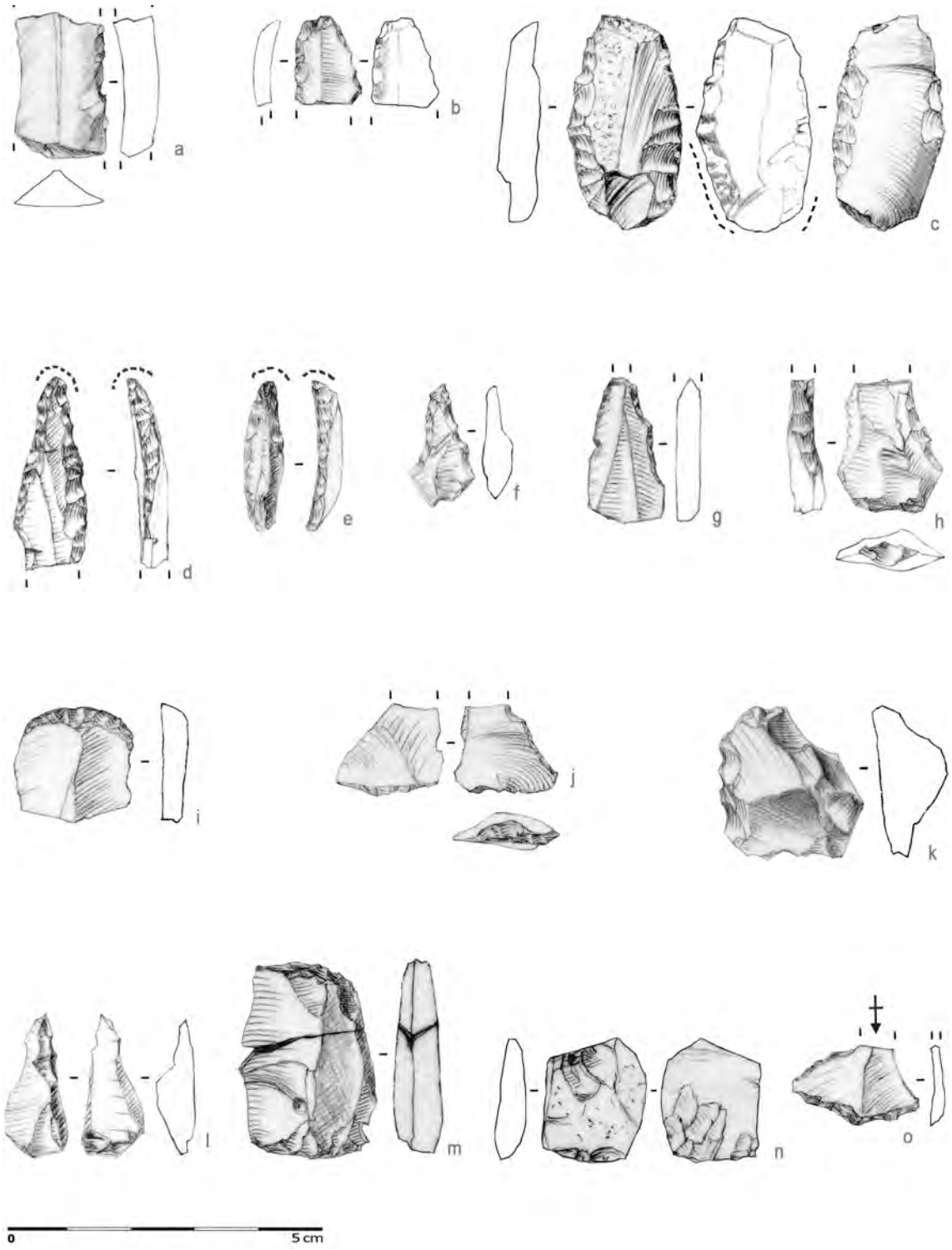


Fig. V.1.16 Lithic Phase 5. a–c: sickle inserts, d–f: beaks/borers, g–i: laterally retouched bladelet and blade, h: end-scraper, i: retouched flake, j: reflaked retouched flake, k–m: splintered pieces and fragment of splintered piece, m: splintered piece, n: bitruncated triangle. All in R/CC. a: PM0342, b: PM0351, c: PM0441, d: PM0366, e: PM0334, f: PM0399, g: PM0358, h: PM0338, i: PM0364, j: PM0421, k: PM0346, l: PM0337, m: PM0404, n: PM0386 (C. Perlès, drawings: M. Ballinger)

deposits, which unfortunately include several diagnostic pieces such as pressure-flaked bladelets and perforating tools, at least ten show thermal alteration. Since no hearth was found in these deposits, this proves beyond any doubt that they were redeposited from other contexts. While the absence of retouched perforating tools in the earlier assemblages suggests that these tools mostly date to the Late Neolithic, the presence of artefacts reworked from earlier contexts cannot be excluded.

*PMZ Lithic Phase 5 and Early Late Neolithic Lithic Assemblages*

Late Neolithic flaked stone assemblages, and especially early Late Neolithic assemblages in Greece are known only by a restricted number of collections and present few idiosyncratic characteristics. One of them is a rather radical transformation in the preparation of the obsidian cores for the detachment of pressure-flaked obsidian bladelets through facetted platforms,[390] resulting in large, flat, triangular or facetted butts without suppression of the overhangs. However, the only obsidian bladelet from the Lithic Phase 5 assemblage (PM0339, Fig. V.1.13t) presents all the characteristics of a Middle Neolithic mode of preparation: a linear butt with abrasion of the overhang. It was found in the deposits overlying Surface F20, where artefacts were redeposited, possibly from earlier contexts (see above).

A second important characteristic of early Late Neolithic assemblages is the appearance of barbed and tanged arrowheads.[391] None was found at PMZ, but our sample is small and they are absent from other early Neolithic assemblages such as Drakaina Cave, where a very characteristic type of asymmetrical points prevails,[392] and from the earliest Late Neolithic levels at Franchthi (Phase III), again a very small assemblage.

In the absence of these two major features of early Late Neolithic assemblages, the most significant elements of Lithic Phase 5 are the three perforating tools ('*mèches*') and the semicircular end-scraper on a flat blade. Given the very small number of retouched pieces (13 plus 3 splintered blades) their presence can be considered a significant shift in the composition of the toolkit, and they all fit well within early Late Neolithic assemblages. A reorientation in the activities using stone tools is also reflected by a higher representation of plant and woodworking. Interestingly this concerned unretouched bladelets, often thought to be the best-fitted tools for butchery. Yet, they were used for entirely different tasks, and butchery activities have still not been identified at PMZ.

A last element that is usually characteristic of Late Neolithic assemblages is a rise in the proportion of obsidian. This is clearly not the case at PMZ. On the contrary, there may even be doubts that any obsidian reached PMZ during Lithic Phase 5. This is all the more paradoxical given that, at precisely that time, PMZ was the centre of active trade in pottery.[393] Obviously, pots were not traded against obsidian: these trading networks were entirely independent.

## V.1.8. Discussion

The main objective of our work was to investigate diachronic change in the strategies of raw material procurement, tool production and tool use during the Middle Neolithic and the Middle to Late Neolithic transition. In this respect, we considered it important to integrate techno-typological and functional analyses, and document not only transformations in the conception of the tools but also the tasks they fulfilled and the way they were used.[394] This integration has indeed proved

[390] Perlès 2004.
[391] See, e.g., Perlès 1981; Perlès 1994b.
[392] Stratouli – Metaxas 2009.
[393] Pentedeka 2011; Pentedeka 2012; Pentedeka 2017b.
[394] We were especially hopeful that we would find contrasts in tool use between the Middle and the Late Neolithic. Unfortunately, the sample to be analysed was chosen at the beginning of our studies, using the only chronological framework available, based on Demoule et al. 1988. It turned out that half of the artefacts that were thought to be Late Neolithic belonged to our Lithic Phase 4, of Middle Neolithic character, thus limiting the possible comparisons.

very fruitful in improving our understanding of the characteristics of the material and the nature of the activities at or near the settlement, and did bring to light diachronic change. In many respects, however, continuity prevailed over change. Throughout the sequence, access to raw materials appears to have been limited, even though PMZ appeared a priori ideally located vis-à-vis recognised lithic trade networks. Even if the proportions vary, the range of raw materials remains stable. Similarly, and perhaps related to the scarcity of raw materials, flakes always predominate over blades and systematically comprise production with a hard hammer. In all phases also, they coexist with blades and bladelets produced by indirect percussion or by pressure. This suggests different levels of expertise among the knappers and a complex, but stable, organisation of production. Finally, from Lithic Phase 1 to Lithic Phase 4, the flaked stone assemblages reveal indisputable similarities in the techniques of production, tool types and dominant activities represented.

Set against this common background, several transformations have nevertheless been documented. Five lithic phases have thus been recognised on the basis of variation in the proportions of raw materials, flakes and blades, retouched and unretouched blanks, tool types and main activities represented. However, the differences from phase to phase are more often of a quantitative than a qualitative order. Considering the relatively small surface excavated and the small size of the lithic samples, this raises the possibility of random spatial variation. Fortunately, some long-term trends, perceptible in raw material exploitation, tool types and activities represented, support the archaeological validity of the sequence we have defined and underline the specificities of the PMZ assemblages in the Thessalian context.

*Continuity in Raw Material Procurement and Exchange Networks*

The absence of suitable raw material in the vicinity of the settlement necessarily entailed reliance on regional and supra-regional sources. The inhabitants of PMZ mostly used regionally available radiolarites and 'chocolate cherts' from the Pindos Range, which predominate throughout the sequence. In this respect, PMZ belongs to Karimali's western Thessalian geographical sphere,[395] where the use of R/CC predominates over obsidian, together with Achilleion or Prodromos for instance.

However, in all phases also, the proportion of cortical products (ca. 10%) is lower than at Achilleion, where R/CC were locally available. The proportion rather aligns with the proportions observed in eastern Thessalian sites, far from the sources, and where radiolarites and chocolate cherts were obtained by trade. This suggests that there was little direct procurement at the sources – whether primary or secondary – and that most of the radiolarites/chocolate cherts were obtained through exchange as already prepared cores and blanks, like in the eastern geographical sphere. The relative proportion of R/CC at PMZ is admittedly much higher than in eastern Thessalian sites, but this does not necessarily imply that more R/CC cores or blanks reached PMZ. Indeed, obsidian is conspicuously scarce at PMZ, thus automatically inflating the relative proportion of R/CC.[396] The very low ratio of flaked stones per $m^3$ and the altogether small size of the Neolithic assemblage rather suggest that only limited quantities of R/CC were available to the inhabitants of PMZ.

The relative and absolute scarcity of obsidian in all Middle Neolithic phases, and even more so in the Tsangli-Larissa Lithic Phase 5, is a second – and striking – element of continuity. The marginal position of PMZ in obsidian trade networks was not a brief or anecdotal phenomenon, but a long-term feature that became even more pronounced in the early Late Neolithic. The proportion of obsidian varies from 3.5 to 22%, but it is systematically lower than at Sesklo, Magoula

[395] Karimali 2009.

[396] For problems in estimating the abundance of a given raw material, see Karimali 2000; Perlès 2004; Perlès 2007; Karimali 2009.

Karamourlar or even Achilleion,[397] and closer to the figures from sites located even further away from the coasts, such as Prodromos, Magoulitsa and Theopetra. The small quantity of obsidian, especially in Lithic Phase 5, when PMZ was exporting wares over large areas, demonstrates that lithic and pottery trade networks were completely independent. In turn, this independence accords with the hypothesis of itinerant knapping specialists dealing only with the production of obsidian tools.[398]

The paucity of obsidian may appear strange: according to Karimali's model, PMZ would be located right on a presumed axis of diffusion of obsidian from east to west.[399] However, since Karimali's model was published, two Middle Neolithic sites located in the southernmost part of the Western Thessalian Plain, Magoula Koutroulou and Magoula Imvrou Pigadi, revealed lithic collections dominated by obsidian. Obsidian reaches 58% at Magoula Koutroulou,[400] located some 40km from the Gulf of Lamia as the crow flies. The contrast between PMZ and Magoula Koutroulou, and to a lesser extent with Achilleion, actually suggests that instead of a single east-west network of diffusion, there were two distinct obsidian networks, one from the Gulf of Lamia to western Thessaly and one from the Gulf of Volos to eastern Thessaly. Rather than being in a 'central' position, PMZ would thus have been in a marginal position vis-a-vis both networks.

This marginality, however, cannot be understood solely in terms of geographic distances, as already underlined by Karimali.[401] Admittedly, the nearest shore for PMZ would be the Gulf of Volos, at about 70km as a crow flies, i.e. further inland than Magoula Koutroulou and Achilleion if they were indeed provisioned from the Gulf of Lamia. This distance is, nevertheless, comparable to the distance from Otzaki and Ag. Sophia to the Gulf of Volos (ca. 60km), two sites where the proportion of obsidian reaches 69% and 86%.[402] Equally significant is the fact that obsidian appears to be more abundant at Magoula Koutroulou than at nearby Achilleion, even though the two sites are located at the same distance from the Gulf of Lamia. Rather than to a straightforward geographic factor, the paucity of obsidian at PMZ must also be attributed to social factors. Insights on this question can be gained through Karimali's study of the production of threshing sledges in Thessaly. She showed that several production systems and overlapping distribution networks operated simultaneously, and that the 'distance' between producers and consumers was primarily a distance in kinship and sociocultural ties: "The fact that human relationships are deeply entrenched on the degree of 'familiarity' developed among human groups assigns a new content to the concept of 'distance', with effective analogies to the Neolithic".[403]

Trade in honey chert blades could not compensate for the scarcity of obsidian. This third exchange network for provisioning lithic raw materials, or rather flaked blanks, also appears to have been stable over time. Honey chert blades were recovered in each phase, and in good enough contexts to eliminate the hypothesis of redeposited older material.[404] These blades are rare at PMZ, but so are they at every Thessalian site. Their overall proportion at PMZ is about 3% of all flaked stones,[405] but about 15% of the regular blades. It compares well with the percentage of 'light-

397 The figure of 14.4% for Achilleion (Karimali 2009, tab. 1) is an average for the whole Neolithic sequence. If only Phases III and IV are considered, i.e. the Early Neolithic/Middle Neolithic and Middle Neolithic, the percentages are 27.1 and 28.6%, respectively (Elster 1989, tab. 10.1). Even when considering the whole assemblage, a rough estimation suggests that obsidian was six times more abundant per $m^3$ at Achilleion than at PMZ.

398 Perlès 1990.

399 Karimali 2009.

400 Hamilakis et al. 2017.

401 Karimali 2009.

402 Karimali 2000. C. P., who has studied both collections, would not exclude biases in recovery at Otzaki. Conversely, the large assemblage from Ag. Sophia appears reliable.

403 Karimali 2005, 53.

404 Below, Fig. V.1.18.

405 This proportion is misleading, since honey cherts were never flaked locally. Consequently, the percentage does not include flaking wastes, as it does with the other categories of raw material.

coloured cherts' in Middle Neolithic assemblages such as Magoula Karamourlar or Sesklo B.[406] For these blanks of excellent quality, PMZ was not at a disadvantage compared to contemporaneous settlements of the same region.[407] Their high value is demonstrated by technical and functional criteria. These tools, no matter what their function was, usually have two or three active zones, often used on different materials. In almost all cases, these versatile tools were extensively used before they were abandoned, a common pattern in Middle Neolithic assemblages.[408]

*Multiple Systems of Procurement and Production*

The difficulties in obtaining laminar blanks, or suitable raw materials for the production of blades, would explain two other unusual elements of continuity: the predominance of flakes over blades and bladelets, and the high proportion of retouched flakes. The proportion of flakes at PMZ is higher than at any other Thessalian site, including those where local raw materials were exploited such as Achilleion and Ag. Petros (Sporades).

The flakes belong to two distinct technological *chaînes opératoires*: the shaping of blade or bladelet cores, and the deliberate production of flakes on discoid cores. Whereas shaping flakes are present in all Thessalian assemblages, where they amount to about a third of the debitage products, the independent production of flakes is more rarely documented.[409] Its presence at PMZ in all phases accounts for the unusually high proportion of flakes and supports the hypothesis of persistent limitations in the supply of radiolarite and obsidian blades. Casually produced with a hard hammer, these flakes can be attributed to unskilled knappers[410] who needed to supplement their supply of laminar products.

The coexistence of these two categories of flakes raises the question of the organisation of production at PMZ. Indeed, even if 'trade networks' can be brought to light, this says little about the state of introduction of the raw materials, the degree of local transformation and the status of the knappers. These aspects are, unfortunately, difficult to apprehend with the assemblages from PMZ. It is probably not an exaggeration to state that each reducing sequence from PMZ is represented by one piece only, leading to indisputable frustration for the analyst… Some hypotheses can nevertheless be put forward.

We have seen that some of the R/CC flakes were produced locally by unskilled craftsmen. It is thus logical to think that they were inhabitants of the settlement, and to consider the production of flakes as a domestic production. Indeed, the absence of local raw materials would have had immediate consequences on the possibility of learning elaborate *chaînes opératoires*. Apprenticeship in lithic production requires years of practice and the consumption of large quantities of wasted raw material before one can fully master the production of blades by indirect percussion or pressure.[411] One can thus assume that local apprenticeship was essentially limited to the much easier production of flakes. However, even for this simple production, local craftsmen would have had to use pebbles that could not be found in the immediate vicinity of the site. Direct procurement further upstream the Peneios and the Portaikos would have required a two-day trip across the Karditsa Plain. This can be envisioned, at least occasionally. However, as we argued, we would have expected larger quantities of raw material, better qualities and a higher proportion of cortical flakes if this had been systematically the case. It is thus possible that even the river pebbles, already partially decorticated, were obtained by exchange with communities nearer to the secondary sources.

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406 Moundrea-Agrafioti 1981, tab. 1.

407 Although precise comparisons are difficult, it would seem that honey chert is much more abundant in the Middle Neolithic at Franchthi, for instance: Perlès 2004.

408 Perlès – Vaughan 1983.

409 Moundrea-Agrafioti 1981, 101. It is absent at Sesklo B and Magoula Karamourlar, but present on local raw materials at Ag. Petros.

410 But not to beginners, as discussed 209.

411 Olausson 2008; Klaric 2018.

In addition, we know that during the Early and Middle Neolithic in central and southern Greece, obsidian blades and bladelets were also usually produced in situ, but by itinerant specialists who perfectly mastered pressure flaking. They brought with them already prepared cores, often already partially exploited, and produced the required blades and bladelets in the villages.[412] The very small number of obsidian artefacts at PMZ, the absence of cortical pieces, the presence of small rejuvenation flakes and pressure-flaked bladelets support this general model. Finally, we know that, conversely, all over Greece during the Early and Middle Neolithic honey chert blades were produced at the sources and traded as finished blanks. Here again, with no indication of local production, PMZ fits the usual pattern.

We can therefore already document three different modes of procurement of the tools: a domestic production, an in situ production of obsidian bladelets by itinerant specialists, and trade in finished honey chert blanks produced at or near the sources.

The situation is more ambiguous for the blades and bladelets in R/CC and translucent cherts. We found repeated indications of a local production for at least some of the laminar products: flakes produced by indirect percussion, crested blades, and a pressure-flaked microcore. The importation of high-quality blocks of raw materials to be worked *in situ* can again be ruled out, given the low proportion of cortical pieces. There remains i) the possibility that local experts obtained already prepared cores from communities living nearer to the sources and produced the blades and bladelets at the site; or ii) that itinerant specialists, similar to those procuring the obsidian, came and flaked upon request at the settlement. Both alternatives have been documented in Neolithic lithic production systems.[413] However, as argued above, it would have been difficult to train for blade production in a settlement devoid of local raw materials. Production by itinerant specialists thus appears more plausible, but does not preclude trade in finished blanks to supplement this in situ production, as for honey chert blades.

The PMZ data thus points towards multiple modalities of procurement and production of the flaked stone tools, a situation that is actually the rule in central and southern Greece, where local resources, obsidian and honey chert blades were always used simultaneously, but for different purposes. Comparable configurations are also known in historical times. Karimali's study of the production of threshing sledges provides an example for the coexistence of multiple systems of procurement and production: some threshing sledge specialists produced the sledges at the villages upon request, using wood and stone they had collected on the way or locally. Others, by contrast, manufactured the complete sledges at home, in the mountains, and came down seasonally to the plain to trade finished products.[414] Eventually, when needed, the villagers could also manufacture their threshing sledges themselves.

### *Continuity in Tool Conception and Use*

Some of the most characteristic tool types are remarkably similar from one lithic phase to another (Fig. V.1.17). This is not unexpected considering the relatively short duration of the Neolithic sequence and the homogeneity documented in the pottery sequence.[415] As discussed earlier, there is, however, the risk for both categories of remains that this homogeneity was created, or minimally reinforced, by the regular reworking of older remains and their incorporation into later assemblages. We can indeed show that some at least of the artefacts found in the 'destruction deposits' between two identified surfaces were redeposited,[416] and cannot eliminate the possibility that they originally came from earlier contexts. Ideally, the analyses ought to be based primarily on the material recovered on recognised 'surfaces'.

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412 Perlès 1990.
413 E.g. Perlès 1990; Léa 2005; Gassin et al. 2010.
414 Karimali 2005.
415 Demoule et al. 1988; Pentedeka in press; Pentedeka in preparation.
416 In particular by the presence of burnt pieces in deposits where no thermal structures were uncovered.

Unfortunately, the flaked stone material directly associated with the more securely stratified contexts, surfaces, floors, pits or hearths, is a small minority: less than one fifth of the total. It also contains extremely few formal tool types. None of the characteristic Middle Neolithic end-scrapers, for instance, comes from such contexts. Only three elements of typological continuity can be demonstrated through the recognised 'surfaces': the presence of sickle blades with bilateral continuous steep retouch from Lithic Phase 1 to Lithic Phase 4, the presence of sickle inserts on flakes in Phases 1 and 2, and the presence of the trapezes and transverse arrowheads in Phases 3 and 4 (Fig. V.1.18). Despite their small number, these examples indicate that the typological continuity is not solely due to the reworking and redeposition of material.

When, perforce, one considers all the material from each lithic phase, other diachronic continuities can be brought to light. Interestingly, several of them appear specific to PMZ: i) the high proportion of sickle inserts on flakes, especially in Lithic Phases 1–3; ii) among the sickle inserts on flakes, the good representation of a distinct subtype on thick-backed flakes; iii) the frequent shaping of the sickle inserts with an 'end-scraper' front; iv) the large, wide-fronted end-scrapers (Fig. V.1.17).

Continuity throughout most of the sequence is also exemplified in the activities identified through use-wear analyses, their relative intensity and in the activities absent from the sample. The dominant category of tools in particular, the sickle inserts, appear to have been used in a similar way from Lithic Phase 1 to Lithic Phase 5. They present typical traces of cereal harvest, such as a well-developed undulating polish and thin striations parallel to the edge. A few of them also show traces of abrasive elements, implying that they came into contact with the soil; they may have been inserted at the tip of the sickle during the harvest, or re-used after the harvest, for instance for cutting the stems near the ground in a dry or semi-dry state, since the stems can be used as fodder or in mudbricks.[417] Throughout the sequence, the sickles appear to have been used with a low cut on dry or semi-dry cereals. This would be expected for domesticated cereals, since they lost their brittle rachis and their seeds ripen at the same time, making harvest in a ripe state more profitable.[418]

The best-represented activity after the harvest is hide working, both on fresh hide and dry hide/leather. Almost all of the tools that show traces of hide working in the different phases performed a transverse movement; only one was used in a rotary motion. Interestingly, only a few typical end-scrapers were found at the site, and they do not show signs of exhaustion. Most of the tools that worked hide were simple flakes or blades, with or without retouch. More precisely, most of these tools were retouched in the earlier lithic phases, whereas even unretouched blades performed a transverse action on hide in Lithic Phase 5. In addition, several of these tools were also used for other tasks. This absence of specialisation is quite striking, and suggests that hide working was not particularly important. The sample analysed probably corresponds to a small-scale activity rather than to a specialised toolkit for leather production.

Finally, a few tools in the analysed sample worked plant materials other than cereals. Two or three tools worked on soft plants, and show the typical plant polish and striations perpendicular or oblique to the edge that imply a transverse action. Tools that worked on hard or semi-hard plant matter, like wood, performed different motions: transverse, bidirectional longitudinal and rotary. This variety reflects different procedures for transforming wood. As we concluded earlier regarding hide working, woodworking was also a small-scale activity: the number of tools involved is small and there is no consistency in the assemblage. Noteworthy is the complete absence in the sample of tools used to butcher carcasses, cut meat, manufacture bone tools or scrape pottery. According to the sample studied by functional approaches, technical activities involving flaked stone tools always remained marginal, except for the exploitation of cereals, and never required a specialised toolkit.

[417] Perlès – Vaughan 1983; Clemente – Gibaja 1998; Ibáñez Estevez et al. 2008.
[418] Unger-Hamilton 1999; Ibáñez Estevez et al. 2014.

Fig. V.1.17 Typological continuity through Lithic Phases 1–4. LP Lithic Phase. BPh/BSPh Building Phase/Building Subphase. a–d: bilaterally used and retouched sickle inserts on blades, e–f: retouched honey chert blades, g–h: sickle inserts on backed flakes, i–k: sickle inserts on blades shaped with an 'end-scraper' front, l–n: end-scrapers on large blades, o–p: transverse arrowheads (C. Perlès)

*Random Quantitative Variation?*

Despite many elements of continuity in the PMZ assemblages, statistically significant variation in the proportion of raw materials, blanks and tools have also been brought to light.

Short-term quantitative variations in raw material proportions are probably structurally inevitable when a large proportion of the raw materials and blanks are obtained through exchange. They were exemplified in the few sequences published in detail, such as Achilleion or Franchthi. In turn, the variation in traded raw materials and blanks could entail variation in the ratio of flakes to blades and bladelets, and possibly in the ratio of retouched tools. If this was the case, the lithic phases from PMZ that differ only by quantitative differences, such as Lithic Phases 1 and 2 on the one hand, and Lithic Phases 3 and 4 on the other, may simply reflect the hazards of provisioning at PMZ, rather than regional diachronic trends. A more conservative approach would thus consist in relying mostly on qualitative differences, i.e. techniques of production and tool types. This would reduce the number of lithic phases to three: Lithic Phases 1 and 2, Phases 3 and 4, and Phase 5. To a certain extent, this tripartite scheme echoes the original division of the sequence into a 'Sesklo', a 'Zarko' and a 'Tsangli-Larissa' phase,[419] but the limits do not correspond: the 'Zarko phase', as it was defined, would encompass Lithic Phases 2 to 4.

Even with this reduced framework, it is, however, difficult, for reasons already explained, to assess the archaeological validity of these phases. Even when in situ production is attested, the *chaînes opératoires* are very incomplete: the flakes corresponding to the cores, or, conversely, the cores corresponding to the flakes are missing from our samples. This inevitably raises the question of the representativity of our samples. The small size of the excavation relative to the size of the settlement and the very low density of stone tools render random spatial variation almost inevitable. Fortunately, some long-term trends suggest that, beyond random variation, a diachronic structure is really present.

*Long-Term Trends*

Several long-term trends in the flaked stone assemblages support the hypothesis of diachronic changes unrelated to sampling hazards. Although this cannot be quantified, the quality of the raw materials and presence of fresh cortex suggests increasing use over time of R/CC and light-coloured cherts procured at or near the primary sources. This trend can be related to an increasing proportion of large bladelets and blades produced by indirect percussion or pressure flaking, which required high quality, homogeneous raw materials.

A second trend relates to the regular decrease, among the retouched tools, in sickle inserts. In Lithic Phase 1, sickle inserts predominate in the retouched toolkit, in proportions above those known in other settlements. In Lithic Phase 4, they represent only 1/5$^{th}$ of the tools, and even less in Lithic Phase 5, i.e. less than in any other published assemblage.

Parallel to this trend is a decrease in sickle inserts made on flakes. While they predominated in Lithic Phase 1, their proportion gradually diminishes. They have disappeared by Lithic Phase 4, with the exception of one unusual specimen in Lithic Phase 5. Since the production of flakes was considered local and domestic, whereas honey chert blades were imported as finished blanks, as well, most probably, as the best R/CC blades, this implies a shift from a partially domestic production of sickle inserts towards a stronger reliance on traded blanks.

This shift may be related to a change in the conception of the sickles themselves. According to the distribution of the polish, the small inserts on flakes or short blades from Lithic Phases 1–3 would have been inserted obliquely into the haft to create a denticulated edge, like the Karanovo sickles.[420] Among the flakes, the thick-backed ones may have required a different haft than the thinner ones, but they, too, were inserted obliquely. The mode of insertion of the fewer long blades

[419] Demoule et al. 1988.
[420] Gurova 2005.

Fig. V.1.18 Retouched tools directly associated with identified 'surfaces' ('floors'). a: PM0838, b: PM0833, c: PM0764, d: PM0723, e: PM0845, f: PM0836, g: PM0686, h: PM0652, i: PM0575, j: PM0502, k: PM0476, l: PM0497, m: PM0495, n: PM0498, o: PM0503, p: PM0506, q: PM0441 (C. Perlès)

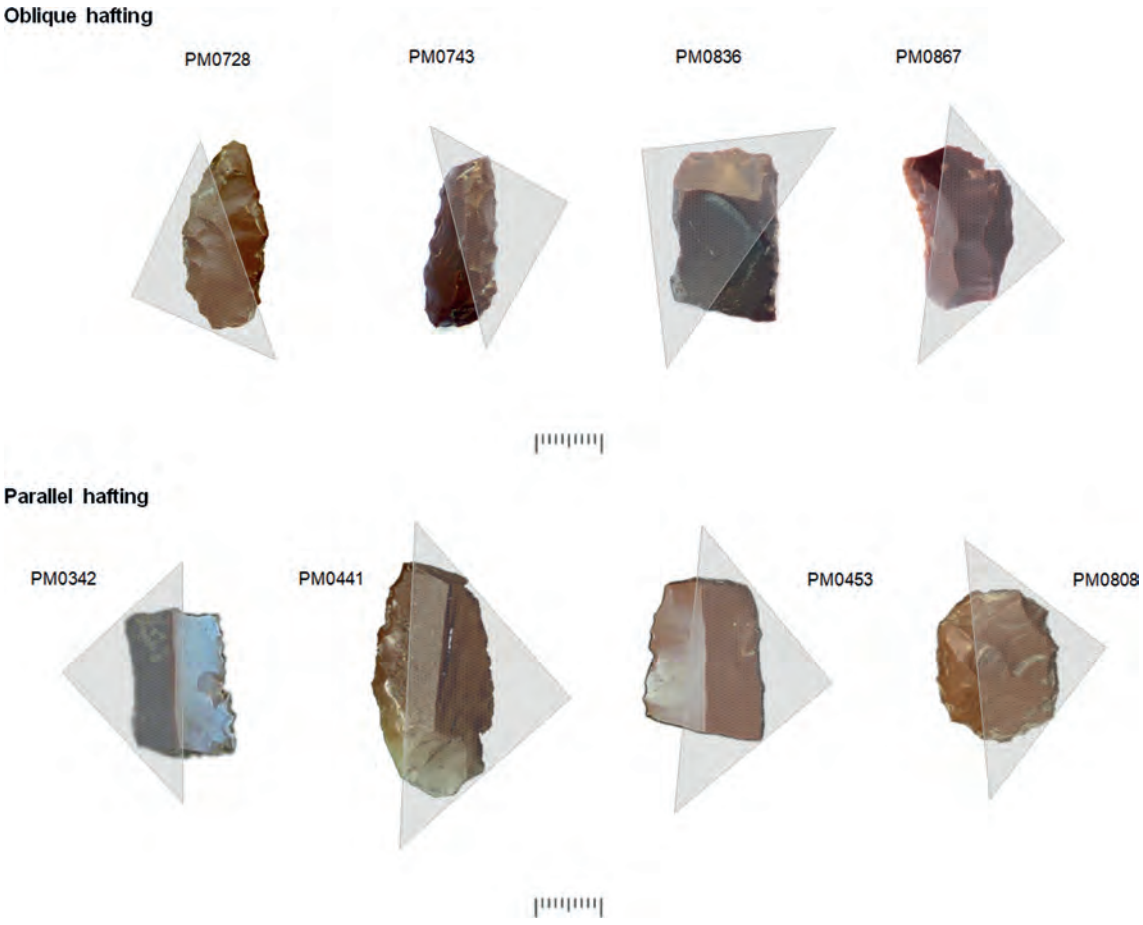



Fig. V.1.19 Oblique and parallel hafting of sickle inserts. The models represent the two modes of hafting for sickle elements. The visible part of the tool represents the active zone, whereas the part hidden behind the dotted triangle represents the hafted edge (L. Papagiannaki)

from these phases remains uncertain, but their bilateral use and the absence of backing suggest a different mode of hafting, possibly similar to the hafting found in the later phases. Indeed, in Lithic Phases 4 and 5, sickle inserts are mainly made on large blades, inserted parallel to or only slightly obliquely into the haft (Fig. V.1.19). They may belong to bigger sickles, still curved but with a straight working edge, as known in the Near East since the 8th millennium.[421] Different types of sickles would thus have been used at the beginning of the Middle Neolithic, with a predominance of denticulated sickles. The latter would have progressively disappeared in favour of the second type, with a straight working edge. Fewer inserts are required with this second type, possibly explaining why the number of sickle inserts diminishes regularly throughout the sequence. However, why sickle blades should become proportionally scarcer in PMZ by the end of the Middle Neolithic than in any other Thessalian site remains unexplained.

A last trend, directly related to the two preceding ones, is a slight diversification of the toolkit. Most notable is the introduction in Lithic Phase 3 of the first geometrics and transverse arrowheads. These artefacts were not studied microscopically, but suggest hunting or warfare activities. New tool types also appear in Lithic Phase 5, in particular borers and splintered pieces, whose quasi-absence in the earlier levels was particularly striking.

[421] Borrell – Molist 2007.

This typological trend towards diversification finds echoes in the activities identified. Lithic Phases 1–3 are dominated by harvesting tools, whereas other activities are essentially marginal. Although very small, the sample from Lithic Phase 4[422] would suggest more diversified activities: we identified four sickle inserts, two of which possibly bear traces of secondary activities, and three tools used on other materials (hide, wood and mineral). Lithic Phase 5 shows, finally, a more balanced and diversified toolkit. The three activities detected (cereal harvest, hide and plant working) are equally represented. The sample of nine used implements comprised three sickle inserts, two tools that worked both hide and wood, one that worked only hide, one that worked only wood, and a last one that was used on soft matter of vegetal or animal origin. Precisely because the sample is very small, this diversification appears significant, and implies either more varied activities or a change in the use of space during the Middle Neolithic/Late Neolithic transition.

*Discontinuities: The Question of the Middle to Late Neolithic Transition*

Investigating the nature of the Middle Neolithic/Late Neolithic transition from the flaked stone viewpoint was one of the major aims of our study. We wished in particular to establish whether the transition was gradual, or whether a break in technical traditions could be perceived.

The answer to this question raises a methodological problem: it depends indeed on which chronological framework is used as a reference. It will be recalled that in the original publication[423] the levels now defined as BPh I–V were related to the Thessalian 'Sesklo' and those from BPh VI to BSPh VIIb to a late Middle Neolithic phase termed the 'Zarko phase'. The transition between the Zarko phase and the Late Neolithic (Tsangli-Larissa) was set at ca. 5.10m, approximately at the limit between present-day BSPh VIIb and BSPh VIIc. The Tsangli-Larissa phase at PMZ, as originally defined, therefore encompassed BPh/BSPh VIIc, VIII and IX.

From a lithic point of view, however, BSPh VIIc cannot be attributed to the Late Neolithic. Our study revealed a strong technological and typological similarity between the material from BSPh VIIb and VIIc, which we grouped as Lithic Phase 4. Both, in addition, present a definite 'Middle Neolithic' character and were clearly related to the earlier Middle Neolithic phases. A significant change in the composition of the flaked stone assemblages only occurred with BPh VIII (Lithic Phase 5).[424] This last phase revealed discontinuities in all aspects of the assemblage: the quasi-disappearance of obsidian in the raw materials, a marked increase in the proportion of bladelets, new techniques for the production of pressure-flaked blades, new tool types and the absence of the most emblematic Middle Neolithic tool types. $^{14}$C dates do not clarify this apparent discrepancy: BSPh VIIb was dated to the Middle Neolithic in the Thessalian absolute chronology, while the date of BSPh VIIc covers the late Middle Neolithic and early Late Neolithic.[425] Both schemes could thus be supported by the radiocarbon chronology.

However, the validity of this original scheme must be questioned. The renewed analyses of the pottery assemblages by Pentedeka led her to a different phasing: BSPh VIIb and VIIc both belong to Ceramic Phase 6, as do BPh VIII and IX. Ceramic Phase 6 is considered Late Neolithic, when BSPh VIIb and VIIc are clearly of Middle Neolithic character for the flaked stone assemblages. Ceramic Phase 5 and 6, respectively correspond to Lithic Phase 4 and 5. The phasing for these later Neolithic levels is thus the same for the flaked stones and the pottery, but whereas some Late Neolithic features are already present in the ceramic assemblage of BSPh VIIb and VIIc, the flaked stones remain of Middle Neolithic character. Our study revealed several other discrepancies between the lithic and ceramic phases, especially in the middle part of the sequence (see chronological chart chapter III). The massive difference in the quantity

422 The initial sample included four artefacts without wear traces.
423 Demoule et al. 1988.
424 There were no flaked stones in BPh IX.
425 Reingruber et al. 2017; but see n. 350.

of material available may explain some of these discrepancies, especially if the flaked stone material was too scarce to recognise subtle quantitative changes. However, during periods of continuous occupation of a settlement by the same community, there is no reason to expect concomitant variations in pottery and stone tools. The flaked stone assemblages vary according to the availability of different raw materials, to the technical traditions and know-how of the knappers, and to the tasks for which flaked stones are required. None of these variables would have any parallel in pottery production and decoration. As argued in a similar stratified context,[426] concomitant changes in lithics and ceramics should only be expected in the case of occupational hiatuses in the sequence, or the arrival of new inhabitants with different technical and cultural traditions.

If one therefore focuses on the flaked stone sequence, without reference to external frameworks, the transition between the earlier and latest Neolithic levels become sharper and the change more abrupt: Lithic Phases 1 to 4 present many aspects of continuity and a Middle Neolithic character, while Lithic Phase 5 shows significant changes in the raw materials, methods and composition of the toolkit, with tool types that can be considered typical of the Late Neolithic. The contrast is admittedly not as marked as it could have been if other typical early Late Neolithic elements had been present, such as Late Neolithic obsidian pressure-flaked blades and Late Neolithic barbed and tanged arrowheads, but it is, nevertheless, stronger than between each of the Middle Neolithic phases. According to this scheme, the transition between the Middle Neolithic and the Late Neolithic in the flaked stone assemblages would not seem 'gradual' but abrupt, and would occur later than in the pottery assemblages.[427] However, two observations lead us to nuance this view: as indicated above, the tendency towards a diversification of the toolkit and the activities represented is already perceptible in Lithic Phase 4, albeit more pronounced in Lithic Phase 5. Similarly, the predominance of sickles with a straight working edge appears already established during Lithic Phase 4. Lithic Phase 5 would therefore represent both the outcome of an internal dynamic anchored in the late Middle Neolithic, and the introduction of new techniques and tool types of exogenous origin.

### *The PMZ Flaked Stone Assemblages in the Thessalian Context*

Among the different factors of variability of the lithic toolkits that we invoked, availability in raw material and blanks for tools may well have been prevalent at PMZ. Lithic Phase 1, in particular, shows signs of a real scarcity of raw material/blanks: a very high ratio of retouched pieces, an unusual rate of flakes in the retouched toolkit, and an unusual degree of curation of the tools. Lithic Phase 2 essentially differs from Lithic Phase 1 in the proportion of the different raw materials, the frequency of blades and the frequency of retouched material. Besides potential random variation, all these changes could be related to slight modification in the procurement of cores and blanks. Most of the differences between the following Middle Neolithic phases also pertain to the proportion of raw materials and laminar products. Again, slight shifts in their respective availability could account for these variations. If this was the case, the Middle Neolithic diachronic sequence brought to light at PMZ would reflect the problems and opportunities of a community deprived of local raw materials, and living at the margins of lithic trade networks. It is the story of a given Thessalian community and how it dealt with its flaked stone tools, and there is no reason to expect that the story be repeated elsewhere in the same terms.

Nevertheless, this community was not isolated. It participated in several lithic trade networks, even if sometimes marginally, and thus benefitted from repeated contacts with trading partners and itinerant specialists. As a consequence, all the tool types found at PMZ are known from other sites, either in Thessaly or in southern Greece, with the exception of the bifacially worked

[426] Perlès 2004.

[427] Unless one assumes important contaminations in the pottery assemblages.

microfoliate point from Lithic Phase 1 (Fig. V.1.1q) and the sickle insert on flake from Lithic Phase 5 (Fig. V.1.14c), for which we know of no equivalent anywhere else. Yet, several tool types present at PMZ are conspicuously rare in the other published Thessalian assemblages. The bifacially worked transverse arrowheads (Lithic Phases 3 and 4), known in southern Greece, have no equivalent in published Middle Neolithic Thessalian assemblages.[428] The sickle blades shaped with an end-scraper front,[429] the trapezes[430] and truncated blades are rare or absent in most Thessalian series. The sickle inserts on thick-backed flakes are present in all published Thessalian assemblages, but at much lower frequencies than at PMZ.[431]

The good representation of these rare tool types at PMZ, together with the absence of others, such as splintered blades, sets it apart from the other settlements and contributes to reinforce the impression of a marked idiosyncratic continuity, especially in the Middle Neolithic. The interplay between raw material availability, the activities performed at PMZ and the tool types that were chosen to perform these technical tasks gives a strong and distinct personality to the PMZ flaked stone tool assemblages, and shows that much remains to be learnt about Thessalian lithic assemblages.

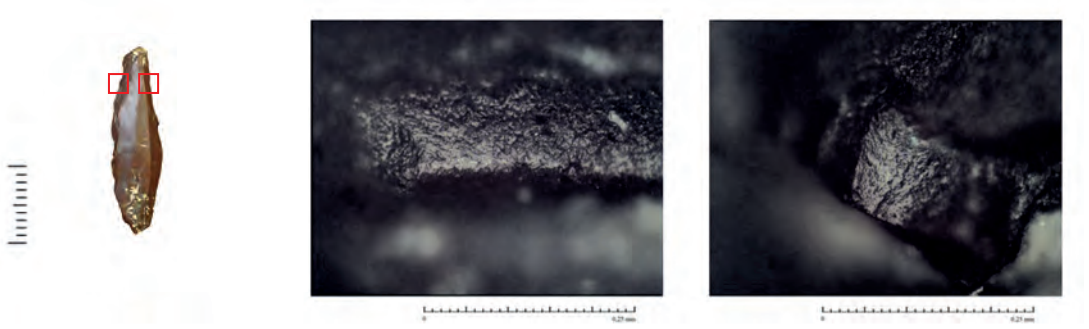
[428] They exist in small numbers in surface collections.
[429] 3% of the sickle inserts in the Thessalian sites studied by Moundrea-Agrafioti (1981, 117).
[430] None is published from Thessaly proper. Two were found at Ag. Petros in the Sporades: Moundrea-Agrafioti 1981, 155.
[431] See above, 222.

## V.1. Appendix 1: Table of Wear Traces

*Lygeri Papagiannaki – Sylvie Beyries*

*PM0334:* Rotary motion possibly on two materials, wood and hide

The point is the active zone, which is heavily rounded; rounding discontinuous and in some places flattened. A discontinuous but invasive polish was detected, with tight to open linkage, irregular and undulating-irregular microtopography, limited on the higher spots. Striations are rare, short and thin, some perpendicular to the edge, others parallel to it. Traces pointing to semi-hard or hard materials. The characteristics of the polish imply that two materials might have been worked, wood and hide.

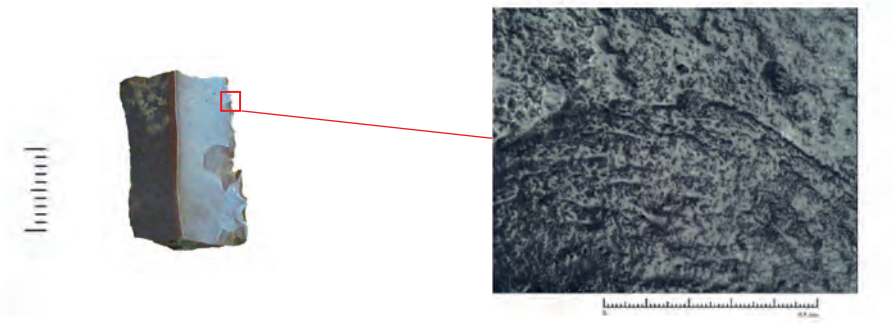


*PM0338:* Transverse action on hide

The shaped front of this end-scraper is the active zone. It shows a poorly developed (or even non-existent) rounding, and some microflakes of use, mostly perpendicular to the edge. Discontinuous and marginal polish, with a semi-tight to open linkage and irregular microtopography limited to the high spots, suggesting working with a high angle. Few striations perpendicular to the edge, thin and superficial. Traces poorly developed, pointing to short-term activity.

*PM0342:* Sickle element

The right edge was the active zone. Characterised by a well-developed though discontinuous (due to microflakes) rounding, equally developed over both faces. Important microchipping: medium or large-sized microflakes, usually oblique with two directions. Continuous and invasive polish, bright, with a compact to open linkage and undulating microtopography and many striations parallel to the edge, some of them filled-in. Sickle element hafted parallel or very slightly oblique, according to the distribution of the polish (see Fig. V.1.19).



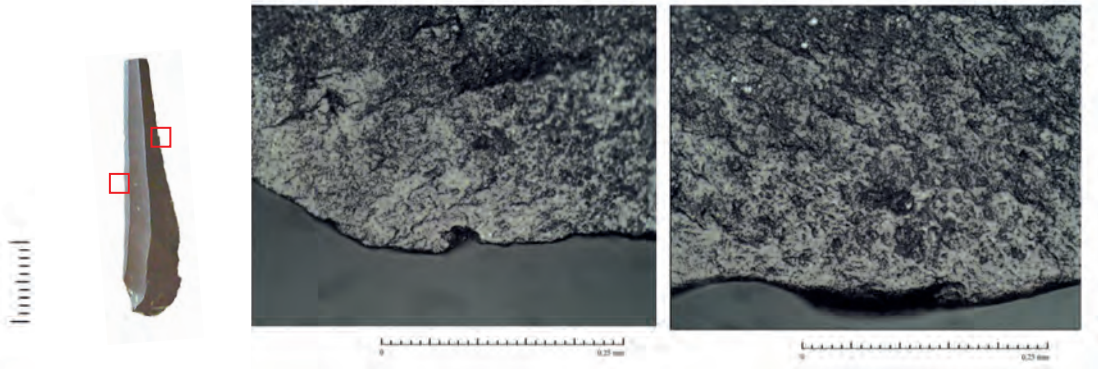
*PM0366:* Rotary motion on hard vegetal matter (dry wood)

The point was the active edge. Well-developed rounding, continuous and flattened on several spots, implying use on a hard material. The aligned microflakes, with feather or step termination, confirm this observation. Discontinuous and marginal polish, bright, with tight to open linkage and undulating or undulating-irregular microtopography, as well as rare striations, some parallel and others perpendicular to the point.

*PM0385:* Left edge: longitudinal action on soft or semi-hard vegetal material (wood)

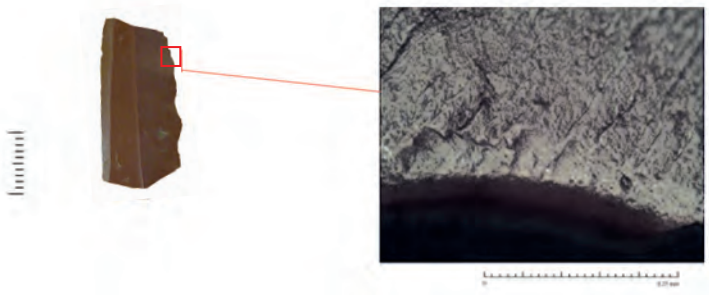
Right edge: transverse action on soft animal matter (fresh hide)

Two active zones identified, the left and the right edge. Poorly developed but continuous rounding on the left edge, equally developed over both faces; continuous but marginal polish, bright, with tight to open linkage and irregular or sometimes domed (spots near the edge) microtopography and striations parallel to the edge, as well as some perpendicular ones, thin and superficial. The right edge also has a poorly developed rounding, sometimes equally developed over both faces; a discontinuous and marginal polish, with tight to open linkage and irregular or irregular-undulating microtopography, and many striations, short, thin and superficial, perpendicular to the edge. Characteristics of the polish similar on both faces, which is expected for these two materials, soft wood and fresh hide. The working motion, however, was clearly differentiated.



*PM0391:* Transverse action on soft animal matter (dry hide)

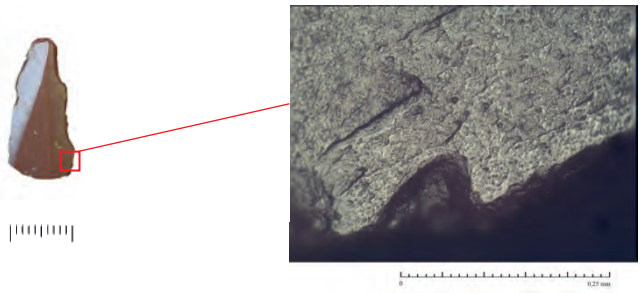
The right edge is the active zone. It bears no rounding/edge blunting but a discontinuous and marginal polish, bright, with tight or semi-tight linkage and irregular microtopography. Striations rare, short, thin and superficial, perpendicular to the edge.



*PM0397:* Without use-wear traces

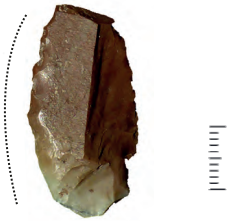
*PM0399:* Transverse action on a soft matter (of animal or vegetal origin)

The proximal edge and proximal part of the right edge were used. Medium to well-developed rounding, sometimes more developed over the dorsal face and flattened on some spots; marginal polish, with compact to open linkage and a microtopography ranging from undulating to irregular. Few striations, short and perpendicular to the edge.



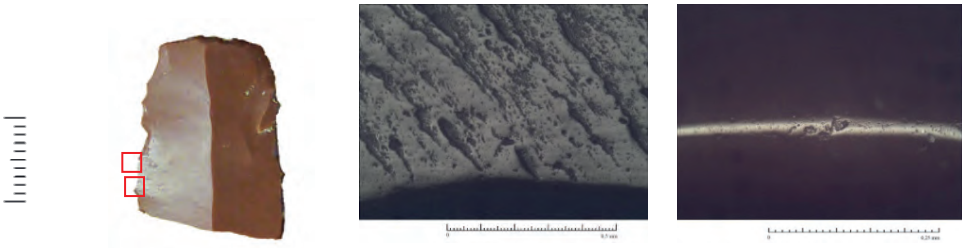
*PM0441:* Sickle element

Left edge used to harvest cereals. Medium and well-developed rounding, continuous and equally developed over both faces. A mostly continuous and invasive polish, bright, with compact to tight linkage and undulating microtopography, and many striations, parallel to the edge, some filled-in. According to N. Mazzucco (personal communication), both edges of the tool were afterwards used to work another material. Polish distribution indicates parallel or slightly oblique hafting (see Fig. V.1.19).



*PM0453:* Sickle element

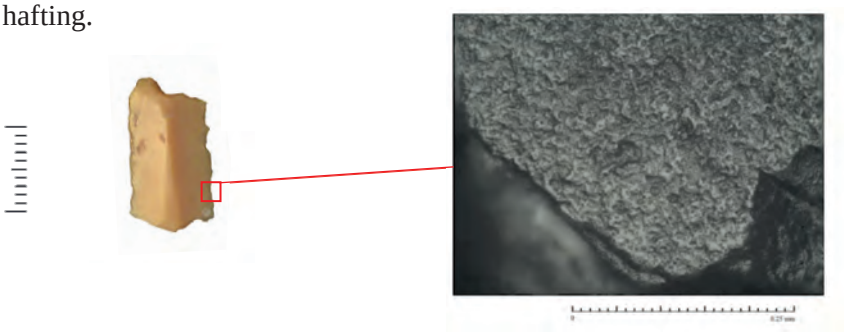
The left edge constitutes the active zone. It bears a discontinuous and medium-developed rounding, equally developed over both faces; a continuous polish, invasive on the proximal part but marginal on the distal one, bright, with compact to open linkage and undulating microtopography; many striations on the ventral face, thin and large ones, parallel to the edge, as well as filled-in and comet-shaped striations. Distribution of the polish indicating a parallel or slightly oblique hafting (see Fig. V.1.19).



*PM0469:* Without use-wear traces

*PM0489:* Bidirectional longitudinal action on wood

The right edge is the active zone. It bears a poorly developed and discontinuous rounding, equally developed over both faces, small microflakes oblique to the edge and a poorly developed and discontinuous crushing of the edge. Polish discontinuous and marginal, with tight to open linkage and undulating microtopography, limited to the higher spots. Striations rare and short, parallel or oblique to the edge. The left edge shows well-developed though discontinuous rounding along with residues on both faces, present even far from the edge on the dorsal face, probably related to hafting.



*PM0490:* Without interpretation

Discontinuous polish, poorly developed, with tight to open linkage and irregular or undulating-irregular microtopography. A few striations, some parallel and others perpendicular to the edge, might also be present.

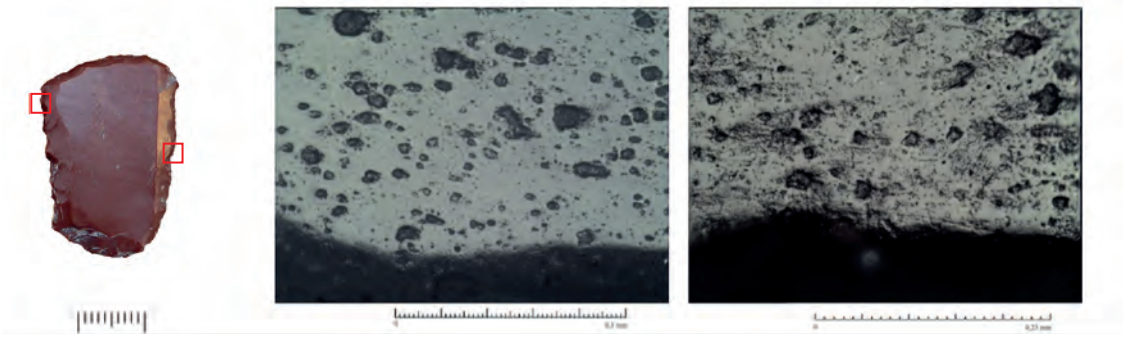
*PM0495:* Exhausted sickle element

The right edge constitutes the active zone. It bears a well-developed but localised and discontinuous rounding, equally developed over both faces. A discontinuous polish, very well-developed on the mesial part, invasive on the mesial and proximal parts, but marginal on the distal part, bright, with compact to open linkage and undulating microtopography. Some striations parallel to the edge. The tool has been resharpened several times; its original width cannot be estimated, and it was finally resharpened before being abandoned – the fresh retouch flakes on the dorsal face do not bear traces of use. Finally, the left edge bears traces of use, according to N. Mazzucco (personal communication), possibly pointing to hide working.

*PM0502:* Without use-wear traces

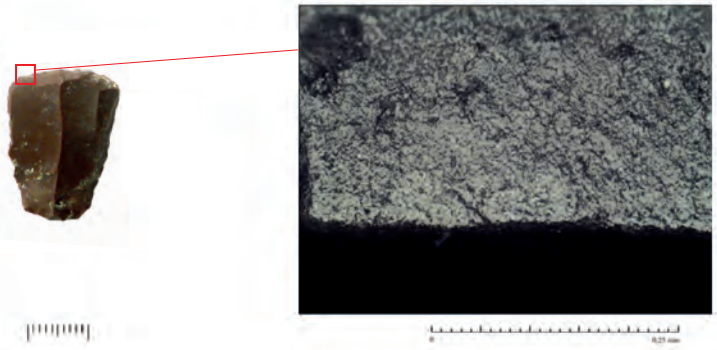
*PM0503:* Sickle element

The right and left edges were the active zones, both showing a well-developed rounding, very localised on the right edge and continuous on the left. Microscopically, they show typical traces of cereal harvest: a continuous and mostly invasive polish, bright, with compact to open linkage and undulating microtopography, and many striations, parallel to the edge or slightly oblique, as well as filled-in, dotted and comet-shaped striations. The right edge might have been the first to be used, it was resharpened, possibly several times, and abandoned after the last retouch, then hafted so that the left edge would be used in turn, resharpened, maybe several times, and abandoned later after use. This could explain the more abraded and striated right edge, hafted after use (see photo). According to N. Mazzucco (personal communication), both edges were also used on a different material after having served as sickle elements. Finally, he noticed traces of use on the scraper-shaped edge, corresponding to traces of hide working.



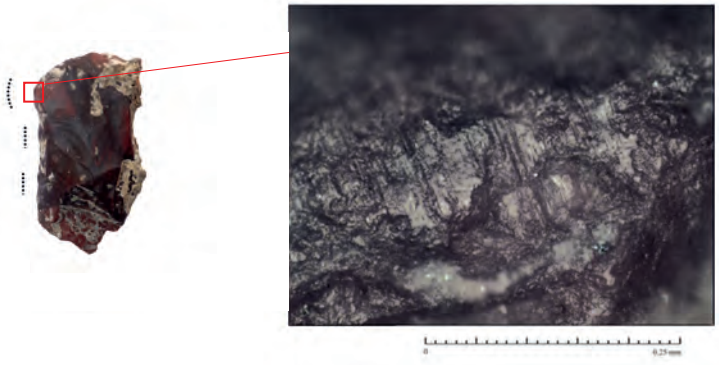
*PM0514:* Transverse action on dry hide

End-scraper bearing use-wear traces on the scraper-shaped edge. Shows medium to well-developed rounding, more developed over the dorsal face, and some microflakes, mostly perpendicular to the edge and with step section. Polish continuous but marginal on the ventral face, discontinuous but invasive on the dorsal one, quite bright, with tight to open linkage and irregular or undulating-irregular microtopography. Striations short, thin and superficial, perpendicular to the edge. Rounding pointing to scraping with a high angle.



*PM0523:* Transverse action on mineral matter

The side-scraper, and secondarily the rest of the left edge, are the active zones. The side scraper shows a well-developed but localised rounding, flattened, more developed over the ventral face; another two spots of medium and well-developed rounding on the mesial and proximal parts of the edge. Discontinuous polish, bright, with compact and tight linkage and smooth microtopography, with clear limits, covering the high spots. Many striations, oblique to the edge, long and mostly superficial and smooth-bottomed. Micro-traces mostly developed on the side scraper, but also some spots of functional striated polish along the edge, associated with the rounding. Traces typical of hard mineral matter, but the material could not be determined more precisely.



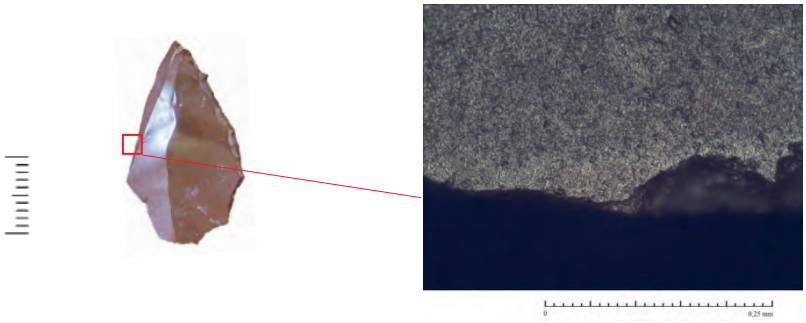
*PM0530:* Sickle element

Small blade fragment bearing wear traces on the left edge. Well-developed and continuous rounding, equally developed over both faces, and several microflakes, mostly oblique with two directions; continuous and invasive polish, bright, with compact to open linkage and undulating microtopography; many striations, parallel to the edge, some of them filled-in. The active edge was resharpened and reused, but not exhausted – the retouch flakes are not covered with wear traces.

*PM0541:* Without use-wear traces

*PM0556:* Transverse action on soft animal material (fresh or remoistened hide) with a high angle

Traces of use on the unretouched left edge of the tool. Poorly developed and discontinuous rounding, equally developed on both faces, and some small microflakes, mostly perpendicular to the edge; discontinuous and marginal polish, bright, with a tight to open linkage and irregular microtopography. Striations are rare, short and perpendicular to the edge. The ventral face seems to be the contact face, according to the development of the traces (polish and striations).

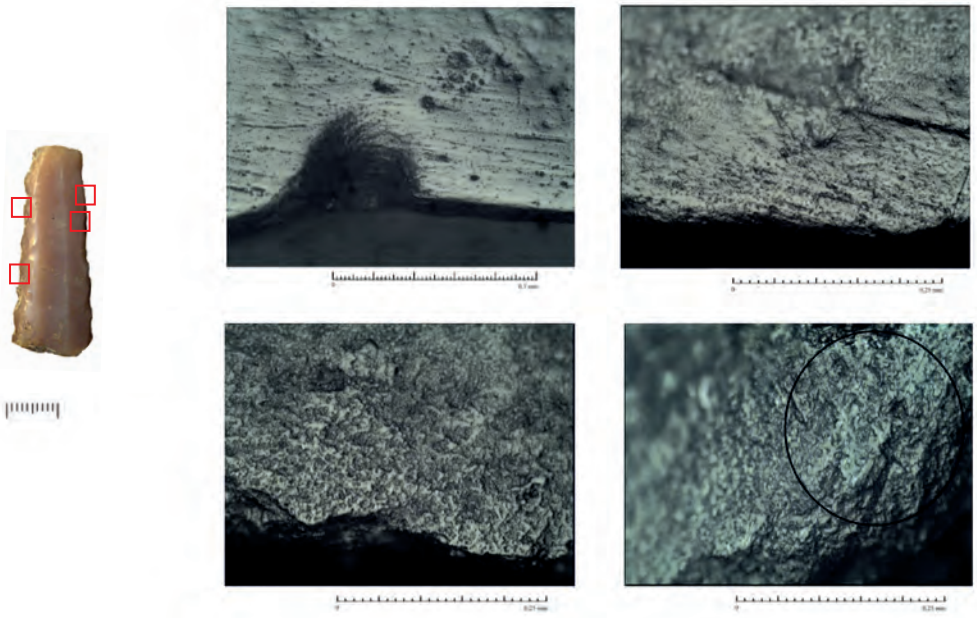


*PM0622:* Without use-wear traces

*PM0623:* Left edge: Exhausted sickle element, Right edge-dorsal face: very localised oblique action on hard bone material, Right edge-ventral face: transverse action on semi-hard/hard vegetal material

Three active zones identified: the left edge and two active zones on the dorsal and ventral face of the right edge. Left edge: typical traces of cereal harvest, such as a medium-developed and continuous rounding on the mesial and proximal parts, equally developed on both sides; a continuous and invasive bright polish with a compact to semi-tight linkage and an undulating microtopography; many striations, parallel to the edge, as well as dotted and filled-in striations. Several spots of abraded polish with perpendicular and random striations, due to contact with the soil. Edge probably rejuvenated several times in order to be reused, until exhaustion. On the right edge, some spots of flat striated polish and residues, maybe linked to hafting. Right edge, dorsal face: very few and localised traces of hard osseous material – a spot of bright polish, with a compact to tight linkage and smooth or smooth-undulating microtopography and many long, large and deep striations, oblique to the edge, roughbottomed and smooth-bottomed alike, noticed far from the edge. Right edge, ventral face: no rounding, but a discontinuous invasive polish, bright with a tight to open linkage and undulating microtopography, only covering the high spots, and a few striations perpendicular to the edge. Traces probably pointing to a

semi-hard or hard vegetal matter. Distal fracture bearing spots of a red residue that have not been further analysed.



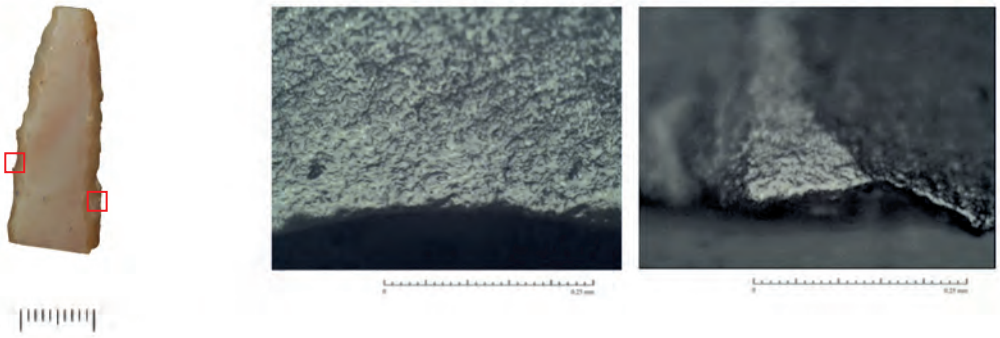
*PM0652:* Sickle element

The left edge is the active zone. Traces characteristic of cereal harvesting: macroscopically a poorly developed, discontinuous rounding, equally developed over both faces; microscopically a discontinuous but invasive polish, with compact to open linkage and undulating microtopography, and many striations, long and short, parallel to the edge, mostly superficial, also filled-in and dotted striations. Polish becoming abraded on the proximal part of the flake, possibly indicating contact with abrasive matter, like the soil.

*PM0686:* Transverse action on semi-hard/hard material (dry hide) with a high angle

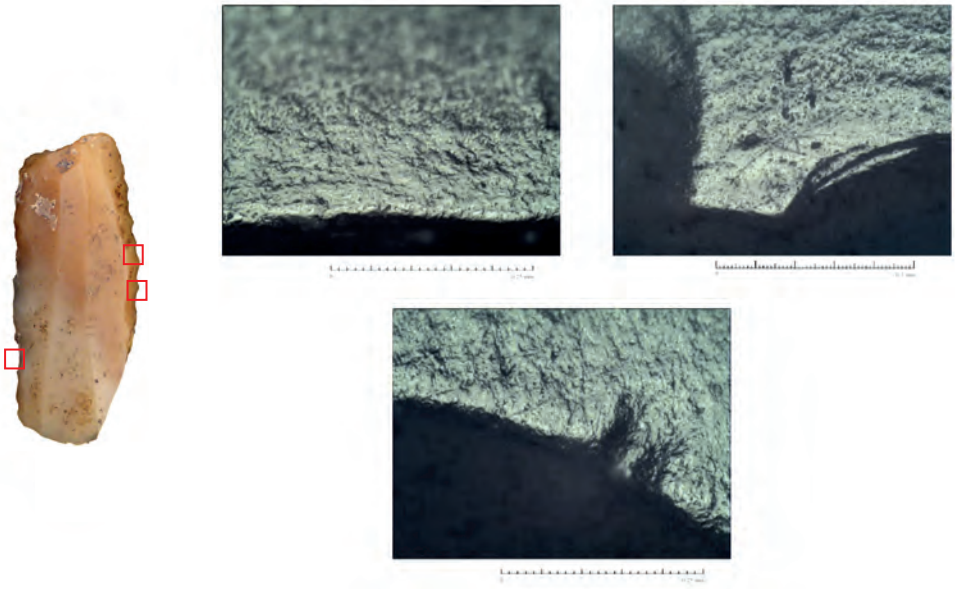
Three active zones identified on this honey flint blade: the right, left and distal edges. Traces similar on all three active zones. The right and left edges do not exhibit rounding (the left edge exhibits edge crushing), but show discontinuous polish, in some parts invasive and in others marginal, dull, with a tight to open linkage and irregular microtopography, and many striations, long and short, perpendicular to the edge, thin and large, superficial or deep. The distal edge shows a poorly developed to medium continuous rounding, more developed over the ventral face, microscopic polish, continuous and invasive, bearing the same characteristics as on the other edges, and

many striations, perpendicular and oblique to the edge. After use, rejuvenation of the right and left edges, which explains the limited striated polish on the dorsal face (very limited on the right edge), mostly evident on the ventral face.



*PM0696:* Right edge: sickle element, Right distal part: transverse action on semi-hard abrasive material (dry hide), with a high angle (~75º), Distal edge: transverse action on semi-hard abrasive material (dry hide), with a high angle (~75º), Left edge: first used as a sickle element then transverse action on semi-hard abrasive material (dry hide), with a high angle (~75º)

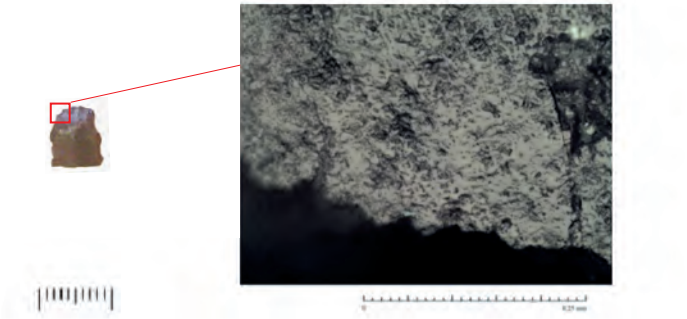
Three active zones were identified on this honey flint blade: the right, left and distal edges. Right edge: the proximal side shows medium to well-developed rounding, continuous and equally developed on both sides; continuous and invasive polish, with compact to semi-tight linkage and undulating microtopography; and many striations, long and parallel to the edge, as well as dotted striations. These are typical traces of cereal harvesting tools. On the dorsal face these traces extend towards the distal part of the tool; on the ventral face the distal part presents a set of different traces covering (and sometimes mixed with) the typical sickle traces. Right distal and left edges: medium to well-developed rounding, equally developed on both sides; continuous and quite invasive polish, dull and abraded, with tight to open linkage and irregular microtopography; and several striations, short and long ones, thin or large, perpendicular to the edge. The left edge also shows microscopic cereal gloss mixed and sometimes covered by the abraded irregular polish described above. Distal edge: traces similar to the left edge; no macroscopic traces indicating an active zone, but microscopically there is continuous and marginal dull/abraded polish, with



tight to open linkage and irregular microtopography, and several striations, short and long ones, perpendicular to the edge. We suggest that the right and left edges were first used for cereal harvest; then the blade was used to work dry hide with the right distal, left and distal edges, and the extent of the polish (slightly invasive) indicates scraping with a high angle. The proximal end of the blade was probably broken after the first task, since the striated undulating polish is interrupted. The left edge was resharpened after the first use, which explains why the harvest traces are scarce, and mostly preserved on the ventral face; the right edge was also resharpened, maybe more intensively on its distal half.

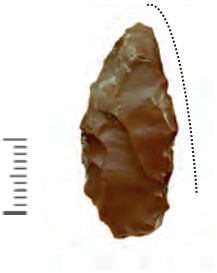
*PM0723:* Transverse action on soft plant material

The active zone is very localised – a part of the scraper-like edge. Well-developed but discontinuous rounding, more developed over the dorsal face; continuous and invasive polish, bright, with compact to semi-tight linkage and undulating microtopography; striations oblique to the cutting edge. The traces are very localised, perhaps pointing to microtechnical work.



*PM0728:* Sickle element

The right edge is the active zone. Continuous, medium to well-developed rounding that develops equally on both faces, and macroscopic gloss as first indicators of use. Microscopically, there is invasive though discontinuous polish, bright, with compact and tight linkage and undulating microtopography, and many striations, long or short, parallel or oblique to the edge. Tool hafted obliquely; left edge rounded towards the distal part, which, combined with the abrupt retouch, confirms that this edge was hafted (see Fig. V.1.19). Active edge possibly resharpened several times, but polish filling or entering most of the retouch flakes is present, thus the tool was reused after the last retouch. According to N. Mazzucco (personal communication), the element is functionally complete, with the distal edge bearing wear traces and the proximal one having been hafted.

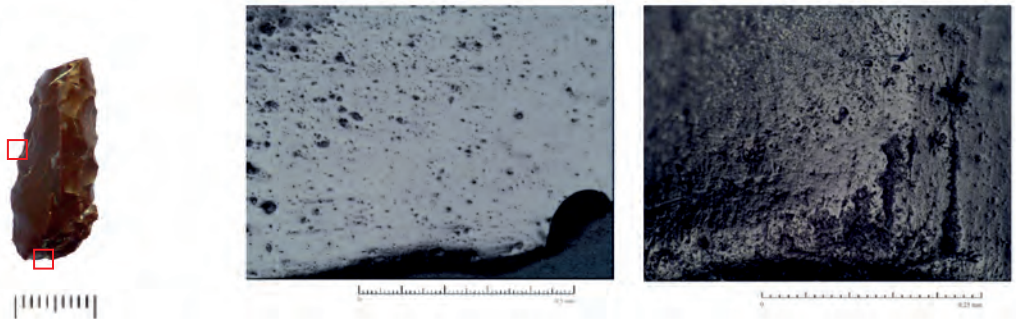


*PM0742:* Transverse action on hide/leather with a high angle

The active zone is the scraper-shaped edge. It shows a strong, continuous rounding, flattened in certain spots, sometimes more developed over the ventral face; a discontinuous, marginal polish, dull, with irregular microtopography, covering only the higher spots; rare striations, limited on the edge, short and thin, and perpendicular to the edge. The marginal polish and striations limited on the edge point to an activity performed with a high angle. The characteristics of the rounding imply that the ventral was the contact face. Lateral sides possibly retouched to fit the haft; a spot of striated polish on the dorsal face may be connected to hafting.

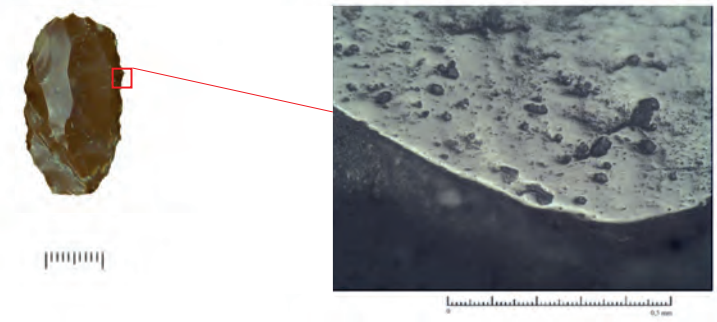
*PM0743:* Sickle element

The left edge is the active zone. Shows a well-developed rounding, continuous and equally developed on both faces. Polish continuous on the ventral face, discontinuous on the dorsal face, invasive, bright, with compact to semi-tight linkage, and undulating or smooth-undulating microtopography. Many striations, long and shorter ones, parallel to the edge, as well as dotted and filled-in striations. An abraded cereal polish, heavily striated, was also observed on the proximal side, due to contact with abrasive matter. Active edge rejuvenated (maybe several times) on the dorsal side – the discontinuous polish shows that it has been reused briefly after the last retouch. The hafted right edge exhibits edge crushing, a few rounded spots and marginal and discontinuous polish with irregular microtopography in the mesial part of the ventral face. Tool hafted obliquely (see Fig. V.1.19).



*PM0751:* Sickle element

The right edge is the active zone. No rounding, due to the resharpening of the edge on the dorsal face, which also removed the macroscopic gloss and the polish from this side. Ventral face presenting traces (polish, striations) typical of sickle elements (Id. PM0743). Element functionally complete with few polished spots on the right part of the distal edge. The absence of new wear traces on the dorsal face implies that the insert was not reused after having been resharpened.

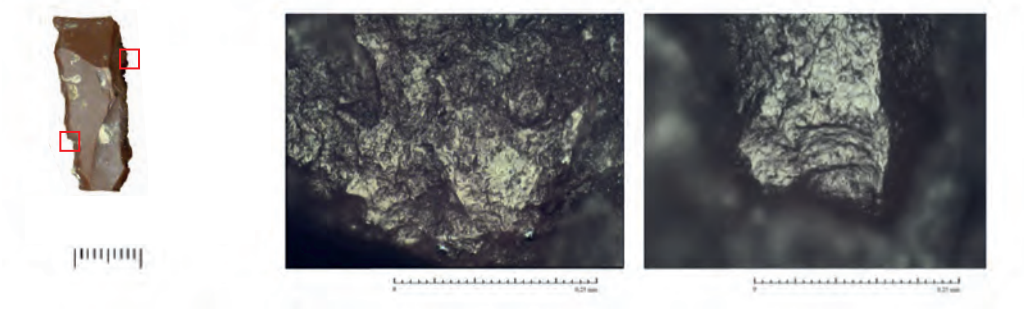


*PM0770:* Sickle element

The active zone is the left edge of the tool. It exhibits a well-developed and continuous rounding and macroscopic gloss. Polish discontinuous, invasive in the middle of the active zone, marginal towards the distal and proximal ends, bright, with a compact to open linkage and undulating microtopography. Many long and short striations, parallel and oblique to the edge, as well as dotted striations. The dorsal face was retouched after use, the microflakes being only partly or not at all polished, indicating limited use after having been re-sharpened.

PM0773: Transverse action on semi-hard material (fresh hide)

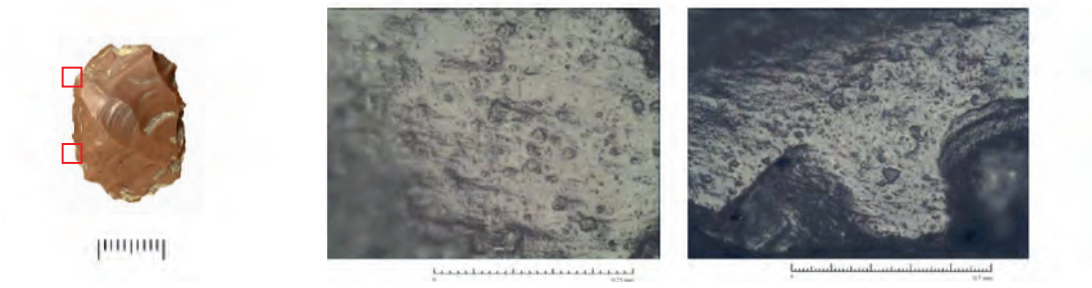
Two active zones, the left and right edges. They both present similar traces: a medium, discontinuous rounding, that seems to develop equally on both faces on the left edge, while it develops more over the ventral face on the right edge; a discontinuous polish, invasive on the dorsal face, marginal on the ventral face, bright, with a tight to open linkage, and undulating or undulating-irregular microtopography; rare striations, short, oblique or perpendicular to the edge.



*PM0784:* Without use-wear traces

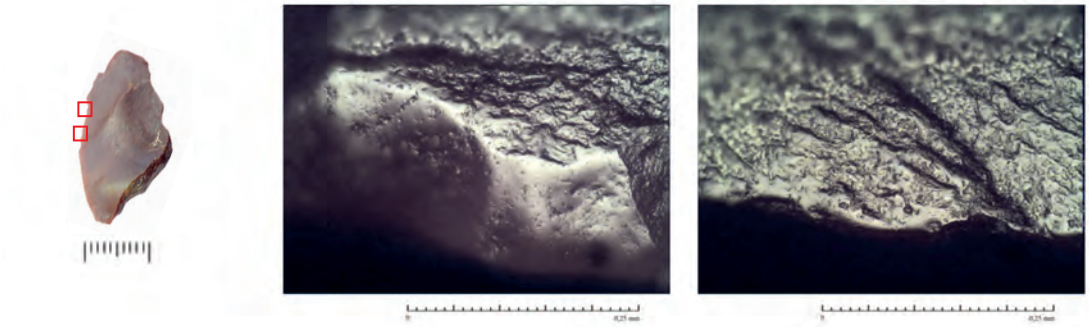
*PM0808:* Sickle element

The active zone is the original distal edge (indicated in the picture). Medium to well-developed rounding, developed equally on both faces. Polish continuous and invasive, with typical characteristics (Id. PM0743); a second type of polish present on the dorsal face towards the right edge, irregular and abraded, due to contact with abrasive matter. The two types of polish observed do not correspond to different worked materials – the abraded polish implies contact with soil. Many striations, parallel and oblique to the edge, with characteristics typical of sickle elements. Distribution of wear traces implying that the element was hafted very slightly obliquely (see Fig. V.1.19).



*PM0812:* Semicircular action on soft plant material (reeds or cereals)

The left edge is the active zone. Shows a medium to well-developed rounding, continuous, present equally on both faces. The polish is continuous on the mesial part of the ventral face, less continuous on the mesial part of the dorsal face, marginal, bright, with compact to semi-tight linkage, undulating microtopography, and only covers the high spots of the microtopography. Many striations, short and rather large, mostly oblique on the edge, often in different directions. Traces pointing to a soft plant material. The distribution of the polish and the striations might indicate work on reeds, though its use as a sickle element cannot be ruled out (suggested by N. Mazzucco, personal communication). The distribution of the wear traces with clear limits imply that the element was hafted obliquely to the haft.



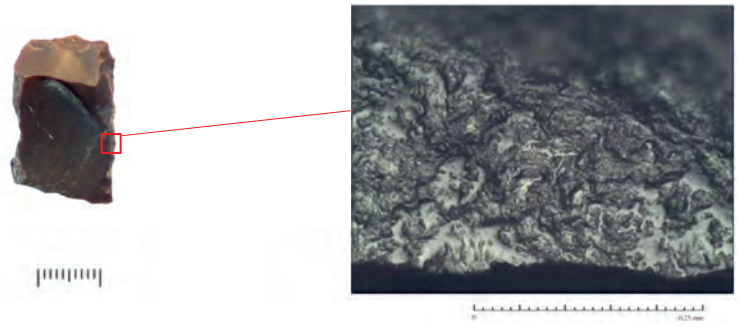
*PM0833:* Sickle element or longitudinal action on other plant material

Both edges of this long blade are active zones, possibly for the same activity. Medium to poorly developed rounding on the left edge, but medium to well-developed on the right one. The polish is discontinuous due to retouch flakes, the initial polish being present far from the edge on the dorsal face, invasive, bright, with compact to open linkage, undulating, undulating-irregular and occasionally irregular microtopography.

Characteristics of the polish not entirely typical for sickle elements, probably due to alterations, not allowing a firm conclusion on the tool's use. Striations are rare, short, thin and superficial, parallel to the edge. Element functionally complete, exhibiting polished spots on the distal edge of the ventral face. The chronology of use of each edge has not been determined. According to the traces, it was probably used for cutting vegetal materials, but we cannot assert that it was used for cutting cereals (observation by L. Papagiannaki and N. Mazzucco).

*PM0836:* Sickle element

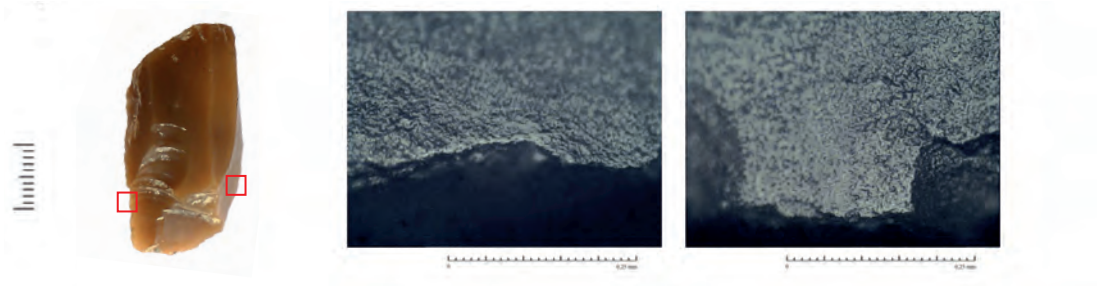
The active zone is the right edge. Poorly-developed rounding on the distal right extremity, continuous and slightly more developed over the ventral face. Discontinuous polish, invasive towards the right extremity, presenting the typical characteristics of sickle elements (Id. PM0743).



Many striations, parallel to the edge, short, thin and superficial, as well as filled-in striations and comet-shaped ones. The truncation on the proximal part probably facilitated the hafting, which may have left few traces, like striated polished spots on the proximal ventral face, implying that the element is functionally complete. Distribution of traces implying that the tool was hafted obliquely (see Fig. V.1.19).

P*M0838:* Transverse action on hard or semi-hard material (wood)

Both edges of this tool made on honey flint have been active. The right edge does not present rounding, while the left edge shows a medium to well-developed rounding, continuous, more developed over the dorsal face. Marginal polish, discontinuous on the right edge, continuous on the left one, bright, with tight to open linkage, irregular or undulating-irregular microtopography. Many striations, perpendicular or oblique to the edge, short, thin and rather superficial.

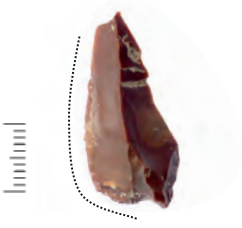


*PM0840:* Without interpretation

The right edge is an active zone, the activity has not been determined. Medium rounding, equally developed over both faces. Microchipping, with isolated small and medium microflakes, oblique or perpendicular to the edge. Discontinuous and marginal polish, bright, with tight or even compact linkage, and undulating-irregular microtopography. Rare striations (or even absent), maybe perpendicular to the edge.

*PM0845:* Sickle element

The left edge is the active zone. It shows a medium to well-developed rounding, continuous and leaning equally towards both faces. Continuous polish, becoming more and more invasive towards the proximal end, bright, with compact to semi-tight linkage and undulating microtopography; a second, more abraded and irregular polish is present, due to contact with abrasive matter, like soil, towards the proximal edge on the ventral face, also limited towards the distal edge on the dorsal face. Many striations, parallel to the edge, long, thin or large ones, some superficial and others deep, as well as several filled-in striations. Polish extending over the proximal end, implying that the element is functionally complete.



*PM0848:* Without interpretation

The point is the active zone. It may show a poorly developed but continuous rounding, small microflakes, aligned or superimposed, discontinuous and marginal polish, bright, with tight to open linkage, and irregular or occasionally domed (on the high spots) microtopography. No striations were seen.

*PM0852:* Transverse action on semi-hard or hard material – without further interpretation

The left edge is the active zone. It shows a medium to well-developed rounding, discontinuous and slightly more developed over the ventral face; small and isolated microflakes, oblique to the edge; discontinuous and marginal polish, bright, with tight to open linkage and irregular microtopography; rare striations, perpendicular to the edge, small, thin and superficial. The tool must have been used for a transverse action with a very high angle. It may not be functionally complete, but no wear traces clarifying this were detected.

*PM0867:* Left edge: sickle element, Distal edge: transverse action on dry hide

Two active zones are noted, the left edge and the distal edge, on different materials. Left edge: well-developed, continuous rounding, equal on both faces, a rather continuous polish, more invasive towards the distal end, typical of cereal harvest (Id. PM0743), and many striations parallel to the edge. Distribution of traces implying that it was inserted slightly obliquely into the haft (see Fig. V.1.19). Distal edge: shows a well-developed rounding, flattened on some parts, a continuous and marginal polish, bright, with compact to open linkage and undulating-irregular or irregular microtopography, and many short striations, perpendicular to the edge, some are rough-bottomed and others are smooth-bottomed. These traces coexist and interact with the traces of harvest.

## V.1.10. Appendix 2: The Flaked Stone Assemblages – A Brief Note on Agricultural Tools

*Niccolò Mazzucco*

Complementarily to the study carried out by Catherine Perlès and Lygeri Papagiannaki, a use-wear analysis was carried out on the flaked stone tools from PMZ, mainly focusing on the stone tools related to agricultural tasks (i.e. cereal harvesting and/or processing). This study was carried out in the framework of a larger project focusing on the spread and change of the harvesting technologies in the Mediterranean Basin, a synthesis of which has recently been published.[432] PMZ took on a main role in the project, allowing us to acquire a detailed image of the change in the agricultural tools in the Thessalian Plain between the Middle and the Late Neolithic. In this brief note, a synthesis of the main results will be given, trying to complete the information already provided by the above-mentioned colleagues.

All flaked stone materials from the PMZ sequence have been observed via stereoscopy in order to detect possible tools used for plant harvesting, collecting or processing. This includes all Middle–Late Neolithic tools, but also a few pieces from the Early and Middle Helladic periods. A detailed study of the use-wear patterns was undertaken using an Olympus BH2 metallographic microscope, following a methodology close to that applied by Perlès and Papagiannaki.

### *An Overview of the Main Results*

30 glossy tools from Middle and Middle/Late Neolithic phases have been detected and 15 glossy tools from later periods (two of which from survey collections). Of the 30 Neolithic glossy tools, 25 can be ascribed to the class of sickle inserts, while the remaining elements show different use-wear patterns. Three of them show marginal or insufficiently preserved use-wear traces, while the other two present much more abrasive wear. The main aspects that can be remarked upon are:

- The presence of two different types of sickle inserts. The first sickle type is characterised by flakes or blade fragments hafted diagonally into some type of wooden or antler haft, forming a coarsely serrated cutting edge. Despite the fact that the use of both flakes and blades may appear strange, given their variable morphology and dimensions, it is quite common in Neolithic assemblages from the Aegean and the southern Balkans.[433] The other type of insert is made on wider and longer blades, often produced through more skilled flaking methods (i.e. different modes of pressure flaking), which show a gloss distributed along the entire used edge, with a parallel distribution. Parallel inserts are present from at least Lithic Phase II (BPh IV). All of them are broken or reused, and it is therefore impossible to assess their original size and morphology. However, they surely represent a different morphotype compared to diagonally glossed inserts. Another aspect to remark upon is that both morphotypes coexist in the same layers, suggesting that different types of harvesting tools were in use at the same time, as already observed for Achilleion (Trench D) and Franchthi.
- The possible presence of threshing inserts. The two above-mentioned inserts showing abrasive use-wear traces (Fig. V.1.20) may have been used as inserts in a threshing board. The type of macro- and micro-wear traces, such as the dulled edge and the presence of striations all over the used margin, partially resemble experimental threshing inserts. At the same time, they differ from experimental inserts, because of the presence of smooth spots of cereal polish. The mixed nature of this type of trace has already been discussed by Patricia C. Anderson.[434]

[432] Mazzucco et al. 2020.
[433] Gurova 2014.
[434] Anderson 1992; Anderson – Whittaker 2014.

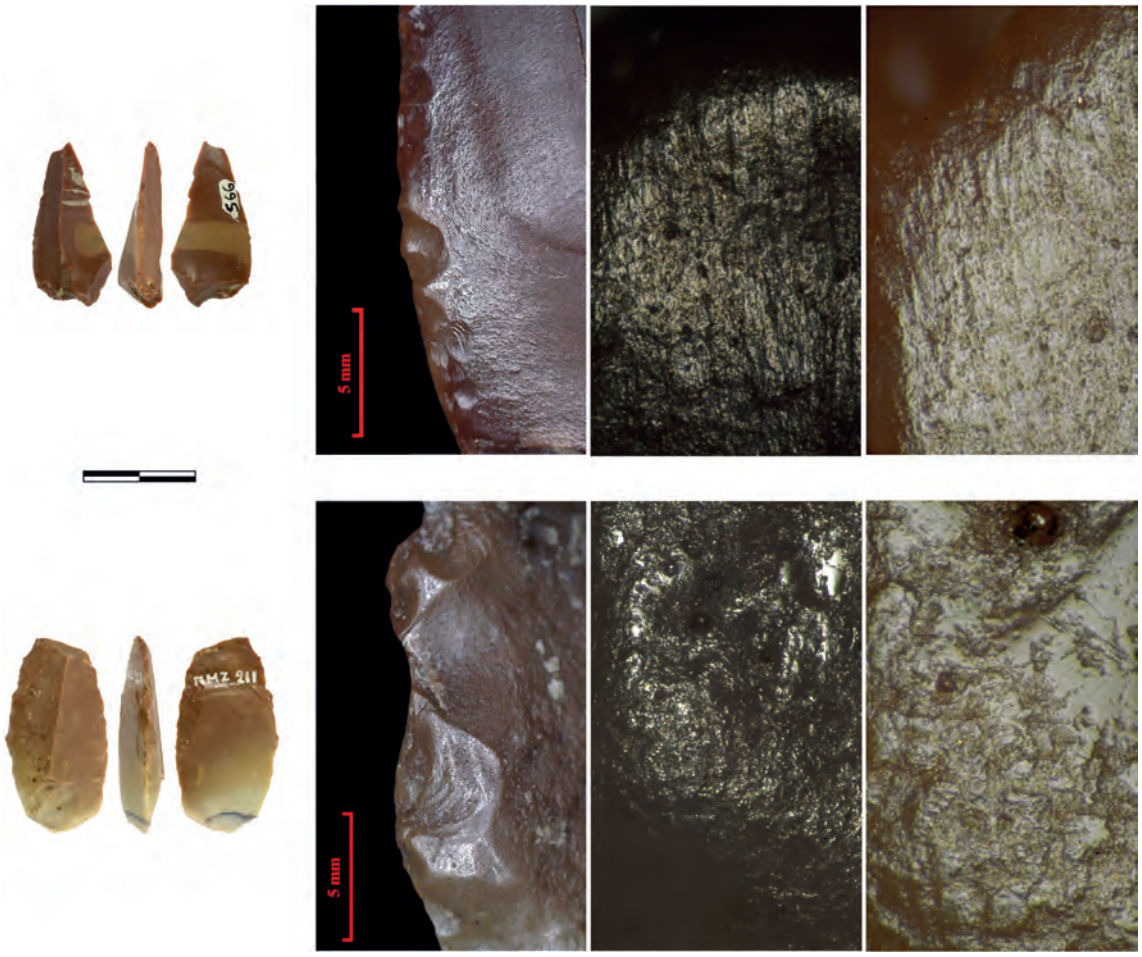



Fig. V.1.20 Two possible threshing inserts from PMZ. On the top PM0845, below PM0441. Note the dulled edge and the use-wear pattern characterised by abrasions and striations (N. Mazzucco)

- A new experimental study is currently ongoing, including confocal microscopy in order to quantitatively discern use wear from cereal harvesting from that produced by cereal threshing. The presence of such innovation may be associated with the increased amount of grain to be processed, possibly in relation to the need for massive quantities of chopped stems (i.e. architecture, fodder, etc.). This data would fit with the presence of training pathologies in cattle, as at least demonstrated for the site of Knossos, from the Early to the Late Neolithic phases (7000–6000 BP).[435] In addition, the use of fodder for feeding sheep and goats has recently been demonstrated for the Middle–Late Neolithic site of Kouphovouno.[436]

[435] Isaakidou 2008.
[436] Vaiglova et al. 2020.

## V.1.11. Appendix 3: Geochemical Sourcing of Chipped Stone Tools from Platia Magoula Zarkou

*Michael Brandl – Christoph A. Hauzenberger – Peter Filzmoser – Maria M. Martinez*

### *Introduction*

Amongst the many questions prehistoric archaeology is concerned with, the reconstruction of economic behaviour is a particularly challenging endeavour. Such a task first and foremost requires tracing the raw materials involved in tool production back to their original source.

Based on sound provenance studies, further inquiries concerning prehistoric resource management can be undertaken. For PMZ, a first attempt is undertaken in the current study for lithic resources, which promises deeper insights and a refined understanding of the strategies Neolithic people adopted to procure particular raw materials used for specific tasks.

We tested the hypothesis that easily accessible sources in the vicinity of the sites were exploited by the prehistoric inhabitants of PMZ, and that their resource management predominantly rested on the supply from river gravels. For this pilot study, geoarchaeological surveys were conducted in the vicinity of the tell site, and raw materials from four source locations were investigated together with selected artefacts from the Late Neolithic period according to the Multi Layered Chert Sourcing Approach (MLA).[437] The MLA combines macroscopic and stereomicroscopic investigations with geochemical analyses applying laser ablation inductively coupled mass spectrometry (LA-ICP-MS) and data evaluation employing compositional data analysis (CODA).

The first results of the current study were presented and discussed at the MinPet2019 meeting at the Graz University of Technology,[438] and provide unprecedented evidence for Neolithic resource management strategies in Thessaly. In this regard, our study is the starting point for investigating the lithic economy in the wider area, also from a diachronic perspective, and will hopefully encourage further investigations into this issue.

### Terminological Issues: Chert, Flint & Co

Specific terminological issues concerning the chipped stone assemblage from PMZ are discussed by Perlès[439] and will therefore not be repeated here. On a more general note, the terminological system used for this contribution is in accordance with Brandl[440] and summarised in Tab. V.1.17.

Tab. V.1.17 Terminology of siliceous rocks (M. Brandl)

| Material | Index fossils | Terminology | Petrological genesis | Structure |
|---|---|---|---|---|
| Silicites (= members of the chert group) | Radiolarians | Radiolarite | Biochemical sedimentary | (Crypto-) micro-crystalline |
| | Sponge spicules | Spiculite | Precambrian – Neogene | |
| | Sponge remains | Spongiolite | c. 3.5Myr – 10Ma | |
| | No dominating type | Chert | | |
| | Cretaceous marine organisms | (Baltic/Scandinavian) flint | Biochemical sedimentary | Crypto-micro-crystalline |
| | | | Upper Cretaceous including Danian | |
| | | | 100.5–61.6Ma | |
| Inorganic siliceous rocks | No fossil inclusions | Jasper, Chalcedony, agate | Volcanic and/or perivolcanic precipitation of $SiO_2$ | Crypto-crystalline |

[437] Brandl 2016; Brandl et al. 2016; Brandl – Hauzenberger 2018; Brandl et al. 2018.
[438] Brandl et al. 2019.
[439] Perlès – Papagiannaki, this volume, Tab. V.1.1.
[440] Brandl 2013/14; Brandl 2016.

Organogenic (i.e. organically formed) $SiO_2$ modifications are therefore subsumed under the overarching chert group, which is predominantly characterised by microfossil inclusions. Index fossils are used to define specific members of the chert group, such as radiolarite, spiculite, or spongiolite. If no dominating fossil type is present, the material is classified as 'chert'.

Inorganically formed siliceous rocks do not contain fossil inclusions and are the result of volcanic or perivolcanic activities, during which hydrothermal waters dissolve silica from other host rocks (e.g. serpentinites), which is subsequently precipitated once the solution is oversaturated.

### Stating the Problem: Provenance Studies of Silicite Raw Materials

Traditional approaches predominantly applying either macroscopic or microscopic techniques are in most cases not able to achieve a secure 'fingerprinting' of geological sources and the assignment of archaeological artefacts to specific source areas. This is especially true for silicites, such as chert, flint and radiolarite. The main problems concern the oftentimes high visual similarities and relatively pure nature of $SiO_2$ materials.[441] Therefore, geochemical methods were increasingly used for chert provenance studies; however, the results of these undertakings also fell short of expectation due to the fact that sources often display greater heterogeneity in their trace element contents than distant locations. The only solution to this predicament is

i) a combination of methods suitable for capturing the full range of characteristics of the investigated sources;

ii) sufficient expertise in geochemical processes in order to select trace elements which afford a source differentiation; and

iii) a rigid systematic sampling strategy based on scientific questions or hypotheses.

In tandem with a sound analytical protocol, such an approach is capable of succeeding in silicite provenance undertakings. This is the foundation of the Multi Layered Chert Sourcing Approach, which combines visual pre-grouping, stereomicroscopic analyses of microfossil inclusion patterns, geochemical trace element analyses applying laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) and statistical analyses employing compositional data analysis (CODA).[442]

### Previous Studies

Although the number of undertakings specifically dedicated to lithic raw material provenance in the wider study region has increased during the last decade, systematic investigations are still scarce and have the character of an overview. The raw materials in the lithic assemblage of PMZ were summarily presented by Ernestine Elster,[443] focusing on the general trends of lithic raw material supply; however, detailed analyses were lacking until now.

The most relevant work involving siliceous raw materials used for stone tools in the study area was undertaken by Panagiotis Karkanas et al.,[444] who investigated the provenance of Middle Palaeolithic radiolarite artefacts from Theopetra Cave using INAA. For this undertaking, over 100 geological samples from nine outcrops along the Koziakas Range, and from three locations along the Peneios River were collected, which provides a solid basis for such an investigation. One constraint of the study is the limited number of trace elements obtained. Nonetheless, the study was able to establish a geochemical 'Koziakas reference group'; however, it was not possible to

441 E.g. Hughes et al. 2010; Brandl 2016; Brandl et al. 2018.
442 Brandl 2016; Brandl et al. 2018.
443 Elster 1994.
444 Karkanas et al. 2008.

correlate the investigated artefacts to this cluster. Consequently, Karkanas et al. conclude that the Thessalian Plain was not the primary source area of the analysed Middle Palaeolithic artefacts.[445]

Petrographic analyses of selected materials found in stone tool assemblages from Neolithic northern Greece were conducted by Sarantis Dimitriadis and Katerina Skourtopoulou,[446] who found that raw materials predominantly derived from local and regional sources.

### Geological Setting

PMZ is located in the centre of the Western Thessalian Plain close to the Peneios River. The plain is formed by mighty alluvial sediments, and bordered by the Aegean Sea in the east, and the Koziakas Mountain range in the west. The alluvial basin fill is predominantly composed of quaternary sands and small gravels, under 3cm in diameter, whereas larger gravels are absent. Several watercourses cut through these alluvial sediments, of which the Peneios is the most important.

The closest source area yielding raw materials suitable for stone tool production is the Koziakas Mountain range c. 40km west of the site. The Koziakas Unit building up this mountain range is composed of a Mesozoic (Triassic to Cretaceous) sedimentary sequence, the Koziakas series, and a Jurassic ophiolitic complex. Tectonically, the Koziakas ophiolite overlies the Koziakas series, which comprises alternating Late Triassic to Middle Jurassic carbonates, cherts, radiolarites and clastic sediments deposited on a continental slope. Cherts and radiolarites in the Koziakas series are associated with the Early to Middle Jurassic Mouzaki formation.[447]

Additionally, siliceous sediments (i.e. radiolarites and cherts) are associated with the Koziakas Ophiolitic Unit (KOU), either as exotic fragments in the ophiolitic melange, which dominates the KOU, or locally covering blocks of pillow lava of the Fourka Unit.[448]

Rocks of the KOU a well as cherts and radiolarites are introduced into the watercourses draining the Koziakas Range, and specimens larger than 5cm in diameter can be found in the river gravels of the upper courses of the Peneios and Portaikos rivers, which are approximately 40km apart in the Mount Koziakas foothills. While silicites are more frequent and of better quality in the Portaikos River, other rock types are present in a much larger quantity and with larger specimens in the Peneios.

Small radiolarite pebbles (max. up to 20mm diameter) occur in the lower course of the Peneios and the Enippeas rivers. The source of radiolarites in the Enippeas could be the more distant Othrys Mountain range, however this was not tested in the course of the current study since they are of no relevance for the archaeological question.

## *Materials and Methods*

### Archaeological Artefacts

For this study, 17 chipped stone artefacts from Late Neolithic contexts were investigated. The samples were selected by Perlès and Brandl. Two of the specimens displayed a slight influence of fire, which was only recognised under the stereomicroscope. These samples had to be excluded from the geochemical analysis. For the selection of the pieces to be analysed we focused on macroscopically characteristic materials representing some of the most frequent types in the chipped stone assemblage from PMZ in order to obtain information regarding the accuracy of pre-determinations, homogeneity within visual groups, and, ultimately, the potential provenance of identified rock types.

445 Karkanas et al. 2008.
446 Dimitriadis – Skourtopoulou 2001.
447 Skarpelis et al. 1992; Pomonis et al. 2005.
448 Pomonis et al. 2005; Bortolotti et al. 2010.

### Geological Samples

Geological comparative samples were collected during targeted field surveys undertaken in November 2018 by Brandl and Alram-Stern. A second survey was conducted in November 2019, primarily in order to locate sources of the macrolithic tools from PMZ. While this question is beyond the scope of this paper, results adding to the occurrence of radiolarites in the vicinity of PMZ are reported here.

### Sampling Strategy

Prior to the fieldwork, geological maps were studied, and Riccardo Caputo (University of Ferrara) and Georgios Toufexis (Ephorate of Antiquities of Larissa) were consulted regarding potential and promising sample locations in the vicinity of the archaeological site.

Caputo pointed out the Mesozoic rock formations of the Koziakas Mountains as the only potential close source area for chert and radiolarite in proximity to PMZ. Toufexis presented a radiolarite nodule of the highest quality and precisely corresponding to the enigmatic chocolate-coloured radiolarites from PMZ which was found during a survey conducted together with various colleagues working on the project some years ago in gravels of the Portaikos River in the foothills of the Koziakas Massif. These advantageous preconditions determined the course of the field surveys and guaranteed their successful outcome.

In particular, we decided to investigate the gravels from both rivers, the Portaikos and the Peneios, from outcrops as close as possible to PMZ, and following the riverbeds up to the Koziakas Mountains in order to locate potential primary sources. During this survey, eleven sources in the vicinity of the archaeological site were sampled (Figs. V.1.21–22; Tab. V.1.18). Of those, four distinct source locations (PMZ 2, PMZ 4, PMZ 5 and PMZ 8) were selected for detailed analyses, resulting in the analysis of 70 geological samples.

Additional fieldwork during the second survey produced evidence for radiolarite pebbles in river gravels of the Peneios (PMZ 12) and the Enippeas (PMZ 13) closer to PMZ; however, their small sizes of 20mm maximum do not correspond to the nodules used for chipped stone tool production in the investigated lithic assemblage.

Observations from these surveys yielded information concerning the (present day) availability of particular materials in different source contexts, predominantly the river gravels. Most importantly, the presence of raw materials visually corresponding to the dominating visual groups of the investigated assemblage was confirmed. It must be specifically noted that gravels of a suitable size for stone tool production are only present in the upper reaches of the Peneios before it drains into the alluvial basin. Source location PMZ 8 marks the easternmost extension of gravels in this watercourse; further to the east only small pebbles occur. There was a notable difference between the Portaikos versus the Peneios River concerning raw material quality and quantity, which allowed us to formulate a more refined hypothesis concerning lithic resource management at PMZ. We tested whether the prehistoric inhabitants of PMZ preferred the Portaikos gravels over those from the Peneios through geochemical investigations.

### Analytical Strategy

#### Macroscopic (Visual) and Microscopic Investigations

Prior to in-depth analyses, macroscopic (visual) grouping is necessary in order to formulate hypotheses which can be tested in the subsequent analytical steps. During this stage, groups are established according to macroscopic criteria such as colour, texture, granularity and inclusions visible without optical instruments. The resulting macroscopic groups are then tested for homogeneity applying stereomicroscopic investigations.

Microscopy is a well-established petrographic method typically performed on thin sections. However, archaeological materials typically require non-destructive or minimally invasive

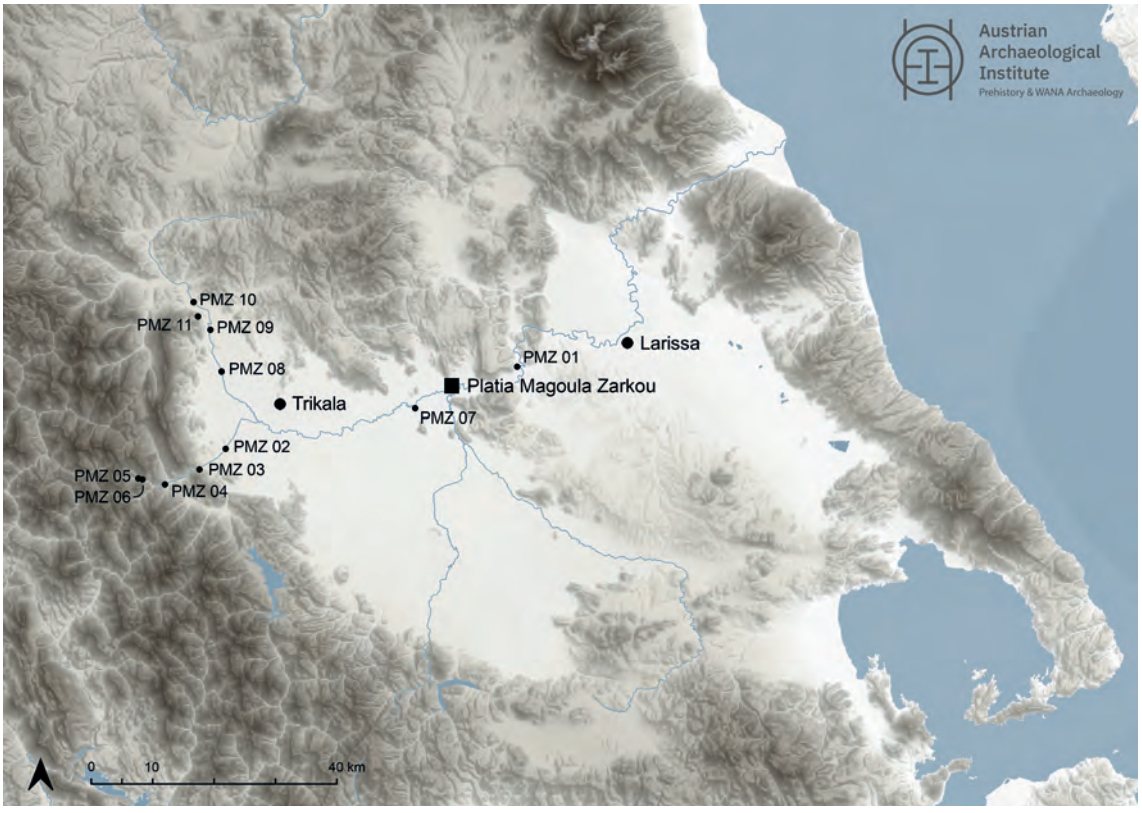



Fig. V.1.21 Map indicating the sampled locations (M. Brandl)

Fig. V.1.22 Selected source locations documented during the geological field survey (M. Brandl)

Tab. V.1.18 Description of sampled sources in the vicinity of PMZ (M. Brandl)

| Source ID | Survey season | Source location | Source type | Source description |
|---|---|---|---|---|
| PMZ 1 | 2018 | Peneiada | Primary | Conglomerate (recrystallised limestone pebbles and boulders) |
| PMZ 2 | 2018 | Portaikos River, north of Ligaria | Secondary | River gravels, c. 5% radiolarite of different qualities. High-quality radiolarites are rare, but do occur |
| PMZ 3 | 2018 | Portaikos River at Pili | Secondary | Same outcrop situation as seen at PMZ 2, some radiolarite nodules are larger, including the high quality 'chocolate'-coloured variety |
| PMZ 4 | 2018 | Riverbed on the road from Pili to Stournareika | Secondary | Massive occurrence of radiolarite, but high-quality specimens are rare. Occurrence of black chert |
| PMZ 5 | 2018 | Road to Stournareika | Primary/ residual | Massive grey limestones change into red limestone banks, which are partially folded. At this locale a geological trap triggered the accumulation of high quality radiolarite |
| PMZ 6 | 2018 | Road to Stournareika | Primary | Heavily cleft grey/green radiolarites |
| PMZ 7 | 2018 | Peneios River, south of Ichalia | Secondary | Alluvial sands only, they are backhoed down to the water level. No gravels occur here |
| PMZ 8 | 2018 | Peneios River at Dialekto | Secondary | Gravels in the riverbed. Some very rare high-quality radiolarites, 5cm in size, bright red variety. All larger specimens are heavily cleft. Large and high-quality (predominantly metamorphic) rocks suitable for the production of macrolithic (ground) stone tools |
| PMZ 9 | 2018 | Peneios River at Sarakina | Secondary | Same situation as seen at PMZ 8. Large heavily cleft radiolarite blocs, medium-low quality |
| PMZ 10 | 2018 | Peneios River at Kalampaka | Secondary | Significantly reduced occurrence of radiolarite and chert in the gravels. Only medium-low quality, heavily cleft |
| PMZ 11 | 2018 | Diava | No result | Attempt to locate primary sources in the northern parts of the Koziakas Mountains potentially supplying the Peneios River. No sources located |
| PMZ 12 | 2019 | Peneios south of Peneiada | Secondary | Sandbank, small pebbles and sand. Radiolarites do occur frequently, but are too small for tool production (max. 20mm diam.). Pottery (including Bronze Age?) and two flakes indicate a prehistoric site in the vicinity (material was apparently washed down the river) |
| PMZ 13 | 2019 | Enipeas River, close to the confluence with the Peneios | Secondary | Large alluvial fan. Only loams and sands, small radiolarite pebbles (1–10mm diam.) are frequent (30–50% of the overall components in the sand) |

analytical techniques. Therefore, a method known as stereomicroscopic individual artefact analysis has been developed, which allows the investigation of the relevant properties on unpolished rock surfaces.[449] This technique aims at the identification of characteristic features such as the microstructure, i.e. size, shape and spatial arrangement of the rock-building components, and fossil, as well as characteristic non-fossil inclusions. In the case of silicites, the primary goal of microscopic studies is the detection of microfossils; however, non-fossil inclusions are also recorded and may be representative of specific source environments. This so-called microfacies analysis is able to reveal the genetic conditions of chert, flint, or radiolarites, and therefore helps narrow down raw material source locations. For the current study, a Zeiss SteREO Discovery. V20 microscope applying 40–150× magnification was used. Micropictures were produced under standardised 40× magnification and water immersion of unpolished rock surfaces from both artefacts and geological samples.

Geochemistry

For geochemical analyses, laser ablation inductively coupled mass spectrometry (LA-ICP-MS) was applied. Analyses were undertaken with an Agilent 7500ce quadrupole ICP-MS unit at the Central Laboratory for Water, Minerals and Rocks, NAWI Graz (University of Graz and Graz University of Technology, Austria), with sample introduction through an ESI NWR-193 laser ablation system. Since silicites typically display a heterogeneous rock matrix due to their sedimentary origin, each sample was analysed at three carefully selected spots in order to control and minimise data distortion, e.g. caused by inclusions.

Small chips of archaeological as well as geological samples were placed in resin mounts and polished prior to analysis in order to avoid analysing chemically altered rock surfaces ('patination'). The 193nm wavelength laser was operated at 75µm spot size, 8Hz pulse frequency and ~7.5 mJ cm-1. Ablated material was transported via helium gas stream (0.71 min-1) into the argon plasma torch section of the mass spectrometer, where it was ionised and passed into the ICP-MS unit. The standard reference glass NIST SRM 612 was routinely analysed for standardisation and drift correction.[450] NIST SRM 610 and NIST SRM 614 were analysed as unknowns in order to allow reproduction within 10% relative error. Silicon (Si) was used as an internal standard element to control ablation efficiency and instrumental drift. A value of 99 wt.% for Si was used for data reduction in GLITTER (GEMOC), except for samples displaying over 10,000 ppm Calcium (Ca), for which Si values were adjusted accordingly. The detection limit of LA-ICP-MS is typically 0.1 ppm for most elements, however the analytical error increases significantly with values below 1 ppm.

Statistics

Bivariate analysis using elemental couples, which are not correlated to each other, allows us to identify geochemical processes involved in the formation of the investigated materials, and to reveal individual elements suitable for a basic source discrimination.

In order to achieve optimal group assignment and, at the same time, best group separation, advanced statistical methods can be applied to multivariate geochemical data sets. Here we use compositional data analysis (CODA) for statistical evaluation. CODA is concerned with ratios between values.[451] Typical units are parts per unit, percentages, ppm, or ppb. In 1982 John Aitchison introduced the log-ratio approach for compositional data analysis in the structure of their sample space, the so-called D-part simplex. This means that raw composition data (i.e. the absolute measured values) are transformed into the Euclidean geometry system, where statistical methods can operate (the simplex lies outside the Euclidean geometry).

[449] Přichystal 1984; Brooks 1989; Affolter 2002.
[450] Concentrations from Jochum et al. 2011.
[451] Aitchison 1986.

After transformation, discriminant analysis (DA) can be applied for classification. Fisher's linear discriminant analysis is the most suitable method to achieve optimal group separation of so-called training data derived from known geological sources. This analytical step generates predefined groups from the training data. The resulting discriminant rules are used for classifying and assigning the test data (i.e. the investigated archaeological specimens) to these predefined groups.[452]

*Analytical Results*

Macroscopic (Visual) and Microscopic

Artefacts

Two main groups of reddish-brown to brick-red, and yellow-greenish to grey silicite varieties were selected for this study and sorted visually based on colour and texture information (Fig. V.1.23). Stereomicroscopic analyses revealed chert and radiolarite in the selected assemblage based on prevailing microfossil inclusions, and resulted in the definition of eight distinct microscopic groups (Tab. V.1.19). Additionally, microphotos were produced from each investigated artefact (Fig. V.1.24). One has to bear in mind that geological sources can always contain several macroscopically and microscopically varying raw material types. It is therefore not expected

Fig. V.1.23 Artefacts from PMZ investigated for this study. Length of the bar: 1cm (M. Brandl)

[452] Filzmoser et al. 2012.

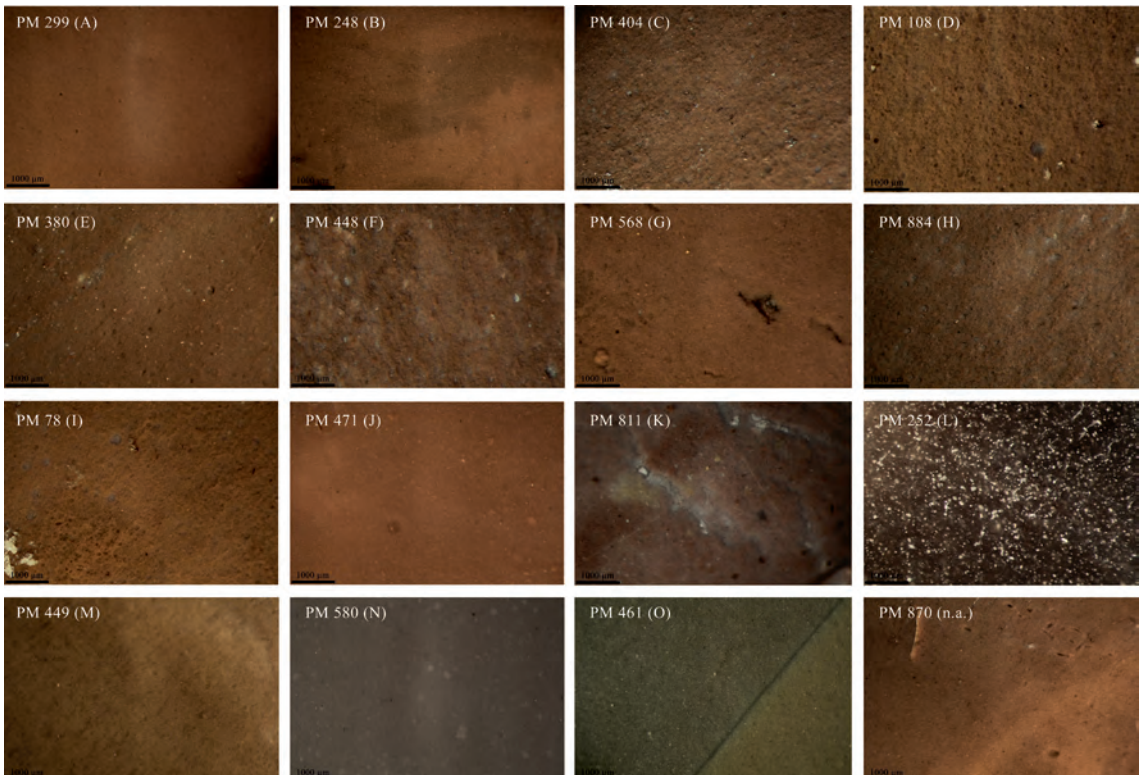



Fig. V.1.24 Microphotographs of the artefacts from PMZ. PM0870 was not analysed (M. Brandl)

that each microscopic group represents a distinct source location. This was also confirmed in the course of our geoarchaeological surveys.

Only microscopic groups 1 and 6 contain more than two specimens, and most groups are only represented by one piece. Amongst the radiolarites, group 1 represents the material with the highest quality (i.e. best knapping properties based on granularity and fissures), corresponding to the enigmatic 'chocolate radiolarite'. An additional goal of this study was to locate sources of this characteristic raw material type, which was popular within a wider region during the Neolithic period.[453]

Geological Samples

At source locations PMZ 2 (gravels of the Portaikos River) and PMZ 8 (gravels of the Peneios River) and the primary/residual outcrop at PMZ 5, radiolarite and red chert varieties are the dominating raw materials suitable for chipped stone tool production. Variegated cherts are also present; they are, however, clearly underrepresented. At those sampling locations, we focused on the collection of radiolarite varieties visually corresponding to the macroscopic groups detected at PMZ. The tested materials range between very fine-grained (dark) reddish-brown types and coarser-grained red varieties.

Additionally, we decided to include a sample of markedly different materials into this study in order to conduct a blind test of our results. At source locale PMZ 4, black cherts occur abundantly in gravels of a small river in the Koziakas Mountain range, which was selected to serve as a test sample.

[453] E.g. Perlès 2001, 202.

Tab. V.1.19 Petrographic description of the investigated artefacts (M. Brandl)

| PMZ number | Raw material | Munsell colour | Granularity | Natural surface | Fire influence | Characteristic inclusions | Comment | Microscopic group |
|---|---|---|---|---|---|---|---|---|
| PM0078 | Radiolarite | 10R 3/4 Dark Reddish Brown | Fine | Not present | Not present | Radiolarians | | 1 |
| PM0108 | Radiolarite | 10R 3/4 Dark Reddish Brown | Fine | Gravel | Not present | Radiolarians | Broken in the course of sampling | 1 |
| PM0248 | Chert | 10R 3/4 Dark Reddish Brown | Fine | Not present | Not present | Very few radiolarians | | 6 |
| PM0252 | Chert | 5YR 4/1 Brownish Gray | Fine | Not present | Uncertain | Peloids | | 8 |
| PM0299 | Chert | 10R 3/4 Dark Reddish Brown | Fine | Not present | Not present | Very few radiolarians | | 6 |
| PM0380 | Radiolarite | 5YR 3/4 Moderate Brown | Fine | Not present | Not present | Radiolarians | | 1 |
| PM0404 | Radiolarite | 10R 2/2 Very Dusky Red | Medium | Uncertain if present | Not present | Radiolarians | | 2 |
| PM0448 | Radiolarite | 5R 2/2 Blackish Red – 10R 2/2 Very Dusky Red | Fine | Not present | Slight | Radiolarians | | 1 |
| PM0449 | Radiolarite | 10YR 5/4 Moderate Yellowish Brown – 10YR 4/2 Dark Yellowish Brown | Fine | Gravel | Not present | Dissolved radiolarians | | 3 |
| PM0461 | Radiolarite | 10YR 4/2 Dark Yellowish Brown – 10YR 5/4 Moderate Yellowish Brown | Fine | Primary | Not present | Heavily dissolved radiolarians | | 3 |
| PM0471 | Chert | 10R 3/4 Dark Reddish Brown | Fine | Primary | Not present | Very few radiolarians | | 6 |
| PM0568 | Radiolarite | 10R 3/4 Dark Reddish Brown | Fine | Not present | Not present | Dissolved radiolarians | | 1 |
| PM0580 | Chert | N8 Very Light Gray – N7 Light Gray | Fine | Not present | Not present | Few intraclasts, some marine detritus | | 7 |
| PM0811 | Radiolarite | 5R 4/2 Grayish Red | Fine | Not present | Not present | Radiolarians, chalcedony veins | | 4 |
| PM0868 | Radiolarite | 10R 3/4 Dark Reddish Brown | Fine | Gravel | Medium | Radiolarians | Not sampled | 5 |
| PM0870 | Chert | 10R 3/4 Dark Reddish Brown | Fine | Not present | Medium | Very few radiolarians | Sampled, but not used for analysis because burnt (fire influence detected during sampling); broken in the course of sampling | 6 |
| PM0884 | Radiolarite | 10R 2/2 Very Dusky Red | Medium | Not present | Not present | Radiolarians | | 2 |

The results of the petrographic analysis of the range of raw materials collected for this study are presented in Tab. V.1.20, including microphoto documentation of representative specimens from each geological outcrop (Fig. V.1.25).

According to these investigations, materials corresponding to the prevalent microscopic varieties in the PMZ assemblage can be found in both the Peneios and Portaikos rivers, whereas the primary/residual deposit at PMZ 5 only produced materials agreeing with groups 1 and 4.

No correspondence with archaeological materials could be established with samples from PMZ 4.

Although the microscopic groups of the archaeological specimens display characteristic patterns also recognised in the geological comparative samples, it is not possible to clearly differentiate between distinct source locations based solely on stereomicroscopic analyses. This is due to the internal heterogeneity of the samples potentially derived from identical geological formations. Petrographic investigations alone are therefore also not suitable to achieve a secure allocation of the tested artefacts to specific sources or source areas. Hence, we additionally employed geochemistry to overcome this constraint.

Tab. V.1.20 Description of the geological comparison samples (M. Brandl)

| Source location | Sampled raw materials | Munsell colour range | Granularity | Source type | Corresponds to microscopic group from PMZ |
|---|---|---|---|---|---|
| PMZ 2 (Portaikos River) | Chert, radiolarite | 5R 2/2 Blackish Red – 5R 4/2 Grayish Red – 10R 2/2 Very Dusky Red – 10R 3/4 Dark Reddish Brown | Medium – fine | Secondary | 1, 4, 6 |
| PMZ 4 (small river in the Koziakas Mountains) | Chert, radiolarite | 5Y 2/1 Greenish black – 5G 3/2 Dusky Green – 5GY 3/2 Grayish Olive Green | Medium – fine | Secondary | No correspondence |
| PMZ 5 (outcrop in the Mouzaki formation | Chert, radiolarite | 5R 2/2 Blackish Red – 10R 2/2 Very Dusky Red – 10R 3/4 Dark Reddish Brown | Medium – fine | Primary / residual | 1, 6 |
| PMZ 8 (Peneios River) | Chert, radiolarite | 5R 2/2 Blackish Red – 5R 4/2 Grayish Red – 10R 2/2 Very Dusky Red – 10R 3/4 Dark Reddish Brown | Medium – fine | Secondary | 1, 4, 6 |

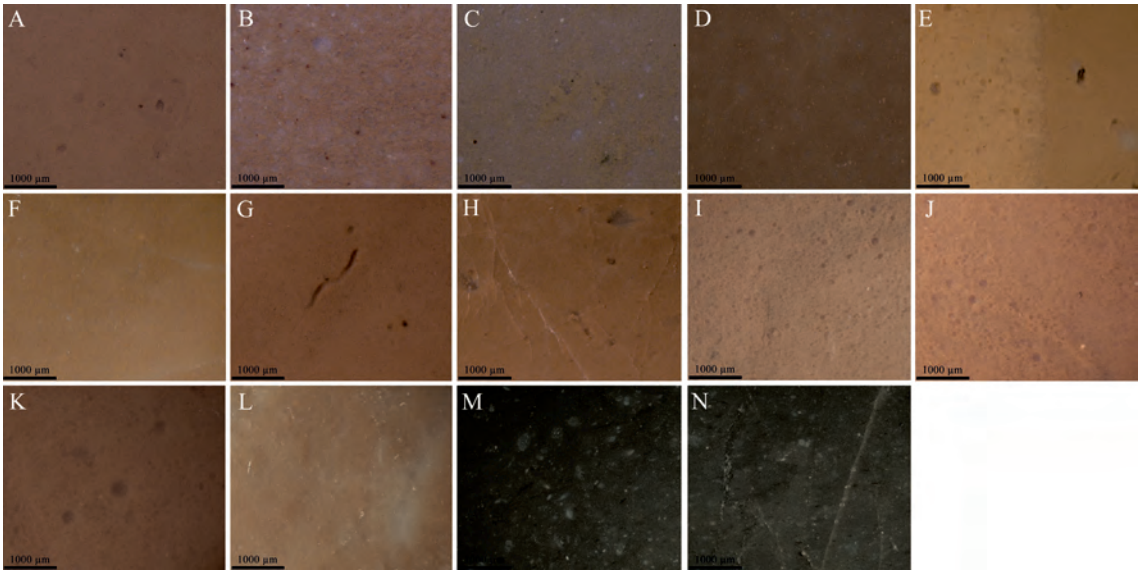



Fig. V.1.25 Microphotographs of representative samples from the geological sources. A–D: PMZ 2; E–H: PMZ 5; I–L: PMZ 8; M, N: PMZ 4 (M. Brandl)

### Geochemistry

From both geological and archaeological samples, concentrations of 41 trace elements were successfully collected, resulting in 255 individual measurements. In the first analytical step, we tested possibilities to establish a chemical fingerprint and subsequently achieve a differentiation of the geological sources. This data set was defined as training data for subsequent statistical evaluation.

Bivariate statistical analysis shows that the elements barium (Ba) and magnesium (Mg), which allow the separation of North Alpine and Carpathian radiolarite sources,[454] do not achieve a separation between discrete source locations in the Koziakas complex (Fig. V.1.26). A differentiation of sampled locations is possible to a certain degree using aluminium (Al) versus strontium (Sr); however, overlapping effects are significant and only the black chert test samples from location PMZ 4 can be securely separated (Fig. V.1.27).

Correlations with calcium (Ca), which is the primary constituent of the host rock facies, can be used to reconstruct the depositional environment of the investigated raw materials. We found no clear correlation between calcium and aluminium or magnesium in the analysed samples (Figs. V.1.28–29); however, a correlation is present between calcium and strontium, whose geochemical behaviour is similar. Bivariate scatter plots display a 45° trend, which indicates the presence of carbonates and/or plagioclase in varying amounts in the geological samples (Fig. V.1.30).

### Archaeological Artefacts

Finally, data from the archaeological artefacts were included to test the possibility of differentiation and potential source assignments. For this task, the artefacts were clustered according to the established microscopic groups. Specimens PM0868 (the only piece in group 5) and PM0870 were excluded from geochemical analysis because they are burnt. Consequently, group 5 is not represented in the geochemical results.

Using aluminium versus strontium, which allowed for some source separation, it becomes visible that all artefact groups except two fall into the source clusters obtained from the geological samples (Fig. V.1.31). Microscopic group 2 shows the closest affinity to data from PMZ 2 (Portaikos River), whereas group 6 tends towards PMZ 8 (Peneios River). Groups 1, 3 and 4 scatter insignificantly, and groups 7 and 8 represent outliers. These results confirm our initial hypothesis that the majority of the lithic resources for the selected chipped stone tools at PMZ were collected from the Koziakas source area. This assessment is supported by the calcium versus strontium correlation, in which the data from the artefacts follow the trend detected for the geological samples (Fig. V.1.32). While these results provide information concerning the geological formation of the investigated samples, they are only useful to a limited extend for provenance purposes. Therefore, more refined statistical techniques have to be applied to the geochemical data sets.

### Compositional Data Analysis (CODA)

To achieve enhanced group separation between training data (i.e. the geological samples) and subsequent assignment of the test data (i.e. the artefacts), we employed compositional data analysis (CODA).

After applying discriminant analysis (DA) according to Fisher, 5-fold cross validation was used to eliminate variables (i.e. elements) causing misclassification. Cross validation splits and resamples the training data for improved performance. For the current study, only the trace elements barium (Ba137), potassium (K39), and samarium (Sm147) could be eliminated, and the

[454] Brandl et al. 2014.

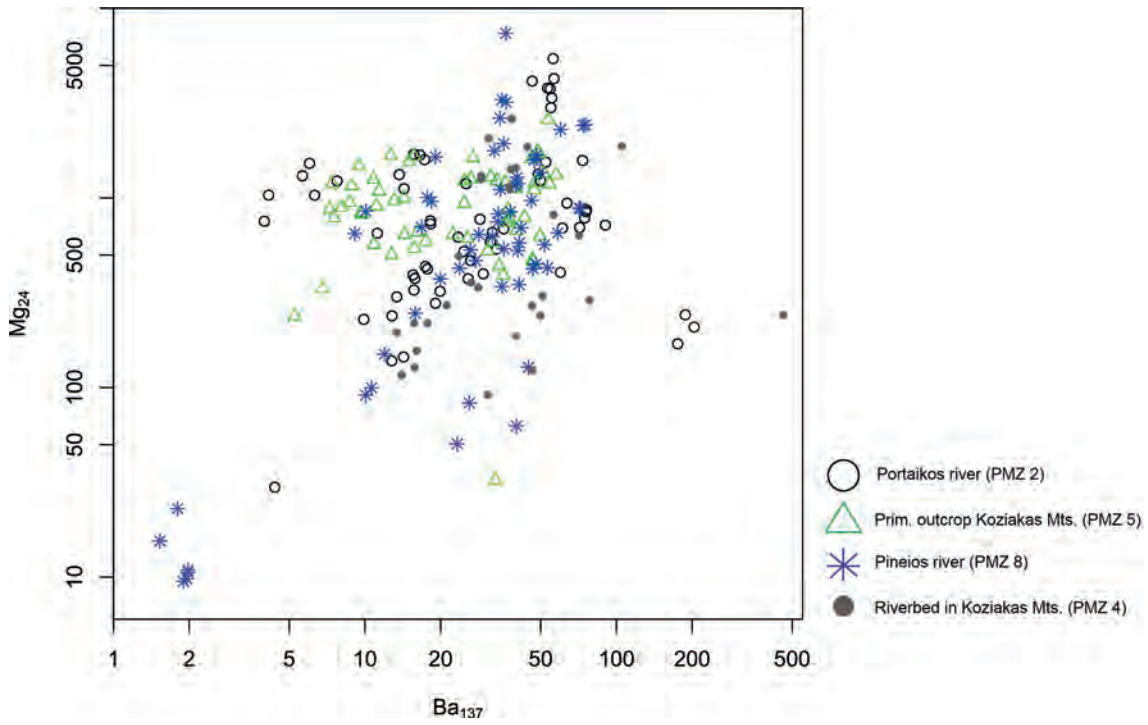



Fig. V.1.26 Barium (Ba) versus magnesium (Mg) concentration plot of the geological samples (M. Brandl)

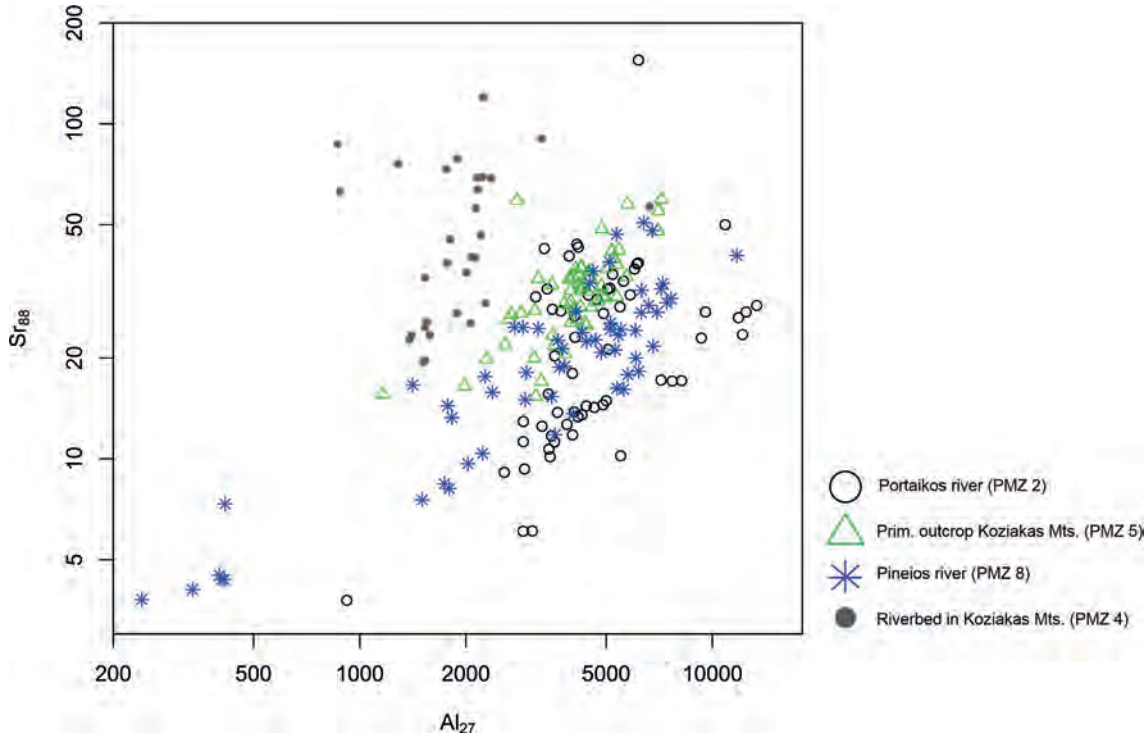



Fig. V.1.27 Aluminium (Al) versus strontium (Sr) concentration plot of the geological samples (M. Brandl)

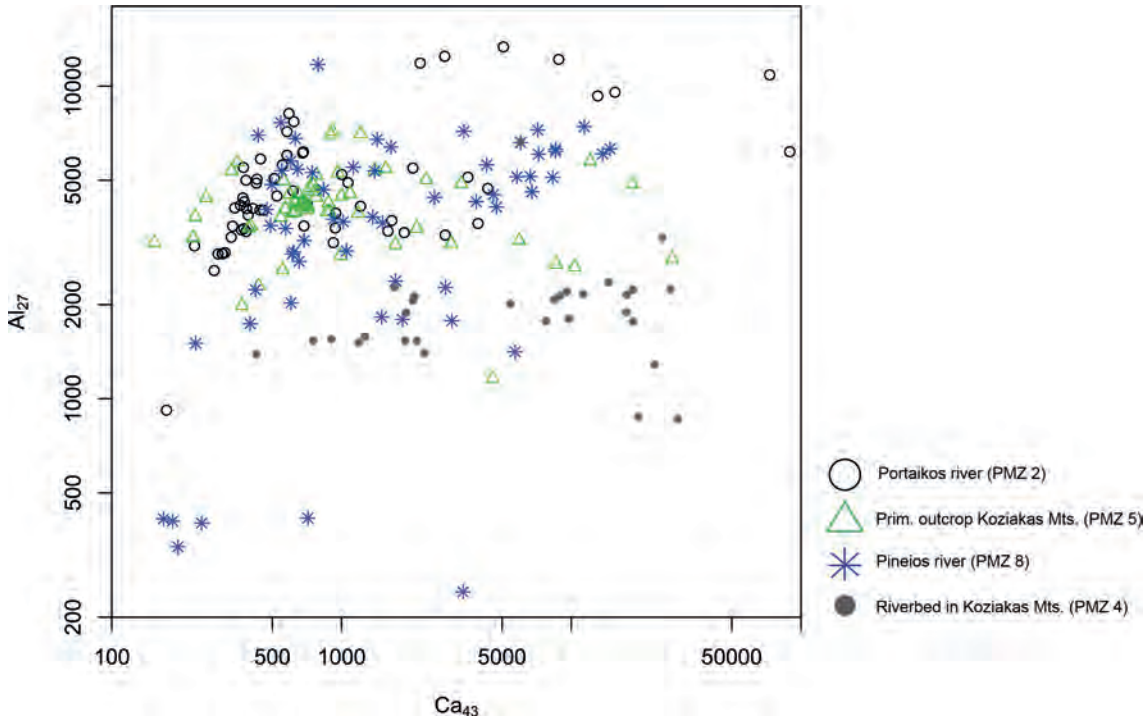



Fig. V.1.28 Calcium (Ca) versus aluminium (Al) concentration plot of the geological samples (M. Brandl)

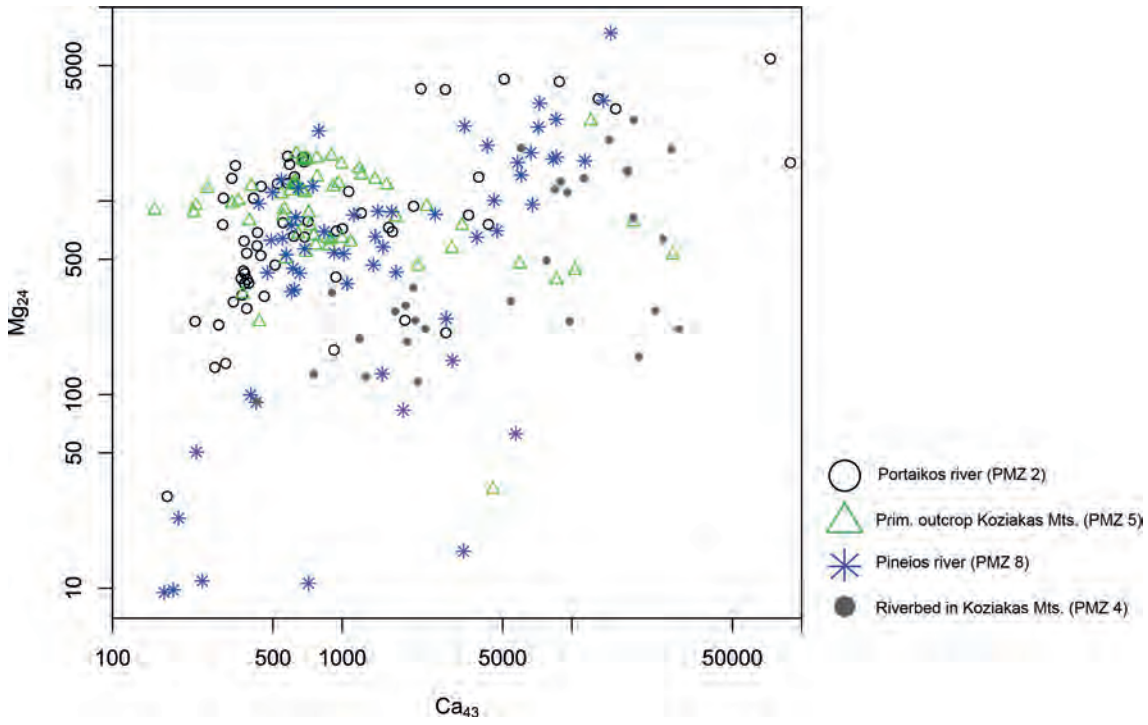



Fig. V.1.29 Calcium (Ca) versus magnesium (Mg) concentration plot of the geological samples (M. Brandl)

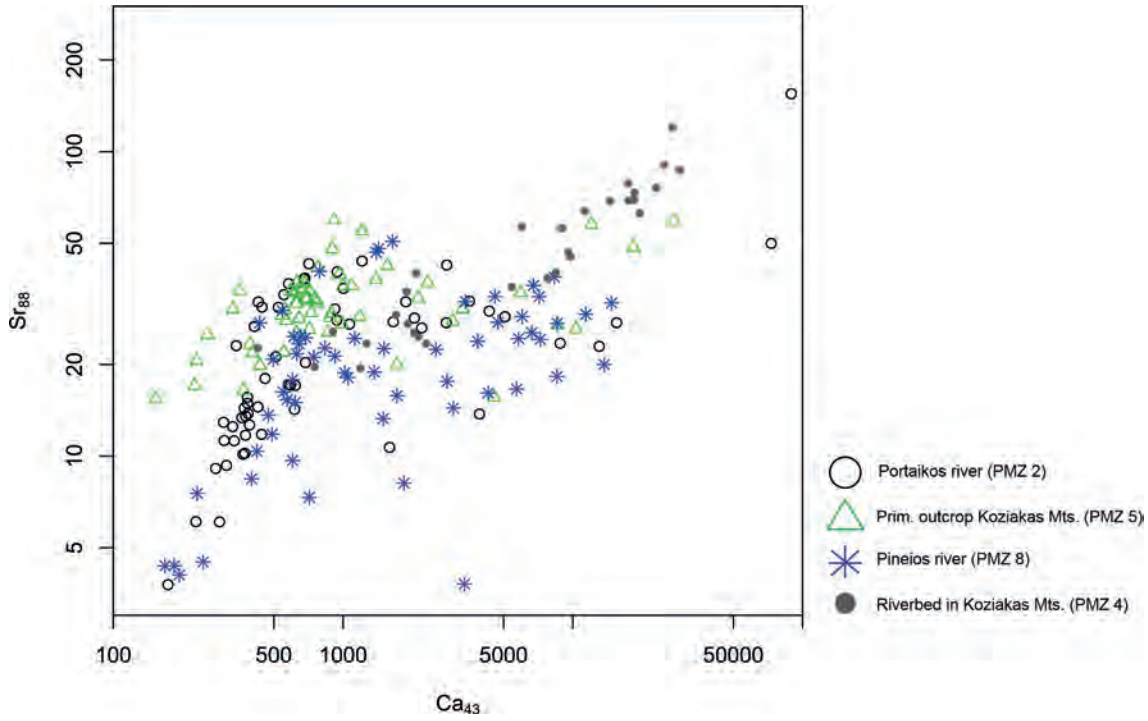



Fig. V.1.30 Calcium (Ca) versus strontium (Sr) concentration plot of the geological samples (M. Brandl)

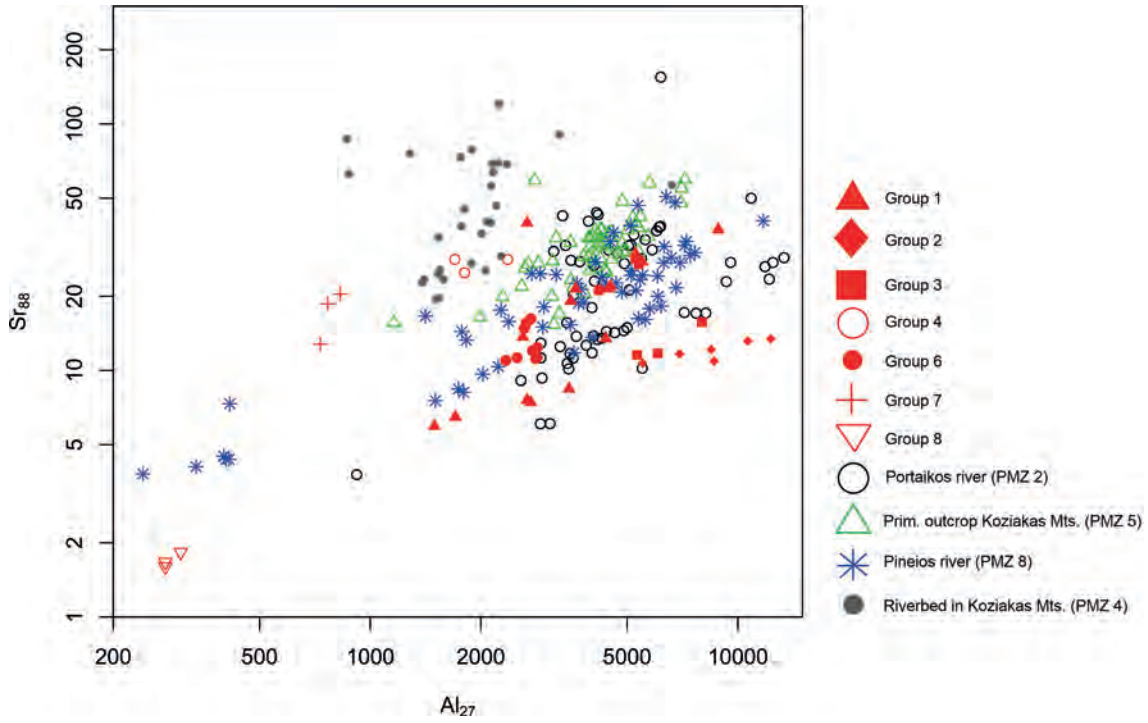



Fig. V.1.31 Aluminium (Al) versus strontium (Sr) concentration plot of the archaeological artefacts (M. Brandl)

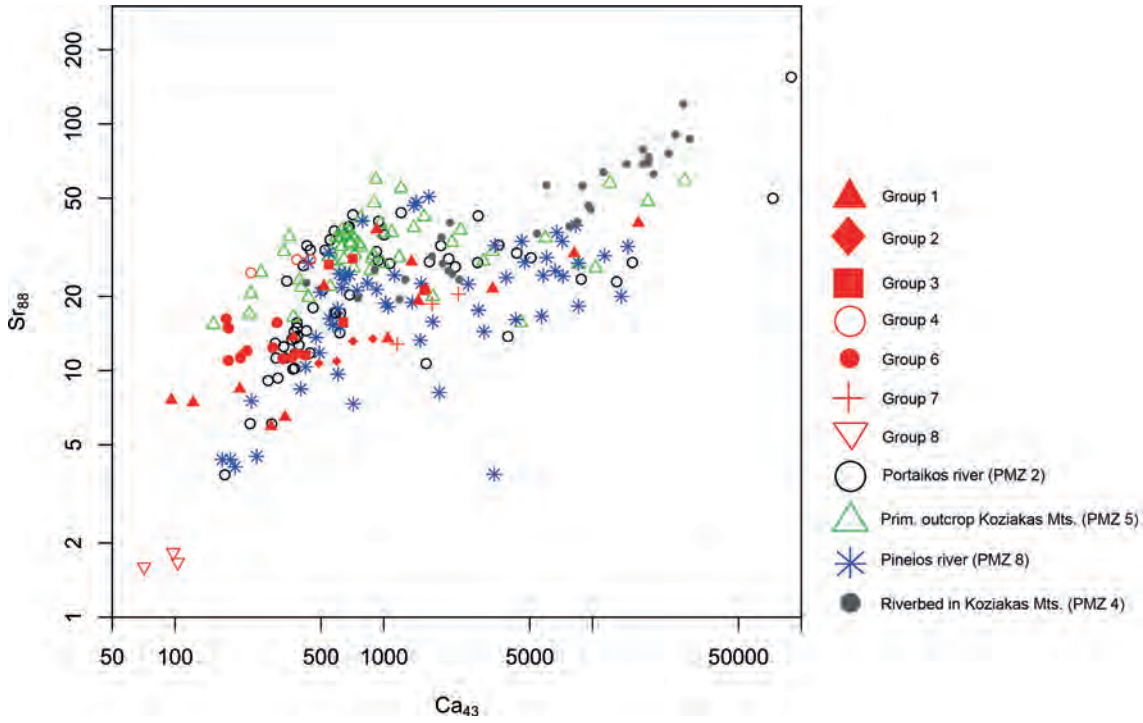



Fig. V.1.32 Calcium (Ca) versus strontium (Sr) concentration plot of the archaeological artefacts (M. Brandl)

misclassification is 22%. Through this measure it was possible to produce a better resolution in source separation (Fig. V.1.33).

As seen in Fig. V.1.33 displaying the quality of assignment, source locations PMZ 2 (Portaikos River) and PMZ 8 (Peneios River) are supplied by source areas displaying similar geochemical properties.

The accuracy of the geochemical information can be tested through the data set obtained from source location PMZ 5, a primary deposit located within the supply zone of the Portaikos River. The statistical result reflects this geological situation perfectly. Additionally, PMZ 4, which served as the geological test sample, can be clearly differentiated from materials derived from the other two river sources. Finally, class assignment was predicted for the test data (i.e. the artefacts). Tab. V.1.21 illustrates the assignment of each investigated artefact from PMZ (i.e. A–O) to the geological source locations.

According to the statistical results, the majority of raw materials for the analysed artefacts were derived from Peneios River gravels (eight specimens), while only three artefacts show a closer affinity to data from Portaikos River samples. Two artefacts can be assigned to the primary outcrop PMZ 5; however, they could also have come from the Portaikos River, which is directly supplied from the catchment area of PMZ 5. Artefact PM0580, a grey chert, shows closest similarities to data from the test sample PMZ 4. It cannot be concluded that this material was collected from this exact river course; however, the source is most likely also found in the Koziakas Range. Specimen PM0252 could not be assigned to any of the sampled source locations and possibly comes from a more distant source area.

*Discussion*

Our study shows the potential and constraints of state-of-the-art lithic provenance studies, particularly considering that the majority of the investigated artefacts were produced from river gravels.

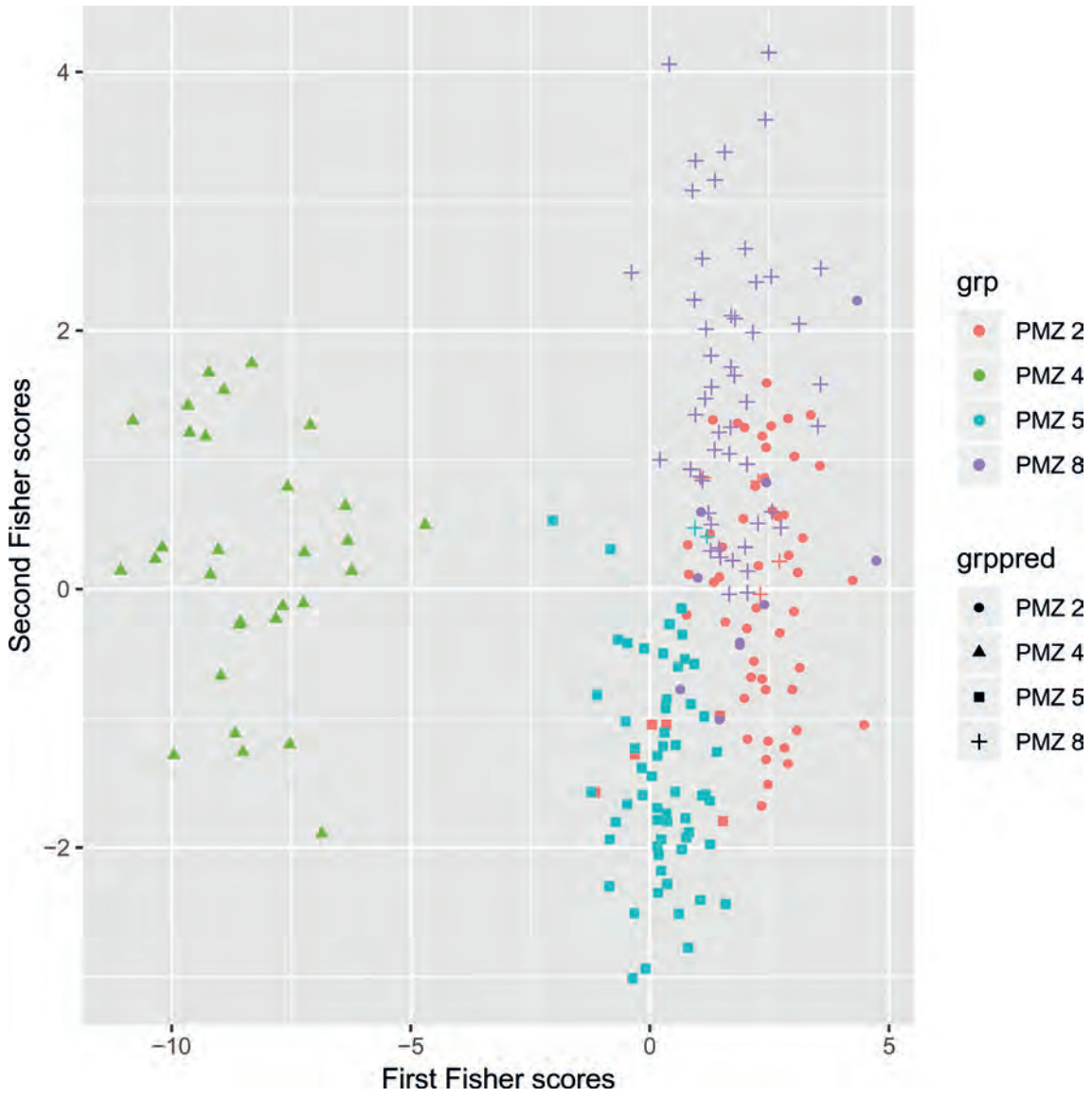



Fig. V.1.33 Fisher resolution plot of the geological source data (M. Brandl)

Sourcing materials from secondary (i.e. river) deposits is an especially challenging endeavour.[455] However, recent undertakings have demonstrated clear possibilities for tracing such materials back to their primary source regions since they exhibit the closest similarities in microfauna and trace element distribution to materials from their original host environments.[456] Consequently, it is also possible to differentiate geological supply zones of gravels, even if the primary sources are not known, provided that the primary formations have characteristics which allow for a separation. Archaeological artefacts produced from raw materials from secondary deposits can thus be traced to potential secondary sources containing material from identified primary host rock environments, as demonstrated in the current undertaking.

[455] E.g. Shelley 1993.
[456] Brandl – Hauzenberger 2018; Brandl et al. 2018.

Tab. V.1.21 Assignment table for geochemical data from the geological sources and the artefacts from PMZ (M. Brandl)

| Artefact | PMZ number | Assignment of source location PMZ |
|---|---|---|
| A | PM0299 | 5 |
| B | PM0248 | 8 |
| C | PM0404 | 2 |
| D | PM0108 | 8 |
| E | PM0380 | 8 |
| F | PM0448 | 8 |
| G | PM0568 | 2 |
| H | PM0884 | 8 |
| I | PM0078 | 8 |
| J | PM0471 | 5 |
| K | PM0811 | 8 |
| L | PM0252 | undetermined |
| M | PM0449 | 8 |
| N | PM0580 | 4 |
| O | PM0461 | 2 |

A geochemical study of Jurassic cherts overlying ophiolitic basalts in the Koziakas Range by N. Skarpelis et al. identified high manganese (Mn) contents in those siliceous rocks.[457] Although the majority of our samples display elevated Mn concentrations, more data from primary deposits would be needed to decide which particular samples collected from secondary sources are associated with the Koziakas ophiolite. This, however, was not the goal of the current study.

Another issue concerns provenance analyses involving radiolarites. Through previous case studies involving radiolarites, we are aware that these materials in particular do not allow secure source allocation based solely on inclusion patterns. Radiolarite is a member of the chert group (see Tab. V.1.17), typically displaying a micro- to cryptocrystalline structure. The rock matrix is composed of organic remains, such as radiolarian and diatom tests, spicules (microscleres) of calcareous marine sponges, and contains several silicon dioxide minerals and mineral varieties. Silt, clay minerals, calcite, clastic quartz, muscovite, biotite, rutile and tourmaline can also occur.[458] In the study region, some sedimentary siliceous rocks underwent subsequent metamorphosis, which resulted in recrystallisation and the almost complete dissolution of once present fossil remains. This material is almost devoid of characteristic fossils, which makes a secure determination difficult. In such cases, the material was classified as chert according to the criteria in Tab. V.1.17. Only few specimens display both preserved rock parts still containing the original fossil content and rock parts altered by metamorphic processes, which allows us to unambiguously identify the rock type (see e.g. Fig. V.1.25).

457 Skarpelis et al. 1992.
458 Brandl et al. 2014.

*Conclusion*

This study produced two significant advancements in lithic studies in Thessaly: First, it was possible to identify sources of the famous 'chocolate radiolarite' in both a primary and a secondary geological position. Second, our geochemical results in combination with compositional data analysis (CODA) allowed us to reconstruct the geological origin of the investigated artefacts, also highlighting the limitations of provenance studies involving secondary sources. It was possible to trace the primary supply zones of gravels from two rivers, the Peneios and the Portaikos. Although the Portaikos originates from the southern end of the Koziakas Mountain range and the Peneios from the northern margin, approximately 40km apart, significant overlapping of the geochemical signatures occurs, indicating that samples from both rivers are related to Mesozoic formations throughout the Koziakas Mountains. Samples from the Portaikos River show a closer affinity to data from the primary deposit at PMZ 5, which was expected given the drainage area of the watercourse, and confirmed through the statistic blind test. Only materials from PMZ 4, a river source deep in the Koziakas Mountains, can unambiguously be separated. Nevertheless, we were able to demonstrate that it is possible to separate the larger source areas supplying the river systems.

One unexpected result of our study is the preference for materials from the Peneios River for tool production, although the geological field survey indicated significantly more material of higher quality in the Portaikos. Consequently, our hypothesis that the Neolithic inhabitants of PMZ preferred the Portaikos River as a raw material source over the Peneios could not be confirmed. This pattern could be a result either of easier accessibility to gravels of the Peneios in Neolithic times, or possibly of local traditions guiding deliberate choices. It is also possible that the Peneios, which is the larger of the two rivers, carried sufficient amounts of high-quality raw materials in its upper course to satisfy the needs of the prehistoric tool makers, and was therefore chosen as the main source. However, our results also indicate that it was not the only source exploited.

The results from this study show the potential of the Multi Layered Chert Sourcing Approach for tracing archaeological materials back to their original (and even secondary) sources, which is the prerequisite and mandatory starting point for reconstructing prehistoric lithic resource management. For PMZ, the sources of some of the most significant non-obsidian materials could thus be established, which significantly contributes to our deeper understanding of Neolithic economic behaviour at this key site for the Greek Neolithic period.

## V.2. The Platia Magoula Zarkou Macrolithics: A Thessalian Industry in its Aegean Neolithic Context

*Anna Stroulia*

### V.2.1. Introduction

Neolithic Thessaly has been explored for over a century and a substantial body of data has been generated on different aspects of its cultures.[459] Yet, due to an almost complete lack of systematic publications, rather little is known about Thessalian macrolithic[460] industries. This is a gap that the following thorough presentation of the material from Platia Magoula Zarkou (henceforth PMZ) aims to address.

Located by the Peneios River on the Western Thessalian Plain, PMZ consists of a 6–7m-high tell covering an area of c. 1.9 hectares. The site was investigated in the course of six field seasons (1976–1990) by the Greek Archaeological Service under the direction of Kostas Gallis. Trench A was dug near the centre of the tell and is the only one that yielded stratified deposits. Initially 5 × 7m, the dimensions of the trench were gradually reduced. When the excavation reached the sterile layer at 10.7m below surface, the trench measured only 2 × 2m.[461]

The impressively thick deposit of Trench A has two components. The first dates to the Bronze Age and comprises the topmost 4.2m of the sequence. Dating to the Neolithic period, the second component is 5.8m thick (from 4.2m to 10.0m below the surface). Its eastern part, however, is cut by a large Early Bronze Age pit down to 5.3m below the surface.[462] Unless otherwise noted, the rest of this chapter refers to the Neolithic deposit only.

A total of nine Neolithic building phases (BPh I–IX) were identified, spanning approximately 400 years (c. 5900–5500 calBC 2σ).[463] Subphases were distinguished in five of them (BSPh IIIa–c, IVa–b, Va–e, VIa–b, and VIIa–c). BPh I–VI and VIIb–IX date to the Middle Neolithic and early Late Neolithic, respectively. BSPh VIIa, on the other hand, was assigned to the transition between the Middle Neolithic and the Late Neolithic.[464]

Consisting of a ditch at the base of the sequence,[465] BPh I contained a small number of artefacts and animal bones, as well as pieces of burnt clay from thermal and other structures. BPh II comprises the overlying sediments. These lack in situ architectural remains but include pieces of burnt clay structures. Each of the following building phases/subphases is defined by a (usually) horizontal activity surface (conventionally called a 'floor'), the associated architectural and other remains (walls, postholes, thermal features, pits, undetermined clay structures or concentrations of ashes and charcoal), as well as the sediments between this surface and the one above it. A total of 16 floors were identified (F19–F34).[466]

Wall remains were found in BSPh IIIa, IIIc, IVa–b, VIa–b, and VIIc. Represented by a series of postholes dug on one side of the trench, the BSPh IIIa wall appears to belong to a post-framed building. In BSPh IIIc, a clay feature tentatively identified as a wall was found in association with a floor and a posthole. In BSPh IVa and IVb, two clay (possibly mudbrick) walls were found on

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459 E.g. Karimali 1994; Reingruber 2005; Toufexis 2016; Dimoula 2017; Pentedeka 2017a; Sarris et al. 2017b.

460 For a discussion of the term 'macrolithics' and its advantages over the traditional term 'ground stone' see Adams et al. 2009; Stroulia 2018a.

461 Toufexis – Batzelas, this volume, 81–83.

462 Toufexis – Batzelas, this volume, 83.

463 Toufexis – Batzelas, this volume, 86; Weninger et al., this volume, 195.

464 Toufexis – Batzelas, this volume, 86.

465 The geophysical survey revealed portions of several other ditches. Their chronological relation to the excavated ditch is unclear, see Sarris et al., this volume, 69–71; Souvatzi, this volume, 593–594.

466 Toufexis – Batzelas, this volume, 84–138.

top of each other. They appear to have been parts of superimposed houses. Each of BSPh VIa and VIb yielded two thin, non-joining clay walls, probably representing light structures situated within an open area. In BSPh VIIc, a series of holes – remains of a post-framed wall – was recovered on one side of what was probably a large open space.

Wall remnants were not identified in the areas assigned to BSPh VIIa and VIIb, but destruction layers imply the existence of houses in their eastern part. The western part in each case appears to represent an outdoor area. Finally, there is no evidence to suggest the existence of buildings in the areas assigned to BPh/BSPh IIIb, Va–e, VIII, and IX. These appear to belong to outdoor spaces (perhaps courtyards) with or without thermal structures, pits, or other features.[467]

Among the Neolithic materials uncovered at the site are the 133 macrolithic specimens presented in this chapter. Neither dry nor water sieving was employed during the excavations. However, judging by the various unmodified pebbles and cobbles[468] included among the excavated finds, I consider the collection process to have been fairly thorough.[469] Unfortunately, not all macrolithics collected in the field were studied. I am referring here to a few inventoried specimens that have not been located in the PMZ storage area of the Diachronic Museum of Larissa.

Each artefact was examined macroscopically and under low magnification (45× maximum). Microwear and residue analyses were not feasible. The assemblage has not been subjected to petrographic, mineralogical, or geochemical analysis either. Visual inspection by geologists Vasilios and Margarita Melfos nevertheless distinguished a variety of raw materials. All but one are of local origin.[470]

On the basis of technomorphological characteristics, I divided the assemblage into five groups: 1) grinding and abrading tools; 2) celts; 3) percussive tools; 4) tools with narrow grooves; 5) miscellanea. The first four groups are relatively homogeneous, the fifth is not. Each group is discussed in one of the following five sections. Given the groups' small sizes, Middle Neolithic and Late Neolithic specimens are presented together. Nevertheless, any differences discerned between the tools of the two phases are noted in the appropriate contexts.

The discussion of each group is accompanied by a table with basic information for all included specimens. In each table, specimens are listed by depth. An asterisk accompanies the fragmentary specimens whose preserved length (measured along the original long axis) is smaller than the preserved width (measured along the original wide axis). The tables contain the following abbreviations: Inv. = Inventory; BPh/BSPh = Building Phase/Building Subphase; Pres. = preservation; c = complete; c- = nearly complete; f = fragmentary; Lg = Length; Wd = width; Th = thickness; Lg/Wd = length/width ratio, Wd/Th = width/thickness ratio, n/a = non-applicable; PT = passive tool; AT = active tool, PT+AT = tool used both passively and actively.

In the remainder of this chapter, I offer a thorough presentation of each group, following the main stages in the tools' biographies (i.e. acquisition of raw material, manufacture, use, curation, and discard); discuss the tools' horizontal and vertical distribution; and compare the PMZ macrolithic industry with others, placing it in its broader Aegean Neolithic context. Tab. V.2.1 lists all Aegean sites mentioned in the text along with relevant bibliographic references. Parenthetical numbers accompanying site names in the text match up with references cited in Tab. V.2.1.

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467 Toufexis – Batzelas, this volume, 126–129.

468 I use the term 'pebble' in this study to refer to a rock measuring no more than 6cm in maximum dimension; 'cobble' for one measuring 6–25cm; and 'boulder' for one larger than 25cm, see Wright 1992.

469 See also Perlès – Papagiannaki, this volume, 200; Giorgos Toufexis, personal communication.

470 Possible sources of macrolithic raw materials were located in the context of two surveys. The first was carried out in 2016 by Vasilios Melfos, Matina Karageorgiou, and the author; the second in 2019 by Michael Brandl, Giorgos Toufexis, and Christos Batzelas.

Tab. V.2.1 Aegean sites mentioned in the text and relevant bibliographic references (A. Stroulia)

| Site | Reference |
|---|---|
| Achilleion | (1) Winn – Shimabuku 1989 |
| Aghios Kosmas | (1) Runnels 1981 |
| Ag. Petros | (1) Efstratiou 1985 |
| Akrotiri | (1) Moundrea-Agrafioti 2008 |
| Alepotrypa Cave | (1) Stroulia 2018a<br>(2) Stratouli 2018 |
| Angelochori | (1) Bekiaris et al. 2021 |
| Apsalos | (1) Ninou 2006 |
| Archontiko | (1) Bekiaris et al. 2021 |
| Argissa | (1) Milojčić 1962<br>(2) Perlès 2001 |
| Asine | (1) Runnels 1981 |
| Avgi | (1) Bekiaris et al. 2017<br>(2) Bekiaris 2018<br>(3) Bekiaris 2020<br>(4) Stratouli et al. 2020 |
| Ayioryitika | (1) Petrakis 1999 |
| Ag. Vlasis | (1) Chondrou et al. 2021 |
| Cyclops Cave | (1) Sampson – Orphanidis 2008 |
| Dikili Tash | (1) Séfériadès 1992a<br>(2) Séfériadès 1992b<br>(3) Christidou 2005<br>(4) Chondrou et al. 2021 |
| Dimini | (1) Tsountas 1908<br>(2) Moundrea-Agrafioti 1981<br>(3) Moundrea-Agrafioti 1987 |
| Dispilio | (1) Stratouli 2002<br>(2) Touloumis 2002<br>(3) Melfos – Stratouli 2002<br>(4) Ninou 2006<br>(5) Ninou 2008 |
| Drakaina Cave | (1) Stratouli 2005<br>(2) Stratouli – Melfos 2008<br>(3) Stratouli et al. 2014<br>(4) Melfos et al. 2020<br>(5) Stratouli et al. 2021<br>(6) Bekiaris in preparation |
| Elateia | (1) Weinberg 1962 |
| Franchthi Cave | (1) Runnels 1981<br>(2) Stroulia 2003<br>(3) Stroulia 2010<br>(4) personal observation |
| Ftelia | (1) Sampson 2002 |
| Heliotopos | (1) Chadou 2011 |
| Kitsos Cave | (1) Perlès 1981<br>(2) Cohen – Runnels 1981<br>(3) Vialou 1981 |
| Kleitos (I and II) | (1) Chondrou et al. 2018<br>(2) Chondrou 2020<br>(3) Chondrou et al. 2021<br>(4) Chondrou – Valamoti 2021 |
| Knossos | (1) Evans 1964<br>(2) Warren et al. 1968<br>(3) Strasser 2004<br>(4) Strasser 2008<br>(5) Strasser – Fassoulas 2003/2004<br>(6) Moundrea-Agrafioti 1992<br>(7) Sampson – Sugaya 1988/1989 |
| Kommos | (1) Blitzer 1995 |
| Koromilia | (1) Bekiaris 2018a |
| Koronia | (1) Almasidou 2019 |
| Kouphovouno | (1) Renard 1989 |
| Kremasti-Koilada | (1) Chondrou 2011<br>(2) Stroulia – Chondrou 2013<br>(3) Stroulia 2014<br>(4) Stroulia et al. 2017<br>(5) personal observation<br>(6) Chondrogianni-Metoki 2009 |
| Lerna | (1) Banks 2015<br>(2) Runnels 1981<br>(3) Pawlikowski – Such, unpublished |
| Berbati-Limnes Survey Findspot 39 | (1) Runnels 1996 |
| Limnes Cave | (1) Sampson 1997 |
| Makri | (1) Bekiaris 2007<br>(2) Efstratiou – Ntinou 2004<br>(3) Melfos et al. 2001<br>(4) Stroulia 2005b |
| Makrychori | (1) G. Toufexis, personal communication |
| Makriyalos | (1) Yeroussi 1999<br>(2) Tsoraki 2007<br>(3) Tsoraki 2008<br>(4) Tsoraki 2011a<br>(5) Tsoraki 2011b<br>(6) Tsoraki 2011c<br>(7) Pappa et al. 2013 |
| Mallia-Quartier Mu | (1) Procopiou 2013 |
| Mandra | (1) G. Toufexis, personal communication |
| Megalo Nisi Galanis | (1) Stroulia 2005a<br>(2) Fotiadis et al. 2019<br>(3) personal observation |
| Mesimeriani | (1) Alisøy 2002a<br>(2) Alisøy 2000b |

Tab. V.2.1 (continued)

| Site | Reference |
|---|---|
| Mikro Nisi Akrinis | (1) Stroulia 2005a<br>(2) personal observation |
| Mycenae | (1) Runnels 1981<br>(2) Evely – Runnels 1992 |
| Nea Nikomedeia | (1) Pyke 1993<br>(2) Rodden 1962<br>(3) Sugaya 1992 |
| Olynthus | (1) Mylonas 1929 |
| Palioskala | (1) G. Toufexis, personal communication |
| Paradeisos | (1) Hellström 1987 |
| Piges Koromilias Cave | (1) Trantalidou – Andreasen 2011/2012 |
| Pontokomi-Souloukia | (1) Stroulia et al. in press<br>(2) personal observation |
| Prodromos | (1) Moundrea 1975 |
| Rachmani | (1) Wace – Thompson 1912<br>(2) G. Toufexis, personal communication |
| Saliagos | (1) Evans – Renfrew 1968<br>(2) Oosterom 1968 |
| Sarakenos Cave | (1) Sampson 2008 |
| Servia | (1) Mould et al. 2000<br>(2) personal observation |
| Sesklo | (1) Tsountas 1908<br>(2) Moundrea-Agrafioti 1981<br>(3) Moundrea-Agrafioti 1987<br>(4) Wijnen 1982<br>(5) Christopoulou 1992 |
| Sitagroi | (1) Elster 2003a<br>(2) Elster 2003b<br>(3) Dixon 2003a<br>(4) Dixon 2003b<br>(5) Christidou 2005 |
| Sosandra | (1) Georgiadou 2015 |
| Stavroupoli | (1) Alisøy 2002a<br>(2) Kotsakis – Kotsos 2013<br>(3) Chondrou et al. 2021 |
| Tharrounia/ Skoteini Cave | (1) Sugaya 1993<br>(2) Sampson – Sugaya 1988/1989<br>(3) Stratouli 1993 |
| Theopetra Cave | (1) Kyparissi-Apostolika 1996<br>(2) Christopoulou 2000 |
| Tiryns | (1) Runnels 1981 |
| Toumba Thessalonikis | (1) Agatzioti 2000<br>(2) Tsiolaki 2009 |
| Tsoungiza | (1) Dabney et al. 2020 |
| Varemenoi Goulon | (1) Stroulia 2018b<br>(2) personal observation |
| Visviki Magoula | (1) Bergner 2015 |
| Yali | (1) Georgiadis 2017 |
| Zas Cave | (1) Zachos 1999 |

## V.2.2. Grinding and Abrading Tools

This group comprises 54 substantial-sized specimens with one or two open work faces (Tab. V.2.2). Most were probably part of toolkits used to grind intermediate substances such as foodstuffs.[471] Grinding toolkits comprise a lower stationary component and an upper mobile one. In the literature, the first is often referred to as a millstone, quern, metate, grinding slab, etc., the second as a handstone, mano, grinder, rubber, etc.[472] Here I use the more neutral terms ‘passive tool’ and ‘active tool’, respectively. A few specimens were additionally or exclusively employed in abrading tasks related to the manufacture or maintenance of celts, bone tools,[473] ornaments,[474] etc. In these contexts, they were used independently – without a complementary component. For the sake of convenience, in the remainder of this section, I use the term ‘grinding tools’ unless I refer specifically to specimens with abrading functions.

[471] The processed foodstuffs probably included glume wheats (emmer and einkorn), hulled barley, and bitter vetch like those found in the small sample of Neolithic botanical remains, see Jones – Halstead 1993. Microwear and phytolith evidence for the use of such tools in grinding grains and pulses comes from Kremasti-Koilada (4), Megalo Nisi Galanis (2), Kleitos (1, 3), Ag. Vlasis (1), Diki Tash (4), Stavroupoli (3), and Pontokomi-Souloukia (1).

[472] See Evans – Renfrew 1968, 71; Hayden 1987a; Hayden 1987b; Wright 1992; Schelberg 1997; Elster 2003a; Tsoraki 2007; Wright – Baysal 2012.

[473] See Christidou, this volume, 358–362.

[474] See Kyparissi-Apostolika, this volume, 571.

Tab. V.2.2 Grinding and abrading tools (A. Stroulia)

| PMZ No. | Old Inv. No. (BE) | Depth [m] | BPh/ BSPh | Date | Material | Function | Pres. | Lg [cm] | Wd [cm] | Th [cm] |
|---|---|---|---|---|---|---|---|---|---|---|
| PM0897 | 617 | 10.35 | I | MN | Gneiss | PT | f | 6.6 | 6.1 | 3.3 |
| PM0894 | 614 | 9.8 | II | MN | Gneiss | PT | f | 17.2 | 17.1 | 6.6 |
| PM0893 | 613 | 9.78 | II | MN | Schist | PT | c- | 25.5 | 15.6 | 5.4 |
| PM0879 | 599 | 9.64 | II | MN | Schist | PT | f | 14.3 | 8.1 | 3.2 |
| PM0877 | 597 | 9.54 | II | MN | Gneiss | PT | f | 16.6 | 4.6 | 5.3 |
| PM0947 | 915 | 9.50–9.77 | II | MN | Gneiss | PT | f | 15.7 | 5.1 | 5.7 |
| PM0952 | 920 | 9.50–9.77 | II | MN | ? | ? | f | 9.2 | 6 | 6.9 |
| PM0954 | 922 | 9.50–9.77 | II | MN | Gneiss | AT | f | 13.4 | 8.8 | 4.6 |
| PM0955 | 923 | 9.50–9.77 | II | MN | Gneiss | AT | f | *10.3 | 12.7 | 4.7 |
| PM0864 | 584 | 9.36 | IIIa | MN | Schist | PT | f | *13.6 | 13 | 2.9 |
| PM0858 | 579 | 9.35 | IIIa | MN | Sandstone | AT | f | 15.3 | 6.3 | 2.9 |
| PM0856 | 577 | 9.34 | IIIa | MN | Gneiss | AT | f | 12.7 | 11 | 5.7 |
| PM0843 | 564 | 8.9 | IIIb | MN | Schist | AT | f | 17.5 | 9.2 | 7.7 |
| PM0817 | 538 | 8.64 | IIIb | MN | Gneiss | ? | f | 13.3 | 12.7 | 4.9 |
| PM0809 | 530 | 8.53 | IIIc | MN | Gneiss | AT | f | 10.3 | 5.1 | 5.9 |
| PM0796 | 517 | 8.29 | IVa | MN | Schist | PT | f | 17.8 | 6.5 | 3.7 |
| PM0795 | 516 | 8.18 | IVa | MN | Schist | AT | c | 28.6 | 14 | 5.4 |
| PM0772 | 493 | 7.62 | Va | MN | Sandstone | PT | f | *14.7 | 15.7 | 6.5 |
| PM0762 | 483 | 7.43 | Va | MN | Sandstone | AT | f | 10.6 | 9.2 | 4.1 |
| PM0760 | 479 | 7.39 | Vb | MN | Gneiss | AT | c | 25.5 | 13.5 | 5.5 |
| PM0756 | 478 | 7.29 | Vb | MN | Gneiss | PT | f | *12.2 | 14.9 | 5.2 |
| PM0759 | 482a | 7.28 | Vb | MN | Sandstone | AT | f | 17.5 | 9.7 | 5.3 |
| PM0748 | 470 | ~7 | Vb | MN | Gneiss | PT | f | 19.9 | 16.4 | 7.1 |
| PM0749 | 471 | ~7 | Vb | MN | Gneiss | PT | f | 12.9 | 8.3 | 4.4 |
| PM0745 | 467 | 6.95 | Vc | MN | Gneiss | PT | f | 29.3 | 19.1 | 18.5 |
| PM0740 | 462 | 6.75 | Vd | MN | Gneiss | AT | c- | 22.9 | 15.8 | 6.4 |
| PM0732 | 455 | 6.77 | Vd | MN | Sandstone | AT | f | 10.1 | 9.6 | 4.2 |
| PM0731 | 454 | 6.7 | Vd | MN | ? | AT | f | 9.6 | 5 | 2.5 |
| PM0721 | 444 | 6.5 | Ve | MN | Sandstone | AT | f | *13 | 13.3 | 5.2 |
| PM0720 | 443 | 6.49 | Ve | MN | Gneiss | PT | f | 14.1 | 14 | 5.9 |
| PM0699 | 427 | 6.34 | VIa | MN | Gneiss | AT | c- | 20.2 | 13.9 | 7.3 |
| PM0691 | 420 | 6.32 | VIa | MN | Schist | PT | c | 27.1 | 16.5 | 5.9 |
| PM0714 | 409 | 6.25 | VIa | MN | Gneiss | AT | c | 25.2 | 16.6 | 7.1 |
| PM0677 | 405 | 6.2 | VIa | MN | Schist | PT | f | 17.2 | 16.1 | 5.6 |
| PM0942 | | 6.15–6.20/6.25 | VIa | MN | Schist | AT | f | 10.5 | 7.1 | 3.5 |
| PM0694 | 422c | 6.01 | VIa | MN | Schist | PT | f | 22.4 | 7.8 | 6.9 |
| PM0693 | 422b | 6.01 | VIa | MN | Gneiss | ? | f | 14.5 | 8.5 | 4.7 |
| PM0695 | 422a | 6.01 | VIa | MN | Gneiss | PT | f | 37.2 | 16.5 | 9.8 |
| PM1095 | | 5.70–5.81 | VIb | MN | Gneiss | ? | f | 13.6 | 6.9 | 7.5 |
| PM0945 | 913 | 5.52–5.62 | VIb | MN | ? | PT | f | 18.7 | 15.2 | 6.2 |
| PM0946 | 914 | 5.52–5.62 | VIb | MN | Gneiss | AT | c- | 27.3 | 12.4 | 5.6 |
| PM0989 | 328 | 5.34 | VIIa | MN/LN | Sandstone | PT | f | *10.9 | 18.5 | 3.9 |
| PM0535 | 267a | 5.15 | VIIb | LN | Gneiss | AT | f | 12.2 | 11.5 | 5.9 |
| PM0554 | 290a | 5.14 | VIIb | LN | Sandstone | PT+AT | f | 15.8 | 9.9 | 4.6 |
| PM0518 | 260c | 5.12 | VIIb | LN | Gneiss | PT | f | *12.9 | 14.3 | 5.2 |
| PM1092 | | 5.04–5.26 | VIIb | LN | Gneiss | AT | f | 18.7 | 13.8 | 7.5 |
| PM1093 | | 5.04–5.26 | VIIb | LN | Gneiss | AT | f | *6.2 | 10 | 6.2 |
| PM1094 | | 5.04–5.26 | VIIb | LN | Gneiss | AT | f | 11.6 | 10.8 | 4.5 |
| PM0491 | 240a | 4.86–4.91 | VIII | LN | Schist | PT | f | 27.3 | 13.6 | 6.2 |
| PM0492 | 240b | 4.86–4.91 | VIII | LN | Sandstone | AT | c- | 23 | 13.5 | 4.6 |
| PM0493 | 240c | 4.86–4.91 | VIII | LN | Gneiss | PT | f | 21.7 | 14.2 | 7.2 |
| PM0450 | 214a | 4.78 | VIII | LN | Gneiss | AT | f | 32.5 | 14.2 | 8.4 |
| PM1071 | | 4.76–4.82 | VIII | LN | Sandstone | PT | f | 13.9 | 11.6 | 4.7 |
| PM1070 | | 4.28/4.30–4.33/4.36 | VIII | LN | Sandstone | PT | f | *11.1 | 16.6 | 4.2 |

Forty-one tools (76%) date to the Middle Neolithic, twelve (22%) to the Late Neolithic, and one to the Middle Neolithic/Late Neolithic (2%). The sample is admittedly small, but, relatively speaking, the percentages of Middle Neolithic and Late Neolithic specimens are consistent with the volumes of excavated Middle Neolithic and Late Neolithic deposits (62% and 23%, respectively).[475]

Only nine tools (17%) are complete. This number includes five nearly complete specimens (missing a part so small or from such a location that their basic dimensions remain essentially unaffected). The vast majority of specimens (n=45 or 83%) are fragmentary. Refits were not found.

Given the high percentage of fragments, the non-microscopic level of analysis, and the absence of complete toolkits, the distinction between active and passive grinding tools was not always straightforward. Nevertheless, I classified 25 specimens (46%) as passive and 24 (44%) as active on the basis of technomorphological characteristics and/or macroscopic use wear. One tool (2%) shows both passive and active wear, whereas the function of the remaining four (7%) is uncertain.

Three main raw materials – gneiss, schist, and sandstone – were identified. Gneiss and schist are locally available in the form of waterworn cobbles and boulders, while sandstone is of (micro) regional origin.[476] Gneiss is rather coarse and accounts for over half of the specimens (n=29 or 54%). Schist is less coarse and accounts for eleven specimens (20%). Sandstone, nearly all of which is fine grained, was used for another eleven (20%) (Figs. V.2.1–11). The material of the remaining three specimens (6%) remains undetermined. Gneiss is the most common material in both the Middle Neolithic and the Late Neolithic and among both passive and active tools, but the schist and sandstone frequencies between the two phases and tool types vary. Due to the small size of the sample, I cannot tell whether these differences reflect general patterns in raw material choice. Without microwear, residue, and experimental studies, it is also impossible to tell whether the three main lithologies were associated with processing different substances or, instead, with producing coarser versus finer textures.

Regarding raw materials and their procurement, PMZ is fairly typical. Though not the sole ones, gneiss, schist, and sandstone are common lithologies for grinding tools in Thessalian sites: see Ag. Petros (1), Rachmani (1), Achilleion (1), Sesklo (4), and Argissa (1). They were also common elsewhere in the Aegean: see Elateia (1), Dispilio (2, 4, 5), Apsalos (1), Lerna (1), Franchthi Cave (1, 3), Tsoungiza (1), Alepotrypa Cave (1), Varemenoi Goulon (2), Kremasti-Koilada (1, 4), Makri (1), Megalo Nisi Galanis (1, 2), Kleitos (1, 2), Sitagroi (1, 2, 3, 4), Saliagos (1), Stavroupoli (1), Servia (1), Drakaina Cave (4, 5, 6), Avgi (1, 2, 3), Makriyalos (2, 3), Sosandra (1), Limnes Cave (1), Sarakenos Cave (1), Cyclops Cave (1), Koronia (1), Koromilia (1), and Pontokomi-Souloukia (1). These (and other) stone types were collected rather than extracted; quarrying was not one of the procurement methods for grinding tool raw materials in Neolithic Greece.[477] Although systematic petrographic, mineralogical, or geochemical analyses have been rare, it appears that, as a rule, local or regional sources were exploited. Materials from more remote sources (over 30–35km away) were only used for certain specimens from Franchthi Cave (1, 3), Kitsos Cave (2), Makri (1, 3), Sitagroi (1, 3, 4), Stavroupoli (1), Makriyalos (3), and, possibly, Argissa (2) and Achilleion (1).[478]

Raw materials at PMZ were transformed into grinding tools by pecking, flaking, and, only rarely, splitting. Only two unfinished grinding tools were found. Both are broken. The first – intended for a passive tool – is a boulder with pecking traces on one face (PM0745). The second was probably meant to be an active tool (PM0450). Its ventral face is pecked, whereas the dorsal face and sides are flaked. Two other tools are lightly used, but their work faces appear to have

[475] Christos Batzelas, personal communication.
[476] Two secondary sources of sandstone were located c. 12km and 18km northeast of the site.
[477] See also Bekiaris et al. 2020.
[478] See also Georgiadis 2017 for the use of materials from remote sources in some Dodecanesian islands.

been produced through splitting (PM0954 and PM1093). The work faces of other specimens do not preserve manufacturing traces. Such traces must have been obliterated by use.[479]

Manufacturing evidence is more often visible on parts of tools not affected by use, i.e. dorsal face, sides, or ends. These were pecked and/or flaked to produce (symmetrical or asymmetrical) subrectangular, ovate, subtrapezoidal, or elliptical plans and (lightly or strongly) convex dorsal faces (Figs. V.2.1–11). The sides of at least one active tool appear to have been flaked to facilitate holding (Fig. V.2.3). Pecking and flaking were not always systematic. Variations in the extent of raw material modification, manufacturing techniques, or care applied to the production process may reflect individual preferences, stone working abilities, time availability, the shape of the raw material, etc.

Overall, the manufacturing process was simple. There is nothing to suggest that the production of grinding tools was a specialised craft carried out by only a few members of the community. At the same time, there is nothing to preclude a specialisation by gender in the making (and use) of these tools such as that encountered in various ethnographic contexts.[480]

The two unfinished grinding tools were excavated in sediments between floors and thus not in situ. A number of percussive tools were also recovered. These may have been involved in the manufacture of grinding tools, but could very well have served other purposes, e.g. resharpening the work faces of these tools or shaping other objects (see below). Unworked raw materials suitable for grinding tools or by-products of the manufacturing process were not found. On this basis, I would argue that the excavated areas did not serve as loci of grinding tool production on a regular basis. Grinding tools must have been fashioned in other parts of the settlement or even outside the settlement.

Of the nine complete or nearly complete specimens, two have been classified as passive, seven as active. Measuring 27.1 × 16.5 × 5.9cm and 25.5 × 15.6 × 5.4cm, the two complete passive tools are rather small and could have been used to process only small quantities of food or other substances (Figs. V.2.7, V.2.9). The complete active tools, on the other hand, are large, ranging from 20.2 to 28.6cm in length, from 13.5 to 15.8cm in width, and from 4.6 to 7.3cm in thickness (Figs. V.2.1–2, V.2.3–4, V.2.6). There is no doubt that these tools were held with both hands during use. Moreover, the use wear extends from one end of the work face to the other, indicating that the length of the active specimens was roughly similar to the width of their passive counterparts. Clearly, the complete active tools are too large for use in conjunction with passive tools such as the complete ones. Their sizes are incompatible.

Some of the discrepancy exhibited by the complete tools can be reconciled through the broken specimens. Several fragments derive from passive tools much larger than the complete ones, e.g. PM0695 (37.2 × 16.5 × 9.8cm) and unfinished PM0745 (29.3 × 19.1 × 18.5cm). Such passive implements would have been compatible with active tools as large as the complete ones. Fragments, on the other hand, securely deriving from small active tools (no longer than 16–17cm) that could match the small complete passive implements, are missing. Perhaps they were fashioned out of wood and were thus not preserved.[481] Alternatively, they were discarded outside the excavated area. Either way, numerical discrepancies between passive and active specimens have been noted

[479] This pattern is rather common. See, for example, the assemblages from Franchthi Cave (2) and Alepotrypa Cave (1).

[480] See Hayden 1987a; Hayden 1987b; David 1998; Baudais – Lundström-Baudais 2002; D'Andrea – Mitiku 2002; Katz 2003; Gelbert 2005; Searcy 2011; Hamon – Le Gall 2013; Arthur 2014; Robitaille 2016; Nixon-Darcus – D'Andrea 2017; Shoemaker et al. 2017.

[481] The use of wooden active grinding tools has been proposed for Bronze Age southern Iberian assemblages, see Menasanch et al. 2002; Delgado Raack – Risch 2009; Delgado Raack – Risch 2016.

Figs. V.2.1–3 1. Active grinding tool PM0740 (gneiss): work face and sections; 2. Active grinding tool PM0795 (schist): one of the work faces and both sections; 3. Active grinding tool PM0492 (sandstone): work face and sections (photos: A. Stroulia, drawings: R. Exarhou)

at other Greek Neolithic sites; see Heliotopos (1), Alepotrypa Cave (1), and Pontokomi-Souloukia (1).[482] They are also known at sites from other periods or areas.[483]

If my understanding is correct, the PMZ community used both large and small grinding toolkits. The large ones comprised a passive and an active component at least 40cm and 20cm long, respectively. The small ones comprised a passive tool no longer than 30cm and an active one (of stone or possibly wood) no longer than 17cm. Both large and small toolkits were employed in the Middle Neolithic. Regarding the Late Neolithic, the use of large toolkits is certain, while that of small ones is not. Large toolkits may have been present in both the Middle Neolithic and the Late Neolithic, but no installations that would accommodate them were excavated in strata of either phase. This absence is consistent with the general Aegean Neolithic picture. Grinding installations are securely known from only two sites: Lerna (1) and Stavroupoli (2).[484]

Without microwear or residue analysis, the functional significance of the distinction between large and small toolkits at PMZ cannot be determined. Such a distinction is, however, well known ethnographically and is generally associated with processing different substances. As a rule, large toolkits are used for grinding grain, small ones for condiments, spices, salt, pigments, medicinal plants, and, sometimes, small grain varieties (e.g. millet).[485] Whatever their functions, the presence of both large and small toolkits at PMZ points to a fairly well-structured grinding system.

The number of Bronze Age grinding tools found at the site (fewer than a dozen) is much smaller than those dated to the Neolithic. More than half are fragmentary, but there is no doubt that some of the fragments belong to large tools. The sizes of grinding tools in Neolithic and Bronze Age Greece have been a subject of discussion, to which the PMZ material can contribute. Based upon a study of a few southern assemblages, Curtis Runnels argued more than three decades ago that Aegean grinding tools were small (with passive tools no longer than 30cm) during the Neolithic and only increased in size during the Bronze Age.[486] Runnels' old claim regarding the generally small size of the Neolithic material was recently reproduced.[487] I disagree with this characterisation and consider it to be a misconception shaped by high rates of fragmentation. My survey of the sizes of both complete and fragmentary tools has revealed a more complex picture.[488] Some Neolithic assemblages, like that of PMZ, include both small and large specimens; see Dispilio (2, 4), Servia (1), Stavroupoli (1), and Avgi (2, 3). Others comprise primarily small tools; see Franchthi Cave (1, 3), Lerna (1, 2), and Makriyalos (3). Yet others appear to include primarily large specimens; see Pontokomi-Souloukia (1), Kremasti-Koilada (1, 4, 5), Alepotrypa Cave (1), and Koromilia (1).[489] A comparable variation characterises Bronze Age assemblages. Most include both small and large specimens: see Servia (1), Mesimeriani (1, 2), Toumba Thessalonikis (1, 2), Asine (1), Lerna (2), Tiryns (1), Mallia-Quartier Mu (1), Ag. Kosmas (1), Kommos (1), Angelochori (1) and Archontiko (1). A few others, like Akrotiri (1) and Mycenae (1, 2), include primarily large tools.[490]

Most of the PMZ grinding tools (n=35 or 66%) have only one work face; seventeen specimens (32%) – nine passive and eight active – have two roughly parallel or (more rarely) diagonal work

482 See also Georgiadis 2017 on a few cave sites on the island of Rhodes.

483 See the Greek Bronze Age site of Toumba Thessalonikis (2), several Pre-Dynastic and Bronze Age Egyptian sites (Samuel 2010; Jérôme Robitaille, personal communication), as well as Bronze Age sites in southern Iberia (Menasanch et al. 2002; Delgado Raack – Risch 2009; Delgado Raack – Risch 2016).

484 See also Bekiaris et al. 2020.

485 See Roux 1985, 32–42; Baudais – Lundström-Baudais 2002; Katz 2003; Gelbert 2005; Searcy 2011, 120–123; Hamon – Le Gall 2013; Nixon-Darcus – D'Andrea 2017.

486 Runnels 1981; Runnels 1985.

487 Chondrou et al. 2018; see also Valamoti et al. 2013.

488 For a similar conclusion see Bekiaris 2018, 112.

489 See also Bekiaris et al. 2020.

490 See also Bekiaris et al. 2020.

0 10cm

Figs. V.2.4–6 4. Active grinding tool PM0760 (gneiss): work face B and sections; 5. Active grinding tool PM0946 (gneiss): one of the work faces and both sections; 6. Active grinding tool PM0699 (gneiss): work face and sections (photos: A. Stroulia, drawings: R. Exarhou)

faces;[491] lastly, one tool has one work face and limited wear on the dorsal face. All but one of the specimens with two work faces date to the Middle Neolithic, a possible indication of a more intensive use of grinding tools in this phase than in the following one.

Work faces exhibit a variety of configurations. Parallel or diagonal work faces do not always have similar configurations. The most common shape is the one known as the saddle. A saddle work face is longitudinally concave but transversally convex (or concave/convex).[492] Both concavity and convexity can be only slight, whereas the concavity is often stronger than the convexity. The saddle configuration is found in both passive and active specimens dated to both the Middle and the Late Neolithic (Figs. V.2.2, V.2.4–5, V.2.9).

This intriguing configuration was also encountered at Kremasti-Koilada (4), Alepotrypa Cave (1), Varemenoi Goulon (2), Avgi (2), Megalo Nisi Galanis (2), Franchthi Cave (3), Kleitos (1, 2), Servia (2), Pontokomi-Souloukia (1), Lerna (1), and Koromilia (1). It is probably found in other Greek Neolithic assemblages which have not been published systematically. Archaeological and ethnographic examples are known from other periods and parts of the world.[493]

The saddle configuration has been interpreted in two main ways: i) as the combined result of manufacture and use; and ii) as the exclusive by-product of use.[494] Interestingly, at PMZ, the pecked work face of one of the unfinished specimens is saddle-shaped (PM0450). Since this face was never used, the saddle configuration must have been produced solely through manufacture. It is impossible to tell whether the saddle shape of other specimens represents an exclusive element of design as well. If so, PMZ saddle tools would be exceptional; neither the archaeological nor the ethnographic literature includes grinding tools with work faces deliberately manufactured in such a shape.

Eleven passive tools have work faces that are concave along both axes (concave/concave) or include a wide shallow groove. Eight of these tools are elongated (Fig. V.2.10), three have a roughly round or polygonal plan (Fig. V.2.11). Most of the elongated specimens were probably used with active tools to process intermediate substances. The active tools must have had convex/convex work faces. Three such tools were identified: PM0714, PM0732, and PM0858. Three passive elongated specimens, on the other hand, include a shallow groove: PM0677 (Fig. V.2.10), PM0772, and PM1071. These were used independently – without an active counterpart – for abrading tasks, e.g. shaping celts, figurines, ornaments, bone tools, or so-called maceheads. The roughly round or polygonal passive tools were used for processing intermediate substances or for abrading purposes.

Six passive tools have work faces that are concave longitudinally and flat transversally (concave/flat) (Fig. V.2.7). These are compatible with active tools whose work faces are flat longitudinally and convex transversally (flat/convex). Only one such tool was identified (PM0955). Finally, two tools have flat faces (PM0693 and PM0952). It is unclear if they were used actively or passively.

The PMZ assemblage includes three variations of recycling. The first is represented by PM0677 (Fig. V.2.10). This tool has two parallel work faces that served two different passive functions. One face is concave/concave and was used reciprocally with an unidentified active tool to process intermediate substances. The other contains a wide, shallow groove formed as a result of an abrading task.

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[491] These percentages were calculated out of a total of 53 tools, since one specimen (PM0864) preserves only one of its faces.

[492] The term 'saddle' has also been used to refer to work faces that are concave longitudinally and flat transversally (concave/flat) or concave along both axes (concave/concave), see, e.g., Hersh 1981, 432; Watts 2002, 25. I consider this usage inaccurate since actual saddles are concave longitudinally and convex transversally, see also Lidström Holmberg 1998; Lidström Holmberg 2004; Stroulia et al. 2017.

[493] For references see Stroulia et al. 2017.

[494] Lidström Holmberg 1998; Menasanch et al. 2002; Risch 2002; Lidström Holmberg 2004; Risch 2008; Delgado Raack – Risch 2009; Hamon – Le Gall 2013; Delgado Raack – Risch 2016; Hamon et al. 2017; Stroulia et al. 2017.

Figs. V.2.7–11 7. Passive grinding tool PM0691 (schist): work face and sections; 8. Passive grinding tool PM0518 (gneiss): work face and sections; 9. Passive grinding tool PM0893 (schist): work face and sections; 10. Passive grinding tool PM0677 (schist): one work face and sections; 11. Passive grinding tool PM0989 (sandstone): work face and sections (photos: A. Stroulia, drawings: R. Exarhou)

In the second recycling variation, the same tool fulfilled both an active and a passive function. One of the two specimens exhibiting this variation is PM0554, a narrow tool with two diagonal faces. The first face – slightly concave/slightly convex – was used actively with an unidentified passive component to grind intermediate substances. The second – concave/concave – was used passively in an abrading task.

In the third variation, represented by PM0760 (Fig. V.2.4), recycling is associated with processing pigment or clay. This subrectangular tool has two diagonal work faces with different characteristics. One face (A) is concave longitudinally and slightly convex transversally. It carries transverse wear throughout its surface. The other face (B) is convex towards the ends but concave in a c. 12cm-long mesial part. The entire face is used, but the mesial part is marked by transverse scratches and a reddish colouration. This face also carries dark stains of unclear origin both in the mesial part and beyond. If my understanding is correct, face A was used actively with the entire surface to grind substances that did not involve a colouring agent. Face B was originally used in a similar manner. At a later point, however, its use involved pigment or clay. The confinement of the transverse scratches and colour traces to the mesial part leaves no doubt that, in this stage of its use life, PM0760 functioned as an overhanging tool. The passive surface, on which the clay or pigment was placed, was not found. Perhaps it consisted of wood. Clearly, this tool had a complex biography.

No other specimen carries traces of colour. The scarcity of grinding tools associated with pigment/clay processing at PMZ appears to fit a general Aegean Neolithic pattern. Such tools are rare or absent in the assemblages that I have personally studied: Franchthi Cave (3), Megalo Nisi Galanis (3), Alepotrypa Cave (1), Kremasti-Koilada (5), and Pontokomi-Souloukia (1). Although detailed information is often lacking, they appear uncommon in other assemblages too: see Stavroupoli (1), Dikili Tash (1), Avgi (2, 3), and Makriyalos (2). Two notable exceptions come from Makri (1) and Drakaina Cave (6), which yielded substantial numbers of specimens with red traces.[495] I doubt that the general absence of colour traces on Greek Neolithic grinding tools is the result of cleaning; there is no evidence that specimens preserving such traces were less intensely or more expertly washed than those that do not. This is supported by a simple comparison. The Makri material was washed by unskilled labourers.[496] Over 100 specimens from Pontokomi-Souloukia (1), on the other hand, were recently washed and examined microscopically by macrolithic expert Jérôme Robitaille. No traces of colour were identified. Grinding tools may not have been regularly used for processing clay/pigment in the Neolithic Aegean. Alternatively, but less likely, such processing occurred outside the settlement.

The use of a second face and recycling represent two types of curation; resharpening and redesigning are two others. Resharpening targeted a blunt work face and aimed to restore its roughness (Figs. V.2.1–2). It involved pecking and must have been carried out with percussive tools such as those found in the excavated area (see below). Redesigning consists of the deliberate reshaping of a tool to serve a function other than the original one. It is represented by at least one tool, which appears to have fractured in the process (PM0772). All four types of curation attest to an effort to extend the tools' use-lives. Given the local availability of almost all raw materials, I would argue that this effort does not reflect environmental constraints but rather has to do with convenience, emotional attachment to one's tools, and/or a flexible attitude towards both tools and raw materials.

Most grinding tools ended their use-lives as a result of breakage. Interestingly, this also applies to the five nearly complete specimens, which were not utilised after a small part was broken off (Figs. V.2.1, V.2.5–6, V.2.9). I treated these five specimens as complete and used them to reconstruct the sizes and shapes of grinding tools in general, but apparently the people of PMZ treated them as fragments. Only four specimens were found intact. One appears to be perfectly functional

[495] On the basis of a preliminary report, the assemblage of Theopetra Cave (1) may represent another exception.
[496] Tasos Bekiaris, personal communication.

(Fig. V.2.7), one seems to be exhausted (Fig. V.2.3), while the other two may be close to the point of exhaustion (Figs. V.2.2, V.2.4).

The end of a tool's use life is one thing; the end of its biography is another. It is to the latter that I now turn as I discuss the grinding tools' contexts of recovery. In this discussion, I distinguish between intact and fragmentary specimens. For reasons just explained, the five nearly complete specimens are treated here as fragments.

Fairly secure information regarding recovery contexts is available for many but not all specimens. Only six of them (11%) were found on floor surfaces. All are fragmentary and date to the Middle Neolithic. A much larger number – at least 19 (35%) – were found in sediment between floors. Except for three intact specimens, all are fragmentary. All are Middle Neolithic apart from four dated to the Late Neolithic.

Eight tools (15%) were incorporated into structures. Two fragmentary specimens were used as packing for Middle Neolithic postholes associated with BSPh IIIa and IIIc. The other six – five fragments and one intact – were integrated into two Late Neolithic thermal features: TS 19, associated with Floor F22 that probably belongs to an indoor space (BSPh VIIb); and TS 18, associated with Floor F20 that appears to belong to an outdoor space (BPh VIII). The intact specimen – active tool PM0492 (Fig. V.2.3) – appears to be exhausted, which may explain why it was used as construction material. Significantly, only Middle Neolithic tools were placed within postholes, while only Late Neolithic ones were placed within thermal structures. It is equally interesting that only 5% of Middle Neolithic specimens were inserted within the fabric of structures, while half of the Late Neolithic specimens were treated in this way. These observations raise the possibility of: i) a shift in the structures targeted by this behaviour; ii) an intensification of this behaviour in the Late Neolithic. Be that as it may, the conversion of grinding tools (and other macrolithics) into building material represents a widespread phenomenon. It has been documented at other Greek sites; e.g. Lerna (1), Knossos (1, 2), Ayioryitika (1), Koronia (1), and Servia (1). It is also well known archaeologically and ethnographically from other parts of the world.[497]

One tool was excavated in the ditch at the bottom of the stratigraphic sequence (BPh I), while another eight (15%) derive from the sediments which overlie the ditch and are devoid of architectural features (BPh II). Lastly, one specimen was recovered from a pit associated with Floor F26 that appears to belong to an outdoor space (BSPh Ve). All the above are fragmentary and date to the Middle Neolithic.

The fact that none of the few intact specimens were found in a primary context implies that they were taken elsewhere after their final use. Given the lack of refits, it also appears that fragments of the same tool ended up in different places. The above data indicate that at PMZ grinding tools were moved around, rearranged, or manipulated before becoming a part of the archaeological record. On this basis, the context of use remains undetermined. It is possible that grinding tools were used on the (mostly outdoor) excavated floors and some intact and fragmentary specimens were taken away before these floors were abandoned. The reverse hypothesis – grinding tools were used elsewhere (inside buildings), but were discarded in the (mostly outdoor) excavated areas after breakage, were brought to these areas to be incorporated into structures, or ended up there when the remains of nearby buildings were levelled – is equally plausible.

I close this section with a note on these tools' vertical distribution. Given the uncertainty regarding the association between the contexts of recovery and use, no reliable conclusions can be reached as to how the excavated floors were employed in relation to food processing activities, abrading tasks, etc. Neither should the vertical distribution be used to assess the intensity of these activities through time. One element of this distribution, however, deserves attention. I am referring to the two earliest building phases: BPh I, consisting of a ditch, and BPh II, comprising

[497] E.g. Woodbury 1954, 56–58; Roux 1985, 46; Schlanger 1991; Schelberg 1997; Katz 2003; Wright 2008; Stordeur – Willcox 2009; Searcy 2011, 111; Hamon – Le Gall 2013; Rosenberg 2013; Nixon-Darcus – D'Andrea 2017; Raczek et al. 2018.

the overlying sediments. Together these two phases exhibit a high density of grinding tools: 17% of the grinding tools were recovered from these sediments which represent c. 10% of the entire excavated Neolithic deposit. Most remarkably, given the absence of floors, it appears that these specimens were utilised elsewhere but ended their biographies in the area of Trench A. This reinforces my hypothesis that grinding tools were moved around after the end of their use-life. In addition, it implies the existence of a residential space outside the excavated area in that early phase of occupation.

### V.2.3. Celts

This group comprises 33 specimens with an edge on one end that was used in an active linear mode (Tab. V.2.3). Specimens whose edge was broken off or recycled to serve a non-linear function are included. Twenty specimens (61%) date to the Middle Neolithic, twelve (36%) to the Late Neolithic, and a single one to the Middle Neolithic/Late Neolithic (3%). The sample is very small, but, generally speaking, the percentages of Middle Neolithic and Late Neolithic specimens do not conflict with those expected on the basis of the volumes of excavated Middle Neolithic and Late Neolithic deposits (62% and 23%, respectively).

Eighteen tools (55%) are complete (or nearly so). They range from 3.0cm to 13.6cm in length ($\bar{x}$=6.5cm), from 1.2cm to 4.9cm in width ($\bar{x}$=3.6cm), and from 0.8cm to 3.5cm in thickness ($\bar{x}$=1.9cm). While both the width and thickness distributions are continuous, that of length is not. All but one of the complete specimens are shorter than 10cm. The exception – PM0741 (Fig. V.2.16) – is 13.6cm long.

Nine of the complete celts are small (measuring up to 5cm in length), eight are of medium size (5–10cm long), and one is large (longer than 10cm). Since there is only one large complete specimen and given the similarities in raw material and manufacture between this and the medium-sized ones, in the remainder of this section I refer to two size categories only: small (no longer than 5cm) and larger (longer than 5cm). Both small and larger tools were found in both Middle Neolithic and Late Neolithic strata.

Fifteen celts (45%) are fragmentary. No refits were found. Significantly, the average length of fragmentary specimens (5.6cm) is not much lower than that of the complete ones, while their average width (3.8cm) and thickness (2.7cm) are both higher. These metrics suggest that most fragments belong to larger tools. As at other sites – Sesklo (2), Dimini (2), Makriyalos (3), Kremasti-Koilada (3), and Varemenoi Goulon (1) – it appears that larger tools were broken more frequently than their small counterparts. The fact, moreover, that four transversally broken specimens are between 8.5 and 9.5cm long indicates that the aforementioned PM0741 (Fig. V.2.16) is an outlier among complete specimens but not in the entire group. Other tools were originally longer than 10cm too.

It is hard to compare the PMZ celts with those from other Thessalian sites in terms of size since adequate information is available only for the material from Theopetra Cave (2). The average length of the complete specimens from that site is 5.7cm.[498] What can be said, nevertheless, is that celts from Macedonia and Thrace tend to be larger than those from southern Greece; see the assemblages from Kremasti-Koilada (3), Servia (1), Olynthus (1), Stavroupoli (1), Makri (4), Avgi (2), and Varemenoi Goulon (1) versus those from Franchthi Cave (2, 3), Kitsos Cave (1), Tharrounia/Skoteini Cave (1), Limnes Cave (1), Sarakenos Cave (1), Alepotrypa Cave (1), Drakaina Cave (6), Saliagos (1), Knossos (1), and Ftelia (1). The PMZ assemblage is closer in size to the northern assemblages. Why there is such a difference between the north and the south is unclear. This may be the mere result of archaeological biases; not many southern Greek assemblages have been studied and most derive from caves. Alternatively, this pattern may be associated with different

[498] Metric data are also available for the assemblage of Visviki Magoula (1). However, due to a lack of distinction between Neolithic and Bronze Age specimens, comparisons with the PMZ material are not possible.

Tab. V.2.3 Celts (A. Stroulia)

| PMZ No. | Old Inv. No. (BE) | Depth [m] | BPh/ BSPh | Date | Material | Pres. | Lg [cm] | Wd [cm] | Th [cm] | Lg/ Wd | Wd/ Th |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PM0783 | 504 | 8.13 | IVa | MN | Gabbro | c | 4.4 | 3.1 | 1.1 | 1.42 | 2.8 |
| PM0777 | 498 | 8.01 | IVb | MN | ? | f | 3.7 | 3 | 1.1 | n/a | n/a |
| PM0766 | 487 | 7.65 | Va | MN | Gabbro | c | 6.9 | 3.8 | 2.7 | 1.82 | 1.4 |
| PM0771 | 492 | 7.62 | Va | MN | Serpentinite | c | 5 | 3.5 | 1.2 | 1.43 | 2.91 |
| PM0758 | 481 | 7.27 | Vb | MN | Serpentinite | c | 3.2 | 2.9 | 1.1 | 1.10 | 2.63 |
| PM0741 | 463 | 6.98 | Vd | MN | Gabbro | c | 13.6 | 4 | 3.5 | 3.40 | 1.14 |
| PM0730 | 453 | 6.73 | Vd | MN | ? | c | 6.9 | 2.7 | 1.8 | 2.56 | 1.5 |
| PM0722 | 445 | 6.57 | Ve | MN | Serpentinite | c | 8.1 | 4.7 | 2 | 1.72 | 2.35 |
| PM0724 | 447 | 6.50 | Ve | MN | Marble | f | 5.2 | 4.3 | 2.5 | n/a | n/a |
| PM0716 | 439 | 6.49 | Ve | MN | Gabbro | c | 9 | 4.1 | 2.9 | 2.20 | 1.41 |
| PM0719 | 442 | 6.43 | Ve | MN | ? | f | 4.1 | 4 | 2.2 | n/a | n/a |
| PM0706 | 430 | 6.40 | Ve | MN | Gabbro | c | 8.2 | 4.9 | 2.3 | 1.67 | 2.13 |
| PM0683 | 412 | 6.30 | VIa | MN | Marble | f | 9.5 | 4.1 | 3.8 | n/a | n/a |
| PM0681 | 410 | 6.28 | VIa | MN | Gabbro | c | 9.9 | 4.1 | 2.8 | 2.41 | 1.46 |
| PM0692 | 421 | 6.25 | VIa | MN | Gabbro | c | 4.8 | 3.6 | 1.3 | 1.33 | 2.76 |
| PM0675 | 403 | 6.16 | VIa | MN | Serpentinite | c | 3.8 | 1.2 | 0.9 | 3.17 | 1.33 |
| PM0674 | 402 | 6.12 | VIa | MN | Gabbro | f | 8.5 | 5.3 | 3.9 | n/a | n/a |
| PM0662 | 391 | 6.06 | VIb or VIa | MN | ? | f | 4.6 | 3.8 | 2.7 | n/a | n/a |
| PM0654 | 383 | 6.01 | VIb or VIa | MN | Serpentinite | c | 3.8 | 3.2 | 1.3 | 1.19 | 2.46 |
| PM0660 | 389 | 6.00 | VIb or VIa | MN | Gabbro | c | 6.3 | 3.9 | 2.8 | 1.62 | 1.39 |
| PM0599 | 326 | 5.45 | VIIa | MN/LN | Serpentinite | f | 4.7 | 3.7 | 0.6 | n/a | n/a |
| PM0540 | 285 | 5.20 | VIIb | LN | Serpentinite | c- | 3.3 | 2.5 | 0.9 | 1.32 | 2.77 |
| PM0525 | 274 | 5.17 | VIIb | LN | Gabbro | c | 5.9 | 3.5 | 1.7 | 1.69 | 2.05 |
| PM0524 | 273 | 5.15 | VIIb | LN | Gabbro | f | 8.8 | 4.4 | 3.7 | n/a | n/a |
| PM0528 | 277 | 5.14 | VIIb | LN | ? | f | 3.3 | 1.9 | 0.9 | n/a | n/a |
| PM0513 | 265 | 5.10 | VIIb | LN | ? | f | 7.1 | 4.5 | 4.3 | n/a | n/a |
| PM0506 | 258 | 5.09 | VIIb | LN | Gabbro | f | 3.6 | 1.8 | 1.1 | n/a | n/a |
| PM0479 | 244 | 5.04 | VIIc | LN | Serpentinite | c | 5 | 3.4 | 1.5 | 1.47 | 2.26 |
| PM0454 | 219 | 4.90 | VIIc | LN | Gabbro | f | 5.4 | 3.4 | 3 | n/a | n/a |
| PM0434 | 206 | 4.74 | VIII | LN | Gabbro | f | *2.3 | 3.1 | 2.4 | n/a | n/a |
| PM0433 | 205 | 4.74 | VIII | LN | Marble | f | *4.3 | 5.3 | 4.6 | n/a | n/a |
| PM0369 | 150 | 4.46 | VIII | LN | Gabbro | f | 8.9 | 4.7 | 3.4 | n/a | n/a |
| PM0333 | 118 | 4.36 | VIII | LN | Serpentinite | c- | 3 | 2.3 | 0.8 | 1.30 | 2.8 |

environmental conditions and building techniques[499] that created a greater or lesser demand for larger tools.

In the PMZ assemblage, size is associated with shape. Small tools are generally short and relatively flat, as indicated by the low average length/width ratio (1.53) and high average width/thickness ratio (2.52) of the complete specimens, respectively. They tend to have asymmetrical triangular or trapezoidal plans, asymmetrical profiles, and subrectangular transverse sections (Figs. V.2.12–14). Two tools deviate from the rule: they have a long narrow chisel-like shape (Fig. V.2.15).

Larger tools, on the other hand, are more or less elongated and quite robust. This is indicated by the high average length/width ratio (2.12) and low average width/thickness ratio (1.65) of the complete specimens, respectively. These tools are roughly trapezoidal, triangular, or (more rarely) rectangular, with symmetrical or asymmetrical profiles, and oval or (more rarely) elliptical/circular transverse sections (Figs. V.2.16–20).

Size is also associated with raw material. Two main lithologies are represented in this group: gabbro and serpentinite. They come in various shades of green and grey. Gabbro is the most common, represented by 15 specimens (45%). It was used primarily for larger tools: all but two of the complete gabbro specimens are of larger size. The gabbro preference for larger tools is probably due to its toughness and density.[500] Serpentinite is represented by nine items (27%). It was used primarily for small tools: all but one of the complete serpentinite specimens are small.[501] Both gabbro and serpentinite were used in both the Middle Neolithic and the Late Neolithic. A third, much softer material, marble, was used occasionally, represented by only three specimens (9%). All are fragmentary but belong to larger tools. The material of the remaining six specimens has not been determined. Waterworn cobbles and pebbles of both gabbro and marble are found in the vicinity of the site. A serpentinite outcrop is found c. 8km to the southeast,[502] but the material may have been collected at nearer secondary sources.

Gabbro and other igneous lithologies as well as serpentinite and so-called greenstone were common in Thessalian Neolithic celt industries: see Sesklo (2), Dimini (2), Prodromos (1), Achilleion (1), Visviki Magoula (1), and Theopetra Cave (2). They were common in other Aegean industries too: see Lerna (1), Ayioryitika (1), Nea Nikomedeia (1, 2), Knossos (2), Sosandra (1), Megalo Nisi Galanis (1, 2), Tsoungiza (1), Kremasti-Koilada (1, 3, 5), Dispilio (1, 3), Avgi (1, 2), Servia (1), Makriyalos (3, 4, 6), Varemenoi Goulon (1), Pontokomi-Souloukia (2), Heliotopos (1), Stavroupoli (1), Koronia (1), Drakaina Cave (2, 3, 4, 5), Sitagroi (1, 3), Ftelia (1), Sarakenos Cave (1), Limnes Cave (1), and Franchthi Cave (2, 3). Although relevant information is often unavailable, it appears that gabbro and comparable igneous materials were preferred for larger celts (see Servia, Sesklo, Dimini, Kremasti-Koilada, and Varemenoi Goulon). Serpentinite was primarily used for small tools at some sites (see Sesklo, Dimini, Prodromos, Tsoungiza, and Heliotopos) and for both small and larger tools at others (see Varemenoi Goulon, Kremasti-Koilada, and Dispilio).

Marble is not suitable for celts,[503] yet its (mostly occasional) use has been attested not only at PMZ but also at Prodromos (1), Sitagroi (1, 3), Heliotopos (1), Paradeisos (1), Makriyalos (3, 4, 6), Servia (1), Nea Nikomedeia (1, 2), Olynthus (1), Varemenoi Goulon (1), Kremasti-Koilada (1, 3, 5), Koronia (1), Knossos (2), Yali (1), and Ayioryitika (1). Why some celts were made of marble is a question awaiting systematic investigation.[504]

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499 The north was more forested than the south. Post-framed houses were the norm in northern sites, while mudbrick and stone buildings were more common in the south. See Bottema 1990; Perlès 2001, 180, 200; Souvatzi 2008, 161–175; Marinova – Ntinou 2018.

500 Dixon 2003a; Vasilios Melfos, personal communication.

501 I should note here that an alternative raw material identification (jadeitite) was proposed by a colleague (Lasse Sørensen) for one of the small specimens (PM0675).

502 At the village of Mesorachi.

503 Dixon 2003a.

504 See also Chadou 2011.

The PMZ assemblage corresponds to the rule regarding the sources of raw materials too: macroscopic examination and, in some cases, petrographic, mineralogical, or geochemical analysis suggest the exploitation of local or regional sources for most celt industries in Thessaly and elsewhere in Greece; see Sesklo (2), Dimini (2), Visviki Magoula (1), Prodromos (1), Servia (1), Dispilio (1, 3), Makri (3), Achilleion (1), Stavroupoli (1), Heliotopos (1), Lerna (1, 3), Alepotrypa Cave (1), Kremasti-Koilada (3), Makriyalos (3, 4), Avgi (1, 2), Sitagroi (1, 3, 4), Koronia (1), Franchthi Cave (2, 3), Knossos (3, 4, 5), and Varemenoi Goulon (1). Materials from more remote sources (over 30–35km away) were rarely used; see the assemblages of Saliagos (1, 2) and Drakaina Cave (1, 2, 3, 4, 5) as well as some specimens from Sitagroi (1, 3, 4), Franchthi Cave (2, 3), Tsoungiza (1), Knossos (3, 4, 5), and, possibly, Prodromos (1).[505] As at PMZ, typically secondary sources were exploited. Primary sources were used only at Dispilio (1) and, to a limited extent, Makriyalos (4).

The PMZ excavations uncovered a single unmodified gabbro cobble (PM0713). Whether it was brought to the site to serve as a raw material for celts remains uncertain for two reasons: i) gabbro gravels are common in the fields around the tell and beyond and thus this cobble may have entered the site randomly as part of construction material; ii) gabbro was used not only for celts but also for percussive tools (see below). Given this uncertainty, PM0713 was assigned to the group of miscellanea (see below).

No unfinished celts or by-products of manufacture were retrieved at PMZ. The reconstruction of the production processes is thus based exclusively on finished specimens and on both direct and indirect evidence. It appears that in the context of manufacture, small and larger tools were treated differently.

The manufacturing process for the small (mostly serpentinite) specimens consisted of a single grinding stage. These specimens are comprehensively ground and show no traces of other techniques. I doubt that such traces existed but were eliminated by grinding. It appears that pebbles were converted to tools by grinding alone (Figs. V.2.13–14).

As a rule, the manufacturing process for the larger (mostly gabbro) specimens involved two techniques: pecking and grinding. Pecking must have been carried out with percussive tools such as those recovered by the excavation (see below). Grinding could have been accomplished with grinding/abrading tools (see above). The two techniques were employed in the context of two stages. In the first stage, pecking gave a cobble/pebble the general shape and size of the intended tool. The second and last stage consisted of grinding. This was not applied equally intensively throughout the body. Instead, the distal end was well ground to create an acute edge, while the mesial and proximal portions were ground only partially, leaving pecking traces more or less visible (Figs. V.2.16, V.2.18). In at least one case, the mesial and proximal parts were ground and pecked over (Fig. V.2.17). Either way, the distal part of these tools is well ground, whereas the rest of the body tends to have a rougher texture. A similar differential treatment of body parts has been encountered in specimens of mostly larger sizes and igneous materials in Thessalian and other Greek assemblages: see Sesklo (2), Dimini (2), Achilleion (1), Franchthi Cave (2, 3), Alepotrypa Cave (1), Lerna (1), and Knossos (1). In the literature, this treatment has been associated with hafting: the mesial and proximal portions were partially ground or left unground since they would be inserted into a haft and therefore invisible; alternatively, they were partially ground, left unground, or pecked after grinding to create a certain roughness that would allow a more secure attachment of the stone head to the haft.[506]

Two tools deviate from the above pattern. The single larger serpentinite tool bears scars that resulted from flaking (Fig. V.2.19). This technique was rarely used in Aegean Neolithic celt industries. Substantial evidence of flaking was identified in only four assemblages: Kremasti-Koilada

[505] See also Georgiadis 2017 for the use of materials from remote sources in some Dodecanesian islands.

[506] Dickson 1981, 33, 99; Moundrea-Agrafioti 1981, 183; Roodenberg 1986, 98; Ricq-de Bouard – Buret 1987, 178–180; O'Hare 1990, 130; Christopoulou 1992; Stroulia 2003; Stroulia 2010, 68–69; Stroulia 2018a.

(1, 3), Dispilio (1), Makri (4), and Varemenoi Goulon (1). Sporadic evidence, like that found at PMZ, derives from another five: Sesklo (2), Makriyalos (1, 5), Koronia (1), Megalo Nisi Galanis (2), and Knossos (1). With the exception of Knossos, all these sites are located in the northern part of the country. One serpentinite specimen, on the other hand, carries evidence of sawing, consisting of a partially preserved groove (PM0599). Due to the fragmentary state of this specimen, it is impossible to tell whether sawing was used to divide a piece of raw material or a finished tool, repair a tool, or alter its proportions/shape. For the same reason, it is impossible to tell how the sawing was carried out. Sawn specimens, mainly of serpentinite, are known from Sesklo (1, 2), Ag. Petros (1), Dispilio (1), Nea Nikomedeia (2), Makriyalos (1, 2, 3), Sitagroi (1), Servia (1), Heliotopos (1), Koronia (1), Olynthus (1), Kremasti-Koilada (3), Stavroupoli (1), Megalo Nisi Galanis (1, 2), Avgi (2), Mikro Nisi Akrinis (2), Varemenoi Goulon (1), and Knossos (1). Significantly, with the exception of Knossos, all sites with sawn specimens are found in northern Greece, as are those with flaked tools. This geographic distribution points to different technological traditions regarding celt industries in the northern and southern parts of the country.[507]

The recovery of only one possible piece of unmodified raw material, the lack of unfinished specimens or other manufacturing debris, as well as the fact that the excavated percussive and grinding/abrading tools may or may not have been employed for pecking and grinding in the context of celt production (see above and below) lead me to suggest that celts were not manufactured in the excavated areas on a regular basis, if at all. Such manufacture must have occurred at an unexcavated part of the settlement or outside the settlement altogether.

Although detailed information is not always available, PMZ appears rather typical regarding evidence of celt production. Such evidence is absent or rare at Greek Neolithic sites. There are four exceptions to this rule and these come from Makri (2, 4), Kremasti-Koilada (3), Dispilio (1, 2), and Varemenoi Goulon (1).

The manufacturing processes for PMZ celts were generally simple. Coupled with a rather low output, they suggest that celt production was not a specialised craft at this site. All adult members of the community likely possessed the basic skills to make these tools. Yet, a non-specialised production in no way precludes a gender specialisation in making and/or using these tools, as is often encountered ethnographically. Among many New Guinea groups, for example, celts are practically and symbolically associated with men.[508] Archaeological evidence of a similar association exists as well.[509]

The manufacturing processes presented above refer to the stone components of the PMZ celts. Most (or all) of these tools, however, were hafted. The excavations yielded no suitable antler/bone hafts/sleeves like those recovered at Sesklo (1, 3), Dimini (1, 3), Rachmani (2), Dispilio (1), Sitagroi (5), Dikili Tash (2, 3), Makriyalos (3), Alepotrypa Cave (2), Sarakenos Cave (1), and Tharrounia/Skoteini Cave (3). Hafting devices must thus have been fashioned out of perishable materials (wood, animal skin, vine strips, resin, beeswax, etc.). They may have been similar to those recovered in lacustrine sites or bogs in northern Greece, France, Switzerland, Spain, Denmark, etc.;[510] known ethnographically;[511] or produced experimentally.[512]

At PMZ, small (mostly serpentinite) and larger (mostly gabbro) specimens were treated differently in the context not only of manufacture, but also of use. The edges of small specimens are almost always in fairly good condition, but vary widely in terms of shape and symmetry. For

507 See also Stroulia 2014; Stroulia 2018a.

508 E.g. Strathern 1970; Godelier – Garanger 1973; Toth et al. 1992; Pétrequin – Pétrequin 1993, 361–387; Stout 2002; Barkai 2005, 60–61.

509 E.g. Pétrequin – Pétrequin 1988, 105–106; Patton 1991; Farrugia 1992; Miles 2016.

510 E.g. Becker 1945; Müller-Beck 1965, 13–49; Pétrequin – Pétrequin 1988, 25, 149–150; Palomo et al. 2013; Chrysostomou et al. 2015.

511 E.g. Steensberg 1980, 5–24; Sillitoe 1988, 43–50; Toth et al. 1992; Pétrequin – Pétrequin 1993, 43–59; Hampton 1999, 72–88.

512 E.g. Pond 1930; Souza – Lima 2014; Elburg et al. 2015.

example, the edge may be straight both in plan and frontally (Fig. V.2.15), slightly curved and symmetrical both in plan and frontally (Fig. V.2.12), or strongly curved and asymmetrical both in plan and frontally. It is unclear whether this variation reflects specialised functions, modifications that occurred during the tools' use lives, or both.

As mentioned above, two small specimens are shaped as stereotypical chisels with long narrow bodies (Fig. V.2.15). They must have been used with indirect percussion, thus serving as intermediate devices, through which the percussive force of mallets was applied to the worked material. The haft (if present) must have been attached in a way that extended the long axis of the stone head. Although lacking a typical chisel shape, most of the other small specimens may have functioned in a similar manner, since their size would have precluded a use in direct percussion.

The edges of only five complete larger specimens are preserved. All are in generally good condition. None is perfectly straight in plan. Instead, they range from almost straight through slightly curved to strongly curved. Frontally they are straight or curved (Figs. V.2.16, V.2.19). All larger specimens are sturdy enough to have been used in direct percussion. I assume that they were hafted as adzes (with the haft perpendicular to the plane of the stone head) or as axes (with the haft roughly parallel to the edge). On the basis of ethnographic accounts, an alternation between an adze and axe hafting/function in the course of a tool's biography is also conceivable.[513]

Without microscopic analysis, the functions of PMZ celts cannot be precisely determined. However, lighter and heavier duty woodworking for small and larger specimens, respectively, are likely on the basis of microscopic examination of specimens from Sesklo (5) and Theopetra Cave (2), similar analysis of non-Aegean material,[514] as well as ethnographic evidence.[515] Other archaeologically or ethnographically known functions, such as butchering, digging, hide processing, and breaking bones, cannot be ruled out.[516]

The PMZ celts bear limited evidence of resharpening. Only five of the 15 preserved edges are resharpened and all but one belong to small specimens (Figs. V.2.12, V.2.14–15). While a few small celts were resharpened, none were recycled.

Larger celts exhibit the reverse pattern. All but one show no traces of resharpening, but most are recycled (Figs. V.2.18, V.2.20). Evidence of recycling is found among both Middle Neolithic and Late Neolithic specimens. Recycling affected both distal and proximal ends and almost always involved active diffused percussion. Distal and proximal ends were not recycled in the same manner, however. The more elongated distal ends were transformed from acute edges to slightly convex rough regular zones (almost always) crossed by a central diagonal ridge. This use wear probably resulted from pecking other objects. The ridge indicates an angled (or combined angled and perpendicular) use. The shorter, elliptical proximal ends developed a convex shape and rough regular texture with or without a ridge in the middle, from a use as pestles in conjunction with small mortar-like objects. The latter were probably made of wood since no stone objects of such shape were recovered. What kind of substances were processed is not known, but they probably came in small amounts. Spices, condiments, salt, herbs, or incense are possible candidates. Interestingly, the active diffused percussive wear of celts' proximal ends is similar to that found on the ends of most percussive gabbro tools (see below).

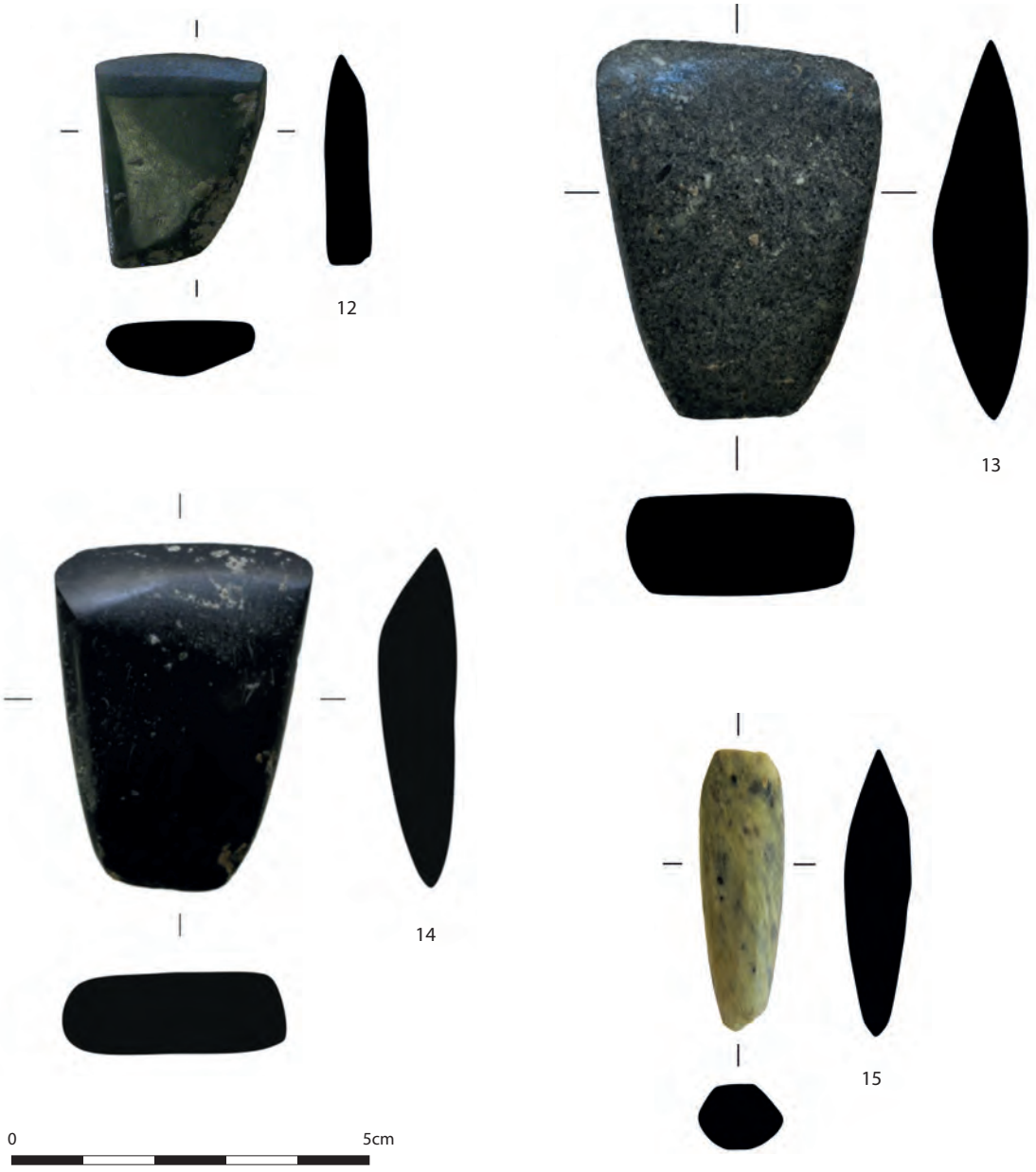
There is no evidence that larger celts were redesigned. It seems that, when fractured, worn out, or no longer needed, larger tools were not treated as useful material for small ones. If my understanding is correct, the inhabitants of PMZ recycled larger specimens through active diffused percussion, but as a rule neither resharpened nor redesigned them. The same people, however, sometimes resharpened small specimens. I identified a comparable differential pattern between

[513] E.g. Malinowski 1934; Heider 1967; Heider 1970, 276; Steensberg 1980, 15; Sillitoe 1988, 43–44; Pétrequin et al. 2012.

[514] E.g. Sonnenfeld 1962; Roodenberg 1983; Yerkes et al. 2012; Dimić 2015.

[515] E.g. Strathern 1970; Best 1974; Steensberg 1980; Pétrequin – Pétrequin 1993.

[516] E.g. Strathern 1970; Séfériadès 1992a; Beugnier 1997; Greenfield – Kolska Horwitz 2012; Masclans et al. 2017.




Figs. V.2.12–15 12. Small celt PM0333 (serpentinite): one face and sections; 13. Small celt PM0692 (gabbro): one face and sections; 14. Small celt PM0771 (serpentinite): one face and sections; 15. Small celt PM0675 (serpentinite or possibly jadeitite): one face and sections (photos: A. Stroulia, drawings: R. Exarhou)

small and larger tools at Franchthi Cave (2, 3) and Alepotrypa Cave (1). In these (and probably other Greek Neolithic) communities, specific rules governed the curation of different-sized tools.

The procurement of two main raw materials and their transformation into small and larger tools through different manufacturing sequences characterise both the Middle Neolithic and the Late Neolithic components of the PMZ assemblage. Overall, this is a conservative industry and thus not unlike others in the Neolithic Aegean that show no significant variation through time; see Sesklo (2), Dimini (2), Servia (1), Franchthi Cave (2, 3), and Knossos (6).[517] For an exception, see Sitagroi (1).

[517] See also Perlès 2001, 236–237; Georgiadis 2017.

Figs. V.2.16–20 16. Larger celt PM0741 (gabbro): one face, one side and transverse section; 17. Larger celt PM0706 (gabbro): one face, one side, and transverse section; 18. Recycled larger celt PM0716 (gabbro): one face and ends; 19. Larger celt PM0722 (serpentinite): faces and edge; 20. Recycled larger celt PM0766 (gabbro): one face, one side, and one end (photos: A. Stroulia, drawings: R. Exarhou)

Changes did occur in the PMZ celt industry, however only after the end of the Neolithic. One of them has to do with tool size. Bronze Age specimens are, for the most part, fragmentary, but, judging from their thickness, were more massive than their Neolithic counterparts. The second change refers to the introduction of perforated specimens – often called hammer, bored, shaft-hole, or battle axes.[518] Of the three found, two derive from Bronze Age strata, while the third was collected on the surface of the site.

Perforated celts may not have been used at PMZ during the Neolithic, but a few specimens dated to this period are known from Sitagroi (1, 2), Kremasti-Koilada (3), Varemenoi Goulon (1),

[518] See Prinz 1988; Voytek 1990; Elster 2003a; Klimscha 2011; Turek 2011.

Koronia (1), and Makriyalos (3).[519] Despite their scarcity, they argue against earlier claims that this artefact type represents a Bronze Age innovation in the Aegean.[520] Significantly, none of the above sites is found in the southern part of the country, reinforcing the impression of cultural and technological differences between the north and the south during the Neolithic period.[521]

I close this section with a discussion of the PMZ celts' horizontal and vertical distribution. Fairly secure contextual information is available for all specimens. The vast majority (n=27 or 82%) were recovered from the fill between floors. Both complete and fragmentary specimens were found in such layers. Fourteen date to the Middle Neolithic, eight to the Late Neolithic, and one to the Middle Neolithic/Late Neolithic.

Five celts were excavated on floor surfaces. Four – one small and three of larger size – are complete. Two of the larger specimens (PM0716 and PM0722) were found on F26, a Middle Neolithic floor with one thermal structure and a pit (BSPh Ve). The third (PM0741, Fig. V.2.16) was found on F27, a Middle Neolithic floor with two thermal structures and two postholes (BSPh Vd). Neither of these floors is associated with a wall. Both probably belong to outdoor spaces. The small specimen (PM0479) was found on F21, a Late Neolithic floor that belongs to what was probably an outdoor space with one thermal structure, several shallow pits, and (on one side) a post-framed wall (BSPh VIIc).

Finally, a small complete specimen (PM0783) was found in thermal structure TS 33. This is associated with the Middle Neolithic floor F32 that appears to belong to the interior of a building (BSPh IVa). For some unknown reason, this tool ended its biography by being thrown into an oven.

Since the vast majority of celts were recovered from fill between floors, it is impossible to assess diachronic trends regarding contexts of use. For the same reason, the vertical distribution cannot be used to assess the intensity of celt use in different phases. That said, I find the complete absence of such tools from the earliest portion of the Neolithic deposit (BPh I–III) intriguing. This part is roughly 1.85m thick (from the sterile layer to c. 8.15m below surface) and for the most part includes no floors. It is easy to explain the absence of celts by the general lack of floors and simply assume that such tools were not discarded in this area because they were not used there. The fact, nevertheless, that the lowest portion of the deposit exhibits a relatively high density of grinding/abrading tools warns us that such a straightforward explanation is inadequate.

### V.2.4. Percussive Tools

This group comprises twenty-eight specimens used in an active diffused percussive mode (Tab. V.2.4). Twenty-four (86%) are dated to the Middle Neolithic, three (11%) to the Late Neolithic, and one to the Middle Neolithic/Late Neolithic (3%). Twenty specimens (71%) are complete, eight (29%) are fragmentary. No refits were identified.

Two main lithologies are represented in this group: quartz and gabbro. Most specimens (n=14 or 50%) are quartz, while eight (29%) are gabbro. Marble, gneiss, and schist were used only occasionally – for a total of six specimens (21%). All materials were procured locally in the form of waterworn cobbles and pebbles.

The excavations uncovered two complete unmodified quartz cobbles. They may have been picked to serve as percussive tools. However, given that such cobbles are very common in the fields around the tell and beyond, it is also possible that they were brought to the site randomly as part of a mass of construction material. One unmodified gabbro cobble could also have been

[519] A few more specimens were found at Sesklo (1), Dimini (1), Visviki Magoula (1), and Heliotopos (1). Whether they date to the Neolithic or the Bronze Age is, however, uncertain.

[520] See Tsountas 1908, 320; Moundrea-Agrafioti 1981, 169; Moundrea-Agrafioti 1992, 175; Elster 2003a. It is worth noting that, while their numbers increased in the Bronze Age, even then perforated celts remained rare, see Treuil 1983, 176–177.

[521] See also Stroulia 2018b.

Tab. V.2.4 Percussive tools (A. Stroulia)

| PMZ No. | Old Inv. No. (BE) | Depth [m] | BPh/ BSPh | Date | Material | Pres. | Lg [cm] | Wd [cm] | Th [cm] | Lg/ Wd |
|---|---|---|---|---|---|---|---|---|---|---|
| PM0895 | 615 | 9.90 | II | MN | Gabbro | c | 5.9 | 5 | 3.3 | 1.18 |
| PM0871 | 591 | 9.58 | II | MN | Gneiss | c | 9.3 | 6.7 | 4.4 | 1.38 |
| PM0869 | 589 | 9.37 | IIIa | MN | Quartz | c | 8.8 | 7.8 | 5.6 | 1.12 |
| PM0860 | 580 | 9.34 | IIIa | MN | Quartz | c | 6.3 | 5.7 | 5.6 | 1.1 |
| PM0839 | 560 | 8.74 | IIIb | MN | Quartz | c | 6 | 5.8 | 5.5 | 1.03 |
| PM0827 | 548 | 8.72 | IIIb | MN | Gabbro | f | 7.2 | 5.8 | 2.8 | n/a |
| PM0794 | 515 | 8.28 | IVa | MN | Schist | f | 7.7 | 5.1 | 3.4 | n/a |
| PM0791 | 512 | 8.25 | IVa | MN | Gabbro | c | 6.7 | 4.7 | 4.4 | 1.42 |
| PM0918 | | 8.20 | IVa | MN | Quartz | c | 6.8 | 6.2 | 5.7 | 1.09 |
| PM0757 | 480 | 7.25 | Vb | MN | Gneiss | c | 8.4 | 6.3 | 3.5 | 1.33 |
| PM0998 | | 7.15–7.30 | Vb | MN | Quartz | f | 8 | 5 | 2.5 | n/a |
| PM0715 | 438 | 6.57 | Ve | MN | Quartz | f | 4.9 | 4.2 | 4.1 | n/a |
| PM0707 | 431 | 6.49 | Ve | MN | Gabbro | c | 5.8 | 3.6 | 2.8 | 1.61 |
| PM0705 | 429 | 6.46 | Ve | MN | Quartz | c | 7.2 | 5.1 | 4.8 | 1.41 |
| PM0710 | 434 | 6.43 | Ve | MN | Quartz | c | 10 | 9.5 | 8.5 | 1.05 |
| PM0689 | 418 | 6.39 | Ve | MN | Marble | c | 12 | 7.3 | 5.4 | 1.64 |
| PM0682 | 411 | 6.32 | VIa | MN | Marble | c | 9.2 | 4.8 | 3.8 | 1.91 |
| PM0697 | 424 | 6.30 | Ve | MN | Quartz | c | 6.4 | 5.8 | 4.8 | 1.1 |
| PM0678 | 406 | 6.24 | VIa | MN | Gabbro | c | 9.6 | 3.6 | 3.1 | 2.66 |
| PM0943 | | 6.15–6.25 | VIa | MN | Quartz | f | 5.8 | 5.4 | 2.5 | n/a |
| PM0656 | 385 | 5.93 | VIb | MN | Marble | c | 4.2 | 4.1 | 3.9 | 1.02 |
| PM0643 | 372 | 5.85 | VIb | MN | Quartz | c | 5 | 4.9 | 4.6 | 1.02 |
| PM1069 | | 5.73–5.81 | VIb | MN | Quartz | f | 4.8 | 3.9 | 1.2 | n/a |
| PM1096 | | 5.70–5.81 | VIb | MN | Quartz | f | 3.8 | 2.6 | 0.5 | n/a |
| PM0631 | 361 | 5.73 | VIIa | MN/LN | Gabbro | f | 6.8 | 4.8 | 4.3 | n/a |
| PM0532 | 281 | 5.12 | VIIb | LN | Gabbro | c | 7.3 | 5.3 | 4.5 | 1.41 |
| PM0466 | 229 | 4.96 | VIIc | LN | Gabbro | c | 6.6 | 6.5 | 3 | 1.01 |
| PM0368 | 149 | 4.46 | VIII | LN | Quartz | c | 7.5 | 6.5 | 4.6 | 1.15 |

brought deliberately or randomly. This specimen, nevertheless, is surrounded by an extra layer of uncertainty since gabbro was used for both percussive tools and celts (see above). For these reasons, I assigned all three specimens to the group of miscellanea (see below).

The two main lithologies were apparently intended for two different types of tools. As a rule, quartz specimens are small and have a roughly globular shape (Figs. V.2.21–23). Both characteristics are illustrated in the average length (7.3cm), width (6.2cm), and thickness (5.4cm) of the ten complete specimens. All quartz tools are a posteriori; cobbles and pebbles were utilised without prior modification. Their use was not comprehensive. Only parts of the surface were involved in percussion. In a couple of cases, the battered areas are crossed by ridges – an indication of angled (or combined angled and perpendicular) contact with the worked material. PM0643 (Fig. V.2.21)

Figs. V.2.21–23 21. Percussive tool PM0643 (quartz): one view and section; 22. Percussive tool PM0697 (quartz): faces and one section; 23. Percussive tool PM0710 (quartz): faces and one side (middle) (photos: A. Stroulia, drawings: R. Exarhou)

is an exception: it was utilised with its entire surface, indeed, intensively enough to acquire a roughly spherical shape. This is the smallest quartz specimen (5.0 × 4.9 × 4.6cm) and appears to be exhausted. PM0710 (Fig. V.2.23) is the largest (10.0 × 9.5 × 8.5cm) and was not used much. Both specimens could serve to argue that the generally small size of quartz tools is the result of intense use. I would refrain from such an interpretation, however: some specimens exhibit substantial unutilised areas indicating that the pieces collected as raw material were not much larger (Fig. V.2.22).

With its high toughness and resistance to splitting, quartz is a particularly suitable material for percussive tasks[522] and was used in this way at other sites; see Stavroupoli (1), Sitagroi (3), Koronia (1), and Heliotopos (1). Quartz percussive tools are known ethnographically from Nigeria, Sudan, Egypt, Kenya, etc., where they are used for resharpening the work faces of grinding tools.[523] This may have been the main function of the PMZ specimens too. To be sure, these tools appear suitable for percussive tasks in the context of fashioning grinding tools, celts, and other objects, but the general absence of roughouts, manufacturing debris, and unmodified raw materials argues against this hypothesis.

Like their quartz counterparts, gabbro percussive tools are also generally small, as evidenced by the average length (7.0cm), width (4.8cm), and thickness (3.5cm) of the six complete specimens.

522 See Dickson 1981, 37–38; Dixon 2003a.
523 Schön – Holter 1990; Haaland 1995, 169; David 1998; Shoemaker et al. 2017.

They tend to be more elongated, however, as shown in the average length/width ratio (1.55). Gabbro specimens are roughly cylindrical or conical (rather than globular) and thus have the general form of pestles (Figs. V.2.24–26). Two complete specimens, PM0466 and PM0895 (Fig. V.2.26), have low length/width ratios: 1.01 and 1.18, respectively. They appear to be exhausted.

With two a posteriori exceptions, gabbro tools were deliberately shaped – another significant difference with regard to quartz specimens. More specifically, their body was pecked and then ground. There is no evidence that the ends were subjected to a similar (or any) process of manufacture. However, the shaping of the body certainly determined the plan and size of the ends; the latter are generally circular/elliptical with a diameter ranging from c. 3.5cm to 6cm.

While manufacture involved the gabbro tools' body, use primarily involved their ends. Thus, these tools not only had a general pestle form but also a pestle function. In almost all cases, both ends were used in an active percussive mode and developed a (more or less) convex shape with a rough regular texture. Sometimes they are crossed by a diagonal ridge, the result of angled

Figs. V.2.24–27 24. Percussive tool PM0791 (gabbro): one face and ends; 25. Percussive tool PM0532 (gabbro): one face, one side, and ends; 26. Percussive tool PM0895 (gabbro): one face, one side, and ends; 27. Percussive tool PM0656 (marble): one view and section (photos: A. Stroulia, drawing: R. Exarhou)

(or combined angled and perpendicular) contact with the processed material (Figs. V.2.24–26). Both the shape and the use wear indicate that the ends were employed in conjunction with small mortar-like implements. Since no such objects have been excavated, they were probably made of wood. Gabbro percussive tools and wooden mortar-like objects may have served to process small quantities of substances such as spices and condiments.[524] The use wear of gabbro percussive tools is quite specialised and, indeed, similar to that developed on the proximal ends of larger gabbro celts in the context of recycling (see above). Over fifteen specimens of both tool types were excavated in Middle Neolithic and Late Neolithic strata, an indication that the associated tasks span the two phases and were fairly common.

The ends of two gabbro percussive tools display secondary active percussive wear (PM0631, not illustrated, and PM0895, Fig. V.2.26). This consists of a flattish or concave rough irregular area that interrupted the convex shape and rough regular wear described above. The secondary wear was not produced in conjunction with mortar-like objects.

Of the percussive tools from materials other than quartz or gabbro, the most interesting is PM0656 (Fig. V.2.27). This marble specimen has a spherical shape that resulted from intense use of its entire surface. This is the smallest complete percussive tool. Measuring only c. 4cm in diameter, it must be exhausted.

Regarding the context of recovery, more or less secure information is available for almost all percussive tools (n=27 or 96%). The majority (n=20 or 71%) were found in fill between floors. Most of these specimens are complete and all but three date to the Middle Neolithic. Only three specimens – all fragments – were found on floor surfaces. Two are Middle Neolithic and one is Late Neolithic. Two complete tools (PM0871 and PM0895) were excavated in the Middle Neolithic sediments overlying the ditch and lacking architectural features (BPh II). Two others (PM0860 and PM0869) were found on a strongly inclined Middle Neolithic surface located next to a series of postholes that probably represents one of the walls of an unexcavated building (BSPh IIIa).

Finally, a note on the vertical distribution. Only 11% of the percussive tools belong to the Late Neolithic compared to 86% assigned to the Middle Neolithic. Given the small size of the sample, it is not possible to tell whether this substantial difference is a reflection of changes in the intensity of use of these tools from one phase to the other.

### V.2.5. Specimens with Narrow Grooves

This group comprises three complete roughly planoconvex specimens from relatively soft materials: schist, chlorite schist, and serpentinite (Tab. V.2.5; Figs. V.2.28–30). Ranging from c. 10.0cm to 11.0cm in length, from 6.5cm to 9.5cm in width, and from 1.5cm to 4.5cm in thickness, these specimens are small enough to have been hand-held during use. The convex face of two specimens is crossed by one narrow groove from one end to the other, while that of the third is crossed by two grooves (PM0747). The grooves are 7.5–10.5cm in length, 0.9–0.10cm in maximum width, and 0.3–0.4cm in maximum depth. They have U or V cross sections and carry longitudinal striations.

It is tempting to consider these specimens' four narrow grooves as part of an incomplete process of dividing raw material through sawing. It is further tempting to hypothesise that the purpose of sawing was to produce blanks for celts. However, for reasons having to do with raw material, size, numbers, and sheer logic, I consider both hypotheses unlikely: i) schist and chlorite schist are not among the materials used for celts at PMZ. Serpentinite is. However, the celts fashioned out of serpentinite are typically small, not exceeding 5cm and 2cm in length and thickness, respectively. These are very unlike the c. 10cm-long and c. 4cm-thick specimens that would result

[524] Similar pestle-like implements were excavated at Alepotrypa Cave (1). They were probably used in conjunction with the uncovered small stone mortars. Variations on pestle-like tools are known from elsewhere, e.g. Franchthi Cave (2), Dispilio (3), Kremasti-Koilada (5), Koronia (1), and Avgi (2).

Tab. V.2.5 Tools with narrow grooves (A. Stroulia)

| PMZ No. | Old Inv. No. (BE) | Depth [m] | BPh/ BSPh | Date | Material | Pres. | Lg [cm] | Wd [cm] | Th [cm] |
|---|---|---|---|---|---|---|---|---|---|
| PM0763 | 484 | 7.38 | Va | MN | Schist | c- | 11 | 6.7 | 1.6 |
| PM0747 | 469 | 7.20–7.40 | Vb | MN | Chlorite schist | c | 10.1 | 8.2 | 2.7 |
| PM0555 | 290b | 5.16 | VIIb | LN | Serpentinite | c | 10.5 | 9.5 | 4.3 |

Figs. V.2.28–30 28. Specimen with two narrow grooves PM0747 (chlorite schist): work face and transverse section; 29. Specimen with one narrow groove PM0763 (schist): work face and transverse section; 30. Specimen with one narrow groove PM0555 (serpentinite): work face and transverse section (photos: A. Stroulia, drawings: R. Exarhou)

from the hypothesised sawing of serpentinite grooved specimen PM0555 (Fig. V.2.30). ii) If the grooves represented sawing that took place in the process of celt manufacture, one would expect to find a number of celts with evidence of sawing. Yet, only one was found (see above). iii) Finally, I find it hard to believe that three pieces of raw material started being sawn, four grooves were formed, between three and seven blanks were planned, yet in no case was the process of division completed. On this basis, I would argue that the grooves are not associated with sawing. They were probably involved in other tasks – e.g. shaft-straightening or polishing and sharpening bone or wooden tools.[525] Specimens with narrow grooves that are not related to sawing have been identified at Prodromos (1), Heliotopos (1), Stavroupoli (1), Makriyalos (3), Makri (1), Franchthi Cave (3), and Alepotrypa Cave (1). In some cases, the grooves represent a secondary use that occurred in the context of recycling.

Two of the PMZ specimens date to the Middle Neolithic and derive from sediment between floors (BSPh Va and Vb). The third (PM0555) was found on the surface of the Late Neolithic floor F22 that belongs to a likely indoor space with a thermal structure and two postholes (BSPh VIIb).

525 See Solecki – Solecki 1970; Moundrea 1975, 95–96; Christensen – Valla 1999.

The fact that these artefacts appear in both the Middle Neolithic and the Late Neolithic shows that the associated tasks took place in both phases.

### V.2.6. Miscellanea

This group comprises fifteen specimens of various materials that I was not able to include in any of the roughly homogeneous groups presented above. I divided these items into the following three subgroups (Tab. V.2.6).

Subgroup 1 includes three specimens with no obvious traces of manufacture or use. PM0956 and PM0999 consist of complete quartz pebbles/cobbles. They may have been collected to serve as percussive tools (see above). However, given that such material is very common in the area around the tell, it is also possible that they entered the site accidentally as part of a mass of construction material. A similar uncertainty surrounds PM0713, a fragmentary gabbro cobble. Moreover, even if this cobble had been collected as raw material, it is unclear if it was intended for a celt or a percussive tool, since gabbro was used for both (see above). All three specimens derive from Middle Neolithic strata. PM0956 was found in the sediments overlying the ditch that contain no architectural features (BPh II), while the other two specimens were recovered from fill between floors (BSPh Vb and Ve).

Tab. V.2.6 Miscellanea (divided into three subgroups) (A. Stroulia)

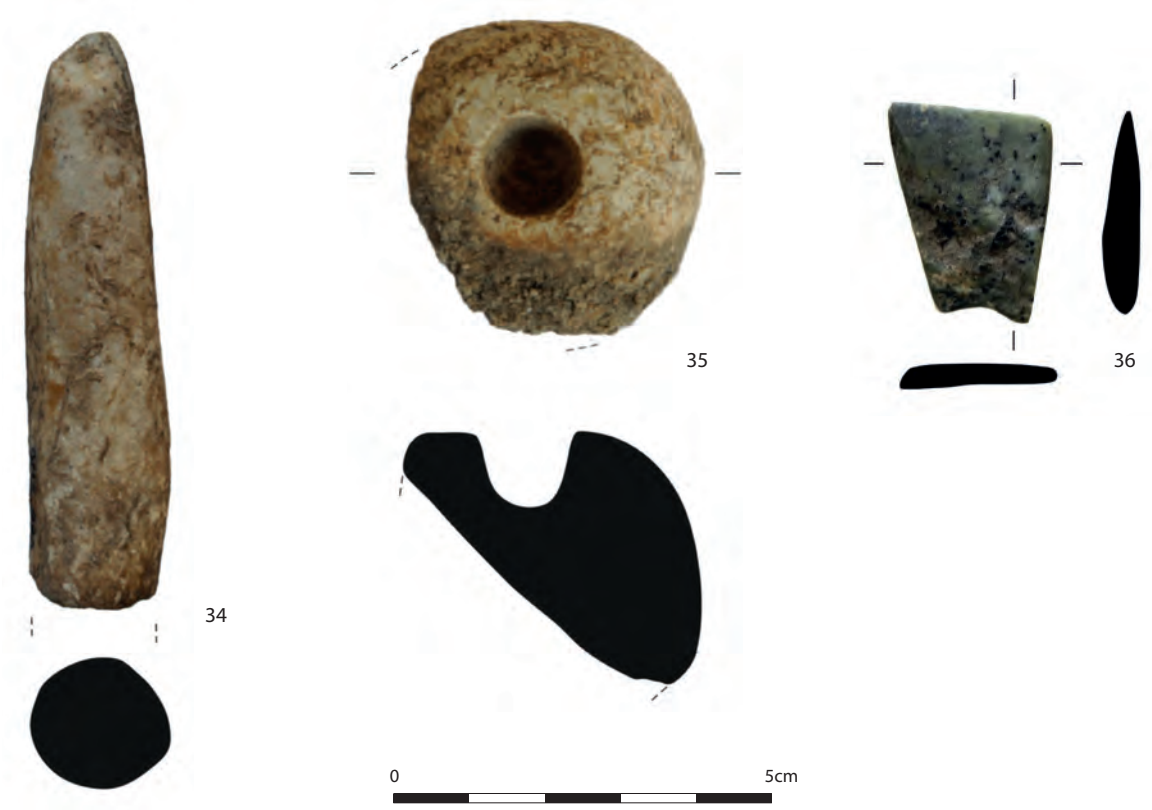
| PMZ No. | Old Inv. No. (BE) | Depth [m] | BPh/ BSPh | Date | Material | Pres. | Lg [cm] | Wd [cm] | Th [cm] |
|---|---|---|---|---|---|---|---|---|---|
| Subgroup 1 | | | | | | | | | |
| PM0956 | 924 | 9.50–9.77 | II | MN | Quartz | c | 8.4 | 5.6 | 4.3 |
| PM0999 | | 7.06–7.15 | Vb | MN | Quartz | c | 9.4 | 5.9 | 5.2 |
| PM0713 | 437 | 6.48 | Ve | MN | Gabbro | f | 8.2 | 3.8 | 3.1 |
| Subgroup 2 | | | | | | | | | |
| PM0938 | | 6.80–6.85 | Vd | MN | Marble | f | 5.6 | 5.8 | 2.2 |
| PM0729 | 452 | 6.55 | Vd | MN | Limestone | f | 7.5 | 6.2 | 5.8 |
| PM0684 | 413 | 6.3 | VIa | MN | Limestone | f | 13.2 | 6.3 | 4.6 |
| PM0680 | 408 | 6.18 | VIa | MN | Limestone | c | 4.7 | 2.5 | 2.5 |
| PM0995 | | 5.95–6.01 | VIb | MN | Marble | c | 10.4 | 9 | 5.1 |
| PM0537 | 282b | 5.12 | VIIb | LN | Marble | f | *2.9 | 4 | 0.6 |
| PM0508 | 260 | 5.11 | VIIb | LN | Flint | c | 2.5 | 1.3 | 1.3 |
| PM0446 | 342 | 4.82–5.03 | VIIc | LN | Marble | c | 5 | 4.1 | 0.5 |
| PM0459 | 344 | 4.82–5.03 | VIIc | LN | Limestone | c | 14.3 | 9.9 | 7.5 |
| Subgroup 3 | | | | | | | | | |
| PM0538 | 282c | 5.12 | VIIb | LN | Marble | f | 4.6 | 3.4 | 2.9 |
| PM0455 | 220 | 4.86 | VIIc | LN | Marble | f | 7.5 | 1.9 | 1.8 |
| PM0345 | 129 | 4.37 | VIII | LN | Serpentinite | c- | 2.8 | 2.1 | 0.4 |

Figs. V.2.31–33 31. Miscellanea specimen PM0508 (flint): one face and sections; 32. Miscellanea specimen PM0680 (limestone): one face and one side (right); 33. Miscellanea specimen PM0995 (marble): one face and transverse section (photos: A. Stroulia, drawings: R. Exarhou)

Subgroup 2 includes nine a posteriori tools of various sizes and shapes. They consist of water-rolled limestone, marble, and flint pebbles and cobbles used in an abrasive and/or percussive mode. Seven specimens bear exclusive active abrasive wear or active abrasive wear with additional active percussive wear. I provide here descriptions of the four specimens that are complete: 1) PM0508 (Fig. V.2.31) is the only flint specimen in the entire macrolithic assemblage. This is a tiny blocky pebble with roughly parallel striations on both faces and one end. Given its size, this tool must have affected a small surface and been hard to hold. 2) PM0680 (Fig. V.2.32) is a small limestone pebble with a semicircular plan and a well-smoothed surface. The most intense wear is found on one of the sides which is flattened and crossed by roughly parallel striations. 3) PM0995 (Fig. V.2.33), a marble tool of roughly square plan and planoconvex sections, was used abrasively with all its surfaces but in two different manners. The faces were used horizontally, whereas the sides and ends were used at an angle. In addition, one of the ends was used heavily in a percussive manner. 4) PM0459 is limestone and has an ovate plan and planoconvex sections. This is the largest specimen in this subgroup and can be held comfortably. One of its faces was used abrasively, becoming flattened and well-smoothed as a result. Its ends, on the other hand, were battered in the context of percussion. It is plausible that the abrasive wear of the above specimens was produced in the context of various burnishing tasks.

The remaining two specimens in subgroup 2 consist of small flattish marble pebbles (PM0446 and PM0537). Parts of their periphery are chipped – perhaps the result of a specialised percussive use.

Five of the specimens of subgroup 2 are Middle Neolithic, while four are Late Neolithic. Three specimens were excavated on floor surfaces. Only one of them is complete (PM0995). It was




Figs. V.2.34–36 34. Miscellanea specimen PM0455 (marble): one view and transverse section; 35. Miscellanea specimen PM0538 (marble): one face and section; 36. Miscellanea specimen PM0345 (serpentinite): one face and sections (photos: A. Stroulia, drawings: R. Exarhou)

found on the Middle Neolithic floor F24 that belongs to a (semi-)outdoor space with two parallel thin clay walls and a thermal structure (BSPh VIb). The remaining six specimens were recovered from fill between floors.

Subgroup 3 comprises three unique manufactured objects. At least two and possibly all three do not consist of tools. All derive from Late Neolithic strata. PM0455 (Fig. V.2.34) is a fragmentary marble artefact found in sediment between two floors (BSPh VIIc). It is narrow, tapering from one end to the other – a shape acquired through grinding. The largest end is broken. The smallest is damaged but was probably originally pointed. This end may have been used in a certain fine task that eventually caused the damage. Alternatively, this end was never utilised and therefore PM0455 does not represent a tool. Artefacts of similar shape and manufacture (but not always of marble) are known from Franchthi Cave (3), Nea Nikomedeia (1), and Heliotopos (1).

PM0538 (Fig. V.2.35) is a fragmentary spherical marble object with an incipient shaft hole. It represents an unfinished version of the perforated objects known as maceheads. The hole has a maximum diameter of 1.3cm and is 0.9cm deep. Its concave bottom and nearly vertical walls indicate the use of a solid, roughly cylindrical drill. The latter may have consisted of a wooden rod,[526] since no stone drill of this shape was excavated at PMZ.[527] The manufacturing process was apparently cut short by breakage, but included an initial stage of shaping through pecking, a second drilling stage, and probably a finishing grinding stage that never happened. This specimen was found on the surface of the Late Neolithic floor F22, which represents a probable indoor

[526] The use of wooden rods as drills was hypothesised for Minoan vases on the basis of both archaeological and experimental evidence, see Morero et al. 2008.

[527] A few cylindrical/conical drills (mostly of sandstone) were recovered at Makriyalos (3).

space with a thermal structure and two postholes (BSPh VIIb). It is easy to assume that this is the area where this specimen started being fashioned and was discarded after an accidental fracture, but, given the absence of refits and the widespread evidence of redeposition of other artefacts (e.g. grinding/abrading tools and flaked stone tools),[528] I would refrain from such a conclusion.

Similar perforated objects are known from a number of Thessalian and other Aegean sites: Sesklo (1), Dimini (1), Visviki Magoula (1), Makrychori (1), Rachmani (2), Palioskala (1), Mandra (1), Knossos (1, 2), Nea Nikomedeia (1), Sitagroi (1, 2), Makri (1), Servia (1), Dikili Tash (1), Zas Cave (1), Makriyalos (3), Megalo Nisi Galanis (1, 2), Alepotrypa Cave (1), Sarakenos Cave (1), Piges Koromilias Cave (1), Avgi (2), Koromilia (1), Franchthi Cave (4), Kremasti-Koilada (5), Sosandra (1), Koronia (1), Mikro Nisi Akrinis (2), and Varemenoi Goulon (2). Regarding its manufacture, PM0538 is similar to examples made with a solid drill (see Makriyalos and Alepotrypa Cave), but different from others made with a hollow drill (see Megalo Nisi Galanis, Varemenoi Goulon, and Servia). Regarding the raw material, shape, date, and frequency, this specimen follows general trends. 'Maceheads' are made in a variety of materials and shapes, of which marble and the sphere are the most common. Most date to the later Neolithic phases[529] (for Early Neolithic and Middle Neolithic exceptions, see Sitagroi, Servia, Nea Nikomedeia, Knossos, Sosandra, and Sesklo). Moreover, the number per site is usually very small (for exceptions, see Mandra, Makrychori, Knossos, Makriyalos, and Megalo Nisi Galanis).[530] The general scarcity of these artefacts could raise the suspicion that they were produced at a few sites from which they were exported, but the unfinished specimens or drill cores found at PMZ, Alepotrypa Cave, Dikili Tash, Servia, Knossos, and Megalo Nisi Galanis indicate that most, if not all, are local creations.

Generally speaking, 'maceheads' have been interpreted as weights, weapons, gaming pieces, or symbols of authority ('sceptres').[531] Systematic arguments for or against these hypotheses are lacking for Neolithic Greece, underscoring the need for a comprehensive study of these artefacts and their contexts.

PM0345 (Fig. V.2.36) dates to the Late Neolithic and was found in sediment between floors. This nearly complete, partially ground serpentinite specimen is very small, thin, and flat. Before the narrower end was broken off, it had a triangular or trapezoidal plan and a general celt shape. Given its thinness and lack of an acute edge, however, I doubt that this specimen was meant to serve as a celt. Instead, I consider the curved broken edge as possible evidence that this object was fractured during drilling and was thus meant to be suspended.[532] Small stone artefacts with a general celt form and an actual or incipient hole on the narrower end are known from a few other Greek Neolithic sites, over half of which are caves: Franchthi Cave (3), Kitsos Cave (3), Tharrounia/Skoteini Cave (2), Drakaina Cave (6), Kremasti-Koilada (6), Knossos (7), and Berbati-Limnes Survey Findspot 39 (1). These were probably personal objects, worn as pendants, necklace elements, wrist/ear-pendants, or sewn onto clothing.[533] They could also have served as amulets.[534] Such artefacts constitute evidence of the symbolic dimensions of celts and their shape, a hypothesis reinforced by four ceramic 'axes' found at Achilleion (1), Nea Nikomedeia (3), and Franchthi Cave (3).

Leaving aside the items of subgroup 1 which are not artefacts, the vertical distribution of miscellanea is characterised by an unexpectedly high number of Late Neolithic specimens. If not random, this perhaps points to the addition of new items in the artefactual inventory of the site during this phase.

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528 See Perlès – Papagiannaki, this volume, 200.

529 See also Moundrea-Agrafioti 1996.

530 The excavations of Neolithic and Early Bronze Age strata at Palioskala yielded over 40 specimens. How many are Neolithic is not clear. The same uncertainty surrounds the specimens from Visviki Magoula (1) and Kouphovouno (1).

531 Pyke 1993, 105; Edmonds 1995, 108–111; Elster 2003a; Runnels et al. 2009; Rosenberg 2010; Sutton 2014.

532 The possibility that this object was made by grinding a thin celt fragment (or flake) should not be ruled out, however.

533 See Skeates 1995; Tsoraki 2007.

534 Sampson – Sugaya 1988/1989.

### V.2.7. Conclusions

The PMZ Neolithic macrolithic assemblage comprises 133 specimens. Ninety five (71%) are dated to the Middle Neolithic and 35 (26%) are dated to the Late Neolithic, while 3 (2%) are assigned to the Middle Neolithic/Late Neolithic. The sample is admittedly small, but the percentages of Middle Neolithic and Late Neolithic specimens roughly match the volumes of excavated Middle Neolithic and Late Neolithic deposits (62% and 23%, respectively).[535]

I divided the assemblage into five groups: 1) grinding and abrading tools; 2) celts; 3) percussive tools; 4) specimens with narrow grooves; 5) miscellanea. The first four groups are relatively homogeneous; the fifth is heterogeneous, since it includes all specimens that do not fit in the other four groups. Groups vary in size, but all are generally small. The largest (grinding/abrading tools) comprises 54 specimens, while the smallest (specimens with narrow grooves) comprises only three.

Most specimens (56%) are fragmentary. However, only the group of grinding/abrading tools has a high percentage of fragments (83%). The latter account for 60% of all broken macrolithics. In the other three homogeneous groups, complete specimens make up the majority (55% of the celts, 71% of the percussive tools, and 100% of the specimens with narrow grooves).

High rates of fragmentation are common among Aegean Neolithic grinding tools; see Makriyalos (3), Dispilio (2, 4, 5), Franchthi Cave (1, 3), Kleitos (1, 2, 4), Kremasti-Koilada (1, 2, 3, 4), Alepotrypa Cave (1), Stavroupoli (1), Makri (1), Tsoungiza (1), Sarakenos Cave (1), and Megalo Nisi Galanis (1, 2). In several assemblages – Makriyalos, Kremasti-Koilada, Franchthi Cave, Kleitos, Megalo Nisi Galanis, and Dispilio – these rates cannot be attributed solely to accidents, raising the suspicion of deliberate destruction. I have no reason to suspect that grinding tools were subjected to such treatment at PMZ. In this case, I am more inclined to see the high percentage of fragments as the result of a tendency to remove intact tools before abandoning a floor and covering it with a new one. The alternative hypothesis – the excavated floors represent not the areas where grinding/abrading tools were utilised but rather those where their fragments were discarded – is also plausible.

All raw materials used in the PMZ macrolithic industry were collected at secondary sources, with the exception of serpentinite, which may have been procured at a primary source. Moreover, all raw materials are local, with the exception of sandstone, which appears to have been collected at (micro)regional sources. Given the local origin of almost all utilised lithologies, expeditions with the exclusive purpose of raw material acquisition may have been largely unnecessary. I assume that, as a rule, the procurement of raw materials was embedded within farming, herding, fishing, clay digging, fuel gathering, and other practices that took place in the site's vicinity on a regular basis.

The lithologies utilised in the context of the four homogeneous groups are quite specific. Gneiss, sandstone, and schist were the primary materials for grinding/abrading tools; gabbro and serpentinite were the materials of choice for celts; while quartz and gabbro were the main ones for percussive tools. Last, three different materials of comparable hardness (schist, chlorite schist, and serpentinite) were employed for the three specimens with narrow grooves. Apparently certain specialisations by raw material exist within groups as well. Serpentinite and gabbro were chosen for small and larger celts, respectively, while quartz and gabbro were used for globular and elongated percussive tools, respectively. These broad patterns in raw material utilisation and specialisation characterise both the Middle Neolithic and the Late Neolithic, an indication of continuity between the two phases. If my understanding is correct, the inhabitants of PMZ operated within deeply embedded traditions as they followed similar rules in making similar tools generation after generation.

[535] Christos Batzelas, personal communication.

There is nothing unusual about the use of local or regional raw materials in the PMZ macrolithic assemblage. The exploitation of such sources was quite common in the macrolithic industries of the Neolithic Aegean. The use of specific materials for specific tool types appears fairly typical as well, as I can tell on the basis of the assemblages I have personally studied as well as others; Franchthi Cave (3), Alepotrypa Cave (1), Kremasti-Koilada (3, 4, 5), Megalo Nisi Galanis (1, 2), Varemenoi Goulon (1, 2), Pontokomi-Souloukia (1, 2), Koronia (1), Sesklo (2), Dimini (2), and Avgi (1, 2). As for the rather static character of the PMZ assemblage, it fits the impression of conservativism conveyed by Aegean Neolithic macrolithic industries in general.[536]

At PMZ, as in other Greek sites, some of the raw materials were put straight to use, without prior modification, but most went through a manufacturing process. There are approximately 30 a posteriori specimens (23%). They are not distributed evenly among the five groups. All quartz percussive tools, all specimens with narrow grooves, and most of the miscellanea are a posteriori. The grinding/abrading tools, on the other hand, include one possible a posteriori case, while the celts include none.

Ninety-eight specimens (74%) were produced through one or more of the following five techniques: pecking, grinding, flaking, sawing, and splitting. Pecking was the most common at PMZ, as it was in Aegean macrolithic industries in general. Grinding was used for all celts, all gabbro percussive tools, as well as a couple of miscellanea. Flaking was employed for several grinding/abrading tools and one celt. Splitting and sawing are the rarest techniques, represented by two grinding/abrading tools and one celt, respectively. I should note here that splitting as a manufacturing technique has been documented in only one other assemblage: that of Varemenoi Goulon (1). In this case, nevertheless, splitting was involved in the manufacture of celts, not grinding/abrading tools. Neither the required skills nor the volume of output supports a case for craft specialisation in macrolithic production at PMZ. All adults were likely able to produce such tools, though, on the basis of the ethnographic record, gender restrictions probably applied.

Regarding the whereabouts of macrolithic production, the scarcity of unfinished specimens as well as the absence of manufacturing debris and unworked raw materials securely intended for macrolithics indicate that the excavated areas did not serve as production loci on a regular basis, if at all. Macrolithic manufacture must have taken place elsewhere. Spanning both the Middle Neolithic and the Late Neolithic, this pattern in the use of space can be taken as another sign of continuity between the two phases. Were macrolithics fashioned at other parts of the site or outside the settlement altogether? This question cannot be answered with the available data, but it is worth noting that, with a handful of exceptions, Greek sites yielded very limited or no evidence of macrolithic manufacture.

In terms of form and size, the PMZ assemblage includes nothing that is out of the ordinary in the context of the Aegean macrolithic industry. Comparable tools have been found at other sites. Although not subjected to use-wear or residue analysis, the PMZ macrolithics appear suitable for a variety of tasks, such as the processing of food and other substances, tree felling and woodworking, and the manufacture and maintenance of tools and other objects.

Fairly secure information on the contexts of recovery is available for the vast majority of macrolithics (close to 95%). Most specimens (over 65%) were found in sediment between floors and thus not in situ. Complete and fragmentary specimens from all five groups were excavated in such sediments. Notably, most flaked stone tools derive from similar contexts.[537]

A total of nineteen macrolithics (14%) were found on floor surfaces. The six complete specimens – four celts, one specimen with a narrow groove, and one miscellanea – derive from four floors that belong to outdoor or semi-outdoor spaces (F21, F24, F26, and F27) and a fifth that likely belongs to an indoor space (F22). Three of the floors are dated to the Middle Neolithic: F24, F26, and F27. The other two are Late Neolithic: F21 and F22. Regarding the specimens found in

[536] See Moundrea-Agrafioti 1992; Perlès 1992; Perlès 2001, 236; Stroulia 2010; Stroulia 2018a.
[537] Perlès – Papagiannaki, this volume, 200.

outdoor or semi-outdoor areas, it is impossible to say whether they were actually used in these spaces. They may have been, but it is equally plausible that they were discarded in the open area of a yard after being used indoors or that they ended up there when the remains of nearby buildings were levelled.

Eight specimens (6%) were incorporated into structures (six in thermal structures, two in postholes). All consist of grinding/abrading tools. Seven are fragmentary, while the eighth is complete but (most likely) exhausted. These specimens attest to a practice of recycling broken or exhausted tools into building material. That both Middle Neolithic and Late Neolithic specimens were thus treated represents another element of continuity, although, it must be noted that there is an apparent variation in both the intensity of the practice and the targeted structures from one phase to another.

One fragmentary grinding/abrading tool was excavated in a pit associated with the Middle Neolithic floor F26 that appears to belong to an outdoor space. One specimen was found in the Middle Neolithic ditch at the bottom of the stratigraphic sequence, while eleven derive from Middle Neolithic sediments overlying the ditch and lacking architectural features. Most of these twelve specimens are fragmentary and consist of grinding/abrading tools. Since no floors are associated with the ditch and the overlying sediments, I assume that the included macrolithics had been used in an unexcavated part of the site before ending their biography in the area of Trench A.

The horizontal distribution of macrolithics provides virtually no secure information regarding the contexts of use and only piecemeal information on the contexts of discard. Yet, along with the horizontal distribution of flaked tools,[538] it underscores the less than straightforward processes that followed the breakage or abandonment of stone tools and the large extent to which material remains were reworked throughout the site's occupation.

A few notes regarding the macrolithic vertical distribution: with one exception, all building phases and subphases are represented in the macrolithic material. The exception is the latest building phase – Late Neolithic BPh IX – which yielded no such specimens. The reasons for this absence are unclear, but it is noteworthy that no flaked stone tools are associated with this building phase either.[539]

As mentioned above, the ratio of Middle Neolithic and Late Neolithic macrolithics is generally consistent with the ratio of the excavated Middle Neolithic and Late Neolithic sediments. There is an exception to this rule, however. The group of miscellanea shows more Late Neolithic specimens than expected – a possible indication of a diversification of material culture in the later phase of the site's occupation.

Finally, a substantial percentage of macrolithics (9%) were recovered from the ditch and the overlying sediments that lack architectural remains. Their presence in these floorless sediments implies the existence of another occupation area outside the excavated space. It was this area that must have served as the context of use for these tools. Significantly, no celts derive from the ditch and the overlying deposits. Nor were such tools recovered from the following building phase (BPh III), which does include floors and/or activity areas. Why celts are absent from the earliest component of the site occupation I cannot tell. This is one of the many questions that my study has inevitably left unanswered.

I end by going back to the beginning. This chapter offered a systematic analysis of a Thessalian macrolithic industry and made comparisons with other Aegean Neolithic materials. Due to an almost complete lack of detailed publications, however, substantial comparisons with other Thessalian assemblages have not been possible. It is my hope that more thorough studies will follow and that we will soon be able to discuss Thessalian macrolithics meaningfully, not only in their broader Aegean context but in their regional context as well.

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538 Perlès – Papagiannaki, this volume, 200.

539 Perlès – Papagiannaki, this volume, 251.

## V.3. Bone Tools

*Rozalia Christidou*

### V.3.1. Introduction

Bone artefacts from the excavation of Stratigraphic Trench A near the centre of the mound of PMZ were described in the report on the faunal assemblages by Cornelia Becker.[540] The Neolithic specimens numbered eighteen and comprised twelve cutting-edge and pointed tools, four complete and broken bones with smoothed surfaces, a pin and a pendant. The latter two objects, one cutting-edge and three pointed tools and two smoothed bones were assigned to the Middle Neolithic. The remaining ten specimens were dated to the Late Neolithic. All of these artefacts were separated from the unworked bone assemblages during the zooarchaeological study. Including an additional twenty-six items, recorded during the excavation but not analysed, adjusted the Neolithic bone artefact collection to forty-four specimens in total. The present chapter examines nineteen unpublished stratified bone artefacts from the Neolithic levels of the abovementioned trench, which were dated on the basis of the new phasing data.[541] For the most part they derive from the Middle Neolithic deposits (Appendix, Tab. V.3.A1). Twelve are from BPh/BSPh II, IIIa–c, IVa–b and Va, which have been associated with Ceramic Horizons 1 and 2 and Lithic Phase 1, corresponding to the Early Middle Neolithic. There are no bone artefacts from BSPh Vb–d. BSPh Ve has two and BSPh VIa and VIb each have one specimen. The pottery from these contexts belongs to Ceramic Horizons 3 and 4, dated to the middle and later parts of the Middle Neolithic. The chipped stone artefacts are from Lithic Phases 1 and 2, which revealed strong similarities and continuities in tool types, production and use. BPh VII–IX cover Ceramic Horizons 5 and 6 and Lithic Phases 3–5 and are dated to the end of the Middle Neolithic and the beginning of the Late Neolithic. From this part of the sequence come three bone artefacts, one from BSPh VIIa, one from BSPh VIIc and one from BPh VIII. Despite different rates of change in the composition and technology of the pottery and lithic assemblages, an in situ, gradual transition from the Middle to the Late Neolithic was observed. BPh VIII and IX are described as typical of the latter period.

Sixteen bone artefacts were recognised during the excavation and three were retrieved from the faunal material. A bone fragment damaged by animal chewing, PM0769, cannot be securely classified as an artefact.[542] The cut marks preserved on its surface represent modification during the butchering process or food consumption rather than manufacturing activities. At the time of writing, no count of bone artefacts from PMZ can be considered as definitive. About one hundred two items were not labelled according to their excavation unit. Apart from a few exceptions identified based on published photographs and drawings, these objects could not be associated with any deposit or chronological horizon. Bone 167, illustrated in figure 19c of Becker's article and dated to the Late Neolithic,[543] shows flattening and thinning of the anterior and posterior surfaces of a sheep metatarsal and is used here for comparative purposes.

This work complements Becker's publication, which focused on the raw materials and morphological traits of the bone artefacts. It is based on anatomical, morphometric, technological and preservation data. By combining the raw materials with the nature, degree and distribution of the damage on the objects, successive modifications of the bones were examined. Artefact manufacturing, use and resharpening are described in the following pages. Fracture characteristics

[540] Becker 1991, 37–45.
[541] Toufexis – Batzelas, this volume, 86; Perlès – Papagiannaki, this volume, 208, 224, 230, 237 and 251.
[542] It is not included in the artefact counts in Toufexis – Batzelas, this volume, 147, Tab. III.1, 166, Tab. III.2.
[543] Becker 1991, 42.

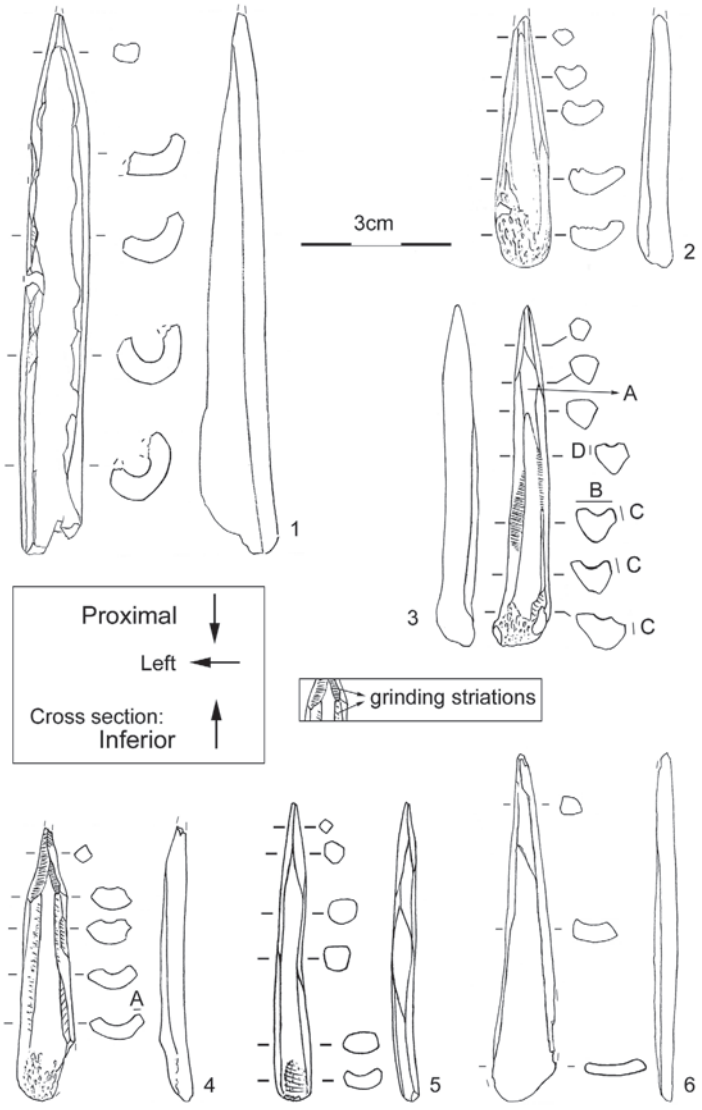


Fig. V.3.1 Pointed tools: (1) PM0468; (2) PM0658; (3) PM0700; (4) PM0717; (5) PM0767; (6) PM0798 (R. Christidou)

were assessed following Paola Villa and Eric Mahieu.[544] Skeletal and taxonomic identifications were made using osteological manuals[545] and the comparative faunal collection of the Wiener Laboratory of the American School of Classical Studies at Athens. The morphological features and dimensions of the artefacts were recorded and analysed following established standards.[546] Manufacturing, use and natural modifications were observed using stereoscopic microscopes at magnifications of 5× to 60× and metallurgical microscopes at magnifications of 100× and 200×.[547]

Nearly all of the artefacts are tools grouped on the basis of the shapes of their active ends. Artefact names widely used in the literature, e.g. awl, needle and smoother, are retained here. The terminology applied to bone orientation is followed for specimens which are hardly modified by

544 Villa – Mahieu 1991.
545 Schmid 1972; Barone 1986; Hillson 1992.
546 See in particular Stordeur 1977; Stordeur 1978; Camps-Fabrer – Stordeur 1979; Stordeur 1985; Choyke 1998.
547 For a relatively recent review of analytical techniques see Legrand – Sidéra 2007.

manufacture. In all other cases, the nomenclature devised for bone tools[548] is used to describe their components and views. There are terms that are common to both descriptive systems but do not have the same meaning. For a tool, proximal refers to a part nearer to the base or the base itself; it points downward on the drawings (see Fig. V.3.1). The opposite of proximal is distal. The surface that shows the greatest amount of modification of the original bone is called inferior and has a left and a right half. The opposite of inferior is superior.

The organisation of the presentation roughly follows that of Becker and facilitates comparisons. The Middle and Late Neolithic groups are examined together because they are small, especially for the latter period. This and the aforementioned shortcomings in artefact recording rendered the outcome of a systematic examination of the abundance and distribution of the material with regard to the spaces excavated uncertain. It is, however, noteworthy that, when the total of sixty-three Neolithic bone objects is compared to ~119m³ of total volume of sediment excavated from this period, low artefact density becomes apparent. A similar observation was made about the chipped stone artefacts. Below, spatial data are considered in relation to the nature and state of preservation of the bone objects. Preservation also helps assess anatomical, morphological and technological information. Comparisons with particular tools, raw materials and manufacturing techniques from other Neolithic sites in Thessaly and neighbouring regions are made.

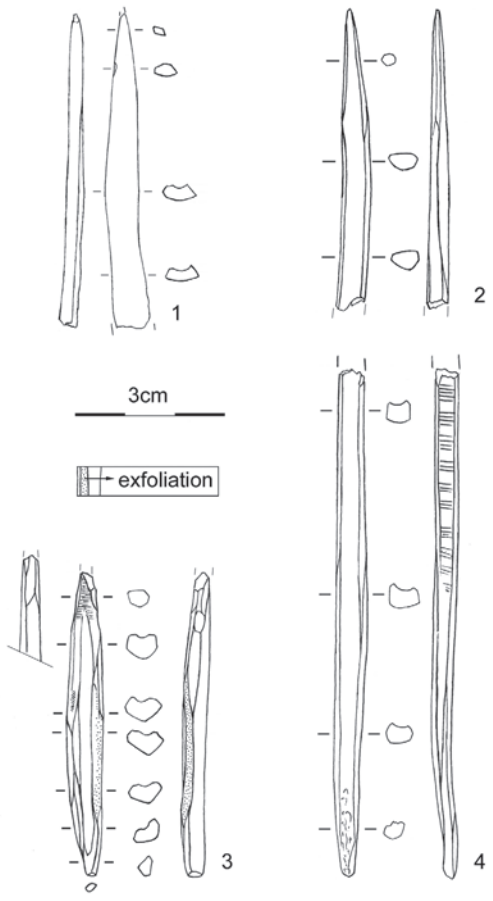


Fig. V.3.2 Pointed tools: (1) PM0661; (2) PM0854; (3) PM0617; (4) PM0835 (R. Christidou)

[548] This terminology has already been employed to describe Neolithic bone tools from Thessaly, see in particular Moundrea-Agrafioti 1980a; Moundrea-Agrafioti 1981.

### V.3.2. Major Groups and State of Preservation of the Bone Artefacts

At least thirteen of the nineteen artefacts are pointed tools. Seven of thirteen (PM0468, PM0658, PM0700, PM0717, PM0767, PM0798 and PM0800; Fig. V.3.1) were sharply pointed at one end and represent awls; another two (PM0661 and PM0854; Figs. V.3.2.1–2), which are broken and lack the proximal end, are also classified as awls on the basis of morphological and technological data. Two pointed tools (PM0617 and PM0835; Figs. V.3.2.3–4) with tapered proximal parts are termed bipoints and the body of a medium, i.e. sheep-sized, mammal rib, which was perforated and used without further modification (PM0865; Fig. V.3.3), a needle. PM0805 (Fig. V.3.4.1) is a point fragment damaged by animal chewing. It is unclear whether it is the distal or proximal end of a pointed tool. Two tool fragments (PM0810 and PM0928; Figs. V.3.4.2–3) that lack the active ends are possibly from pointed tools. If this were the case, PM0928 would be an awl. There are also two cutting-edge tools (PM0414 and PM0785; Figs. V.3.5.1–2) and a body fragment of cattle rib (PM0930; Fig. V.3.5.3), which was abraded through use. The latter object is a central fragment of a tool, which is damaged by animal chewing at both ends. Its original form cannot be reconstructed. It is described as a smoother solely on the basis of use wear. A single artefact (PM0929; Fig. V.3.6) represents reduction waste.

Four objects (PM0700, PM0767, PM0798 and PM0865) are complete. PM0785 is essentially complete, but it bears the negative of a recently removed large flake (length: 54mm, greatest width: 7.2mm) on the superior face. Another five artefacts (PM0414, PM0468, PM0800, PM0805 and PM0835) display recent fractures. Nearly all of the fragments of PM0468 were recovered; a single piece is missing. PM0800 is a pig incisor (Appendix, Tab. V.3.A2) broken into very small pieces (length <11mm, greatest width <2.5mm). Twelve splinters and three enamel chips were counted; other fragments were severely crushed. The tooth could not be mended. Ten objects (PM0464, PM0617, PM0661, PM0658, PM0717, PM0928, PM0810, PM0930, PM0854 and PM0929) present old fractures. Four of them are pointed tools featuring oblique (PM0468 and PM0617) and hinged fractures (PM0658 and PM0717) at distances of less than 10mm from the distal tip (cf. Appendix, Tab. V.3.A3). Such fractures occur on awls before discard, but there is no evidence to suggest here that they represent use damage. PM0929 is a nearly complete metatarsal from a red deer and exhibits multiple weathering fractures and cracks (see Fig. V.3.7.1). This damage affects the preserved portion of the distal metaphysis of the bone, which was chewed (Fig. V.3.7.2). As mentioned above, chewing animals had also destroyed PM0930. PM0854 and PM0928 display transverse rough broken surfaces. The broken ends of PM0661 and PM0810 are jagged. Such occurrences are mostly related to dehydrating or dried bone broken before or after deposition.[549] A hinged fracture was recorded at the broken distal extremity of PM0810.

The complete objects have different forms, raw materials and sizes, suggesting that none of these variables alone influenced completeness. Length having been the dimension mostly affected by fragmentation, it is used here to examine artefact size (Fig. V.3.8.1). The longest complete specimens are the 170mm-long rib body used as a needle and a goat tibia fragment with complete shaft circumference, shaped into a cutting-edge tool, PM0785, which is about 129.7mm long. The recently broken cutting-edge implement PM0414, made from a fragment similar to PM0785, would be long too; it is 91mm in length. Both the lengths and the blanks of the cutting-edge tools accord with data reported by Becker, who observed that the implements of this kind from the Neolithic and Bronze Age levels of PMZ were most often made from caprine tibiae, radii and metapodials broken across the shaft and measured 100–180mm in length.[550] The smoother fragment is also long; it probably reflects the large size of the original rib. With the exception of specimen PM0468, which is 107.8mm long, the lengths of the complete and nearly complete pointed tools termed awls and bipoints range between 49.7mm and 68.8mm. All of these tools were made from

[549] For rough surfaces see, e.g., Johnson 1985, 176; Shipman 1993 [1981], fig. 7.2 bottom; Outram 2002, 54.
[550] Becker 1991, 38.

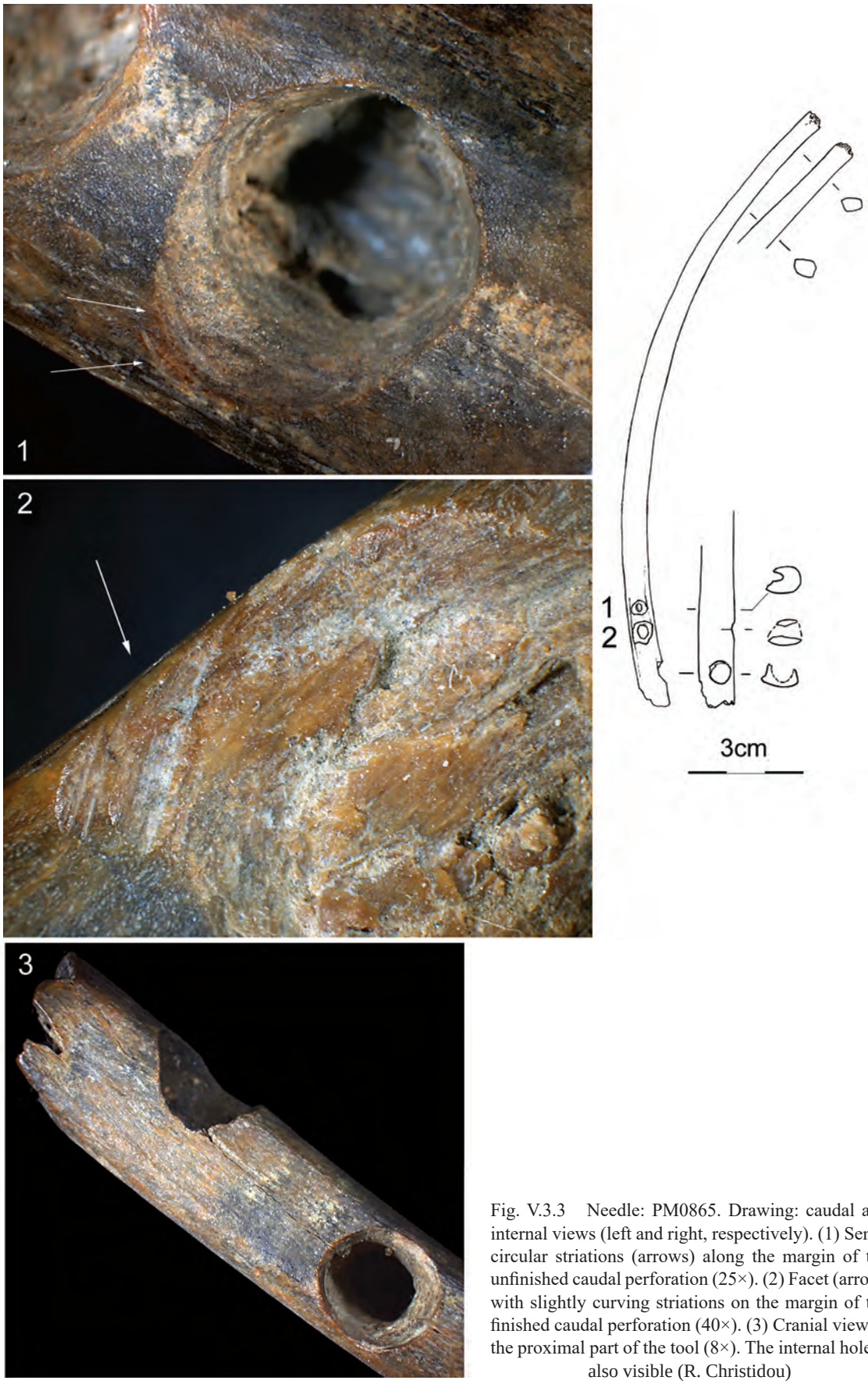


Fig. V.3.3 Needle: PM0865. Drawing: caudal and internal views (left and right, respectively). (1) Semi-circular striations (arrows) along the margin of the unfinished caudal perforation (25×). (2) Facet (arrow) with slightly curving striations on the margin of the finished caudal perforation (40×). (3) Cranial view of the proximal part of the tool (8×). The internal hole is also visible (R. Christidou)

linear fragments of long bones of mammals of medium (PM0468, PM0617, PM0658, PM0717, PM0798) or perhaps larger sizes (PM0700 and PM0798). The plot of greatest width versus thickness of these artefacts (Fig. V.3.8.2) shows that dimensional variations are present but limited overall. Among the fragmented specimens is PM0835, which was recently broken. It is a proximal fragment of a bipoint with attached partial shaft and measures 100.9mm in length. Its maximum width and thickness, preserved near the midpoint of the fragment, are 5.8mm and 3.7mm, respectively. From this height, the tool tapers again toward the broken end. It would be a relatively long, slender form of tool. To judge from the evidence above, the causes of the old breaks recorded on the artefacts are unclear, except for a couple of well-defined cases of weathering and gnawing damage (PM0929 and PM0930). Weathering was not uncommon, but no straightforward relationship could be identified between this kind of damage and tool breakage in general. PM0929 was severely weathered and deep cracks tore the bone, as noted above. The other weathered artefacts were less altered and seem to have fared better; perhaps they were buried more rapidly. On these objects, the damage consisted of fine longitudinal cracks and sometimes loss

Fig. V.3.4 Unclassified partial bone tools: (1) PM0805; (2) PM0810; (3) PM0928. The photograph of specimen 2 shows use-worn oblique grinding striations (25×). These marks are macroscopic. Sketch in rectangle used to show fracture profile of the same specimen. Dashed line used to indicate thick crust on specimen 3. Sketched outlines are only provided for this specimen; dimensions are approximate. Oblique and transverse lines on the drawings indicate grinding (R. Christidou)

of portions of the outer bone surface. The areas damaged varied. On five specimens (PM0661, PM0717, PM0798, PM0835 and PM0930), more than 50% of the tool surface was affected; on two (PM0617 and PM0767), the percentage is lower (about 40% and 17%, respectively); while on another two (PM0414 and PM928), encrustations prevent such observations.

In addition to weathering, chewing and encrustations, burning, root etching, natural abrasion, flaking and cracking were recorded as post-discard damage of the bone artefacts. Modern damage in the form of surface removals and cleaning tool marks was also observed, but was never extensive. A single object, PM0468, was burnt. Corrosion by plant roots was present on about half of the artefacts. The etch marks were both light-coloured (and therefore recent) and stained; recent and old damage often coexisted on the same object (PM0414, PM0785, PM0810, PM0854 and PM0865). At any site where archaeological surfaces remain exposed for the best part of the year, root etching damages the bones lying near the surface. The pits and channels formed by the roots quickly become coloured. It is therefore difficult to associate plant damage exclusively with prehistoric times. Considering edge abrasion, it was recorded on broken edges of four specimens.

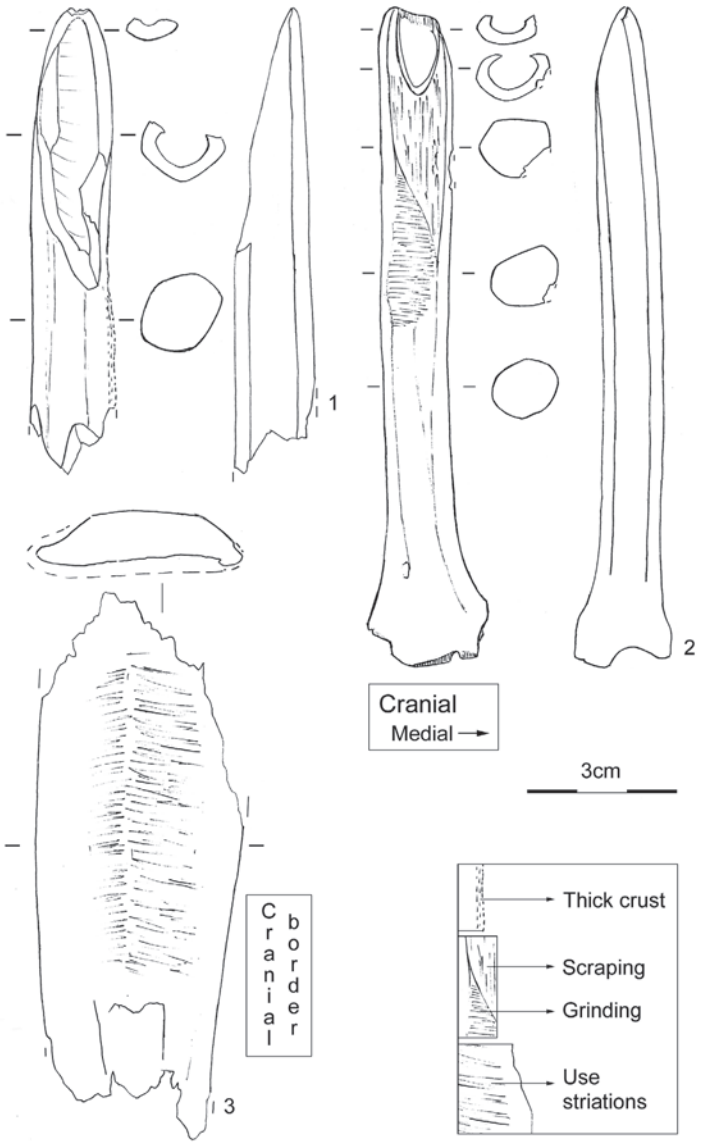


Fig. V.3.5 Cutting-edge tools and smoother: (1) PM0414; (2) PM0785; (3) PM0930. Dashed line used to indicate weathered surface on specimen 3 (R. Christidou)

Fig. V.3.6 Reduction waste: PM0929. Outline of bisected metatarsal (left) reconstructed from fragments (middle). Dimensions are approximate. Shallow medullary grooves (right) cut to guide motion for quartering the bone. Their location is indicated by rectangle (a). Rectangles (b) and (c) locate details shown in Fig. V.3.7 (R. Christidou)

In one case (PM0929), it was related to weathering. Otherwise, it was light. Cracking and local exfoliation often arose from weathering, which, together with crusting, were the major causes of surface destruction. Carbonate and manganese deposition appear pervasive. In only one instance (PM0928) were concretions thick (Fig. V.3.4.3). Manganese deposits, usually forming thin layers on the tool surfaces, could perhaps be related to the high levels of humidity at the site. Crusts often covered more than 50% of the artefact surfaces. On seven objects (PM0658, PM0717, PM0798, PM0805, PM0835, PM0854 and PM0930), up to 75% of the bone surface was affected; on another five (PM0414, PM0468, PM0700, PM0928 and PM0929), the extent of the damage was greater. In these cases, it was not always possible to evaluate the areas of the tools previously modified by other processes including polishing through use. By contrast, manganese coatings seldom prevented the observation of bone shape modifications (see Fig. V.3.7).

Burning is consistent with the discovery of PM0468 in BSPh VIIc, which has yielded burnt remains. The bone was not calcined. It was probably simply lying or buried near a place where fire was burning. Its position in a fill (SU 152) beneath the virtual floor F20 of BPh VIII and above the house floor F21 of BSPh VIIc does not establish a direct relationship with the use or destruction of a given structure and, in any case, the architectural features sampled from the latter phase are quite restricted in extent and fragmentary. Two of the three chewed specimens, PM0805 and PM0930, come from BSPh IIIc and IIIb, respectively, which represent dump and activity areas, probably open and semi-open, accessible to chewing animals. PM0930 was weathered as well; the entire caudal edge and the internal smooth surface of the rib had degenerated; they are rough and crossed by narrow cracks.[551] An additional two weathered artefacts, PM0798 and PM0835, come from the same levels. BPh VIII, BSPh Ve and BSPh Va, which would also correspond to non-built-up space, yielded three weathered objects, PM0414, PM0717 and PM0767. As noted above, PM0929, from BPh II, for which architectural evidence was totally lacking, was seriously weathered. Nearly all of its fragments were recovered and it is not unreasonable to assume that degradation took place on the spot. This, the great length of the artefact and the complete state of the medium-sized rib body PM0865 that comes from the same building phase could suggest that the area remained fairly undisturbed by human activities during the formation of the deposit or later. The remaining three weathered objects, PM0617, PM0661 and PM0928, come from BSPh VIIa, VIb and IVa, where house interiors as well as outdoor space were excavated. PM0928, more damaged than the other two specimens, comes from the exterior space north of the house in BSPh IVa. PM0617 and PM0661 are two of the three bone artefacts that could be associated with house floors; the third specimen is PM0785. They come from Floors F23, F24 and F31, respectively. Since levelling for rebuilding occurred at the settlement, some degree of exposure to bone-damaging factors could be expected.

### V.3.3. Raw Materials and Tool Blanks

This chapter examines in further detail the raw materials and the blanks of the tools. A single specimen (PM0810) was not assigned to a specific skeletal element or type of bone.[552] It is a small piece of compact bone, highly modified around the entire circumference. Of fifteen long bones, all represented by fragments, seven could be assigned to a skeletal element and to a species or broader taxonomic group. Three (PM0414, PM0785 and PM0928) are tibiae of small ruminants and one (PM0854) a pig fibula. Three bones (PM0700, PM0835 and PM0929) are metapodials. PM0929 is a red deer metatarsal. Of the other two, at least one, PM0835, comes from a small ruminant, as suggested by the thickness of the compact bone (Appendix Tab. V.3.A2). Eight specimens (PM0468, PM0617, PM0661, PM0658, PM0717, PM0767, PM0798 and PM0805) are

[551] Cf. stage 3 of weathering as defined in Behrensmeyer 1978, 151, fig. 2.
[552] It could be from a long bone or a mandible, or even an edge of scapula with thick cortical wall.

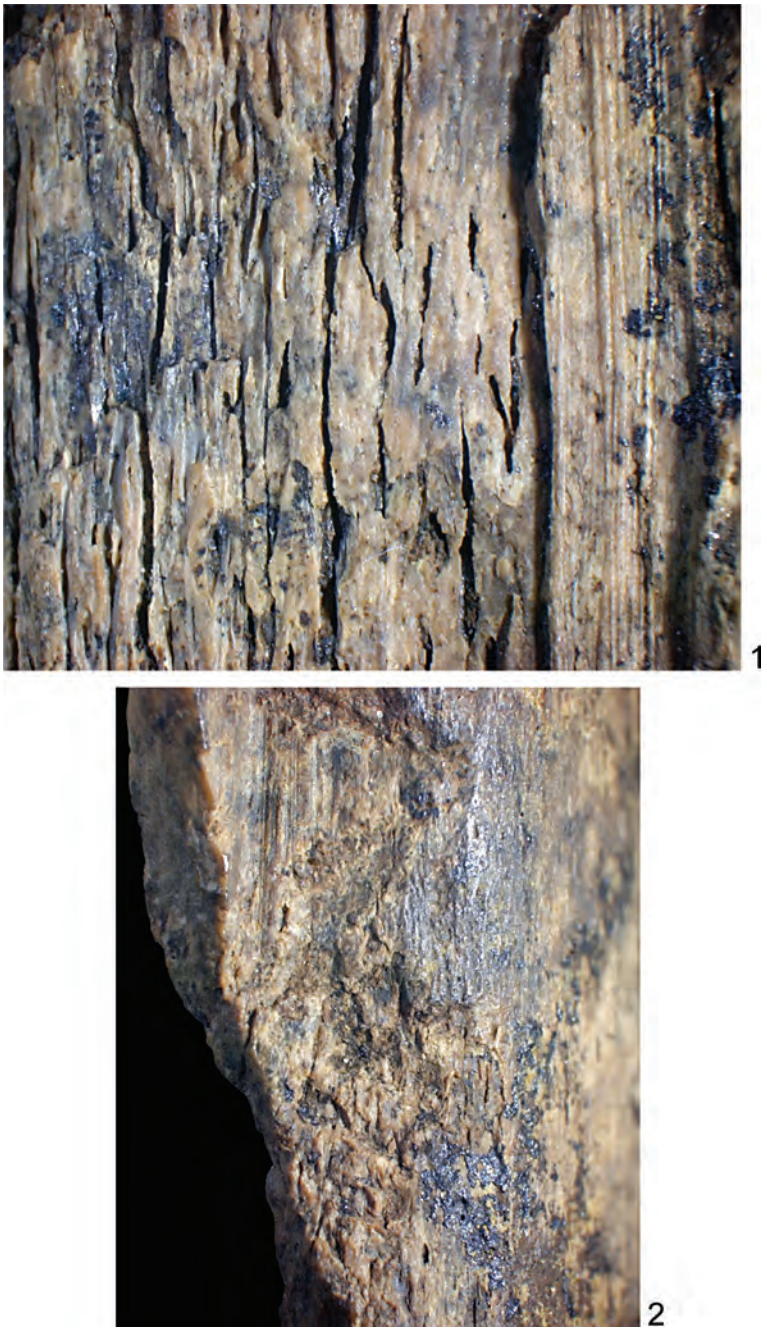


Fig. V.3.7 PM0929: post-discard damage. (1) Cracking and removal of surface bone as a result of weathering (20×). For image location see rectangle (b) in Fig. V.3.6. (2) Chewing marks (10×). For image location see rectangle (c) in Fig. V.3.6. Note also the thin dark-coloured crust (R. Christidou)

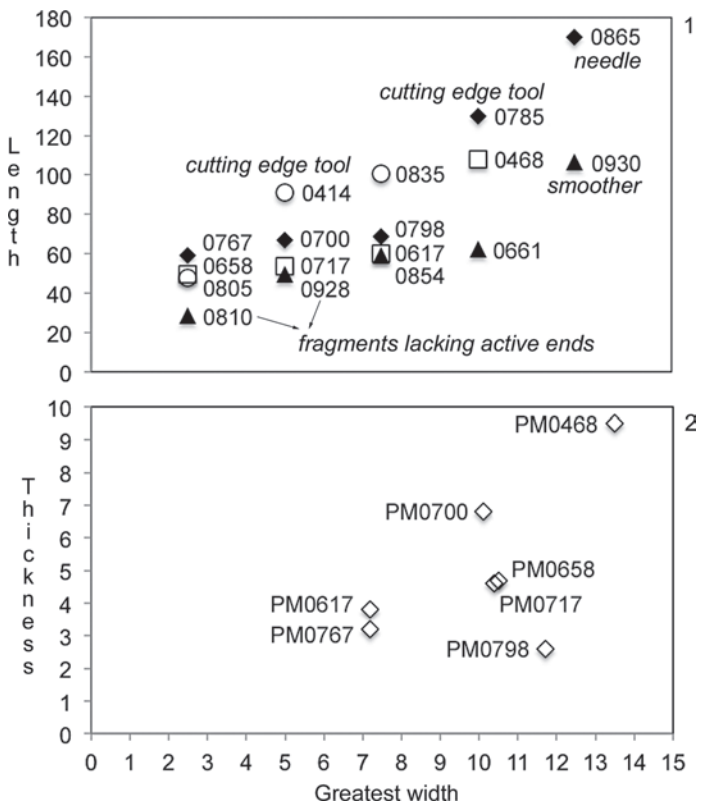


Fig. V.3.8 (1) Comparison of artefact lengths (measurements in millimetres). Specimens PM0800 and PM0929 are excluded from comparison because of extreme fragmentation. PM0785 is analysed as a complete specimen since flaking affects the superior face away from the extremities. Diamond: complete; blank square: nearly complete; triangle: old fragment; blank circle: recent fragment. (2) Greatest width/thickness of complete and nearly complete pointed tools (measurements in millimetres) (R. Christidou)

fragments of long bone shafts, which could not be identified to the element level.[553] Most of them represent mammals of medium sizes such as caprines and pigs. For PM0700 and PM0805, assignment to a body-size class is uncertain as a result of thorough shaping. These data accord with the results of the study of the Neolithic animal bone assemblages and suggest local production. Small ruminants, specifically sheep and goats, predominate in the identified bones, which are mostly from medium-sized mammals.[554] Domestic pig is well represented in this size group, which also includes some roe deer and dog. Regarding the large mammals, domestic cattle in the Middle Neolithic were rather large in stature;[555] wild individuals have also been recognised. The greatest width of the smoother, which is dated to this period, is 40.4mm indicating a large individual. Working of the red deer metatarsal is in accordance with the transport and deposition of parts of the hind and fore limbs of this animal within the settlement during the same period.[556] No fallow deer were recognised. The evidence available for this species from Neolithic Thessaly is remarkably limited.[557] Their absence would mean there would be no intermediate between the small and the large ruminants in the worked bone collection. With regard to the age of the individuals from which the worked elements originate, there is no evidence for use of young bone other than the

553 PM0468 could be from a tibia, but the identification is uncertain.
554 Becker 1991, 19–20; Becker 2000, 8–9. See also Halstead, this volume, 585, Tab. VIII.1.
555 Becker 2000, 12.
556 Becker 2000, 11, 21, appendix, tab. 6.
557 Becker 2000, 17 with references. Cf. Yannouli – Trantalidou 1999, 251.

porous surfaces of PM0717 and PM0835. This criterion does not suffice for aging, but some further observations should be made for PM0835. This bipoint was made from a halved metapodial of a small ruminant and terminates in the distal metaphysis of the bone. As a rule, tools made from such blanks retained the halved distal or proximal articular end at the base. When the distal end was not fused, it was sometimes removed, accidentally or deliberately. The absence of epiphysis from PM0835 could suggest use of a bone from a juvenile and detachment prior to or during the manufacturing process (see also below, Chapter V.3.5).

The pig incisor and the fibula shaft could be used directly to shape the implements. The proximal part of the fibula tool is missing. The portion preserved is located within the central third of the bone. In the pig, the fibular shaft is compact, long, straight and slender, suitable for producing pointed tools. Evidence available from various Neolithic sites of Thessaly and neighbouring regions indicates occasional use of this bone as well as small ruminant ulnae for awls. The naturally tapering forms of the ulnae were also convenient for awl shaping.[558] With regard to PMZ, intense fragmentation of the limb bones of the domestic animals for food was observed in the Neolithic period, especially the Middle Neolithic.[559] This could partly explain the use of fragments of other long bones, which also provide a wide range of sizes and forms of fragments for various uses.[560] The tibia fragments from which the two cutting-edge tools were made could have been produced during butchery and then recovered for artisanal purposes. For the active end of both tools, breaks in the proximal third of the bone were exploited. PM0414 was based on a fracture with a curved outline. The unworked part of the fracture surface is smooth-textured, suggesting green bone breakage.[561] On PM0785, the morphological characteristics of the broken end were obliterated during the shaping process. Below the broken ends, the diaphyses were kept complete on both tools.

Except the fibula, the incisor and the medium-sized mammal rib shaft, which was broken near the costal angle, the other pointed objects were linear fragments of long bone shafts. There were two ways of acquiring longitudinal fragments: by splitting and by grooving the bones. Four artefacts (PM0468, PM0617, PM0717 and PM0798) were splinters; three of them (PM0468, PM0617 and PM0717) had twisted profiles. The tapering end of splinter PM0468 was shaped into a sharp point; the proximal part of the tool was approximately half the shaft diameter of the bone. PM0468 is the largest splinter among the four measured (see also Fig. V.3.8). The other three represent roughly a quarter or less than a quarter of the diameters of the diaphyses from which they came. PM0717 and PM0798 also retained a portion of metaphysis at the proximal end. PM0617 is a fragment of a natural ridge of a diaphysis, where the compact bone was thick-walled. In this case, the tapering end was shaped into a blunt point, which was used as the base of the tool. Splinter lengths are tricky to evaluate. The confirmed splinters number only four. Moreover, they were modified through use; PM0617 and PM0717 were resharpened and somewhat shortened. It can, however, be stated that the lengths of the four specimens are consistent with those of splinters produced from shattered long bones of sheep-sized mammals, which are usually smaller than 100mm.[562]

PM0929 is the medial half of the red deer metatarsal mentioned above. It has yielded evidence of reduction using longitudinal grooving with a stone edge. First, approximately half of the thickness of the bone wall was worn down by grooving the anterior fusion line of the metatarsal. At an earlier stage of the work, this side of the bone had been lightly scraped, perhaps for removing any residue of the periosteum. The posterior edge of the half does not preserve grooving marks. Weathering damage could perhaps explain this absence. However, it is possible

558 For Neolithic examples of use of pig fibulae and small ruminant ulnae, in the Aegean see, e.g., Leroy-Prost 1981, 247; Moundrea-Agrafioti 1981; Wijnen 1981, 43; Stratouli 1993, 498; Isaakidou 2003, 236–237.

559 Becker 1991, 34–35. For the Middle Neolithic see Becker 2000, 11.

560 Otherwise, the same fractures were reproduced for making tools.

561 E.g. Lyman 1994, 320 with references. Cf. above, 345 (n. 543).

562 Christidou 1999.

that the toolmaker's final decision was to simply crack this side of the bone. Whatever the case, the metatarsal was split since the anterior groove had not reached the medullary side of the bone wall and another longitudinal groove was prepared on this side in order to bisect the half and produce two quarters. This action was not completed: the depth grooved varies, but overall it is much shallower than that on the outer anterior side. Basically, only cuts that were going to guide the shaping of the groove along which the half would be divided were incised. They are discontinuous, long or relatively short, curving or sinuous at some points (Fig. V.3.6). There are also superficial incisions, oblique or nearly parallel to the deepest cuts. Deviations from the main grooving direction and secondary cuts indicate difficulties to be expected since the work concerned the deepest part of the marrow cavity of the bone. They are also related to intermittent movements used in the beginning of the shaping of the groove as noted above. On PM0929, the medullary grooving was approximately 215mm long. The anterior groove was preserved along a length of 190mm.

The surfaces of PM0661, PM00658, PM0700, PM0767, PM0928, PM0805 and PM0835 are thoroughly shaped or damaged and cannot be used to describe blanks in detail. More precisely, encrustations on PM0658 and PM0928, exfoliation on PM0661 and chewing on PM0805 obscure such details. PM0700, PM0767 and PM835 show a high degree of modification of the blanks during the shaping process. However, a number of specific observations can be made. PM0928 and PM0700 indicate quartering of a tibia and a metapodial, respectively. A portion of epiphysis, distal for the tibia and proximal for the metapodial, remained attached to the blanks. Specimen PM0928 is located in the craniomedial quarter of the bone; PM0700 is too modified to distinguish between metacarpal and metatarsal, but it is possible that the tool was made from a posterior edge where the cortical bone of the metapodial is thick. PM0658 also retained a portion of metaphysis at the base. On the left side of the fragment, the bone thickens and suggests exploitation of a ridge or similar formation on which the active end of the tool was located. The proximal end of PM0767 clearly curves outward and preserves a small portion of medullary cavity, but the rest of the artefact suggests use of a thickened area of the bone shaft such as a crest or other ridge. PM0805, like splinter PM0617, is a fragment of ridge.

The choice of fragments of tibiae, particularly from the distal two thirds of the bone, metapodials and naturally thick portions of compact bone from natural ridges would suggest the use of blanks with inherent resistance to mechanical loading.[563] The longitudinal fragments produced by breaking or by grooving had rectilinear vertical cross sections, curving slightly near the metaphysis or epiphysis portions attached to some pieces, including the proximal part of PM0767 described above. Some splinters had twisted forms. Such fragments often taper toward one end[564] and are therefore suitable for shaping pointed tools. This was specifically the case for PM0468 and PM0617.

The quartering of the small ruminant tibia is peculiar. By contrast, the use of fragments with complete shaft diameters from the same animal group, caprines in particular, is a recurrent feature of the Neolithic bone industries from Thessaly.[565] It is also observed in varying frequencies and at different locations in adjacent regions.[566] The halving of caprine metapodials is very familiar. The metapodial halves and quarters of ruminants including fallow and red deer had patterned

[563] See Currey 1984. Specifically, data on bone density are a prime concern in studies of bone survivorship. See the synthesis in Lyman 1994, 234–258. Cf. Lam et al. 2003; Lam – Pearson 2004; Stiner 2004 inter al. The physical qualities including the mechanical properties of the various bones also concern bone technology. See, e.g., MacGregor – Currey 1983; Scheinsohn – Ferretti 1995; and a discussion by Alice Choyke (2013).

[564] See, e.g., examples presented in Johnson 1985 and Peretto 1996.

[565] E.g. Moundrea-Agrafioti 1980b, fig. II.7; Batziou 1981, 114, figs. 16–17; Moundrea-Agrafioti 1981; Moundrea-Agrafioti 1988, 41–42; Winn – Shimabuku 1989b, 262, figs. 9.3.3, 9.3.5, 9.5.1; Stratouli 1998.

[566] E.g. Leroy-Prost 1981, 244, 249, 251, 255; Stratouli 1993, 497, 512; Christidou 1999; Christidou 2012, 228, tab. 3. At Makriyalos, located immediately north of Thessaly, caprine tibiae represent an important category of raw materials, but tool blanks are not described, see Isaakidou 2003, 236, fig. 24.2.

uses; they also reveal local variations in technology, environment and economy.[567] As a rule, their production involved grooving or a combination of grooving and snapping. The smaller blanks, obtained from caprines, were about 80–120mm.[568] Based on the data available for Neolithic sheep and goats from PMZ, a length in the order of 80–100mm could be expected.[569] Indirect evidence for procurement of longer specimens comes from PM0835, which is a proximal fragment of tool with attached partial shaft and measures 100.9mm in length. The blank could be from a caprine or a roe deer. PM0700 is complete and measures 67mm in length. It was thoroughly shaped and reworked; the size of the ruminant that yielded the raw material is indeterminate and the length of this blank cannot be discussed further. Considering the red deer metatarsal, the absence of finished products made from this bone (unless PM0700 was from a red deer) must be noted. Other sites show that awls and sometimes cutting-edge tools could be manufactured from quarters which far exceeded 150mm in length, a measure compatible with the length of the grooves on the example from PMZ. The blanks from this bone would be large. Finally, splinter utilisation was reported from Prodromos in western Thessaly.[570] Eastern Thessaly has provided good evidence for their use for making awls.[571] They were chosen more frequently than other blanks in the Early Neolithic at Sesklo and in the Late Neolithic at Dimini. Large and narrow ones are mentioned. However, detailed descriptions of splinter forms and locations on the bone shafts are lacking.

In conclusion, medium-sized mammals, particularly caprines and pigs, are recognisable sources of long bones used to make pointed and cutting-edge tools. Toolmakers were selective with respect to metapodials and tibiae from which halves and quarters were obtained. This is also reflected in the reduction of the red deer metatarsal, which specifically represents the body parts of the game brought into the settlement. Toolmakers also responded to the size and shape variations of broken elements and exploited green bone fractures for different tools. The two ribs suggest ease of procurement and use since they were hardly modified.

### V.3.4. Tool Shaping and Resharpening

Often, the entire length of the blank was shaped (Tab. V.3.1; cf. Appendix, Tab. V.3.A4). Otherwise, working was limited to the distal end of the tool (PM0414, PM0800 and PM0854) and in one case the base (needle PM0865). On PM0785, shaping marks extended from the active end down to the midpoint of the shaft or farther away, but did not cover the entire tool. The distal articular surface of the tibia on which the tool was based was also worked. Central fragment PM0810 is from a thoroughly shaped tool shaft; the original length worked cannot be determined. PM0930 does not bear any shaping modification, nor was it reworked. Shaping techniques were examined for sixteen tools. Scraping and grinding were employed in combination for the majority of these specimens. Grinding was also used to resharpen four active ends (PM0617, PM0700, PM0717 and PM0785), for one of these (PM0717) along with scraping.

Scraping consisted in moving repeatedly a stone cutting edge in a straight line parallel to the bone grain. In one case (PM0717), relatively thick shavings were removed by pushing the scraper downward and then forward. Semicircular strokes were used to perforate the needle. As regards grinding, the movement was usually perpendicular or oblique to the bone grain. In only two instances was it longitudinal. It was used to rejuvenate the working edge of PM0785 and to flatten Bone 167. As a rule, fine abrasives were chosen.[572] For three specimens (PM0785, PM0810 and PM0835), grinding was performed with coarse-grained materials.

567 Christidou 2001; Christidou 2005; Christidou 2011a.

568 As at PMZ, the measurements reported from other sites give an approximate idea of the size of the tools. Tool shaping and damage as well as unworked bone fragmentation hamper accurate estimates.

569 Becker 1991, 23, tab. 6.

570 Moundrea-Agrafioti 1980b, 494.

571 Moundrea-Agrafioti 1981.

572 Both fine- and coarse-grained grinding tools are represented in the macrolithic collection, see Stroulia, this volume, 315.

Tab. V.3.1 Bone tool shaped parts and shaping techniques (R. Christidou)

| | Observed number | PMZ number |
|---|---|---|
| **Tool part shaped** | | |
| Distal end | 3 | PM0414; PM0800; PM0854 |
| Proximal end | 1 | PM0865 |
| Distal end and shaft portion; proximal end | 1 | PM0785 |
| Distal through proximal end | 9 | PM0468; PM0617; PM0658; PM0700; PM0717; PM0767; PM0928; PM0798; PM0835 |
| Distal end and shaft portion preserved | 1 | PM0661 |
| End and shaft portion preserved | 1 | PM0805 |
| Shaft portion preserved | 1 | PM0810 |
| No shaping | 1 | PM0930 |
| **Technique** | | |
| Scraping | 3 | PM0414; PM0798; PM0854 |
| Grinding | 3 | PM0468; PM0800; PM0810 |
| Scraping and grinding | 8 | PM0617; PM0658; PM0700; PM0767; PM0785; PM0928; PM0805; PM0835 |
| Scraping; removal of thick shavings (semicircular motion); grinding | 1 | PM0717 |
| Perforation (semicircular scrapes) | 1 | PM0865 |

Transverse and sometimes oblique grinding using fine abrasives helped to wear bone away carefully and obtain the desired profiles. Such work followed the scraping of PM0617, PM0658, PM0700, PM0717 and PM0767 and determined the outlines of the tools. The entire surface of PM0700, PM0717 and PM0767 was scraped. On PM0617 and PM0658, relatively small lengths, 25.7mm and 13.2mm, respectively, were scraped on the outer side of the cortical wall of the bones in order to sharpen the points (Appendix, Tab. V.3.A4). On PM0658, scraping was limited to the outer margins of the lateral sides. The lengths ground for these five tools range between 7mm and 31.3mm. PM0617 is a bipoint with a deliberately blunted proximal tip. This latter end is a flat facet. It is covered with manganese and the technique used to flatten it cannot be recognised. Scraping and transverse grinding were applied to the proximal point, which is approximately half the tool length. Grinding specifically served to reduce the thickness of the blank from the split side of the splinter, particularly the right edge of the medullary cavity, and to create a smooth transition between the distal and proximal points. The asymmetry observed between the right and left sides of the tool was the result of the twisted form of the blank. Grinding also reduced the lateral edges and, close to the point, the superior side. Narrow facets were formed during the grinding. They were convex in cross section. Thus, the transitions between intersecting planes appear smooth. With few exceptions, this is a constant feature of the ground surfaces of the tools examined from PMZ. It also characterises the 'pencil' point of PM0767, which was fashioned using transverse grinding. The thickness of the blank of this tool was also reduced by grinding transversely the right edge of the medullary cavity, which is preserved along a length of only 8mm above the tool's base. The proximal half of PM0658 is covered with a thin layer of manganese, which makes it possible to observe the narrow facets cut along the lateral edges during the shaping. The distal part of the tool shows transverse grinding of the lateral edges to complete tapering.

Oblique grinding was applied on the edges of the medullary cavity preserved on a large part of PM0717. To maintain the virtual smooth plane thus created, a proximal facet (A on Fig. V.3.1.4) was cut to reduce the right edge, which rose and turned in the direction of the cavity since the

blank had a helical shape. Working in an oblique direction assures uniformity of the ground profiles.[573] It clearly served this purpose on the smoothed split surface of PM0717, which measured 31mm in length but could be longer since the distal point that interrupts it was cut in order to resharpen the tool. Oblique grinding was also observed on two areas of the medullary side of the bone fragment used to make PM0700. Figure V.3.1.3 illustrates a wide and slightly convex inferior facet, named A, and, proximal to A, plane B that extends over both edges of the marrow cavity. The two areas represent two different operations. Area A is related to resharpening. It is interrupted distally by numerous narrow elongated facets cut using transverse grinding around the circumference of the tool in order to form the pencil point in the second and final stage of the resharpening. Area A interrupts area B, which corresponds to the final smoothing of the edges of the marrow cavity during the shaping of the original tool. The length smoothed could, then, be longer than that preserved after the tool was reworked.[574] Transverse grinding was also applied locally on the outer side of the lateral edges of the bone fragment in order to create regular profiles. These corrections are observed on the proximal part of the right edge (C on Fig. V.3.1.3) and the central part of the opposite one (D on Fig. V.3.1.3).

Grinding with a coarse abrasive played a major role in manufacturing PM0835. It was employed to thin both the anterior and posterior sides of the metapodial half and reduce it to approximately a quarter of the bone. The stick thus created had flat sides, which were subsequently scraped to taper the proximal part of the tool. This scraping is poorly preserved as a result of weathering damage. The facets cut are slanted to the superior and inferior sides of the tool. The edges of the medullary cavity were smoothed during the scraping. The original flattening is preserved along 77.5mm on the left face and 44.5mm on the opposite face. Above the midpoint of the tool fragment, grinding had also been used to taper the blank and shape the active end. A similar operation could be observed on the left and right sides of the portion of distal epiphysis retained as the base of PM0928. The tool shaft portion now preserved shows scraping. Because of the presence of heavy crusts covering most of the object, it is impossible to find out whether scraping preceded grinding or vice versa. For the same reason, the grain of the abrasive used cannot be described.

Coarse abrasives are efficient at removing quickly large amounts of material. Combined with oblique movements at PMZ, they probably helped control the degree of wear and the regularity of the profiles cut. Bone 167 was, however, ground longitudinally (Fig. V.3.9). It shows extreme thinning and flattening of the posterior face of the metapodial. The marks of this operation are interrupted by the breakage through the metaphysis of the bone, indicating that a larger length was ground, possibly the entire posterior face. On the opposite side, the same kind of treatment was abandoned quickly; only the highest points of the relief of the bone were worn. Neolithic sites in Thessaly yield examples of bifacial thinning and flattening of caprine metapodials prior to bisection by grooving.[575] The same sites also provide evidence, albeit rare, for application of the so-called '*débitage par usure*'.[576] The specific objective of the grinding of Bone 167 cannot be deduced, but, when it is compared to PM0835, which was thinned after reduction, it shows that there was no single process for reducing the thickness of the small ruminant metapodial halves and that the order of the actions performed could vary.[577]

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573 Personal communication from Gérard Déraprahamian cited in Christidou 1999.

574 Partial or complete flattening by grinding the split surface of the awls made from long bones was often observed in northern Aegean Late and Final Neolithic sites, see Christidou 1999; Christidou 2001, 43. The axis of symmetry thus created guided the tapering of the lateral sides of the tools. For PM0700, partial flattening by grinding followed the scraping of the cut surface.

575 See in particular the descriptions in Moundrea-Agrafioti 1981.

576 Poplin 1974, 89–91.

577 Extreme variability in the application of the manufacturing processes related to small ruminant metapodials characterises the bone industries of the Late Neolithic from the northeast part of the Aegean, see Christidou 1999; Christidou 2011a, 126, 130. Variability in the order and types of actions is only random up to a point. It is also related to the production of different sizes and shapes of tools, mainly awls.

Oblique rough grinding was applied to flatten the wide sides of the tool shaft (or a portion of it) from which PM0810 derived. The narrow left side was worked with a fine-grained material. The right side does not bear evidence of shaping; it is heavily polished and smoothed as a result of use wear. This surface most probably corresponds to the outer, i.e. cortical, side of the original bone.

PM0468 and PM0805 were extensively ground. The former was fashioned exclusively using this technique. Not only the split side and the point but also the outer surface of the bone and possibly the base (now too damaged to reveal shaping marks) were worked. The outer grinding, mostly transverse, rectified profiles. The point formed rounded obtuse angles with the tool's shaft at a distance of 20.5–25mm from the tip. Flat and sometimes concave facets with clear-cut, sharp edges were ground around the circumference of the point. The dimensions of the blank and its shaping differentiate this tool from the rest of the pointed forms. PM0805 was scraped prior to grinding. The entire circumference, as observed above the chewed point, was ground. However, this work was mostly concentrated on thinning and flattening the medullary side of the fragment and on rounding and tapering the lateral edges toward the point. The direction of grinding varied between these areas; transverse movements were mostly used along the edges. Clear-cut facets with sharp edges were formed on the inferior and lateral sides.

The shaft of the tibia fragment PM0785 was scraped after the cranial face was ground. Marks of this grinding are now observed on an area about 40mm long and 10mm wide along the lateral margin of this face. The uppermost limit of the ground surface is located at a distance of about 30mm from the active end of the tool. This surface is slightly concave and rough, indicating crude reduction of the area where the cranial face curves outward and the tibia thickens. The scraping that followed this operation extends to cover about half the length of the caudal and the lateral sides of the specimen; it is even more extensive on the other two sides. It was employed to shape straight profiles on the bone's medial and lateral sides and to gradually thin the cranial and caudal sides toward the broken end. The fracture angle most probably determined the convex bevel, which was formed during the cranial scraping. On the opposite face, between approximately 3mm and 17.5mm from the distal end, the bone surface was further flattened using transverse grinding. The grinding striations on this area are narrower than the inferior ones and barely visible at low magnification as a result of use wear. Grinding was also employed to reduce the natural relief of the articular surface. The highest points of this surface, located on the cranial edge, were chiefly altered; the plane ground forms an obtuse angle with the cranial face of the bone. The external caudal margin of the articular surface was also ground transversely.

The base and part of the shaft of PM0414 are missing. The aim of the work on the distal part was to sharpen the tapering broken end of the tibia. The fracture surface extends for a distance of about 56mm below the distal tip of the tool; approximately 35mm were scraped. The opposite face was also scraped to thin and sharpen the active edge; the length worked cannot be measured because of the manganese deposit on this side of the specimen. The left side of the active part of the tool was scraped to taper toward the distal tip of the tool, which is a convex edge. This side was thicker than the right side as a result of the spiral fracture of the bone: the preserved part of the caudal side of the bone curves up in a lateral direction; the left side of the distal end of the tool is located on this area of the bone. The medial wall was nearly completely removed and a relatively thin edge was formed.

The point fashioned on the fibula shaft PM0854 indicates a similar process. Starting from a distance of about 44mm from the apex of the point, scraping was applied on the circumference of the shaft to reduce its thickness and form the point. Several narrow facets were cut deeper along the left and right edges, which clearly converge toward the apex. The greatest scraped length recorded on these facets is 24mm. The right edge was more intensively worked because the thickness of the bone was greater on this side. Wavy striations and occasional transverse cuts and ripples also evince energetic scraping. Such marks are not common on the other scraped sides. Although the lengths scraped for PM0798 were longer, the shaping of the splinter was also fairly simple. It involved reduction of bone along the lateral sides and smoothing of the edges of the medullary cavity. The superior side of the tool is weathered and shaping cannot be recognised. The proximal tip has a rounded profile, but it does not preserve shaping traces either.

Incisor PM0800 and rib PM0865 show minimal modification. A single facet, about 10mm long, was abraded in order to sharpen the naturally tapering end of the tooth root. PM0865 shows three transverse round holes near the broken end of the rib. Two holes have an axis running in a craniocaudal direction. Of these, one was finished and the other, opened from the caudal side, stopped at a depth of about 2.4mm, i.e. less than halfway between this side and the cranial edge. The third perforation, cut from the internal side of the rib, was also unfinished. Its depth is approximately 4.7mm, i.e. slightly greater than halfway into the bone's cancellous interior. The finished hole is an opening measuring approximately 3.5mm in length and 3mm in width. The perforation was biconical and therefore the rim diameters are larger. The length of the opening on the cranial side is about 6mm long and 5mm wide; on the caudal side the lengths measured are 5mm and 4.5mm, respectively. The cranial cone is somewhat deeper than the caudal one. The unfinished perforations are also conical. The rim diameter of the caudal hole is about 4mm; that of the ventral hole measures 6mm in length and 5mm craniocaudally. All of the measurements reported here are approximate because the perforations are partially covered with manganese deposits. Moreover, their rims present more or less complex outlines as a result of the natural relief of the bone, which is broader on the external and furrowed on the caudal side by the costal groove (see also Fig. V.3.3). The perforations were made with a hand-held tool. This is inferred by the changing profiles of the perforation walls and the overlapping groups of curving striations, which indicate variations in cutting angles and incomplete tool rotation (cf. Figs. V.3.2.1–2). Angle variations are also responsible for rims that flare locally. The proximal margin of the finished hole is located at a distance of 17.5mm from the proximal end of the rib fragment. The distance is 23mm for the proximal rim of the unfinished perforation cut on the same side of the bone and only 6mm for the ventral hole. The reason why the drilling of two holes was abandoned before completion is unknown.

In conclusion, shaping played an essential role in the production of the majority of tools. Scraping, whether employed in the initial or the final stage of shaping, or even as the only shaping technique, did not alter the blanks drastically. In fact, bone reduction by scraping is slow[578] allowing for control of the modifications made. Grinding at an angle to the bone grain was efficient at yielding local modifications and corrections of the profiles of the tools. Variations in abrasives were also acknowledged, and coarse abrasives were exploited when the need for removal of large amounts of bone arose. There is no evidence of care being taken to obtain a uniform finish of the tool surfaces.

### V.3.5. Tool Types and Morphometric Features

The perforated rib body, or needle, and the pig incisor with worked root end are 'ad hoc' tools.[579] The smoother from cattle rib cannot be considered to be such a tool. Transverse fragments of rib shafts were worked and used in a similar way in the Bronze Age at PMZ.[580] Fragmentation may have obliterated shaping modifications on the Neolithic specimen. The other PMZ tools examined are associated with more or less well-known tool types and forms (Tab. V.3.2). Despite the limited number of pointed tools examined, typological and dimensional variability is observed.[581]

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578 Olsen 1984.

579 Occasionally, bones that were not regularly chosen for tools were used for their convenient natural forms and sizes. Such an example comes from Achilleion, Thessaly; it is a calcaneum of a pig: Winn – Shimabuku 1989b, 262, fig. 9.3.4. Pig incisors, especially those of juveniles with the root naturally worn at a bevel, are sometimes collected as tools. There is no such wear on PM0800.

580 They are referred to as spatulas in Becker 1991, 43, fig. 22. Such tools, which were shaped, were recently analysed for manufacturing and use wear: Christidou 2016. Similar implements are found in other sites of the same period: e.g. Christidou 2010, 773, fig. 9; they also occur in Neolithic sites (e.g. Dikili Tash, northeast Greece, personal observation). Moreover, the central parts of some scrapers made from transverse fragments of rib shafts show secondary zones of use for smoothing.

581 The morphological and dimensional variability of the Neolithic and Bronze Age pointed tools of PMZ is stressed by Becker 1991, 39.

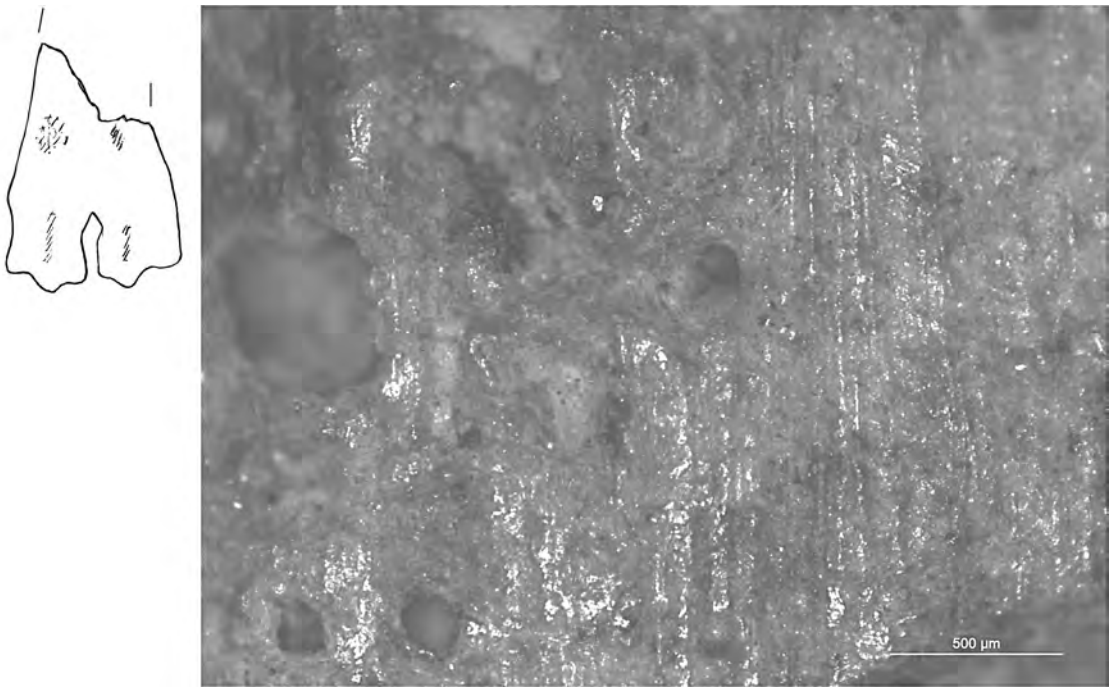



Fig. V.3.9 Ground flat metatarsal: Bone 167. Oblique lines on the sketch locate grinding marks on the anterior side of the bone (not presented in scale). The photograph shows striations of longitudinal grinding and exposure of cancellous tissue on the posterior face (50×) (R. Christidou)

The fibula and the incisor represent tools on whole bones. There are two variants of pointed tools made from longitudinally cut metapodials: a quarter, with a portion of the proximal epiphysis retained as the base of the tool, and a half, ground flat and thinned. The latter option was observed on specimen PM0835. If the distal epiphysis of this metapodial was unfused and detached (see above, Chapter V.3.3), the tapering of the metaphyseal area would be an alternative to that observed on several halved distal condyles in other Neolithic sites.[582] The tibia quarter with the attached portion of distal epiphysis can be compared to metapodial quarters, but the flattening of the lateral sides of the tibia specimen is a modality primarily associated with the treatment of metapodials before or after bisection.

The awls on linear fragments of long bone shafts were made in a simple manner. Their bases were only smoothed; they are plain. Three of these tools (PM0468, PM0717 and PM0798) are fragments derived from broken bones. PM0617 and PM0805 are in the same style; PM0617 is a splinter. Its greatest width is 7.2mm, placing the artefact among the narrowest measured (Fig. V.3.8.2; Appendix, Tab. V.3.A3). It is also relatively short. At a rough estimate, its length would be 60mm. PM0805 is a fragment; the original length of the tool cannot be estimated. It measures 7.6mm at its greatest width. Since the shaping of the majority of linear fragments did not reduce them dramatically, it is not unreasonable to assume that the original greatest width of PM0805 would not be significantly larger. However, this proposition is tentative because of the fragmentary nature of the object. Moreover, chewing damage does not permit distinction between a distal and a proximal point. Simple bipointed forms made from linear fragments of long bones from medium-sized or large mammals and deer antler occur sporadically in the Neolithic and Bronze Age sites in the wider Aegean region.[583] Large numbers are only reported from Dispilio in north-

[582] E.g. Christidou 2011a, fig. 3.2.

[583] E.g. Cave of Cyclope, Neolithic (and mainly Mesolithic): Moundrea-Agrafioti 2003, 138, figs. 10.5.5–8; Kastanas, Bronze Age: Hochstetter 1987, 62, pl. 32.7; Nichoria, Bronze Age: Blitzer 1992, 754, pl. 12.240; Prodromos,

Tab. V.3.2 Bone tool types. The objects of undetermined type are listed in the second part of the table (R. Christidou)

| | Observed number | PMZ number |
|---|---|---|
| **Type** | | |
| Awl on whole bone | 2 | PM0854; PM0800* |
| Awl on metapodial quarter with epiphysis as the base | 1 | PM0700 |
| Awl on linear fragment of long bone with plain base | 5 | PM0468; PM0658; PM0717; PM0767; PM0798 |
| Bipoint on ground flat metapodial half | 1 | PM0835 |
| Bipoint on linear fragment of long bone | 1 | PM0617 |
| Blunt curved needle | 1 | PM0865* |
| Cutting edge tool on tibia fragment with complete shaft diameter | 2 | PM0414; PM0785 |
| Smoother | 1 | PM0930 |
| **Undetermined** | | |
| Awl fragment | 1 | PM0661 |
| Bipoint or awl | 1 | PM0805 |
| Tool (awl?) on tibia quarter with epiphysis as the base | 1 | PM0928 |
| Tool shaft fragment (pointed tool?) | 1 | PM0810 |

* Ad hoc tools

west Greece. Tool forms are not standard and morphological details (e.g., flattened point, blunt or acute proximal tip, shouldering) vary even in the same locality.

The measurements of the active ends of pointed tools (Fig. V.3.10.1) indicate that the fibula point (PM0854) is distinctly slender, while that of the metapodial quarter (PM0700) is sturdy. For the rest of the implements, the widths and thicknesses at a distance of 10mm from the apex are about the same. Only the needle and the largest splinter awl, PM0468, are larger. Measurements at a distance of 30mm from the tip (Fig. V.3.10.2) basically reflect blank forms. PM0468 is broken at this height; its width would be less than 13mm and larger than 11.6mm, which places the specimen close to PM0717 and PM0798. Except for the basal area, the shaft and point of PM0767 are solid and thick, probably reflecting their position on a bone ridge or crest (see above, Chapter V.3.3). This tool also bears a shallow concavity, about 20mm long, which was ground in the middle of the right edge. This feature marks the transition from the proximal compressed area to the point.

The blank represented by a long bone shaft fragment with complete diameter is a basic criterion for classifying cutting-edge and pointed tools from Neolithic Thessaly and neighbouring areas. The amount of shaping of the cutting-edge tools made from tibia fragments that retained the distal epiphysis varied, but tool lengths were generally important, probably as a result of the use of fractures located within the proximal third of the bone.[584] The specimens from PMZ are also long (see above, Chapter V.3.2). Although PM0785 shows grinding of the distal epiphysis and the cranial side of the shaft, this should not be linked with the shaping process of distal tibiae, which combined cranial flattening with the smoothing at various degrees of the natural prominences of the articular end. This process is represented in the northeast Aegean region and in more eastern areas.[585] The active ends of the tools from PMZ are different from each other. PM0414 displays

Neolithic: Moundrea-Agrafioti 1980b, fig. II.4. Bipoints are numerous at the Neolithic lake settlement of Dispilio: Stratouli 2002, 167.

584 See in particular Moundrea-Agrafioti 1981.

585 E.g. Christidou 2011b, 303–304; Christidou 2012, 230; Azeri 2015. The double-bevelled base of a specimen from Attica is peculiar: Leroy-Prost 1981, 249–250.

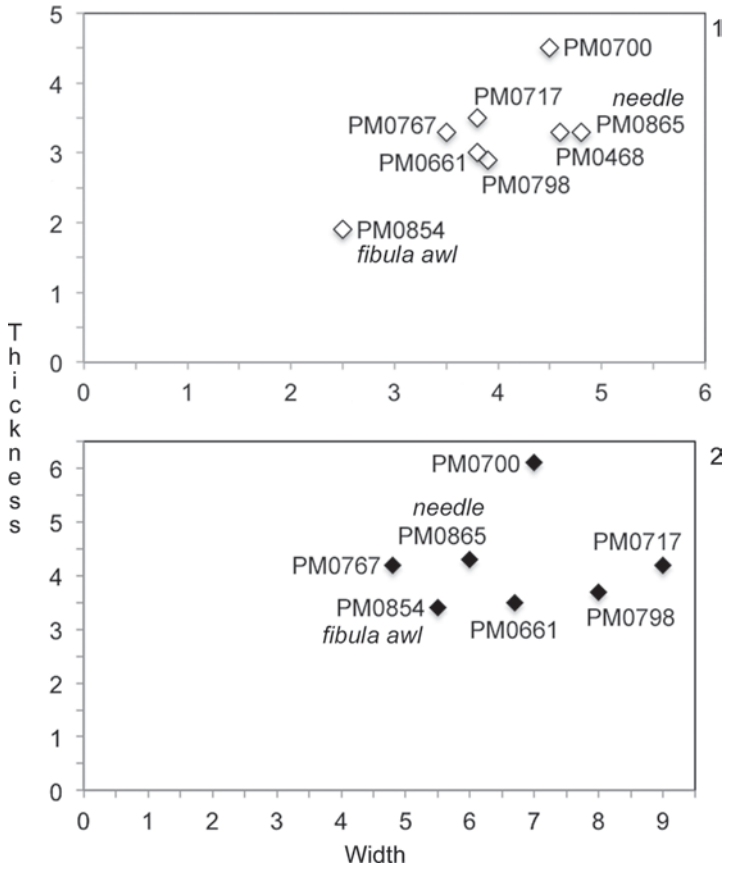



Fig. V.3.10 Points: (1) Width/thickness measured at a distance of 10mm from the apex. Four tools are excluded from comparison: PM0617 and PM0658 because the length of the broken point is not calculated (Appendix, Tab. V.3.A3), PM0800 because it is shattered and PM0835 because it is a proximal fragment. (2) Width/thickness measured at a distance of 30mm from the apex. To the five tools excluded from comparison in Fig. V.3.8.1 is here added PM0468 because it is broken and its form and dimensions at 30mm from the distal tip are not reconstructed (R. Christidou)

a convex cutting edge about 6mm long. The middle of the tip was damaged through use. The edge angle is 81–92º; a rough estimate of the original angle is 44º. The active edge of PM0785 is oblique and slightly concave as a result of use and resharpening. Rounding is pronounced and the angles measured along the edge are 95–103º. The resharpened angle would be in the order of 51º. The bevels formed on the split side of the bones measure approximately 30mm for PM0414 and 14mm for PM0785. The bevel of PM0414 is straight; that of PM0785 is convex. Such differences reveal the potential offered by the proximal and midshaft fractures of the tibiae of small ruminants for manufacturing tools. The evidence from Neolithic sites in Thessaly shows that they were also exploited for awls.

### V.3.6. Tool Use

Except for PM0800, which was broken into minute pieces, and PM0661 and PM0928, which presented extensive post-discard alterations, the other tools were examined for use marks (Appendix, Tab. V.3.A5). All of them were used. The four resharpened tools (PM0617, PM0700, PM0717 and PM0785) were used again. Below, use data are presented for each of the three major tool categories.[586] PM0810 is compared to the pointed tools.

[586] For comparisons see, e.g., Christidou 1999; Griffitts 2001; Christidou – Legrand 2005; Legrand 2005; Maigrot 2005; van Gijn 2005; Stordeur – Christidou 2008.

*Pointed Tools*

PM0468 was singled out mainly on the basis of the dimensions of the blank. The use action also separates it from other pointed implements. Well-formed distal as well as proximal damage points to an intermediate tool used to punch holes into a soft animal material like leather.[587] Numerous striations observed under 100× and 200× magnifications on the point run predominantly in a longitudinal or slightly oblique direction and are associated with the smoothing of the surface on the crests that separate the facets ground during the shaping of the tool (Figs. V.3.11, V.3.12.1). The manufacturing striations have been obliterated from these areas of the tool relief, which were more exposed to the wear than the interior of the facets, where the grinding striations are present but appear worn down and polished. Overall, the polish invades the low spots of the surface relief, rounding and smoothing irregularities. In addition to the longitudinal striations, the polished relief displays transverse and oblique ones as well as pits. Most of these abrasion features have a polished appearance. Polish streaks and striations with smooth glossy bottoms occur intermittently. The widths of the striations are mostly small, ≤3μm. Specimens measuring up to 6–7μm in width appear as well. The pits are for the most part circular with small diameters. This state of surface is observed within an area extending down to about 4.7mm from the broken tip. From this height down to approximately 9mm, the wear reduces. Polished manufacturing marks gradually appear on the crests (Fig. V.3.12.2). As one moves toward the tool's interior, the deepest points of the surface appear hardly worn or unaltered. The polished areas are incompletely smoothed or rough. Longitudinal and diagonal striations, isolated or grouped, persist; transverse striations as well as pits are also present. Between 9mm and 12.5mm from the distal break, rounding, smoothing and polishing are observed on the highest surface relief; evidence of preferential striation orientation is poor.

The base of the tool has an irregular profile as a result of cracking, which produced a wide V-shaped fracture, and flaking of the medullary side of the extremity. The portion of edge preserved at the left angle of this end is a smooth shiny facet with a couple of polished pits and few striations or polished cracks. This wear is consistent with percussion with a soft hammer such as a piece of wood. Light-to-moderate rounding and polish on the edge of the broken area suggest continuation of tool use for a small amount of time after the damage described above. As has already been mentioned (Chapter V.3.2), it is unclear whether the distal break represents use damage. Whatever the case, the oblique fracture would not have rendered the awl useless. Base damage seems the more likely cause.

The awl's shaft exhibits hand wear (Fig. V.3.13). This wear is best developed on the proximal half of the shaft, particularly the edges and the convexities, where the grinding striations are completely or incompletely worn down and their edges muted.[588] Several aspects of the hand wear are comparable to that of the active end, since the nature of the contact material was the same. However, mark associations show a different situation. Invasiveness in depressions and the smoothing out of irregularities are here linked with a high degree of fine abrasion features, i.e. pits and striations. They are polished or dark. The polished relief is rounded or flattish.

Four tools (PM0617, PM0658, PM0700 and PM0717) suggest use of a rotating movement for perforating a similar animal material. The points are partially preserved on three of them (PM0617, PM0658 and PM0717), but PM0658 clearly shows polish following the contours of the original surface, which are rounded and homogenised (Fig. V.3.14.1). The polish is associated with numerous multidirectional narrow (≤2μm) and occasionally wider (up to 7μm) striations, which are also polished. Small use pits are infrequent. They are more common at a distance of about 1–2mm from the broken tip, where polished lower areas preserving roughness appear. The wear fades as one moves toward the interior of the tool. Incompletely smoothed plateaus appear

[587] For this particular action see Christidou – Legrand 2005, 391, fig. 13; see also Legrand 2005.
[588] E.g. Stordeur – Christidou 2008, 474, figs. 19.2–4.

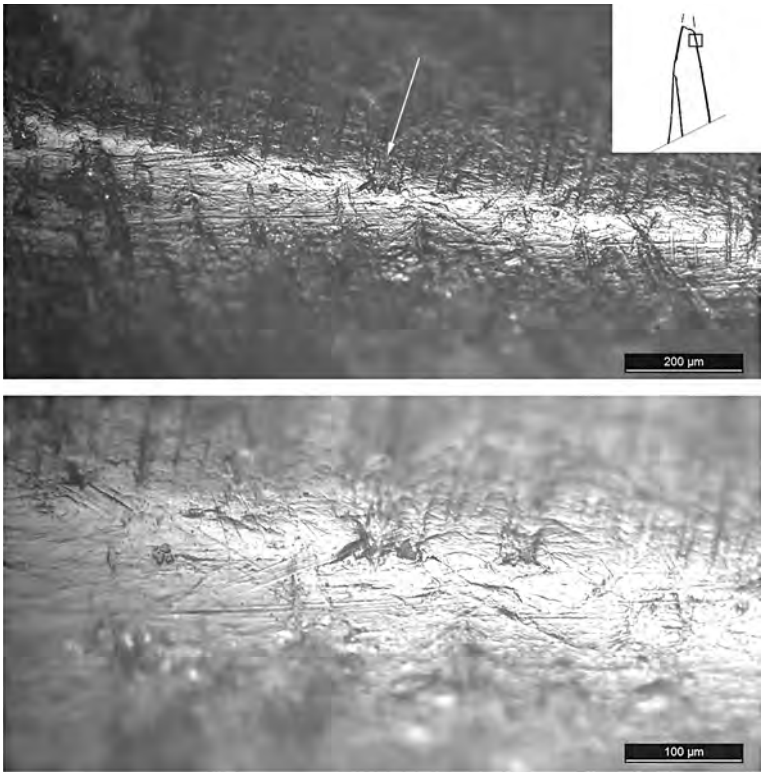



Fig. V.3.11 PM0468: point, superior highest relief (ridge). Grinding marks obliterated from the ridge, preserved on the slopes (arrow). Upper and lower images captured at 100× and 200× magnifications, respectively (R. Christidou)

(Fig. V.3.14.2) and gradually become extensive; use striations are sparser. Farther away, the smoothing reduces further and at about 10mm from the distal extremity it disappears; polish and striations affect the upper relief, which is rough in texture (Fig. V.3.14.3). The scraped topography is well preserved. There is no limit to the polished zone, which is interrupted by extensive crusts at a distance of about 21mm from the distal end.

PM0617 exhibits polishing and rounding of the crests and striations created during the resharpening of the distal end. Invasiveness in depressions and an abundance of use striations, which include straight and curving specimens with smooth glossy bottoms, are observed (Fig. V.3.15.1). The striations measure 1–10µm in width and run in various directions. Their lengths also vary. They are more or less polished, especially the finest of them, which are superficial. Scattered superficial small round pits are also present. The plateaus appear smoothed, completely or incompletely, depending on the position (crest or facet interior), rounded or flattish. Between approximately 4mm and 10mm away from the distal break, the polish begins to withdraw from the deepest zones of the surface. Otherwise, the overall aspect of the surface is similar to that previously described. Below this zone, the striations become less marked; small widths predominate. These features blend with a worn surface comparable to that observed on the shaft of PM0468. On the central and proximal parts of the tool, rounding, smoothing and polishing (Fig. V.3.15.2) are observed. They are also perceptible with the naked eye. The wear suggests prehension rather than hafting of the bipoint.[589]

Down to about 4mm from the distal break, the point of PM0717 is polished all over and the intersections of the facets cut during the resharpening exhibit strong rounding. Under magnification, these edges appear heavily striated (Fig. V.3.15.3). The striations are mainly narrow, in the

[589] Cf. Rots 2005, 65.

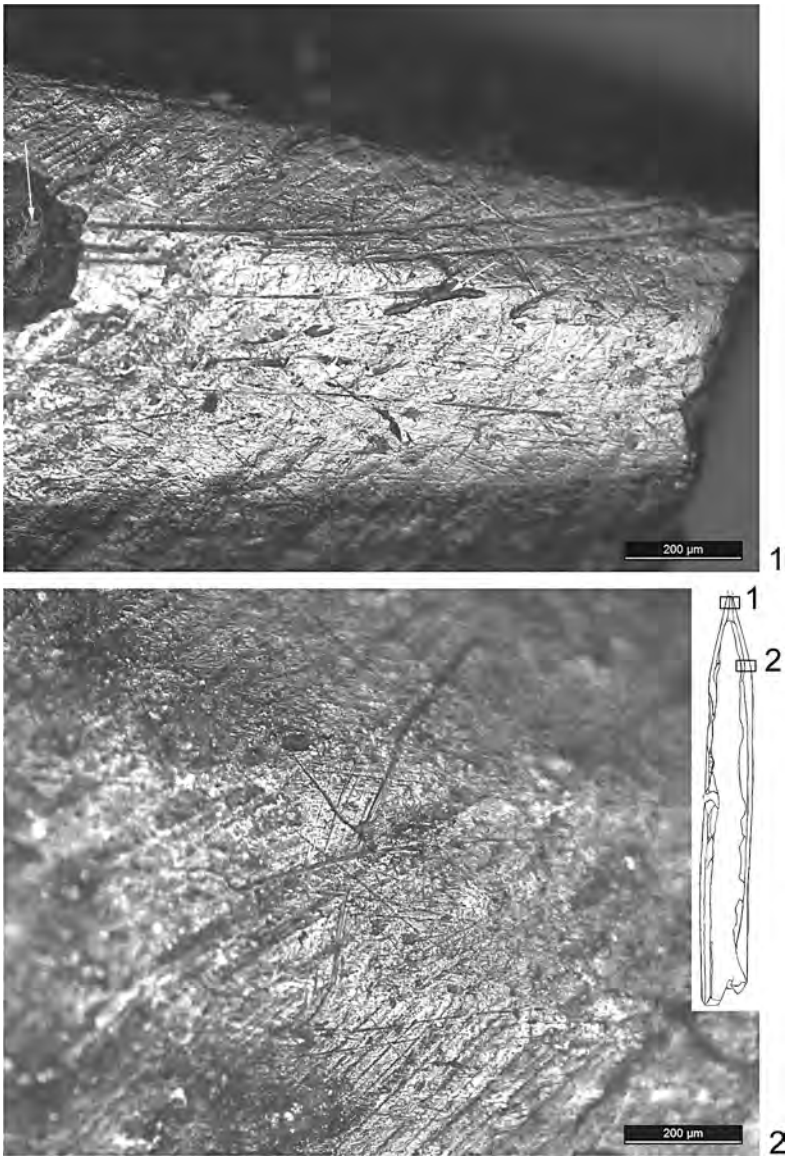



Fig. V.3.12 PM0468: point, inferior central facet above the medullary cavity. (1) Grinding marks severely worn. They are best preserved away from the broken tip, above the dark flake negative (left), which represents post-discard damage (arrows). (2) Grinding marks nearly completely worn down on facet intersection (middle); narrow use striations running in various directions. Images captured at 100× magnification (R. Christidou)

order of 2µm. Larger specimens measure 3–6µm. They are longitudinal and diagonal or transverse. Small pits occur on the smoothed plateaus. The striations formed during the resharpening are very worn. Overall, the polish follows the upper and lower components of the topography. Between 4mm and 9mm, the wear gradually withdraws from the lowest spots. The rounding of profiles persists. Fine abrasion marks are common; the directions of the striations vary. The shaft and the base of the tool show rounding and homogenisation of the original surface contours (Fig. V.3.15.4). The polish is associated with scattered small pits and fine striations running in variable directions. This wear is comparable to moderate hand wear.

The distal tip of the reworked point of PM0700 was preserved. It had been slightly damaged by two tiny scale removals (≤0.5mm) on the left margin. It is not possible to say whether this damage was produced during the resharpening or at the beginning of the last use of the point. The scars and the apex, which was roughened, possibly by compression, during the first stage of the

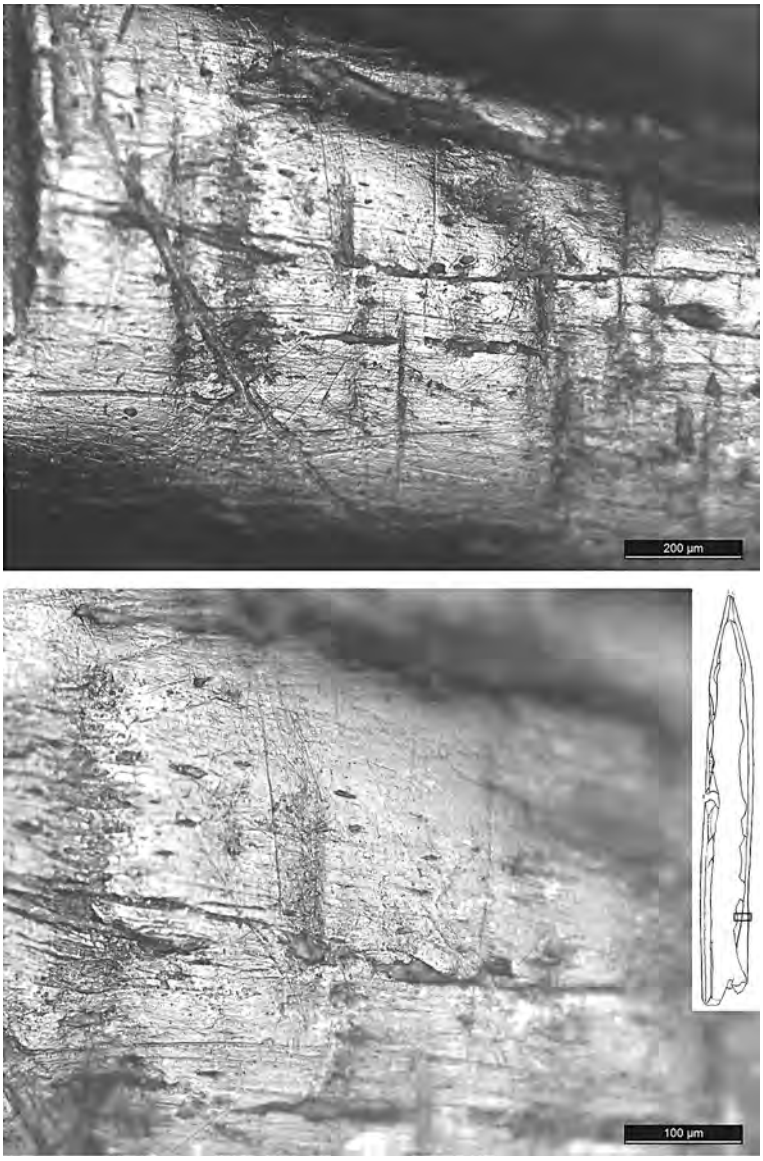



Fig. V.3.13 PM0468: inferior proximal shaft. Advanced prehension wear. Upper and lower images captured at 100× and 200× magnifications, respectively (R. Christidou)

formation of the use-wear, were subsequently polished and worn down. The angle of the point is 95º and shows that the sharpness was completely lost. Down to about 2.5mm from the tip, the upper relief of the point is rounded and the manufacturing marks obliterated or severely worn down or even unrecognisable. The entire surface is polished (Fig. V.3.16.1). This includes abundant use abrasion marks, basically striations and tiny pits. The striations are fine or well marked, long and short, multidirectional. Their widths range between 1µm and 5µm. Occasionally larger specimens occur. Invasive polish and abrasion marks characterise the lower wear zone too (Fig. V.3.16.2). This zone reaches to about 5mm from the distal extremity of the tool. Polishing, scratching and rounding continue down to about 10mm from this tip. However, smoothing gradually becomes restricted to the uppermost relief of the tool (Figs. V.3.16.3–4). It is incomplete on the interior of the facets. The wear extends to a distance of about 15.8–18.2mm from the distal tip.

Wear that is not consistent with the distal pattern or with hand damage was observed on the shaft of PM0700 (Fig. V.3.16.5). Its main characteristics are the smoothing of plateaus, scattered striations and pits with rough bottoms, the complete or incomplete polishing of these features and the low degree of wear in recessed zones. The deepest areas are unpolished; some are from

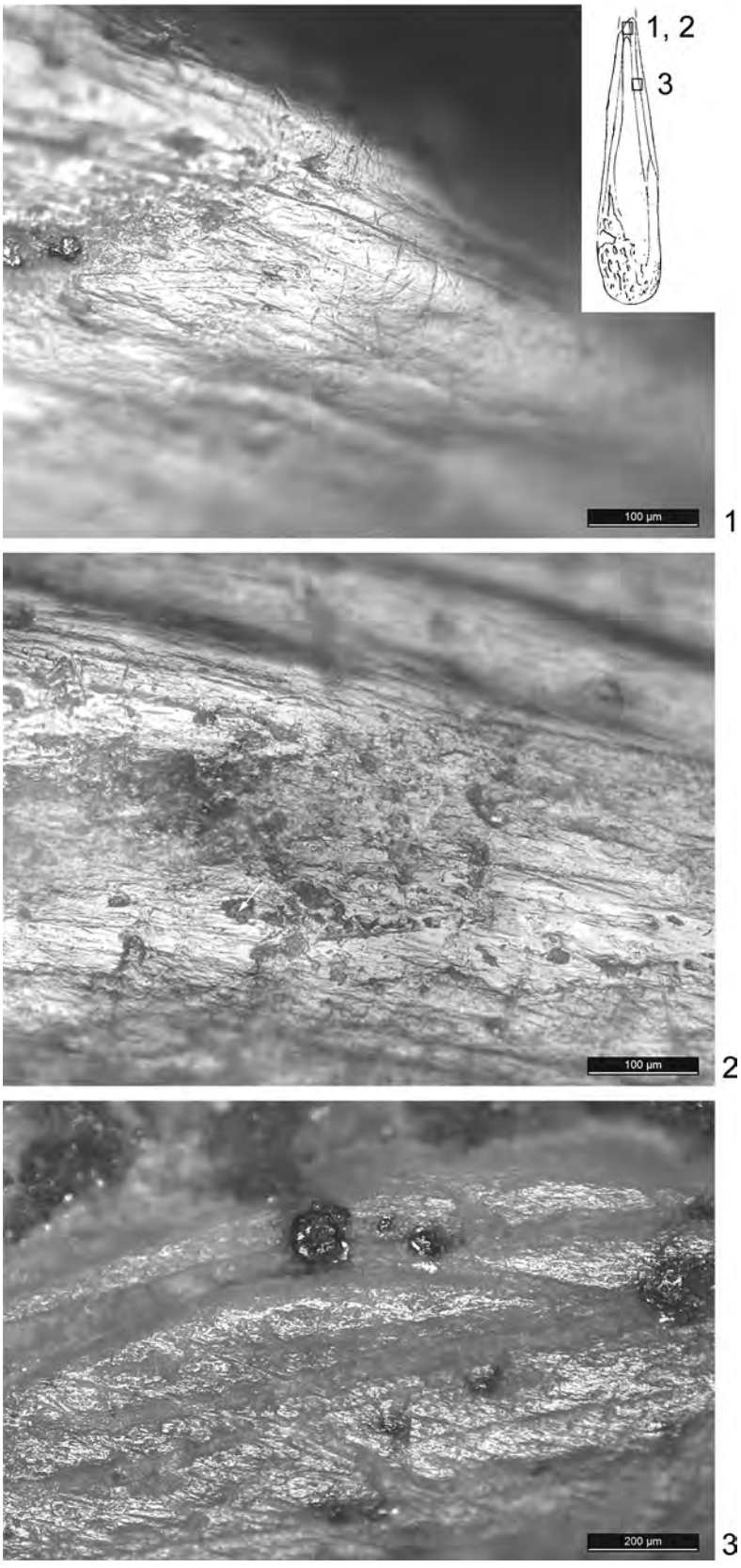



Fig. V.3.14 PM0658: point, inferior side. (1) Polishing and rounding following the surface contours near the distal break located farther to the right. The polishing of the depressed area on the left is superficial. (2) Image captured immediately below image 1. Similar wear. Incompletely smoothed plateaus are visible. Unpolished pits in the middle (arrow) represent post-discard damage. (3) Scraped topography unmodified, light polishing and striations. Images 1 and 2 captured at 200× magnification, image 3 captured at 100× magnification (R. Christidou)

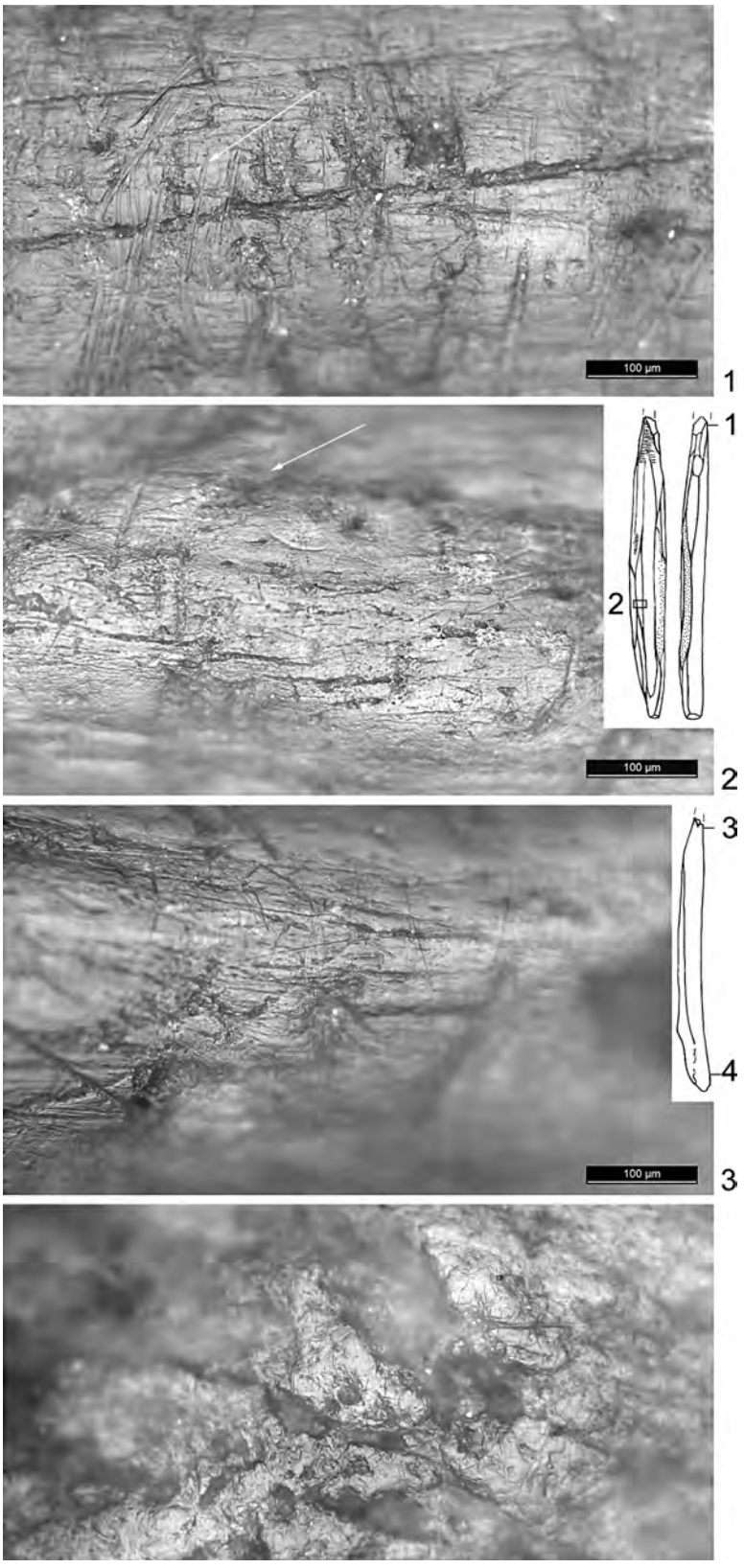



Fig. V.3.15 (1) PM0617: point, middle of superior face. The arrow indicates polished streaks and shallow striations with flat polished bottoms. (2) PM0617: left edge of the marrow cavity, shaped facet. Outer edge of the facet rounded and polished (cf. Fig. V.3.13). Cracking postdates use. The arrow indicates a worn grinding striation on the interior of the facet. (3) PM0717: point, superior face. Wear following surface contours near the distal break (right). (4) PM0717: base margin, superior side. Flaky outer surface of the metaphysis portion preserved on the tool. Images captured at 200× magnification (R. Christidou)

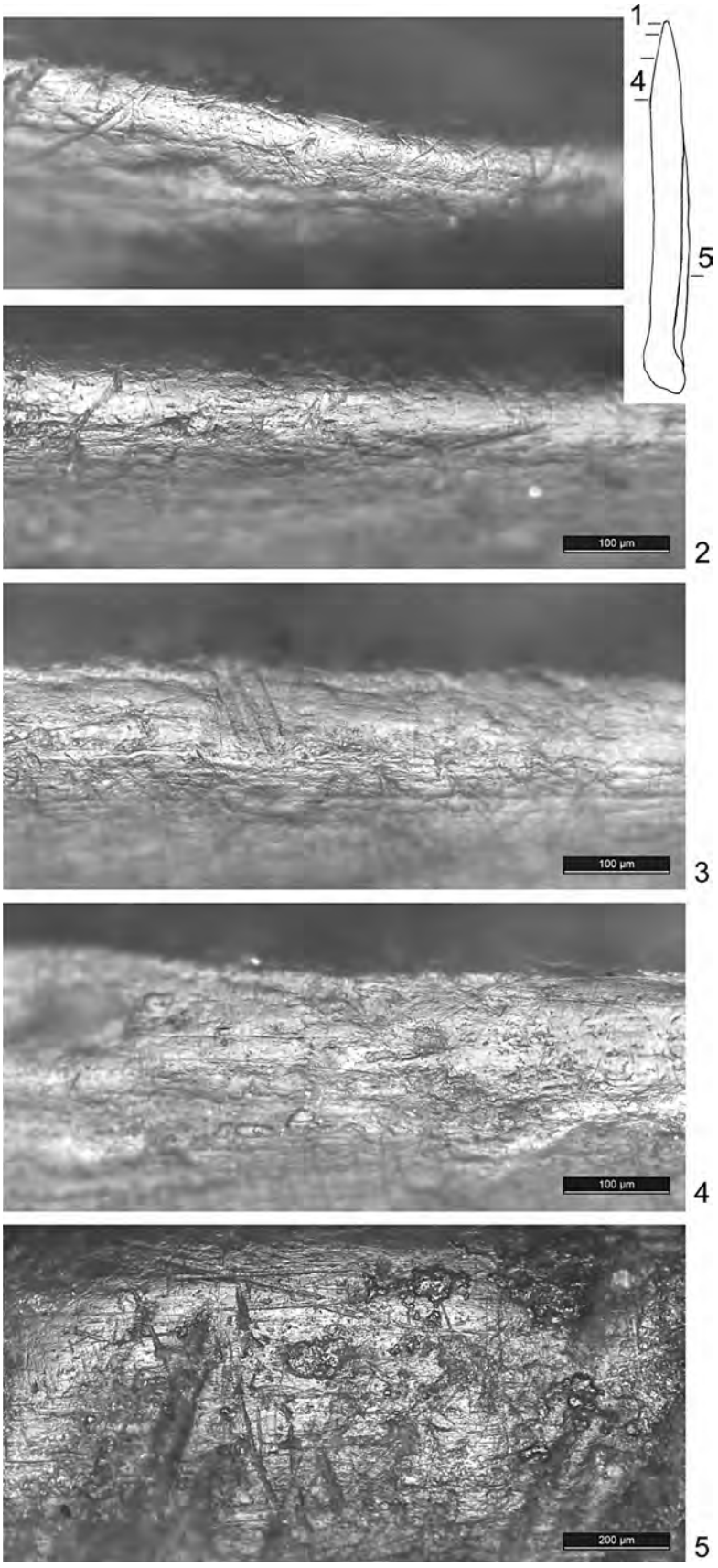



Fig. V.3.16 PM0700: (1–4) Point, superior highest relief (ridge). Gradual wear pattern. (5) Left edge of the marrow cavity, shaped facet. Undetermined wear on the outer edge and the interior of the facet. Images 1–4 captured at 200× magnification, image 5 captured at 100× magnification (R. Christidou)

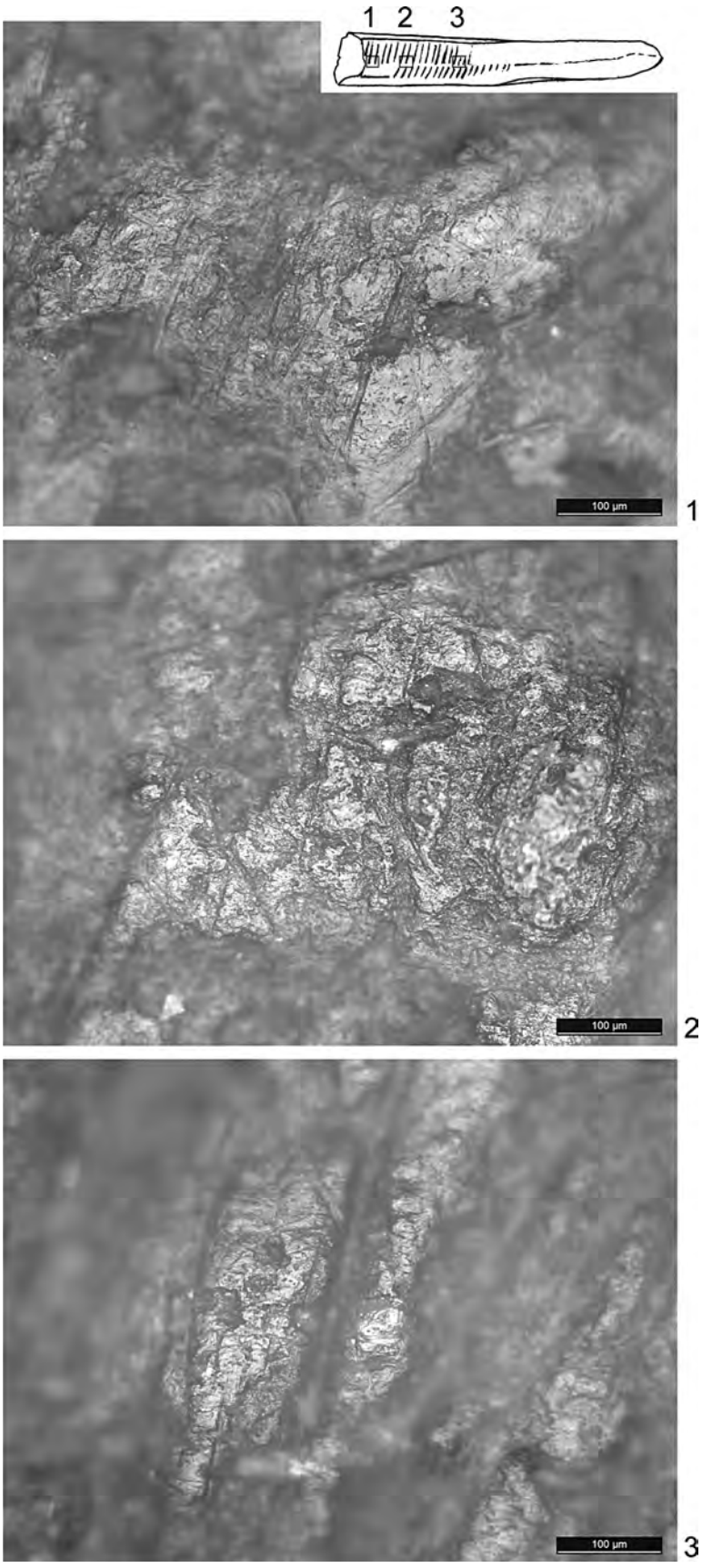



Fig. V.3.17 PM0805: superior highest relief (crest rounded by manufacture). Irregular ground topography unmodified, polishing and rounding of plateaus and ridges (cf. Fig. V.3.15.4). Images captured at 200× magnification (R. Christidou)

post-discard damage and should be ignored. The striations are long and short, narrow and large, transverse or oblique. This wear, which could suggest contact with a relatively rigid material, is difficult to interpret since the tool in places shows smoothing and invasive polish. This situation may be the result of prolonged tool use and possible use change.

The pointed fragment PM0805 also reveals contact with skin or a similar material (Fig. V.3.17). However, it is difficult to decide whether the polish is related to the use of an active end (cf. Fig. V.3.15.4). Wear observations were limited to areas near the central break, which were not severely damaged and feature polish that follows surface contours and is associated with rounding, scattered small round pits and short narrow striations running in various directions. The initial topography is preserved; the grinding marks are deep and large.

The wear features of PM0767 differentiate it from the tools described above. The distal tip exhibits a hinged fracture. Its contour is completely rounded. Under magnification, the topography preserves no recognisable features of transverse grinding, which was employed to sharpen the point. Long rough straight striations, for the most part longitudinal and oblique (Fig. V.3.18.1), cover the surface. Their widths mostly range between 2μm and 7μm. The upper relief is fairly homogeneous, polished, flattish or slightly rounded. It is incompletely smoothed or rough as a result of the presence of small pits and tiny striations, which are polished. Otherwise, invasiveness in depressions is little developed. Proximal to this area, manufacturing striations appear gradually (Figs. V.3.18.2–3). They are interrupted by longitudinal and oblique striations. The plateaus show the same features as described above. The rough-bottomed striations are usually long; they become randomly spaced and oriented. The wear features become thinner and superficial as one moves along the tool shaft down to approximately 15mm from the base (cf. Fig. V.3.18.4). The point was probably used for weaving with an abrasive and/or rigid material of vegetal origin.

The abrasion features on PM0854 are less intense and suggest a soft vegetal material. The distal tip of the tool was roughened (i.e. crushed). It became polished and rounded later. A 90º tip angle was measured and an original of 63º calculated. Therefore, the aim of point shaping was not tip sharpness but the tapering of the naturally slender fibula shaft in order to facilitate the insertion of the tool into the worked material. The wear extends down to approximately 40mm from the tip. The initial topography is preserved, except for a length of 2–3mm around the tip where there are no typical marks from the scraping which was employed to shape the point. The surface is polished and homogenised (Figs. V.3.19.1–2). There are individual irregularly spaced rough-bottomed pits and longitudinal and oblique rough-bottomed striations measuring between 2μm and 6μm in width. Some pits are larger, up to 10–12μm. The polish affects their edges and in several instances their interior partially or completely. There are also transverse or slightly oblique striations, which are comparatively short and more or less polished. Below the limit of 2–3mm, worn scraped features appear (Figs. V.3.19.3–4, V.3.20.1–2); they are best preserved below 4.8mm. Scratching is widespread; transverse and oblique striations of various lengths are common. At a distance of about 11mm from the tip, the banded aspect of the scraped surface is perceptible despite the polishing and scratching of the upper relief. Further away from the distal end, large areas of the low spots of the surface appear hardly worn or unpolished. At a distance of about 15mm from the distal tip, the polish becomes thin; the scratching reduces and is superficial. Below 41mm, the tool surface displays weak polish (Fig. V.3.20.3), which is not classified.

The entire length of the blunt curved needle (PM0865) exhibits use wear from a material of vegetal origin. The naturally bulging distal end of the rib shaft is totally polished (Fig. V.3.21.1); the topography is irregular as a result of differences in the extent, form and orientation of the depressions. Well-formed striations are, however, frequently transverse, straight, narrow (1–2μm), superficial, long, continuous or discontinuous. The upper relief is homogeneous, rounded or flattish but not completely smoothed. Below the end, the polish begins to thin out and to concentrate on the upper relief (Fig. V.3.21.2). Striations, isolated or grouped, dark or polished, fine or relatively large (3–6μm), short or relatively long, run in various directions. They are rough-bottomed, like the pits, which are common. The plateaus, flat and extensive, have a homogeneous appearance. The fibrous aspect of the bone surface becomes perceptible. This is best observed at

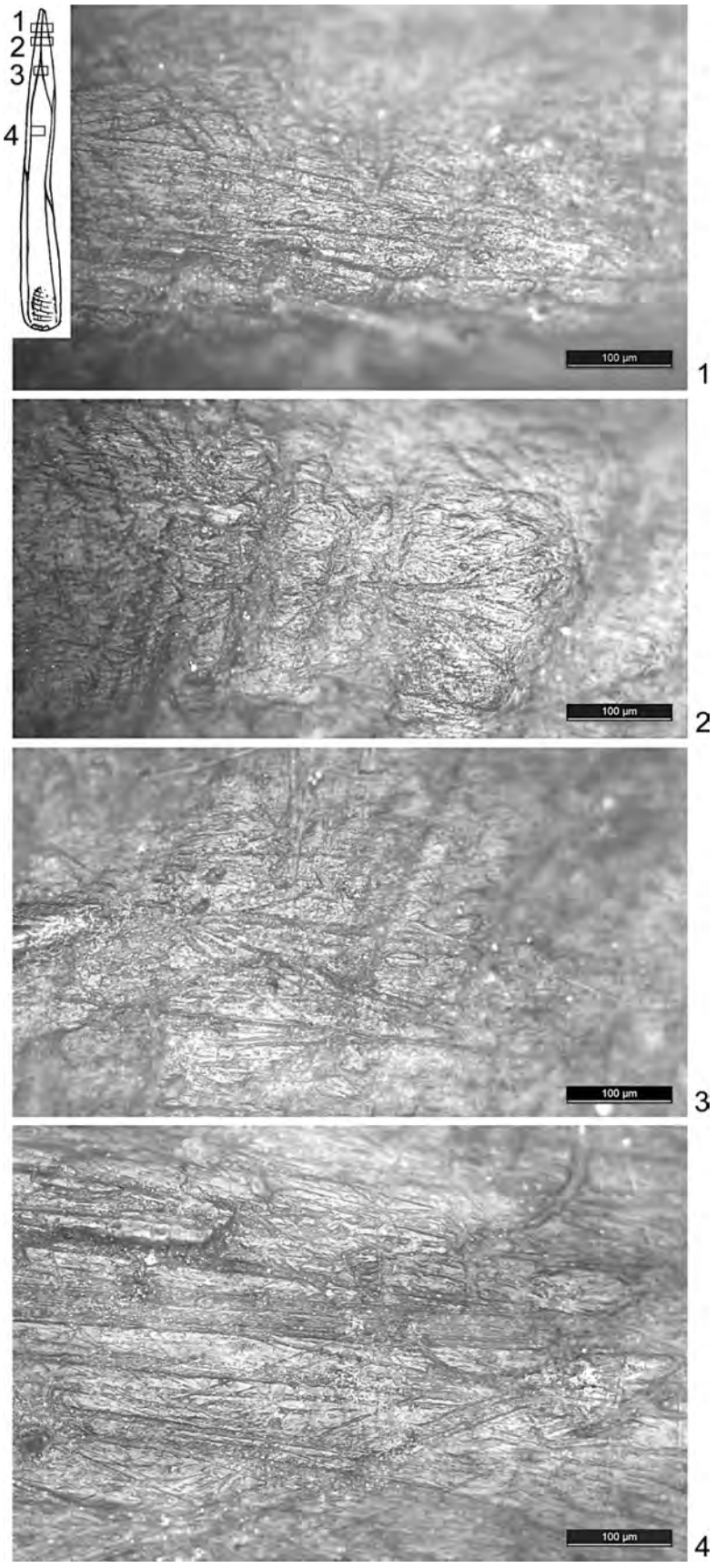



Fig. V.3.18 PM0767: inferior side. (1) Point, high central ridge. Striated used surface. (2–3) Ground topography preserved, upper relief altered. (4) Scraped topography preserved, upper relief altered. Images captured at 200× magnification (R. Christidou)

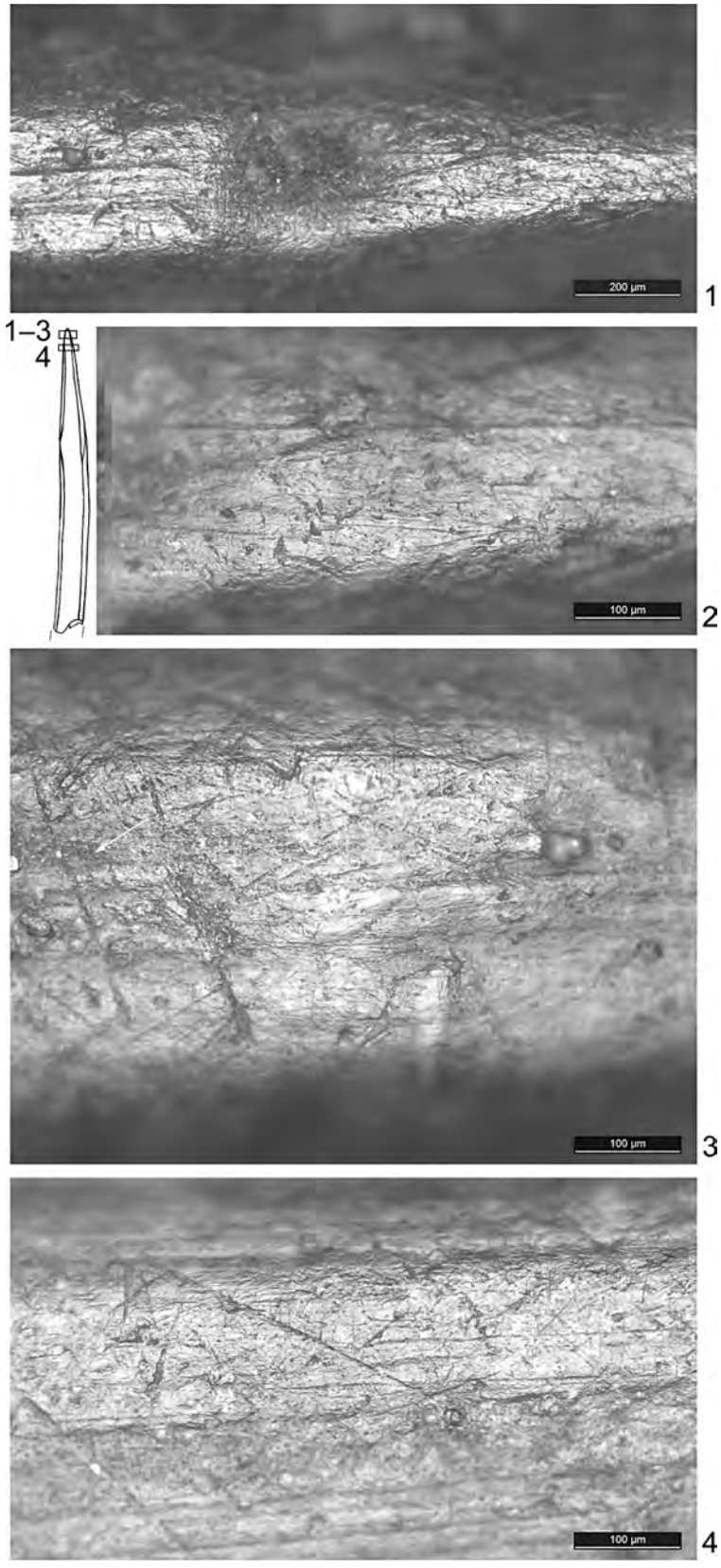



Fig. V.3.19 PM0854: point, inferior side along the facet of the right side of the point. (1) Homogenisation. The large deep concavity in the middle probably belongs to the initial, scraped, topography. It was perhaps the result of an accidental surface removal. (2) Distal (i.e. right) to the concavity shown in image 1. (3) Remnants of the deep scraped valleys (arrow) preserved on the facet of the right edge of the point. (4) Original valleys preserved on the facet captured in image 3. Image 1 captured at 100× magnification, images 2–4 captured at 200× magnification (R. Christidou)

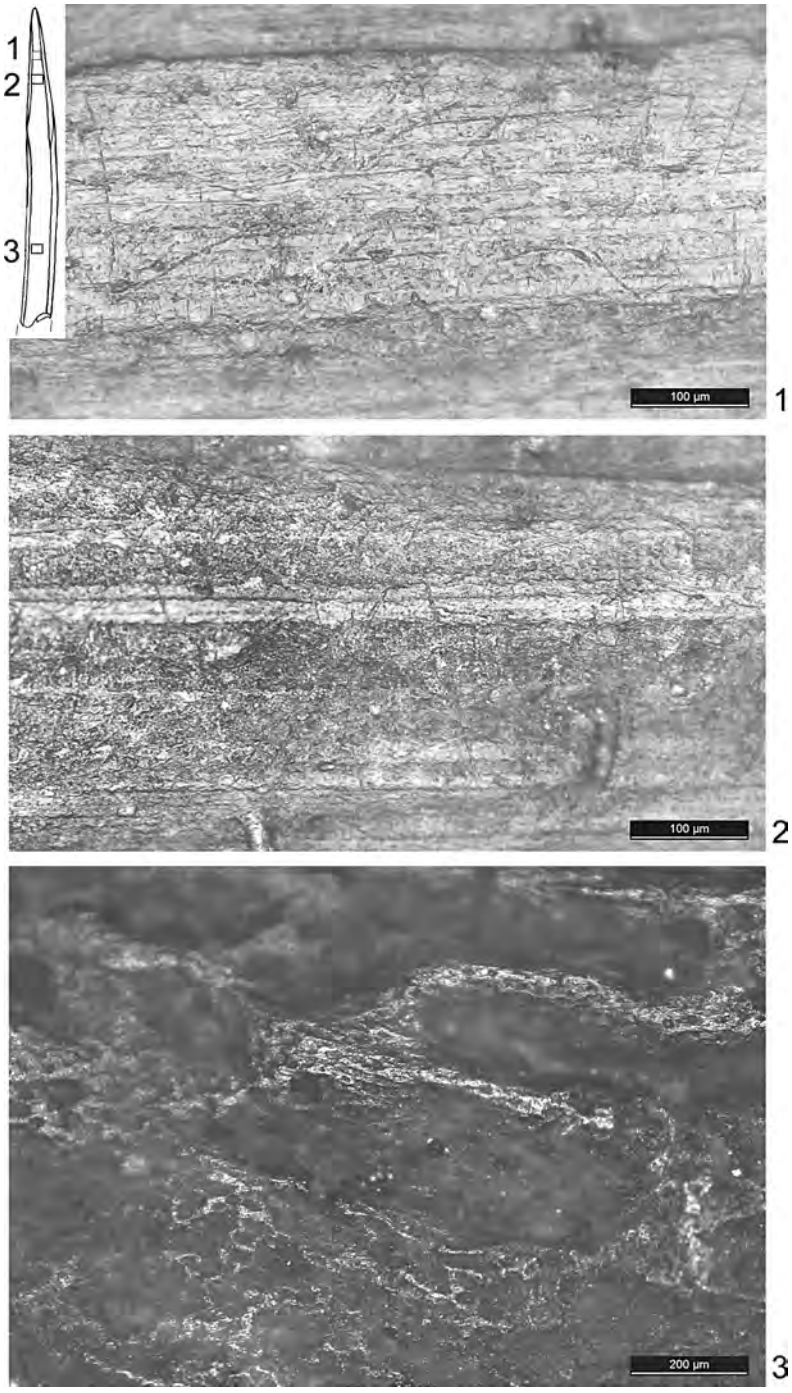



Fig. V.3.20 PM0854: point, inferior side. (1) Scraped relief altered, polished. (2) Scraped topography, superficial wear. (3) Natural surface, weak polish. Images 1–2 captured at 200× magnification, image 3 captured at 100× magnification (R. Christidou)

distances greater than 20mm from the distal end. All the way down to the proximal third of the rib shaft, the variations observed are basically fluctuations in the quantity of striations, which are abundant in places (compare Figs. V.3.21.3, V.3.22.1–2). They are mostly transverse or diagonal. They are up to 6µm wide; larger specimens, up to 10µm, are uncommon. On the proximal third of the bone shaft, the abrasion features diminish. The polish is extensive and the upper natural relief smoothed; natural depressions are well preserved and extensive, with little or no polish at all. The profiles are flattish or slightly rounded. The wear features again become more intense at the level of the hole and the base, in a way similar to the distal end (Fig. V.3.22.3).

The hole was used to hold a thread. Overall, the edges were rounded and polished (Fig. V.3.23), faceted in some places. Faceting is seen on the very edge or its inner slope and may represent remnants of shaping marks or use microflaking. There are scattered pits and frequent short striations, perpendicular or slightly oblique to the edge, isolated or grouped, usually polished. The wear sweeps over the edge and affects the upper relief of the outer bone surface. It fades quickly. In some areas, there are variations in polishing and rounding. The caudal hole was cut through the costal groove; its edge, when observed on the high zones of the bone relief, is narrow and clearly shows a high degree of wear (see especially Fig. V.3.23.3).

Polish observation was limited to a length of about 40mm from the central break of specimen PM0835 (Fig. V.3.24). On the rest of the tool surface, weathering caused loss of polish. The length analysed shows extensive polishing and an appearance of plateaus comparable to that of tools used to work with vegetal materials.

The morphometric and use characteristics of PM0810 suggest a slim form of tool with a sharp, possibly pointed, or blunt distal end. The object displays macroscopic gloss and edge rounding as well as severe smoothing down of grinding marks (cf. Fig. V.3.4.2). These marks are rough furrows in the interior of the facets shaped; they were obliterated from the edges, which show fine longitudinal cracks blunted through wear development. Under 100× and 200× magnifications (Fig. V.3.25), numerous use striations are visible. They are multidirectional, unevenly spaced, continuous or discontinuous. Their widths range between 1μm and 12μm; their texture is rough. Together with rough-bottomed rounded and irregular pits of various sizes, they represent irregularities on the broad polished plateaus, which are otherwise homogeneous and flat or slightly rounded. Intrusive polish is observed, but it concerns mainly superficial pits and striations and does not spread deeply into the lower-relief zones. The alteration and obliteration of the roughness from the sides of the sunken areas are localised too. The overall appearance and individual features of the wear can be compared with that caused from vegetal materials. The morphometric characteristics do not help estimate the distance of the fragment from the active end of the original tool and therefore also not the degree of penetration of the tool shaft into the worked material.

A rotating movement could be inferred for PM0798 (Fig. V.3.26), but a pattern of wear development was difficult to establish because of extensive weathering damage. The material worked would be soft, of animal or vegetal origin.

In sum, animal and vegetal tissues were worked with the pointed tools. The first category of worked material is comparable to (and probably represents) skin. Five awls were associated with this material category and had functioned as perforators. It was not possible to interpret similar wear preserved on fragment PM0805. Of the five awls, one (PM0468) was employed as an intermediate tool. It was probably abandoned because of extreme base damage. The other specimens (PM0617, PM0658, PM0717 and PM0700) suggest a rotary motion. All but one (PM0700) lack the distal tip. The complete point exhibits strong rounding that would constrain tool function. On the other tools, the wear is fairly well formed on the point portions preserved, suggesting that the tips would be even more worn. The complete specimen indicates a used point length of about 18mm. On the three broken points, the distal wear measured between 9mm and 21mm in length. All of the tools used with a rotary motion are short. The complete specimen is 67mm long; PM0717 has a calculated length of 56.9mm. The lengths missing from PM0617 and PM0658 would be greater than 5mm, possibly in the order of 8–10mm, i.e. too long to be securely reconstructed. If this order is accepted, then the widths and thicknesses measured below the broken ends, 3.2 × 2.7mm for PM0617 and 3.6 × 2.9mm for PM0658, are comparable to those measured at a distance of 10mm from the apex of PM0717, 3.8 × 3.5mm (Fig. V.3.10.1). In this case, the wear observed would be associated with rather short implements and small points. PM0700 was comparatively thick (4.5 × 4.5mm). There was no attempt to rework the tool, which had already been resharpened.

Four pointed tools including the blunt curved needle (PM0767, PM0835, PM0854 and PM0865) and the central fragment PM0810 were associated with vegetal materials. Two (PM0854 and PM0865) indicate contact with rather soft materials. Overall, the wear on these tools is extensive.

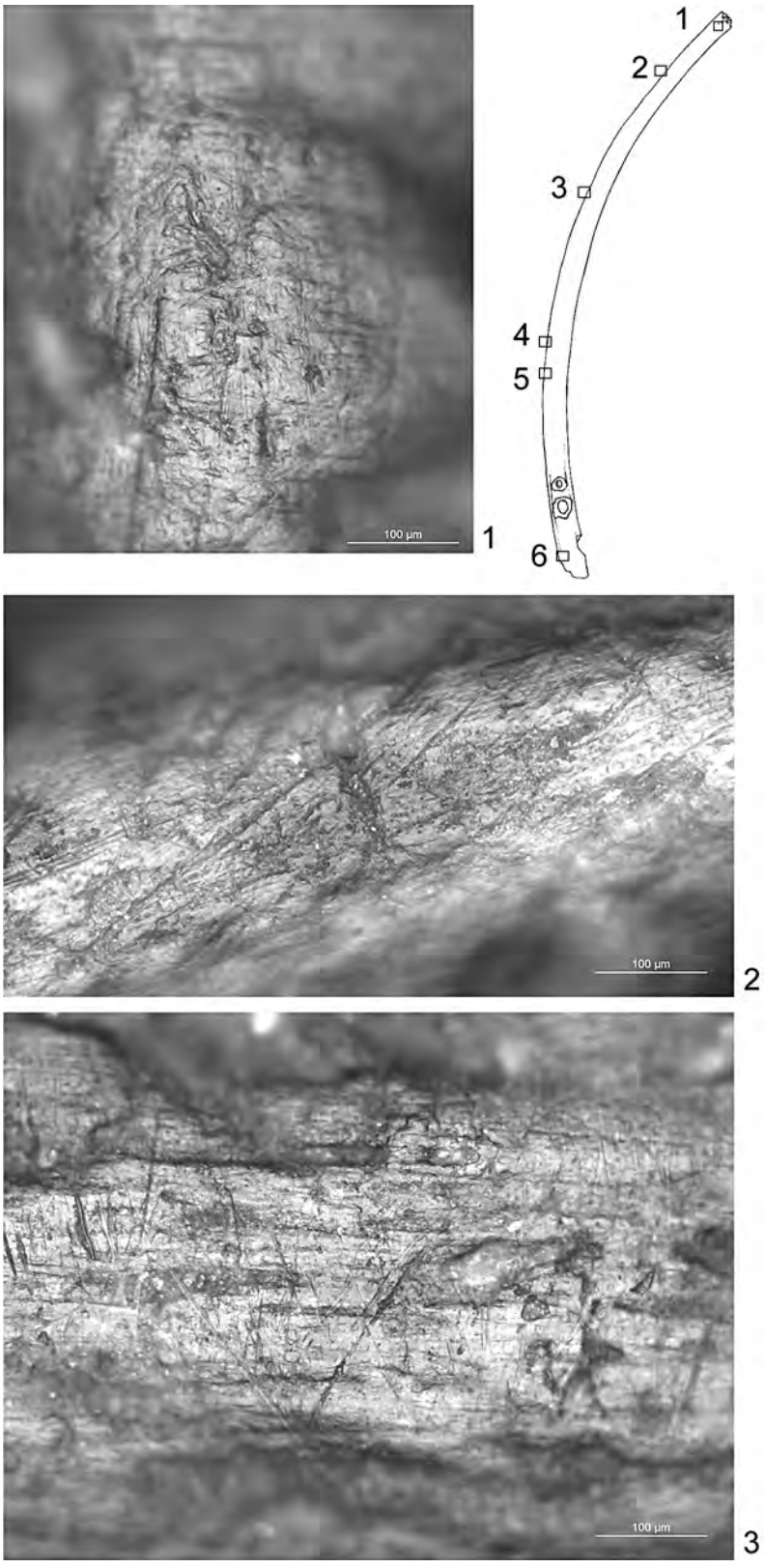



Fig. V.3.21 PM0865: external side. (1) Distal tip to external face transition. Complete polishing. (2) Individual striations and smoothing of the upper natural relief. (3) Frequent transverse striations. Images captured at 200× magnification (R. Christidou)

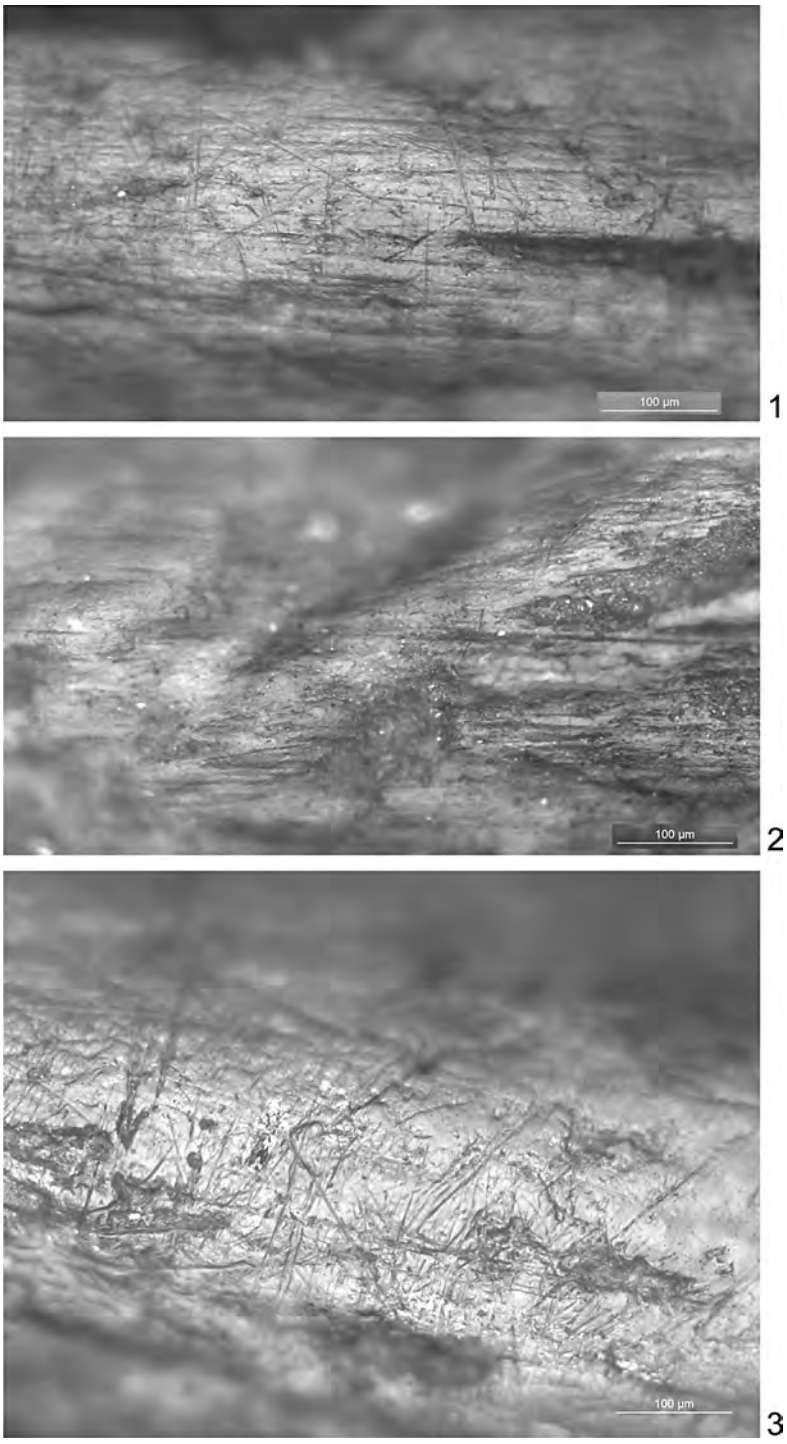



Fig. V.3.22 PM0865: external side. (1) Spot 4 on the drawing of Fig. V.3.21. (2) Spot 5 on the drawing of Fig. V.3.21. (3) Spot 6 on the drawing of Fig. V.3.21. Note superficial polishing and smoothing on image 2. Images captured at 200× magnification (R. Christidou)

The blunting of sharp tips, probably in the first stage of use, did not stop the work. The needle was never sharpened. In fact, it was the long, curved body of the bone that had been exploited as a tool. The tools were worn but there is no damage detected that could explain their abandonment. The cause of fracture of PM0854 is unknown. The sizes, forms and raw materials of the tools associated with vegetal materials vary. The shortest was abraded through use; striation orientations suggest a simple use motion, but PM0854 and PM0865 are linked with more complex actions.

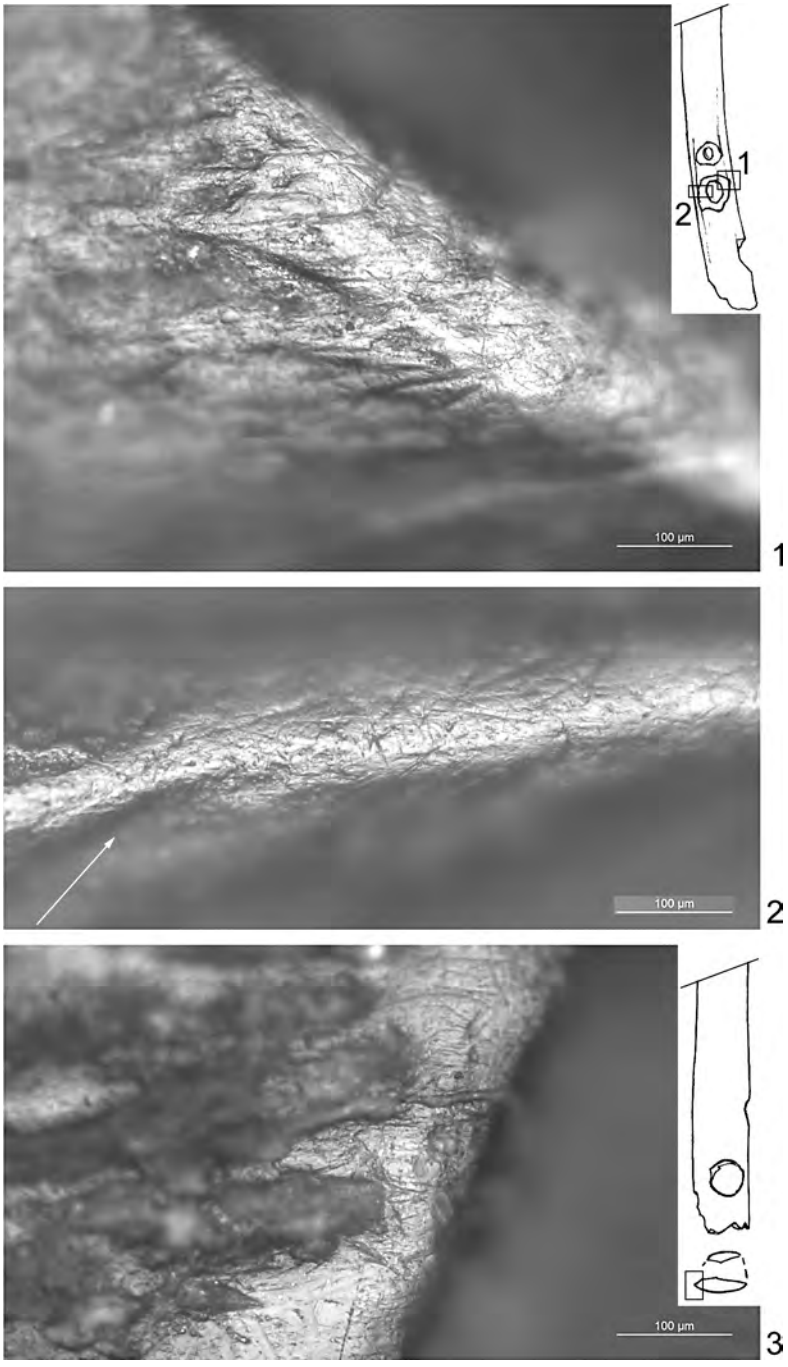



Fig. V.3.23 PM0865: caudal side of the finished hole. Edge rounding and polishing. The arrow indicates a groove cut during the perforation. Images captured at 200× magnification (R. Christidou)

*Cutting-Edge Tools*

Both specimens indicate transverse use actions, i.e. movements perpendicular to the working edges. The wear and tear on these edges point to worked materials of different hardness and different origin, vegetal for PM0414 and animal for PM0785. As mentioned above (Chapter V.3.5), in both cases use had modified the angles of the distal (i.e. active) edges considerably.

The main characteristics of the use marks on the active end of PM0414 were studied despite the presence of crusts. These characteristics are the deformation of the middle part of the active edge as a result of flaking and the polishing of the flaked zone and the scraped inferior and superior sides of the tool. Flaking is bifacial and consists of scaled removals no longer than 1mm,

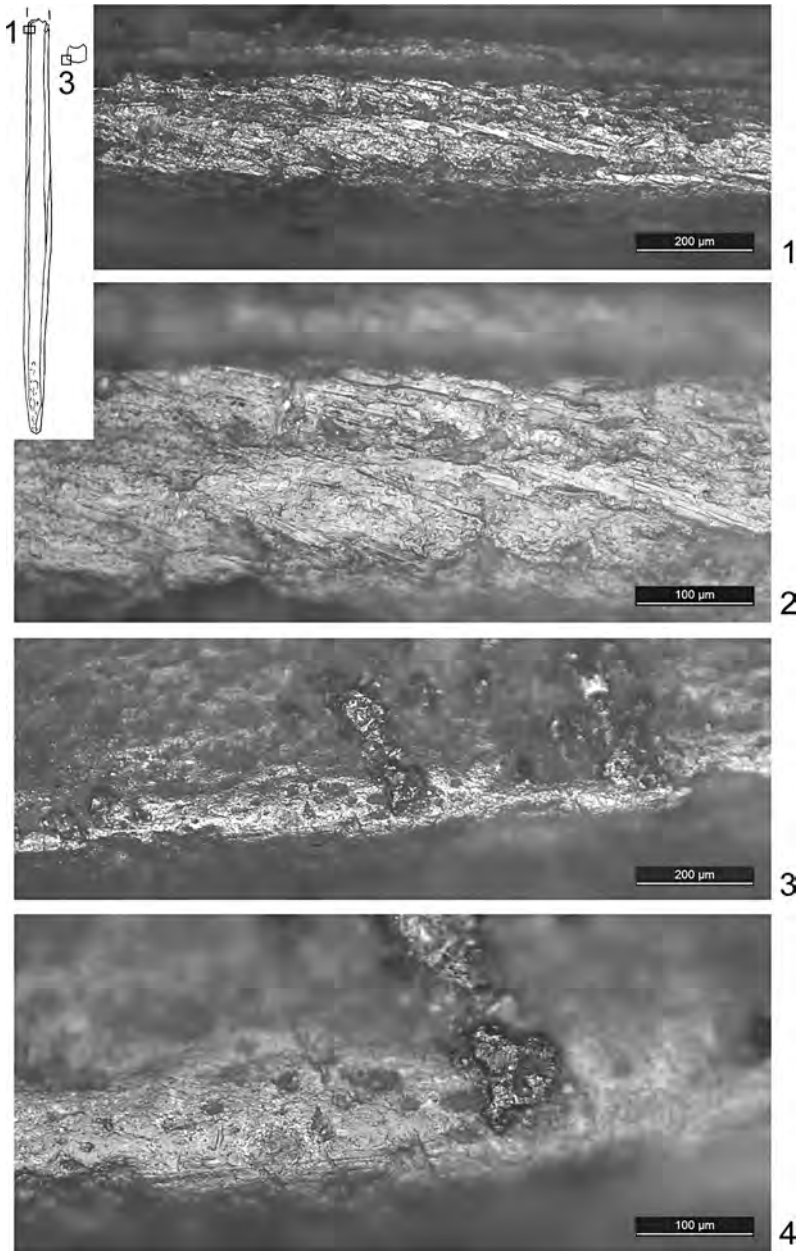



Fig. V.3.24 PM0835: (1–2) left edge of the marrow cavity, facet scraped to flatten. Rough polished plateaus, deep original valleys preserved. Note also the flat discontinuous polished streaks in image 2. (3–4) Superior left ridge rounded. Images 1 and 3 captured at 100× magnification, images 2 and 4 captured at 200× magnification (R. Christidou)

except for a superior 3.3mm-long and relatively deep triangular negative with an asymmetric V-shaped cross section. The portion of edge altered by the removals is 3mm in length and has a slightly concave irregular outline. The superior margin of the edge is rounded, with a radius of about 1.3mm. Rounding is unobtrusive on the opposite side. The border and slopes of the triangular scar are glossy. The distal edge and the ridges at the intersections of the flake scars are also polished. The right half of the inferior flaked zone has a compressed appearance. Polishing of the inferior face was observed all the way down to approximately 9mm from the edge. On the opposite face, crusted to a great extent, the length examined was about 3mm.

Smoothing and use striations developed on the inferior face (Figs. V.3.27.1–2). Maximum smoothing is observed on extensive plateaus that start within the flaked zone, are flat or rounded and bear longitudinal narrow (<2μm) striations, continuous or discontinuous, as well as sporadic

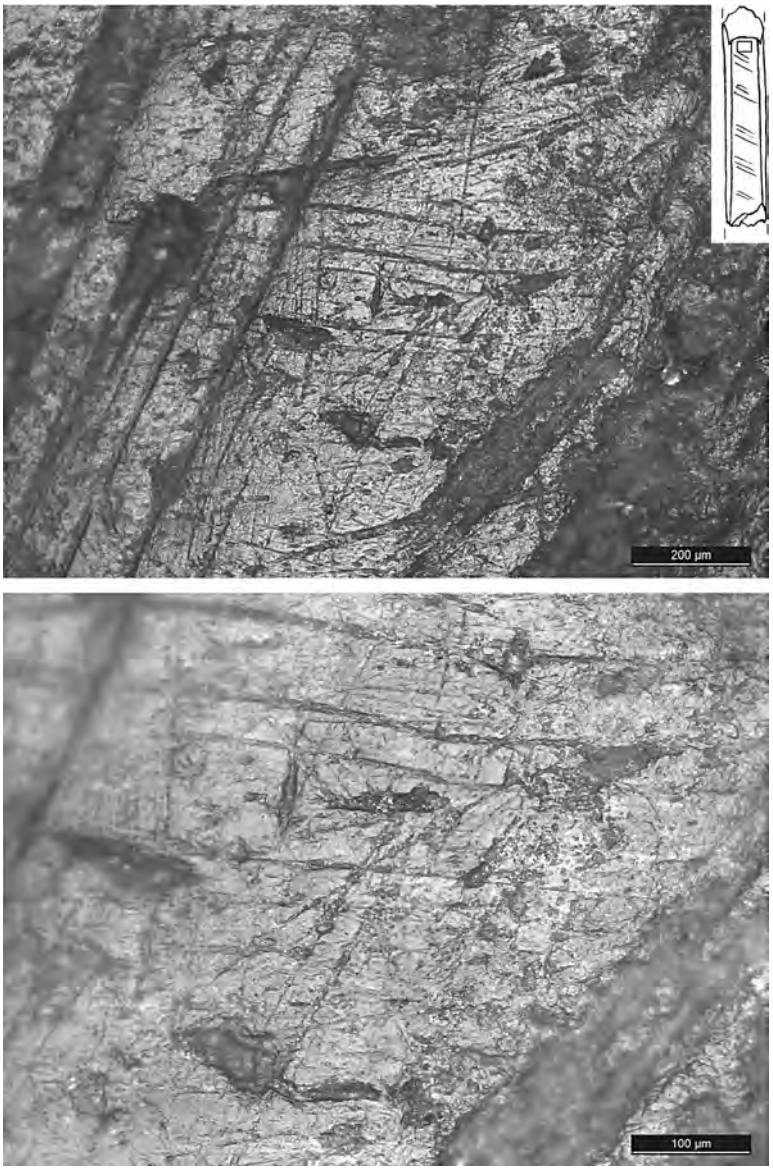



Fig. V.3.25 PM0810: ground topography preserved, altered upper relief. Upper and lower images captured at 100× and 200× magnifications, respectively (R. Christidou)

small pits and transverse or oblique striations. These marks appear polished. The longitudinal striations are smoothed down in the most distal zone. This effect fades as one moves away from the edge. The polish spreads toward recessed zones, which include longitudinal valleys with poorly defined borders. These latter marks are remnants of scraping striations with their distal ends erased or blurred as a result of the use wear. Overall, low relief zones are not smoothed; the deepest ones appear slightly or not worn. This state of surface reaches to about 2mm in length in the middle of the worn face. Its limit is irregular. Within this limit and proximal to it, the networks of longitudinal use striations on smooth plateaus tend to shrink and occupy the highest surface relief. The limits of these formations are located at various distances ranging between roughly 3mm and 4mm from the working edge. Otherwise, scraping striations are apparent and deepen as one moves away from the distal tip (see especially Fig. V.3.27.2). The raised areas of the scraped topography are polished, completely or incompletely smoothed, flat or rounded, and show scattered superficial narrow striations and small pits. The striations are multidirectional, dark or polished and usually short. Lower-relief zones are slightly or not worn. Polish and abrasion features gradually

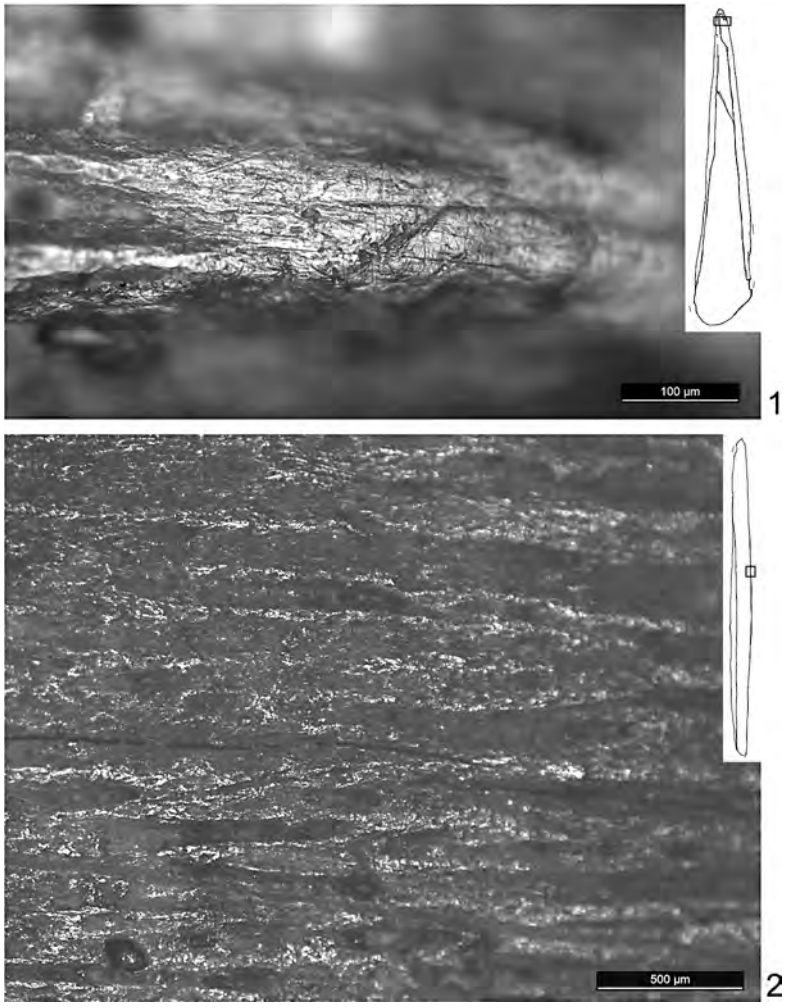



Fig. V.3.26 PM0798: (1) point, inferior side, non-flaked area. Wear following surface contours. The wide deep unpolished valleys on the left represent weathering damage. (2) Middle superior shaft. Loss of polished outer bone, furrowing and cracking as a result of weathering. Image 1 captured at 200× magnification, image 2 captured at 50× magnification (R. Christidou)

diminish and resemble those seen on the less-worn areas recorded on the superior face. On this face, the wear is also gradual. The edges of the superior flake scars and the upper relief of the surface immediately below blend together. This relief consists of extensive plateaus, incompletely smoothed or rough, sometimes crossed by fine or larger (width: ≤6μm), transverse or oblique, isolated or grouped striations, which are more or less polished (Fig. V.3.27.3). The wear spreads to cover the margins of the plateaus and reaches the shallowest longitudinal rough furrows, which are reminiscent of scraping marks. This is mainly observed within 2mm from the edge. Farther away, the wear becomes restricted to the raised zones of the surface; the low-relief ones are little worn or unpolished. The surface preserves narrow scraping striations, which appear smoothed down. The cross section of the distal part of the tool shows convex superior and inferior faces, except the medullary cavity portion on the latter face. The wear fades toward the lateral edges of the tool, which are lightly polished.

The bifacial gradual invasive pattern of wear suggests penetration of the working edge of PM0414 into the worked material. The predominance of longitudinal use striations near the distal tip indicates a movement parallel to the long axis of the tool. The best-developed smoothing and use striations are inferior as the bevelled face of the tool was more exposed to friction than the opposite straight side. The flaking of the active edge at an early stage of the work and the wear

fading toward the lateral edges suggest contact with a rigid material. This can be linked with texture changes between the lower and upper relief within the most distal (i.e. most worn) areas. The low degree of variation in the shape and width of the longitudinal use striations, the smoothness of the upper relief in the most altered zones and the edge damage are comparable to wear features on cutting tools used to tear or split materials of vegetal origin. When the surface is not crusted, light rounding and polish are observed on high points of the tool relief, away from the active end. This wear was not analysed.

The left angle of the working edge of PM0785 shows a superior shallow rectangular flake scar measuring 1.8mm in length and 1.3mm in width. This negative was smoothed down along a length of about 0.5mm. The same effect is observed on the irregularities created on the edge during the resharpening. The entire length of the superior slope of the edge including the right and left angles is rounded in profile, with a radius of about 0.8mm. The surface is striated (Fig. V.3.28.1). The striations are deep or shallow, narrow (1–2µm) or relatively large (width: ≤5µm), rough-bottomed, more or less polished. They start from the edge and cover the rounded slope. They are perpendicular to the edge or slightly oblique and intersect or overlap frequently. There are also transverse specimens and polished finely striated streaks. The transition to the tool's interior is gradual and several striations extend there for a distance of about 1.7mm from the edge (Fig. V.3.28.2). Some large specimens measuring up to 12µm in width appear, showing use wear merging into the scraped surface. Along the edge and the worn slope, the upper surface relief is rounded or flattish. It has a bumpy appearance. The manufacturing striations first appear worn down. This effect quickly diminishes in a distal-to-proximal (i.e. active edge-to-base) direction. The wear invades depressed zones by gently polishing and rounding them. It fades at a distance of about 2mm from the edge; its limit is dim. The use polish hardly affects the opposite face. The extent of rounding and polishing on the edge and the superior margin, the striation pattern and the polish that extends into low-relief areas of the surface are consistent with the use of the tool with a scraping motion for working moistened hide. Wear on the superior slope indicates that this side of the tool was facing the worked material during use. As mentioned above (Chapter V.3.5), after rejuvenation a 51° edge angle was created. If the tool was used for fleshing, this modification had greatly reduced the cutting qualities of the edge.[590]

Polish is well developed and visible macroscopically on the shaft of PM0785. Such wear was frequently observed on the tools made from tibiae broken across the shaft during the Neolithic and the Bronze Age at PMZ.[591] It was attributed to extreme use, handling in particular. PM0785 also bears abrasion marks, specifically rough striations and pits of various dimensions, intense in places, which suggest exposure to other damaging factors during storage or long-term use and contact with dirt. These marks are more or less affected by prehension polish and are not recent. The metaphysis and the margin of the epiphysis of the tibia show polishing of the worked and natural surfaces. The uneven plateaus formed during the grinding display polish and rounding (Fig. V.3.29.1). The wear also invades recessed zones. There are scattered superficial striations and small pits, completely or partly polished. Striations are usually narrow and only occasionally wide, up to about 10µm. They are also more or less polished. Sporadic polished streaks and striations with smooth glossy bottoms are also present. Such features also occur on the unworked main shaft areas, which are smoothed or finely granular (Fig. V.3.29.2). Here, the natural topography was completely worn away. The wear extends on the scraped shaft, which shows polish following the surface contours, similar to that observed on the worked base (Fig. V.3.29.3).

590 Christidou – Legrand 2005, 389.
591 Becker 1991, 38.

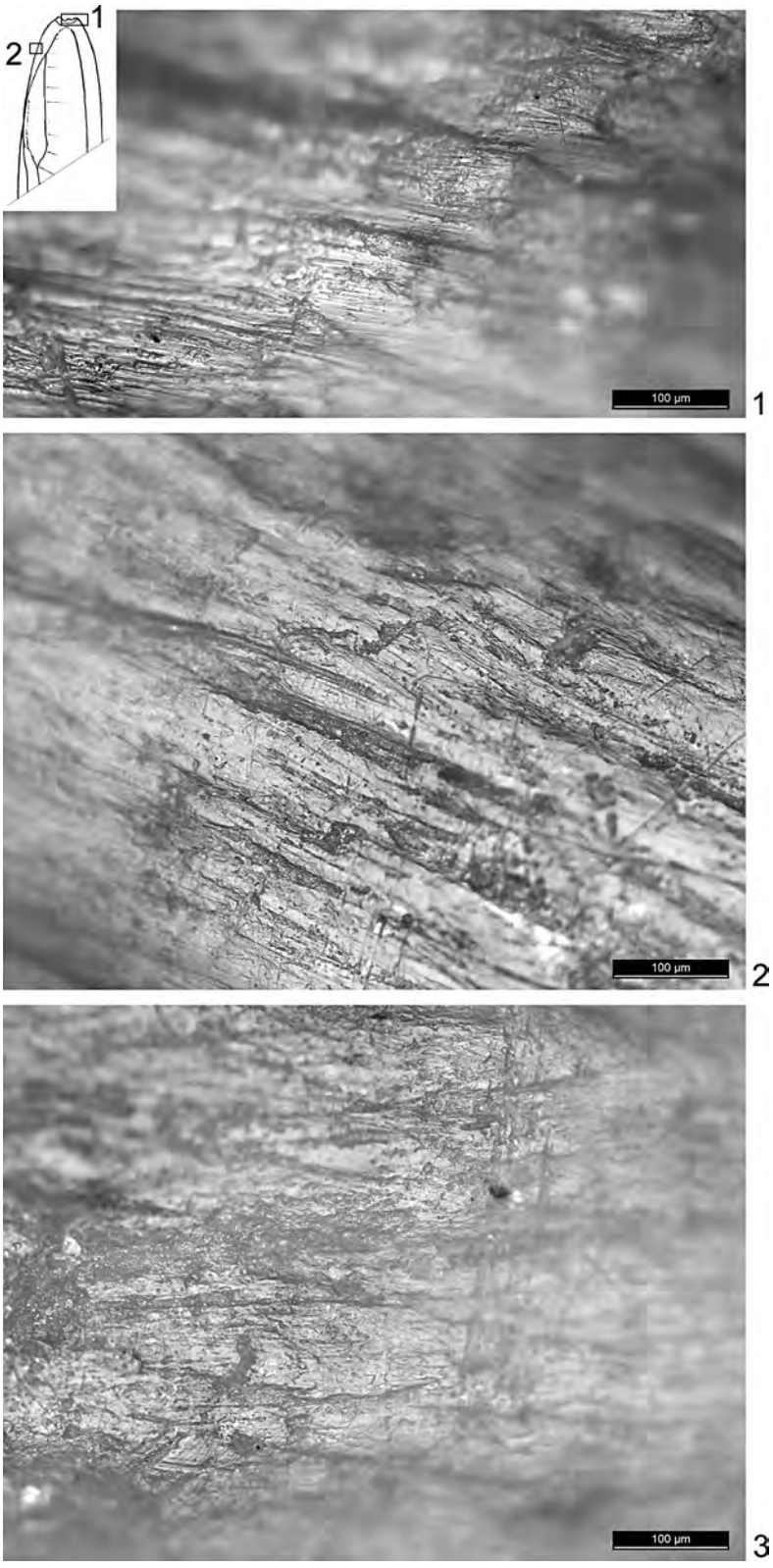



Fig. V.3.27 PM0414: (1–2) inferior surface, (3) superior surface below the flaked zone. Images captured at 200× magnification (R. Christidou)

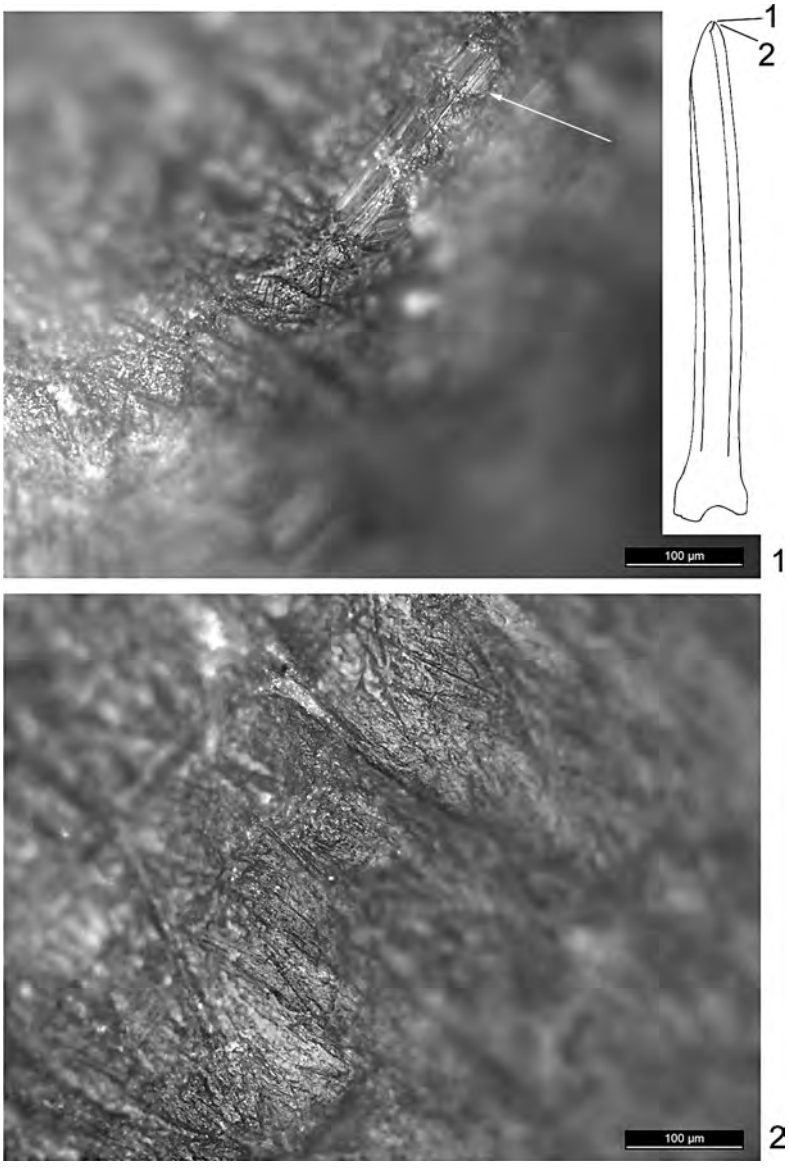



Fig. V.3.28 PM0785: superior slope of the working edge. The arrow indicates a polished streak. Images captured at 200× magnification (R. Christidou)

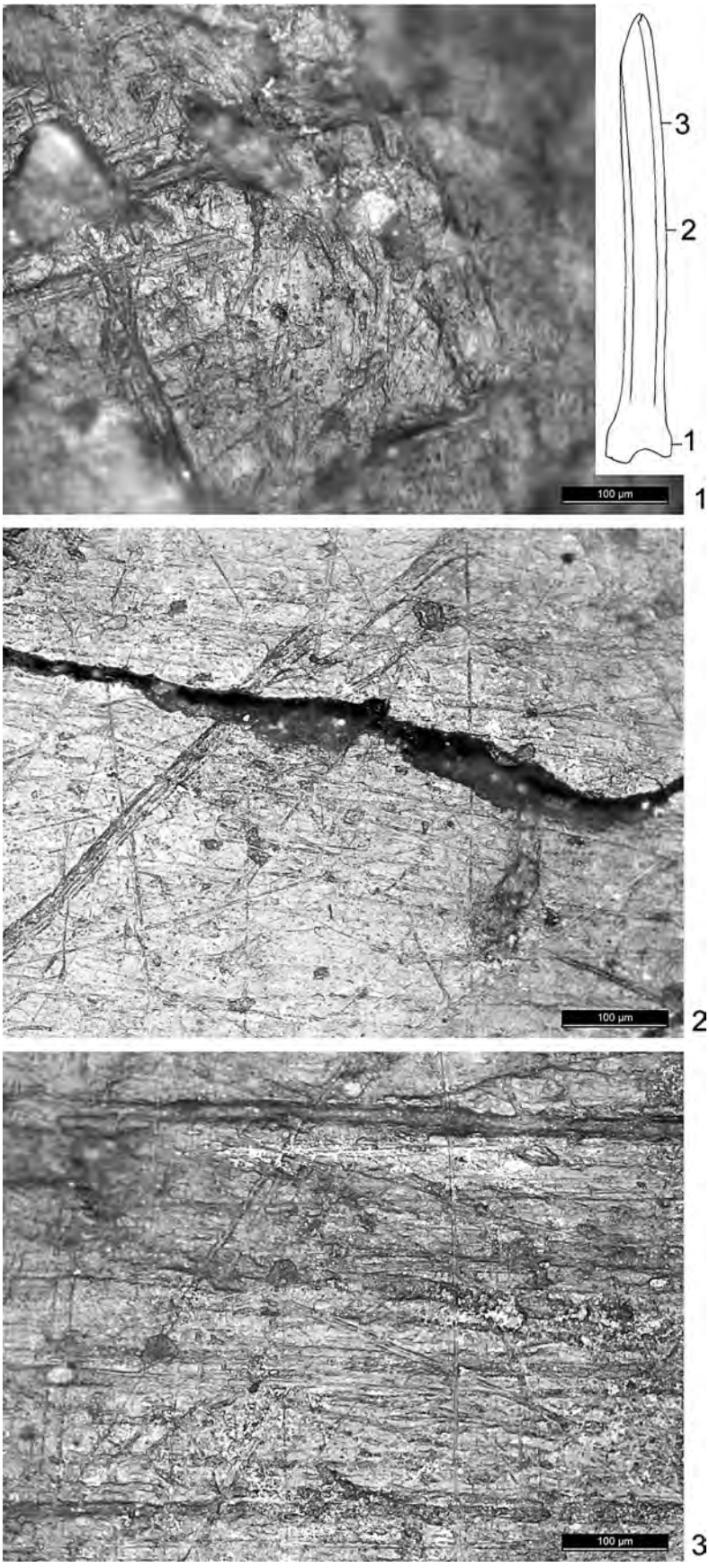



Fig. V.3.29 PM0785: shaft, superior side. (1) Ground, (2) natural and (3) scraped topographies altered by use. Images captured at 200× magnification (R. Christidou)

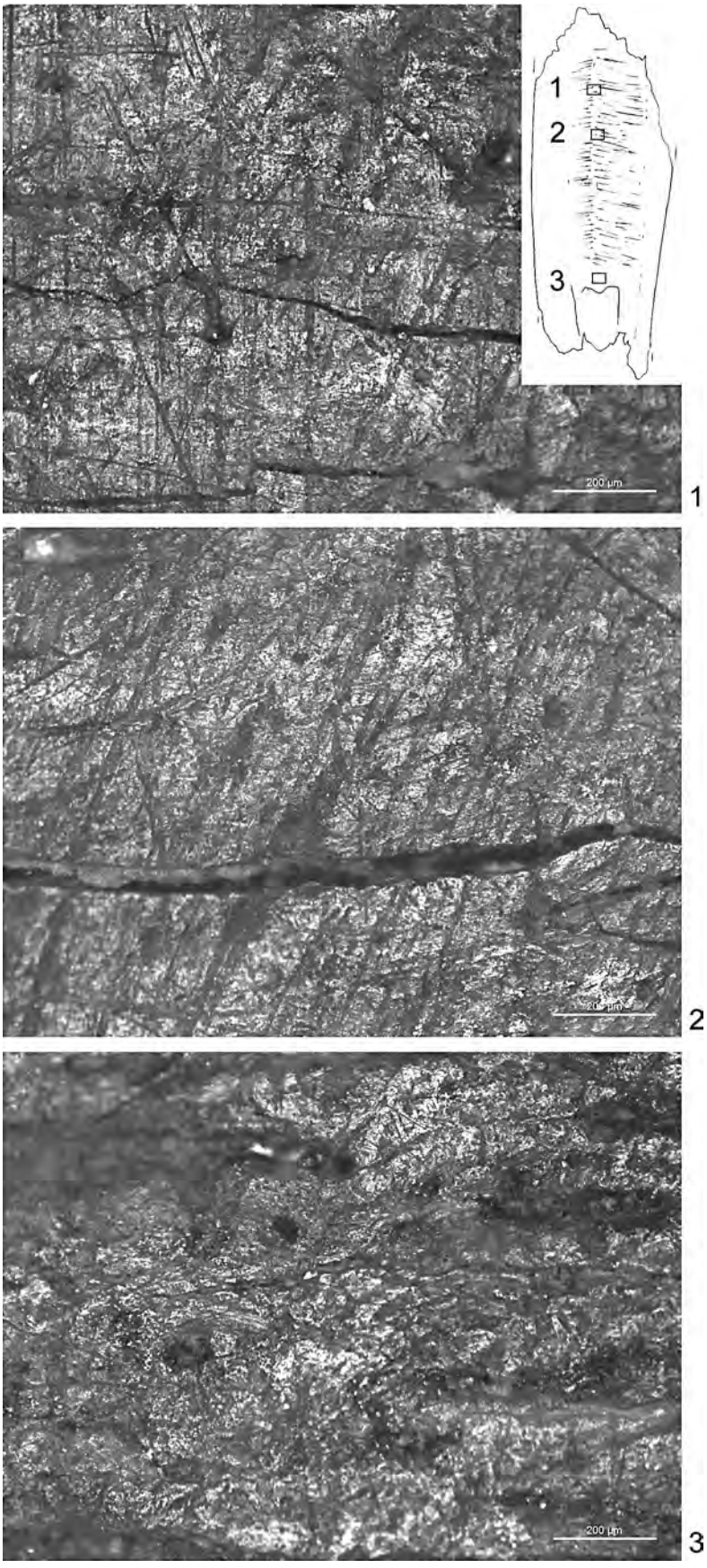



Fig. V.3.30 PM0930: external surface. Image 3 shows light, superficial, wear. Cracks and extensive deposits represent post-discard damage. Images captured at 100× magnification (R. Christidou)

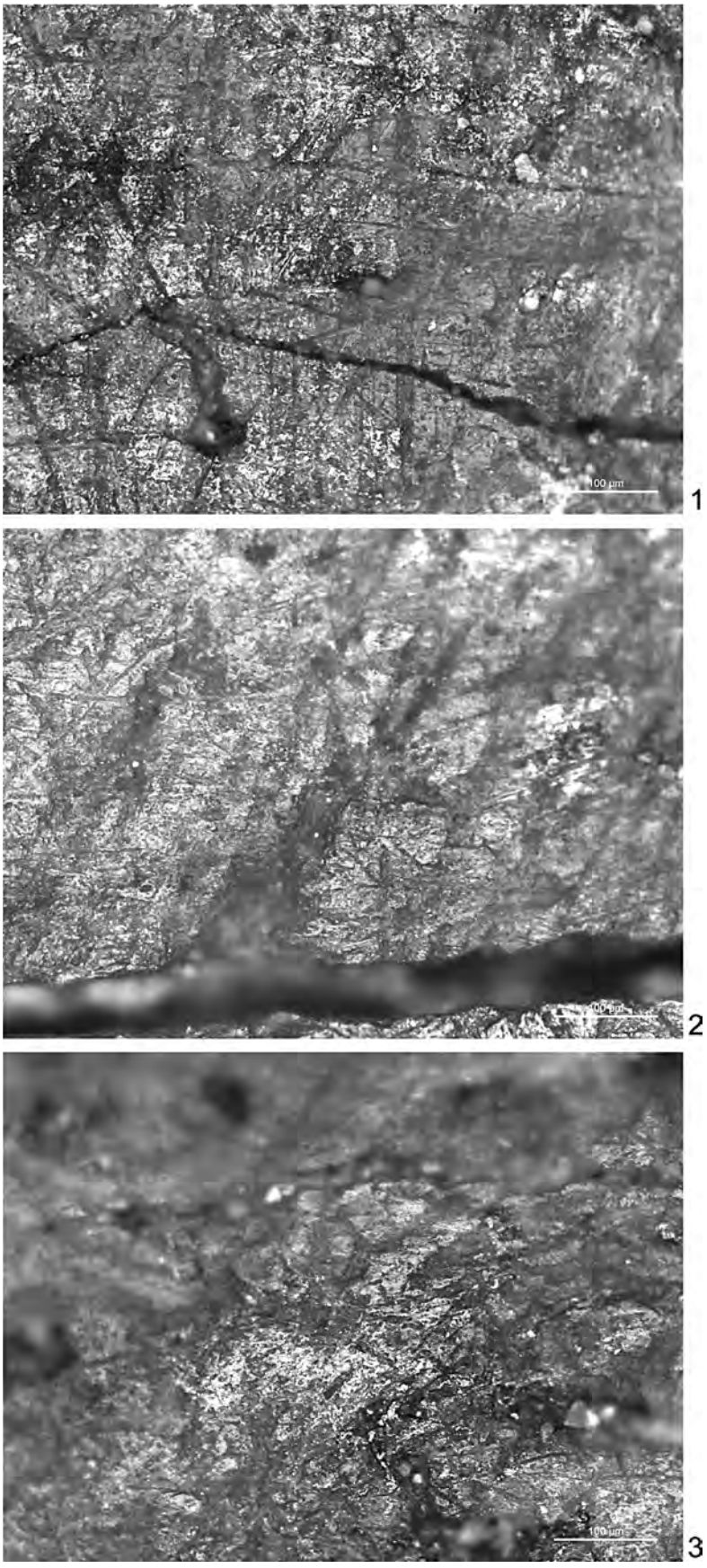



Fig. V.3.31 PM0930: external surface. Images captured at 200× magnification. The spots are the same as those captured at 100× magnification in Fig. V.3.30 (R. Christidou)

*Smoother*

Two poorly formed facets displaying gloss and striations covered much of the external face of the cattle rib fragment PM0930. The length worn is about 60mm. It is interrupted distally by multiple punctures inflicted by the chewing animal. At a distance of about 31.5mm from the proximal end of the fragment, striations and gloss are replaced by light polish, partly damaged by cracking, and, close to the extremity, by punctures. Of the two facets, one measures 14–14.5mm in width and the other 5.5–6mm. The broader one slopes gently toward the cranial edge of the rib following the natural shape of the bone. Its limit along this side is a rounded obtuse angle (see Fig. V.3.5.3). There is no sharp transition between the facets. The striations sweep over their intersection, which is also rounded. The limit of the narrow facet along the caudal side has no particular morphology. The striations are long, straight, rough-textured furrows running perpendicular or oblique to the long axis of the bone (Figs. V.3.30.1–2, V.3.31.1–2). They form sets that overlap and crosshatch in places. There are also individual curved and discontinuous specimens of variable directions. Most of the striations measure between 2µm and 10µm. Apart from linear marks, pits occur as both recessed unpolished zones and as components of the polished upper relief, which consists mainly of homogeneous flat or slightly rounded plateaus. The plateaus also bear sporadic short oblique or longitudinal narrow striations. Under magnification, the polish appears dull and thin. Near the limit of 31.5mm from the proximal end of the fragment, striations are poorly developed (Figs. V.3.30.3, V.3.31.3). Wide irregular valleys including natural channels and holes define the topography.

The large quantity of striations and the faceting in the major contact regions of PM0930 indicate repetitive friction of the bone against an abrasive material and changes in the planes of contact. Striations that intersect and overlap point to a reciprocal sliding motion. Gradual and rounded transitions between planes and dull polish suggest contact with a malleable mineral material. Poorly formed striations show loose, perhaps intermittent, contact. It is likely that the less worn proximal area was near the limit of the used bone surface. Otherwise, it was little used.

## V.3.7. Summary and Discussion

The majority of the bone tools examined are Middle Neolithic. The dating of three specimens to the Early Late Neolithic does not alter the basic conclusions regarding the tool blanks. Spiralling splinters, plain linear fragments and ridges of bone diaphyses were worked into pointed tools. With the exception of a halved metapodial and a splinter (PM0835 and PM0468, respectively), these fragments were about a quarter or less of the diameters of the diaphyses from which they were derived. Along with an incisor, a fibula and a rib shaft, they came from medium-sized mammals such as caprines and pigs. The undetermined specimens would be from the same size group or from larger species. The discovery of a fragment of red deer metatarsal showing reduction into quarters appears as a pure happenstance, but it also testifies to the need for sizeable blanks. Perhaps the feet of this species were introduced to the site with skins. Whatever the case, at PMZ their utility in tool production is confirmed. Based on evidence from other sites, the quarters were mainly shaped into awls. A metapodial half, a tibia quarter, both from small ruminants, and a metapodial quarter of a small or larger ruminant were also found. Whether the tibia specimen was an awl is uncertain. This find is interesting because it was shaped following modalities known from the production of metapodial awls. As has already been noted, PMZ, like other Thessalian sites, yielded evidence for the bisection of caprine metapodials as well as their thinning by grinding. PMZ showed that metapodial thinning could take place before or after the halving. Large samples of bone tools could eventually indicate more specific trends. Here the observation that can be made is that toolmakers exploited different concepts and raw materials. The use of the broad external face of a cattle rib body for smoothing and of the partially broken diaphyses of small ruminant tibiae for making cutting-edge tools further illustrates this point.

With the exception of the smoother fragment, which does not bear manufacturing wear, and the pig incisor and the medium-sized mammal rib body, which were barely worked, the other

blanks were shaped at various lengths prior to use. The fibula and the tibiae with complete shaft diameters were basically modified in order to sharpen the distal ends. Other modifications are absent or relatively limited. The rest of the tools were extensively worked. However, shaping had not severely modified the blanks, which were often shaped by means of scraping. Fine abrasives were also employed for local modifications. Since breakage does not produce standard or regular forms of fragments, the need to reduce bone locally and shape profiles arose. Overall, the size of the tool mirrored the size of the blank, but in at least two cases, the thinning of the halved metapodial PM0835 and of the metatarsal referred to as Bone 167, the shaping aimed at reducing the sizes of the blanks substantially. Then, there was flexibility, which is also reflected in the shaping of a blunt proximal point on the tapering end of the narrow splinter PM0617. There is no evidence whatsoever of hafting on this tool. Bipoint PM0835 might also have been an adaptation after removal, accidental or intentional, of the distal epiphysis half. In this case, bad preservation does not permit observation of the state of abandonment of the tapered proximal end for studying hafting.

The acquisition and shaping of the tool blanks were use-oriented. The largest splinter was employed as an intermediate tool for punching holes into skin by indirect percussion. Four relatively short tools had served as perforators of the same kind of material using a rotary motion. Small distal widths and thicknesses were measured and estimated for these objects; the size of the point of PM0700, made from a metapodial quarter, was the largest. The modest length of this tool could be the result of tool reworking. Its original length would be at least 80mm. It is also possible that the use of the tool had changed. It is not known whether complete reworking and size reduction of the distal end of splinter awl PM0717 would also have shortened the tool considerably. In both cases, continuation of tool use would require extensive reworking and shortening for obtaining small distal widths and thicknesses. The same observation applies to the other perforators of soft animal materials. This category of worked material was also recognised during the use-wear analysis of chipped stone implements. Skin processing in particular would be the second most frequent activity performed with these artefacts at PMZ. While the stone tools were used employing transverse actions, the osseous ones were used for perforation.

A slender piece of fibular shaft, a slender point, the thinned metapodial half, a medium mammal rib shaft and a small central fragment of tool, probably slim, were used to work with vegetal materials of different hardness and with simple as well as relatively complex motions. While the perforators of animal materials seem to have been well used and the intermediate tool heavily damaged before abandonment, such data could not be produced from the examination of the other pointed tools. The cutting-edge tools were thoroughly used and linked with the processing of vegetal and soft animal materials. The smoother was employed for working with an abrasive substance. That is to say, all of the tools examined would have been involved in artisanal activities.

Anatomical data point to production based on bones from carcasses or parts thereof processed on the site. It is also possible that broken elements were directly recovered from bone refuse. The absence of deer antler, whether shed and harvested outside the site or cut from killed individuals, must be stressed. It has been considered as a characteristic of the late phases of the Thessalian Neolithic,[592] which are not represented in the samples studied from PMZ. No evidence for use of wild carnivore or even hare bones was recovered, either. Reliance on small ruminants and pigs suggests availability, since these species predominated in the bone refuse of the site. Availability could explain flexibility in tool production. Coupled with opportunistic behaviour, reflected in ad hoc implements, it suggests adoption of an expediency strategy.[593] The time, the place and the conditions of the activities to be performed would be predictable, and acquired know-how of the osseous raw materials and technical solutions would have permitted adaptation in order to satisfy

[592] Moundrea-Agrafioti 1981; Moundrea-Agrafioti 1987.
[593] Nelson 1991, 64.

the needs that arose. All this would conform to the idea of small-scale artisanal activities, as suggested in the study of the chipped stone tools.

Less can be said about the distribution of the activities related to bone tool manufacturing and use in the settlement, since the sample analysed represents only a fraction (about half) of the assemblage excavated. The abandonment of the halved red deer metatarsal and the rib needle in BPh II that hints at the intermittent use of an open area is noteworthy. Such artefacts are not present in the built-up space. The needle seems to be an ad hoc tool, but this is not the case of the implements made from grooved metapodials of large ruminants, red deer in particular. Moreover, while the use of chipped stone for working bone is not confirmed by the study of use wear (yet the working of hard materials like bone has been identified), scraping with stone edges appears to have been a central activity when the bone industry is examined. It is possible that routine in and near the houses did not involve some activities, which are thus absent or underrepresented in the excavated samples. Working with vegetal materials was observed in the earliest BPh/BSPh II, IIIa–b, and then again in BPh VIII, i.e. open-air spaces. Two of the long pointed tools used to work with vegetal materials, PM0810 and PM0835, were found in rather close stratigraphic proximity, in SU 43 and SU 42 of BSPh IIIb. If these occurrences are not just a coincidence reflecting the vagaries of a small sample size, they are another indication of space-related activities. In contrast to cereal harvesting, the processing of plant materials for artisanal purposes is poorly represented in the chipped stone assemblage. Clay tools associated with textile production (Chapter V.4) are also few. Ultimately, the data examined from the Neolithic sequence of PMZ stir up one's interest in the norms that underpinned village life and that also occur as a subtle interplay between built environment and basic processing and foraging activities.

## V.3.8. Appendices/Catalogues

Tab. V.3.A1 PMZ bone tools: catalogue number, tool class, state of preservation and assignment to building, ceramic, lithic and chronological phase (R. Christidou)

| PMZ number | Old Inv. No. (BE) | BPh/BSPh | Toufexis – Batzelas, this volume | CH | LP | CP | Tool class | Tool fragmentation | Fracture(s) |
|---|---|---|---|---|---|---|---|---|---|
| PM0414 | 190 | VIII | p. 122, Fig. III.37 | 6 | 5 | LN | Cutting-edge tool | Distal-central frag. | Recent |
| PM0468 | 231 | VIIc | P 119, Fig. III.34 | 6 | 4 | LN | Awl | Nearly complete (3 joining frags.) | Old (distal fracture) and recent (other fractures) |
| PM0617 | 334 | VIIa | p. 112, Fig. III.29 | 5 | 3 | LN | Bipoint | Nearly complete | Old |
| PM0661 | 390 | VIb | p. 109, Fig. III.27 | 4 | 2 | MN | Awl | Distal-central frag. | Old |
| PM0658 | 387 | VIa | p. 108, Fig. III.26 | 4 | 2 | MN | Awl | Nearly complete | Old |
| PM0700 | 428 | Ve | p. 106, Fig. III.25 | 3 | 1 | MN | Awl | Complete | – |
| PM0717 | 440 | Ve | p. 106, Fig. III.25 | 3 | 1 | MN | Awl | Nearly complete | Old (both fractures) |
| PM0767 | 488 | Va | p. 102, Fig. III.21 | 2 | 1 | MN | Awl | Complete | – |
| PM0785 | 506 | IVb | p. 99, Fig. III.19 | 1 | 1 | MN | Cutting-edge tool | Complete | – |
| PM0928 | – | IVa | p. 97, Fig. III.17 | 1 | 1 | MN | Tool frag. (awl?) | Proximal-central frag. | Old |
| PM0798 | 519 | IIIc | p. 95, Fig. III.15 | 1 | 1 | MN | Awl | Complete | – |
| PM0800 | 521 | IIIc | p. 95, Fig. III.15 | 1 | 1 | MN | Awl | Nearly complete (15 frags.) | Recent (all fractures) |
| PM0805 | 526 | IIIc | p. 95, Fig. III.15 | 1 | 1 | MN | Bipoint or awl | Terminal frag. | Recent |
| PM0810 | 531 | IIIb | p. 93, Fig. III.12 | 1 | 1 | MN | Tool frag. | Central frag. | Old (both fractures) |
| PM0835 | 556 | IIIb | p. 93, Fig. III.12 | 1 | 1 | MN | Bipoint | Proximal-central frag. | Recent |
| PM0930 | – | IIIb | p. 93, Fig. III.12 | 1 | 1 | MN | Smoother | Central frag. | Old (both fractures) |
| PM0854 | 575 | IIIa | p. 91, Fig. III.10 | 1 | 1 | MN | Awl | Distal-central frag. | Old |
| PM0865 | 585 | II | p. 89, Fig. III.8 | 1 | 1 | MN | Needle | Complete | – |
| PM0929 | – | II | p. 89, Fig. III.8 | 1 | 1 | MN | Manufacturing waste | Nearly complete (9 joining frags.) | Old (all fractures) |
| Bone 167 | – | – | – | – | – | LN* | Ground metapodial | Distal frag. (epiphysis) | Old |
| *PM0769* | *490* | *Va* | – | *2* | *1* | *MN* | *Probably not utilised* | *Splinter* | *Old* |

* After Becker 1991

Tab. V.3.A1 (continued)

| PMZ number | Weathering | Chewing | Burning | Root etching | Edge abrasion | Crusting | Cracking | Flaking | Recent damage |
|---|---|---|---|---|---|---|---|---|---|
| PM0414 | + | – | – | + | – | + | * | * | Cuts |
| PM0468 | – | – | + | ? | – | + | – | + | Flaking |
| PM0617 | + | – | – | + | + | + | * | * | Cuts |
| PM0661 | + | – | – | – | – | + | * | * | – |
| PM0658 | – | – | – | – | – | + | – | + | Flaking |
| PM0700 | – | – | – | + | – | + | – | + | Flaking |
| PM0717 | + | – | – | – | + | + | * | * | – |
| PM0767 | + | – | – | + | – | + | * | – | Cuts |
| PM0785 | – | – | – | + | – | + | + | + | Flaking |
| PM0928 | + | – | – | – | – | + | * | * | – |
| PM0800 | Object shattered, alterations not recorded | | | | | | | | |
| PM0798 | + | – | – | – | – | + | * | * | – |
| PM0805 | – | + | – | – | – | + | – | + | – |
| PM0810 | – | – | – | + | + | + | + | – | – |
| PM0835 | + | – | – | – | – | + | * | * | – |
| PM0930 | + | + | – | – | – | + | * | * | – |
| PM0854 | – | – | – | + | – | + | + | + | – |
| PM0865 | – | – | – | + | – | + | + | + | – |
| PM0929 | + | + | – | – | * | + | * | * | Flaking |
| Bone 167 | – | – | – | – | – | + | – | – | – |
| *PM0769* | – | + | – | – | + | + | – | – | – |

* Alterations related to weathering and, in one case (PM0767), to root etching.

Tab. V.3.A2 PMZ bone tools: anatomical data (measurements in millimetres) (R. Christidou)

| PMZ number | Animal | Bone | Bone part preserved | Side | Compact bone Th |
|---|---|---|---|---|---|
| PM0414 | Small ruminant | Tibia | Shaft frag., central third | Left | Crusted, not measured |
| PM0468 | Medium size | Long bone | Shaft frag. | – | 3.6 |
| PM0617 | Medium size | Long bone | Shaft frag. | – | 2.7 (edge: 4.5) |
| PM0661 | Medium size | Long bone | Shaft frag. | – | 2.8 |
| PM0658 | Medium size | Long bone | Metaphysis+shaft frag. | – | 2.9 (edge: 4) |
| PM0700 | Undetermined (Small or large ruminant) | Metapodial | Proximal epiphysis+shaft frag., quarter | – | 5.3 (edge) |
| PM0717 | Medium size | Long bone | Metaphysis+shaft frag. | – | 2.9 |
| PM0767 | Undetermined (Medium size?) | Long bone | Shaft frag. | – | 4.2* |
| PM0785 | Goat | Tibia | Distal epiphysis+shaft frag., distal two thirds | Right | Flaked, not measured |
| PM0928 | Small ruminant | Tibia | Distal epiphysis+shaft frag., craniomedial quarter | Left | Crusted, not measured |
| PM0798 | Medium size | Long bone | Metaphysis+shaft frag. | – | 2.8 |
| PM0800 | Pig | Incisor | – | – | – |
| PM0805 | Undetermined (Medium size?) | Long bone | Shaft frag. | – | 4.2 (edge)* |
| PM0810 | Undetermined | Compact bone | – | – | 3.5* |
| PM0835 | Small ruminant | Metapodial | Distal metaphysis+shaft frag., halved metapodial | – | 3.3 |
| PM0930 | Cattle | Rib | Body frag. | – | – |
| PM0854 | Pig | Fibula | Shaft frag., central third | – | – |
| PM0865 | Medium size | Rib | Body | – | – |
| PM0929 | Red deer | Metatarsal | Proximal epiphysis–distal metaphysis, medial half | Right | 5.5 |
| Bone 167 | Sheep | Metatarsal | Distal epiphysis | Left | – |
| *PM0769* | *Large mammal* | *Rib* | *Body frag.* | – | – |

* Specimen with all-over shaping, thickness reduced

Tab. V.3.A3 PMZ bone tools: metric data (measurements in millimetres). Maximum and minimum dimensions are noted for flaked and/or crusted parts of the tools (R. Christidou)

| PMZ number | Lg | Lg calcul. | Max. Wd/Th | | Point Wd at 10mm from the apex | Point Th at 10mm from the apex | Point Wd at 30mm from the apex | Point Th at 10mm from the apex | Distal angle | Active edge Lg |
|---|---|---|---|---|---|---|---|---|---|---|
| PM0414 | 91 | – | 16.2 | 12.7 | – | – | – | – | 81°–92° | 6 |
| PM0468 | 107.8 | 109.8 | 13.5 | 9.5 | 4.6 | 3.3 | >11.6, <13 | 6.3 | Tip broken | – |
| PM0617 | 59.9 | – | 7.2 | 3.8 | – | – | – | – | Tip broken | – |
| PM0661 | 62.5 | 64 | 7 | 3.7 | 3.8 | 3 | 6.7 | 3.5 | Tip broken | – |
| PM0658 | 49.7 | – | 10.5 | 4.7 | – | – | – | – | Tip broken | – |
| PM0700 | 67 | – | 10.1 | 6.8 | 4.5 | 4.5 | 7 | 6.1 | 95° | – |
| PM0717 | 53.9 | 56.9 | 10.4 | 4.6 | 3.8 | 3.5 | 9 | 4.2 | Tip broken | – |
| PM0767 | 59 | – | 7.2 | 3.2 | 3.5 | 3.3 | 4.8 | 4.2 | Tip rounded | – |
| PM0785 | 129.7 | – | 23.4 | 18.3 | – | – | – | – | 95°–103° | 9 |
| PM0928 | 49.8 | – | >9, <9.4 | <10 | – | – | – | – | – | – |
| PM0798 | 68.8 | – | 11.7 | 2.6 | 3.9 | 2.9 | 8 | 3.7 | Tip rounded | – |
| PM0800 | Object shattered, not measured | | | | | | | | | |
| PM0805 | 47.7 | – | 7.6 | 4.3 | – | – | – | – | – | – |
| PM0810 | 28.4 | – | 5 | 3.3 | – | – | – | – | – | – |
| PM0835 | 100.9 | – | 5.8 | 3.7 | – | – | – | – | – | – |
| PM0930 | 106.8 | – | 40.4 | 9.5 | – | – | – | – | – | – |
| PM0854 | 59.3 | – | 5.7 | 3.7 | 2.5 | 1.9 | 5.5 | 3.4 | 63° | – |
| PM0865 | 170 | – | 8.7 | 6.4 | 4.8 | 3.3 | 6 | 4.3 | Natural tip | – |
| PM0929 | 234 | – | 14.6 | 32 | – | – | – | – | – | – |
| Bone 167 | 31.7 | – | 22.3 | 10 | – | – | – | – | – | – |

Tab. V.3.A4 PMZ bone tools: blanks and position of modifications by shaping and resharpening on the tools. On the split surface of the long bone fragments, the medullary cavity is not worked unless noted otherwise (R. Christidou)

| PMZ number | Blank | Shaping/Resharpening | |
|---|---|---|---|
| | | **Position** | **Technique** |
| PM0414 | Tibia broken across the shaft | *Shaping*. Distal inferior and left faces: approx. 35mm; distal superior face: nearly completely crusted, length worked undetermined | Scraping |
| PM0468 | Splinter | *Shaping*. Circumference: nearly covering | Grinding |
| PM0617 | Splinter | *Resharpening*. Distal circumference: approx. 10–12mm | Grinding |
| | | *Shaping*.<br>Inferior face, lateral edges: covering; distal superior face: 25.7mm<br>Proximal inferior face: approx. 35–38mm; proximal lateral edges: approx. 31.3mm; proximal superior face: approx. 7mm | Scraping<br>Grinding |
| PM0661 | Linear frag. | *Shaping.* | Not recorded |
| PM0658 | Linear frag. | *Shaping*.<br>Proximal 23.2mm of the tool surface completely crusted, not observable<br>Distal inferior face, distal lateral edges<br>Distal lateral edges | Undetermined<br>Scraping<br>Grinding |
| PM0700 | Metapodial quarter | *Resharpening*. Distal circumference: approx. 15–29.3mm (superior face, lateral edges: approx. 15–17mm; inferior face: approx. 25–29.3mm) | Grinding |
| | | *Shaping.*<br>Inferior face including the medullary cavity; lateral edges; superior face<br>Left side of inferior face: distal 31.8–48.3mm, right side: distal 29.3–37mm; left edge: distal 25–46mm; right edge: distal 37.9mm–base | Scraping<br>Grinding |
| PM0717 | Splinter | *Resharpening*. Distal circumference: approx. 11.3–17.5mm (inferior/right: 13.3–15.5mm; superior/left: 11.3–17.5mm) | Scraping, grinding |
| | | *Shaping.*<br>Inferior face including the distal half of the medullary cavity; lateral edges; superior face<br>Right edge: distal 17–24.5mm<br>Inferior face: approx. 31mm between point and metaphysis at the base | Scraping<br>Thick shavings<br>Grinding |
| PM0767 | Linear frag. | *Shaping*.<br>Circumference: nearly covering<br>Distal circumference: approx. 14.5–16.2mm; right side of proximal inferior face: approx. 8mm | Scraping<br>Grinding |

Tab. V.3.A4 (continued)

| PMZ number | Blank | Shaping/Resharpening | |
|---|---|---|---|
| | | **Position** | **Technique** |
| PM0785 | Tibia broken across the shaft | *Resharpening*. Distal inferior margin | Grinding |
| | | *Shaping.*<br>Distal inferior side: approx. 85mm; distal right side: approx. 72mm; distal left side: approx. 61mm; distal superior side: approx. 54mm<br>Inferior face, distal 30–64mm; superior face: distal 3–17.5mm; base: upper relief of the articular surface of the bone | Scraping<br>Grinding |
| PM0928 | Tibia quarter | *Shaping.*<br>Proximal lateral faces: approx. 28mm, non-crusted areas<br>Tool shaft: non-crusted areas on inferior face and lateral edges | Grinding<br>Scraping |
| PM0798 | Splinter | *Shaping*. Inferior face, lateral edges | Scraping |
| PM0800 | Pig incisor | *Shaping*. | Grinding |
| PM0805 | Linear frag. | *Shaping*.<br>Proximal 17.5 (superior side)–22.6mm (inferior) chewed, shaping marks damaged<br>Distal left side of the inferior face; distal left edge: approx. 11.5–27.7mm; distal superior face<br>Distal circumference: nearly covering | Undetermined<br>Scraping<br>Grinding |
| PM0810 | Linear frag. | *Shaping*. Inferior, superior and left sides: covering | Grinding |
| PM0835 | Metapodial half | *Shaping.*<br>Distal left face: approx. 77.5mm; distal right face: approx. 44.5mm<br>Inferior face: covering; proximal lateral sides: approx. 65.5mm | Grinding<br>Scraping |
| PM0930 | Rib body | – | – |
| PM0854 | Pig fibula | *Shaping*. Distal circumference: approx. 44mm | Scraping |
| PM0865 | Rib body | *Shaping*. Proximal perforation | Semicircular strokes |
| Bone 167 | Anterior face (uppermost relief) and posterior face of the bone. Work done during the reduction phase | | Grinding |

Tab. V.3.A5 PMZ bone tools: presence, extent and development of use modifications, tool motion and worked material (R. Christidou)

| PMZ number | Used | Distal wear extent/development | Major use modification | Motion | Worked material |
|---|---|---|---|---|---|
| PM0414 | Yes | Invasive/gradual | Flaking, polishing | Transverse | Plant |
| PM0468 | Yes | Invasive/gradual | Polishing | – | Soft/animal |
| PM0617 | Yes | Invasive/gradual | Polishing | Rotary | Soft/animal |
| PM0661 | Not analysed | – | – | – | – |
| PM0658 | Yes | Invasive/gradual | Polishing | Rotary | Soft/animal |
| PM0700 | Yes | Invasive/gradual | Crushing, polishing | Rotary | Soft/animal |
| PM0717 | Yes | Invasive/gradual | Polishing | Rotary | Soft/animal |
| PM0767 | Yes | Invasive | Fracture, polishing | – | Plant |
| PM0785 | Yes | Short/gradual | Polishing | Transverse | Soft/animal |
| PM0928 | Not analysed | – | – | – | – |
| PM0798 | Yes | Invasive/gradual | Fracture, polishing | Undetermined | Soft |
| PM0800 | Not analysed | – | – | – | – |
| PM0805 | Yes | Undetermined | Polishing | Undetermined | Undetermined* |
| PM0810 | Yes | Probably invasive/undetermined | Polishing | Undetermined | Plant |
| PM0835 | Yes | Undetermined** | Polishing | Undetermined (complex?) | Soft/plant |
| PM0930 | Yes | External face of the rib | Polishing | Transverse | Mineral |
| PM0854 | Yes | Invasive/gradual | Crushing, polishing | Complex | Soft/plant |
| PM0865 | Yes | Covering/discontinuous | Polishing | Complex | Plant |
| PM0929 | – | – | – | – | – |
| Bone 167 | – | – | – | – | – |

* Wear from contact with soft animal material not related to activity; ** invasive or covering

## V.4. Clay Spinning and Weaving Implements

*Christopher Britsch*

### V.4.1. Introduction

Early interest in the function of ancient textile production in Greece is already visible in the 1913 publication by H. Ling-Roth.[595] The paper mainly focuses on ancient looms and weaving technologies and covers artefacts and pictorial sources, as well as written evidence. Ancient Greek spinning techniques, as well as those of the Near East and Egypt, were later discussed in further detail by Grace M. Crowfoot.[596] The first accounts on Neolithic textile production in Greece can be found in Gill Carrington Smith's dissertation from 1977.[597] The most comprehensive study of prehistoric and ancient Greek textile production, as for many other countries and regions, was the famous publication by Elizabeth W. Barber in 1991.[598] The book contains both presentations of artefacts from different sites and a detailed discussion of textile technologies, which are still referred to in current studies.

Around this time, textile tools were featured with increasing frequency in publications on different excavations.[599] A large increase in recognition as well as general publication of textile tools can be noticed after the studies of the Centre for Textile Research (CTR) in Copenhagen were issued. A plethora of artefact studies were published in the collective volumes of that institute.[600] However, most of these studies concern periods from the Early Bronze Age onwards and the Neolithic periods in particular are only marginally observed. Nevertheless, the common presence of spindle whorls and loom weights during the Neolithic in Greece proves that textile production was certainly a part of daily life. However, the small number of artefacts and other evidence make the interpretation of the role of textile production and the social standing of textile workers problematic. This notwithstanding, each individual artefact can at least offer an insight into the presence and variety of Greek Neolithic textile production. It is therefore vital to present and discuss these tools in detail, for the record on Neolithic textile production can only deliver important insights if it grows.

The textile tools of Neolithic PMZ are an ideal example for establishing a record. The reprocessing of the excavation data by Giorgos Toufexis and Christos Batzelas delivers a much-needed foundation upon which to base our understanding of social and economic process. The very exact structuring of the old excavation layers and the clear layering resulting from this, allows us to demonstrate easily the conditions and developments of the available Neolithic textile tools.

The analysis of the textile tools follows a methodology based on the experimental studies of the CTR. The studies of the CTR demonstrated that the main factors influencing the spinning and weaving processes are the width and the weight of the textile tools.[601] The tests showed that – next to the spinner's abilities – the weight of the spindle whorl is the main predictor for the yarn thickness and strength. It is therefore possible to determine a frame of possibility, how thick and strong a yarn made with a certain spindle whorl could have been. The strength of the yarn gives information about the so-called 'warp-tension'. The 'warp-tension' is the physical force that is needed to pull a thread down straight, without tearing it apart. The term derives from the terminology used for warp-weighted looms. A warp-weighted loom is a type of loom on which threads are hung on

595 Ling-Roth 1913.
596 Crowfoot 1931; Crowfoot 1937.
597 Carrington Smith 1977.
598 Barber 1991.
599 See, e.g., Weißhaar 1989; Christmann 1996; Elster 2003c.
600 See, e.g., Siennicka 2012; Spantidaki – Moulhérat 2012; Bruun-Lundgren et al. 2015; Militello et al. 2015; Papadopoulou et al. 2015; Rahmstorf et al. 2015; Tournavitou et al. 2015; Tzachili et al. 2015.
601 Andersson et al. 2008; Mårtensson et al. 2009.

a horizontal wooden beam which is supported by a wooden structure or a wall.[602] The vertically hanging threads on the loom are called warp threads. Loom weights are attached to these threads to pull them straight, for which reason the loom is called 'warp-weighted' and the force needed to pull down the threads 'warp-tension'. This means it is possible, by estimating the potential thickness of a yarn – and thereby its strength –, to know how much force had to be applied to pull the threads straight. Therefore, the mass of a loom weight can give information on how many threads had to be fastened on said loom weight to give optimal conditions for weaving. The width of the loom weight gives additional information about how many loom weights were hung next to each other on a certain loom set-up. However, more importantly, the loom weight width allows us to calculate how close to each other the warp threads were hung on the loom. This, in turn, informs about the general structure of the weave and the potentially applied weaving techniques.

This short excursion on the functionality of textile tools demonstrates how relevant a detailed recording of such tools is and how much insight into technology it can yield. This furthermore outlines the necessity of the analyses here presented, in order to fully comprehend the modus operandi of Neolithic textile workers in general. To understand the choices, possibilities, actions and developments of prehistoric textile production at PMZ, first short definitions and explanations of the artefact terminologies used will be given. The artefacts will then be described in detail, in reference to the respective settlement layers they derived from. Furthermore, if possible, a short description of the spatial situation they were found in will be given, as well as a short preliminary discussion and/or interpretation. The results of these chapters and their intermediary discussions will then be collectively evaluated in the final section of this chapter, which tries to give an impression of the developments of textile production at PMZ.

### V.4.2. Artefact Categories

Textile tools can be tricky to identify and define. This is mainly due to the fact that 'nothing special' is needed to work either as a spindle whorl or loom weight. A spindle whorl, technically speaking, is a swing weight. This means its function is to keep an oscillating movement going by supplying an additional moment of inertia to the spindle. This purpose can, theoretically, be accomplished by any rotationally symmetrical object with a hole in its centre. This leads to two artefact categories that can cause difficulties in identification of an item as a spindle whorl: beads and pierced recycled pottery sherds. Beads are, in most cases, relatively easy to distinguish from spindle whorls. Spindle whorls usually have very typical abrasions around the holes, different to those on beads, which usually makes it possible to determine if an object was used as a bead or as a spindle whorl. This, of course, mainly concerns clay beads. Small disc beads made from bone or stone can be excluded anyhow, due to their petite nature. Pierced and often rounded recycled pottery sherds are another matter, however. These objects appear from the Neolithic onwards and their purpose is still under discussion. In a paper concerning the finds of the western Anatolian tell settlement Çukuriçi Höyük, it was argued that these objects could have been weights for still nets.[603] However, in other cases these artefacts are interpreted as potential drilling supports or net sinkers, but also as spindle whorls.[604] As already mentioned, the main requirement for a spindle whorl is to be a rotationally symmetrical and pierced object. While it can be argued that most pierced sherds are not as rotationally symmetrical as the typical spindle whorls, it has to be admitted that they come very close to it. Thus, the possibility that pierced, rounded, recycled pottery sherds have been used as spindle whorls cannot be neglected. These objects will therefore also be taken into account as potential spinning tools in the current study. To clarify the difference

[602] See, e.g., depictions in Crowfoot 1937.
[603] Britsch – Horejs 2014.
[604] See, e.g., Blegen et al. 1950; Sharp Joukowsky 1986; Hochstetter 1987; Obladen-Kauder 1996; Strommenger – Miglus 2010.

from specially produced spindle whorls, however, they were recorded and will be presented as an individual category.

The identification of loom weights is even more problematic, as regards excluding certain objects. As a matter of fact, any object that can be fastened to threads in any way could technically be a loom weight. The main importance lies in the reproducibility of the objects. A loom set-up can easily include 50 or more loom weights. To achieve an optimal set-up, each loom weight should weigh about the same. Therefore, a loom weight should be shaped in a way that allows simple reproduction and comparison to other objects. However, two problems arise with this approach. Firstly, in many cases only small numbers or even individual loom weights are found at archaeological sites. Secondly, certain loom weight types – which are securely confirmed as such tools – have rather complex shapes. Good examples for this are the pyramidal or crescent loom weight shapes appearing during the Early Bronze Age in Greece.[605] Thus the classification of loom weights often has to be made with reference to other sites, regions or even periods, in which these artefacts could be securely identified.

The exact definition for each tool category, as it is used in the current paper, will be given in the following paragraphs. It should be noted that these definitions are only given for the reader's benefit and do not constitute a general definition of the terms.

*Spindle Whorls*

Spindle whorls are rotationally symmetrical objects with a hole running vertically through their centre. Typical materials for the manufacturing of a spindle whorl are clay, stone and bone. Furthermore, a spindle whorl is a tool made specifically for its task, not made from recycled material. If a spindle whorl has been used, abrasions will be visible around the holes. Decoration on a spindle whorl can occur, mostly in the form of incisions, but does not, however, influence the technical definition. In place of spindle whorl, the word 'whorl' can also be used on its own.

*Pierced Sherds*

Pierced sherds are made from recycled pottery sherds. These are chipped into a roughly round shape and then the verges are further rounded and smoothed by abrasion. Additionally, a hole is drilled through the short, vertical axis, roughly through the centre of the object. Thus, the correct definition would be: 'pierced and rounded recycled pottery sherd with smoothed verges'. For ease of reading, the shortened term 'pierced sherd' will be used in the current paper. This is also due to the fact that certain minor differences between such pierced sherds can occur. Sometimes the verges are not completely smoothed or rounded, and in rare cases they are not rounded at all, only chipped. The hole is mostly drilled from both sides, meeting roughly in the middle, creating an hourglass shape. However, this is also not a hard and fast rule. The current paper only applies the term pierced sherd to objects which are fully pierced and at least partially made into a round shape which could enable them to be used as spindle whorls.

*Loom Weights*

As already described above, loom weights are objects that are hung on several threads on a loom. Thus, such objects can theoretically be made from any material and turned into any shape. Typically, however, loom weights are made from burned or unburned clay and turned into reproducible shapes, which allows the manufacturing of multiple similarly heavy weights. However, this definition would be applicable to any kind of weight. Therefore, the current study only defines as loom weights objects for which evidence exists that either proves or indicates their use as a loom

[605] See Britsch 2018; Britsch in press.

weight. This can, for example, be the find situation: in some cases loom weights are found lying in two rows of roughly equal number. This indicates that the weights were used on a warp-weighted loom. If such evidence exists, even if it is at another archaeological site, the current study accepts this as an indicator of these objects'/shapes' use. While this definition may reduce the number of potential loom weights, the benefit of only referring to quite securely identified objects as loom weights is seen as being more relevant.

### V.4.3. Textile Tools by Phases[606]

*Building Phase II*

Artefacts

*PM0876*. Fig. V.4.1. Pierced sherd. Clay: ext. beige brown, core dark grey, int. whitish grey, mid-fine pores, slightly micaceous. Diam. 5.39cm; H 1.04cm; hole ø ~0.44cm; weight 34g; preserved 100%. Object is not fully pierced, possibly an interim product; verges not rounded or smoothed.

*PM0882*. Fig. V.4.2. Pierced disc. Clay: ext. pinkish grey, fine pores, fine mineral inclusions, very strongly micaceous. Surface: ext. polished. Diam. 4.12cm; H 0.71cm; hole ø 0.49cm; weight 14.7g; preserved 100%. Hole asymmetrically drilled.

*PM0886*. Fig. V.4.3. Pierced disc. Clay: reddish to pinkish and slightly greyish, fine pores, fine mineral inclusions, strongly micaceous. Surface: ext. polished. Diam. 5.83cm; H 0.53cm; hole ø 0.45cm; weight 13.6g; preserved 50%.

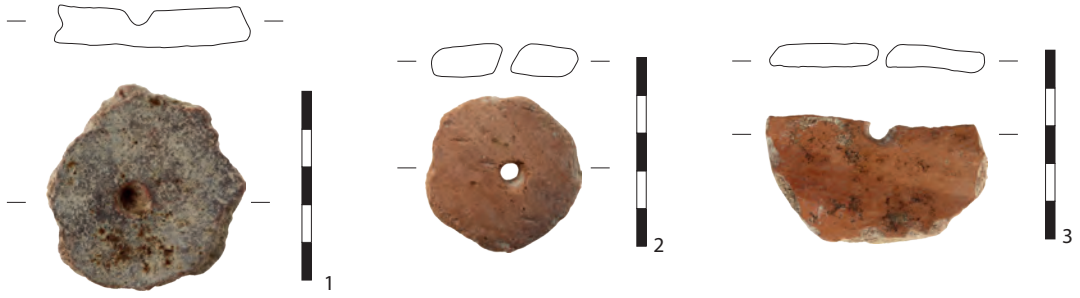



Fig. V.4.1–3 Pierced sherds: (1) PM0876, (2) PM0882, (3) PM0886 from BPh II (MN I)
(photos: K.-V. von Eickstett, drawings: C. Britsch)

Context
All three pierced sherds of BPh II were found in the deposit above the fill of the PMZ I ditch, together with a large variety of other small finds. The layers all belong to the earliest Middle Neolithic Ceramic Horizon 1. However, no other architectural or spatial specifications can be given.

Interpretation
Whether or not the object PM0876 was meant to be a fully pierced sherd is difficult to tell. Such half-pierced objects appear regularly at prehistoric sites.[607] It is possible that, given the slightly

off-centre position of the hole, the object was abandoned during production and thus ended up as a half-finished product. However, alternative explanations, for example use as a drill support, are just as possible.

Regarding the other two objects from this phase (PM0882 and PM0886), it was already discussed above that the use of pierced sherds is not absolutely clear. Considering the weight, both tools could certainly have been used as spindle whorls. According to the spinning experiments of the CTR,[608] PM0882 would have spun yarn of 0.4–0.5mm thickness and PM0886 of about 0.7–0.8mm. The second estimate is not secure, since the experiments did not include a similarly sized whorl. However, the results of the experiments allow deduction of the approximate yarn thickness.

Since there is no further information to be gained from the spatial analysis, it cannot be stated securely if these pierced sherds were used as spindle whorls.

### *Building Subphase IIIc*

#### Artefact

*PM0960*. Fig. V.4.4. Pierced disc. Clay: ext. slightly reddish brown, int. reddish brown, fine mineral inclusions and strongly micaceous. Diam. 4.33cm; H 0.49cm; hole ø 0.50cm; weight 6.95g; preserved 40%.

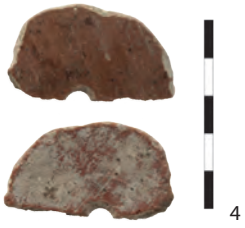



Fig. V.4.4 Pierced sherd PM0960 from BSPh IIIc (MN I)
(photos: K.-V. von Eickstett)

#### Context

The pierced sherd PM0960 derived from a layer directly above the activity area SU 174. The layer was mixed with bones, building materials and a lot of pottery, as well as multiple other small finds. The high number of bone tools in particular is noteworthy.[609] It can therefore be rather safely assumed, that the pierced sherd was actively used as a tool and discarded when broken.

#### Interpretation

The spatial situation clearly indicates that the pierced sherd was in use as a tool of some kind. The fact that it is the only such object in BSPh IIIc can be seen as an indicator that the activity the tool was used in only required a solitary piece. This speaks against use as, for example, a net sinker, since several similarly sized objects would have been necessary. The combination with several bone tools in the same SU could be an indicator for a use in textile production. Though it cannot be completely excluded that the pierced sherd was used as something else – e.g. a pendant, a toy, etc. –, the use of this particular piece as a spindle whorl can be considered distinctly possible.

[609] One of them, the awl PM0798, was probably used for textile production; see Christidou, this volume, 363–364, 378, 384.

*Building Subphase IVb*

Artefact

*PM0919*. Fig. V.4.5 Pierced sherd. Clay: ext. beige reddish brown, core grey brown to dark grey, int. reddish brown, fine pores and very fine mineral inclusions, very strongly micaceous. Diam. 3.79cm; H 0.71cm; hole ø 0.43cm; weight 10.0g; preserved 75%.

Fig. V.4.5 Pierced sherd PM0919 from BSPh IVb (MN I)
(photos: K.-V. von Eickstett)

Context
PM0919 derived from a layer in between the two activity areas SU 52 and SU 61 mixed with charcoal and anthropogenic material. No other small finds were found in this layer.

Interpretation
Compared to other such objects, PM0919 is rather well and accurately produced. The context is, however, difficult to interpret. While the situation in between two activity areas speaks in favour of use as a solitary tool (see above regarding PM0960), the respective activity areas (SU 52 and SU 61) feature no tools that indicate textile production. As for PM0960, it is possible that the tool was used as a spindle whorl; however, it cannot be completely clarified.

*Building Subphase Va*

Artefact

*PM0765*. Fig. V.4.6. Pierced sherd. Clay: ext. reddish grey brown, int. grey brown, fine to mid-fine pores, fine mineral inclusions, strongly micaceous. Diam. 5.41cm; H 1.01cm; hole ø 0.85cm; weight 33.7g; preserved 85%. Slightly oval shaped and hole not in centre.

Fig. V.4.6 Pierced sherd PM0765, from BSPh Va (MN II)
(photos: K.-V. von Eickstett, drawing: C. Britsch)

Context
The pierced sherd PM0765 derived from a layer directly above activity area SU 76. The layer itself features bones, building materials and a lot of pottery, but no other small finds. Both the layer the tool was found in and the activity area below contain traces of burning. No other contextual information is available.

Interpretation
Though it is possible that the object was used as a spindle whorl, it is rather unlikely. The hole is comparatively large and off-centre. Furthermore, the sherd is oval shaped, making it not rotationally symmetrical. While this pierced sherd could have functioned as a spindle whorl, it would not have provided very good conditions of use. Since the context of the find does not offer any further indications for the use of this tool, it has to remain unclear what task the pierced sherd was made for. However, use as a textile tool is unlikely.

### *Building Subphase Vb*

Artefact

*PM0933*. Fig. V.4.7. Pierced sherd. Clay: ext. and int. reddish brown, int. slightly brighter, fine mineral inclusions, slightly micaceous. Diam. 4.00cm; H 0.76cm; hole ø –; weight 6.90g; preserved 40%. Seems asymmetrical.

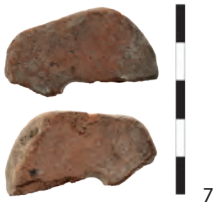



Fig. V.4.7 Pierced sherd PM0933 from BSPh Vb (MN II)
(photos: K.-V. von Eickstett)

Context
The layer PM0933 derived from also included several other small finds, most of them ground stone tools. This layer was further positioned between two activity areas, SU 85 and SU 92. Both activity areas also contained several other small finds, yet SU 85 contained more ground stone tools.

Interpretation
As for PM0765, it seems unlikely that the pierced sherd PM0933 was used as a spindle whorl. The tool seems asymmetrical, which, however, has to be stated with care, since more than 50% of the pierced sherd is missing. Furthermore, neither the layer itself nor the adjacent activity areas offer any indications of textile production in these areas. Though it cannot be completely disproven, the use of PM0933 as a spindle whorl is unlikely.

### *Building Subphase Vd*

Artefacts

*PM0739*. Fig. V.4.8. Pierced sherd. Clay: ext. beige brown to dark grey, core reddish brown to grey, int. reddish brown, mid-fine pores, fine mineral inclusions, very strongly micaceous. Diam. 6.46cm; H 1.03cm; hole ø 0.53cm; weight 43.5g; preserved 98%.

*PM0939*. Fig. V.4.9. Pierced sherd. Clay: ext. and int. slightly reddish brown, fine mineral inclusions, strongly micaceous. Surface: slipped. Diam. 4.12cm; H 0.75cm; hole ø –; weight 10.25g; preserved ~25%.

Fig. V.4.8–9 Pierced sherds: (8) PM0739, (9) PM0939 from BSPh Vd (MN II)
(photos: K.-V. von Eickstett, drawing: C. Britsch)

Context
The pierced sherd PM0739 derived from the activity layer SU 101 and PM0939 from a deposit between activity areas SU 101 and SU 108. The two pierced sherds therefore did not derive directly from the same layer, but are spatially related. Both the activity area SU 101 and the deposit contained several other small finds, most of them stone tools.

Interpretation
Both pierced sherds could have been used as spindle whorls. The slightly asymmetrical shape of PM0739 should not have been too great an obstruction. Also interesting is the fact that the reconstructed weight for both objects would have been very similar (PM0739 = 44.38g; PM0939 ≈ 41g). This could be a further hint to their usage. If the two objects were used as spindle whorls, this would demonstrate that, during BSPh Vb, textile workers produced spindle whorls in relatively exact measure. This would, in turn, proclaim a very sensible handling of textile tools. However, one must also always consider alternative functions. It has already been mentioned that such pierced sherds could also have been used as net sinkers.[610] Therefore, the very similar weight could result from the need to have net sinkers of a similar weight on a fishing net. Since the accompanying finds from the layers do not offer any conclusion for either hypothesis, it cannot be completely clarified. However, it can be stated that use as a spindle whorl is very possible and furthermore, if so, they were produced in a very controlled fashion.

### *Building Subphase Ve*

Artefact

*PM0718.* Fig. V.4.10. Pierced sherd. Clay: ext. and int. slightly reddish brown, fine mineral inclusions, slip cover, strongly micaceous. Diam. 4.22cm; H 0.95cm; hole ø 0.50cm; weight 15.5g; preserved 96%.

Fig. V.4.10 Pierced sherd PM0718 from BSPh Ve (MN II)
(photos: K.-V. von Eickstett, drawing: C. Britsch)

[610] See above, 402.

Context
The pierced sherd PM0718 derived from the activity area SU 108. This activity area included several other small finds, all of them, however, stone tools (ground stone and chipped stone).

Interpretation
The finding of the pierced sherd in an activity area without other objects of a similar weight could indicate that the object was used in an action that needed a solitary tool, such as spinning. However, the fact that no other textile tools were found accompanying the pierced sherd challenges this interpretation. Nonetheless, the possibility that this pierced sherd was used as a spindle whorl is given.

### *Building Subphase VIa*

Artefact

*PM0993*. Fig. V.4.11. Pierced sherd. Clay: 5YR 5/1 grey, medium coarse, well sorted, many fine silver mica and small white inclusions. Surface: ext. 5YR 7/3 pink slip, burnished, int. 5YR 7/1 light grey, burnished. Diam. 4.50cm; H 0.70cm; hole ø –; weight 6g; preserved 50%. Oval shape, slightly irregular rim.

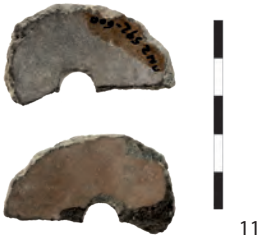



Fig. V.4.11 Pierced sherd PM0993 from BSPh VIa (MN III)
(photos: K.-V. von Eickstett)

Context
The pierced sherd PM0993 derived from a deposit below activity area SU 122 (SU 121). The layer was rich in pottery and burnt clay and also included several other small finds, most of which were stone tools. However, a figurine head, a sling bullet and a bone awl[611] were also found in the same layer.

Interpretation
Since only 50% of the tool is preserved, it is not absolutely clear what the original shape looked like. However, the placement of the hole and the curve of the rims suggest a slightly irregular oval shape. This makes the object rather impractical for use as a spindle whorl. Nevertheless, the connection with a bone awl in the same layer could be an indicator for textile production. The identification of this particular pierced sherd as a spindle whorl therefore has to at least be seen as possible.

[611] PM0658, a bone awl used for perforating hides, see Christidou, this volume, 366.

*Building Subphase VIb*

## Artefacts

*PM0650*. Fig. V.4.12. Pierced sherd. Clay: ext. beige brown to grey, int. reddish to dark grey, fine pores, fine mineral inclusions. Diam. 3.90cm; H 0.73cm; hole ø 0.30cm; weight 10.3g; preserved 100%. Sherd is not perfectly round and the verges are still rough. The hole is oblique.

*PM1017*. Fig. V.4.13. Pierced sherd. Clay: 7.5YR N6/ grey, 5%, very well sorted, many fine sparkling and many small white inclusions. Surface: int. and ext. 7.5YR N6/ grey (interior slightly darker), burnished. Diam. 5.20cm; H 0.70cm; hole ø –; weight 11.0g; preserved 55%. Slightly irregular shape, crudely made.

Fig. V.4.12–13 Pierced sherds (12) PM0650 and (13) PM1017 from BSPh VIb (MN III)
(photos: K.-V. von Eickstett, drawing: C. Britsch)

### Context

PM0650 was found in the activity area SU 122, together with a chipped stone tool, a ground stone tool and a figurine. However, no other finds or features are mentioned regarding activity area SU 122. PM1017 derived from a deposit (SU 126) above activity area SU 122 and below activity area SU 127. This deposit contained a lot of pottery and small finds, among which were a clay hook and a sling bullet, chipped and ground stone tools, but also clay beads, several figurine parts, shell pendants and several rounded sherds.

### Interpretation

As mentioned in the notes on the artefact, the crudely made verges and, in particular, the strongly oblique hole make it very unlikely that the tool was used as a spindle whorl. The possibility cannot be completely excluded since it might still be possible to use this pierced sherd as such. However, since the context could also offer no further insights, it has to be considered rather unlikely that the pierced sherd PM0650 was used as a spindle whorl. The mixture of small finds in SU 126 on the other hand – containing several artefacts with a potentially representative function (beads, pendants, figurines) – gives the deposit an interesting character. One could suggest that an overproportional number of artistic objects were connected with the deposit, which could very well include tools for textile production. Thus, the interpretation as a spindle whorl for PM1017 seems rather likely.

*Building Subphase VIIa*

## Artefacts

*PM1011*. Fig. V.4.14. Pierced sherd. Clay: 2.5YR 6/6 light red, upper part light grey, 2.5%, very well sorted, many sparkling and small white inclusions. Surface: ext. 2.5YR 5/6 red, burnished, int. 2.5YR 6/6 light red, unfinished. Diam. 4.30cm; H 0.55cm; hole ø –; weight 7.00g; preserved 50%. Rims not rounded, otherwise well made.

*PM1023*. Fig. V.4.15. Loom weight, discoid. Clay: 5YR 6/4–6/6 light reddish brown to reddish yellow, 15%, moderately sorted, very many small and few large white inclusions, sparkling inclusions, pores. Surface: 5YR 6/4–6/6 light reddish brown to reddish yellow, both sides smoothed, one side just moderately. Diam. 3.80cm; H 2.00cm; hole ø –; weight 46.6g; preserved 25%. Well-produced object, seemingly symmetrical, although difficult to tell because of fragmentary state.

Fig. V.4.14–15 Pierced sherd (14) PM1011 and loom weight (15) PM1023 from BSPh VIIa (transition MN III–LN I) (photos: K.-V. von Eickstett, drawing: C. Britsch)

### Context

The pierced sherd PM1011 was found in an activity layer (SU 127) containing several other small finds. These included several chipped stone tools and clay objects, as well as a ground stone tool, a sling bullet, a bipoint of bone,[612] a figurine fragment and a bronze fragment. Directly above SU 127 was SU 132 which included the loom weight PM1023, as well as several chipped and ground stone tools and figurine fragments.

### Interpretation

It is fairly likely, that the pierced sherd PM1011 was used as a spindle whorl. The rather symmetrical shape would have facilitated easy use of the tool. However, the fact that the rim was not well rounded seems odd. The surroundings also offer no clear indications. A hint, however, could be PM1023 which was found in close proximity to it. Though it was found in another layer (SU 132), SU 127 lay directly below it. The well-made shape of PM1023 makes it entirely possible that the fragment derived from a discoid loom weight. Though it could also stem from a spindle whorl, the rather high weight speaks against this. Even the fragment weighs 46.6g, which would mean the former tool must have weighed about 185g. In any case, it can be stated that it is highly likely that PM1023 was used in textile production.

[612] PM0617, see Christidou, this volume, 363.

*Building Subphase VIIc*

## Artefacts

*PM0456*. Fig. V.4.16. Loom weight, discoid. Clay: beige brown to grey, fine to mid-fine pores, strongly micaceous. Diam. 6.56cm; H 2.68cm; hole ø 0.41cm; weight 128g; preserved 100%. Very small hole compared to artefact's size.

*PM0478*. Fig. V.4.17. Spindle whorl, biconical. Clay: reddish beige brown, fine pores, fine mineral inclusions, strongly micaceous. Diam. 5.13cm; H 3.69cm; hole ø 1.06cm; weight 74.0g; preserved 98%.

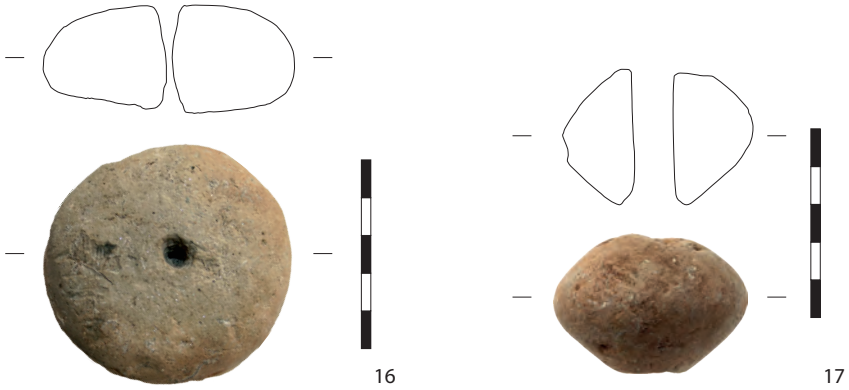



Fig. V.4.16–17 Loom weight (16) PM0456 and spindle whorl (17) PM0478 from BSPh VIIc (LN I) (photos: K.-V. von Eickstett, drawings: C. Britsch)

### Context

Both artefacts derived from layers rich in small finds. Moreover, the two layers were spatially related. PM0478 was found in activity area SU 142 and PM0456 in a deposit between SU 142 and another activity area (SU 153). Interestingly, in both the activity area SU 142 and the deposit layer, several rounded but unpierced sherds were found. Otherwise the majority of small finds mainly consists of stone tools.

### Interpretation

Both the identification of the loom weight and the spindle whorl is very secure. Both shapes occur in large numbers at different prehistoric sites.[613] The spindle whorl PM0478 is relatively heavy, but still perfectly usable. Interestingly, however, it is far heavier than the pierced sherds from earlier phases, which were considered potential spindle whorls. Also, the hole is relatively large compared to these pierced sherds, but also compared to other contemporary spindle whorls. Nonetheless, both the shape and the spatially close connection to the loom weight PM0456, definitely allow identification as a spindle whorl.

PM0478 is comparable in shape and size to other discoid loom weights from Greece, the Aegean or Bulgaria, confirming the identification.

Very interesting is also the presence of several rounded, unpierced sherds among the finds. A connection between these find categories must therefore be considered. The unpierced, rounded sherds could technically be interim products for pierced sherds, which, in turn, could have been intended for spindle whorls. However, the large number of these potential interim products, with not a single finished pierced sherd nearby casts this assumption into question. These circumstances will be interpreted in the final discussion considering finds from all phases.

[613] Britsch in press, figs. 18, 35.

*Building Phase VIII*

## Artefacts

*PM0347*. Fig. V.4.18. Loom weight, spool-shaped. Clay: dark grey, fine pores, fine and mid-fine mineral inclusions, very little mica. Diam. 1.86/2.88cm; H 4.07cm; hole ø 0.29cm; weight 32.1g; preserved 98%.

*PM0348*. Fig. V.4.19. Spindle whorl, conical. Clay: slightly greenish dark grey, mid-fine to medium coarse mineral inclusions, mid-coarse pores. Surface partially smoothed. Diam. 5.66cm; H 2.77cm; hole ø 1.01cm; weight 96.9g; preserved 98%.

*PM0377*. Fig. V.4.20. Loom weight, discoid. Clay: light reddish to pinkish, fine to mid-fine pores, very strongly micaceous. Diam. 7.83 cm; H 1.42cm; hole ø 1.92cm; weight 74.5g; preserved 85%. Identification not secure.

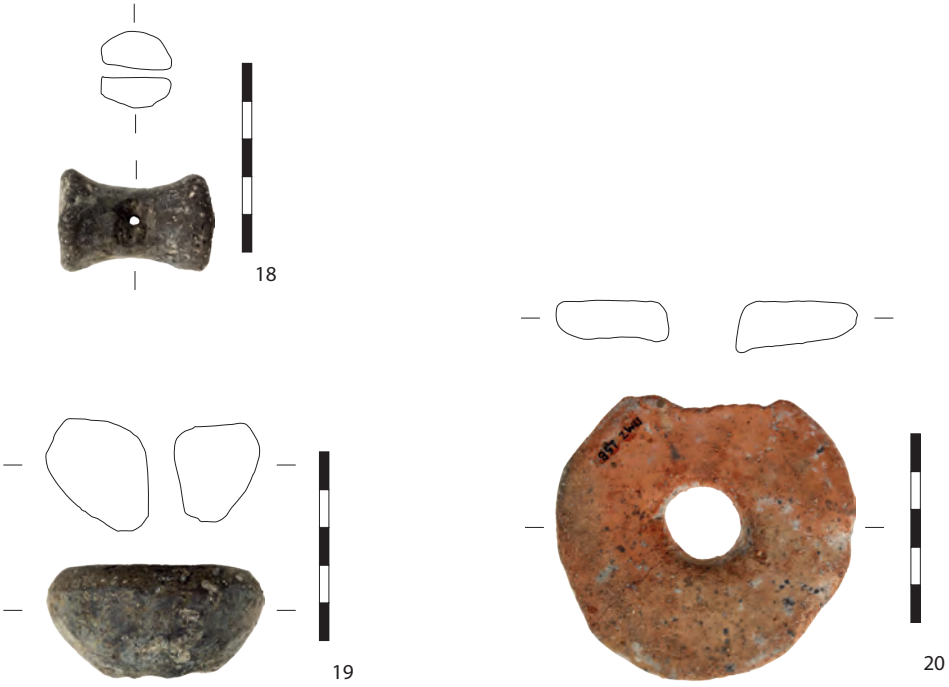



Fig. V.4.18–20 Loom weight (18) PM0347, spindle whorl (19) PM0348 and loom weight (20) PM0377, all from BPh VIII (LN I; 0348 possibly intrusive) (photos: K.-V. von Eickstett, drawings: C. Britsch)

### Context

The spindle whorl PM0348, as well as the loom weight PM0347 all derived from layers directly under the activity area SU 166. For PM0348, we have to be cautious for its date, since conical spindle whorls are an Early Bronze Age feature. Therefore, it may be intrusive. In layers SU 163 and SU 165, the only other small finds were chipped stone tools. The artefact PM0377 derived from a layer directly above activity area SU 153. This layer contained several small finds, mainly ground stone tools and chipped stone tools, but also a shell ornament and three rounded, unpierced clay discs.

### Interpretation

The identification of the loom weight PM0347 is secure. Its shape exists at several other sites and the weight and size also fits to comparable objects.[614] Slightly atypical – though not without comparative pieces – is the piercing through the mid-section of the spool-shaped loom weight

[614] Britsch in press, figs. 18, 35, 36.

PM0347. Since the warp threads were tightened around the mid-section on spool-shaped loom weights, the hole seems slightly redundant. However, it could have just been intended for providing additional security for attaching the threads. The spindle whorl PM0348 is very heavy.[615] However, this is no clear exclusion criterion, since spinning with a whorl of that size is still practical. Furthermore, whorls from other prehistoric sites appear in the same dimensions, in some cases even heavier.[616] The conical – slightly biconical – shape, the centred hole and the rotational symmetry also clearly speak in favour of an identification as a spindle whorl. The spatial relation of the three textile tools furthermore indicates textile production activities in the related activity areas SU 166.

The potential loom weight PM0377 is more problematic to interpret. While the object could generally be addressed as a discoid loom weight, the giant hole seems very atypical compared to other such loom weights.[617] As mentioned in the introduction of this paper, the identification of loom weights can be generally problematic. PM0377 could just as easily have been hung on a loom as on a fishing net or something else. To secure the identification it would be necessary to compare the object to other artefacts, either from the same or another site. Since the unusual hole does not allow this, the identification becomes vague. The context also does not give much additional information. Neither the ground stone tools, nor the chipped stone tools can be seen as indicators for textile production. Also, the shell ornament and the three rounded, unpierced sherds cannot be seen as clear indicators. It is, however, interesting that in PMZ BSPh VIIc, several rounded, unpierced sherds were also found in the same layer as a textile tool. Though this could just be a coincidence, it could also be an indicator that these rounded sherds were interim products for pierced sherds/spindle whorls. This hypothesis has to be further analysed in the final discussion. For now, the interpretation of PM0377 as a loom weight has to be stated with care.

### V.4.4. Characteristics and Development of Neolithic Textile Production at Platia Magoula Zarkou

The previous section gave detailed information about each artefact and its context. This chapter analyses and discusses all finds collectively. The aim is to detect differences and commonalities in textile tools from the pure Middle Neolithic until the early Late Neolithic at PMZ. Finally, a statement about the development of the site's textile production, as well as about the identification of its (potential) textile tools will be given.

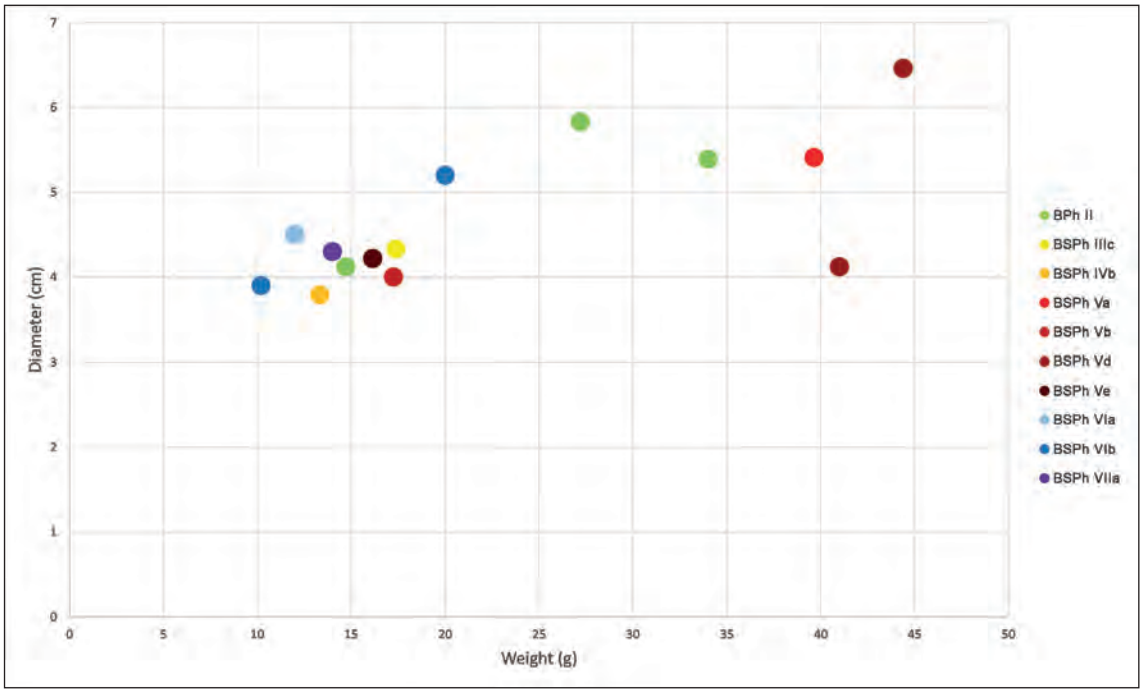
The following discussion includes a comparison of the spindle whorls and pierced sherds of the different PMZ phases (Tab. V.4.1 and V.4.2–4) and a comparison of the loom weights of the different PMZ phases (Tab. V.4.5 and V.4.6). Additionally, a comparison between the pierced and unpierced rounded sherds was made, to further explore the question of whether unpierced sherds could be interim products (Tab. V.4.7). Furthermore, an assessment of the potentially produced yarn thicknesses is given and is related to the loom weights of the respective phases to judge the possible combinations and practicability of different loom set-ups. All relevant information for these comparative approaches is given in Tabs. V.4.4 and V.4.5.

615 For their potential post-Neolithic date see above, 413.
616 See, e.g., Hood et al. 1981; Hood et al. 1982; Britsch – Horejs 2014.
617 See, e.g., Mårtensson et al. 2009; Petrova 2011; Elster et al. 2015; also see PM0456.

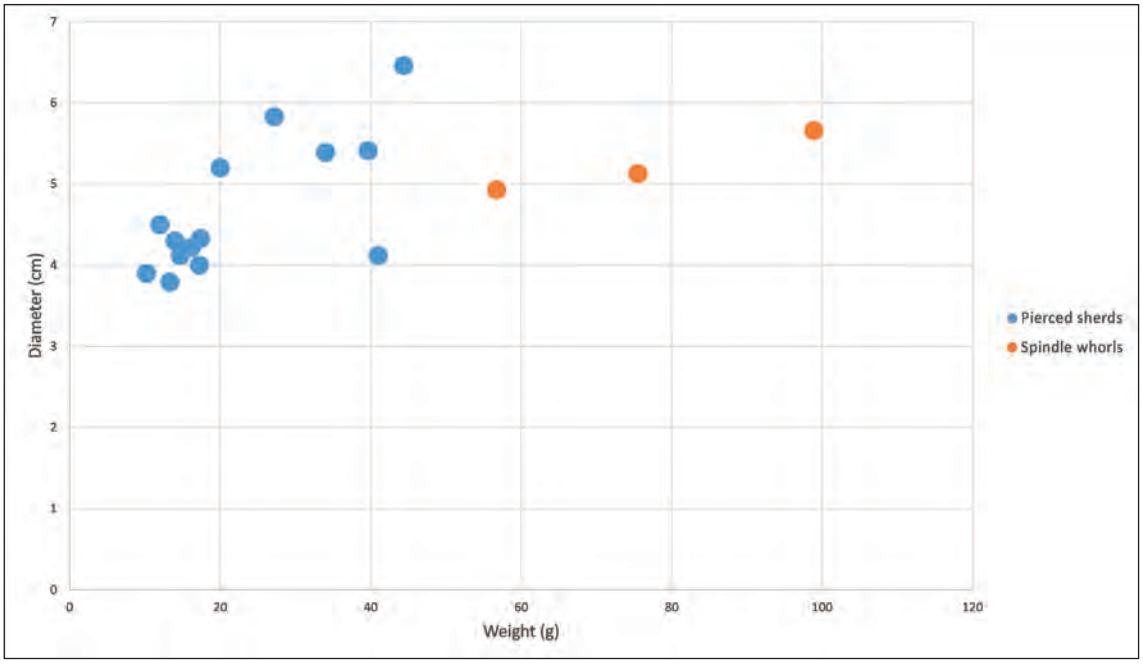
Tab. V.4.1 Details on Neolithic spindle whorls and pierced sherds of PMZ (N=17) (C. Britsch)

| PMZ number | BPh/BSPh | Type | Diameter [cm] | Reconstructed weight [g] |
|---|---|---|---|---|
| PM0882 | II | Pierced sherd | 4.12 | 14.70 |
| PM0886 | II | Pierced sherd | 5.83 | 27.20 |
| PM0876 | II | Pierced sherd | 5.39 | 34.00 |
| PM0960 | IIIc | Pierced sherd | 4.33 | 17.37 |
| PM0919 | IVb | Pierced sherd | 3.79 | 13.33 |
| PM0765 | Va | Pierced sherd | 5.41 | 39.65 |
| PM0933 | Vb | Pierced sherd | 4.00 | 17.25 |
| PM0939 | Vd | Pierced sherd | 4.12 | 41.00 |
| PM0739 | Vd | Pierced sherd | 6.46 | 44.39 |
| PM0718 | Ve | Pierced sherd | 4.22 | 16.15 |
| PM0993 | VIa | Pierced Sherd | 4.50 | 12.00 |
| PM0650 | VIb | Pierced sherd | 3.90 | 10.20 |
| PM1017 | VIb | Pierced sherd | 5.20 | 20.00 |
| PM1011 | VIIa | Pierced sherd | 4.30 | 14.00 |
| PM0478 | VIIc | Spindle whorl | 5.13 | 75.51 |
| PM0320 | VIII | Spindle whorl | 4.93 | 56.73 |
| PM0348 | VIII | Spindle whorl | 5.66 | 98.88 |

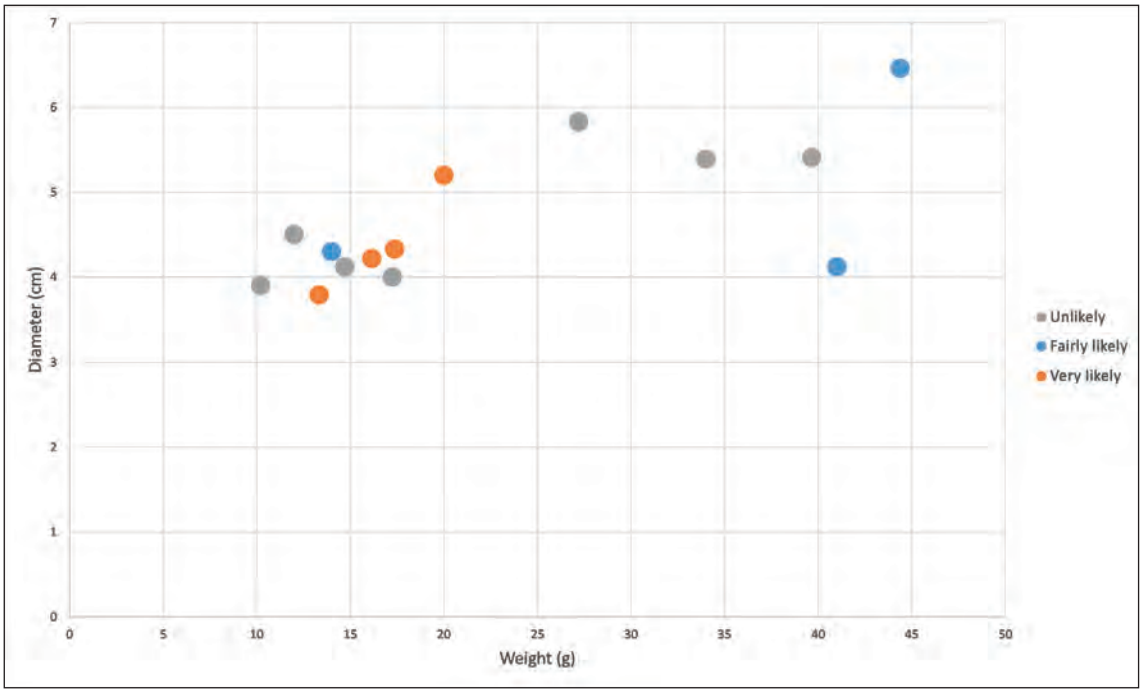
Tab. V.4.2 Scatter-plot of the weight and diameter of PMZ pierced sherds in relation to their respective phases (N=14) (C. Britsch)



Tab. V.4.3 Scatter-plot of the weight and diameter of PMZ spindle whorls and pierced sherds (N=17) (C. Britsch)



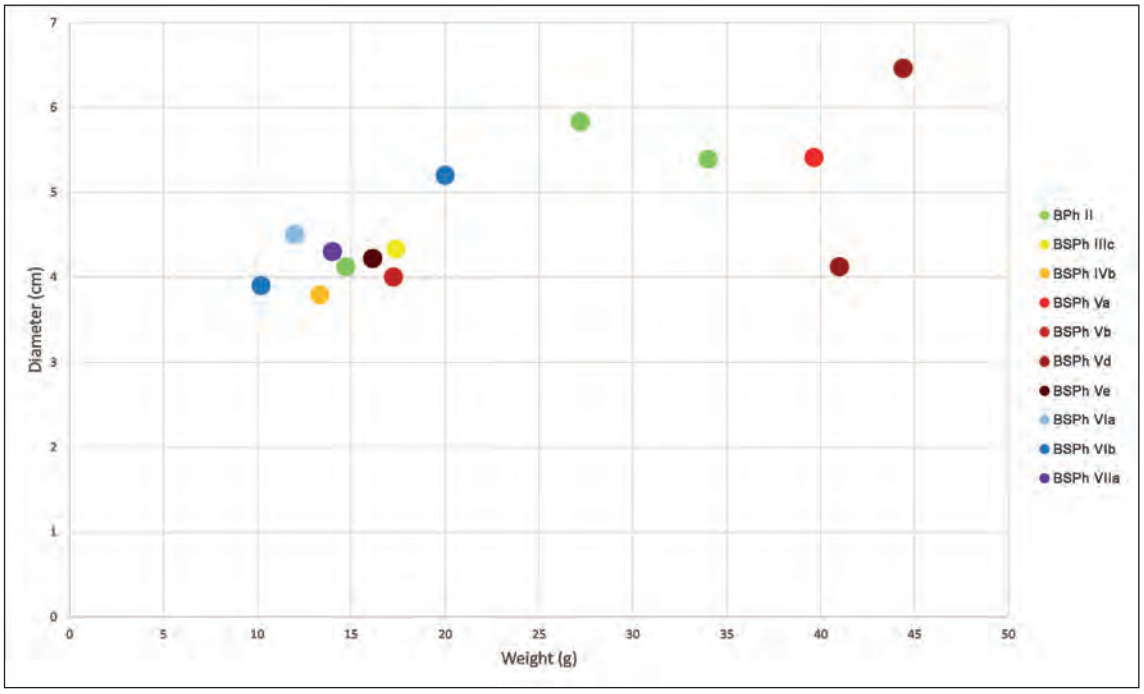

Tab. V.4.4 Scatter-plot of the weight and diameter of PMZ pierced sherds regarding the probability that they were used as spindle whorls (N=14) (C. Britsch)



Tab. V.4.5 Details on Neolithic loom weights of PMZ (N=4) (C. Britsch)

| PMZ number | BPh/BSPh | Type | Diameter [cm] | Reconstructed weight [g] |
|---|---|---|---|---|
| PM1023 | VIIa | Loom weight | 8.60 | 186.40 |
| PM0456 | VIIc | Loom weight | 6.56 | 128.00 |
| PM0347 | VIII | Loom weight | 1.86 | 32.76 |
| PM0377 | VIII | Loom weight | 7.83 | 87.65 |

Tab. V.4.6 Scatter-plot of the weight and diameter of PMZ loom weights (N=4) (C. Britsch)




The comparison of the different tools yields the following insights:

i) The pierced sherds seem to be generally lighter than the spindle whorls (see Tab. V.4.2).

ii) A cluster of pierced sherds with weights between 10 to 17.5g is visible (see Tab. V.4.2 and V.4.3).

iii) There is no clear clustering of pierced sherds regarding the phases (see Tab. V.4.3), meaning that these tools did not get progressively heavier or lighter.

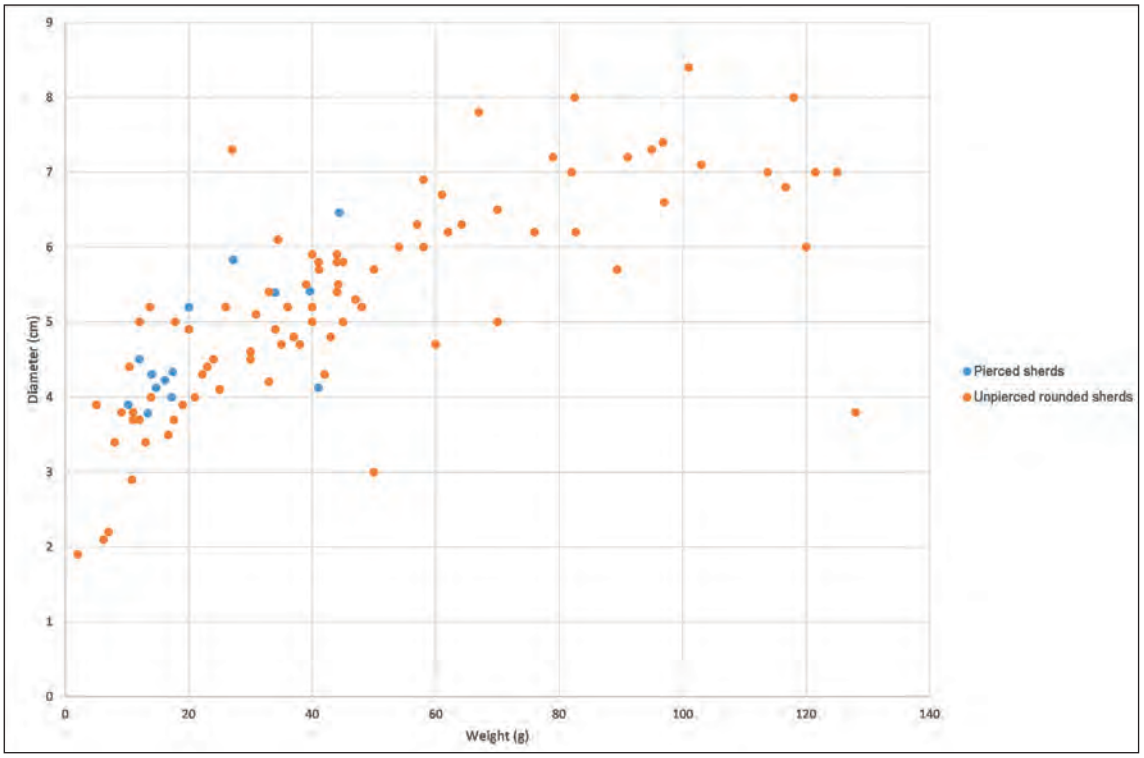
iv) If all pierced sherds that have too oblique a hole or are strongly rotationally asymmetrical are excluded, only five pierced sherds remain that are fairly or very likely to have been used as spindle whorls (see Tab. V.4.4).

v) Considering the weight or diameter, there are no clearly differing clusters visible between pierced sherds that were potentially used as spindle whorls and those which were not (see Tab. V.4.4).

vi) The loom weight shapes do not fall in clusters (see Tab. V.4.6), indicating different loom set-ups for different weaves/techniques.

vii) Unpierced rounded sherds have a larger range in weight and diameter than pierced sherds, however, similarly sized objects exist (see Tab. V.4.7).

Tab. V.4.7 Scatter-plot of the weight and diameter of PMZ pierced and unpierced rounded sherds (N=104) (C. Britsch)




*Pierced Sherds, Unpierced Sherds and Spindle Whorls: A Comparison*

Before delving into the question of the development of textile production at Neolithic PMZ, the first aspect to be discussed is which artefacts can ultimately be regarded as textile tools and which not. For the PMZ tools this concerns mainly the pierced sherds and the uncertainly identified loom weight PM0377.

In the chapter, 'Artefact Categories', it has already been stated that the identification of the pierced sherds is generally ambiguous in prehistoric archaeology. The usage as spindle whorls is – even though a common one – still only one suggestion for the function of these artefacts. The pierced sherds found at PMZ were therefore analysed in detail, to establish as many objective arguments and indicators as possible. It has already been stated that the most important factors in order for an object to function as a spindle whorl are i) to be (roughly) rotationally symmetrical, ii) to have a centred hole and iii) to weigh neither too much nor too little. Regarding point iii), it can be safely assumed that all pierced sherds and spindle whorls from Neolithic PMZ fall comfortably within a weight range that allows them to be used as spindle whorls. Therefore, only points i) and ii) need to be discussed further.

Rotational Symmetry

Several of the pierced sherds analysed in the current paper were not rotationally symmetrical. This included PM0765, PM0933 and PM0993, as well as the not fully pierced sherd PM0876. For the last one, however, it has to be considered that the rounding to a rotationally symmetrical shape could have been the last step in production, which, due to its premature disposal, never occurred. For the remaining eight pierced sherds, a rotationally symmetrical shape can at least be assumed. Due to the strong fragmentation of PM0886, PM0960 and PM0939, their former shapes cannot be reconstructed with absolute certainty; however, the shapes of the fragments allow us to assume a symmetrical shape.

Centred Hole

Most of the pierced sherds have a centred hole. The only exception in this respect is PM0765. However, several pierced sherds exhibit another problem: an oblique form. This concerns PM0882, PM0886 and PM0650. If those pierced sherds were put on a spindle, the oblique hole would result in the sherd sticking to the spindle at an unusual angle. This, in turn, would interfere with the rotational movement of the spindle and thus make it impractical as a tool.

Another general criticism regarding the piercing of a pierced sherd also has to be mentioned. In the absolute majority of all cases (not only at PMZ), the holes in these artefacts are drilled from both sides, vaguely into the centre of the sherd. This process results in an hourglass shaped hole. As a result the area within the hole that actually touches the spindle, and therefore provides grip, is absolutely minimal. This could lead to an incident in which the pierced sherd is detached from the spindle during the spinning process. This means that the hole must be carefully shaped to turn a pierced sherd into a stable spindle whorl.

Considering these two aspects as exclusion criteria, this would leave only seven objects that could have been used as spindle whorls: PM0960, PM0919, PM0739, PM0939, PM0718, PM1011 and PM1017. For these seven pierced sherds, PM0960, PM0919, PM0718 and PM1017 were considered as 'very likely' spindle whorls and PM0739, PM0939 and PM1011 as 'fairly likely' (see Fig. V.4.8, 9, 14). The downgrading of PM0739 was due to its slightly oblique hole and of PM0939 due to the strong degree of fragmentation and the resulting uncertainty regarding its symmetry.

Another aspect that was considered was the possibility of unpierced rounded sherds being interim products on the way to becoming a pierced sherd. If that were to prove true, a lot more data on the weight and sizes of potential Neolithic spindle whorls from PMZ would exist. On the other hand, a big question arises: why would so many rounded sherds have been left as interim products?

To investigate this, 90 unpierced rounded sherds and 14 pierced sherds were compared in diameter and weight (see Tab. V.4.7). This comparison, however, yielded a slightly inconclusive picture. While a large portion of the unpierced rounded sherds fall into the same range as the pierced sherds, many unpierced rounded sherds are heavier and larger and several are smaller and lighter. This mismatch could certainly also result from the strongly differing quantities of the two artefact categories (14 pierced sherds vs. 90 unpierced sherds), meaning that very large and very small pierced sherds were simply not found in the limited excavation area. Assuming, however, that we have a rather realistic representation of past proportions, there are two possible interpretations for the partly matching and partly mismatching results. Either the rounded sherds with comparable sizes and weights to pierced examples were interim products meant to be pierced later on and the remaining rounded sherds were made for another task, or all unpierced rounded sherds were made for a different task to the pierced sherds.

In my opinion, it is far more likely that all unpierced rounded sherds were made with a different purpose than the pierced examples. The reason is simply that it seems counterintuitive to produce objects in a similar manner but to use different sizes for completely different functions. This leads back to the question of identifying the pierced sherds as spindle whorls. As for the unpierced rounded sherds, it could theoretically be possible that not every pierced sherd was made for the same purpose. However, to separate pierced sherds into categories which imply different functions, seems suspect. This would again mean that similarly produced, shaped, partly even sized, tools were created for different purposes. Moreover, this would either indicate that asymmetry or oblique piercing had an advantage when used for a certain task or that 'badly' created pierced sherds were used for different tasks from 'well'-produced ones. It is more likely that all pierced sherds were used for the same purpose. One can conclude that aspects like asymmetry or oblique holes were either just accidents with which people learnt to cope, or the pierced sherds were actually used for a task, for which neither symmetry nor a straight hole is important. The latter would, however, mean that no pierced sherds were used as spindle whorls.

Another possibility would be that the production of the pierced sherds was, at least partly, still in its early stages and the imperfect manufacture was the result of inexperience. Since, at Neolithic PMZ, pierced sherds and spindle whorls do not appear in the same phases (see Tab. V.4.1), it could mean that the pierced sherds evolved into the spindle whorls. Thus, the pierced sherds would portray an early stage or attempt at creating spindle whorls and that understanding of important technical factors and the knowledge for creating suitable tools emerged. However, this seems unlikely for two main reasons. Firstly, some of the impractical pierced sherds are younger than certain well-produced ones. Thus, no clear process of advancement is visible. Secondly, even though it is not the case at PMZ, many other prehistoric sites feature both pierced sherds and spindle whorls in the same phases.[618] A clear development from pierced sherds to spindle whorls can therefore not be attested. Nonetheless, the apparent supersession of pierced sherds by spindle whorls at PMZ needs to be investigated.

Interestingly, during the potential transition from pierced sheds to spindle whorls at PMZ, loom weights also appear, from BSPh VIIa onwards. This could speak in favour of a new or developed more intense and stronger specialised kind of textile production at the site. However, the calculations of potential loom set-ups showed that the spindle whorls found did not function well with the respective loom weights (see Tab. V.4.5). This indicates that important parts of the textile tool assemblage are missing. This is not surprising, considering that one loom weight would not suffice for a whole loom set-up, nor would one or two spindle whorls be enough to supply the yarn needed in an entire settlement phase. Certainly, there is hardly any archaeological site at which it is possible to ensure the complete record of material culture. However, it is important to note the potentially large extent of missing information.

### *Spindle Whorls and Loom Weights*

The next step is to check how the loom weights fit together with the spindle whorls of the respective phase. This means that the yarn thicknesses have to be estimated to calculate what a loom set-up could have looked like. The estimations here follow the spinning experiments of the CTR. These experiments may show that the yarn thickness is directly related to the spindle whorl weight (see Tab. V.4.8). Based on these results, assumptions about the potential yarn thicknesses that may have been produced with the PMZ tools can be made (see Tab. V.4.9). It was already mentioned in the introduction of this chapter that the yarn thickness gives information about the warp-tension, i.e. the strength needed to pull a thread straight without tearing it apart. This factor was already tested by the CTR (see Tab. V.4.8) and was estimated for the PMZ tools (see Tab. Tab. V.4.9). It must be noted that these are only estimates, since an actual test with each tool and weight class was not performed. The information is then used to calculate a potential loom set-up by using the warp-tension of spindle whorls and weight of loom weights from the same phases. The results show how many threads could and had to be attached per loom weight (see Tab. V.4.10).

Tab. V.4.8 Results of the spinning tests undertaken at the CTR (after Andersson et al. 2008, 173; Mårtensson et al. 2009, 378) (C. Britsch)

| Spindle whorl [g] | Yarn thickness [mm] | Warp-tension [g/thread] |
|---|---|---|
| 4 | < 0.3 | 10 |
| 8 | 0.3–0.4 | 15–20 |
| 18 | 0.4–0.6 | 25–30 |
| 44 | 0.8–1.0 | ~40 |

618 See, e.g., Blegen et al. 1950; Sharp Joukowsky 1986; Hochstetter 1987; Obladen-Kauder 1996; Strommenger – Miglus 2010; Siennicka 2012; Britsch – Horejs 2014.

Tab. V.4.9 Estimated yarn thicknesses and warp tensions for the PMZ spindle whorls and pierced sherds (N=17) based on the results of the CTR spinning tests (see Tab. V.4.3) (C. Britsch)

| PMZ number | BPh/BSPh | Type | Reconstructed weight [g] | Yarn thickness [mm] | Warp tension [g/thread] |
|---|---|---|---|---|---|
| PM0882 | II | Pierced sherd | 14.70 | 0.4–0.5 | 20–25 |
| PM0886 | II | Pierced sherd | 27.20 | 0.6–0.7 | 30–35 |
| PM0876 | II | Pierced sherd | 34.00 | 0.7–0.8 | 30–35 |
| PM0960 | IIIc | Pierced sherd | 17.37 | 0.4–0.6 | 25–30 |
| PM0919 | IVb | Pierced sherd | 13.33 | 0.4–0.5 | 20–25 |
| PM0765 | Va | Pierced sherd | 39.65 | 0.7–0.9 | 30–40 |
| PM0933 | Vb | Pierced sherd | 17.25 | 0.4–0.6 | 25–30 |
| PM0939 | Vd | Pierced sherd | 41.00 | 0.7–0.9 | 30–40 |
| PM0739 | Vd | Pierced sherd | 44.39 | 0.8–1.0 | ~40 |
| PM0718 | Ve | Pierced sherd | 16.15 | 0.4–0.6 | 25–30 |
| PM0993 | VIa | Pierced sherd | 12.00 | 0.4–0.5 | 20–25 |
| PM0650 | VIb | Pierced sherd | 10.20 | 0.3–0.5 | 15–25 |
| PM1017 | VIb | Pierced sherd | 20.00 | 0.4–0.6 | 25–30 |
| PM1011 | VIIa | Pierced sherd | 14.00 | 0.4–0.5 | 20–25 |
| PM0478 | VIIc | Spindle whorl | 75.51 | 1.1–1.2 | 40–45 |
| PM0320 | VIII | Spindle whorl | 56.73 | 0.9–1.1 | 35–40 |
| PM0348 | VIII | Spindle whorl | 98.88 | 1.2–1.3 | 45–50 |

Tab. V.4.10 Calculations of potential loom set-ups with the spindle whorls and loom weights found in the respective phases (C. Britsch)

| BPh/BSPh | Spindle whorl/Pierced sherd [g] | Yarn thickness [mm] | Warp tension [g/thread] | Loom weight [g] | Threads/ Loom weight | Practical set-up? |
|---|---|---|---|---|---|---|
| VIIa | | | | | | |
| | 14.00 | 0.4–0.5 | 20–25 | 186.40 | 7–9 | No |
| VIIc | | | | | | |
| | 75.51 | 1.1–1.2 | 40–45 | 128.00 | ~3 | No |
| | | | | | | |
| VIII (a) | | | | | | |
| | 56.73 | 0.9–1.1 | 35–40 | 32.76 | <1 | No |
| | 98.88 | 1.2–1.3 | 45–50 | 32.76 | <1 | No |
| VIII (b) | | | | | | |
| | 56.73 | 0.9–1.1 | 35–40 | 87.65 | ~2 | No |
| | 98.88 | 1.2–1.3 | 45–50 | 87.65 | ~2 | No |

The calculations of the loom set-ups in Tab. V.4.5 have shown that none of the combinations between spindle whorls or pierced sherds and loom weights that derived from the same phases resulted in practical set-ups. In all cases too few threads could have been hung per loom weight, which would result in excessively large gaps between the warp threads. This, in turn, would make the weaving process exhausting and impractical or even impossible. This, however, does not mean that Neolithic textile workers did not use these tools as suggested or were too unprofessional to know how to use them properly. Instead, it indicates mainly one thing: we are missing a large part of the tool assemblage that was in use at PMZ.

The reasons and the potential meaning of this need to be further evaluated in the following discussion. This will also include a statement about the general nature of textile production and textile tools at Neolithic PMZ.

The individual loom weights and very few spindle whorls in BSPh VIIc and BPh VIII, make this very clear. Therefore, it can be expected that both the existence of spindle whorls in older phases, as well as that of pierced sherds in younger phases, is possible at Neolithic PMZ. This, however, strongly limits the validity of conclusive statements about the development of textile production at PMZ. At this point, both the ascription of the purpose of PMZ's pierced sherds and the detailed development of its textile production have to remain in active and reflective discussion.

*Conclusion*

With that in mind, the data presented here imply that textile production developed very slowly before BSPh VIIc, but grew in importance and autonomy afterwards. From the Early Late Neolithic on, textile production at PMZ seems to have developed rapidly. The change in loom weight shapes from BSPh VIIc to BPh VIII demonstrates that developments progressed rather quickly during this period. This indicates well-organised textile workers. For a statement on the extent to which these textile workers were specialised, further information is given by related artefact categories, such as bone tools used in textile production.[619] Due to its wide chronological range and rich findings of other artefacts in even a small excavation area, the settlement of PMZ would be a promising target for conducting further research yielding more detailed information about the textile production in a very vital environment.

[619] See Christidou, this volume, 366–380.

## V.5. Various Clay and Sherd Tools

*Eva Alram-Stern*

### V.5.1. Sling Bullets

All in all, 14 sling bullets were found in Trench A. All of them are made of clay and have an ovoid form, nine of them have pointed, five, rounded ends. Their length varies between 4.5 and 5cm, their width between 2.7 and 3.5cm. Their weight varies considerably from 24.4 to 45.6g. All of them are made of fine clay. The clay of the items corresponds to the clay types identified for PMZ by Areti Pentedeka: fabric 1 is macroscopically identified by many sparkling and many white, non-sparkling fine inclusions (visible with the naked eye); while fabric 2 is characterised by additional small (<1mm) or fine dark inclusions (visible with the naked eye). Fabric 2 is definitely rarer than fabric 1, numbering just five pieces (PM0435, PM0632, PM0646, PM0711, PM0726). Therefore, the clay used for the sling bullets is the same as was used for pottery production and it must be argued that the clay was collected at the same place as for pottery production.[620]

At several sites it has been observed that these sling bullets of clay are not well fired, but sun-dried or baked in ovens or hearths so that they disintegrate easily.[621] At PMZ two pieces (PM0332, PM0646) are cracked into smaller parts and definitely look very badly fired. Two further pieces (PM0435, PM0726) show some slight cracking on the surface. From my experience, I would not consider them as sun-dried, but their firing temperature must have been considerably lower than that used for pottery or figurines. The other pieces are well smoothed and well preserved so that little can be said about their firing temperatures. Interestingly, three of the cracked pieces belong to fabric 2, so that it is possible that their bad condition is due to the fabric. In contrast to other sites,[622] no ovoid sling bullets made of pebbles are known from PMZ. Catherine Perlès mentions that this may be a chronological indicator since at Early Neolithic sites sling bullets of stone are absent.[623] However, sling bullets of stone are known from other Middle Neolithic Thessalian sites.[624] Therefore, since the Western Thessalian Plain around PMZ is not rich in river pebbles, their exclusive production in clay may reflect the availability of raw material at the site.[625]

Regarding their distribution at the site, sling bullets are present from the lower, earlier Middle Neolithic layers (BPh II) to the last Late Neolithic Tsangli-Larissa phase (BPh VIII). Considering the small excavation area during the earliest phases, one may estimate a quite regular appearance and use from the start to the end of the settlement. This fits with the evidence at other Thessalian sites, their appearance in the Early Neolithic and their use during the Middle and Late Neolithic periods.[626]

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620 Areti Pentedeka, personal communication; Pentedeka in press.

621 See Perlès 2001, 228, following Rodden 1962, 285; see also Tsountas 1908, 344–345; Wace – Thompson 1912, 125; Wijnen 1981, 47.

622 E.g. at Visviki Magoula/Velestino: Bergner 2015c.

623 Perlès 2001, 228.

624 Vutiropoulos 1991, 37–40.

625 Riccardo Caputo has shown that in the area of PMZ the Peneios River only rarely carries stones or pebbles: Caputo et al., this volume, 61–63.

626 For their appearance in the PPN of the Near East see Korfmann 1972. In Thessaly, sling bullets are reported since the Early Neolithic period at various sites such as Argissa Magoula (Milojčić 1962, 15, pl. 10.2), Prodromos, Sesklo and Otzaki (Vutiropoulos 1991, 18–20; Perlès 2001, 229, n. 5) as well as at Middle Neolithic sites. To them belongs the deposition at House Q of Tsangli, at Makrychori, Magoula Chatzimissiotiki, Sesklo and Achilleion (Vutiropoulos 1991, 37–40). The continuity of their use is proven by their abundance at Late Neolithic sites like Visviki Magoula (Bergner 2015c), Sesklo and Dimini (Vutiropoulos 1991, 51).

There are no clusters of sling bullets within the stratigraphic units of the site, and only eventually do two sling bullets come from one layer.[627] So, there are no concentrations of sling bullets, as known from other sites like Elateia and Tsangli, House Q, which have been interpreted as storage of these items.[628]

Since Vere Gordon Childe's work on culture groups, sling bullets have been regarded as weapons used as projectiles for slings,[629] which stand in contrast to the use of bows and arrows,[630] an assumption supported by Manfred Korfmann.[631] Their identification as weapons has been stressed by the works of Korfmann, Nikos Vutiropoulos and Mariya Ivanova.[632] By contrast, Perlès interprets sling bullets as a means for hunting small animals such as birds and especially as missiles used by herders to assemble their flocks.[633] As a matter of fact, the evidence from PMZ cannot contribute much to this discussion. In any case, arrowheads are rare in the chipped stone material of PMZ. On the other hand, the number of sling bullets uncovered is not significant enough to stress their significance as weapons.

[627] This is the case for PM0727 (Fig. V.5.1.4) and PM0726 (Fig. V.5.1.5), as well as PM0646 (Fig. V.5.1.9) and PM0996 (Fig. V.5.1.10).

[628] Elateia: Weinberg 1962; Tsangli: Wace – Thompson 1912, 121, 125.

[629] For the use of slings see Korfmann 1986, 134; Bosch 2017.

[630] Childe 1952 [1928].

[631] Korfmann 1972; Korfmann 1986.

[632] Korfmann 1972; Korfmann 1986; Vutiropoulos 1991; Ivanova 2008, 57–63.

[633] Perlès 2001, 229–231.

*Catalogue*

| PM no. | Figure | BPh BSPh | SU | Preser-vation | Form | Length [cm] | Width [cm] | Weight [g] | Clay colour Munsell | Clay colour | Inclu-sions % | Inclusions sorting | Inclusions colour | Surface treatment | Surface Munsell | Surface colour |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0881 | V.5.1.1 | II | 179 | 100% | Pointed | 4.6 | 2.7 | 24.4 | 2.5YR 5/6 | Red | 2.5% | Very well sorted | Sparkling, white | Smoothed | 2.5YR 5/6 | Red |
| 0888 | V.5.1.2 | II | 179 | 80% | Rounded | 4.4 | 2.6 | 16.4 | 5YR 7/4 | Pink | 2.5% | Very well sorted | Sparkling, white | Smoothed | 5YR 7/2 | Pinkish grey |
| 0779 | V.5.1.3 | IVb | 190 | 100% | Slightly pointed | 4.5 | 3.2 | 33.3 | 5YR 6/6 | Reddish yellow | 2.5% | Very well sorted | Sparkling, white | Smoothed | 5YR 6/6 | Reddish yellow |
| 0727 | V.5.1.4 | Vd | 204 | 30% | Rounded | 3.6 | 3.2 | 21.1 | 7.5YR N4–5 | Dark grey, originally red | 2.5% | Very well sorted | Sparkling, white | Smoothed | 7.5YR N4–5 | Dark grey, burnt |
| 0726 | V.5.1.5 | Vd | 204 | 90% | Pointed | 5.2 | 2.9 | 34.7 | 7.5YR 7/4 | Pink | 2.5% | Very well sorted | Sparkling, white, dark | Slightly cracked, worn | 7.5YR 6/2 | Pinkish grey |
| 0711 | V.5.1.6 | Ve | 208 | 60% | Pointed | 4.4 | 3 | 20.3 | 7.5YR 7/2 | Pinkish grey | 2.5% | Very well sorted | Sparkling, white, dark | Worn | 7.5YR 7/2 | Pinkish grey |
| 0655 | V.5.1.7 | VIb | 216 | 100% | Pointed | 4.5 | 2.7 | 26.2 | 5YR 5/6 | Yellowish red | 2.5% | Very well sorted | Sparkling, white | Smoothed | 5YR 5/4 | Reddish brown |
| 0653 | V.5.1.8 | VIb | 216 | 97% | Pointed | 5 | 3.1 | 38.4 | 5YR 6/4 | Light reddish brown | 2.5% | Very well sorted | Sparkling, white | Burnished | 7.5YR 7/2 | Pinkish grey |
| 0646 | V.5.1.9 | VIb | 221 | 80% | Rounded | 4 | 3.5 | 46.4 | 7.5YR 6/2 | Pinkish grey | 7.5% | Moderately sorted | Many red, few spar-kling + white | Cracked, worn | 10YR 8/2 | White |
| 0996 | V.5.1.10 | VIb | 221 | 45% | Rounded | 4 | 3.1 | 21 | 7.5YR 7/6 | Reddish yellow | 5% | Well sorted | Sparkling, white | Smoothed | 6YR 6/1 | Grey |
| 0578 | V.5.1.11 | VIIa | 241 | 100% | Pointed | 5.1 | 2.7 | 29.2 | 7.5YR 6/6 | Reddish yellow | 5% | Very well sorted | Sparkling, white | Smoothed | 7.5YR 7/4 | Pink |
| 0632 | V.5.1.12 | VIIa | 231 | 100% | Pointed, irregular | 4.9 | 3 | 45.6 | 7.5YR 5/4 | Brown | 2.5% | Very well sorted | Sparkling, white, dark | Worn | 7.5YR 6/4 | Light brown |
| 0332 | V.5.1.13 | VIII | 263 | 98% | Pointed | 5 | 3.2 | 32 | 7.5YR 5/4 | Brown | 5% | Very well sorted | Sparkling, white | Cracked, worn | 7.5YR 7/4 | Pink |
| 0435 | V.5.1.14 | VIII | 261 | 30% | Pointed | 2.4 | 2 | 6.7 | 7.5YR 7/2 | Pinkish grey | 2.5% | Very well sorted | Sparkling, white, dark | Slightly cracked, worn | 7.5YR 5/2 | Brown |

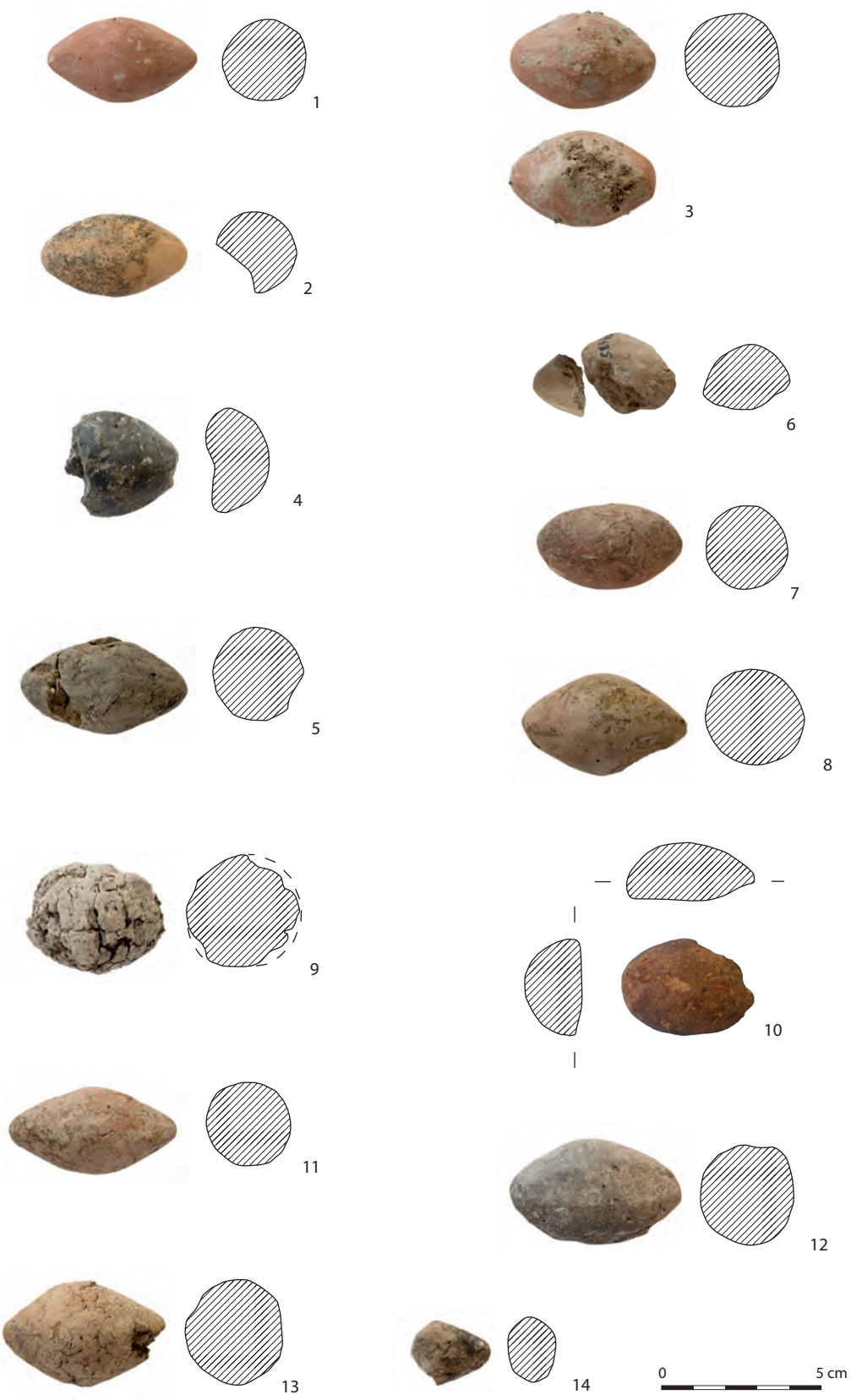



Fig. V.5.1 Sling bullets: (1) PM0881, (2) PM0888, (3) PM0779 BPh II and BSPh IVb (MN I); (4) PM0727, (5) PM0726, (6) PM0711 from BSPh Vd and Ve (MN II); (7) PM0655, (8) PM0653, (9) PM0646, (10) PM0996 from BSPh VIb (MN III); (11) PM0578, (12) PM0632 from BSPh VIIa (transition MN III/LN I); (13) PM0332, (14) PM0435 from BPh VIII (LN I) (photos: M. Börner, drawings: S. Horwath)

## V.5.2. Scrapers – Abrasive Instruments

In the Middle and Late Neolithic layers of PMZ four very similar oblong objects which were formed of very coarse clay have been identified. The clay is characterised by angular inclusions of 1–2mm in length, which are also present on the surface so that the objects have a rough appearance. Their shape is oblong, one side is slightly concave, the other sides are slightly rounded. On some of the objects this slightly concave side also shows finger impressions, and this detail may be due to its handling. Therefore, the items were most likely held as tools in the hand because of their oblong shape, but also because of their length, between 5 and 7cm. Based on their rough surface, I suggest that these tools were used for abrasion, e.g. for abrading the surface of objects of softer material like bone or for cleaning hair from hides.

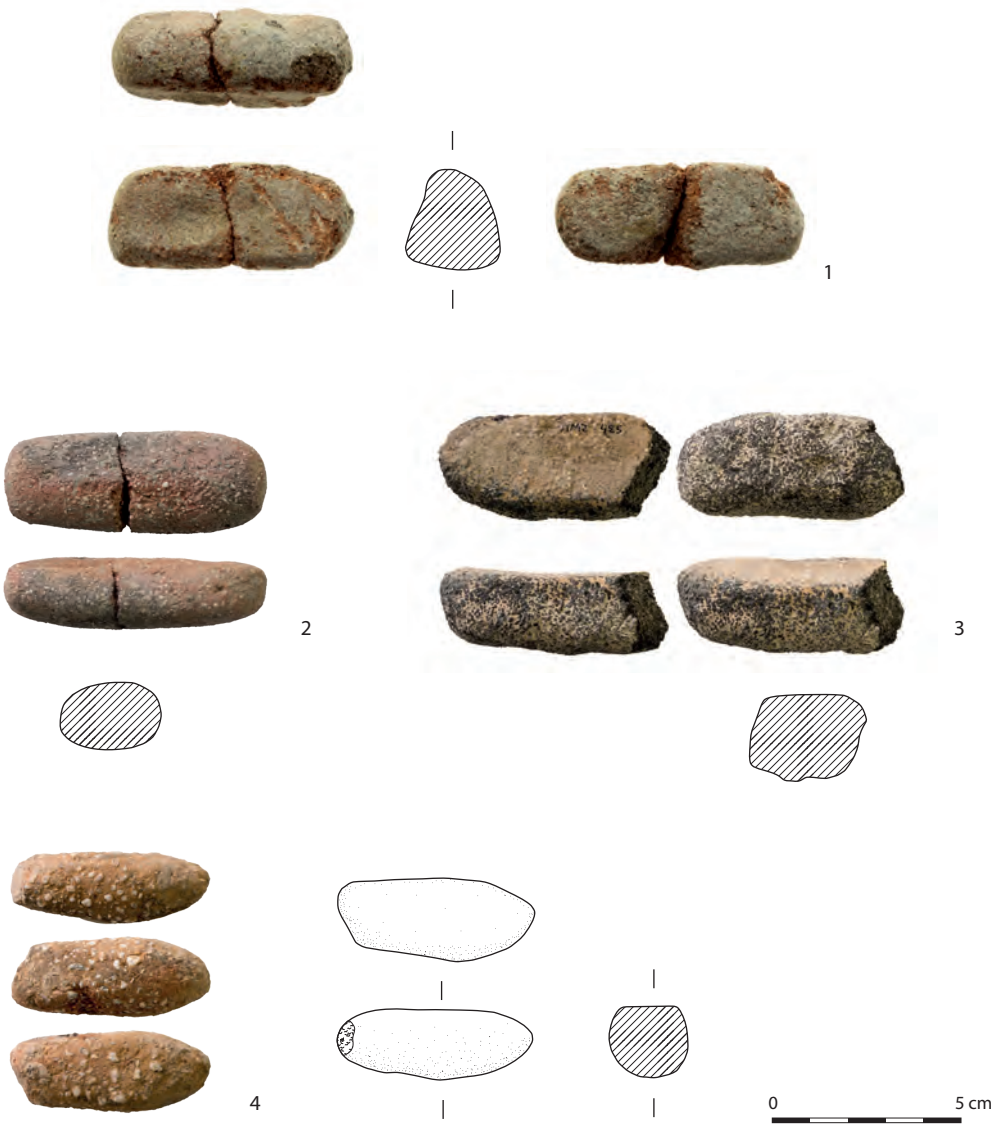



Fig. V.5.2 Scrapers from BSPh IIIc, Ve and BPh VIII: (1) PM0917 + PM0961, (2) PM0690, (3) PM0698, (4) PM0444 (photos: M. Börner, K.-V. von Eickstett, drawings: S. Horwath)

*Catalogue*

*PM0917+0961*. Fig. V.5.2.1. BSPh IIIc, SU 46, EU 186. Entire oblong object of coarse clay with three sides, one flat and straight, for use, one with a round depression (finger impression?), one with an oblong impression, probably of fingers. Flat side probably used for abrasion. Ends are rounded, but most probably not used. Preservation: 90%, broken. Preserved length 6.3cm, width 2.6cm, diameter 2.7cm. Weight: 41g. Clay: 2.5YR 5/6 red; inclusions: very well sorted, 30%, many small white and red rounded and many fine mica inclusions. Surface: 2.5YR 6/6 light red, gritty.

*PM0690*. Fig. V.5.2.2. BSPh Ve, SU 112, EU 209, above Floor F26. Oblong object with two flat, rounded sides and two short sides. All flat and short sides may have been used for scraping/abrading surfaces. Preservation: 100%. Length 6.8cm, width 2.6cm, diameter 1.8cm. Weight: 37.3g. Clay: 2.5YR 5/6 red; inclusions: moderately sorted, 40%, many large (>1mm) and small (<1mm) rounded and angular white, some small dark, some gold and silver mica inclusions. Surface: 2.5YR 6/6 light red with dark spots, gritty.

*PM0698*. Fig. V.5.2.3. BSPh VIe, SU 117, wall W35. Oblong object with one flattened, slightly concave side and three irregular sides, possibly used for holding the object, and one slightly flattened end, which may have been used for abrasion/scraping. Preservation: 90%. Preserved length 6.4cm, complete c. 7.5cm, width 2.9cm, diameter 2.2cm. Weight: 56.4g. Clay: 2.5YR N3–N4 very dark grey; inclusions: very well sorted, 40%, many small (<1mm) rounded and oblong white, small and fine mica inclusions. Surface: 7.5YR N4 dark grey, spots 7.5YR 4/6 light brown, gritty.

*PM0444*. Fig. V.5.2.4. BPh VIII, SU 155, EU 259, above Floor F20. Oblong object with one flat and three rounded sides, one pointed and one rounded fragmented end. Probably used on the flat side and perhaps on the pointed side. Preservation: 100%; length 5.2cm, width 2.1cm, diameter 1.8cm. Weight: 19.7g. Clay: 2.5YR 5/6 red; inclusions: moderately sorted, 40%, many large (>1mm), small and fine white angular, some small dark and fine mica inclusions. Surface: 5YR 7/4 pink, gritty surface.

## V.5.3. Rounded Sherds

The pottery material of PMZ includes sherds which were shaped to be applied in secondary use as tools. Three main types are discerned in the material of PMZ, rounded sherds, eight-shaped sherds, and sherds with one or more smoothed sides which are interpreted as burnishers.

Rounded sherds are pottery fragments, which have been chipped to a round shape. In addition, many of them also had their sides smoothed.[634] Of the 85 recorded items from PMZ, 29 show regular marks of chipping. Thirty-seven rounded sherds have smoothed sides, some are very well smoothed, and another 17 show only slight smoothing on their chipped sides. So, it seems that this chipping and smoothing was part of the forming process of these rounded sherds, although smoothing could also result from use. However, the upper and the undersides of the discs show no use wear.

A few rounded sherds do not have a perfectly round shape, but have one pointed edge (PM1054, PM1055). Possibly these sherds should not be included in the group of the rounded sherds in a strict sense, but they could be used as scraping or burnishing tools. However, for all the other rounded sherds, it is difficult to handle them as such instruments.[635]

In the material of PMZ there are also rounded sherds with perforations situated more or less in their centre. Since they have often been interpreted as spindle whorls they are discussed with the weaving implements.[636]

The rounded sherds show a high variability in their diameter of 1.9–8.4cm through all architectural phases, the majority of them having a diameter of 4–6cm (Tab. V.5.1).[637] Furthermore, they were mainly made of coarse wares, and sherds made of fine ware are comparatively rare. Corresponding to the size and the thickness of the sherds, there is also a high variation in weight.

634 Cf. Rahmstorf 2008, 37–38.
635 Perlès 2001, 251.
636 See chapter by Britsch, this volume, 418–420.
637 See Britsch, this volume, Tab. V.4.7.

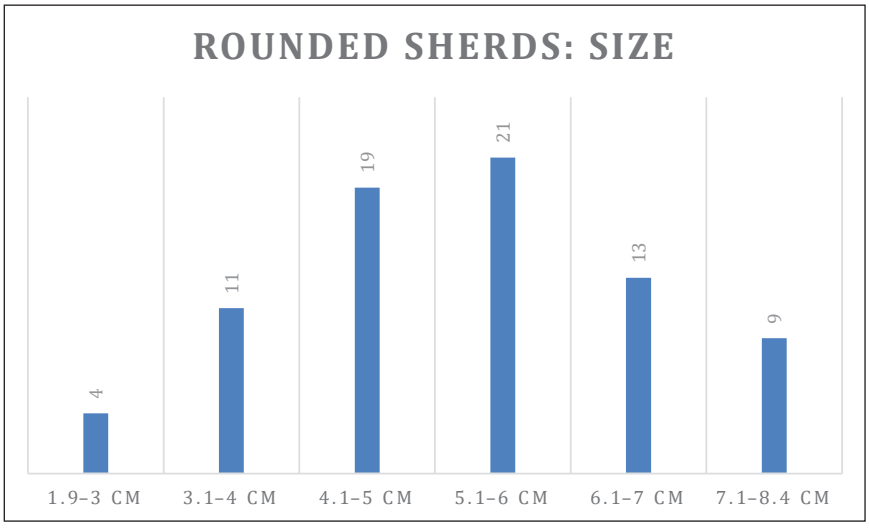
All in all, it seems that neither the fabric nor the decoration of the sherd was of importance for the choice for its secondary processing, although heavier sherds were used by preference.

Rounded sherds were used in Thessaly from the Early Neolithic and are known for the entire Neolithic period.[638] For PMZ it is important to note that 65 pieces come from the upper Neolithic levels of the site, BSPh VIIb, VIIc and BPh VIII, which are dated to the latest Middle Neolithic and the earliest Late Neolithic (Tsangli-Larissa) phases. Furthermore, a comparatively high density was present in certain stratigraphic units (SU 141/EU 251–252, SU 152/EU 255, SU 153/EU 260, SU 161/EU 261). Therefore, it has to be argued that rounded sherds were more important during these architectural phases, and especially in certain levels. This distribution clearly differs from the perforated sherd discs which were identified as possible spinning whorls.

Various suggestions have been made for their use.[639] It has been suggested that they were the primary production stage of perforated sherd discs, which were used as spindle whorls[640] or as net sinkers.[641] However, for Visviki Magoula it is clearly proved that perforated discs are usually smaller and made of thinner sherds than the unperforated rounded sherds, which were considerably larger and thicker. Therefore, their purpose was probably different from that of the perforated sherds.[642] For PMZ, Christopher Britsch has shown that unpierced rounded sherds have a much higher variability in size and weight than pierced sherds.[643] Furthermore, their distribution by phases varies considerably, rounded, unperforated sherds being most abundant during the early Late Neolithic BSPh VIIb, VIIc and BPh VIII (see Tab. V.5.2). Lorenz Rahmstorf has proposed their use as lids.[644] However, vessels with such a comparatively small diameter are rare in the pottery assemblage of PMZ.

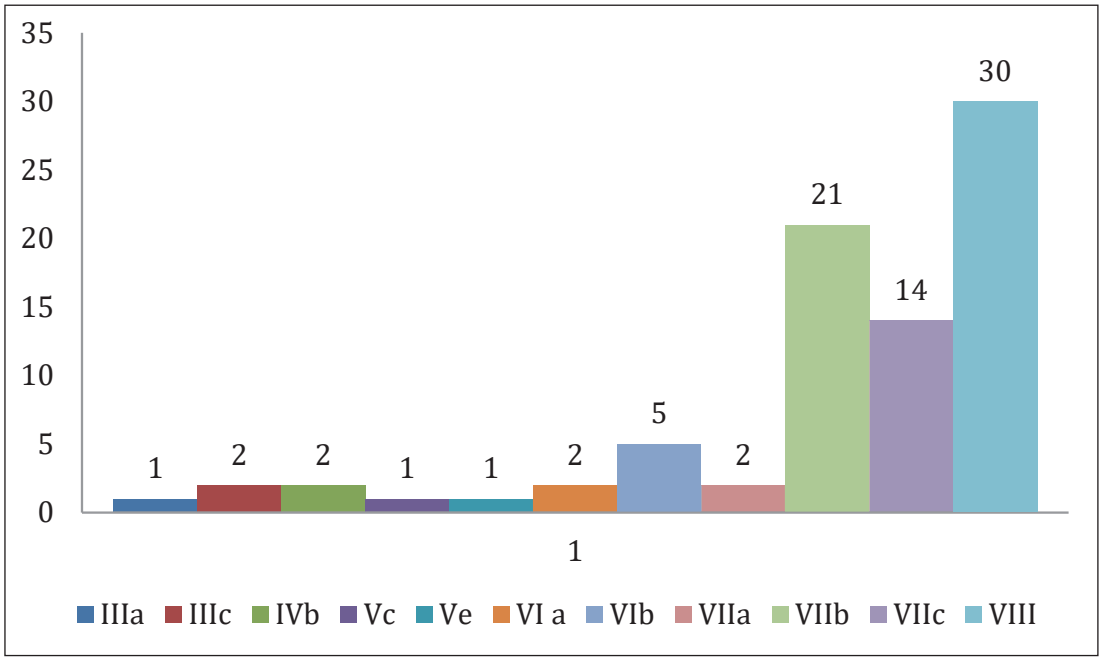
In 1918, Bernice M. Cartland made an interesting discovery through the use of x-rays on Egyptian balls of thread. It showed that the thread was wound around rounded sherds.[645] In this case the rounded sherds were connected with textile production. If this was also the case for the items from PMZ, this could explain their abundance in the strata of its latest Neolithic settlement

Tab. V.5.1 Number of rounded sherds by size (E. Alram-Stern)




638 Achilleion: Gimbutas 1989, 254–256, figs. 8.8–11; Theopetra Cave: Kyparissi-Apostolika 2000b, 203, 230, fig. 14.16.3.
639 Rahmstorf 2008, 51–52.
640 Carrington-Smith 2000, 208.
641 Carrington-Smith 2000, 208; Britsch – Horejs 2014, 234–236.
642 Alram-Stern 2015.
643 See Britsch, this volume, Tab. V.4.7.
644 Rahmstorf 2015, 5.
645 Cartland 1918, 139, pl. 22. I owe this hint to Christoph Schwall.

Tab. V.5.2 Number of rounded sherds per building phases (E. Alram-Stern)




phases, when the excavated area was dominated by hearth and oven structures in an open space. Since such spaces were the centre of household activities they were the place where people also gathered for various activities, including crafting. A concentration of rounded sherds close to an oven has also been observed at Visviki Magoula.[646] This picture may fit with the increasing importance of textile production during the early Late Neolithic phases of PMZ.

John Papadopoulos has dealt with the use of rounded sherds during Classical times. He suggests that they may have been used as gaming pieces, but also in the toilet as cleaners. In this context, he also mentions their connection with the term *pessoi* which has a variety of meanings, including a 'medicated plug of wool or lint to be introduced into the vagina, anus etc'.[647] In this case, the use of rounded sherds is again connected with wool which was wound around them.

At PMZ, during BSPh VIIb and BSPh VIIc nearly all rounded sherds were located in a line in the centre of the trench (Figs. III.32, III.34). This could indicate that they were attached to a soft material and used as something like weights set along a textile, a net or a loom. For BPh VIII the situation is different, and two concentrations of rounded sherds were located (Fig. III.37). So, again, the situation of the rounded sherds could either point to their connection with textile production, or, similarly to the pierced or eight-shaped sherds, as net sinkers.[648]

646 Alram-Stern 2015, 445.
647 Papadopoulos 2002.
648 Weißhaar 1989, 214, no. 19, pl. 82; Britsch – Horejs 2014.

*Catalogue*

| PM no. | Figure | BPh BSPh | EU/SU | Preser-vation | Produc-tion detail | Diam 1 [cm] | Diam 2 [cm] | Thick-ness [cm] | Weight [g] | Clay colour Munsell | Clay colour |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0319 | V.5.3.1 | | EU 105 SU 166 | 100% | Well smoothed | 5.7 | | 2 | 89.4 | 2.5YR 5/6 | Red |
| 0913 | V.5.3.2 | IIIa | EU 183 SU 24 | 50% | Chipped, slightly smoothed | 7.6 | | 1 | 3.78? | 5YR 6/6 | Reddish yellow |
| 0915 | V.5.3.3 | IIIc | EU 186 SU 46 | 100% | Chipped | 7.4 | 7.3 | 1.3 | 96.8 | 5YR 5/6 | Yellow-ish red |
| 0916 | V.5.3.4 | IIIc | EU 186 SU 46 | 90% | Chipped, slightly smoothed | 4.0 | 3.6 | 0.6 | 12.5 | 2.5YR 5/6 | Red |
| 0921 | V.5.3.5 | IVb | EU 192 SU 39 | 50% | Chipped | 5.0 | | 0.6 | 8.9 | 5YR 6/6 | Reddish yellow |
| 0922 | V.5.3.6 | IVb | EU 192 SU 39 | 30% | Smoothed | 4.8 | | 0.9 | 12.9 | 5YR 5/4 | Reddish brown |
| 0937 | V.5.3.7 | Vc | EU 199 SU 92 | 20% | Chipped | 3 | | 0.7 | 10 | 5YR 5/6 | Yellow-ish red |
| 0941 | V.5.3.8 | Ve | EU 209 SU 112 | 100% | Smoothed | 4.7 | 4.1 | 1.5 | 38 | 5YR 6/6 | Reddish yellow |
| 0676 | V.5.3.9 | VIa | EU 404 SU 120 | 100% | Smoothed | 3.8 | 3.8 | 1 | 9.1 | 5YR 6/6 | Reddish yellow |
| 0990 | V.5.3.10 | VIa | EU 214 SU 121 | 100% | Smoothed | 5.8 | 5.5 | 1.7 | 44 | 7.5YR 7/6 | Reddish yellow |
| 0961 | V.5.3.11 | VIb | EU 223 SU 126? | 95% | Smoothed | 5.2 | 4.3 | 0.4 | 13 | 7.5YR 7/6 | Reddish yellow |
| 1002 | V.5.3.12 | VIb | EU 225 SU 126 | 100% | Chipped | 5 | 4.6 | | 12 | 5YR 4/1–5/1 | Grey |
| 1008 | V.5.3.13 | VIb | EU 226 SU 126 | 50% | Chipped | 5.9 | | 0.7–0.9 | 22 | 5YR 6/4 | Light reddish brown |
| 1009 | V.5.3.14 | VIb | EU 228 SU 126 | 100% | Chipped, slightly smoothed | 3.4 | 3.1 | 0.7–0.9 | 13 | 5YR 7/4 | Pink |
| 1015 | V.5.3.15 | VIb | EU 235 SU 126 | 100% | Chipped, slightly smoothed | 6.2 | 5.9 | 1.5–1.9 | 76 | 5YR 7/6 | Reddish yellow |
| 1016 | V.5.3.16 | VIb | SU 126 | 100% | Chipped, slightly smoothed | 3.9 | 4.1 | 0.75 | 19 | 5YR 6/4 | Light reddish brown |
| 0553 | V.5.3.17 | VIIb | SU 135 | 100% | Smoothed | 2.1 | 2.1 | 0.8 | 6.2 | 5YR 6/6 | Reddish yellow |
| 1022 | V.5.3.18 | VIIb | EU 246a SU 136 | 100% | Chipped | 3.8 | 3.7 | 0.6 | 11 | 5YR 5/4 | Reddish brown |
| 1025 | V.5.3.1) | VIIb | EU 244 SU 135 | 100% | Smoothed | 7.1 | 6.9 | 1.4–1.7 | 103 | 5YR 6/6 | Reddish yellow |
| 1026 | V.5.3.20 | VIIb | EU 244 SU 135 | 100% | Smoothed | | | | 52 | | |
| 1027 | V.5.3.21 | VIIb | EU 244 SU 135 | 100% | Chipped, slightly smoothed | 6.3 | 5.7 | 1.2 | 57 | 5YR 7/6 | Reddish yellow |

| Core shape Core colour | Fabric | Fabric detail | Ware | Surface treat int. | Surface treat ext. | Slip/surface int. Munsell | Slip/surface int. colour | Slip/surface ext. Munsell | Slip/surface ext. colour | Decoration colour |
|---|---|---|---|---|---|---|---|---|---|---|
| 5YR 6/4 | 2 | Medium coarse | Red monochrome | Wiped | Wiped | 2.5YR 5/6 | Red | 2.5YR 5/6 | Red | |
| | 2 | Medium coarse | Red monochrome | Wiped | Wiped | 5YR 6–7/4 | Light reddish brown | 5YR 6–7/4 | Light reddish brown | |
| | 2 | Medium coarse | Red monochrome | Wiped | Wiped | 5YR 6/6 | Reddish yellow | 5YR 6/6 | Reddish yellow | |
| | 2 | Medium fine | Red monochrome | Wiped | Burnished | 2.5YR 5/4–2 | Reddish brown | 2.5YR 5/4–2 | Reddish brown | |
| | 2 | Medium coarse | Red monochrome | Smoothed | Burnished | 5YR 6/6 | Reddish yellow | 5YR 6/4 | Light reddish brown | |
| | 2 | Medium coarse | Dark monochrome | Wiped | Smoothed | 5YR 5/4 | Reddish brown | 5YR 6/1 | Grey | |
| | 2 | Medium fine | Red monochrome | Burnished | Burnished | 5YR 5/6 | Yellowish red | 5YR 5/6 | Red | |
| | 1 | Medium coarse | Red monochrome | Smoothed | Smoothed | 5YR 6/4 | Light reddish brown | 2.5YR 5/6 | Red | |
| | 2 | Medium coarse | ‘Scraped’ | Burnished | Burnished | 5YR 7/4 | Pink | 5YR 6/6 | Reddish yellow | 2.5YR 5/4–6 |
| Interior part, light grey | 1 | Medium fine | Dark monochrome | Worn | Smoothed | 5YR 5/3 | Reddish brown | 5YR 5/3 | Reddish brown | |
| Interior part, light grey | 1 | Fine | ‘Scraped’: v-shaped, diagonal lines | Wiped | Burnished | | | 7.5YR 7/6 | Reddish yellow | 7.5YR 7/4 |
| Pink | 1 | Medium coarse | Dark monochrome | Wiped | Wiped | 5YR 7/3 | Pink | 5YR 4/1–5/1 | Grey | |
| | 1 | Medium coarse | White slipped | Wiped | Burnished | 5YR 7/3 | Pink | 5YR 7/3 | Pink | |
| | 1 | Medium fine | Red monochrome | Wiped | | 5YR 7/4 | Pink | 5YR 6/6 | Reddish yellow | |
| | 1 | Coarse | White slipped | Wiped | Wiped | 5YR 7/4 | Pink | 5YR 7/4 | Pink | |
| | 2 | Medium fine | Red monochrome | Wiped | Burnished | 5YR 6/4 | Light reddish brown | 5YR 6/4 | Light reddish brown | |
| | 2 | Medium fine | Red monochrome | Wiped | Wiped | 5YR 6/4 | Reddish brown | 5YR 6/4 | Reddish brown | |
| | 1 | Medium fine | ‘Scraped’: diagonal lines | Burnished | Burnished | 5YR 7/3 | Pink | 5YR 7/3 | Pink | 5YR 5/3 |
| | 2 | Coarse | Red monochrome | Smoothed | Smoothed | 5YR 6/4 | Light reddish brown | 5YR 7/4 | Pink | |
| | 1 | Medium fine | Dark monochrome | | | | | | | |
| | 2 | Medium fine | Red monochrome coarse | Smoothed | Smoothed | 2.5YR 6/6 | Light red | | | |

| PM no. | Figure | BPh BSPh | EU/SU | Preser-vation | Produc-tion detail | Diam 1 [cm] | Diam 2 [cm] | Thick-ness [cm] | Weight [g] | Clay colour Munsell | Clay colour |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1028 | V.5.3.22 | VIIb | EU 252 SU 141 | 100% | Smoothed | 4.1 | 3.9 | 1.2 | 25 | 2.5YR 6/6 | Light red |
| 1029 | V.5.3.23 | VIIb | EU 252 SU 141 | 100% | Smoothed | 4.4 | 3.8 | 1.1 | 23 | 5YR 6/6 | Reddish yellow |
| 1030 | V.5.3.24 | VIIb | EU 252 SU 141 | 100% | Chipped | 5.2 | 4.8 | 0.7 | 26 | 2.5YR 6/6 | Light red |
| 1031 | V.5.3.25 | VIIb | EU 252 SU 141 | 100% | Chipped | 5.8 | 5.3 | 0.9–1 | 41 | 2.5YR 5/6 | Red |
| 1032 | V.5.3.26 | VIIb | EU 252 SU 141 | 100% | Chipped | 6.9 | 6.3 | 1 | 58 | 5YR 7/4 | Pink |
| 1033 | V.5.3.27 | VIIb | EU 252 SU 141 | 100% | Well smoothed | 7.3 | 7.3 | 1.3 | 95 | 5YR 6/8 | Reddish yellow |
| 1034 | V.5.3.28 | VIIb | EU 251 SU 141 | 100% | Well smoothed | 3.7 | 3.4 | 0.6 | 12 | 5YR 7/6 | Reddish yellow |
| 1035 | V.5.3.29 | VIIb | EU 251 SU 141 | 100% | Chipped | 4.6 | 4.5 | 1.2 | 30 | 2.5YR 5/8 | Red |
| 1036 | V.5.3.30 | VIIb | EU 251 SU 141 | 100% | Chipped, two oppo-site sides smoothed | 4.7 | 4.4 | 1.2 | 35 | 5YR 6/6 | Reddish yellow |
| 1037 | V.5.3.31 | VIIb | EU 251 SU 141 | 100% | Chipped | 4.8 | 5.1 | 0.9–1.1 | 37 | 5YR 6/6 | Reddish yellow |
| 1038 | V.5.3.32 | VIIb | EU 251 SU 141 | 100% | Chipped, slightly smoothed | 6 | 6 | 1–1.4 | 58 | 5YR 6/4 | Light reddish brown |
| 1039 | V.5.3.33 | VIIb | EU 251 SU 141 | 100% | Chipped | 6.2 | 6.8 | 1.2–1.5 | 62 | 2.5YR 6/8 | Red |
| 1040 | V.5.3.34 | VIIb | EU 251 SU 141 | 100% | Slightly smoothed | 7 | 6.5 | 1.1–1.5 | 82 | 5YR 7/4 | Pink |
| 1041 | V.5.3.35 | VIIb | EU 251 SU 141 | 100% | Chipped, partly smoothed | 1.9 | 1.9 | 0.6 | 2 | 5YR 6/6 | Reddish yellow |
| 1046 | V.5.3.36 | VIIb | EU 252 SU 141 | 100% | Chipped | 3.7 | 3.7 | 0.5 | 11 | 5YR 6/1 | Grey |
| 1042 | V.5.3.37 | VIIc | EU 253 SU 142 | 100% | Smoothed | 4 | 3.7 | 1.2–1 | 21 | 5YR 6/6 | Reddish yellow |
| 1043 | V.5.3.38 | VIIc | EU 253 SU 142 | 100% | Smoothed | 5.3 | 5 | 1.2 | 47 | 5YR 5/6 | Yellow-ish red |
| 1044 | V.5.3 .39 | VIIc | EU 253 SU 142 | 100% | Chipped | 6.7 | 6.1 | 1.2 | 61 | 5YR 6/6 | Reddish yellow |
| 1047 | V.5.3.40 | VIIc | EU 255 SU 152 | 15% | Well smoothed | 6 | | 1.6 | 18 | 5YR 6/6 | Reddish yellow |
| 1048 | V.5.3.41 | VIIc | EU 255 SU 152 | 50% | Chipped | 5.2 | | 1.2 | 18 | 2.5YR 5/6 | Red |
| 1049 | V.5.3.42 | VIIc | EU 255 SU 152 | 7%? | Chipped | 5 | | 1.7 | 24 | 2.5YR 5/8 | Red |
| 1050 | V.5.3.43 | VIIc | EU 255 SU 152 | 100% | Chipped | 5.4 | 4.8 | 0.8–1.1 | 33 | 5YR 5/6 | Yellow-ish red |

| Core shape Core colour | Fabric | Fabric detail | Ware | Surface treat int. | Surface treat ext. | Slip/surface int. Munsell | Slip/surface int. colour | Slip/surface ext. Munsell | Slip/surface ext. colour | Decoration colour |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | Medium coarse | Red monochrome | Smoothed | Burnished | 5YR 8/4 | Pink | 2.5YR 5/4 | Reddish brown | |
| | 1 | Medium coarse | Dark monochrome | Smoothed | Burnished | 5YR 7/4 | Pink | 5YR 4/3 | Reddish brown | |
| | 2 | Medium fine | Red monochrome | Wiped | Burnished | No | None | 2.5YR 5/6 | Red | |
| Thin, grey | 1 | Medium coarse | Red monochrome coarse | Burnished | Burnished | 2.5YR 5/4 | Reddish brown | 2.5YR 6/4 | Light reddish brown | |
| | 1 | Medium coarse | White slipped | Smoothed | Burnished | None | None | 5YR 7/4 | Pink | |
| | 1 | Medium coarse | White slipped | Smoothed | Smoothed | 5YR 7/4 | Pink | 5YR 7/4 | Pink | |
| | 1 | Fine | White slipped | Smoothed | Burnished | 5YR 7/4 | Pink | 5YR 7/4 | Pink | |
| | 2 | Coarse | White slipped | Unfinished | Smoothed | | | 2.5YR 6/6 | Light red | |
| Medium, light grey | 2 | Medium coarse | Red monochrome | Burnished | Burnished | 2.5YR 5/6 | Red | 2.5YR 5/6 | Red | |
| Thin, grey | 1 | Medium fine | Red on white | Smoothed | Smoothed | 5YR 8/3 | Pink | 5YR 7/4 | Pink | Red |
| | 2 | Medium coarse | Dark monochrome | Burnished | Burnished | 5YR 5/6 | Yellowish red | 5YR 4/3 | Reddish brown | |
| | 2 | Medium coarse | White slipped | Smoothed | Smoothed | 2.5YR 6/6 | Light red | 2.5YR 6/6 | Light red | |
| | 1 | Medium fine | Dark monochrome | Smoothed/ burnished | Smoothed/ burnished | 5YR 8/4 | Pink | 5YR 6/4 | Light reddish brown | |
| | 1 | Medium fine | Red on white: parallel lines | Burnished | Burnished | 5YR 7/6 | Reddish yellow | 5YR 7/6 | Reddish yellow | 2.5YR 5/4 |
| | 1 | Fine | Grey painted: vertical parallel lines | Burnished | Burnished | 5YR 7/1 | Light grey | 5YR 7/1 | Light grey | 5YR 6/6 Reddish yellow |
| | 1 | Medium coarse | Dark monochrome | Smoothed | Burnished | 5YR 6/4 | Light reddish brown | 5YR 5/3 | Reddish brown | |
| | 2 | Coarse | Dark monochrome | Smoothed | Smoothed | 5YR 5/4 | Reddish brown | 5YR 5/4 | Reddish brown | |
| | 2 | Medium coarse | Red monochrome | Unfinished | Unevenly smoothed | 2.5YR 5/4 | Reddish brown | 5YR 6/4 | Light reddish brown | |
| | 2 | Medium coarse | | Wiped/ smoothed | Wiped/ smoothed | | | | | |
| | 2 | Coarse | White slipped | Wiped | Wiped | 5YR 7/6 | Reddish yellow | 5YR 7/3 | Pink | |
| | 1 | Medium fine | Red monochrome | Smoothed | Smoothed | | Red | | Red | |
| | 1 | Medium coarse | Dark burnished | Wiped | Burnished | 5YR 6/4 | Light reddish brown | 5YR 5/4 | Reddish brown | |

| PM no. | Figure | BPh BSPh | EU/SU | Preser-vation | Produc-tion detail | Diam 1 [cm] | Diam 2 [cm] | Thick-ness [cm] | Weight [g] | Clay colour Munsell | Clay colour |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1051 | V.5.3.44 | VIIc | EU 255 SU 152 | 100% | Well smoothed | 4.9 | 4.5 | 1–1.2 | 34 | 2.5YR 5/8 | Red |
| 1052 | V.5.3.45 | VIIc | EU 255 SU 152 | 100% | Smoothed | 5.2 | 5.2 | 1.1–1.3 | 48 | 5YR 6/6 | Reddish yellow |
| 1053 | V.5.3.46 | VIIc | EU 255 SU 152 | 100% | Chipped | 7 | 7 | 1.8–2 | 125 | 5YR 7/4 | Pink |
| 1054 | V.5.3.47 | VIIc | EU 255 SU 152 | 100% | Chipped, one point-ed edge | 7.8 | 6.5 | 0.8–1.3 | 67 | 2.5YR 5/6 | Red |
| 1055 | V.5.3.48 | VIIc | EU 255 SU 152 | 100% | Chipped, slightly smoothed, one point-ed edge | 8.4 | 6.9 | 1 | 101 | 2.5YR 6/6 | Light red |
| 1056 | V.5.3.49 | VIIc | EU 256 SU 151 | 100% | Chipped | 4.3 | 4.3 | 1.7 | 42 | 5YR 6/4 | Light reddish brown |
| 1057 | V.5.3.50 | VIIc | EU 256 SU 151 | 30% | Smoothed | 6.8 | | 1.1 | 35 | 5YR 6/6 | Reddish yellow |
| 0407 | V.5.3.51 | VIII | SU 161 | 100% | Chipped, slightly smoothed | 5.1 | | 0.6–0.8 | 30.9 | 5YR 5/4 | Reddish brown |
| 0415 | V.5.3.52 | VIII | SU 161 | 95% | Well smoothed | 7 | 7 | 1.8 | 115.4 | 5YR 5/6 | Yellow-ish red |
| 0425 | V.5.3.53 | VIII | SU 160 | 100% | Smoothed | 3.7 | 3.7 | 0.9 | 17.6 | 5YR 6/6 | Reddish yellow |
| 0426 | V.5.3.54 | VIII | SU 160 | 100% | Chipped, one side smoothed | 2.9 | 2.7 | 2.1–0.9 | 10.8 | 5YR 6/8 | Reddish yellow |
| 0427 | V.5.3.55 | VIII | SU 160 | 100% | Smoothed | 2.2 | 2.2 | 1.1 | 7 | 5YR 6/6 | Reddish yellow |
| 1058 | V.5.3.56 | VIII | EU 260 SU 153 | 40% | Well smoothed | 4.7 | | 1.1 | 24 | 5YR 6/6 | Reddish yellow |
| 1059 | V.5.3.57 | VIII | EU 260 SU 153 | 100% | Smoothed | 5.2 | 5.2 | 1.2 | 40 | 5YR 5/1 | Grey |
| 1060 | V.5.3.58 | VIII | EU 260 SU 153 | 100% | Smoothed | 5.4 | 5.2 | 1.3–1 | 44 | 5YR 6/6 | Reddish yellow |
| 1061 | V.5.3.59 | VIII | EU 260 SU 153 | 80% | Smoothed | 7 | 6.7 | 1.3–1.5 | 91 | 5YR 6/8 | Reddish yellow |
| 1062 | V.5.3.60 | VIII | EU 260 SU 153 | 100% | Chipped, partly smoothed | 7.2 | 7.2 | 1.1 | 79 | 5YR 5/6 | Yellow-ish red |
| 1063 | V.5.3.61 | VIII | EU 258 SU 153 | 30% | Well smoothed | 5 | | 0.9 | 21 | 5YR 6/6 | Reddish yellow |
| 1064 | V.5.3.62 | VIII | EU 261 SU 161 | 90% | Chipped | 4.3 | 3.9 | 1 | 20 | 5YR 6/6 | Reddish yellow |
| 1065 | V.5.3.63 | VIII | EU 261 SU 161 | 100% | Chipped | 5.5 | 5.5 | 1 | 39 | 5YR 6/4 | Light red brown |
| 1066 | V.5.3.64 | VIII | EU 261 SU 161 | 95% | Smoothed | 5.5 | 5.2 | 0.9–1.1 | 42 | 5YR 6/6 | Reddish yellow |

| Core shape Core colour | Fabric | Fabric detail | Ware | Surface treat int. | Surface treat ext. | Slip/surface int. Munsell | Slip/surface int. colour | Slip/surface ext. Munsell | Slip/surface ext. colour | Decoration colour |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | Medium coarse | White slipped | Worn | Smoothed | 5YR 7/3 | Pink | 5YR 8/2 | White | |
| | 2 | Medium coarse | White slipped | Wiped | Smoothed | 5YR 8/2 | White | 5YR 8/2 | White | |
| Thick, grey | 1 | Medium fine | Dark monochrome | Smoothed | Smoothed | 5YR 6/4 | Light reddish brown | 5YR 5/4 | Reddish brown | |
| | 1 | Medium coarse | Red monochrome | Unfinished | Smoothed | 2.5YR 5/6 | Red | 2.5YR 5/6 | Red | |
| Exterior, grey | 1 | Medium fine | Red monochrome/ white slipped | Smoothed | Smoothed/ burnished | 2.5YR 6/6 | Light red | 5YR 7/3 | Pink | Part of a flat base |
| | 2 | Medium coarse | Dark monochrome | Smoothed | Smoothed | 5YR 6/4 | Light reddish brown | 5YR 5/3 | Reddish brown | |
| | 2 | Medium coarse | Red monochrome | Smoothed | Worn | 2.5YR 5/4 | Reddish brown | 2.5YR 5/4 | Reddish brown | |
| 5YR 4/6 | 2 | Medium fine | Red monochrome | Wiped | Burnished | 5YR 5/4 | Reddish brown | 5YR 5/6 | Yellowish red | |
| | 1 | Coarse | Dark monochrome | Smoothed | Smoothed | 5YR 5/4 | Reddish brown | 5YR 5/4 | Reddish brown | |
| | 1 | Medium coarse | Red monochrome | Wiped | Wiped | 5YR 6/4 | Light reddish brown | 5YR 6/4 | Light reddish brown | |
| | 1 | Medium coarse | Red monochrome | Wiped | Wiped | 2.5YR 5/6 | Red | 2.5YR 5/6 | Red | |
| | 1 | Medium fine | Dark monochrome | Wiped | Smoothed | 5YR 5/3 | Reddish brown | 5YR 4/3 | Reddish brown | |
| | 1 | Fine | Red monochrome | Smoothed | Burnished | 2.5YR 5/6 | Red | 2.5YR 5/6 | Red | |
| | 1 | Fine | Grey monochrome | Smoothed | Burnished | 5YR 6/1 | Grey | 5YR 6/1 | Grey | |
| | 2 | Medium coarse | White slipped | Wiped | Smoothed | 5YR 7/3 | Pink | 5YR 7/3 | Pink | |
| | 2 | Coarse | Dark monochrome | Smoothed | Smoothed | 5YR 5/4 | Reddish brown | 5YR 4/3 | Reddish brown | |
| | 2 | Medium coarse | Dark monochrome | Burnished | Smoothed | 5YR 5/3 | Reddish brown | 5YR 5/4 | Reddish brown | |
| Thin, grey | 1 | Medium coarse | Dark monochrome | Burnished | Burnished | 5YR 5/3 | Reddish brown | 5YR 5/3 | Reddish brown | |
| Thin, grey | 1 | Medium fine | Red monochrome | Burnished | Burnished | 5YR 8/1 | Pinkish white | 2.5YR 5/8 | Red | |
| | 2 | Medium coarse | Dark monochrome | Wiped | Burnished | 5YR 7/3 | Pink | 5YR 5/3 | Reddish brown | |
| Outer part, greyish | 2 | Medium coarse | Dark monochrome | Smoothed | Burnished | 5YR 5/4 | Reddish brown | 5YR 5/2 | Reddish grey | |

| PM no. | Figure | BPh BSPh | EU/SU | Preser-vation | Produc-tion detail | Diam 1 [cm] | Diam 2 [cm] | Thick-ness [cm] | Weight [g] | Clay colour Munsell | Clay colour |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1067 | V.5.3.65 | VIII | EU 261 SU 161 | 100% | Chipped, partly smoothed | 5.9 | 5.9 | 0.8–1 | 40 | 5YR 6/6 | Reddish yellow |
| 1068 | V.5.3.66 | VIII | EU 261 SU 161 | 100% | Well smoothed | 6 | 6 | 1.2–1.3 | 54 | 5YR 6/6 | Reddish yellow |
| 1073 | V.5.3.67 | VIII | EU 263 SU 161? | 50% | Chipped | 4.9 | | 0.5 | 10 | 5YR 6/6 | Reddish yellow |
| 1074 | V.5.3.68 | VIII | EU 263 SU 161? | 90% | Smoothed | 7.2 | 6.9 | 1.3 | 82 | 5YR 6/6 | Reddish yellow |
| 1075 | V.5.3.69 | VIII | EU 265 SU 161 | 30% | Well smoothed | 3.5 ? | | 0.4 | 5 | 5YR 7/4 | Pink |
| 1076 | V.5.3.70 | VIII | EU 265 SU 161 | 50% | Chipped | 5 | | 1–1.3 | 20 | 5YR 4/2 | Dark reddish grey |
| 1077 | V.5.3.71 | VIII | EU 278 SU 161 | 100% | Chipped | 4.5 | 4 | 1–1.4 | 30 | 5YR 6/4 | Light reddish brown |
| 1078 | V.5.3.72 | VIII | EU 281 SU 161 | 40% | Well smoothed | 8 | | 1–1.2 | 33 | 2.5YR 5/6 | Red |
| 1079 | V.5.3.73 | VIII | EU 281 SU 161 | 100% | Chipped | 4.2 | 4 | 1.5–1.2 | 33 | 5YR 6/6 | Reddish yellow |
| 1080 | V.5.3.74 | VIII | EU 281 SU 161 | 100% | Well smoothed | 3.4 | 3 | 0.4 | 8 | 5YR 7/1 | Light grey |
| 1081 | V.5.3.75 | VIII | EU 283 | 10% | Well smoothed | 6.5 | | 1.2 | 7 | 5YR 6/6 | Reddish yellow |
| 1082 | V.5.3.76 | VIII | EU 283 | 90% | Chipped | 5.7 | 5.8 | 0.9–1.1 | 37 | 5YR 6/1 | Grey |
| 1083 | V.5.3.77 | VIII | EU 283 | 100% | Smoothed | 4.5 | 4.2 | 1 | 24 | 5YR 6/4 | Light reddish brown |
| 1084 | V.5.3.78 | VIII | EU 283 | 90% | Chipped/ slightly smoothed | 6.1 | 5.8 | 0.6–1.2 | 31 | 7.5YR 6/2 | Pinkish grey |
| 1085 | V.5.3.79 | VIII | EU 283 | 95% | Chipped | 6.3 | 5.7 | 1.3 | 61 | 2.5YR 5/6 | Red |
| 1086 | V.5.3.80 | VIII | | 100% | Chipped/ slightly smoothed | 8 | 7.3 | 1.4 | 118 | 5YR 6/6 | Reddish yellow |
| 1087 | V.5.3.81 | VIII | | 75% | Well smoothed | 6.2 | | 1.5 | 62 | 2.5YR 5/6 | Red |
| 1088 | V.5.3.82 | VIII | | 40% | Smoothed | 5 | | 1.3–1.5 | 18 | 5YR 6/6 | Reddish yellow |
| 1089 | V.5.3.83 | VIII | | 100% | Chipped | 5.8 | 5.8 | 1 | 45 | 5YR 6/6 | Reddish yellow |
| 1090 | V.5.3.84 | VIII | | 100% | Chipped | 5.7 | 5.1 | 1.1–1.3 | 50 | 5YR 6/6 | Reddish yellow |
| 1091 | V.5.3.85 | VIII | | 100% | Smoothed | 6.6 | 6.8 | 1.1–1.8 | 97 | 5YR 7/6 | Reddish yellow |

| Core shape Core colour | Fabric | Fabric detail | Ware | Surface treat int. | Surface treat ext. | Slip/surface int. Munsell | Slip/surface int. colour | Slip/surface ext. Munsell | Slip/surface ext. colour | Decoration colour |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | Medium coarse | Red mono--chrome | Smoothed | Smoothed | 2.5YR 5/6 | Red | 2.5YR 5/4 | Reddish brown | |
| | 1 | Medium coarse | Dark monochrome | Smoothed | Smoothed | 5YR 5/3 | Reddish brown | 5YR 5/3 | Reddish brown | |
| Thick, 5YR 5/2 | 1 | Medium fine | Red monochrome | Burnished | Burnished | 2.5YR 5/6 | Red | 5YR 7/4 | Pink | |
| | 1 | Medium coarse | Red monochrome | Smoothed | Burnished | 2.5YR 5/6 | Red | 5YR 7/3 | Pink | |
| | 1 | Fine | Red monochrome | Burnished | Burnished | 2.5YR 5/6 | Red | 2.5YR 5/6 | Red | |
| | 1 | Medium fine to coarse | White slipped | Smoothed | Burnished | 5YR 8/2 | Pinkish white | 5YR 8/2 | Pinkish white | |
| Inner part, 5YR 4/2 | 1 | Medium coarse | White slipped | Smoothed | Smoothed | 5YR 7/3 | Pink | 5YR 7/3 | Pink | |
| | 2 | Coarse | White slipped | Smoothed | Smoothed | 5YR 7/4 | Pink | 5YR 7/4 | Pink | |
| Inner part, 5YR 4/2 | 1 | Medium coarse | Dark monochrome | Smoothed | Smoothed | 5YR 5/3 | Reddish brown | 5YR 6/4 | Light reddish brown | |
| | 1 | Fine | Grey on grey: parallel lines: 1 thick, 4 thin lines | Burnished | Burnished | 5YR 7/1 | Light grey | 5YR 7/1 | Light grey | 5YR 5/1 |
| | 1 | Coarse | Dark monochrome | Smoothed | Smoothed | 5YR 5/2 | Reddish grey | 5YR 5/2 | Reddish grey | |
| | 1 | Fine | Red on white: linear design | Burnished | Burnished | 5YR 8/2 | Pinkish white | 5YR 8/2 | Pinkish white | Red/ brown |
| | 2 | Medium coarse | Dark monochrome | Burnished | Burnished | 5YR 5/3 | Reddish brown | 5YR 5/3 | Reddish brown | |
| | 1 | Fine | Grey monochrome | Burnished | Smoothed/ burnished | 7.5YR 7/2 | Pinkish grey | 7.5YR 7/2 | Pinkish grey | |
| | 1 | Medium coarse | Red monochrome | Smoothed | Smoothed | 2.5YR 5/8 | Red | 2.5YR 5/2 | Weak red | |
| | 2 | Medium fine | Red monochrome | Worn | Worn | 2.5YR 5/8 | Red | 2.5YR 5/8 | Red | |
| | 1 | Medium coarse | Red monochrome | Smoothed | Worn | 2.5YR 5/6 | Red | 2.5YR 5/6 | Red | |
| | 1 | Medium fine | Red monochrome | Smoothed | Smoothed, worn | 2.5YR 5/2 | Weak red | 2.5YR 5/6 | Red | |
| Thick, dark red | 1 | Medium fine | Dark monochrome? | Wiped | Smoothed, worn | 2.5YR 5/4 ? | Reddish brown | 2.5YR 5/4 ? | Reddish brown | |
| | 1 | Medium coarse | Red monochrome | Wiped | Smoothed | 5YR 7/4 | Pink | 2.5YR 5/6 | Red | |
| Outer part, black | 1 | Coarse | Red monochrome | Worn | Worn | ? | ? | 2.5YR 5/8 | Red | |

Fig. V.5.3.a Rounded sherds: (1) PM0319, (2) PM0913, (3) PM0915, (4) PM0916, (5) PM0921, (6) PM0922, (7) PM0937, (8) PM0941 from BSPh IIIa–c, IVb and Ve (MN I) (photos: K.-V. von Eickstett)

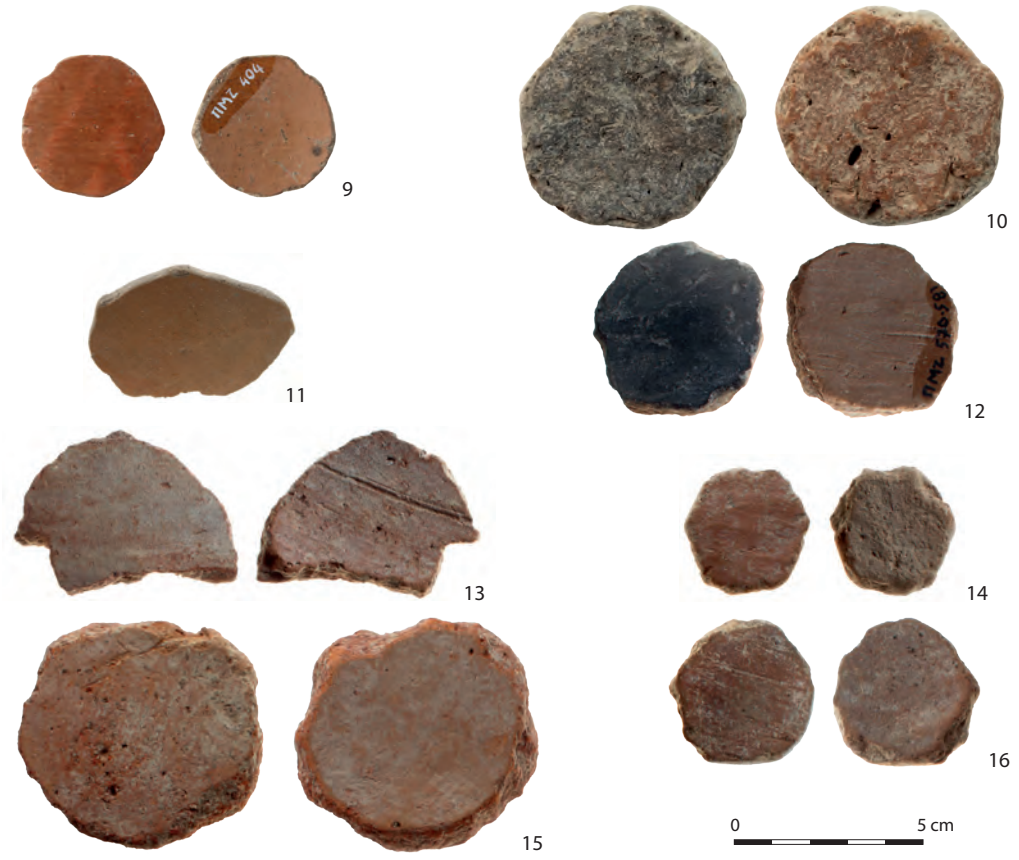



Fig. V.5.3.b Rounded sherds: (9) PM0676, (10) PM0990, (11) PM0961, (12) PM1002, (13) PM1008, (14) PM1009, (15) PM1015, (16) PM0553 from BSPh VIa and VIb (MN III) (photos: K.-V. von Eickstett)

Fig. V.5.3.c Rounded sherds: (17) PM1016, (18) PM1022, (19) PM1025, (20) PM1026, (21) PM1027 from BSPh VIIb (LN I: SU 135 and 136) (photos: K.-V. von Eickstett)

Fig. V.5.3.d Rounded sherds: (22) PM1028, (23) PM1029, (24) PM1030, (25) PM1031, (26) PM1032, (27) PM1033, (28) PM1034, (29) PM1035 from BSPh VIIb (LN I: SU 141) (photos: K.-V. von Eickstett)

Fig. V.5.3.e Rounded sherds: (30) PM1036, (31) PM1037, (32) PM1038, (33) PM1039, (34) PM1040, (35) PM1041, (36) PM1046 from BSPh VIIb (LN I: SU 141); (37) PM1042, (38) PM1043, (39) PM1044 from BSPh VIIc (LN I: SU 142) (photos: K.-V. von Eickstett)

Fig. V.5.3.f Rounded sherds: (40) PM1047, (41) PM1048, (42) PM1049, (43) PM1050, (44) PM1051, (45) PM1052, (46) PM1053, (47) PM1054, (48) PM1055, (49) PM1056, (50) PM1057 from BSPh VIIc (LN I: SU 151 and 152) (photos: K.-V. von Eickstett)

Fig. V.5.3.g Rounded sherds: (51) PM0407, (52) PM0415, (53) PM0425, (54) PM0426, (55) PM0427, (56) PM1058; (57) PM1059, (58) PM1060, (59) PM1061, (60) PM1062, (61) PM1063 from BPh VIII (LN I: SU 153) (photos: K.-V. von Eickstett)

Fig. V.5.3.h Rounded sherds: (62) PM1064, (63) PM1065, (64) PM1066, (65) PM1067, (66) PM1068, (67) PM1073, (68) PM1074, (69) PM1075, (70) PM1076, (71) PM1077, (72) PM1078, (73) PM1079, (74) PM1080 from BPh VIII (LN I: SU 160 and 161) (photos: K.-V. von Eickstett)

Fig. V.5.3.i Rounded sherds: (75) PM1081, (76) PM1082, (77) PM1083, (78) PM1084, (79) PM1085, (80) PM1086, (81) PM1087, (82) PM1088, (83) PM1089, (84) PM1090, (85) PM1091 from BPh VIII (LN I) (photos: K.-V. von Eickstett)

### V.5.4. Eight-shaped Sherd Tools

Two sherds chipped to an elongated shape with incurved sides have been identified at PMZ. In consequence, these sherds were most probably used secondarily for the working of surfaces. From their shape, they could also have served for twisting a thread around them, similarly to the rounded sherds which Cartland has identified in Egypt. Otherwise, similar items have been addressed as net sinkers.[649]

#### *Catalogue*

*PM0925*. Fig. V.5.4.1. EU 193, SU 67–69 or 73, BSPh IVb. Preservation 90%. Measurements: length 6.9cm, width 5.1cm, thickness 0.8cm. Clay: ext. 7.5YR 6/6 reddish yellow, int. 7.5YR 6/2 pinkish grey. Surface: ext. 7.5YR 6/6 reddish yellow, int. 7.5YR 6/2 pinkish grey, ext. + int. slightly burnished.

*PM0997*. Fig. V.5.4.2. EU 221. SU 126. Preservation: 85%. Measurements: length 9.2cm, width 5.3cm, thickness 1cm. Weight: 77g. Clay: ext. 7.5YR 7/6 reddish yellow, int. 7.5YR 6/2 pinkish grey, inclusions: 7.5%, very well sorted, many silver mica, many white, red and dark small inclusions. Surface: ext. 7.5YR 7/6 reddish yellow, int. 7.5YR 6/2 pinkish grey, ext. + int. slightly burnished.

Figs. V.5.4 Eight-shaped sherd tools (1) PM0925, (2) PM0997 (photos: K.-V. von Eickstett, drawings: S. Horwath)

### V.5.5. Sherd Burnishers

On ten sherds at least one (PM0920, PM0940, PM0944, PM1012, PM1018?, PM1021?), sometimes two (PM0923, PM0926) or even three parts (PM0914) of their breaks have been smoothed. The other sides of the sherds show sharp fractures. Characteristically, for the production of these implements usually fine ware pottery sherds were used, most probably because their fine texture was favourable for their secondary use. Based on the smoothed breaks and their consistency they were used as burnishing tools, and their size and their shape also meant they were ideal for handling. Similar implements were identified by Maria Pantelidou Gofa at Nea Makri.[650] Just one specimen from PMZ has a more pointed edge and may also have been used as a borer (PM0926).

[650] Pantelidou Gofa 1993.

Fig. V.5.5 Sherd burnishers: (1) PM0914 from BSPh IIIa; (2) PM0920, (3) PM0923, (4) PM0926 from BSPh IVb; (5) PM0940 from BSPh Ve; (6) PM0944 from BSPh VIa; (7) PM1012, (8) PM1018, (9) PM1021 from BSPh VIIa; (10) PM1045 from BSPh VIIc (photos: M. Börner, drawings: S. Horwath)

*Catalogue*

| PM number | Figure | BPh BSPh | EU/SU | Preser-vation | Production detail | Diam 1 [cm] | Diam 2 [cm] | Thickness [cm] | Weight [g] | Clay colour Munsell |
|---|---|---|---|---|---|---|---|---|---|---|
| 0914 | V.5.5.1 | IIIa | EU 183 SU 24 | 100% | Three sides smoothed | 3.8 | 3.7 | 0.4 | 9.0 | 5YR 5/6 |
| 0920 | V.5.5.2 | IVb | EU 192 SU 69 | 100% | One side smoothed | 6.5 | 3.3 | 0.4 | 19.6 | 5YR 5/6 |
| 0923 | V.5.5.3 | IVb | EU 192 SU 69 | 100% | Two sides smoothed | 6.7 | 3.9 | 0.5 | 18.0 | 5YR 5/6 |
| 0926 | V.5.5.4 | IVb | EU 193 SU 69 | 80% | Two sides smoothed | 4.4 | 3.3 | 0.3 | 8.3 | 5YR 5/6 |
| 0940 | V.5.5.5 | Ve | EU 208 SU 112 | 50% | One side smoothed | 4.7 | 4.3 | 0.6 | 17.0 | 5YR 5/6 |
| 0944 | V.5.5.6 | VIa | EU 211 SU 120 | 100% | One side smoothed | 6.4 | 5.6 | 0.6 | 30.0 | 5YR 5/8 |
| 1012 | V.5.5.7 | VIIa | EU 231 SU 127 | 100% | One side smoothed | 7.3 | 4.2 | 0.7 | 27 | 5YR 6/1 |
| 1018 | V.5.5.8 | VIIa | EU 236 SU 127 | 100% | Fracture on upper side smoothed | 3.9 | 2 | 0.6 | 5 | 2.5YR 5/6 |
| 1021 | V.5.5.9 | VIIa | EU 238 SU 132 | Frag-mented | Fracture on upper side smoothed | 3.4 | 2.3 | 0.6 | 6 | 5YR 7/4 |
| 1045 | V.5.5.10 | VIIc | EU 253 SU 142 | Worn | Two sides smoothed | | 7 | 0.6 | 66 | 7.5YR 6/4 |

| Clay colour | Core colour | Fabric | Fabric detail | Ware | Surface treat int. | Surface treat ext. | Slip/ surface int. Munsell | Slip/ surface int. colour | Slip/ surface ext. Munsell | Slip/ surface ext. colour |
|---|---|---|---|---|---|---|---|---|---|---|
| Yellowish red | | 2 | Medium fine | Dark monochrome | Burnished | Burnished | 5YR 6/6 | Reddish yellow | 5YR 5/4 | Reddish brown |
| Yellowish red | | 2 | Medium coarse | Red monochrome | Smoothed | Burnished | 5YR 5/6 | Yellowish red | 5YR 5/6 | Yellowish red |
| Yellowish red | | 2 | Medium fine | ‘Scraped’ | Burnished | Burnished | 5YR 6/6 | Reddish yellow | 5YR 5/6 | Yellowish red |
| Yellowish red | | 2 | Medium fine | Red on white | Wiped | Burnished | 5YR 7/6 | Reddish yellow | 5YR 7/4 | Pink Dec. Red |
| Yellowish red | | 1 | Fine | Red monochrome | Unfinished | Burnished | 5YR 5/6 | Yellowish red | 5YR 5/4 | Reddish brown |
| Yellowish red | | 2 | Medium fine | Red monochrome | Scraped | Wiped | 5YR 6/4 | Light red-dish brown | 5YR 5/8 | Yellowish red |
| Grey | | 1 | Fine | Grey monochrome | Burnished | Burnished | 5YR 6–5/1 | Grey | 5YR 6–5/1 | Grey |
| Red | | 1 | Medium coarse | burnished | Burnished | Burnished | | | | |
| Pink | | 2 | Fine | Red monochrome | Burnished | Burnished | | | 2.5YR 5/6 | Red |
| Light brown | Grey | 1 | | Coarse Ware | Smoothed | Smoothed | | | | |

# VI. Figurines, House Model and Ritual Vessels

*Eva Alram-Stern*

## VI.1. Introduction

Trench A of PMZ produced 43 single pieces of figurines and ritual vessels, including the special find of the house model, its figurines and objects.[650] The house model is the most important find, and differs from the other figurines as regards their context, style, decoration and completeness. Therefore, they will be treated more fully in a separate comprehensive chapter which puts emphasis on its deposition, use and meaning.

This trench represents a stratigraphic sequence that allows us to assign the artefacts to building phases, which are correlated by radiocarbon data and pottery with the Middle Neolithic sequence, including the MN III and LN I (Tsangli-Larissa phase).

Following the stratigraphy, the catalogue of figurines is arranged according to the building phases and stratigraphic units of the site. This allows manufacturing and typological characteristics to be considered as well as depositional practices over time. In addition, based on typology, the figurines are examined in relation to comparable finds in Thessaly and beyond, elaborating local or regional similarities and differences.

## VI.2. Anthropomorphic Figurines

### VI.2.1. Fabric, Manufacture, Decoration

*Fabric*

As for pottery, a determination of fabrics is important for identifying local and non-local clay sources to distinguish items produced in the area of PMZ or in more distant areas. However, for figurines, archaeometric investigations were beyond the scope of this publication. Therefore, I have to refer to macroscopic observations which may be corrected by future scientific investigations.[651]

The fabrics of figurines vary in colour. Most Middle Neolithic figurines have a red or pink clay body. Just a few figurines, such as PM0892, Fig. VI.2 (BPh II), PM0733, Fig. VI.13 (BSPh Vd), PM0657, Fig. VI.15 (BSPh VIa), PM0645, Fig. VI.19 (BSPh VIb), PM1020, Fig. VI.26 (BSPh VIIa), the house model PM0912, Figs. VI.27–37 (BSPh VIIa), PM0327, Fig. VI.38 (Early Bronze Age pit) and PM0329, Fig. VI.39 (Early Bronze Age pit) have a grey fabric. This shows that the

[650] I am most grateful to Kostas Gallis, who has handed the material to me for publication. I am indebted to Giorgos Toufexis (Ephorate of Larissa) for discussion, to Argyris Fassoulas and Nektaria Alexiou for sharing with me their unpublished works on Thessalian Neolithic figurines, and to Nancy Krahtopoulou for providing me with unpublished information on figurines from her surveys. Furthermore, I am most grateful to Catherine Perlès and Tracey Cullen, who have discussed this chapter with me extensively.

[651] Argyris Fassoulas is planning x-ray analyses as well as thin sections of figurines from PMZ.

number of figurines made of grey fabric increases during the settlement sequence of PMZ. Some of them (PM0645 [Fig. VI.19], PM1020 [Fig. VI.26] and PM0327 [Fig. VI.38]) are slipped so that their surface colour is different from their fabric colour.

Macroscopically, the fabric of most figurines is very similar concerning the inclusions, which consist of many fine sparkling, fine white and occasionally small dark inclusions. Therefore, they seem to fit with the petrographic fabrics defined by Areti Pentedeka.[652] Just a few figurines, i.e. the fragment of a figurine sitting on a stool PM0878 (Fig. VI.4), the arm of a red-on-white painted figurine PM0924 (Fig. VI.9) and the standing figurine PM0753 (Fig. VI.10) had golden, macroscopically visible inclusions. Therefore, these items may come from a clay source different from that of the other figurines.

*Manufacture*

According to a classification based on manufacture, Argyris Fassoulas distinguished figurines formed in one, two or three parts.[653] This classification, in combination with detailed observations on manufacture gives insight into production processes. However, since the figurines were not x-rayed, manufacturing in a certain number of parts cannot be proved, and therefore I have omitted such a categorisation.[654]

Macroscopically, some interesting forming details were visible, demonstrating that figurines were produced in parts:[655] the legs of the squatting figurine PM0892 (Fig. VI.2) and the two standing figurines PM0590 (Fig. VI.24) and PM0620 (Fig. VI.21) must have been added to the bodies of the figurines in a leather-hard state. For the two standing figurines in particular, the upper parts of the legs were well finished and they were only attached to the body by a thin layer of clay covering the entire body. This method of production results in a predictable fragmentation of figurines in certain parts.[656]

Figurine PM0725 (Fig. VI.12) is characterised by a deep cavity for inserting the head. This separate manufacture and inserting of the head have been noticed for figurines in Thessaly,[657] but it seems that it also belongs to transculturally dispersed techniques known from Anatolia.[658] The same figurine was formed around a core of perishable organic material, so that it now appears to be hollow, a feature also observed at other sites in Thessaly.[659] Furthermore, the arms and the breasts were formed separately and attached to the body.

In addition, figurines PM0016 (Fig. VI.40) and PM0873 (Fig. VI.3) show that they were built in layers, a thin layer of clay covering the entire surface of the figurine.[660] This technique is known for Thessaly, but has also been studied for Anatolia, and its distribution possibly goes back to common origins of the technique in the Neolithisation core area.[661] By contrast, an exchange of technical knowledge may have had an impact on the style of the figurines, which definitely differs in both regions.[662] The use of sticks as tools is visible on the underside of various figurines, and it produced concave bases, such as the figurines from the house model PM0912 (Figs. VI.27–28, VI.34–36).

652 Pentedeka in press.
653 Fassoulas 2017, 85–127; for forming in three parts: Chourmouziadis 1994, 60, fig. 4a.
654 X-ray and petrographic analyses are planned as a follow-up project, executed by Argyris Fassoulas.
655 Fassoulas 2017, 165–167, fig. 25.
656 For fragmentation see below.
657 Magoula Sykeon: Alexiou 2020, 153, fig. 9; Paliouri: Alexiou 2018, 190, fig. 12; Sykourion near Larissa: Rakatsanis – Kougkoulos 1990, 301, pls. 6–7; Chourmouziadis 1994, pls. 74–75.
658 On various types from Höyücek: Hansen 2007, pls. 69–73.
659 Fassoulas 2017, 170–174; Alexiou 2018, 185, fig. 6.
660 Chourmouziadis 1994, 57–63, figs. 4–5; Fassoulas 2017, 164–170, esp. figs. 24, 27.
661 Perlès 2001, 52–63.
662 For a technological analysis of comparable figurines in Anatolia: Pizzeghello et al. 2015.

*Decoration: Variability and Chronology*

Most of the surface treatment techniques of the figurines are comparable to the techniques known from pottery. Apart from a few dark monochrome figurines, the majority have a red monochrome surface.

In addition, there is also a large portion of figurines, mainly from the Middle Neolithic and occasionally from MN III and transitional MN III/LN I strata, with red paint on a white or buff slip (PM0878 [Fig. VI.4], PM0819 [Fig. VI.5], PM0830 [Fig. VI.6], PM847 [Fig. VI.7], PM0792 [Fig. VI.8], PM0924 [Fig. VI.9], PM0753 [Fig. VI.10], PM0737 [Fig. VI.14], PM0651 [Fig. VI.16], PM1014 [Fig. VI.20], PM0590 [Fig. VI.24]). This comparatively high number stands in contrast to pottery, in which red-on-white/buff painted fragments make up just a few per cent of the entire material.[663] This decoration does not reproduce the decorative design of a garment or body decoration but consists of blurs or thick lines highlighting the human body or animal figurines. At PMZ this patterned painted surface is often associated with figurines sitting on stools, so that this kind of decoration was not mere bodily decoration, but served to emphasise this kind of representation in relation to other figurines.[664] Furthermore, it was usually used on animal figurines or protomes.

In addition, the material includes figurines with fine incised decoration. They all come from MN III (Fig. VI.15 [PM0657]), or transitional MN III/LN I contexts (PM0620 [Fig. VI.21], PM1020 [Fig. VI.26], PM0912 [Figs. VI.27–37]: figurines from the house model), demonstrating that at PMZ this incised decoration developed during the Middle Neolithic period. In general, two kinds of incision are present: fine incised lines on a red monochrome surface (PM0725 [Fig. VI.12], PM1020 [Fig. VI.26]), and incisions consisting of short horizontal lines on a brown surface (leg PM0620 [Fig. VI.21], head PM0657 [Fig. VI.15]) as well as most of the figurines of the house model). This incised decoration was filled with a red or white crust. This kind of incision has analogies at other sites in western Thessaly such as Prodromos[665] and Magoula Sykeon.[666] It has to be noted that – in addition to their incised decoration – some of the figurines of the house model have the top of their heads decorated with red or brown burnished surfaces (PM0912, Figs. VI.27–28, Figs. VI.35–36), emphasising this part of the head.

According to its grey, macroscopically fine clay body and its polished surface, the figurine PM0016 (Fig. VI.40), found in a surface layer, belongs to the 'Late Neolithic grey ware' of the Tsangli-Larissa phase.

### VI.2.2. Typology

Thessalian figurines have been classified according to the typology of Giorgos Chourmouziadis and of Kostas Gallis – Laia Orphanidis.[667] However, for this publication I follow the typology by Stratos Nanoglou, who – based on all published figurines from Thessaly and Macedonia – distinguishes figurines with two legs (Type A) from figurines without separately modelled legs (Type B). Figurines with two legs are depicted in several versions: standing, in various postures sitting on the ground, sitting on stools, or with four legs.[668]

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663 Pentedeka in press; Pentedeka in preparation.
664 Petru 2006.
665 Alexiou 2018, 184, fig. 5η.
666 Alexiou 2018, 188, fig. 10α–β.
667 Chourmouziadis 1994; Gallis – Orphanidis 1996.
668 Nanoglou 2004, pls. A–B.

Although the trench of PMZ has only produced a limited number of figurines within its Neolithic settlement sequence, a typological classification of figurines according to their posture and gesture can show a longevity of certain types, but also the appearance of new types in certain settlement phases. At the same time, it may give insight into the comprehensiveness of Neolithic ideology and interaction.[669]

Not included in Nanoglou's typology is the style of the figurines, which, independently of their representation as females or males, may be naturalistic – either steatopygous, or more naturalistic – or schematic. Within the trench at PMZ, steatopygous figurines disappear in the upper layers so that a change of style might have taken place during the MN II or MN III phases.

### *Figurines Sitting on the Ground*

Steatopygous figurines sitting on the ground are considered as typical for the Early and Middle Neolithic periods of Thessaly. In the material of PMZ, three fragments belong to figurines squatting on the ground. Two of them come from strata of BPh II (and even from the same stratigraphic unit), in terms of pottery phases from the Middle Neolithic Ceramic Horizon 1 (PM0892 [Fig. VI.2], PM0873 [Fig. VI.3]), and one from BSPh Vc, i.e. Middle Neolithic Ceramic Horizon 2 (PM0936, Fig. VI.11). In consequence, this evidence confirms the general opinion that these types are characteristic for the Middle Neolithic period.

All these figurines have a reddish-yellow or pink clay and are painted monochrome red, a very common surface treatment in Thessaly.[670] The flat and quadrangular outline of PM0892 (Fig. VI.2) points to a figurine sitting asymmetrically on the ground, one leg upright above the other.[671] PM0936 (Fig. VI.11), probably part of the upright leg, belongs to the same type. PM0873 (Fig. VI.3) may belong to a type with both legs lying on one side.[672] The flat back of PM0892 (Fig. VI.2) may point to a front view of such figurines, and they may have been positioned along a wall.

### *Figurines Sitting on Stools*

Steatopygous figurines sitting on stools, with the legs of the figurine merging with the front legs of the stool, are well documented for the Middle Neolithic period in Thessaly. At PMZ just three legs of such figurines have been identified, so we have no information on the appearance and sex of these sitting figurines, which, in contrast to the other types, were frequently males.[673]

Typologically, two kinds of legs are discerned: those with slightly rounded legs and those with clearly indicated knees (PM0878 [Fig. VI.4], PM0792 [Fig. VI.8]). They have been located in various layers, belonging to BPh II (PM0878 [Fig. VI.4]) and BSPh IVa (PM0792 [Fig. VI.8]), both, in pottery terms, Middle Neolithic, PMZ Ceramic Horizon 1. Furthermore, such a leg has also been located in BSPh VIb (PM0651 [Fig. VI.16]), in pottery terms MN III, Ceramic Horizon 4.

For the material used, it is important to note that all of them were made of pinkish or reddish-yellow clay, with macroscopically visible white and dark as well as sparkling inclusions, known from locally produced pottery. However, in contrast to the fragments of figurines sitting on the ground, all pieces have a white or pink slip with red painted decoration. This technique is characteristic for the Middle Neolithic period, but in the pottery assemblage of PMZ this decoration technique is only rarely used.[674] As far as can be seen from published analogies, this type is also

669 For the theoretical background of style as indicator of interaction: Talalay 1993, 58.
670 Fassoulas 2017, 240–243.
671 Nanoglou 2004, pl. A, type AII5.
672 Nanoglou 2004, pl. A, type AII4; Orphanidis – Gallis 2011, 257–263, nos. 570–582.
673 Nanoglou 2005, 145–146; Nanoglou 2006, 161–163, fig. 4; Mina 2008b, 113.
674 Pentedeka in press.

frequently connected with painted decoration at other sites.[675] Therefore, I suspect that this decoration was specially applied on this type of figurine, underlining that figurines sitting on a stool were images of social power.[676] Since red-on-white decoration is rare at PMZ, it would be interesting to know if these figurines were produced locally or were imported.

### *Figurines with Three or Four Legs*

The tetrapodal figurines, as they are depicted in the house model (Figs. VI.27, VI.36), seem to have developed from the figurines sitting on a stool. This type is known all over Thessaly, all of them having incised decoration,[677] but it seems to be especially frequent in western Thessaly.[678] Although this type is highly schematised, showing the head and the body growing out of the legs, other sites have produced examples with indication of a penis.[679] However, tetrapodal figurines with a more steatopygous upper part of the body can also have sexual indications pointing to their female sex.[680] Furthermore, there also exist extremely small tetrapodal figurines of this type, which may even represent children.[681]

### *Standing Figurines with Two Legs*[682]

Figurines standing on two legs are rather fragmented, consisting of one lower body only as well as legs or parts of legs. The single legs preserved in the material probably come from columnar legs of standing figurines of the steatopygous type. The most fragmented pieces, which, in consequence, are most difficult to interpret (PM0898 [Fig. VI.1], PM0733 [Fig. VI.13], PM0640 [Fig. VI.17], PM0329 [Fig. VI.40]) come from BPh I, BSPh Vd, BSPh VIb and the Early Bronze Age pit.

Two legs, PM0620 (Fig. VI.21) and PM0590 (Fig. VI.24) from BSPh VIIa (transition MN III/LN I), are well preserved. They belong to typical Middle Neolithic figurines with separately modelled legs and round buttocks. In terms of their production, both pieces demonstrate how the separately formed legs and buttocks have been stuck into the other part of the figurines in a leather-dry state, the incised lines indicating the separation of the body from the leg.[683] In contrast to characteristic Middle Neolithic painted examples, PM0620 (Fig. VI.21) has a fine incised decoration.

According to a stratified analogy coming from the 'upper layer' of the settlement sequence of Otzaki,[684] which, according to a reappraisal of its chronology, is dated after 6000 BC,[685] the type seems to start late in the Early Neolithic. Furthermore, this type is present at Prodromos in a Middle Neolithic stratum.[686] At PMZ legs of standing figurines cover the entire Middle Neolithic

675 Papathanassopoulos 1996, 298, no. 203; Alram-Stern – Dürauer 2015, 439, 441, VKe01.

676 Chourmouziadis 1994, 82; Kokkinidou – Nikolaidou 1997, 101–102. The importance of chairs and the persons sitting on them has been outlined for the figurines from Çatal Hüyük (Hansen 2007, pl. 57.10 after Mellaart 1963) and Hacılar VI (Hansen 2007, pl. 63.2 after Mellaart 1961).

677 Gallis – Orphanidis 1996, 370–380, nos. 319–330; Alexiou 2018, 188, fig. 11; Alexiou 2020, 150, fig. 3 (Magoula Sykeon).

678 Gallis – Orphanidis 1996, 372, no. 321 (Sofades, western Thessaly); 373, no. 322 (Astritsa, western Thessaly); Nanoglou 2004, II, 235 (Astritsa); Hamilakis et al. 2017, 466, pl. II, chapter 6, fig. 8 (Koutroulou Magoula); Fassoulas 2017, pl. 31, MP14 (Megalo Pazaraki); Alexiou 2018, 188, fig. 11; Alexiou 2020, 150, fig. 3 (Magoula Sykeon).

679 Alexiou 2020, 152, fig. 6 (Magoula Sykeon).

680 Gallis – Orphanidis 1996, 270, no. 212 (Chalkiades 2/Pref. Larissa).

681 Gallis – Orphanidis 1996, 362, no. 311 (Larissa 2, 2.5cm height).

682 Chourmouziadis 1994, 120–141, Typ IIIa–b; Nanoglou 2004, pl. A, type AI.

683 Nanoglou 2005, 144.

684 Milojčić – Milojčić-von Zumbusch 1971, pl. U1a–b, summarised by Hansen 2007, 114, fig. 42.2; 116.

685 Reingruber 2008, 272–275.

686 Fassoulas 2017, PRO 25, pl. 479.

sequence. In consequence, this type probably developed late in the Early Neolithic period, and was common throughout the Middle Neolithic period. In contrast to the figurines sitting on a stool, all of the figurines from PMZ are dark or red monochrome, or they have an incised decoration. No pattern-painted surfaces, which are frequent on figurines sitting on stools, are present.

The only figurine with a preserved body comes from the surface of trench A PM0016 (Fig. VI.40). From its manufacture in grey ware, it dates to the last habitation phase of the Neolithic settlement sequence of PMZ, the Late Neolithic Tsangli-Larissa phase. The figurine has an accented belly and strong buttocks, but, in contrast to the steatopygous Middle Neolithic figurines with heavy breasts, it ends in a thin and flat body. Figurines of a similar type in grey ware come from Magoula Sykeon and Mavrachades Sophadon[687] as well as from Mavrachades Tataria in the Kambos region.[688] Like our piece, they have a flat body with an accentuated belly. They are provided with two small breasts, and the missing part of the figurine from PMZ may be reconstructed in a similar way. It therefore seems that in Thessaly this type with a flat and thin upper body and strong buttocks replaced the steatopygous standing type at the start of the Late Neolithic period.

*Figurines with a Base*

Three figurines of this type (PM0753 [Fig. VI.10], PM0725 [Fig. VI.12], PM0327 [Fig. VI.38]) come from various layers of Trench A of PMZ. Furthermore, six figurines from the house model PM0912 (Figs. VI.28, VI.30–32, VI.34–35) belong to the same type.

Nearly all figurines of this type are clearly identified as female by the indication of their breasts. Furthermore, they are characterised by the same gesture, their arms laid underneath their breasts, for PM0327 (Fig. VI.38), only to be reconstructed via analogies.[689] The only exceptions are two asexual, more schematic figurines from the house model (PM0912, Figs. VI.31, VI.34).

Typologically, by the ratio of the upper body to the lower body, they are separated into different groups. PM0725 (Fig. VI.12)[690] and the three female figurines from the house model (PM0912, Fig. VI.30, VI.34–35) are all provided with a conical or bell-shaped skirt, the figurines of the house model with incisions in the lowermost area of the skirt which might indicate the feet. In contrast, PM0753 (Fig. VI.10) and PM0912 (Fig. VI.32) have extremely short lower bodies and remarkably protruding breasts. PM0327 (Fig. VI.38) differs from both types, having a very long cylindrical body and schematized arms and breasts. Another common feature of most of these figurines is their convex base, and only PM0327 (Fig. VI.38) and PM0920 (Fig. VI.32) have a flat base.

There is also a remarkable difference in their decoration: all figurines of the stratigraphic sequence, starting from a MN II layer, are monochrome red, while the figurines of the house model with their incised decoration most probably belong to the transition from MN III to the earliest Late Neolithic phase. For their chronology, PM0753 (Fig. VI.10) belongs to BSPh Vb and therefore to the MN II Ceramic Horizon 2, while PM0725 (Fig. VI.12) comes from BSPh Vd and MN II Ceramic Horizon 3. In consequence, we can be sure that this type is common during the Middle Neolithic. PM0327 (Fig. VI.38) was located in the Early Bronze Age pit, so that it is not clear to which period it belongs. However, since at Magoula Sykeon this type is dated to the early Late Neolithic,[691] and another analogy comes from the early Late Neolithic cemetery of PMZ,[692] we may argue that at the settlement of PMZ it was also filled into the pit from an upper Neolithic layer.

687 Alexiou 2020, 149, fig. 1e; 154, fig. 10.
688 Nancy Krahtopoulou personal communication.
689 Alexiou 2018, 187–188, figs. 9, 10ε.
690 For production details, see above, 454.
691 Alexiou 2020, 154, fig. 10.
692 Gallis 1982, pl. 21, lower row, right.

*Schematic Figurines*

Three objects located in the upper layers of the Neolithic sequence of PMZ can be identified as schematic figurines. PM0621 (Fig. VI.18) and PM0645 (Fig. VI.19) come from the same SU 126, BSPh VIb (MN III), while PM0591 (Fig. VI.25) was located in a layer of BSPh VIIa (transition MN III/LN I); in terms of ceramic chronology they therefore belong to the MN III (Ceramic Horizon 4) and the earliest Late Neolithic phases (Ceramic Horizon 5).

None of the figurines has a head or legs, or shows details which could determinate their sex, so that we cannot be sure if all of them are figurines or tools. I argue that PM0621 (Fig. VI.18) derives from the type of figurine seen in PMZ PM0725 (Fig. VI.12) with the arms folded under the breasts, a deep hole in which the head was inserted and a concave base. Reminiscent of the former, but in a simplified form, PM0621 (Fig. VI.18) has its arms still visible, the part of the legs still seen by their angular form. The place where the head was inserted is indicated by a shallow groove, and the concave base is indicated by another groove. By analogy, PM0591 (Fig. VI.25) has a rounded and a more angular part, which may indicate the upper and the lower body of the figurine, both provided with similar shallow grooves, which are definitely not to be used for inserting a head. In contrast, the parts of PM0645 (Fig. VI.19) are of similar shape, although one of them is slightly larger than the other, and therefore could indicate the upper body. However, both sides are provided with a deep groove, which could definitely have surrounded the head and could have served for inserting heads on both sides of the figurine; producing a two-headed being in this way has been proven for Final Neolithic figurines.[693]

In consequence, according to our interpretation, the three objects are schematic figurines which compare with the female figurine PM0725 (Fig. VI.12); their shape copies the folded arms and the conical lower body. However, it should not be excluded that PM0645 (Fig. VI.19) and PM0591 (Fig. VI.25) were actually tools to be compared with sherd tools in the shape of an eight.[694] PM0645 (Fig. VI.19) in particular is doubtful and may have been used as an implement, e.g. for textile production.

In general, all three figurines have a secure date in MN III and the transitional phase MN III/LN I, representing a typological sequence. Therefore, this schematisation is not linked with the schematic figurines or objects from Late or Final Neolithic contexts.[695] Furthermore, it is more than questionable whether the Thessalian acrolithic figurines, which had marble heads inserted into a clay body, are connected to these early examples.[696]

One of the objects presented in this chapter belongs to the group of artefacts subsumed under the term 'plaque'. PM1020 (Fig. VI.26) dates to the mixed earliest Late Neolithic BSPh VIIa. Actually, it is an oblong object of quadrangular section, more correctly named a bar. It is made of comparatively fine, light-coloured clay with fine incisions and covered with a red slip. Three or four similar objects have been found in the Kambos area, northwest of Karditsa and Prodromos.[697] Their function is unknown. It has been argued that they were used as a counting device. However, the high variability in its decoration does not support this interpretation. Use as a stamp is to be excluded, since the incisions are too fine and thin for such a purpose. On the other hand, based on the extremely high quality of the surface treatment, it does not seem that it had a purely utilitarian purpose. On the contrary, the decoration could point to a very schematic representation of details of the human body and dress/decoration. In our case, the lines on the short side of the bar may have indicated the hair, and the triangular incisions may indicate eyes. Similar items from Magoula Makrychoriou in the Kambos area may also show dress and hair.[698] Similar bar-shaped

[693] Nanoglou 2018.
[694] Cf. Alram-Stern, this volume, 448.
[695] Nanoglou 2004, I-34 (Prophitis Langada); Fassoulas 2017, PAL 11 (Palioskala).
[696] Nanoglou 2005, 150–151; Nanoglou 2018.
[697] Nancy Krahtopoulou, personal communication.
[698] I am grateful to Nancy Krahtopoulou for showing me these figurines.

figurines are known from the Körös and Starčevo cultures.[699] However, parallels from north Macedonia and Greek Macedonia which would link these figurines with the items in western Thessaly are not yet available.

*Figurine Holding an Object*

The figurine PM0819 (Fig. VI.5), coming from BSPh IIIb, the earliest Middle Neolithic part of the trench, has coffee-bean eyes and a bird-like face. It belongs to the type with the arms laid under the breasts. In addition, a pellet on the left side indicates that it had an object in his hands. A similar figurine, holding a sickle in its arm, has been recorded by Gallis and Orphanidis at Ambelonas.[700] Further examples come from Magoula Palaiochori, Kambos and Mesiani Magoula.[701]

*Head*

PM0657 (Fig. VI.15), which comes from BSPh VIb, in terms of pottery the MN III Ceramic Horizon 4, is made of dark-grey clay and has a flat, oval shape, its sides being decorated with short horizontal incised lines which may indicate the hair. For this fragment, a head of similar form and decoration has been found in the area of Mezourlo,[702] heads of figurines from Thessaly usually having a cylindrical form.[703] Furthermore, a similar type is characteristic for the area of Starčevo-Körös-Criş with a body with accentuated buttocks,[704] and which has a similar flat, oval head with incised lines representing the hairstyle, so that this head may show stylistic connections to this area.[705]

### VI.2.3. Towards a Chronology of the Figurines

We also tried to evaluate the 40 figurines (including the count of the nine figurines, one movable and two unmovable objects from the house model) according to their frequency in the individual building phases of PMZ (Pls. III.1–2). For this, we have to be aware that the number of items is comparatively small and several of the figurines are not significant enough to be used. These include a number of legs. Furthermore, we excluded animal figurines and anthropomorphic and zoomorphic vessels. Based on 28 pieces (including those from the house model) we differentiate three horizons.

The earliest Horizon 1 is characterised by the appearance of figurines squatting on the ground (three pieces) of steatopygous style as well as legs of figurines (three pieces) sitting on a stool. However, one of these legs was found in a stratum which I attribute to the next horizon. In addition, two naturalistic figurines come from Horizon 1. Horizon 1 therefore covers BPh II till BSPh Vd, i.e. datable between 5824 ± 46 and 5733 ± 34 calBC (unmodelled dates) and, based on the pottery, these building phases have been attributed to MN I and II.

Horizon 2 is characterised by two features: the appearance of schematised figurines (three pieces), developed from naturalistic standing figurines. In addition, this horizon shows figurines with incised decoration (ten objects from the house model, two figurines, one possible figurine). The figurines from the house model are partly naturalistic; however, the two tetrapodal figurines are schematised figurines sitting on stools. The dating of the house model in Horizon 2 has further

699 Hansen 2007, pl. 110.
700 Gallis – Orphanidis 1996, 337, no. 349.
701 Nancy Krahtopoulou personal communication: one piece from Magoula Palaiochori, presented by Theogianni – Sofianou in press; several pieces from Kambos. Mesiani Magoula: Alexiou – Anetakis 2017.
702 Orphanidis – Gallis 2011, 183, no. 473.
703 Gallis – Orphanidis 1996, 136–137, nos. 70–71.
704 E.g. Hansen 2007, pl. 117 (Endröd).
705 Hansen 2007, 143.

Tab. VI.1 The figurines in their stratigraphic and chronological context (E. Alram-Stern)

| Periodisation of Neolithic Thessaly (Reingruber et al. 2017) | Building Phase | Figurines (see catalogue) | | Figurine Horizon |
|---|---|---|---|---|
| MN I | BPh I | | Fig. VI.1 | |
| | BPh II | Squatting figurines | Fig. VI.2<br>Fig. VI.3 | 1 |
| | | Sitting figurines (legs only) | Fig. VI.4 | |
| | BSPh IIIa | | | |
| | BSPh IIIb | Naturalistic figurines | Fig. VI.5 | |
| | | Anthropomorphic vessel | Fig. VI.6 | |
| | | Animal figurine | Fig. VI.7 | |
| | BSPh IIIc | | | |
| | BSPh III | | | |
| | BSPh IVa | Sitting figurines (legs only) | Fig. VI.8 | |
| | BSPh IVb | | Fig. VI.9 | |
| MN II | BSPh Va | | | |
| | BSPh Vb | Naturalistic figurines | Fig. VI.10 | |
| | BSPh Vc | Squatting figurines | Fig. VI.11 | |
| | BSPh Vd | Naturalistic figurines | Fig. VI.12 | |
| | | | Fig. VI.13 | |
| | | Animal figurine | Fig. VI.14 | |
| | BSPh Ve | | | |
| MN III | BSPh VIa | Figurines with incised decoration | Fig. VI.15 | 2 |
| | BSPh VIb | Sitting figurines (legs only) | Fig. VI.16 | |
| | | | Fig. VI.17 | |
| | | Schematic figurines | Fig. VI.18<br>Fig.VI.19 | |
| | | Zoomorphic vessel | Fig. VI.20 | |
| | | Figurines with incised decoration | Fig. VI.21 | |
| Transition MN III/ LN I | BSPh VIIa | Anthropomorphic vessel | Fig. VI.22 | |
| | | | Fig. VI.23 | |
| | | | Fig. VI.24 | |
| | | Schematic figurines | Fig. VI.25 | |
| | | Figurines with incised decoration | Fig. VI.26<br>Figs. VI.27–37 (figurines from house model) | |
| Earliest LN I | BSPh VIIb | | | |
| | BSPh VIIc | | | |
| LN I | BPh VIII | | | 3 |
| | BPh IX | | | |
| EBA pit, surface | | Late Neolithic figurines | Fig. VI.38 | |
| | | | Fig. VI.39 | |
| | | Late Neolithic figurines | Fig. VI.40 | |

implications for the dating of the cemetery: if we group its figurines in Horizon 2 prior to the Tsangli horizon which has been considered as the date of the cemetery, the small figurine from burial cluster E21,[706] which has a close parallel in the small figurine from the house model, should either originally be older than the cemetery, or the cemetery has a longer life circle than considered before. Horizon 2 covers BSPh VIa till BSPh VIIa, i.e. 5751 ± 33 calBC (modelled by B. Weninger: 5657 ± 1 calBC) and before 5583 ± 32 calBC (unmodelled dates). Based on the pottery, these building phases have been attributed to MN III and the transition between MN III and LN I.

The final Horizon 3 is only defined by two figurines that were found in the post-Neolithic layers, the Early Bronze Age pit and the topsoil, respectively, while no figurines come from the uppermost Neolithic layers. Both are of wares which are characteristic for the early Late Neolithic Tsangli phase, the one monochrome matt-painted, the second of burnished grey ware. Furthermore, one of them has a parallel in the nearby Late Neolithic cemetery.[707] Therefore, although PMZ does not provide them with absolute dates we should consider them to come from the last Neolithic strata of the site.

### VI.2.4. The Anthropomorphic Figurines: Their Use and Meaning

With the exception of the house model and two further figurines, all anthropomorphic figurines come from destruction layers and are not connected with any architectural features. Therefore, no conclusions can be drawn from the contexts. In consequence, I will analyse them using details of their imagery and try to draw conclusions on their social background.[708] For this, I follow Douglass Bailey in considering figurines as miniatures and abstractions of reality.[709] Other authors have considered figurines as representations of individuals.[710] However, based on the repetition of their postures and gestures, they do not represent given individuals, but rather of classes of individuals.[711] For prehistoric people, figurines may have served as points of reference for the conceptualisation of themselves and others, as well as defining themselves as part of a group of identities, even constituting regional identities.[712] In this respect, in a separate chapter special emphasis will be given to the house model and its contents, providing an insight into the society and ritual of Neolithic Thessaly.

#### *Indications of Sex*

Apart from the nine figurines from the house model, three complete figurines and six large fragments of figurines have been uncovered at the site. Concerning their sex, none of the figurines shows primary indications of sex. Four single figurines (PM0327 [Fig. VI.38], PM0577 [Fig. VI.23], PM0725 [Fig. VI.12], PM0753 [Fig. VI.10]) and Figs. VI.28, VI.30, VI.32, VI.35 from the house model were identified as female by the indication of their breasts.[713] This indication of breasts is taken as an indication of their female sex, although we have to be aware of the fact that figurines with a combination of breasts and a penis are known.[714]

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706 Cf. Gallis 1982, 72, 114, pl. 21, lower row, left (cemetery of PMZ, cluster E21).

707 Gallis 1982, pl. 21, lower row, right (cemetery of PMZ, cluster ΣΤ 27).

708 On the role of anthropomorphic imagery in Neolithic Thessaly: Nanoglou 2005, 141–145.

709 Bailey 2005, 28–32.

710 For a definition of the individual as a physical, mortal human being: Knapp – van Dommelen 2008, 17; for figurines as representations of individuals: Bailey 1994.

711 I am grateful to Catherine Perlès for the discussion of this issue; for the repetition of postures and gestures in the typology of figurine see also Orphanidis 1998.

712 Nanoglou 2009, 292.

713 About 22.5% of the Thessalian figurines have breasts indicated: Nanoglou 2005, 146.

714 Nanoglou 2006, 161. See also: Talalay 2000, 8, 12.

Three figurines have no sex indicated by their schematisation (PM0621 [Fig. VI.18], PM0645 [Fig. VI.19], PM0591 [Fig. VI.25]). In addition, there are a number of fragmented figurines, which do not allow any attribution to a certain sex. However, while squatting and standing figurines more frequently represented females, three legs come from figurines sitting on a stool, an imagery more often representing males than females.[715]

In consequence, at PMZ female representations most probably predominated over male figurines, a fact also seen in other sites. According to counts from other Thessalian sites, asexual representations are even more frequent than sexed body representations.[716]

For the house model, in addition to the female figurines, two asexual figurines with four legs have been argued to represent males sitting on stools. Connected with two female figurines, they were interpreted as the male part of two couples.

In addition to these, the house model holds three figurines without any indication of sex. Maria Mina has argued that such representations may depict immature children. Following this interpretation, Fig. VI.31 is a figurine with its head on a conical body and with the decoration of the dress, hairstyle and jewellery incised in the same way as is common on the large female figurines. Since this figurine shows a decoration comparable to the female figurine, I argue that this figurine actually represents a girl before her maturity.[717] The second, damaged, small figurine (Fig. VI.34) also has a conical body, but its decoration differs from the other figurines. Since it has been grouped with a couple, I argue that it also depicts a child. The third figurine (Fig. VI.33), which belongs to the same group, is oblong and flat and provided with a tiny, damaged protrusion. Because of an incision on one of the sides which are characteristic for the cheeks of the figurines, this protrusion is reconstructed as a tiny head, and I suggest that it depicts a baby. For these depictions in context with the other figurines in the house model see below.

### *Posture and Gesture of the Figurines*

Another feature in the material of PMZ is the variety of postures of the figurines, either standing on two legs, squatting on the ground in various postures (PM0892 [Fig. VI.2], PM0873 [Fig. VI.3], PM0936 [Fig. VI.11]), or sitting on a stool (PM0878 [Fig. VI.4], PM0792 [Fig. VI.8]). Some figurines have their arms folded under or over their breasts, but have their lower body formed as a base, and therefore look more static. These include PM0753 (Fig. VI.10), PM0725 (Fig. VI.12), PM0327 (Fig. VI.38) and the figurines from the house model (Figs. VI.28, VI.30. VI.35). Such representations are characteristic for the Middle Neolithic figurines of Thessaly, including the southern parts of western Macedonia.[718] Since these kinds of representations were well known, they were intelligible to the beholder. At the same time, this reiteration enabled every new figurine to have a certain meaning in an existing network.

According to Nanoglou, these representations constituted classes of individuals in certain postures,[719] and they may have been grouped.[720] We can follow the idea of such grouping since some of the figurines from PMZ show details indicating that their reverse side was not intended to be turned to the observer. PM0892 (Fig. VI.2) and PM0819 (Fig. VI.5.) had a dark, flattened reverse. PM0753 (Fig. VI.10) and PM0725 (Fig. VI.12) had a rougher back. This may go back to their positioning in front of a wall.

In contrast to Middle Neolithic figurines squatting, sitting or standing on two legs, evidence of figurines with bases starts late in the Middle Neolithic sequence of PMZ. The schematic figurines PM0591 (Fig. VI.25), PM0645 (Fig. VI.19) and PM0621 (Fig. VI.18), coming from MN III and

[715] Mina 2008b, 113.
[716] According to Nanoglou 2005, 146 just 10% of the Thessalian figurines are sexed.
[717] Mina 2007, 274.
[718] See pages 457–458, 496, 500, 530, 546, 565.
[719] Nanoglou 2005, 145–148.
[720] Nanoglou 2009, 287.

transitional MN III/LN I layers, have no parallels in other Thessalian sites, and possibly represent a local or regional development of this part of the Western Thessalian Plain. By their style they already announce the more static Late Neolithic figurines.[721]

### *Decoration and its Meaning*

Most figurines from Middle Neolithic layers are red monochrome, and some are pattern painted. In particular, the legs of the three figurines sitting on a stool show red-on-white painted decoration, either vertically, following the structure of the figurines, or horizontally. In combination with the fact that they probably represented a class of individuals of special importance sitting on stools, it may be argued that this painted decoration underlined the importance of the figurines.

In contrast, at PMZ incised decoration appears on figurines from the late Middle Neolithic and the transitional MN III/LN I, i.e. on the figurines of the house model as well as on two heads (PM0657 and PM1020) and a leg of a standing figurine PM0620 (Fig. VI.21).[722] This change in decoration seems to coincide with the preference for more static figurines and points to a focus on the surface of the body. Incision, like inscription, has been seen as a most powerful act upon something, carrying certain insignia.[723] For PMZ we can say that emphasis was given to the hairstyle of all figurines, followed by the illustration of their jewellery, most probably indicating the social or familial position of a class of individuals as well as the dress.

### *Fragmentation*

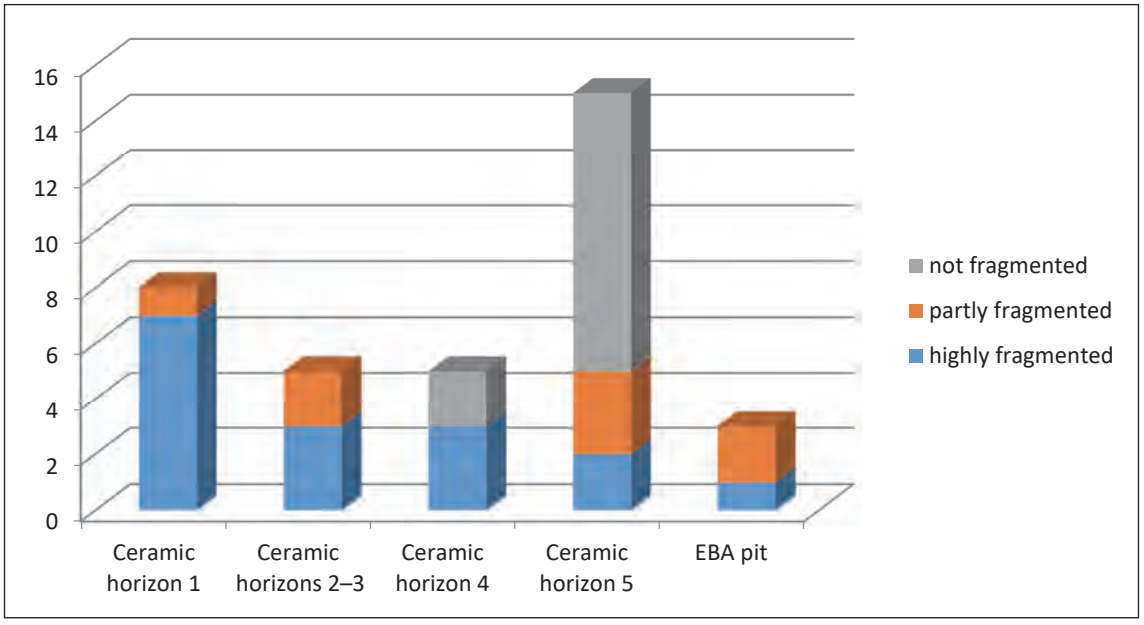
With the exception of the house model, only the three schematic figurines are complete. For four further figurines, the body is quite complete, but the heads are missing, in one case the hole for inserting it in the leather-dry stage is still visible, and only three upper parts/heads are present in the material.

By contrast, eleven fragments are legs separated from the body, three of them being separated due to the separate manufacture of legs, the others just broken away from the body. Although Trench A only represents a small area of the site, this number of legs in this area is intriguing, especially if we think of the missing other parts of these figurines. Especially frequent is the occurrence of legs in the lower part of the trench, while complete or nearly complete figurines are more abundant in the MN III and later layers. This number of legs stands in contrast to assemblages from other sites, such as Aşağı Pınar, where mainly heads and bodies were located.[724] Therefore, we have to consider whether the deposition of the legs at PMZ happened by chance or had a certain meaning, the rest of the figurine being deposited somewhere else.

In three cases (PM0590b [Fig. VI.24], PM0620 [Fig. VI.21], PM0892 [Fig. VI.2]), the appearance of legs alone is the result of the shaping of figurines in parts which were put together only before firing, and therefore the result of the fragmentation of body parts in a predetermined way. The same fragmentation was observed for northern Greece, Anatolia and the Balkans.[725] We have to face the fact that the destruction of an object means that it was no longer usable.[726] Therefore, explaining the usefulness of fragmented objects is paradoxical in itself,[727] and the dumping of figurines points to their limited period of use.[728] However, such a reduction of the figurine to

[721] Nanoglou 2005, 149–152; Nanoglou 2009, 289.
[722] Makrychori 2: Hansen 2007, pl. 92.6.
[723] Nanoglou 2009, 290, following Meskell 1999.
[724] Hansen 2007, 352, fig. 197.
[725] Chapman 2000, 68–79; Hansen 2005, 205–206; Becker 2012.
[726] Becker 2012; Nanoglou 2015, 49–50.
[727] Nanoglou 2005, 143.
[728] Perlès 2001, 363.

Tab. VI.2 Grade of fragmentation of figurines in the ceramic sequence of PMZ (E. Alram-Stern)




component parts may have enhanced its symbolism.[729] For southern Greece, Lauren Talalay has argued that their being broken into parts was intentional at the time of their production, the parts being used as tokens symbolising social and economic bonds between settlements.[730] John Chapman has argued similar meanings for the breaking of figurines from the Balkans.[731]

*Connection of Figurines to Contexts*

With the exception of the house model, which will be discussed below, only one figurine comes from a context that may point to the original position of the figurines in the settlement. It is the torso of a standing female figurine PM0753 (Fig. VI.10), which was found on Floor F29 of BSPh Vb and belongs to SU 88 (Fig. III.22). Connected to this unit are three hearths, and the figurine was found next to the hearth TS29. Marja Gimbutas has argued for Achilleion that figurines were often connected to hearths.[732] However, the evidence from PMZ is too thin to support this hypothesis, and the house model points to ritual actions which go beyond the hypothesis of assembling them close to hearths. Otherwise, figurines used to be discarded after their use.[733] Another interesting feature is that the fragment of a figurine PM0640 (Fig. VI.17) was found in BSPh VIb (Fig. III.27) in the same context as three pieces of ornament. Furthermore, aside from the house model, BSPh VIIa showed a concentration of figurines (PM0577, PM0590, PM0591, PM0620, PM0621, PM0912, PM1013, PM1014, PM1020; Fig. III.29), some of them even preserved completely (PM0621, PM0645, PM0591). Although we cannot expect that they were found in situ, it is important to note that this phase is characterised by an increase in figurines, maybe due to an enhanced importance of figurines in ritual.

729 Tracey Cullen, personal communication.
730 Talalay 1987.
731 Chapman 2000, 73–75; For a summary: Bailey 2017, 827–829.
732 Gimbutas 1989, 213–218.
733 Perlès 2001, 263.

*External Connections and Regional Identities*

Figurines are objects that, according to some specialists, were distributed across networks of production and consumption.[734] To check this hypothesis and to get a clear distribution pattern, it is important to conduct archaeometric investigations which compare local and potentially non-local fabrics. Since such analyses are not yet available for our site, the figurines were just checked macroscopically. According to these observations, all except three figurines may have been produced locally. This means that a small-scale exchange of figurines is to be expected. However, in order to acquire a better understanding of the exchange of figurines, we have to wait for future analyses which may correct this picture.[735]

Otherwise, figurines serve as points of reference for the conceptualisation of communal identities. In this sense, they are a defining trait for a group of people,[736] and we may argue that sites sharing similar figurines had similar cultural and ritual perceptions and shared some sort of identity. In contrast to such a comparison of figurines from nearby regions, similarities of style and manufacture visible over large distances, such as in Chalcolithic Anatolia and Middle Neolithic Greece, should be considered with caution, since they could be interpreted as transcultural phenomena.[737] On the other hand, we have to keep in mind that figurines in northern and central Greece are comparably frequent, but much rarer in southern Greece.[738]

Therefore, I will compare figurines under a local and regional aspect and consider in what way PMZ was part of a network of sites sharing similar representations. It has to be remarked that most figurines identified in our material are fragmented and the collection of analogies in the catalogue mainly served the identification of these figurine types. Only for a smaller number of figurines were we able to distinguish characteristic details which compare with finds from other sites.[739]

Many figurines from PMZ belong to types that are known all over Thessaly, if not all over Middle Neolithic Greece. To these belong steatopygous figurines squatting on the floor in various postures known all over Thessaly (PM0873 [Fig. VI.3], PM0892 [Fig. VI.2], PM0936 [Fig. VI.11]), at least as far south as Koutroulou Magoula[740] and as far as Pontokomi-Souloukia in western Macedonia in the north.[741] It is likely that the distribution of these types points to regional interrelations connecting the large north-central Greek plains.

Figurines sitting on a stool (PM0651 [Fig. VI.16], PM0792 [Fig. VI.8], PM0878 [Fig. VI.4]) are well known from the Western as well as from the Eastern Thessalian Plain,[742] and comparable items are also located in western Macedonia.[743] However, until now Middle Neolithic figurines sitting on a stool have not been recorded in central and southern Greece.[744] Therefore, for them a similar distribution pattern has to be argued as for the figurines sitting on the ground.

In general, standing female, steatopygous figurines (PM0590 [Fig. VI.24], PM0620 [Fig. VI.21]) with two legs are also present all over Greece. Their stylistic similarities do not correspond to the variety of pottery styles known for the various areas of Greece, so that they possibly

734 Talalay 1987, 58.
735 See above,453–454.
736 Nanoglou 2009, 292.
737 Maran 2017. By comparing pottery decoration techniques and styles, certain similarities, but also differences, are visible, which point to a steady exchange of knowledge, but also to differences which define them as different cultural units.
738 Talalay 1987.
739 Nanoglou 2006, 160–164.
740 Hamilakis et al. 2017, 466, pl. II, chapter 6, fig. 8.
741 Pontokomi-Souloukia: Karamitrou-Mentessidi 2002, 628–630, figs. 30–31. For transcultural connections see, e.g., the Lady of Saliagos (Evans – Renfrew 1968, 62–63, fig. 75, pl. XLII), but also in Anatolia such as Çatal Hüyük and Hacılar (Hansen 2007, 360).
742 Nanoglou 2006, fig. 4; Orphanidis – Gallis 2011, 188–191, nos. 482–485.
743 Karamitrou-Mentessidi 2009, 120, fig. 23 (Pontokomi-Souloukia).
744 Hansen 2007, 115.

point to far-distant contacts.[745] However, for several figurines, mainly coming from the upper layers of PMZ, we observe a regional distribution pattern: figurine PM0725 (Fig. VI.12), from a Middle Neolithic context, with hands lying under its breasts, an inserted head, an incised line separating the lower body from the navel as well as a concave base, has close connections to Prodromos and Tsangli, so that a closer connection between these sites may be argued.[746]

The standing figurine with two legs and a flat upper part PM0016 (Fig. VI.40) belongs to a type present in Late Neolithic Thessalian and western and central Macedonian contexts.[747] In southern Greece it is known under the name 'split-leg figurines' from various sites during the Middle Neolithic and Late Neolithic period.[748] A central Balkan transcultural connection is given by analogies in Thrace and Serbia.[749] All these analogies indicate that standing figurines with two legs continued to be produced after the end of the Greek Middle Neolithic period. Moreover, a more regional distribution pattern is visible for figurines of this type with an accented belly on the flat upper part, if produced in grey ware: three analogies at Magoula Sykeon, Mavrachades Sophadon and Mavrachades Tataria indicate an interconnectivity of these communities of the Western Thessalian Plain.[750]

For the female figurine with a flat base and quite schematically indicated breasts from the Early Bronze Age pit PM0327 (Fig. VI.38), there are analogies in the material of Magoula Sykeon, which point to close connections between the two sites.[751] Another analogy comes from the cemetery of PMZ, which points to a direct connection between the cemetery and the settlement. In consequence, since the type is not documented elsewhere in Thessaly, it is possibly typical for western Thessaly and points to regional networks in this region.

By contrast, there are a number of figurines that do not compare with published Thessalian material. Three schematic figurines with angular or rounded upper and lower parts and incisions in the place where a head would be inserted (PM0591 [Fig. VI.25], PM0621 [Fig. VI.18], PM0645 [Fig. VI.19]) belong to this group. They come from late Middle Neolithic and early Late Neolithic contexts, so that they are not contemporaneous with schematic figurines of later Late Neolithic and Final Neolithic date. However, they remind one of the more naturalistic figurine PM0725 (Fig. VI.12) with its arms folded under the breasts, a cavity for the head to be inserted and a convex base. Therefore, we argue that they actually developed from this type, possibly in this area of western Thessaly or even at the site of PMZ itself.

Furthermore, two fragments, which I interpret as heads, can hardly be connected with any published figurines. PM0657 has a form which is attested for heads of Thessalian figurines; however, analogies for the incised decoration are rare.[752] For the quadrangular head with linear incised decoration on the top and incised triangles as eyes, vague analogies can be found in angular or

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745 For the variety of pottery styles during the Middle Neolithic period of Greece, which probably define areas of close contact: Washburn 1983, 151–157. Compare, e.g., Chaironeia (L. Orphanidis, in: Papathanassopoulos 1996, 315, no. 236); Aegina-Kolonna ([1] Staatliche Antikensammlungen, München, inv.-no. 10.060: Welter 1938, 7–8, 10, fig. 8; Thimme 1977, 421, no. 10; Talalay 1993, 109; [2] Athens, Archaeological National Museum no. 8772: Welter 1954, 40, 41, figs. 3–5; Papathanassopoulos 1996, 318, no. 239; Papadimitriou – Tsirtsoni 2010, 116, no. 16); Corinth (Phelps 1987); Lerna (Caskey 1958); western Macedonia, Pontokomi-Souloukia (Karamitrou-Mentessidi 2002, 628–630, figs. 30–31).

746 Prodromos: Fassoulas 2017, pl. 1, PRO 1 (Type GM); pl. 1, PRO 2 (Type MP); pl. 2, PRO 5; pl. 5, PRO 17; Tsangli: Wace – Thompson 1912, 122, 126, fig. 75a.

747 Thessaly: Hansen 2007, 16; pl. 101.16 (Rachmani); Hauptmann 1981 (Otzaki); Western Macedonia: Phelps 2000, 202, SF219 (Servia); Karamitrou-Mentessidi 2011, 86–87, fig. 10 (Grevena region); Nanoglou 2004, I-80 (Paliambela).

748 Southern Greece: Talalay 1993, 25, FC 122 (Franchthi Cave); Phelps 1987, 242–243, nos. 5–11, pl. 33–34 (Corinth).

749 Thrace: Hansen 2007, pl. 78.1–4, 7–8 (Ilıpınar).

750 Alexiou 2020, 140, fig. 1e; 154, fig. 10 (Magoula Sykeon and Mavrachades Sophadon); Nancy Krahtopoulou, personal communication (Mavrachades Tataria in the Kambos region).

751 Alexiou 2018, 187–188, figs. 9, 10ε.

752 Gallis – Orphanidis 1996, 137, no. 71 (Chalki 3 = Gallis 1992a, 189, fig. 33); Orphanidis – Gallis 2011, 183, no. 473; Fassoulas 2017, pl. 51, RACH 14 (Rachmani).

rounded heads ending in a rod-shaped body, which have a wide distribution from the southeastern Balkans to the Carpathian Basin,[753] but a connection with this head remains insecure and needs further research. For both heads, I suggest that they either belong to a chronological or to a local phenomenon which has not yet been considered.

The figurines from the house model with their incised decoration also seem to belong to types with a regional distribution in the area of western Thessaly: the small asexual figurine Fig. VI.31. from the house model PM0912 has a good analogy at Magoula Sykeon[754] as well as another in the cemetery of PMZ.[755] Furthermore, a female figurine similar to Fig. VI.28 has been found at PMZ as a stray find.[756]

In general, incised decoration, consisting of short horizontal lines, which is present on the figurines of the house model, but also on the head of PM0657 and the leg PM0620 (Fig. VI.21) is confined to the MN III and the transitional phase MN/LN I of PMZ and is present at western Thessalian sites such as Magoula Sykeon and Mavrachades.[757] In consequence, this decoration style for figurines seems to be unique to this period and to this area.

To conclude, based on their style and decoration, several figurines from PMZ are confined to western Thessaly and indicate that this settlement had close connections to communities in the Western Thessalian Plain. This is especially well demonstrated by the similarities with figurines from Magoula Sykeon, situated not more than 15km south of PMZ.

## VI.3. The House Model Assemblage: Context and Deposition, Composition and Meaning

One of the most important finds from the western Thessalian tell site of PMZ is the open house model, which is on display at the Diachronic Museum of Larisa, PM0912. It was excavated by Kostas Gallis in 1983 and brought to the knowledge of the public in 1985.[758] Since then, this house model has been discussed extensively by Gallis[759] and several other specialists.[760]

It contains a platform and an oven as fixed installations, as well as four female figurines, identifiable by their breasts, two tetrapodal figurines without indication of sex, three small asexual figurines, and an oblong object which will be discussed below. Therefore, with the exception of a few contexts in the Aegean and the Balkans,[761] the house model is a rare assemblage which helps us to gain a better understanding of figurative representations and what they tell us about the Neolithic society.

### VI.3.1. Context and Deposition of the House Model

The house model and all nine figurines and the movable object were found in situ as one assemblage.[762] The house model was found in the BSPh VIIa fire destruction levelling layer SU 134 directly below habitation Surface F22 (SU 136) (Fig. III.29). This layer has been dated to the

[753] E.g. Hansen 2007, 137, fig. 51; 143–144 (Zăuan); pl. 121.1–4; 128.3, 5 (Méhtelek).
[754] Alexiou 2018, 188, fig. 10α.
[755] Gallis 1982, 72, 114, pl. 21 lower row left.
[756] Orphanidis – Gallis 2011, 288–289, 615.
[757] Alexiou 2018, 187–188, figs. 10α, β, ε; 11; Alexiou 2020, 150, fig. 3ε, στ, ζ.
[758] Gallis 1985b; see also Gallis, this volume, 23–25.
[759] Gallis 1990, 15, fig. 4, drawing 1; 17–18; Gallis 1992b; Gallis 1996d; Gallis 2001.
[760] Marangou 1992, 36–37, 225; Marangou 1996a, 185–186; Marangou 1996b; Nanoglou 2004, 183–191; Nanoglou 2005, 149; Hansen 2007, 122, 499; Crnobrnja 2011; Risch 2018, 54–55.
[761] See below, 479.
[762] In 2020 the video 'Man creates Man', paraphrasing Childe' s classical book 'Man Makes Himself' (Gordon Childe 1936), was installed in the exhibition hall of the Diachronic Museum of Larissa, dealing with the house model. This video won the First Pan-European Prize of 2020 in the 'Museums in Short' contest. Cf. <https://youtu.be/u2cn6r2k1aM> (last access 10 Feb. 2022).

transition MN III/LN I, while Surface F22 already belongs to the earliest LN I. Surface F22 was connected with the hearth or oven Thermal Structure TS 19 (SU 139).

Layers SU 133 and 134, which are characterised by fire destruction debris, including burnt clay and wooden building material probably coming from the wall of a house and from its roof, covered the lower Surface F23 (SU 127). Since the house model was not found on this lower surface, it belonged to the levelling SU 133 and 134, which must have taken place before the upper Surface F22 was installed.

The excavator interpreted this position as being the result of a pit which had been dug into the destruction layer and into which the house model had been placed. However, on the photographs and drawings, no lined pit dug from the higher level is documented, although such deposition pits are usually marked by linings and are therefore clearly visible.[763] Therefore it is more probable that the house model with the figurines was found in a shallow pit within the burnt material and the difference in the consistency of its material probably derives from the relocation of the burnt material. Consequently, I suggest that the house model should be connected with the levelling of the destruction debris SU 123 and 124 above Floor F23.

The practice of depositing figurines below floors is well known from the Balkans.[764] In consequence, for the deposition of the house model in this transitional Middle Neolithic/earliest Late Neolithic layer, I would like to suggest an interpretation that follows the theory propounded by John Chapman and Ruth Tringham, which suggests that Neolithic houses were retired from use by being buried.[765] According to them, such burials of houses could be connected with intramural burials of the inhabitants of the household. Otherwise, such burials could also be replaced by burning down the house, and in this way, burying the household itself.[766] Therefore, since the house model was deposited after the house had burnt down and before the floor above was made, and specifically during the phase of levelling for erecting the new house, it could have been a symbol of such a buried house. In this sense, it is not a foundation offering in its proper sense, as has been suggested for a long time,[767] but a deposition in memory of ancestors. This interpretation fits with the find of a fragment of a house model in Školska Tumba at Mogila/northern Macedonia, where a house model has been identified in a comparable find situation.[768] This interpretation also coincides with a thesis by Talalay,[769] which – based on ethnographic studies – argues for an important meaning of figurines as ancestor images. This idea fits with increased burial rituals at the contemporaneous cemetery of PMZ.[770]

While during the transitional Middle/Late Neolithic phase the western part of the trench was an open area, the abundant burnt pieces indicate that during BSPh VIIa and BSPh VIIb the eastern half – where the model was found – was a roofed area,[771] which contrasts with Late Neolithic sites like Mandra, Makrychori 1, Galini and Rachmani, where the majority of the figurines come from open areas.[772] Therefore we argue for PMZ that the house model was deposited in the course of a ritual which was carried out in the interior of a house by its residents.

This hypothesis may also be correlated with the Neolithic radiocarbon sequence of PMZ, which indicates comparatively short-lived floor sequences, the levels being rebuilt on average every

763 E.g. Cucoş 1973 (Ghelăieşti); Karamitrou-Mentessidi 2002 (Pontokomi-Souloukia); Alram-Stern 2016, 9–11 (Aegina-Kolonna, where a stone-lined pit contained more than 20 figurines).

764 Tringham – Conkey 1998, 38.

765 Chapman 1999; Tringham 2005; Chapman 2015.

766 For speculations on the background of such 'cremations' of houses in connection with changes in the kinship hierarchy of a house: Nikolov 2019, 9.

767 Gallis 1985b; Marangou 2009, 87. For foundation offerings in the Balkans: Makkay 1983.

768 Naumov – Tomaž 2015, 86.

769 Talalay 1991, 49.

770 Fowler 2004, 62.

771 Toufexis – Batzelas, this volume, 113.

772 Toufexis 2017; Giorgos Toufexis, personal communication.

18 years, which is one generation.[773] Therefore, if we interpret the house model as connected to the burial of the transitional Middle/Late Neolithic habitation level 23 and the construction of the early Late Neolithic level 22, we have to be aware of the short-lived building-destruction-rebuilding sequence of the site, connected to an alternation of generations.

Such short phases of construction/rebuilding do not necessarily imply that the inhabitants of the subsequent building phase knew about the house model buried below their floor. However, interestingly enough, the subsequent building phase included a thermal structure constructed closely above the place where the house model had been deposited. It is an oven very similar to the one depicted in the house model. So, it is still possible that for the people who deposited the house model, the deposition of the house model was part of the practice of the levelling undertaken before constructing the subsequent house at the site.[774]

### VI.3.2. Form and Decoration of the Model and the Figurines

*The House Model (Fig. VI.27)*

The house model belongs to the type of the open house model which is known from southeastern Europe[775] and much rarer than its roofed counterpart. Analogies come from Macedonia,[776] as well as from Thessaly.[777] In general, house models are connected to the emergence of the household as the social unit of the Neolithic period.[778]

The house model of PMZ consists of a plaque of clay on which the walls were set in the form of a low enclosure with a door opening. It was made by crudely hand shaping the clay and then smoothing the surface.[779] The sides of the house model were made of thick slabs of clay, which were stuck onto the sides of the base.

The bench and the oven are fixed installations, which were modelled separately and subsequently put into the house model before smoothing and firing. At PMZ the bench, which is situated in the left rear corner of the model, shows short incisions on its sides, which are similar to the decoration of the figurines. The oven was set in the rear centre and had a protruding opening on its front. Ovens of this type are known from PMZ,[780] but also from various Neolithic sites like Achilleion,[781] Magoula Rizava[782] and Dikili Tash.[783] In BSPh Ve of PMZ, an oven was accompanied by a bench.[784] The oven and the bench must have been the most important installations in a house since they were present in all open house models, as in those from Sitagroi[785] and Ovčarovo.[786] Furthermore, oven models as independent miniatures are known from other northern

773 Weninger et al., this volume, 195.

774 I am most indebted to Tracey Cullen for her most helpful discussion of these find circumstances.

775 See the collection in Marangou 1992, 204, n. 30–38 (from Russia, Ovčarovo, Porodin, Popudnia, Dobrovoda, Čičerkozkovska, Souškovska).

776 Kleitos: Ziota 2011, 217–218, fig. 11; Limnochori II: Chrysostomou 2017, 132; Sitagroi: Renfrew et al. 1986, 216, fig. 8.20, pl. XL.1a–d = Theocharis 1973, 340, fig. 290; Promachonas-Topoliča: Koukouli-Chrysanthaki et al. 2005, 100; Aslanis 2010, 41, 45. For further house models from Thermi B and Vasilika: Marangou 1992, 435, 437, 441–443.

777 One piece from Otzaki (Marangou 1992, fig. 23) and one from Magoula Aliphaka, Kastro A.T.A.E. 9 (Gallis 1992a, 128, fig. 14).

778 Toufexis 1996a; Souvatzi 2008, 56; Toufexis in press.

779 In connection with the crude forming of this open house model, an unbaked house model from Ovčarovo should be mentioned which was formed and deposited at the same place: Marangou 1996a, 181.

780 Toufexis – Batzelas, this volume, e.g. 105-106 (TS 23) and 107 (TS 23a).

781 Winn – Shimabuku 1989a, 40 (in combination with a bench to the left of the oven), 43, 48–49, 54–55, 61.

782 Krahtopoulou et al. 2018.

783 Treuil 1992b, 42–43, 46–47.

784 Toufexis – Batzelas, this volume, 105–106 (TS 23).

785 Renfrew et al. 1986, 215, fig. 8.20, pl. XL.1.

786 Todorova 1982, 40, fig. 24.

Greek and Balkan sites.[787] The front side of the model shows damage, which may have been a result of its deposition and/or of its previous use.

In consequence, the open house model of PMZ represents either a one-roomed house as known from Middle Neolithic sites like Sesklo,[788] Tsangli[789] and Otzaki,[790] or a room that may have been part of a two- or multi-roomed building.[791] In addition, although the house model does not indicate steps to a second storey, we should not rule out the possibility that this room represents the ground floor of a two-storied building, as reconstructed for the Tsangli house type.[792] Such houses with two floors are also represented in a few Middle Neolithic Thessalian house models.[793] In such a case, there exists the possibility that the ground floor served for the activities represented in this house model, whereas other rooms and the second storey could have been dedicated to different activities, probably for residential purposes[794] or just for storage.[795] In any case, we have to be aware that the house model illustrates an idealised situation showing a part of the Neolithic society with its social relations described below.

### *The Figurines*

#### The Three Female Figurines

Three female figurines (Figs. VI.28, VI.30, VI.35), although differing in their size, have the same form and decoration. All of them have the same triangular head, the beak-shaped face with coffee-bean eyes, the same upper body with pointed breasts, the same hands, with the fingers indicated by incisions, laid under the breasts, and a similarly bell-shaped lower body. As far as we can tell from the surface, they were formed in the same way, the eyes, the breasts and the arms attached to the body, and the underside hollowed with an instrument. All of them also have the same fine incised decoration, which has partly been adapted to the size of the figurines. The two for which the head is preserved (Figs. VI.28, VI.35) have three diagonal lines on their cheeks. The back of the head has a row of small vertical lines at the edge of the back of the head. The back of the head of the largest figurine (Fig. VI.28) is decorated with two rows of short diagonal lines, the smaller one (Fig. VI.35) with one row. These incisions probably indicate the hairstyle, and the same kind of representation of the hair is common on Middle Neolithic figurines all over Greece.[796] The tops of the heads are painted red/reddish-brown and burnished. This treatment may either indicate a head covering or point to the importance of this part of the body. All three figurines are provided with two horizontal rows of short linear incisions around the neck. The front and the back of the upper part of the body of the figurines is decorated with vertical lines, the two larger ones (Figs. VI.28, VI.35) with three, the smaller one (Fig. VI.30) with two lines. The arms are decorated with short vertical and diagonal lines. These lines are best visible on the largest figurine (Fig. VI.28) and only very faintly on the smallest (Fig. VI.30). The back of the lower part of the body of the largest figurine (Fig. VI.28) is adorned with two diagonal lines, arranged in a V. The lower end of the lower body of all three figurines is decorated with short horizontal lines, the largest with four (Fig. VI.28), the second largest with three (Fig. VI.35), and the smallest with four lines

787 Marangou 1992, 165.
788 Theocharis 1973, 65, figs. 176–179; Theocharis 1993, 88–102; Kotsakis 2006, 211, fig. 2.1.
789 Wace – Thompson 1912, 115–117, 121.
790 Milojčić 1983b, 7–8.
791 Kotsakis 2006, 211, fig. 2.2.
792 Alram-Stern 1996, 110.
793 Toufexis 1996a, 328, no. 264; Toufexis in press.
794 Nikolov 2019, 6: Two-storey Late Neolithic houses in the area of today's Bulgaria show that the ground floor was devoted to household activities while the upper level was used for residential purposes.
795 Catherine Perlès, personal communication.
796 E.g. Phelps 1987, 241, no. 1, pl. 33.1 (Corinth); Chourmouziadis 1994, 208d; Hansen 2007, Taf. 96.2 after Efstratiou 1985 (Ag. Petros).

(Fig. VI.30). Consistently with the form of the lower part of the figurines, which copies a skirt, the linear incisions on the body probably indicate the dress of the women, the upper horizontal lines representing either a necklace or the collar of the dress. The edge of the lower part of the body of all three figurines has short vertical lines, perhaps indicating their feet. These similarities and small differences in the decoration of these figurines have a certain meaning, which will be discussed below.

### Tetrapodal Figurines

Two tetrapodal figurines (Figs. VI.27, VI.36) are the counterparts of the female figurines. The four legs of these figurines derive from the Middle Neolithic representations of figurines sitting on stools, the legs melted with the front legs of the stool. During the Middle Neolithic period most of these figurines represent males, but females are also present.[797] However, based on their difference from the female figurines, Gallis has interpreted them as males, and all subsequent publications have followed him.[798]

The upper part of the figurines, i.e. their heads and their necks, are shaped and decorated in a very similar way to the female figurines. The underside also has a concave depression, formed by a half-rounded instrument. It should be noted that the legs of the two figurines are positioned differently, the larger having one leg in front and one at the back (Fig. VI.27), the smaller one two legs in front and two at the back (Fig. VI.36).

In contrast to the female figurines, the body of the figurines is represented in a truncated version, the four legs growing out of a short, conical body. Like for the female figurines, the heads of the figurines are triangular, have attached coffee-bean eyes, and below them three short diagonal incised lines. The back of the head is decorated in an identical and more elaborate way than the female figurines, with short, vertical, incised lines on its edge and three courses of short lines hanging down the neck, indicating the hair. The tops of their heads are painted and burnished. The further decoration of the two figurines differs according to their size. Like the female figurines, the neck of the tetrapodal figurines also has rows of short, horizontal, linear impressions. However, compared to the females, more emphasis is put on them, consisting of five (Fig. VI.27), respectively four lines (Fig. VI. 36). Furthermore, on the front of the figurines, a vertical row of dot incisions hangs down between the horizontal lines, and on the larger figurine this vertical line is combined with some horizontal v-impressions. This decoration of the tetrapodal figurines may indicate necklaces, so that they were more splendidly decorated than the female figurines. The legs of the larger figurines are decorated by three parallel lines following the course of the legs; the legs of the smaller figurine by two lines.

### Asexual Figurines

Three figurines (Figs. VI.31, VI.33–34), all of them stylistically different, have no indication of sex. Fig. VI.31 is a small figurine with a triangular head and the right eye formed as a coffee bean, the left most probably flaked away.[799] The back upper part of the head is separated by a line from the neck. The nose has been formed by pressing the clay with the fingertips. Similarly to the female and tetrapodal figurines, the cheeks are decorated with two fine and short diagonal incised lines. The lower body is rounded and has two faint horizontal lines consisting of short incisions. The base is flat. The rounded shape of the lower body and the horizontal incisions connect this figurine with the female figurines of the house model.

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797 Nanoglou 2006, 161–163.

798 Gallis 1985b.

799 Similar small figurines are rare and come from Larissa 2 (Gallis – Orphanidis 1996, 362, no. 311) and Magoula Sykeon (Alexiou 2018, 184, fig. 5η).

Since asexual figurines need not represent genderless types of individuals, the small size of the figurine may point to a representation of an individual in childhood or adolescence.[800] Based on the rounded shape of the lower body, I argue that this figurine represents a girl in the stage before sexual maturity. This may be confirmed by a figurine which Gallis found above the cremation burial urn 21 of the Late Neolithic cemetery of PMZ, north of the settlement.[801] In contrast to the genderless figurine in the house model, this figurine is characterised by a quadrangular, pointed base, which reminds us of the tetrapodals from the house model, and actually, Gallis was able to correlate it to a young, probably male adult which was found cremated in the urn.[802] So this evidence shows that premature male and female figurines were probably distinguished and that the small figurine from the house model most likely represented an immature female individual.

The figurine Fig. VI.34 has a damaged upper part, and its completion is difficult. However, it seems that the pointed end of the figurine represents the nose while the upper part, which would represent the back of the head is broken away. For its shape, it best parallels beaked figurines from Achilleion[803] and Koutroulou Magoula[804] as well as figurines from the Late Vinča assemblage of Stubline.[805] The base of the figurines is slightly triangular, and the underside is slightly concave. The figurine differs from the other figurines not only in its shape but also in its decoration, which consists of deep *pointillé* incisions arranged in rows.[806] Similar to the female figurines, two rows of incisions follow the base. The upper part of the nose is decorated with two rows of incisions, and one more laterally placed incision may represent an eye. Two further rows of incisions surround the broken part of the head and hang down vertically in the back. Therefore, similar to more plastically elaborated representations, I would like to interpret it as decoration of the head or a hairstyle.[807] From the size of the figurine and its situation alongside a female figurine, it should be interpreted as a child. However, without any primary sexual indication it would be daring to attribute any sex to it. This figurine differs considerably from all other figurines of this assemblage, and the implications will be discussed below.

The small flat object Fig. VI.33 is characterised by vertical lines and a small globular protrusion at one end. Its interpretation has been controversial for some time. Being connected to the oven, it has been interpreted as a bread loaf.[808] However, the recording with the 3D scanner clearly indicates that the rounded protrusion on the one end of the object makes it more likely that it represents a human being with a head. The remains of an incised line at the edge of its broken area may come from an eye. Furthermore, two diagonal incised lines along the sides of this protrusion/head have parallels in the diagonal incised lines on the cheeks of the female and tetrapodal figurines of the house model and therefore prove its interpretation as an anthropomorphic figurine. Consequently, the vertical lines on the flat part of the object may indicate cloth, and this small object most probably represents a small individual wrapped in cloth, i.e. a baby.

### Female Figurine

The female figurine Fig. VI.32, identified as female by its breasts, is of a different type than the other female figurines from the house model. Characteristically, its lower body ends in a short cylindrical base, concave on the underside.[809] In contrast to the other figurines, it is undecorated.

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800 Mina 2007, 280; Marangou 2009, 89.
801 Gallis 1982, 72, 114, pl. 21 lower row, left.
802 Gallis 2001.
803 Gimbutas 1989, 238, no. 89.
804 Papadopoulos et al. 2019, 16, fig. 7.
805 Crnobrnja 2011, 145–146, pl. 1–2.
806 Decoration comparable to a figurine from Vršnik, northern Macedonia: Hansen 2007, 148–150, figs. 61–62.
807 Gallis – Orphanidis 1996, 91, no. 23 (Koilada 1); Alexiou 2018, 188, fig. 11γ (Magoula Sykeon).
808 Risch 2018, 54.
809 Cf. Orphanidis – Malakasioti 2011, 204, no. 136 (Magoula Margarita).

Otherwise, the triangular head with its flattened upper side and its coffee-bean eyes resembles the typical Thessalian figurines. Furthermore, having the arms folded under the breasts, it follows a common Thessalian type.

### Oblong Object

Another controversial item is the oblong object which was lying between the bench and the oven of the house model (Fig. VI.29). It is characterised by its long, narrow form, ending in upright points, as well as its square section. Furthermore, it has three rows of short incisions covering the surface of the object. Concerning its interpretation, several suggestions have been made. One of them is that it was a boat.[810] However, it is quite unlikely that a boat is characterised with such incisions and placed beside the oven. Rather, this object must represent an object connected with the household, the oven, the bench and the woman laid down beside the object. Therefore, it seems more likely that it was connected with food production. People working on ground stone tools have suggested an interpretation as a grinding slab, the incised lines seen as a not purely decorative element, but as an indication of the roughened work face of a grinder.[811] An unfinished specimen, probably intended as a handstone, has a pecked surface (PM0450).[812] However, none of the grinding stones of PMZ has the same elaborated form which is only found in central European grinders of this period.[813]

### *Production of the House Model and Figurines*

The house model and the figurines were produced as one assemblage: the figurines and the one object, which was formed separately, were formed of the same clay as the house model. Furthermore, they show a very similar smoothing of the surface. Apart from two, the figurines also share the same decoration technique and style consisting of short, fine, linear incisions arranged in one line. This decoration is also present on the bench, which was attached to the house model before firing.

For its production, the possibility has to be envisaged that the figurine making was a collaborative act, most probably by female potters,[814] so that the female figurines in the house model may even be related to the social class of their makers. At the same time, it was possibly an act executed by the community.[815] A communal construction of assemblages has already been argued for the deposit of figurines from Aegina-Kolonna.[816]

### *Relationship of the Figurines Based on Form and Decoration*

So the figurines are closely connected to each other by their manufacture, being made of the same clay. Furthermore, their similar and exact modelling implies that all details had a meaning. Apart from two figurines, all of them were decorated in the same fine, incised linear style.[817] It is likely that this incised decoration represents the hairstyle, jewellery, pleats and patterns of the attire.[818]

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810 Gallis 1985b, 22; Marangou 1991; Marangou 1992, 37. For discussion I am indebted to Christoph Schwall.
811 Already Gallis 1990, 17; see also Risch 2018, 54.
812 Stroulia, this volume, 320.
813 Graefe 2009, 268, no. 25; for Neolithic grinders in Greece: Bekiaris 2007, 99, fig. 5 (incised lines on grinding stones), fig. 43 (grinder).
814 Vitelli 1993; see also Gallis, this volume, 25 and below, 479.
815 Papadopoulos et al. 2019.
816 Alram-Stern 2017.
817 For the incised style on figurines in the Balkans and the meaning of such insignia which are inscribed into the body of the figurines: Nanoglou 2009, 289–290.
818 Mina 2007, 277–278; Mina 2008a, 121.

However, analogies in form and decoration are found in two cases at PMZ,[819] but only in one case in the nearby site of Magoula Sykeon in western Thessaly.[820] Therefore, the figurines were possibly related to a local style which distinguishes them from other sites and in PMZ was specially related to the house model. Attire and jewellery provide information on social identity and age. Therefore, similarities in decoration display close interrelations between the figurines.[821]

The three figurines representing women have identical decoration, two disrupted lines for the necklace, vertical and v-shaped lines for the costume, using two to four disrupted horizontal lines depending on the size of the figurine. The two figurines with four legs, which were interpreted as males,[822] have identical linear decoration. The hair is indicated by a vertical zigzag pattern, the necklace by five disconnected lines on the larger figurine, and four lines on the smaller figurine. The four legs of the male figurines have three zigzag lines on the larger example, and two zigzag lines on the smaller one.[823] The width of the decoration zones may be due to the size of the figurines, but it could also express their importance.

For the tetrapodal (male) figurines, the rich decoration of the neck is remarkable and may point to their high social position. Overall, the similarity and association of the figurines indicates that – although differentiated by size and decoration – they were related to each other by social and possibly family ties. Only two figurines, whilst made of the same clay, differ in their decoration.[824] The first is the asexual figurine found together with the couple, interpreted as a child, with rows of incised points. The second is the undecorated female figurine, which was placed together with the female figurine and the asexual figurine (the girl) to the right of the oven. The stylistic differences in the small, asexual figurine, which was connected with the couple, may either be due to its age or to a looser connection to the family. However, an interpretation of the undecorated female figurine connected with two figurines with incised decoration next to the oven as alien is obvious.

### VI.3.3. The House Model as a Social Arena

*The House Model as a Container of Figurines*

In Thessaly, a large number of closed house models have been collected, showing the importance of the house as a social and political entity.[825] Furthermore, the appearance of these models of buildings coincides chronologically with the practice of rebuilding structures.[826] In contrast, open house models, much rarer in northern Greece, offer the possibility to present the equipment of the houses. One of the most important structures in the house is the oven,[827] not only represented as a fixed installation in house models, but also produced as a separate model.[828] Furthermore, these models provide an opportunity to place figurines as representations of allied individuals in their domestic settings.[829] For this, the house model of PMZ is a unique example, which is only paralleled by house models from Ghelăieşti and Popudnia,[830] which also contained figurines. All other house models were found empty, so that we cannot be sure if all open house models were initially

819 Gallis 1982, 72, 114, pl. 21, lower row, left (cemetery of PMZ, cluster E21); Orphanidis – Gallis 2011, 288–289, 615 (PMZ, stray find).
820 Alexiou 2018, 188, fig. 10α (Magoula Sykeon).
821 Mina 2008a, 123.
822 Gallis 1985b, 21; Gallis 1990, 17.
823 For gender as stereotypic illusion: Bailey 2013, 252–253.
824 For the figurines of different style also: Nanoglou 2004, 187.
825 Toufexis – Skafida 1998.
826 Nanoglou 2005, 148.
827 Marangou 1992, 17.
828 E.g. from Sitagroi: Marangou 1992, fig. 22b.
829 Marangou 1996a.
830 Bailey 2010, 120, fig. 5.5.

made for such a purpose. In any case, the deposition at PMZ was a special act, asserting kinship.[831] In this sense, the focus was directed at the people utilising the building, not at the building itself.

However, we have evidence that creating space for connecting figurines was not restricted to house models, since on certain occasions figurines were deposited in pots, such as in Ghelăieşti,[832] where they were put in a pot with a cover, or at Aegina-Kolonna, where pairs or single figurines were placed upright inside miniature bowls.[833] Otherwise, figurines were arranged on platforms within houses, such as in Ovčarovo or Stubline.[834] In this sense, the open house model, like the pots or the platforms, represented space for presenting the familial relations of groups of people. In all these cases we have to keep in mind that restricted areas are related to groups of people, so that space reflects domestic organisation.[835]

Therefore, we argue that the figurines were arranged in the house model as an effigy especially designed for them, showing the prototype of a group of people living in a Neolithic house, although it cannot be ruled out that the figurines and their grouping are related to the particular individuals who once lived in this area.[836] So, the house model and the figurines should be seen in the ideological system of Neolithic societies and their organisation system, as well as their use of space,[837] i.e. the house and the household.[838]

### *Grouping, Relationship and Position of the Figurines and the Objects in the House Model*

In contrast to all other house models, the open house model of PMZ contained nine figurines as well as one movable and two non-movable miniature objects. Since miniatures and figurines may be representations and interpretations of reality,[839] this arrangement might well illustrate the preferred relationship among people and their built environment[840] giving information on the social structure of communities.[841] Special emphasis is given to those objects which are thought to structure the environment immediately around them, while individuals belong to pairs, groups or sets, one being dominant over the other.[842] Based on this statement and the assumption that an arrangement was meant to be meaningful,[843] it is important to examine the relationship of space and objects to the figurines, and the connections between the figurines themselves.

The figurines from PMZ vary in size and shape[844] and were arranged in three groups. The first group consists of the tall figurine of a woman lying in the rear left side of the model and the tetrapodal figurine lying in front of it. The female figurine was lying on a platform beside the oven, the installations fixed on the ground of the house model. The oblong object was deposited at the side of the figurine. Therefore, we have assumed that the installations and the object were closely related to the woman and her activities. If the oblong object was connected to the oven, it could have been a tool connected to cooking and food preparation, i.e. typical activities practised in a household.[845] The platform on which the female figurine was lying may have been the working surface for such activities. For the large female figurine this means that it is connected to the

831 Nanoglou 2005, 149.
832 Ghelăieşti: Cucoş 1973; Popudnia: Gimbutas 1956.
833 Alram-Stern 2016, 19–21; Alram-Stern 2017.
834 Todorova 1982, 67–68; Crnobrnja 2011.
835 Ardener 1997, 1–2.
836 For discussing this issue, I am indebted to Tracey Cullen.
837 Skafida – Toufexis 1994, 13.
838 Souvatzi 2008, 97.
839 Bailey 2013, 245.
840 Marangou 1996a, 180.
841 Bailey 2017, 834–836.
842 Ardener 1997, 3.
843 Nanoglou 2015, 51–52.
844 For the differentiation of figurines by variation of shape: Bailey 2005, 153–154.
845 For the discussion of its interpretation as a grinding stone see above, 474.

most important household activities, which are food preparation and production. The tetrapodal figurine, as opposed to the female figurine, has been interpreted as a male, sitting on a stool. It is placed in front of the female figurine, close to the entrance and without any objects connected to its activities. It is definitely smaller than the female figurine, probably pointing to its minor importance in the setting of the space represented in the model, which is underlined by the fact that no tools are connected to it. On the other hand, it is lying close to the entrance pointing to its field of activities outside the room. Although the tetrapodal, i.e. male, figurine is smaller than the female figurine, we may argue its high rank based on the elaborate decoration around the neck, i.e. its dress or jewellery. This male figurine could have been connected to the large female figurine, and in such a case represent her husband.[846] However, the female figurine beside the oven represented the most important and probably also the oldest individual in this household. Following Gallis, we may call her 'the lady of the household'.[847]

The second group in the right front corner comprises a female figurine in a lying position, a tetrapodal figurine, interpreted as a male, a small figurine without any sexual indications as well as the flat figurine interpreted as a baby. As such, it was placed close to the warmest place in the room, the oven. So, the function of this group was expressed by their relation to each other as a couple with two children, representing a family and its importance through reproduction seen in two generations of people in the household.[848] As in the group with the largest figurines, the male figurine is smaller than the female figurine, and it is placed closer to the entrance, pointing to its field of activities outside the house. In contrast, the female figurine was emphasized in her size since her status as mother is of higher importance to the household. Based on their size, which is smaller than the female and the male figurine on the left side of the house model, they were of less importance to the house than the big couple. This is underlined by the space designated to them, which is around half the size of the space allocated to the large female figurine and the associated male figurine. However, their decoration, which is nearly identical to that on the larger couple, suggests that they were related to them, possibly by kinship. By contrast, the small asexual figurine, interpreted as a child, differs from them in form and decoration. Since every detail in this assemblage was constructed, we have to be aware that its characteristics probably gave an indication on its provenance, its connection to the figurines alongside it and its age.

Finally, a third group is lying beside the oven. It consists of two females and another asexual figurine, which I would like to interpret as another girl, i.e. a female in an immature state. So the function of this group is expressed by its deposition beside the oven as well as by its composition, all of them being females. The woman, who has a damaged head, and the asexual figurine (the immature girl) have similar decoration to the other female figurines of the house model and could therefore be related to the women of the other groups, being younger relatives of them. However, the other woman in this group is of a different style, with large breasts and without incised decoration. Therefore, most probably she was not related to the other figurines in the household. In consequence, this group does not represent a family, but is dominated by women connected to the household by their activities. Furthermore, in relation to the other figurines, they are the smallest, also occupying only half the amount of space allocated to the family, and therefore, in this house, represent not necessarily the younger ones, but most probably the group of the lowest familial status.[849]

In summary, we have stated that the figurines in the house model were arranged in three groups, perhaps an older couple of high status within the family, a family of four individuals and a group of three female figurines of minor status. This means that the figurines are represented

[846] Gallis 1985b, 21; Talalay 2000, 5.
[847] Gallis, this volume, 23.
[848] Kokkinidou – Nikolaidou 1997, 92–96.
[849] Contra Gallis, this volume, 24.

in their horizontal social position.[850] At the same time, these figurines were linked to each other by grouping them in the house model. Therefore, I argue that they represent an extended family unified in one household. At the same time, their function has been defined through their being combined with objects characteristic for actions in a household: the oven, the bench or platform and the instrument, perhaps a grinding stone.

### *Handling of the Figurines in the House Model*

For the use of the figurines, we have to be aware that, in general, figurines were most probably produced to be touched and handled.[851] For the house model, this means that the figurines were produced to be arranged in the house model. Similar connections of the forming of a figurine together with its container are seen in the assemblage of Chalcolithic figurines from Aegina-Kolonna. Here a male figurine was produced from the same clay as the container to fit into it, as can be argued from the foot imprints of the figurine in the inner surface of the bowl.[852]

Furthermore, it has been noted that the house models of Ovčarovo were originally unbaked and only hardened by the conflagration of the fire destruction.[853] As can be seen by the coherent nature of the figurines and the house model concerning fabric and style, the house model and its contents were produced together as one set,[854] meaning that the makers already envisaged its use.

As regards their size and shape, the figurines were found lying down in groups within the house model, and their size suggests they were purposely made to fit in this way.[855] This is further suggested by the presence of soft depressions on the ground of the house model below the figurines, indicating that the figurines were positioned in the model while the clay was still soft, before being fired. This evidence implies that the figurines were not produced to stand upright but to lie in the house. This is also supported by the fact that the side walls of the model are very low in comparison to the figurines, so standing figurines would appear much higher than the house model itself . Otherwise, based on their even bases, the figurines were also capable of standing in an upright position. Thus, we cannot exclude that, before lying them down, they were kept standing up during some sort of ritual.[856]

In consequence, I consider that the position of the figurines in the assemblage was of importance for the Neolithic people and was intended from the very beginning of its construction. The evidence from PMZ shows that the figurines were produced for laying in the house, even if they also had a use before deposition. This is, of course, possible, and the damage seen on three of the figurines (Figs. VI.30, VI.33–34) could go back to such prior use.[857]

### *Arrangements of Neolithic Figurines as Effigies of the Neolithic Society*

Up to now, arrangements of figurines found in situ are rare: at Stubline, a site of the late Vinča Culture, a platform held figurines which – with the exception of the central figurine – were of identical type and were arranged in seven or eight groups so that this could indicate the roles of individuals on the community level. At the same, the replicas of tools/weapons found in the context were meant to identify the role of the representations in society. Like the house model from PMZ, the context of Stubline shows individuals in relation to each other. However, in contrast to

850 Fowler 2004, 62.
851 Bailey 2013, 251; for the advantages of 3D scanning for visualize this act: Papadopoulos et al. 2019.
852 Alram-Stern 2016, 19–21.
853 Marangou 1996a, 181.
854 A similar production of models as sets is also seen in other figurative assemblages: Marangou 1996a, 181.
855 For the lying position of the figurines in the house model see also Nanoglou 2004, 185–187.
856 Cf. Tracey Cullen, personal communication; see also Gallis 1985b.
857 For a possible use of miniatures on several occasions before their deposition: Marangou 1996a, 196–197.

the former, they are not represented in the closed space of a house but in a more dispersed way, and therefore represent people from a group beyond the household.[858]

In Building 7 of Ovčarovo, 26 miniature objects, including four figurines, three upright plaques of clay, eight chairs, three tables, three bowls and two pans and three cylinders were set along a wall.[859] In consequence, the figurines were placed in relation to the objects, and due to their interpretation as ritual objects, the miniatures were interpreted not as a representation of daily life, but as part of a ritual scene.[860]

The importance of the position of figurines is underlined by other finds of figurines intentionally fixed in a certain position, such as at Aegina-Kolonna, where single figurines and pairs of figurines were fixed standing in miniature bowls.[861] However, in contrast to the house model, these pairs are of the same gender, but of different size, so that the relationships between the figurines must have had a different meaning than for the figurines from the house model. In particular, the preponderance of male figurines points to a masculine section of the Neolithic society usually underrepresented in figurative art and contradicting a matriarchal view of Neolithic society. Groups of figurines were also found in House T in Tsangli.[862]

In consequence, the house model of PMZ and the groups of figurines described above have in common that they were intentionally constructed, combined and arranged according to their intended meaning. It also becomes clear that there are a variety of such 'scenes', which most probably differed according to their purpose.

### *The House Model as an Effigy of a Neolithic Household*

For the house model of PMZ we may state that it represents a room as an architectural feature, which is occupied by the members of a household.[863] Of importance is the fact that just one door opened to the room so that there was restricted access to the house.[864] For the figurines, they were used to assert membership of the household, and such social practices aimed to consolidate already existing identities.[865]

According to social studies in most cultures, women dominate the household, the males being occupied with activities outside the household. This is seen in the house model by the number of females in the house but also by their size compared to the two tetrapodal figurines interpreted as males. In the house model the female figurines are placed close to their activity area, which is the fireplace or the oven. For this we also have to envisage the fact that women were probably producers of pottery and also of the figurines, and that the oven represented in the house model may have been used for firing the figurines.[866] Furthermore, they are connected to their two main tasks, the tallest female figurine with food preparation, the second with raising children. By analogy, Pierre Bourdieu has shown that in the Berber house women are connected with the dark and secret rear zone of the house, which was devoted to food production and the raising of children. By contrast, men are connected with life outside the house, which may be their occupation with the animals and the fields, but also their life in public.[867] So, following Ian Hodder's terminology, the women

858 Crnobrnja 2011.
859 Bailey 2005, 26–28.
860 Todorova 1974; Marangou 1996a, 196.
861 Alram-Stern 2016, 19–21.
862 Wace – Thompson 1912, 115–117, 123–124.
863 For the character of the Neolithic household in the Balkans: Borić 2008. For the house model as its effigy: Borić 2008, 131–132.
864 Nanoglou 2001.
865 Bailey 2000, 103, 268.
866 Gallis, this volume, 25. For pottery production in special ovens at Magoula Rizava in western Thessaly: Krahtopoulou et al. 2018. For Magoula Imvros: Kyparissi-Apostolika 2012.
867 Bourdieu 2003.

are connected to the *domus* while men are linked to the wild or the *agros*.[868] This is expressed by the fact that the males were placed close to the door.

*The Lying Position of the Figurines and its Meaning*

Since the lying position of the figurines was planned from the shaping of the house model and the figurines, its deposition must have had a meaning from the very beginning of their construction, such as at Aegina-Kolonna, where pairs of figurines were fixed standing in miniature bowls.[869] Unfortunately, it is impossible to know if figurines from other contexts found in a lying position were intentionally placed or not. However, contexts like the figurines at Stubline, which were arranged on a bench before the house was burnt down and buried, could be seen in analogy with the house model of PMZ.[870] Therefore, we argue that the figurines in the house model were brought together to be placed as if in sleep or death in a manner symbolic of the demise of the house and maybe even the passing on of the ancestors.[871] At the same time, they were hidden and meant to be buried in their function in or as a household,[872] maybe to increase stability within the community (or wishful thinking by community members).[873] Maybe it replaced occasional intramural burials,[874] although for PMZ, intramural burials were not identified in the previous nor in the subsequent strata of the excavated, admittedly small Trench A. For the last settlement phase, an extramural cemetery points to increasing emphasis on burial ritual during the early Late Neolithic Tsangli-Larissa phase.[875] As regards the meaning of figurines, this manner of deposition under the surface of an open area in the settlement may be related to the fact that figurines might represent the community's ties to the ancestral spirits, which were thus present, close to the space of the living.[876]

## VI.3.4. Conclusions

To conclude, the figurines and house model belong to a special set of figurines produced for a special kind of arrangement and deposition, and even their production was connected to this. Thus their position in the house model had a certain meaning, possibly from the very beginning of their production, but definitely at the moment they were placed in the container. Most probably their position should demonstrate that the figurines were put to sleep, possibly forever.

Furthermore, this house model and the figurines give a most detailed picture of a social group living in an early Late Neolithic household of PMZ. The spatial formation and the differences in shape and size most likely relate to the different ages and/or the horizontal social position of the individuals represented by the figurines. In any case, their containment within the same house model shows that they were members of the same household, and this household consisted of an extended family[877] as well as people connected to them by their activities, but who need not be, in a narrower sense, kin-related.[878]

The house model also points to the important role of women in the household. It has been suggested that this demonstrates that the role of the women in society was more active than that of

868 Hodder 1984; Hodder 1990.
869 Alram-Stern 2016.
870 Crnobrnja 2011.
871 Tracey Cullen, personal communication.
872 Marangou 2009, 84.
873 Tracey Cullen, personal communication.
874 Chapman 2015.
875 Fowler 2004, 61–62.
876 Talalay 1991, 49; Fowler 2004, 63.
877 Souvatzi 2008, 97–99 contra Gallis 1985b, 22 and Gallis 2001, 141 who identified a nuclear family.
878 Souvatzi 2008, 12–14.

men.[879] However, this runs counter to the representation of well-decorated men sitting on stools who may have had their main task outside the house. Therefore, we should not conclude a matriarchal society from this effigy, but we should keep in mind that, according to anthropology, women may also play an important role in household societies with a patrilinear social background.[880]

## VI.4. Zoomorphic Figurines or Vessel Protomes

The Middle Neolithic contexts of PMZ produced two heads of animal figurines, PM0847 (Fig. VI.7) from BSPh IIIb, and the back part of a head PM0737 (Fig. VI.14) from BSPh Vd, both of Middle Neolithic date. No bodies for these heads are preserved. Therefore, we cannot ascertain whether they represent animal figurines or animal-head attachments of vessels, i.e. animal protomes.[881] According to a residue analysis of such vessels from Dikili Tash they contained oil/fat, Cedrus/Cypressus/Juniperus, fossil fuel and beeswax. Consequently, they may have been used as lamps, incense or fumigant burners or containers of aromatic or medicinal substances,[882] i.e. as objects closely connected to ritual.

Toufexis has already pointed out that Neolithic animal figurines usually represent domesticated animals related to the mixed farming character of Neolithic subsistence,[883] and our two heads were most probably goats or sheep.

The application of coffee-bean eyes, which is a general feature on anthropomorphic figurines, underlines a close relation of the animal head PM0847 to representations of humans.[884] Furthermore, its red-on-white painted decoration shows the importance of this figurine, as it is used at PMZ for anthropomorphic figurines sitting on stools.

Interestingly, such figural representations of domesticated animals are comparatively rare in Thessaly: if we take the house model as one special find, the ratio of animals to humans is 1:10–1:15, as also counted by Nanoglou for Thessaly.[885] This rarity, also seen in other contexts,[886] stands in contrast to the central Balkans, where zoomorphic figurines are much more abundant with a ratio between 1:2 and 1:4.[887] This frequency of animal figurines has been interpreted to mirror their importance due to the built environment of the settlements, the central Balkans being characterised by extended settlements with domesticated animals within the settlement area,[888] while the limited settlement of Thessalian sites allowed breeding of animals outside the settlement area only.[889] Since figurines seem to be connected to the settlements and the ritual actions of their inhabitants, the popularity of animal figurines in the Balkans could be interpreted as their incorporation in a common identity, whereas their symbolic meaning was of minor importance in Thessaly.

879 See Risch 2018, 55.
880 Cveček 2020, 16–19; Cveček in press, chapter VI.2.
881 Toufexis 2003, 263. For vessels with animal protomes of later date from Dikili Tash: Marangou 2004, 273, 276 (M163), 277 (M637), 278 (M1234–1235), 281 (M1911).
882 Marangou – Stern 2009.
883 Toufexis 1996b; Toufexis 2003, 264, 268.
884 Toufexis 2003, 263.
885 Nanoglou 2009, 286. For a summary see also Marangou 2000, 234.
886 Extremely rare, e.g., in Sarakenos Cave: Orphanidis 2015, 365, nos. 734–736 (with horns or ears), 367, no. 738, 368, no. 739 (several bovine figurines, LN).
887 For zoomorphic figurines from Delcevo: Chapman 1996, 222–225.
888 Bailey 2000, 174–177. However, we should consider the frequency of animal figurines in eastern Macedonia with its characteristic tell sites.
889 Halstead 1996, 35; Kotsakis 1999; Nanoglou 2009, 287–288.

## VI.5. Anthropomorphic Vessels

At PMZ two fragments of anthropomorphic vessels have been identified. PM0830 (Fig. VI.6.) from a layer of the Middle Neolithic BSPh IIIb is a plastically formed face attached below the rim of a vessel. Characteristically it is painted red on a whitish slip, and the face is provided with coffee-bean eyes. The fabric of this vessel has gold mica inclusions rarely seen macroscopically at PMZ. However, petrographic analyses are needed for a further provenance analysis. Similar fragments are rare, but known in western Thessaly as well as Macedonia. Another fragment, PM1013 (Fig. VI.22), representing the plastically formed lips of a face comes from the earliest Late Neolithic phase BSPh VIIa. It is characterised by a brown burnished surface.

Both faces may belong to anthropomorphic vessels with a human-shaped body;[890] one of the most prominent anthropomorphic vessels is a vase with a lower body with separately formed legs from Tzani.[891] Otherwise they could have been part of vessels with the face set on the neck, but without any further indication of the human body.[892] Both types are rare in Greece, most examples being faces disconnected from the body of the vessel.

The Middle Neolithic face application synchronises with finds from Middle Neolithic Achilleion,[893] Sitochoro 2[894] and Tzani[895] in western Thessaly as well as from Sesklo,[896] Rachmani[897] and Karamourlar in eastern Thessaly.[898] Further Early Neolithic anthropomorphic vessel fragments come from Nea Nikomedeia.[899] At Sitochoro 2 and in one case at Achilleion, the face is applied on the neck of a jar. At Tzani the face belonged to an upper body formed as a bowl with the face set directly under the rim. According to the shape of the rim, it is highly likely that our face application belonged to this type, which was provided with a slightly flaring bowl.

In contrast, the burnished fragment dating to the first Late Neolithic period synchronises with finds from Makriyalos in central Macedonia[900] and from Dispilio in western Macedonia.[901] In both sites the published pieces belong to burnished jars. Like at PMZ, the features of the face are applied directly to the surface of the vessel; however, in contrast to the fragment from PMZ, the faces are not provided with lips. So for both fragments from PMZ, the Balkan connection is evident. Like at PMZ, in relation to figurines, anthropomorphic vessels are scarce.[902]

All in all, anthropomorphic vessels representing the human body, similar in style and dating to the Early and Middle Neolithic period, have a wide distribution from northern Mesopotamia to southeastern Europe,[903] the tradition continuing in the Balkans throughout the Late Neolithic period. Most of these anthropomorphic vessels are characterised by features of the female body – there are no examples of the male body – using the human body in its sexual and procreative

890 'Gefäßfigurinen': Schwarzberg 2011, 23–79 (for Greece: 31–32, 39).
891 Wace – Thompson 1912, 147, fig. 91b (Tzani).
892 'Gesichtsgefäße': Schwarzberg 2011, 81–134 (for Greece: 93).
893 Gimbutas 1989, 238, no. 94; 242, no. 125, pl. 7.13; 248, no. 181, fig. 7.54, 1–3, pl. 7.13 (Phase IIIb/IVa, IVb, Achilleion).
894 Orphanidis – Gallis 2011, 116, nos. 374–375. A further piece is of unknown provenance: Orphanidis – Gallis 2011, 117, no. 376.
895 Wace – Thompson 1912, 147, fig. 91b.
896 Tsountas 1908, 299–300, fig. 228.
897 Orphanidis – Gallis 2011, 117, no. 377.
898 Orphanidis – Malakasioti 2011, 147, no. 29.
899 Theocharis 1973, figs. 219–220; Pyke – Yiouni 1996, 88.
900 Nanoglou – Pappa 2009, 254, 255 drawing 5a with a face set on the rim (Makriyalos I); Nanoglou – Pappa 2009, 255 drawing 5b, 257 with a face set on the body of a closed vessel (Makriyalos II).
901 Vougari 2017, 27, fig. 2.2, 32, fig. 2.5.
902 Naumov 2017, 57.
903 Hansen 2007, 167–169, fig. 75, pl. 40.1 (Hassuna), pl. 169.11 (Rakitovo); Schwarzberg 2011, 74–79.

capacity.[904] Another aspect is the concept of the body as a container, the human body strengthening the accumulative and protective features of the vessel.[905]

## VI.6. Table and Miniature Bowl

The high leg PM0935 (Fig. VI.41) of a three- or four-legged circular vessel or table is red monochrome and comes from the Middle Neolithic BSPh Vc (Fig. III.23). Legged vessels are well known in Middle Neolithic Thessaly. The vessel from PMZ should probably be reconstructed in analogy to a four-legged circular shallow bowl from Tsangli.[906] In the Balkans, 'ritual tables' have been attributed to cultic contexts,[907] and Gimbutas has argued their ritual function based on their association with figurines at Achilleion.[908] Elster attributes this kind of pot to "social ceramics, emphasizing the social role of ritual".[909] At the Late Neolithic cemetery of PMZ, a closed vessel with an attached animal head and legs containing a cremation also argues for a ritual connection of legged vessels.[910] In consequence, a ritual function of such vessels seems very plausible for Thessaly, too.

The complete miniature bowl PM0641 (Fig. VI.42) from BSPh VIb (MN III) is included in this chapter, since miniature bowls seem to have been used in connection with figurines and other miniatures and therefore seem to have a ritual connotation.[911] Furthermore, miniature vessels are connected with the Early Neolithic cremation burials of Souphli Magoula, and Gallis argues that they were fired in the course of the cremation, so that they were connected with the burial ritual.[912]

The miniature bowl from PMZ is completely preserved. It is fired brown, has an uneven surface, and has vertically incised lines from the base to the middle of the side. The vessel seems to have been low fired, a feature also seen at other sites.[913] Miniature bowls come from various sites, mainly dating to the Late Neolithic period.[914]

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904 Kokkinidou – Nikolaidou 1997, 100; Naumov 2008, 93–94; Naumov 2010, 230–231.
905 Naumov 2017, 54–55.
906 Wace – Thompson 1912, 99, 107, fig. 57g.
907 Schwarzberg 2003.
908 Gimbutas 1989, 204.
909 Elster 1986.
910 Gallis 1996d, 530, 548, fig. 13; 549, fig. 14.
911 Todorova 1982, 67–68, 69, fig. 31; 71, fig. 32.
912 Gallis 1996d, 532–533.
913 E.g. at Visviki Magoula: Alram-Stern – Dousougli-Zachos 2015b, 190, 193.
914 Marangou 1992, 178–179.

## VI.7. Catalogue

### VI.7.1 Anthropomorphic and Zoomorphic Figurines

*Fig. VI.1. PM0898.*
BPh I, SU 3, ditch; 0.73m from east, south side (Fig. III.5).
H (pres.) 3.8cm, Wd (av.) 2cm, Th (av.) 1.9cm.
Clay: 5YR 5/1 grey, very well sorted, 5%, many small white and fine sparkling inclusions. Surface: 5YR 4/1 dark grey, cracked, smoothed.
Lower part or leg of an anthropomorphic figurine, cylindrical, slightly flattened, slightly uneven; base indented.
Cf. Gimbutas 1989, 237, no. 79 (Achilleion/Pref. Larissa, Phase IIIb); Kyparissi-Apostolika 2000b, 198, no. 1 (Theopetra Cave/Pref. Trikala).

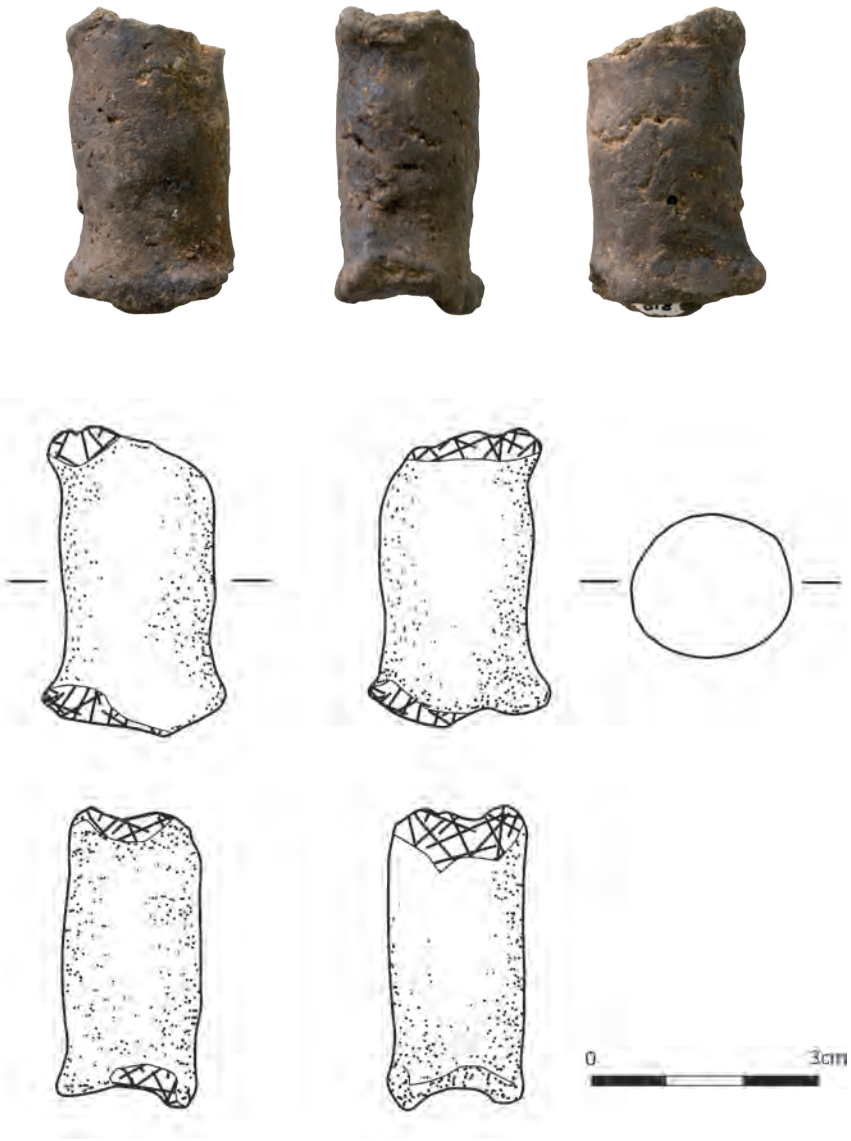



Fig. VI.1 PM0898. Leg or lower part of an anthropomorphic figurine, from BPh I (photos: M. Börner, drawing: S. Horwath)

*Fig. VI.2. PM0892.*
BPh II, SU 8, directly above fill of the ditch; 2.03m from north, 0.80m from west (Fig. III.8).
Lg (pres.) 4.8cm, Wd 5.3, H (pres.) 4.4cm.
Clay: 2.5YR 6/6 light red, very well sorted, 5%, many fine sparkling inclusions, fine white inclusions. Surface: 2.5YR 5/4 reddish brown, burnished; painted (?) spots of dark-grey colour, back side blackened.
Left leg and lower part of an anthropomorphic figurine sitting on the floor, left leg lying on the floor and bowed to its right side; right leg probably set upright, only rudimentarily preserved; flat buttocks and flat back at right angles; inner side irregular, showing that the lower part was formed separately.
Cf. Gallis – Orphanidis 1996, 250, no. 193 (Domeniko 1/Pref. Larissa); Kyparissi-Apostolika 2000b, 198, no. 3 (Theopetra Cave/Pref. Trikala); Phelps 2000, 196, SF716, 195, fig. 4.28 (Servia/western Macedonia); Fassoulas 2017, pl. 22, PRO 111 (Prodromos/Pref. Karditsa), showing the unfinished surface of the interior part of the leg.

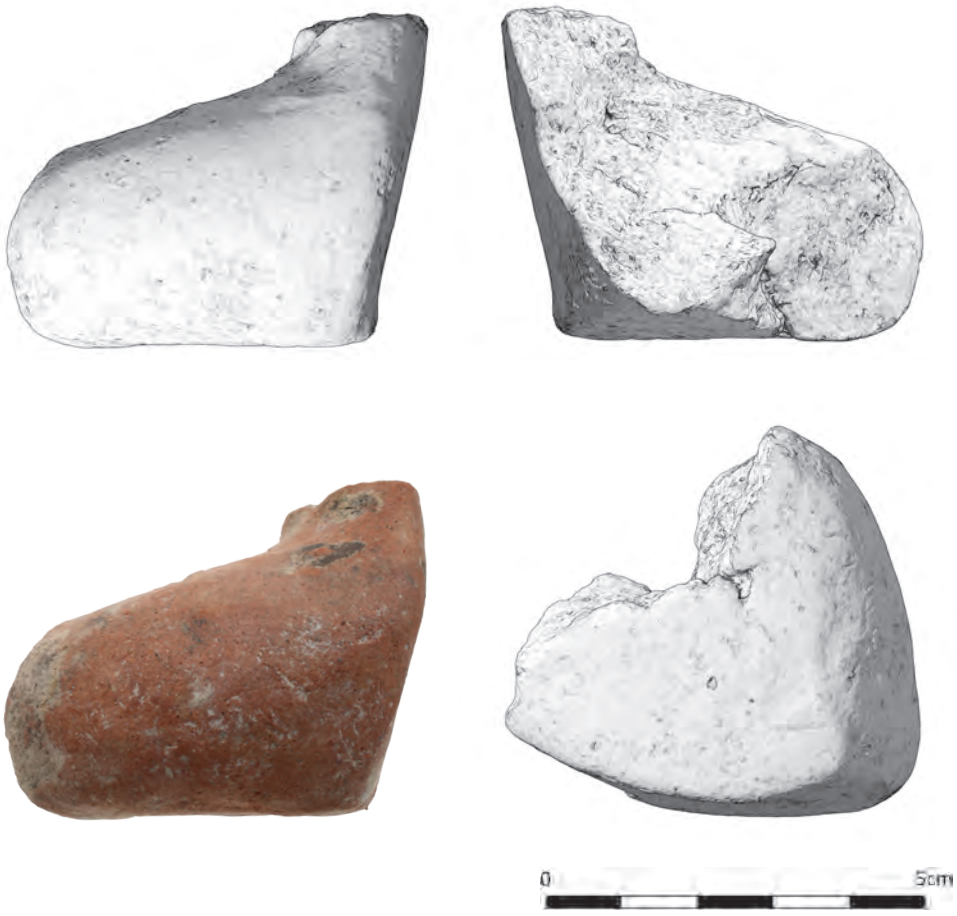



Fig. VI.2 PM0892. Leg of a seated anthropomorphic figurine, from BPh II
(photo: K.-V. von Eickstett, 3D-model: M. Börner)

*Fig. VI.3. PM0873.*
BPh II, SU 14, above fill of the ditch (Fig. III.8).
Lg (pres.) 5cm, Wd 1.8cm, Th 1.55cm.
Clay: 5YR 7/4 pink, very well sorted, 2.5%, small dark and fine white and sparkling inclusions, a few golden inclusions. Surface: 2.5YR 6/6 red monochrome paint, burnished (?)
Leg of a sitting anthropomorphic figurine, curved, bent to its right side; probably left leg, formed from a coil; rough area attached to the upper right leg visible.
Cf. Theocharis 1973, fig. 38 (Pharsala area/Pref. Larissa); Gimbutas 1989, 241, no. 116 (Achilleion/Pref. Larissa, Phase IVa); Gallis – Orphanidis 1996, 242, no. 185 (Zappeio 5); Hansen 2007, pl. 96.3 (Pontokomi-Souloukia/western Macedonia); Orphanidis – Gallis 2011, 257–263, nos. 570–582 (various sites).

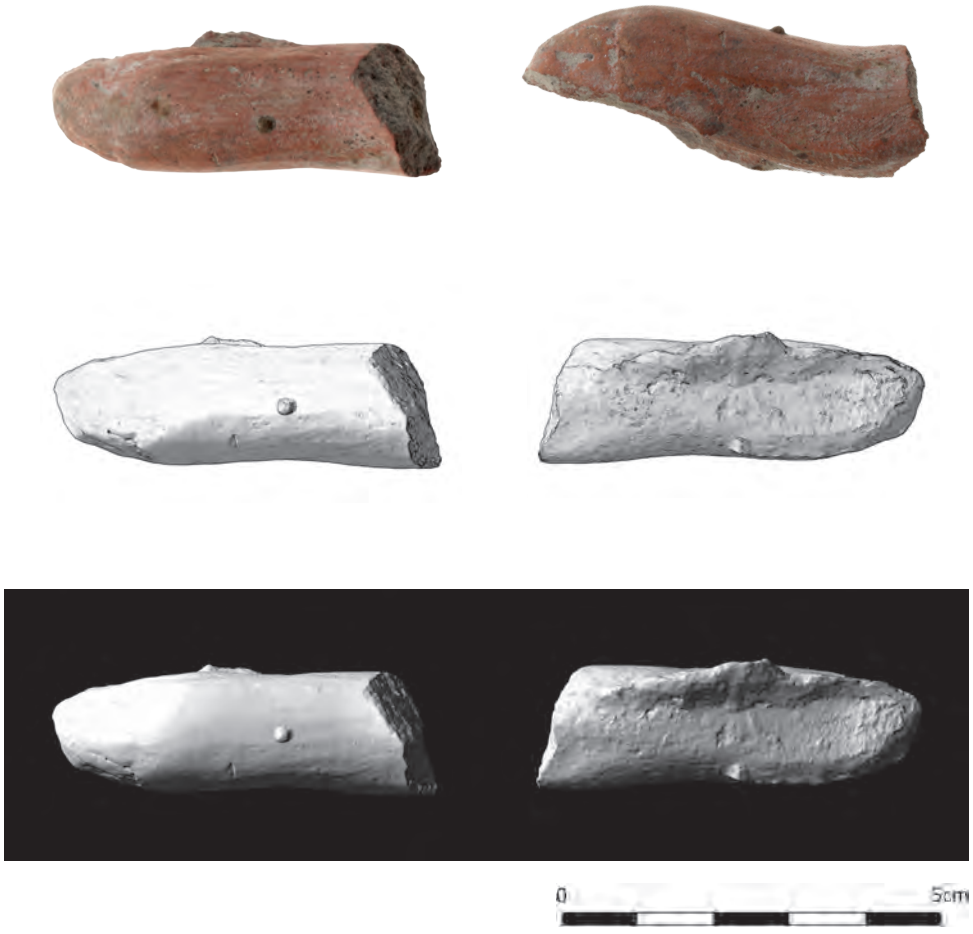



Fig. VI.3 PM0873. Leg of a seated anthropomorphic figurine, from BPh II
(photos: K.-V. von Eickstett, 3D-model: M. Börner)

*Fig. VI.4a–b. PM0878.*
BPh II, SU 14, above fill of the ditch; 1m from east, 1.85m from north (Fig. III.8).
Lg 5cm, Wd (av.) 2cm, Th (lower part) 1.6cm.
Clay: 5YR 7/4 pink, very well sorted, 5%, many small and fine white, many fine sparkling, some golden sparkling inclusions. Surface: Slip: 5YR 8/2 pinkish-white, paint: 5YR 4/4 dark-red, worn, red on white.
Right leg of a seated anthropomorphic figurine, painted; rounded knee, lower leg bent at the knee so that figurine could sit on a stool; on the outer, upper part of the leg, round abraded spot on which the arm may have rested; small, pointed foot with flattened, slightly concave sole, four thin incisions indicating the toes; painted red on white: vertical band with short fringes, interior with dark patches.
Cf. Theocharis 1973, fig. 37 (Sesklo/Pref. Magnesia) = Chourmouziadis 1994, pl. 8; Gallis – Orphanidis 1996, 236, no. 180 (Paliouri/Pref. Karditsa).

Fig. VI.4a PM0878. Right leg of a seated anthropomorphic figurine, from BPh II
(3D-model: M. Börner, photos: K.-V. von Eickstett)

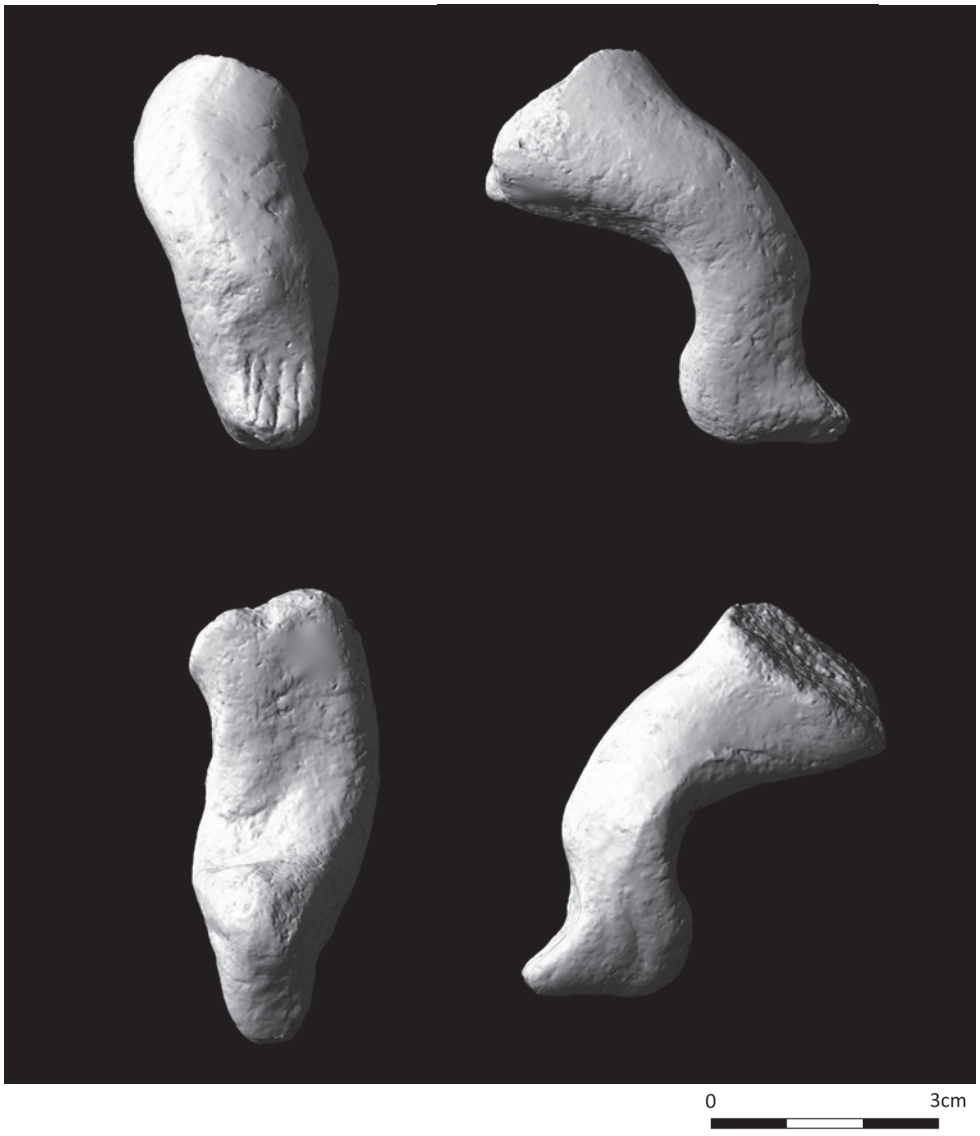



Fig. VI.4b PM0878. Right leg of a seated anthropomorphic figurine, from BPh II
(3D-model: M. Börner)

*Fig. VI.5. PM0819.*
BSPh IIIb, SU 42, uppermost thin layer of black soil; 1.49m from south, 0.74m from east (Fig. III.12).
H (pres.) 4.2cm, Wd 4.5cm, Th (max.) 1.2cm.
Clay: 5YR 7/4 pink, very well sorted, 2.5%, many fine sparkling, few fine white and red inclusions. Surface: 5YR 6/6 reddish-yellow slipped, worn, probably red monochrome, or red-on-buff linear painted.
Upper part of an anthropomorphic figurine; head, upper body and arms preserved; small head on a long, thin, cylindrical neck; face separated from the neck by a thin incised line; right coffee-bean eye preserved, left eye chipped off; bird-like nose damaged; incised mouth; horizontal upper arms, bent at elbows; lower arms, bent to the body, are broken off; the pellet above the left arm either represents the left hand or, more probably, an object attached to the shoulder; body and neck rod-shaped.
Pub.: Gallis 1996d, 541, fig. 4.
Cf. Gallis – Orphanidis 1996, 337, no. 349 (Ambelonas, Sofades/Pref. Karditsa), with a sickle on right shoulder; Nancy Krahtopoulou, personal communication: similar from Kambos and Magoula Palaiochori/Pref. Karditsa.

Fig. VI.5 PM0819. Upper part of an anthropomorphic figurine, from BSPh IIIb
(photos: K.-V. von Eickstett, 3D-model: M. Börner)

*Fig. VI.6. PM0830.*
BSPh IIIb, SU 42, uppermost thin layer of black soil (Fig. III.12).
H (pres.) 4.cm, Wd 5.1cm. Th (max.) 0.8cm.
Clay 5YR 6/3 light reddish brown, very well sorted, 5%, many fine white, many fine sparkling inclusions, many small gold mica inclusions, few red/grey inclusions. Surface: 5YR 7/4 pink slip, interior: uppermost part burnished, lower part smoothed, exterior: rim and paint well burnished. Paint: 5YR 5/6 yellowish-red, red on white.
Triangular head attached directly under the rim of a closed, narrow-mouthed vessel; straight triangular nose, coffee-bean eyes; paint around triangular face, on cheeks, on the back of the nose and on the rim, as pending semicircles hanging down from rim (hair, decoration); diagonal 1cm-deep hole in left upper part of the head.
Pub.: K. Gallis, in: Papathanassopoulos 1996, 303, no. 212; Gallis 1996d, 541, fig. 4.
Cf. Wace – Thompson 1912, 147, fig. 91b (Tzani/Pref. Karditsa); Theocharis 1973, figs. 219–220 (Nea Nikomedeia/western Macedonia); Gimbutas et al. 1989, 238, no. 94; 248, no. 181, figs. 7.54, 1–3, pl. 7.13 (Achilleion/Pref. Larissa, Phase IIIb/IVa, IVb); Chourmouziadis 1994, pls. 98, 103; Orphanidis – Gallis 2011, 116, nos. 374–375 (Sitochoro 2); 117, no. 376 (provenance unknown); 117 no. 377 (Rachmani/Pref. Larissa).

Fig. VI.6 PM0830. Triangular head attached directly under the rim of a closed, narrow-mouthed vessel, from BSPh IIIb (drawing: R. Exarhou, photos: K.-V. von Eickstett)

*Fig. VI.7. PM0847.*
BSPh IIIb, SU 24–25 or 37; 0.9m from W, 2.10m from south (Fig. III.12).
H (pres.) 4cm, Wd (pres., horns) 2.8cm, Wd (neck) 1.3cm, Th (neck) 1.3cm.
Clay: 2.5YR 6/6 light red, very well sorted, 2.5%, many fine dark, white and sparkling inclusions.
Surface: 5YR 6/6 reddish yellow. Paint: 2.5YR 5/6 red, burnished, red on buff.
Head of an animal figurine or animal protome of a zoomorphic vessel, with horns, a pointed mouth und applied coffee-bean eyes, long neck; paint in the area between the horns and the head.
Cf. Marangou 1986, 339, fig. 5.Talalay 1993, 26–27, FC 41, pls. 18–19 (Franchthi Cave/Argolid, Final Neolithic).

Fig. VI.7 PM0847. Head of an animal figurine or animal protome of a zoomorphic vessel, from BSPh IIIb (3D-model: M. Börner, photos: K.-V. von Eickstett)

*Fig. VI.8. PM0792.*
BSPh IVa, SU 51, deposit below Surface F32; 2.6m from south, 1.5m from west (Fig. III.17).
Lg 5.4cm, Wd (av.) 1.8cm, Wd (lower part) 2.2cm.
Clay: 5YR 7/3 pink, very well sorted, 2.5 %, small white and dark inclusions, some fine sparkling inclusions. Surface: Slip: 5YR 8/2 pinkish-white, paint: 2.5YR 5/8 red, worn, red on white.
Left leg of a seated anthropomorphic figurine; lower columnar leg hanging from bent knee so that the figurine could sit on a stool; flat sole; upper, outer part abraded so that arm may have been placed there; red-on-white painted vertical band on outer side of the leg, oval spot on the knee; inner side flattened and unpainted.
Cf. Chourmouziadis 1994, pl. 9 (Tzani/Pref. Karditsa); Fassoulas 2017, pl. 33, MP 21 (Megalo Pazaraki/Pref. Karditsa).

Fig. VI.8 PM0792. Left leg of a seated anthropomorphic figurine, from BSPh IVa
(photos: K.-V. von Eickstett, 3D-model: M. Börner)

*Fig. VI.9. PM0924.*
BSPh IVb, SU 69, above Surface F31 (Fig. III.19).
Lg (pres.) 2.6cm, Wd (pres.) 2cm, Th (pres.) 1.5cm.
Clay: 5YR 7/4 pink, well sorted, many small, fine and larger black rounded inclusions, few fine white and sparkling inclusions, few golden large inclusions. Surface: Slip: 5YR 8/2 white, paint: 2.5YR 5/6 red, worn, red on white.
End of an arm, rounded with thin diagonal/crossing and horizontal red-on-white painted decoration.
Cf. Nanoglou 2004, I.6 (Ag. Christophoros/western Macedonia, Late Neolithic); Fassoulas 2017, pl. 13, PRO 63 (Prodromos/Pref. Karditsa).

Fig. VI.9 PM 0924. Arm of an anthropomorphic figurine, from BSPh IVb
(photos: K.-V. von Eickstett, drawing: S. Horwath)

*Fig. VI.10a–c. PM0753.*
BSPh Vb, SU 88; 1.35m from west, 1.87m from north; on Surface F29 with three hearths, next to the hearth TS 29, in situ? (Fig. III.22).
H (pres.) 6.6cm, Wd (pres., arms) 6.3cm, Wd (pres., base) 4.7cm; Wd (waist) 4cm, Th (body) 3cm, Th (breasts/arms) 3.3cm.
Clay: 5YR 5/4 reddish brown, very well sorted, 5%, many fine sparkling and many golden sparkling inclusions, many small black, some small white rounded inclusions. Surface: 5YR 8/4 light red paint, worn, on a white slip, not certain if there was a red pattern decoration (broad bands) around the neck, horizontal around the arms and vertical at the sides and at the sides, red on white.
Standing female anthropomorphic figurine, head missing, arms and lower body fragmented, worn; back with rough surface; torso with an oval, deeply indented base (two deep impressions visible); arms formed as protrusions and possibly folded under the breasts; belly chipped off, impressed navel and lower part indicated as incision.
Cf. Gallis – Orphanidis 1996, 309, no. 252 (Zoodochos Pigi, Pharsala 1/Pref. Larissa).

Fig. VI.10a PM0753. Standing female anthropomorphic figurine, from BSPh Vb
(photos: K.-V. von Eickstett, 3D-model: M. Börner)

Fig. VI.10b PM0753. Standing female anthropomorphic figurine, from BSPh Vb
(3D-model: M. Börner)

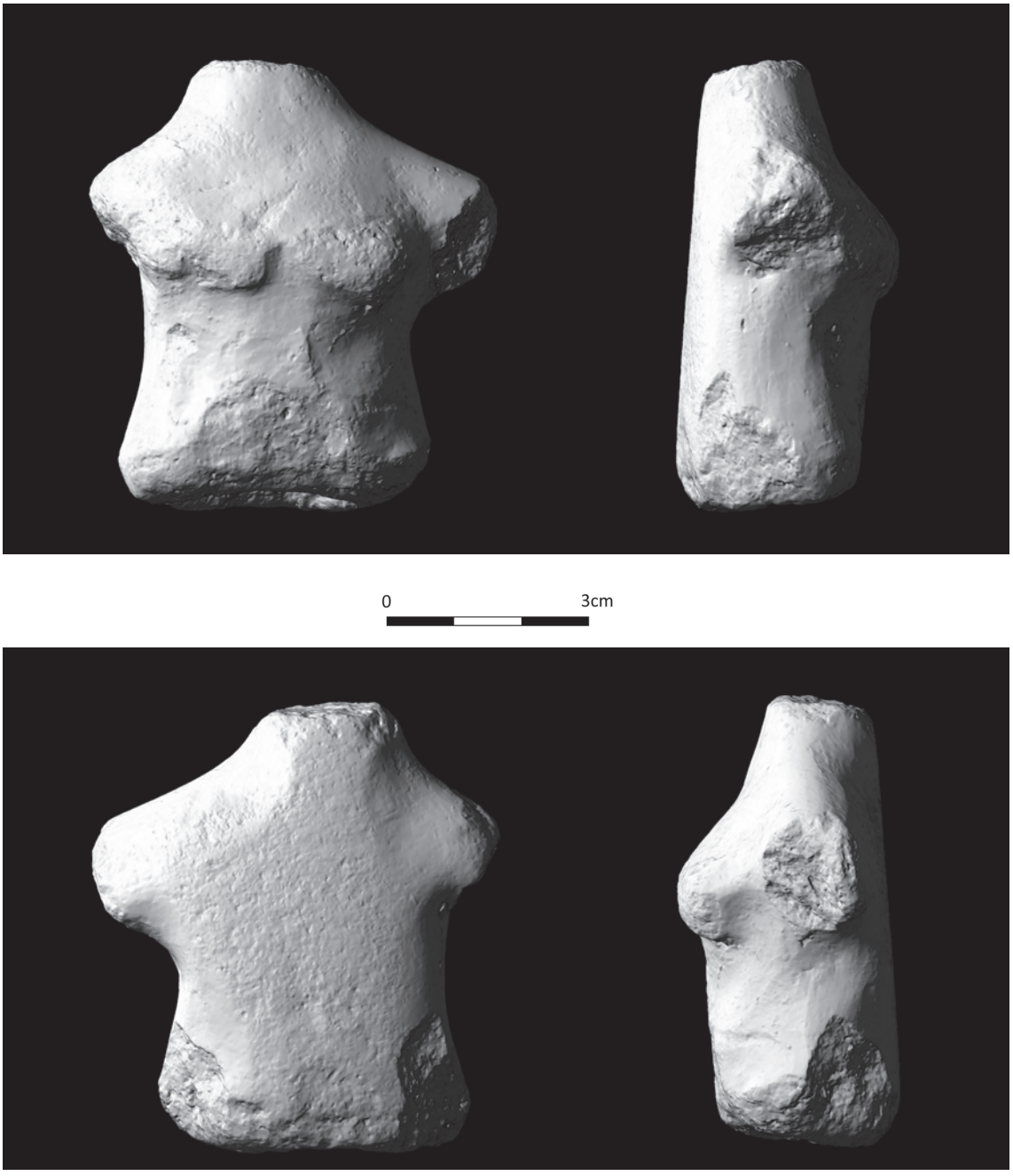



Fig. VI.10c PM0753. Standing female anthropomorphic figurine, from BSPh Vb
(3D-model: M. Börner)

*Fig. VI.11. PM0936.*
BSPh Vc, SU 92, Surface F28 (Fig. III.23).
Lg (pres.) 4.8cm, Wd (max.) 2.7cm, Wd (leg) 2.2cm, Th (av.) 1.5cm.
Clay: 5YR 7/6 reddish yellow, well sorted, 5%, many fine sparkling inclusions, small dark and white inclusions. Surface: 5YR 6/8 red, burnished.
Possibly leg of an anthropomorphic figurine seated on the ground, one leg upright above the other; rod-shaped leg with oval section, ending in a flat area.
Cf. Gallis – Orphanidis 1996, 196, fig. 142.

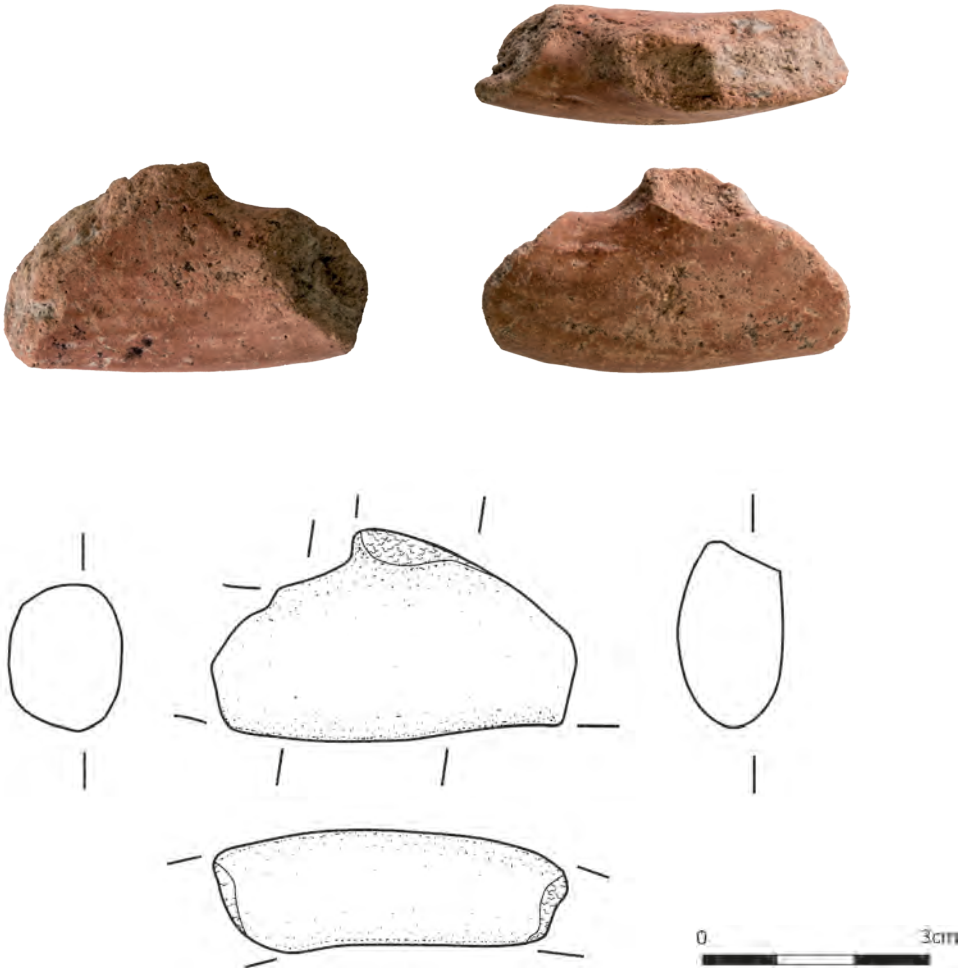



Fig. VI.11 PM 0936. Possibly leg of an anthropomorphic figurine seated on the ground, from BSPh Vc (photos: K.-V. von Eickstett, drawing: S. Horwath)

*Fig. VI.12. PM0725.*
BSPh Vd, SU 107, between Surface F27 and F26; 0.12m from west, 2.48m from north (Fig. III.24).
H 5.5cm, Wd (arms) 5.7cm, Wd (waist) 2cm, Wd (base) 3.1cm, Diam. (waist) 1.7cm, Diam. (belly) 2cm, Diam. (breast) 2cm.
Clay: 5YR 5/8 yellowish red, very well sorted, 5%, many fine white and sparkling inclusions. Surface: 5YR 6/4 light reddish brown, smoothed.
Standing female anthropomorphic figurine, base damaged, head missing; upper body with arms stretched horizontally and folded below the breasts; left breast preserved, right breast flaked off; head broken away; conical lower part of the body, slightly protruding belly and incised navel, belly separated from the lowermost part by an incised line; lowermost part broken away; back flattened and roughened.
Forming details: upper part of the body hollow, head inserted into an oval indentation, arms formed of coils attached to the body, breasts attached to the body, area underneath right breast, which was flaked away, is rough so that it must have been attached on the half-dry surface before smoothing; underside oval and concave.
Cf. Fassoulas 2017, pl. 1, PRO 1 (Type GM); pl. 1, PRO 2 (Type MP); pl. 2, PRO 5; pl. 5, PRO 17 (all from Prodromos/Pref. Karditsa); for inserting the head: Wace – Thompson 1912, 122, 126, fig. 75a (Tsangli/Pref. Larissa); Chourmouziadis 1994, pl. 74–75; Fassoulas 2017, pl. 14, PRO 70.

Fig. VI.12 PM0725. Standing female anthropomorphic figurine, from BSPh Vd
(photos: K.-V. von Eickstett, 3D-model: M. Börner)

*Fig. VI.13a–b. PM0733.*
BSPh Vd, SU 107, between Surface F27 and F26; 1.85m from west, 0.00m from north.
H 4.1cm, Wd (base) 4.4cm, Wd (body) 3.2.cm, Th (body) 3cm.
Clay: 5YR 5/1 grey, very well sorted, 10%, many small and fine white inclusions, many fine sparkling inclusions. Surface: 5YR 5/1 grey, burnished.
Right lower part of a leg of an anthropomorphic figurine with a cylindrical trunk, slightly thickened toward the top; left narrower parts, where probably connected to the other leg, unburnished and rough; foot protruding to back and front, base rectangular and flat.
Cf. Gallis – Orphanidis 1996, 395, no. 344; L. Orphanidis, in: Papathanassopoulos 1996, 315, no. 236 (Chaironeia/Boeotia); Kyparissi-Apostolika 2000b, 198, no. 1 (Theopetra Cave/Pref. Trikala).

Fig. VI.13a PM0733. Right lower part of a leg of an anthropomorphic figurine, from BSPh Vd (3D-model: M. Börner)

Fig. VI.13b PM0733. Right lower part of a leg of an anthropomorphic figurine, from BSPh Vd (photos: K.-V. von Eickstett, 3D-model: M. Börner)

*Fig. VI.14. PM0737.*
BSPh Vd, SU 107, between Surface F27 and F26 (Fig. III.24).
Lg (pres.) 1.85cm, Wd (pres.) 2cm, Th (pres.) 1.5cm.
Clay: 5YR 6/6 reddish yellow, very well sorted, 5%, many small white and fine sparkling inclusions. Surface: 5YR 7/4 pink, smoothed. Paint: red, red on white.
Back part of the head of an animal figurine or animal protome of a zoomorphic vessel, with high, pointed horns; horn with red paint; (its) right horn and the mouth broken away, neck broken, worn.

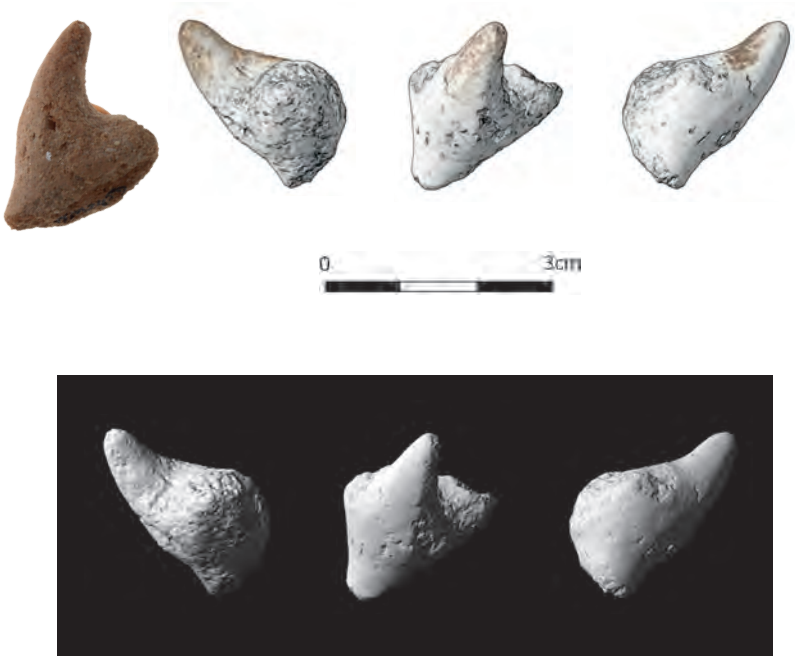



Fig. VI.14 PM0737. Back part of the head of an animal figurine, from BSPh Vd
(photo: K.-V. von Eickstett, 3D-model: M. Börner)

*Fig. VI.15. PM0657.*
BSPh VIa, SU 121, below Surface F24 (Fig. III.26).
H (pres.) 3cm, Wd 2.7cm, Th 1.4cm.
Clay: 10YR 4/1 dark grey, very well sorted, many fine white and sparkling inclusions. Surface: 10YR 5/1 grey, smoothed (?), four rows of short incisions around the back upper part.
Flat head of an anthropomorphic figurine, of oval shape, face chipped off; back and sides decorated by four lines of short incisions; on the back side, short incisions along the edge of the neck.
Cf. Gallis – Orphanidis 1996, 137, no. 71 (Chalki 3/Pref. Larissa) = Gallis 1992a, 189, fig. 33; Orphanidis – Gallis 2011, 183, no. 473 (area of Mezourlo/Pref. Larissa); Fassoulas 2017, pl. 51, RACH 14 (Rachmani/Pref. Larissa).

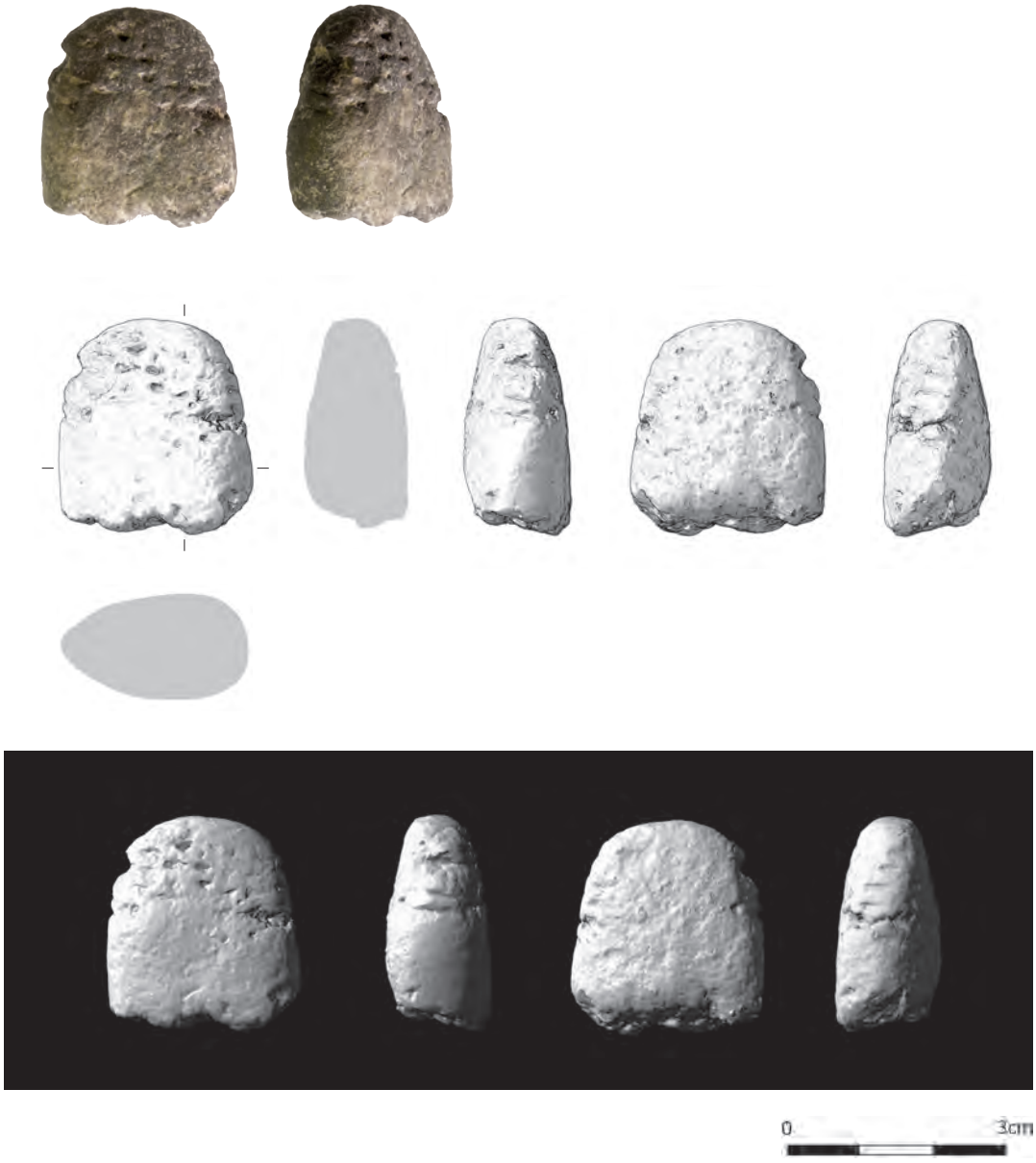



Fig. VI.15 PM0657. Flat head of an anthropomorphic figurine, from BSPh VIa
(photos: K.-V. von Eickstett, 3D-model: M. Börner)

*Fig. VI.16. PM0651.*
BSPh VIb, SU 122, Surface F24 (Fig. III.27).
H 5.8cm, Wd (av.) 2.2cm, Th (av.) 1.9cm.
Clay: 5YR 5/6 yellowish red, very well sorted, 5%, many small white, some small dark and many fine sparkling inclusions. Surface: Slip: 5YR 6/2 pinkish grey (originally pink/buff?), paint: 5YR 4/4 reddish-brown, burnished, red on white.
Left leg of a seated anthropomorphic figurine, right side slightly irregular, left side straight; foot slightly protruding beyond the leg; sole flattened, attachment to the body preserved; red horizontal band in the upper part around the entire leg.
Cf. Gallis – Orphanidis 1996, 180, no. 125.

Fig. VI.16 PM0651. Left leg of a seated anthropomorphic figurine, from BSPh VIb
(3D-model: M. Börner, photo: K.-V. von Eickstett)

*Fig. VI.17. PM0640.*
BSPh VIb, SU 126, between Surface F23 and F24 (Fig. III.27).
H (pres.) 4.1cm, Wd 2.3cm, Th 1.5–1.7cm.
Clay: 5YR 6/6 reddish yellow, core 2.5Y 7/1 light grey, 2.5%, very well sorted, fine white inclusions, many sparkling inclusions. Surface: 2.5YR 5/6 red slipped, burnished, one narrow side coarse.
Cylindrical, slightly oval leg of an anthropomorphic figurine; underside flattened; interior side, to which the second leg may have been attached, has a flattened, rougher surface.
Cf. Karamitrou-Mentessidi 2009, 119, fig. 21; Karamitrou-Mentessidi et al. 2013, 40–41, figs. 9–10 (Pontokomi-Souloukia/western Macedonia) = Karamitrou-Mentessidi 2002, 628–629, fig. 32.

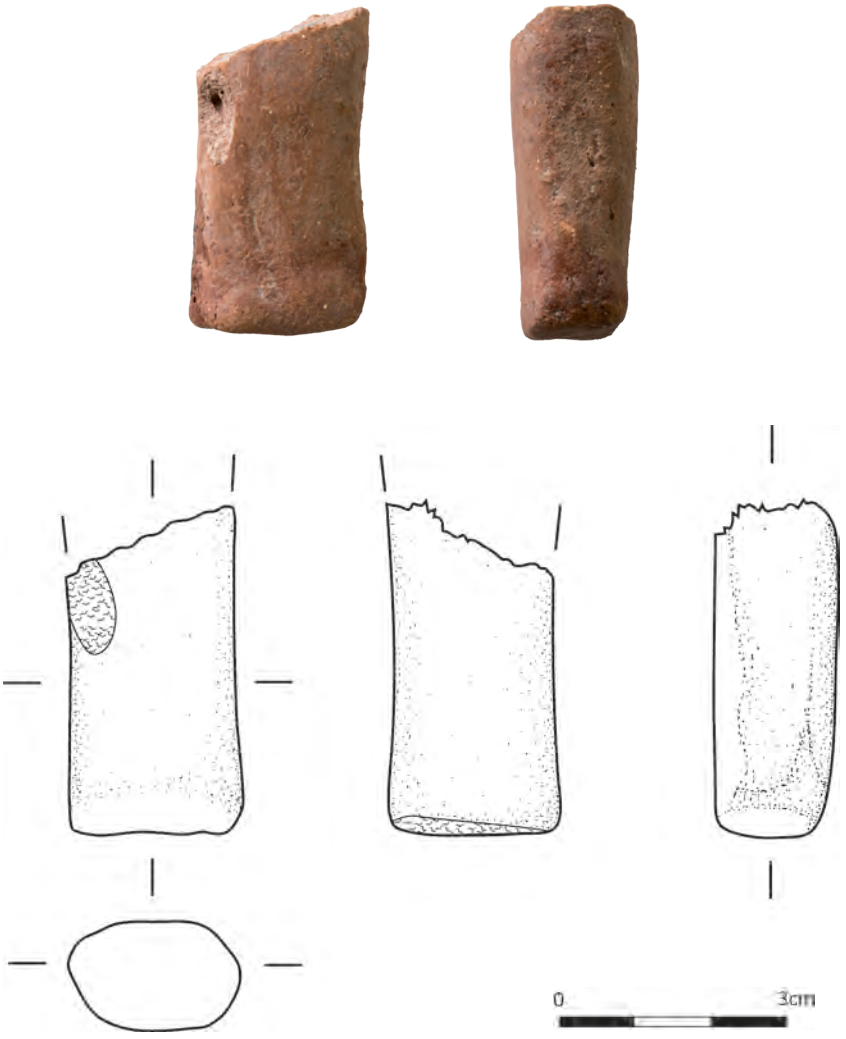



Fig. VI.17 PM0640. Cylindrical, slightly oval leg of an anthropomorphic figurine, from BSPh VIb (photos: K.-V. von Eickstett, drawing: S. Horwath)

*Fig. VI.18a–b. PM0621.*
BSPh VIIa, SU 126, between Surface F23 and F24, close to PM0620; 2.5m from north (Fig. III.29).
Lg 6.2cm, Wd (upper part) 4.1cm, Wd (lower part) 3.3cm, Th 1.5cm.
Clay: 5YR 6/6 reddish yellow, dark-grey core, well sorted, 5%, small reddish-black and white inclusions, many fine sparkling inclusions. Surface: 5YR 6/6 reddish yellow, partly wiped, partly smoothed.
Completely flat, schematised anthropomorphic figurine without head; back flat, front has belly slightly indicated; lower part of the back slightly rounded; arms slightly visible as folded horizontally, legs indicated as protruding stumps; thin incised line on the top and slightly roughened surface may indicate that a head had been attached.

Fig. VI.18a PM0621. Complete flat schematised anthropomorphic figurine, from BSPh VIb
(3D-model: M. Börner)

Fig. VI.18b PM0621. Complete flat schematised anthropomorphic figurine, from BSPh VIb
(photos: K.-V. von Eickstett, 3D-model: M. Börner)

*Fig. VI.19a–c. PM0645.*
BSPh VIb, SU 126, between Surface F23 and F24 (Fig. III.27).
H 6.7cm, Wd (upper part) 4.2cm; Wd (lower part) 3.6cm; Th 2.2cm.
Clay: 7.5YR N7 light grey, 1%, fine white and fine sparkling inclusions. Surface: 5YR 7/6 reddish-yellow slip, powdery.
Complete (?) anthropomorphic figurine, without head (missing?); body flattened, back slightly rounded, arms and legs indicated as flattened, rounded angular ends; top and base characterised by a deep groove over the entire width which may have served for inserting the head and lower body; however, since the groove has a slip, it is possible that it was not intended to have a head inserted.

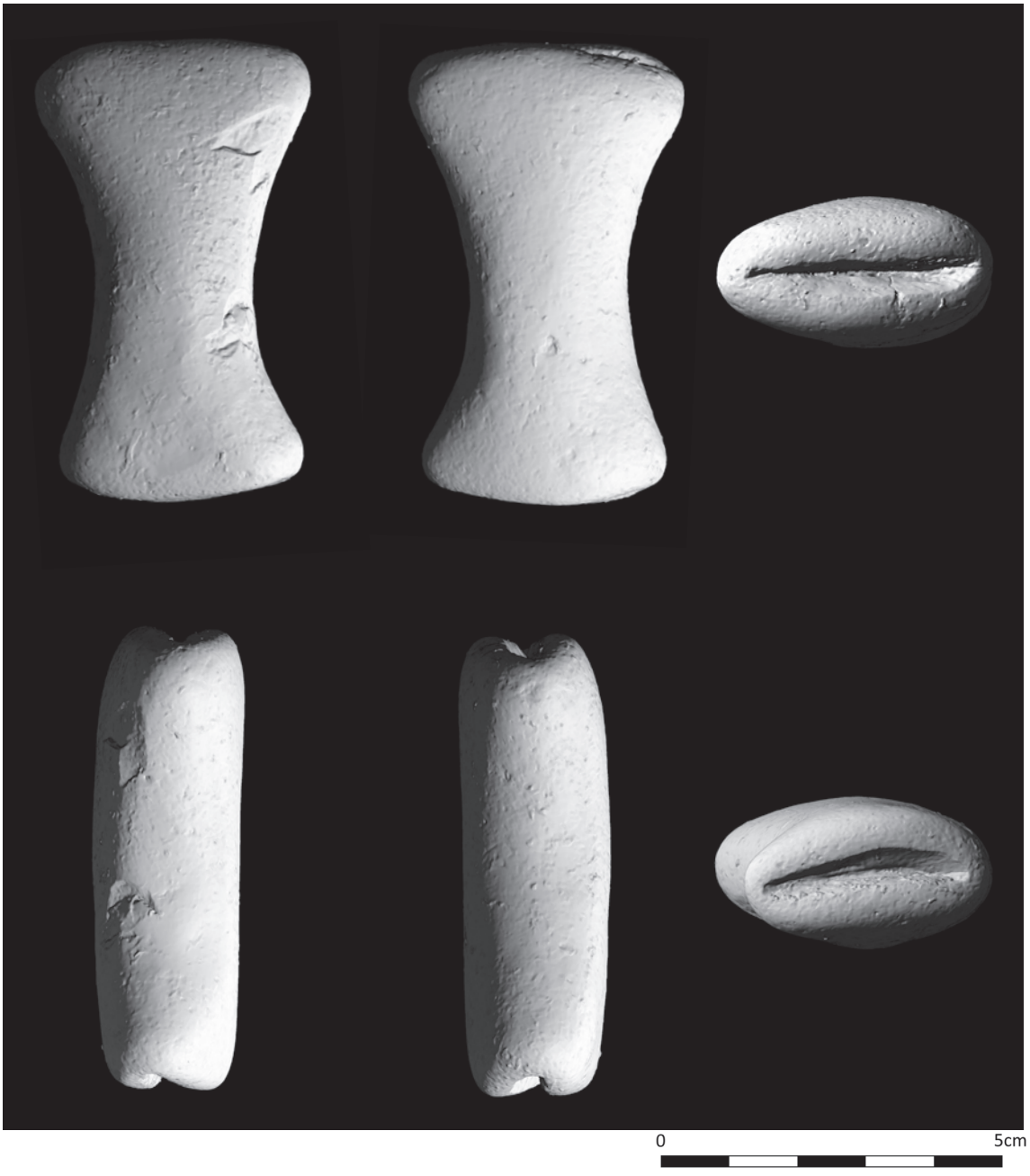



Fig. VI.19a PM0645. Complete (?) anthropomorphic figurine, without head, from BSPh VIb (3D-model: M. Börner)

Fig. VI.19b PM0645. Complete (?) anthropomorphic figurine, without head, from BSPh VIb
(photos: K.-V. von Eickstett, 3D-model: M. Börner)

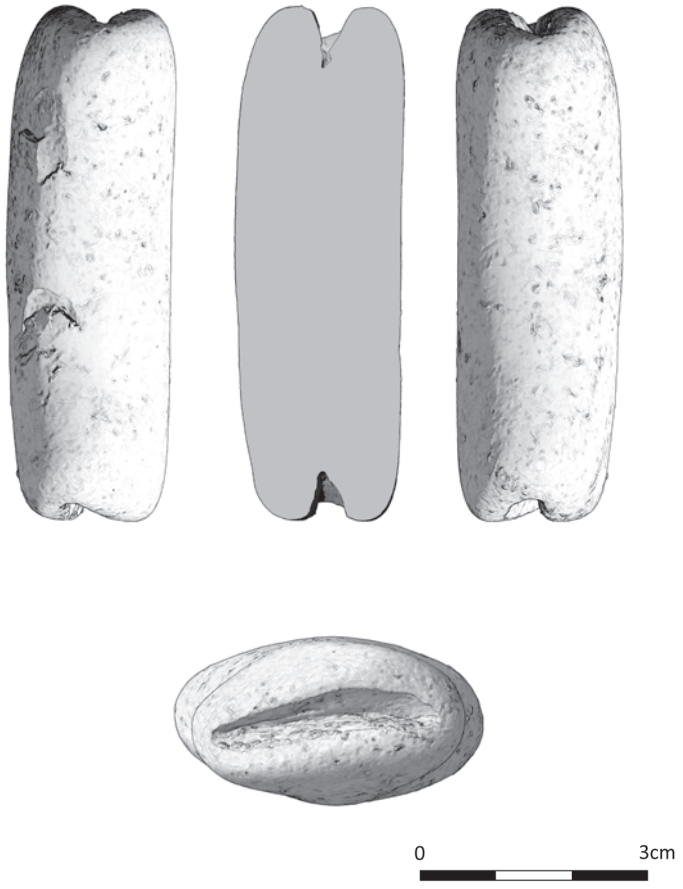



Fig. VI.19c PM0645. Complete (?) anthropomorphic figurine, without head, from BSPh VIb (3D-model: M. Börner)

*Fig. VI.20. PM1014.*
BSPh VIIa, SU 126 (Fig. III.29).
H (pres.) 3.5cm, Wd (pres.) 2.8cm, Th 0.4–1.3cm.
Clay: 2.5YR 4/4 light red, very well burnished, 1–2.5%, very well sorted, many fine white and sparkling inclusions, very few darker inclusions, pores in the form of channels. Surface: black on red. Paint: 2.5YR 4/4 reddish brown (now looking whitish) on 2.5YR 5/6 red surface, exterior burnished, interior smoothed.
Lower part of an animal-head attachment, quite narrow, showing plastically nose and eyes with three plastically raised parts and incised mouth of an animal (bovid or sheep/goat?).

Fig. VI.20 PM1014. Lower part of an animal head attachment, from BSPh VIb
(drawing: R. Exarhou, photo: K.-V. von Eickstett)

*Fig. VI.21. PM0620.*
BSPh VIIa, SU 126, between Surfaces F23 and F24, close to PM0621; 2.15m from north, 3.35m from east (Fig. III.29).
H (pres.) 5.2cm, Wd (max.) 2.5cm, Wd (leg) 1cm, Th (max.) 2.7cm, Th (leg) 1.1cm.
Clay: 7.5YR 6/6 reddish yellow, very well sorted, 5%, many small white, few dark inclusions, many fine sparkling inclusions. Surface: 7.5YR 6/2–5/2 pinkish grey, smoothed, incised.
Thin left leg of an anthropomorphic figurine ending in a globular buttock, probably of a standing figurine; cylindrical, straight leg with indications of the upper and lower leg, ending in a small foot with a flat sole; front and outer side decorated with short, horizontal incisions, leg separated from the body by two thin incised lines; inner und upper part shows rough surface attached to the body.
Forming details: leg and buttocks were formed and half-dried as one piece, to be attached to the body; core was covered by a thin layer of clay.
Cf. Chourmouziadis 1994, pl. 29 (Otzaki Magoula/Pref. Larissa); Gallis – Orphanidis 1996, 205, no 148; E. Skafida, in: Papathanassopoulos 1996, 299, no. 204 (Early Neolithic).

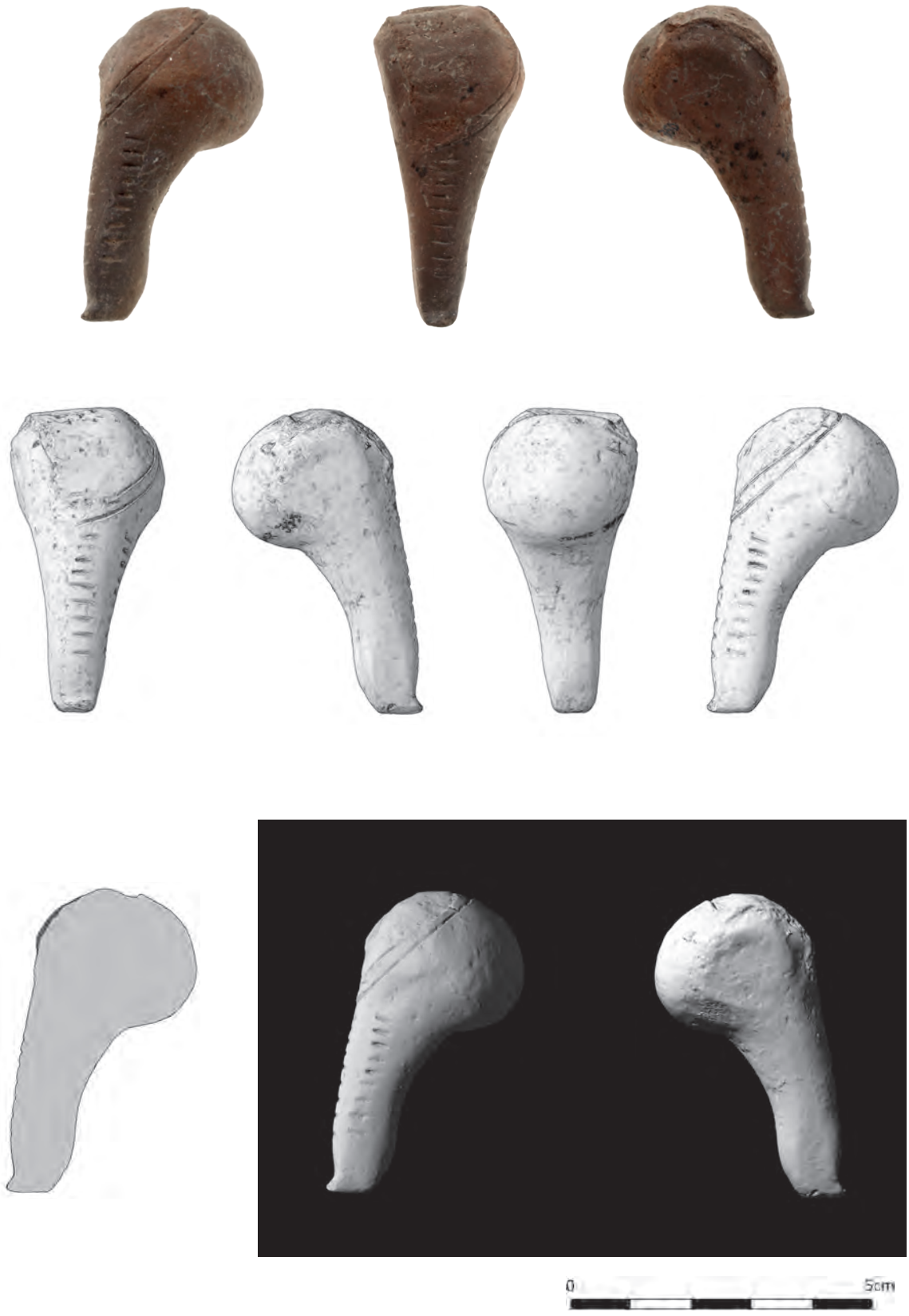



Fig. VI.21 PM0620. Thin left leg of an anthropomorphic figurine, from BSPh VIb
(photos: K.-V. von Eickstett, 3D-model: M. Börner)

*Fig. VI.22. PM1013.*
BSPh VIIa, SU 127 (Fig. III.29).
Diam. (vessel interior) 13cm, Th 0.5cm.
Clay: 5YR 4/1 dark grey to 7.5YR 4/2 dark brown, 5%, well sorted, many fine and small white inclusions and sparkling inclusions. Surface: 7.5YR 5/2 brown, interior burnished, exterior well burnished, shiny.
Body sherd of an anthropomorphic vessel, decorated with the lips of a face, upper lip less plastic than lower.
Cf. Tsountas 1908, 299–300, fig. 228 (Sesklo/Pref. Magnesia); Gimbutas 1989, 242, no. 125, pl. 7.13 (Achilleion/Pref. Larissa, Phase IVa); Orphanidis – Malakasioti 2011, 147, no. 29 (Karamourlar/Pref. Magnesia); Nanoglou – Pappa 2009, 254, 255 drawing 5a (Makriyalos I/central Macedonia); Nanoglou – Pappa 2009, 255 drawing 5b, 257 (Makriyalos II/central Macedonia).

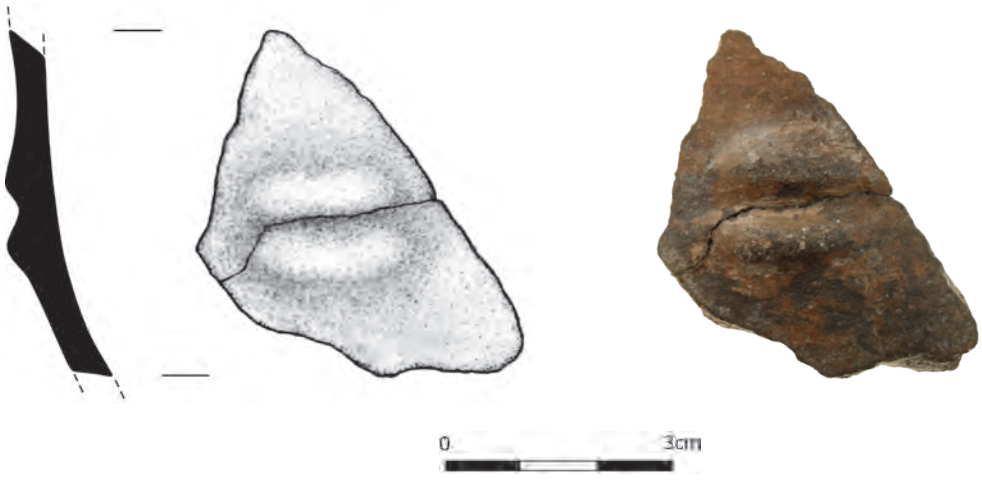



Fig. VI.22 PM 1013. Body sherd of an anthropomorphic vessel, from BSPh VIIa
(drawing: R. Exarhou, photo: K.-V. von Eickstett)

*Fig. VI.23. PM0577.*
BSPh VIIa, SU 132, directly above Surface F23 (Fig. III.29).
H (pres.) 3.3cm, Wd (pres.) 3.9cm, Th 1.6–2cm.
Clay: 7.5YR 6/6 reddish yellow, very well sorted, 5%, many small white rounded inclusions, many fine sparkling inclusions. Surface: 7.5YR 6/2 pinkish grey, wiped.
Upper body of a female anthropomorphic figurine with rudiments of the neck and the arms; front side with small pellets on both sides, indicating the breasts; cylindrical neck; arms probably horizontally orientated.

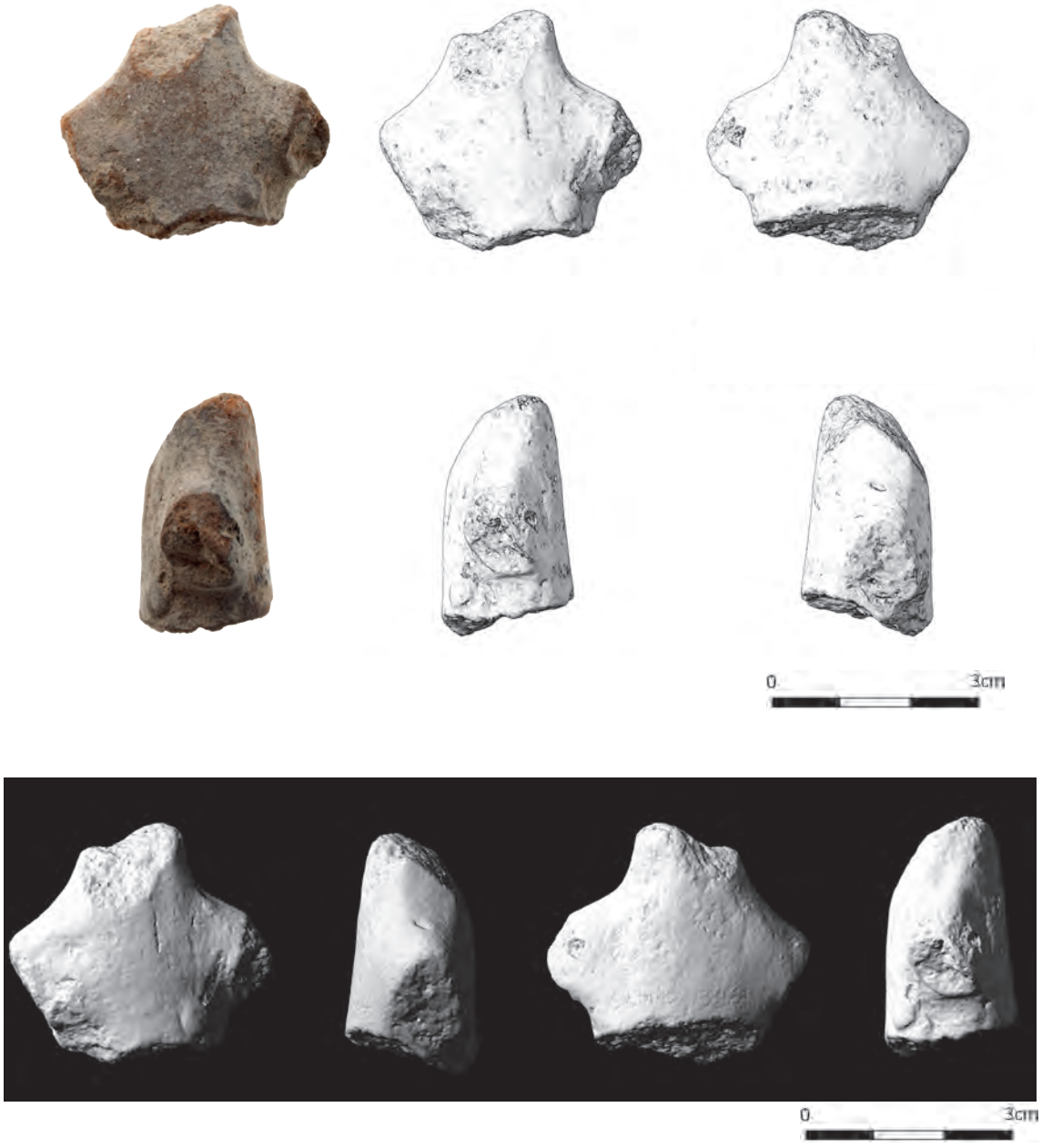



Fig. VI.23 PM0577. Upper body of a female anthropomorphic figurine, from BSPh VIIa
(photos: K.-V. von Eickstett, 3D-model: M. Börner)

*Fig. VI.24a–b. PM0590.*
BSPh VIIa, SU 132, directly above Surface F23; 1.75 from north, 3.5m from west (Fig. III.29).
Lg/H (pres.) 6.8cm, Wd (max.) 3.3cm, Th (max.) 3.9cm.
Clay: 7.5YR 6/6 reddish yellow, very well sorted, 2.5%, many small white and dark, rounded inclusions, many fine sparkling inclusions. Surface: slip: 7.5YR 8/4 pink, paint: 2.5YR 5/6 red, burnished, red on white.
Right leg of an anthropomorphic figurine, upper part ending in a quadrangular buttock, foot fragmented; interior and upper interior part rough so that it may have been glued to the left leg and to the body; furthermore, the right arm may have been placed on it; belonging to a standing figurine; incised line along the upper part of the leg; painted with a vertical, red line on a buff surface.
Forming details: leg and buttock were formed and half-dried separately to be attached to the body; covered with a thin layer of clay, which has been burnished.
Cf. Fassoulas 2017, pl. 7, PRO 25 (Prodromos/Pref. Karditsa).

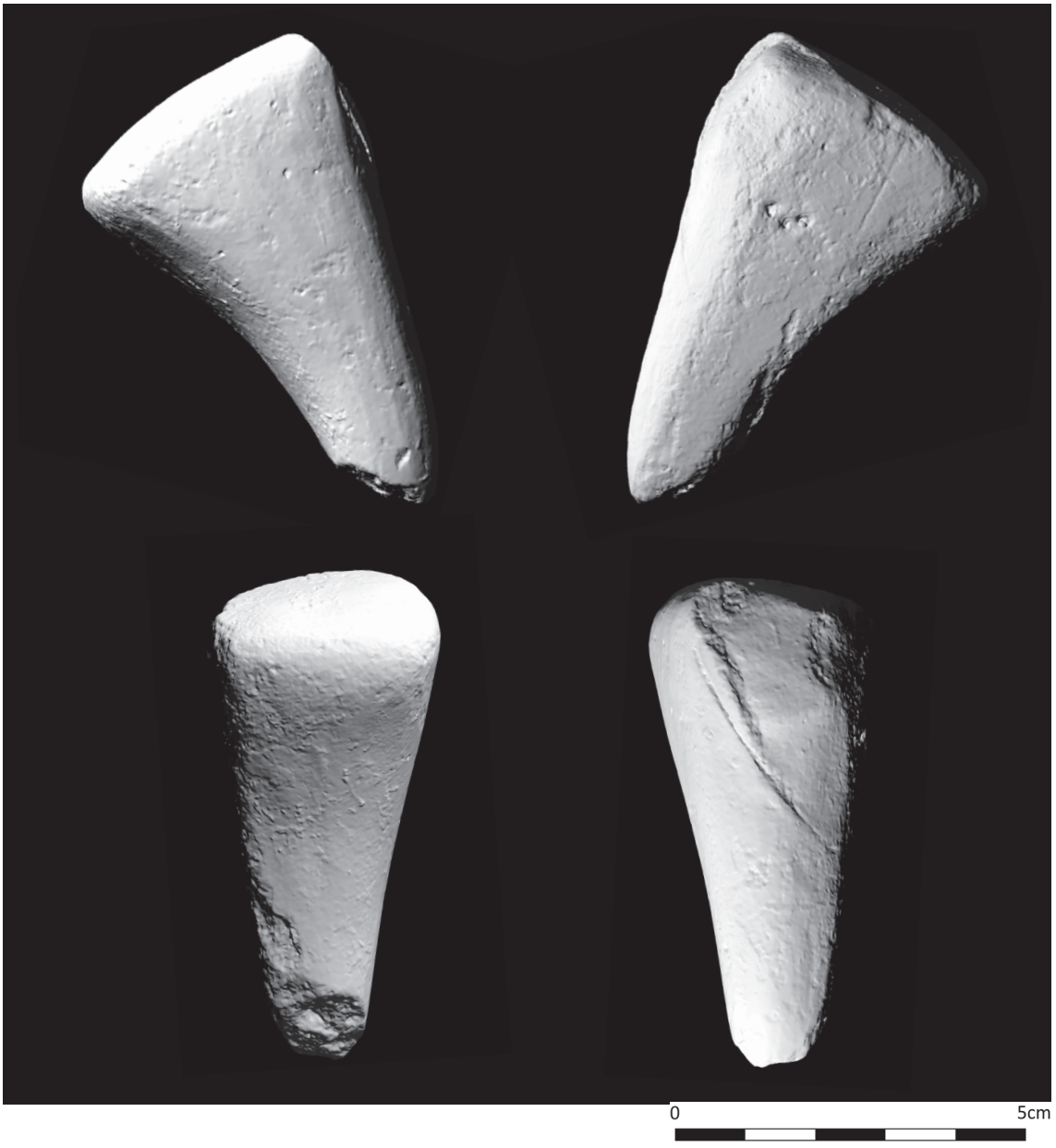



Fig. VI.24a PM0590. Right leg of an anthropomorphic figurine, from BSPh VIIa
(3D-model: M. Börner)

Fig. VI.24b PM0590. Right leg of an anthropomorphic figurine, from BSPh VIIa
(photos: K.-V. von Eickstett, 3D-model: M. Börner)

*Fig. VI.25a–b. PM0591.*
BSPh VIIa, SU 132, directly above Surface F23; 0.9m from south, 1.28m from east (Fig. III.29).
H 6.3cm, Wd 3.7cm, Th 1.8cm.
Clay: 5YR 6/6 reddish yellow, moderately sorted, 15%, many smaller and larger white inclusions, few small dark inclusions, many fine sparkling inclusions. Surface: 5YR 6/6 reddish yellow, worn, probably originally wiped.
Eight-shaped, flat figurine, complete; upper part with well-rounded lobes, lower part more angular; on the top and the underside of the figurine are thin incised lines, which may be residual traces from inserting the head and legs, irregular incised line on the back of the figurine.
Pub.: Gallis – Orphanidis 1996, 405, no. 354.
Cf. Gallis – Orphanidis 1996, 402, no. 351; 403, no. 352: both of stone (Deleria 1/Pref. Larissa).

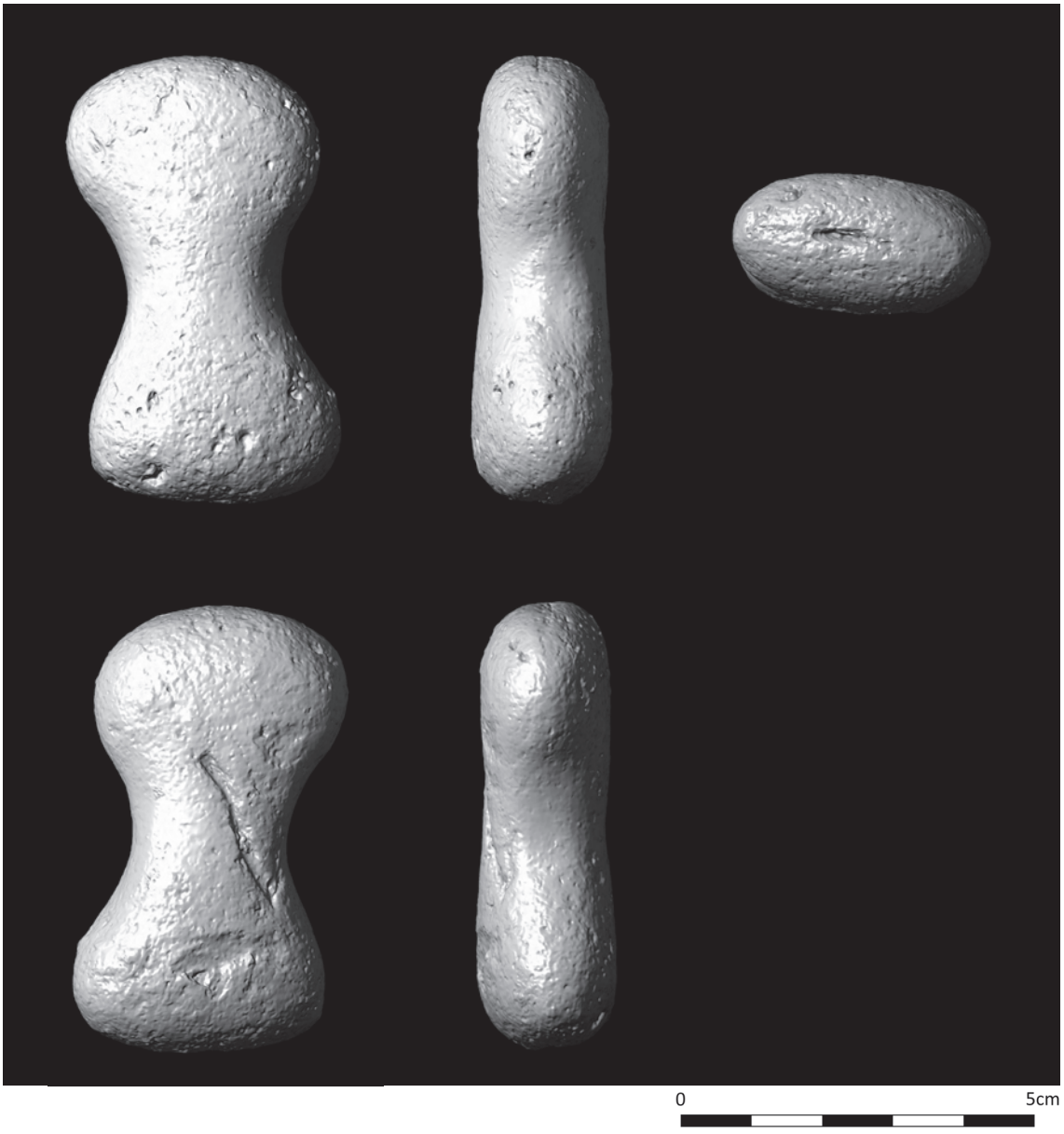



Fig. VI.25a PM0591. Eight-shaped, flat figurine, from BSPh VIIa
(3D-model: M. Börner)

Fig. VI.25b PM0591. Eight-shaped, flat figurine, from BSPh VIIa
(photos: K.-V. von Eickstett, 3D-model: M. Börner)

*Fig. VI.26. PM1020.*
BSPh VIIa, SU 127 (Fig. III.29).
H (pres.) 2.2cm, Wd 1.8cm, Th 1.4cm.
Clay core (entire fracture): 5YR 6/1 light grey, exterior 5YR 7/4 pink, very well sorted, 5%, many small white and sparkling inclusions, few reddish-grey inclusions. Surface: 5YR 6/6 reddish yellow, burnished, but matt, red monochrome.
Quadrangular end of a plaque or bar, front side at its edges with two lines of vertical zigzag incisions; upper side with two lines incised on each side; back side plain.
Cf. Nancy Krahtopoulou, personal communication: Makrychori, Kambos area/Pref. Karditsa; reconstruction as figurine: Hansen 2007, pl. 110.1–5, 7–8 (Körös and Starčevo sites); 137, fig. 51 (Zăuan/Rumania).

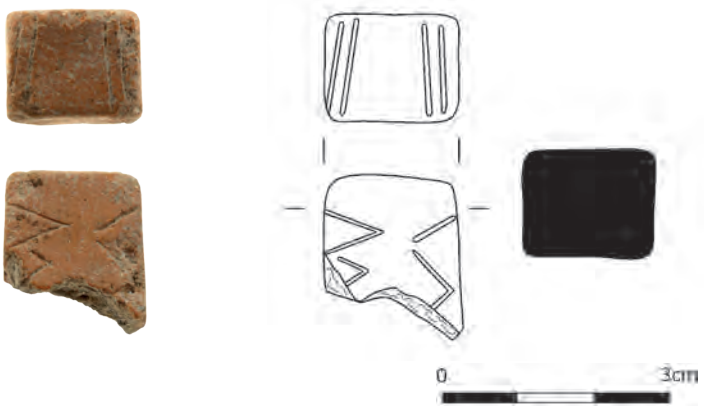



Fig. VI.26 PM1020. Quadrangular end of a plaque or bar, from BSPh VIIa (photos: K.-V. von Eickstett, drawing: R. Exarhou)

*Fig. VI.27/37a–c. PM0912.*
BSPh VIIa, SU 134, layer of fire destruction directly above SU 133 and below Surface F22 (Fig. III.29).
Clay: 7.5YR 4/2 to 10YR 4/1 brown-dark grey, very well sorted, 5%, some small (<0.3mm) and many fine (<0.1mm) silver sparkling inclusions. Surface: 10YR 4/1 dark grey, figurines, objects and interior surface of the house model smoothed, figurines incised with short lines, occasionally with dots, incised lines partly filled with brown paint, in some cases tops of the heads painted brown (7.5YR 4/6 strong brown to 5YR 4/6 yellowish red) and burnished.
Pub.: Gallis 1985b, 20–24; Gallis 1990; Gallis 1992b, 206–207; Marangou 1992, 36–37; K. Gallis, in: Papathanassopoulos 1996, 328–329, no. 266; Gallis 2001, 140–141.

Fig. VI.27–37a PM0912. House model with figurines in situ, from BSPh VIIa (photo: M. Börner)

Fig. VI.27–37b PM0912. House model with figurines in situ, from BSPh VIIa
(photos: M. Börner)

Fig. VI.27–37c PM0912. PM0912. House model with figurines in situ, from BSPh VIIa
(3D-model: M. Börner)

*Fig. VI.27a–d.*
H 6.05cm, Wd 3.5cm, Wd (neck) 1.25, Th 3.4cm.
Standing anthropomorphic figurine with four legs, no sex indicated; complete; one leg placed in front, one at the back and two at the sides of the figurine; long neck growing out of the legs and the lower, conical body; triangular, beaked head with applied coffee-bean eyes; under the eyes, three short, diagonal lines; mouth indicated by a thin incision; upper side of the head flattened and burnished; hair indicated on the back side by vertical, incised short zigzag lines; cylindrical neck decorated with five horizontal, intermittent incised lines; front with two horizontal v-shaped ornaments as well as a vertical line of incised dots; legs decorated with three diagonally running incised lines; underside of the figurine with impressed cavity.
Cf. Gallis – Orphanidis 1996, 370–380, nos. 319–330. Western Thessaly: Gallis – Orphanidis 1996, 372, no. 321 (Sofades/Pref. Karditsa); 373, no. 322 (Astritsa/Pref. Karditsa); Nanoglou 2004, II.235 (Astritsa/Pref. Karditsa); Fassoulas 2017, pl. 31, MP14 (Megalo Pazaraki/Pref. Karditsa); Hamilakis et al. 2017, 466, pl. II, chapter 6, fig. 8 (Koutroulou Magoula/Pref. Phthiotida); Alexiou 2018, 188, fig. 11 = Alexiou 2020, fig. 3α–γ and below (Magoula Sykeon/Pref. Karditsa).

Fig. VI.27a PM0912. Standing anthropomorphic figurine with four legs from house model, as placed in the house model, BSPh VIIa (3D-model: M. Börner)

Fig. VI.27b PM0912. Standing anthropomorphic figurine with four legs from house model, BSPh VIIa (photos: M. Börner)

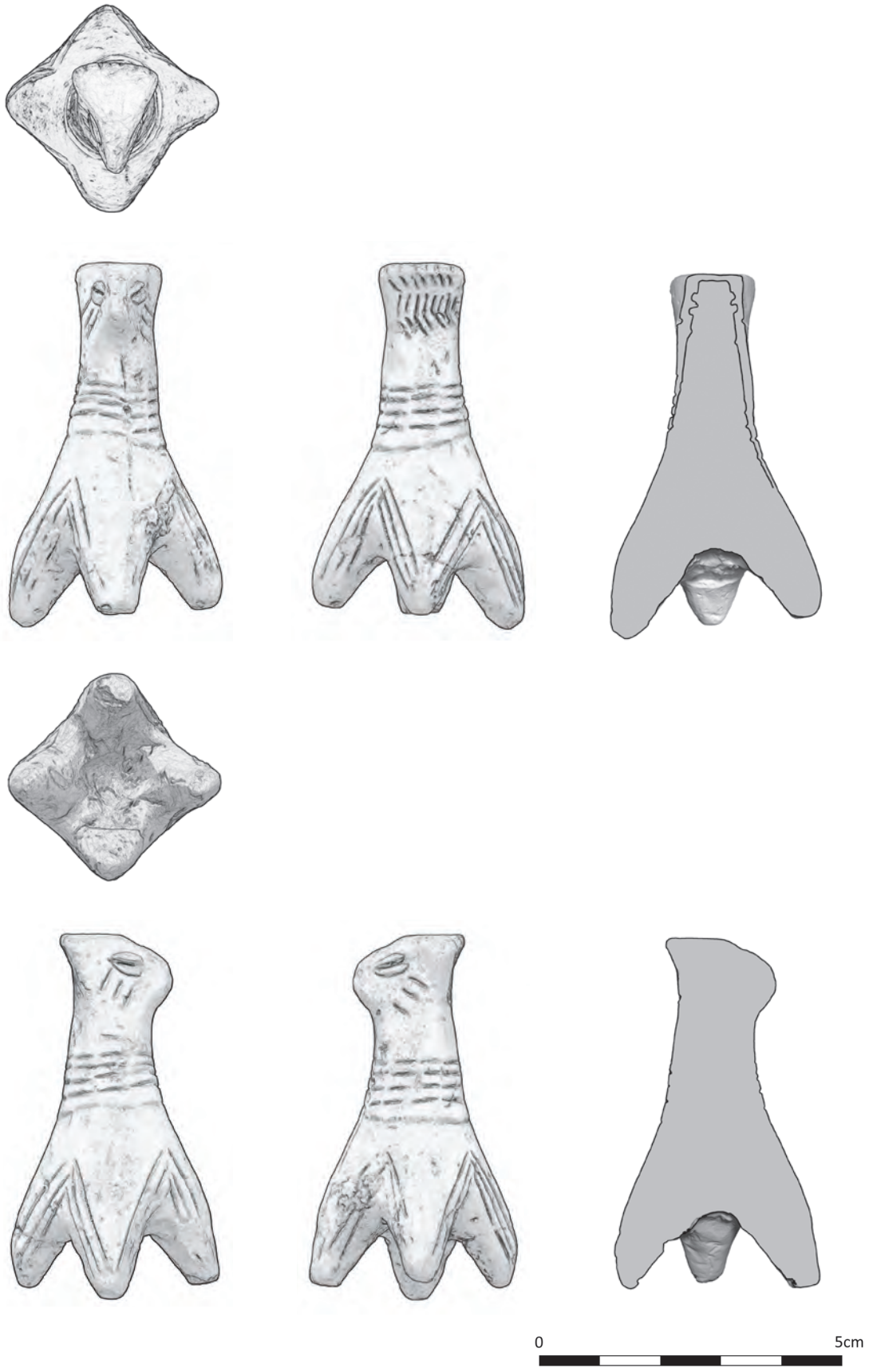



Fig. VI.27c PM0912. Standing anthropomorphic figurine with four legs from house model, BSPh VIIa (3D-model: M. Börner)

Fig. VI.27d PM0912. Standing anthropomorphic figurine with four legs from house model, BSPh VIIa (3D-model: M. Börner)

*Fig. VI.28a–d.*
H 7.35cm, Wd 3.7cm, Wd (waist) 2.15cm, Th 2.75cm; incised lines filled with reddish-brown pigment.
Standing female anthropomorphic figurine; complete; triangular, beaked head with applied coffee-bean eyes; under the eyes three short diagonal lines; beaked face; head flattened, red slipped and burnished on the upper side; hair indicated on the back by short, incised lines at the edge of the head and vertical incised short zigzag lines hanging down to the neck; short neck decorated with two horizontal, intermittent incised lines; cylindrical body, back flattened, front slightly rounded; decorated in front and in the back by three vertical incised lines; applied protruding pellets indicating the breasts and separated from the body by incised lines; upper arms lifted horizontally, hands placed underneath the breasts; arms decorated with vertical incised lines, fingers indicated by incised lines; bell-shaped lower part of the body, broadening to the back and flattened on the back which is decorated by two incised, v-shaped lines; around the lower part, a band consisting of four horizontal intermittent incised lines; on the front side, a number of irregular, vertical incised lines, which may indicate the legs or feet; underside of the figurine with deeply impressed cavity.
Cf. Orphanidis – Gallis 2011, 288–289, 615 (PMZ, stray find).

Fig. VI.28a PM0912. Standing female anthropomorphic figurine from house model, as placed in the house model, BSPh VIIa (3D-model: M. Börner)

Fig. VI.28b PM0912. Standing female anthropomorphic figurine from house model, BSPh VIIa (photos: M. Börner)

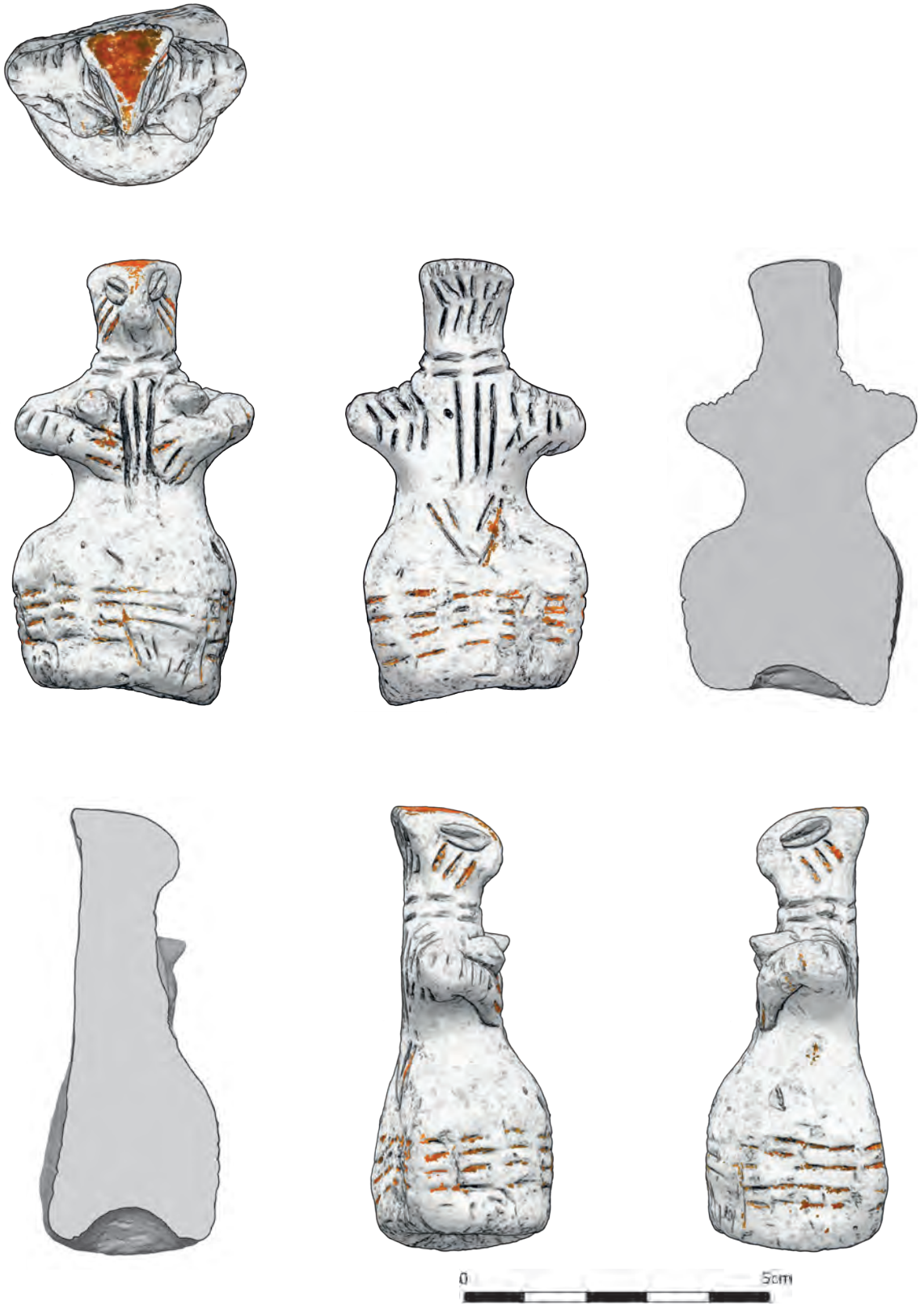



Fig. VI.28c PM0912. Standing female anthropomorphic figurine from house model, BSPh VIIa
(3D-model: M. Börner)

Fig. VI.28d PM0912. Standing female anthropomorphic figurine from house model, BSPh VIIa (3D-model: M. Börner)

*Fig. VI.29a–b.*
Lg 6.9cm, H 1.35cm, Th 1.1cm.
Oblong object; complete, minor damage on one of the sides; quadrangular section, narrowing and lifting to its ends, which terminate in elevated points; upper side with three rows of short linear impressions, which overlap the edges of the upper side.

Fig. VI.29a PM0912. Oblong object from the house model, as placed in the house model, BSPh VIIa (3D-model: M. Börner)

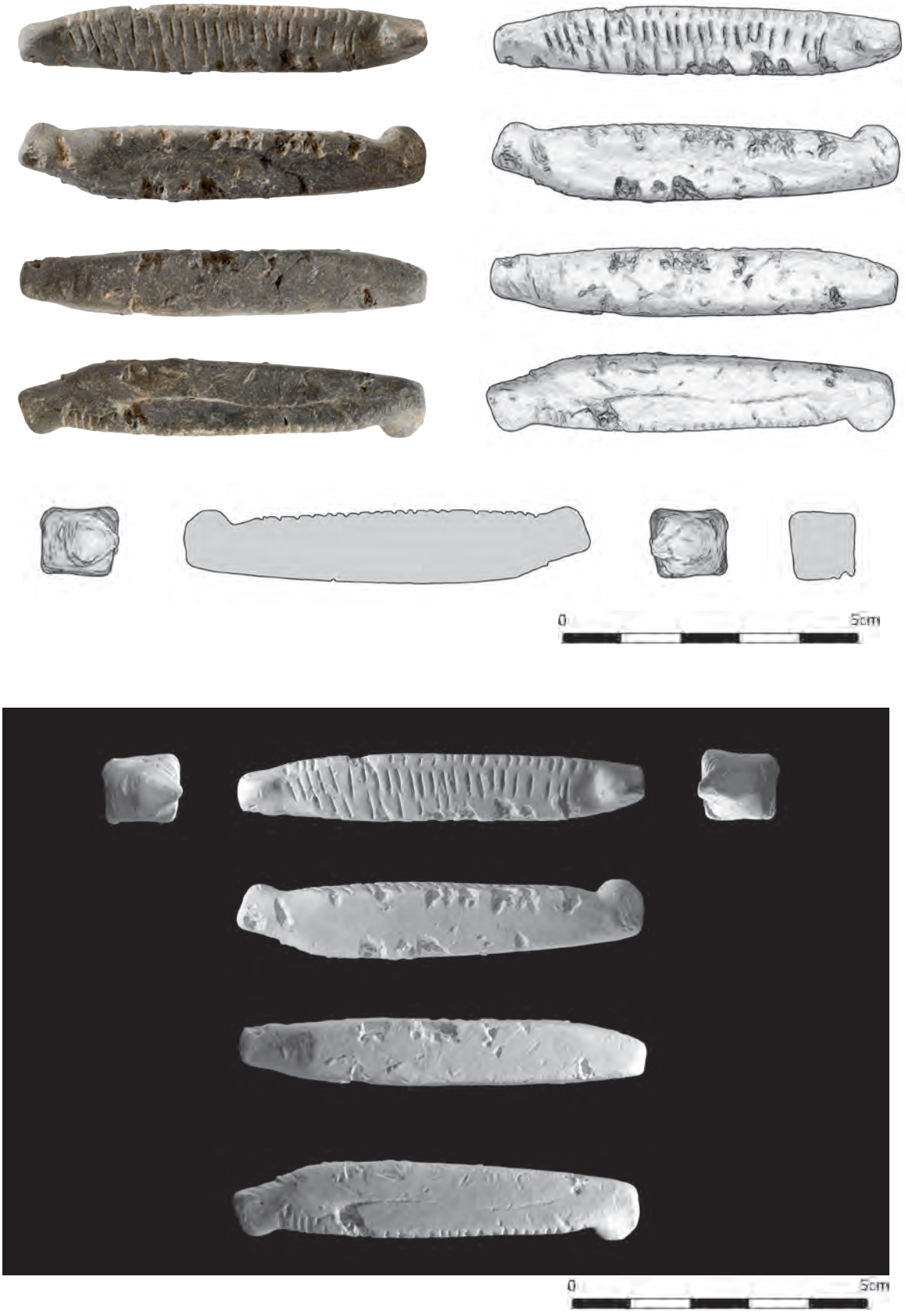



Fig. VI.29b PM0912. Oblong object from the house model, BSPh VIIa
(photos, 3D-model: M. Börner)

*Fig. VI.30a–c.*
H (pres.) 4cm, Wd 2.2cm, Th 1.8cm; incised lines filled with red pigment.
Small standing female anthropomorphic figurine; head missing, arms worn; upper body with plastically formed breasts and incised points indicating the nipples; around the neck, two horizontal, intermittent, incised lines; between the breasts and on the back, two vertical, intermittent incised lines; under the breasts, on a flat bulge, three incised lines, indicating the arms and hands; conical lower body, around the lower part, two horizontal intermittent incised lines; on the front side, below the horizontal lines, four short vertical incisions, perhaps indicating the legs; backside flattened, underside slightly indented.

Fig. VI.30a PM0912. Small standing female anthropomorphic figurine from house model, as placed in the house model, BSPh VIIa (3D-model: M. Börner)

Fig. VI.30b PM0912. Small standing female anthropomorphic figurine from house model, BSPh VIIa (photos: M. Börner)

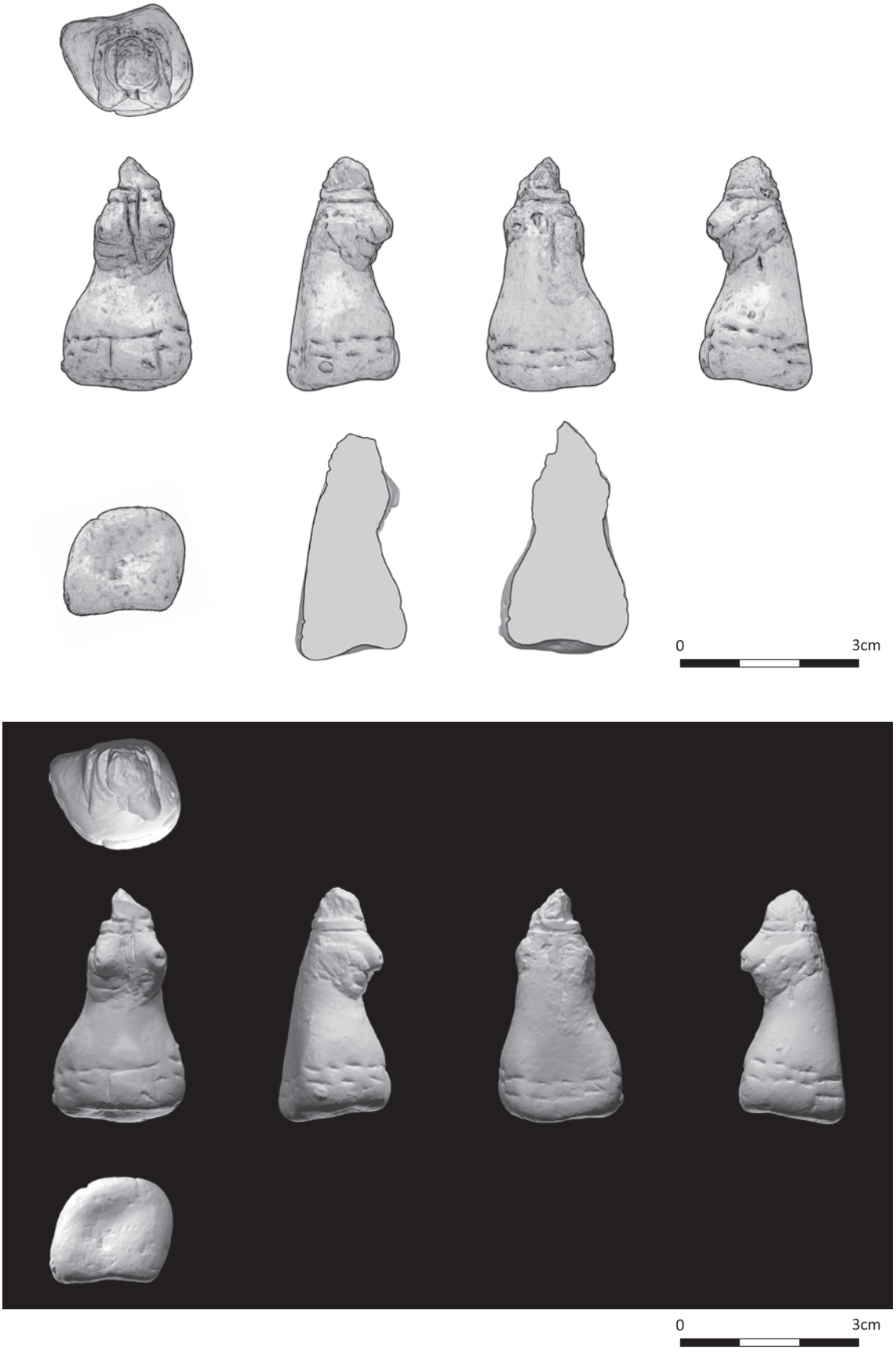



Fig. VI.30c PM0912. Small standing female anthropomorphic figurine from house model, BSPh VIIa (3D-model: M. Börner)

*Fig. VI.31a–b.*
H 2.7cm; Wd/Th 1.5cm; incised lines filled with red pigment.
Small asexual, standing anthropomorphic figurine; complete; conical body; triangular head with coffee-bean eyes, upper side flattened, painted brown and burnished; on each cheek, two diagonal lines filled with brown paste, two faint horizontal incisions on the back of the head; short vertical line on the breast; body rounded toward the flat base, with two faint horizontal incised lines around the lowest part and three short vertical lines in front; flat base.
Cf. Gallis 1982, 72, 114, pl. 21, lower row, left (cemetery of PMZ, cluster E21); Alexiou 2018, 188, fig. 10α (Magoula Sykeon/Pref. Karditsa).

Fig. VI.31a PM0912. Small asexual standing anthropomorphic figurine from house model, as placed in the house model, BSPh VIIa (3D-model: M. Börner)

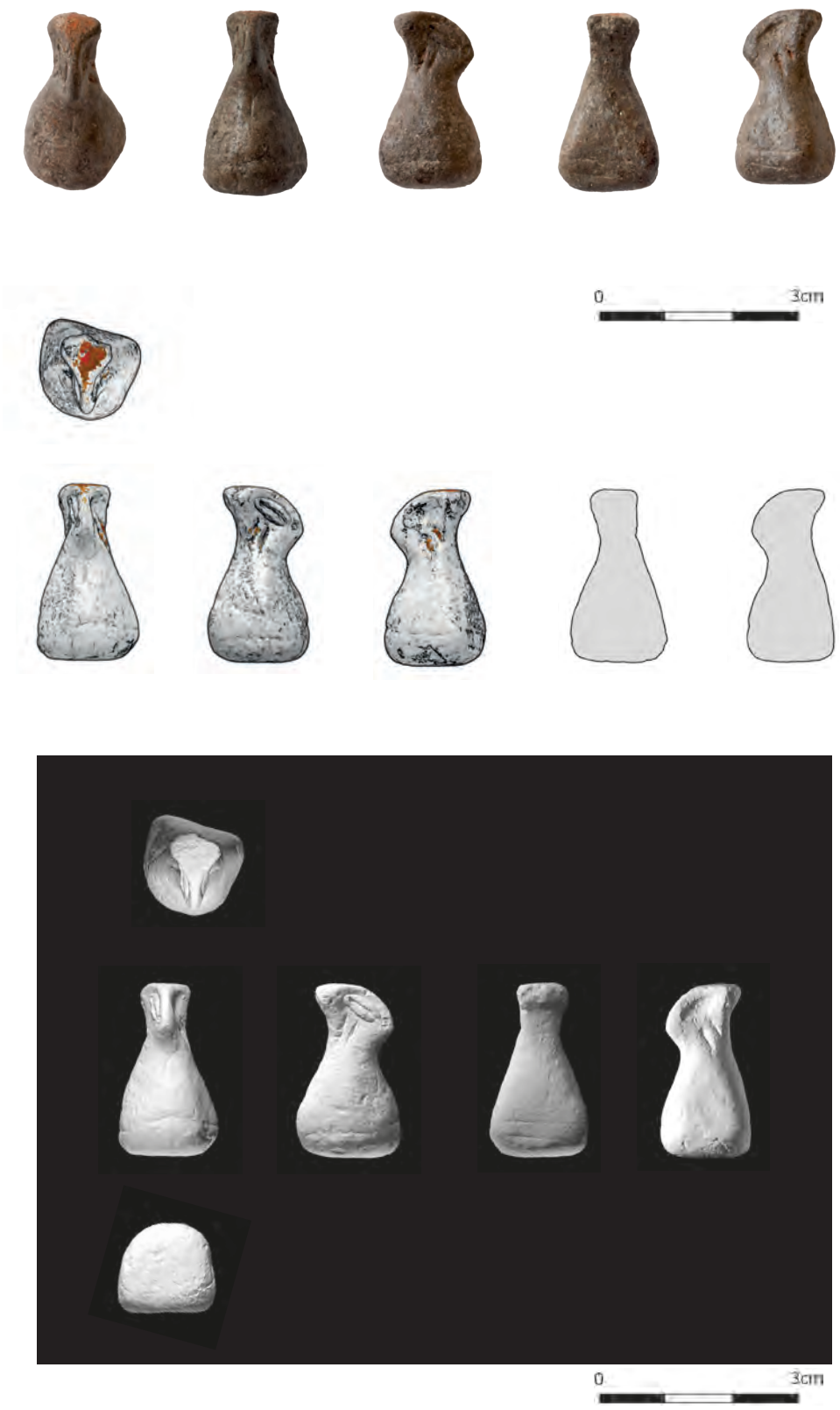



Fig. VI.31b PM0912. Small asexual standing anthropomorphic figurine from house model, BSPh VIIa (photos, 3D-model: M. Börner)

*Fig. VI.32a–b.*
H 2.9cm, Wd 1.6cm, Th 1.7/1.2cm.
Standing female anthropomorphic figurine, plain; complete, nose slightly damaged; cylindrical, short body with two irregular, protruding pellets indicating the breasts; arms indicated as faint diagonal bulges; back flattened; underside indented; triangular head with coffee-bean eyes, upper side flattened, leaned to the back; on the left side, an incised line; beaked nose; a few irregular incised lines visible on the body.

Fig. VI.32a PM0912. Standing female anthropomorphic figurine from house model, as placed in the house model, BSPh VIIa (3D-model: M. Börner)

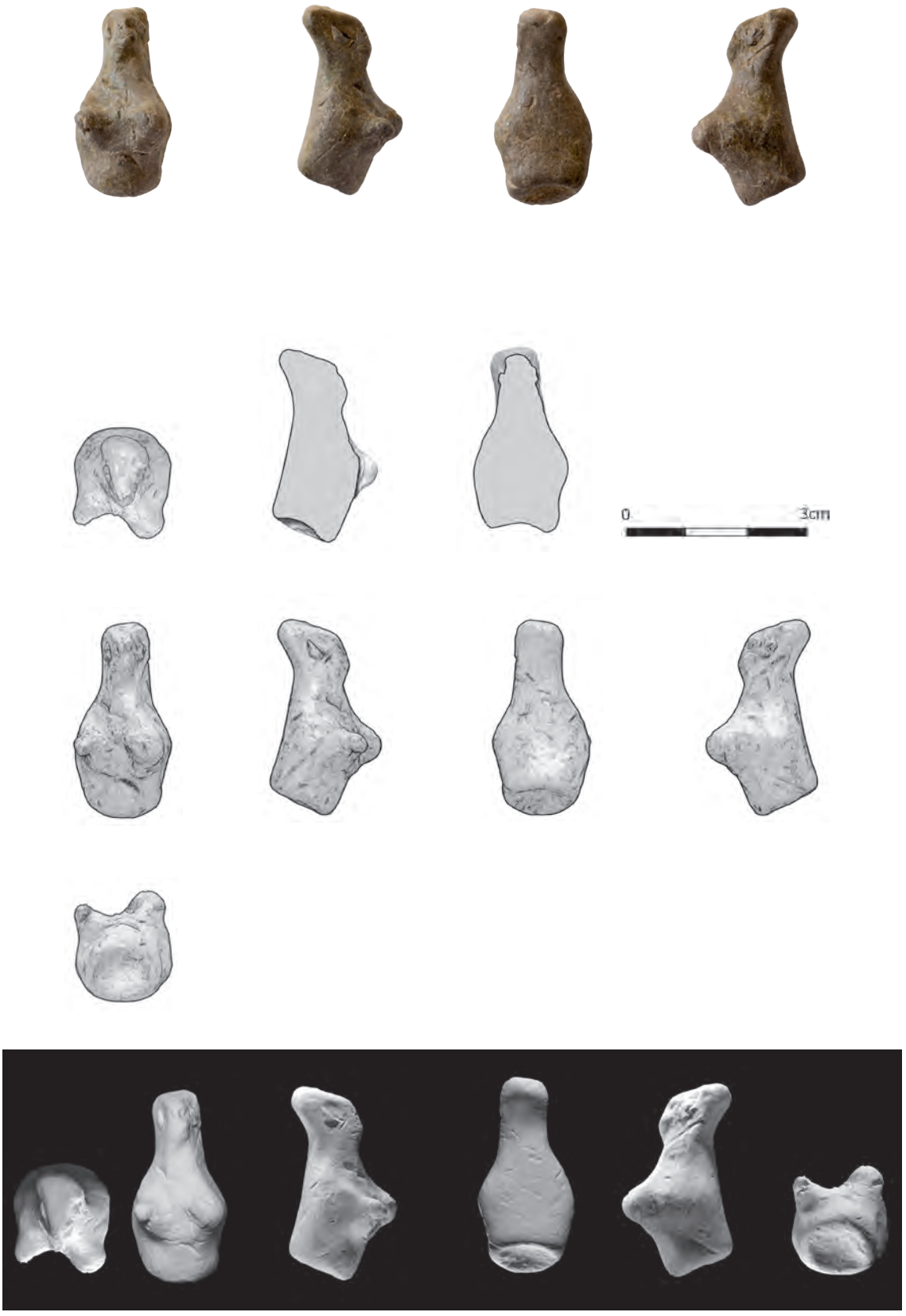
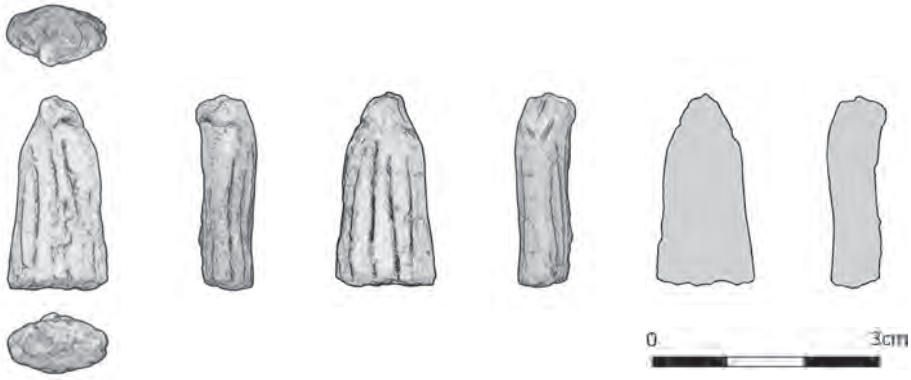



Fig. VI.32b PM0912. Standing female anthropomorphic figurine from house model
(photos, 3D-model: M. Börner)

*Fig. VI.33a–b.*
H 2.6cm, Wd 1.3cm, Th 0.7cm.
Small flattened anthropomorphic figurine, upper and lower part broken; front and back of the body decorated with five vertical incised lines; on the top, small part of a head with beaked face preserved; small depression on the sides of the head may be provided for inserting the eye; sides with diagonal incised lines.

Fig. VI.33a PM0912. Small flattened anthropomorphic figurine from house model, as placed in the house model, BSPh VIIa (3D-model: M. Börner)



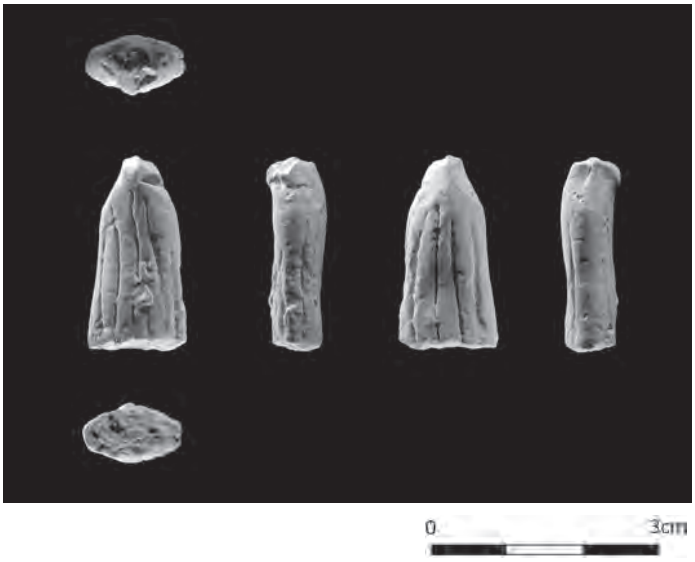




Fig. VI.33b PM0912. Small flattened anthropomorphic figurine from house model, BSPh VIIa (photos, 3D-model: M. Börner)

*Fig. VI.34a–b.*
H 2.76cm, Wd 1.8cm, Th 1.8cm.
Small asexual standing anthropomorphic figurine with *pointillé* incisions, head damaged; conical body with beaked head; one incision indicating an eye (?), upper side (nose?) decorated with four *pointillé* incisions; upper back part of the head surrounded by two rows of incisions; a tiny protrusion points to the possibility that they surrounded the upper head; in the back, two vertical lines of *pointillé* incisions, probably indicating a vertical band; along the base, two, partly three horizontal lines of *pointillé* incisions; lower part slightly triangular, underside slightly indented.

Fig. VI.34a PM0912. Small asexual standing anthropomorphic figurine from house model, as placed in the house model, BSPh VIIa (3D-model: M. Börner)

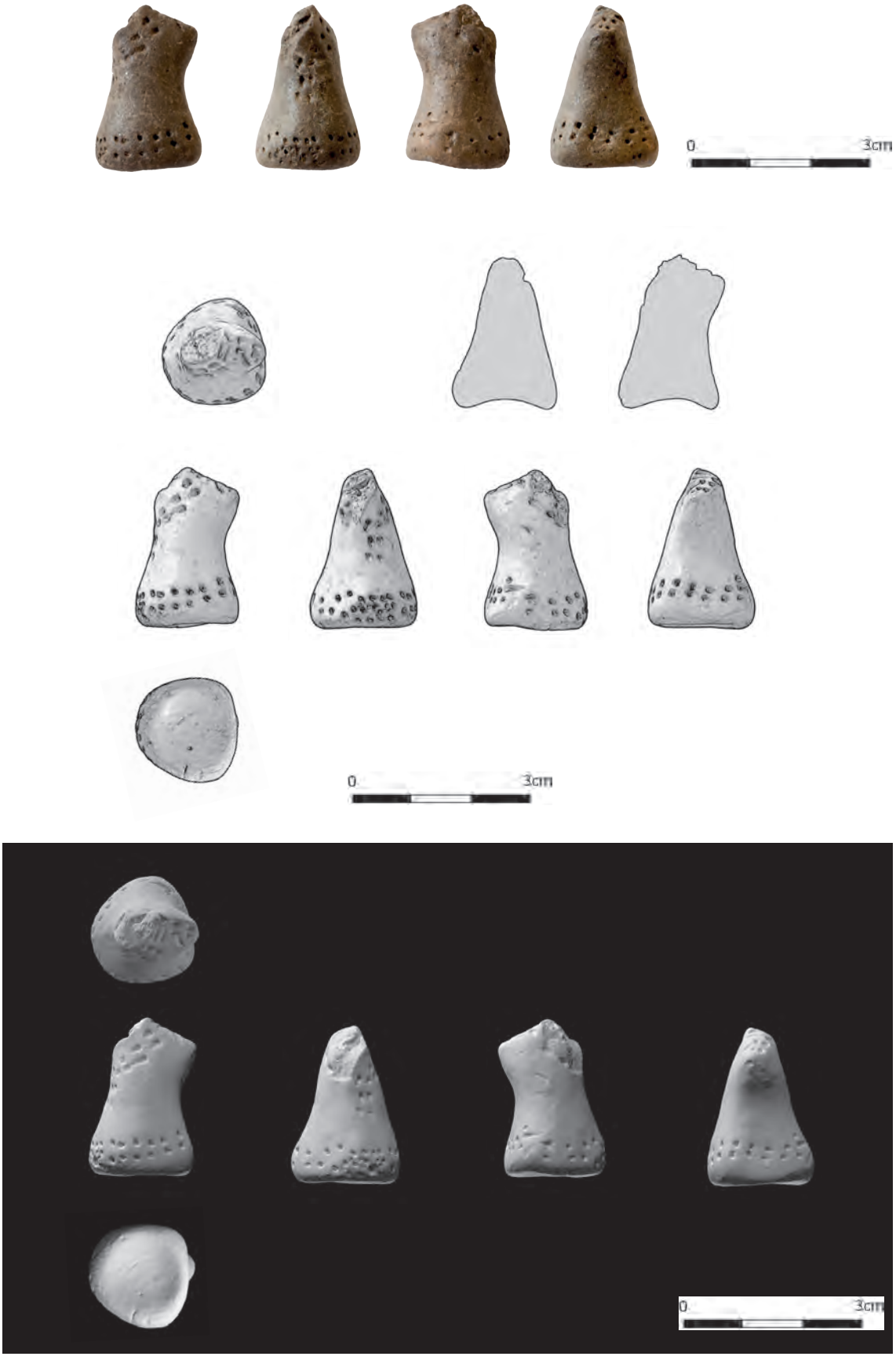



Fig. VI.34b PM0912. Small asexual standing anthropomorphic figurine from house model, BSPh VIIa (photos, 3D-model: M. Börner)

*Fig. VI.35a–c.*
H 5.3cm, Wd (upper part) 2.4cm, Wd (lower part) 2.1cm, Th (lower part) 1.7cm; incised lines filled with red pigment.
Standing female anthropomorphic figurine; complete; triangular, beaked head with applied coffee-bean eyes; under the eyes, three short, diagonal incised lines; beaked face; head on the upper side flattened, brown slipped and burnished; on the back, at the edge of the head, hair indicated by short, incised lines and, hanging down to the neck, by short diagonal incised lines; neck decorated with two horizontal, intermittent incised lines; upper body with two protruding pellets as breasts which are partly separated from the body by incised lines; nipples indicated by dot incisions; on the front, between the breast, two, on the back three vertical lines; arms bowed horizontally, hands placed on the belly under the breasts; arms decorated in front as well as in the back by vertical incised lines; fingers indicated by three incisions; conical lower body, broadening to the back; flattened on the back, decorated by three horizontal intermittent lines, filled with white paste (?); in front, below them, short vertical lines, continuing on the underside of the figurine; underside of the figurine indented.

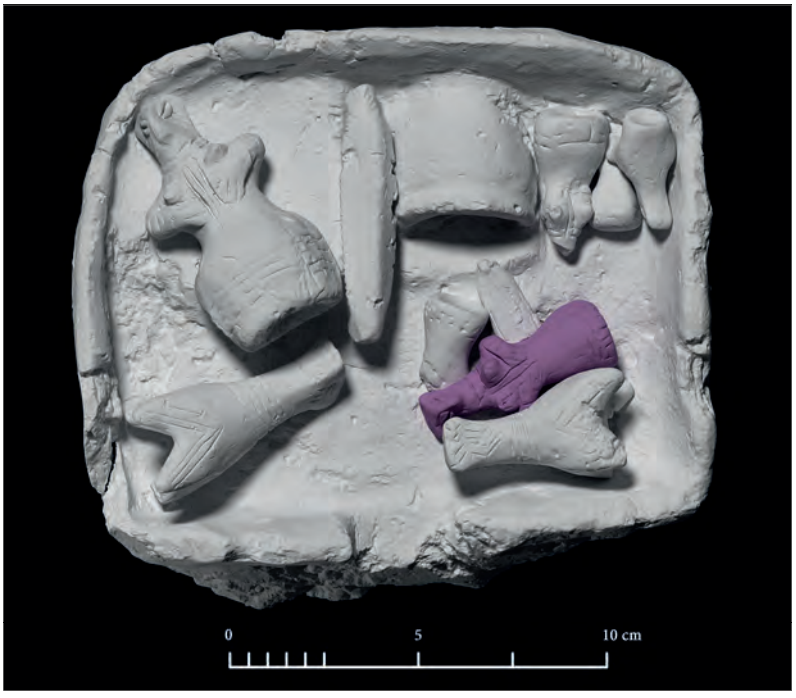



Fig. VI.35a PM0912. Standing female anthropomorphic figurine from house model, as placed in the house model, BSPh VIIa (3D-model: M. Börner)

Fig. VI.35b PM0912. Standing female anthropomorphic figurine from house model, BSPh VIIa (photos: M. Börner)

Fig. VI.35c PM0912. Standing female anthropomorphic figurine from house model, BSPh VIIa (3D-model: M. Börner)

*Fig. VI.36a–c.*
H 5.3cm, Wd 2.7cm, Th 2.1cm; incised lines filled with red pigment.
Standing anthropomorphic figurine with four legs, no sex indicated; three of the four legs damaged; legs placed at the sides of the figurine; long neck growing out of the legs and the lower, conical body; triangular, beaked head with applied coffee-bean eyes; under the eyes, three short, diagonal lines; upper side of the head flattened, painted with red, abraded slip and burnished; hair indicated on the back side by vertical, incised, short zigzag lines; cylindrical neck decorated with four horizontal, intermittent incised lines; on front side, a long vertical line from the neck to the area between the legs; along the legs, two diagonal lines, partly filled with red colour; underside of the figurine with impressed cavity.
For parallels see Fig. VI.27.

Fig. VI.36a PM0912. Standing anthropomorphic figurine with four legs from house model, as placed in the house model, BSPh VIIa (3D-model: M. Börner)

Fig. VI.36b PM0912. Standing anthropomorphic figurine with four legs from house model, BSPh VIIa (photos, 3D-model: M. Börner)

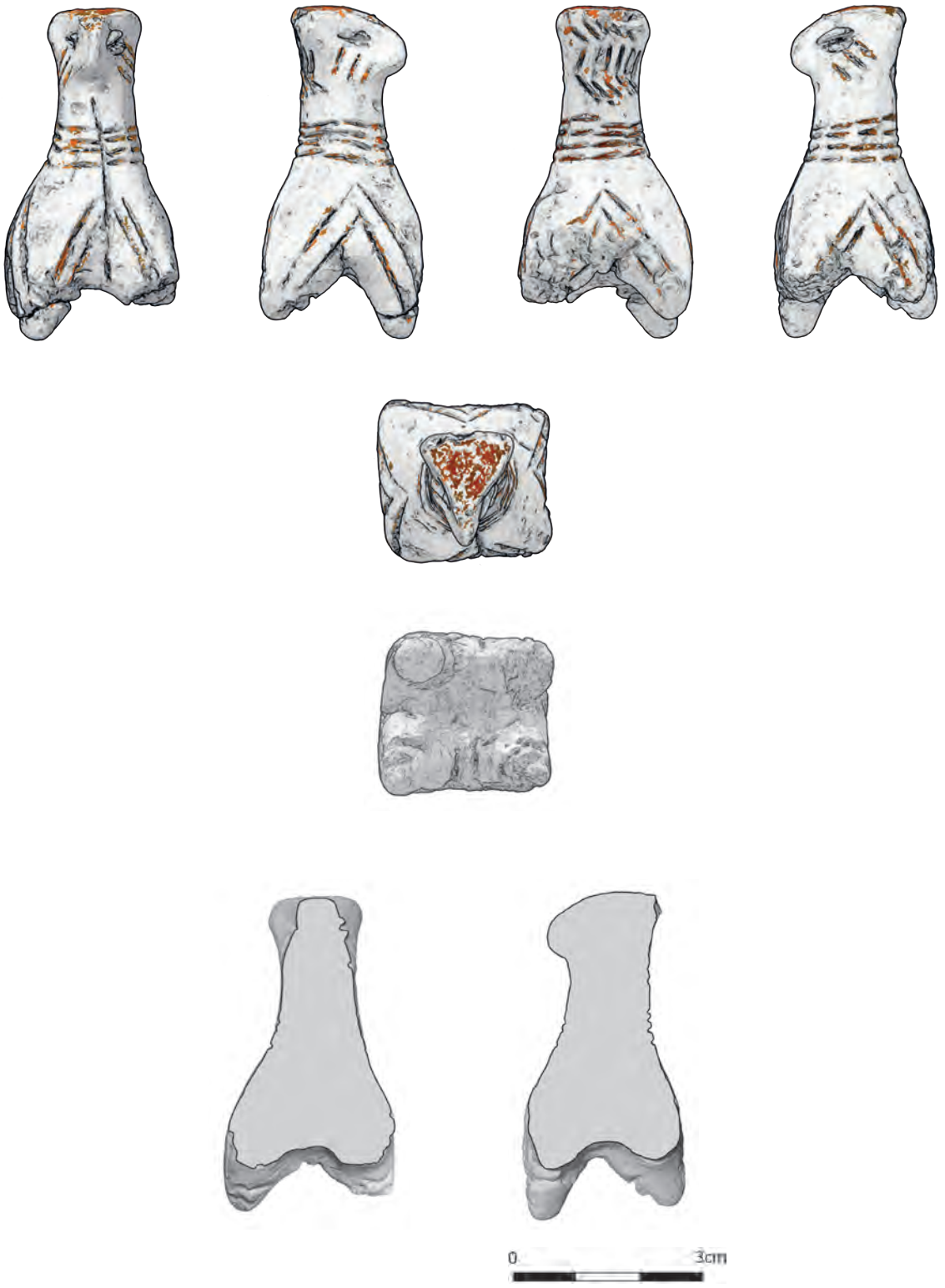



Fig. VI.36c PM0912. Standing anthropomorphic figurine with four legs from house model, BSPh VIIa (3D-model: M. Börner)

*Fig. VI.37a–k.*
Lg 17cm, Wd 15.2cm; H (front) 5.5cm.
Open house model, sides damaged; house model consisting of a thick coarse plaque of clay on which low sides have been added as slightly curved plaques; interior smoothed, sides coarser, underside rough with impressions of chaff, in the corners of the underside, low ridges; front with 2.8cm-wide entrance; in the left corner, a quadrangular bench with small vertical incisions on its edges; in the centre, an oblong, barrel-shaped oven with a semi-globular roof and a slightly bulging opening; entrance of the oven supplied with a narrow bench; floor of the oven slightly declining to its interior; floor of the interior slightly declining to the sides and featuring shallow depressions.
Cf. Gallis 1992a, 128, fig. 14: fragment of an open house model with oven and bench from Kastro (Magoula Aliphaka/Pref. Larissa, A.T.A.E. 9); Marangou 1992, 204. See also Gimbutas 1956, 103, fig. 56 (Popudnia/western Ukraine); Garašanin et al. 1971, no. 82 (northern Macedonia); Todorova 1974, 39–46 (Ovčarovo/Bulgaria); Renfrew et al. 1986, 216, fig. 8.20, pl. XL.1a–d = Theocharis 1973, 340, fig. 290 (Sitagroi/eastern Macedonia); Ziota 2011, 218, fig. 11 (western Macedonia).

Fig. VI.37a PM0912. The open house model in an empty state, from BSPh VIIa (photo: M. Börner)

Fig. VI.37b PM0912. The open house model in an empty state, from BSPh VIIa (photo: M. Börner)

Fig. VI.37c PM0912. The open house model in an empty state, from BSPh VIIa (photo: M. Börner)

Fig. VI.37d PM0912. The open house model in an empty state, from BSPh VIIa
(3D-model: M. Börner)

Fig. VI.37e PM0912. The open house model in an empty state, from BSPh VIIa
(3D-model: M. Börner)

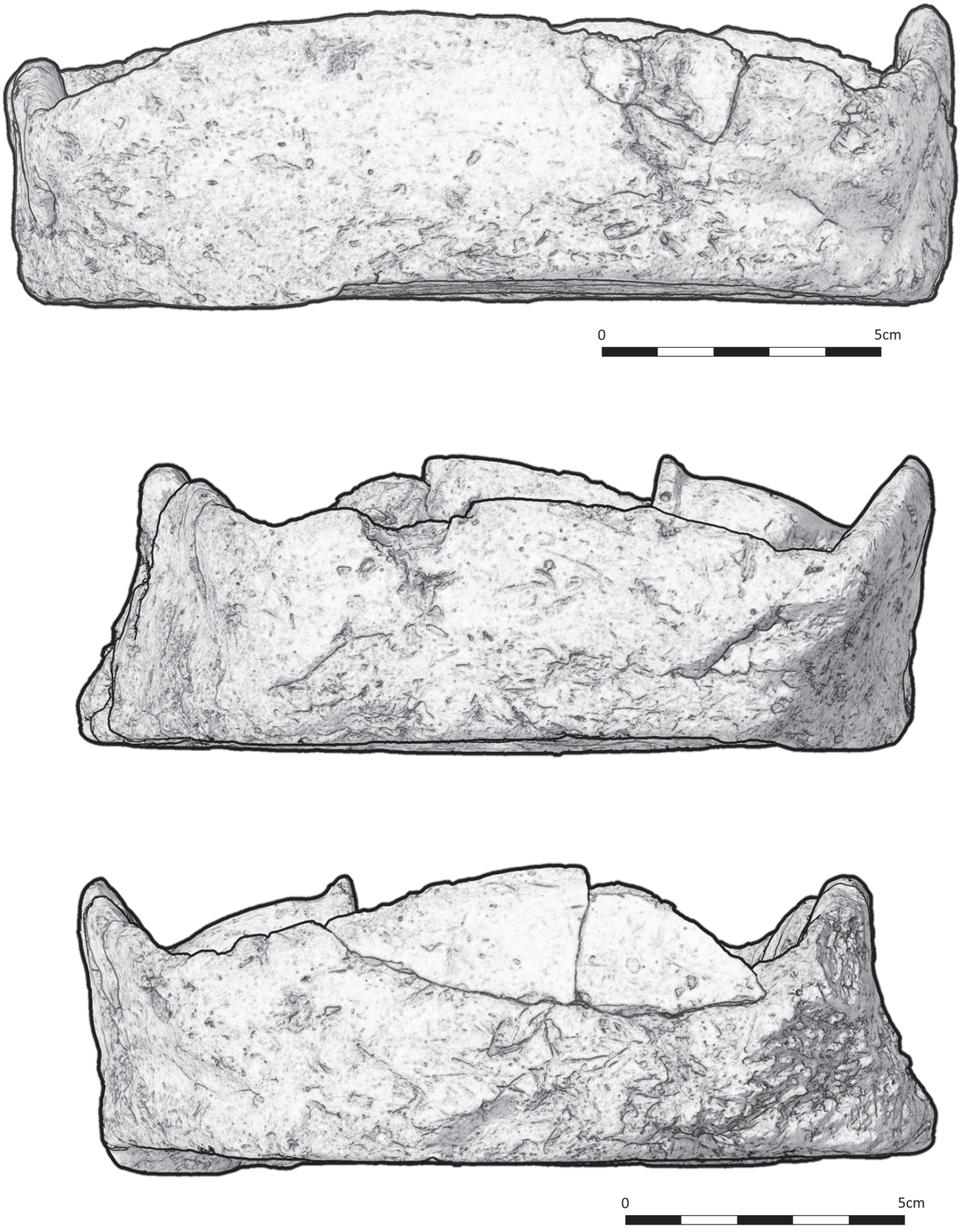



Fig. VI.37f PM0912. The open house model in an empty state, from BSPh VIIa
(3D-model: M. Börner)

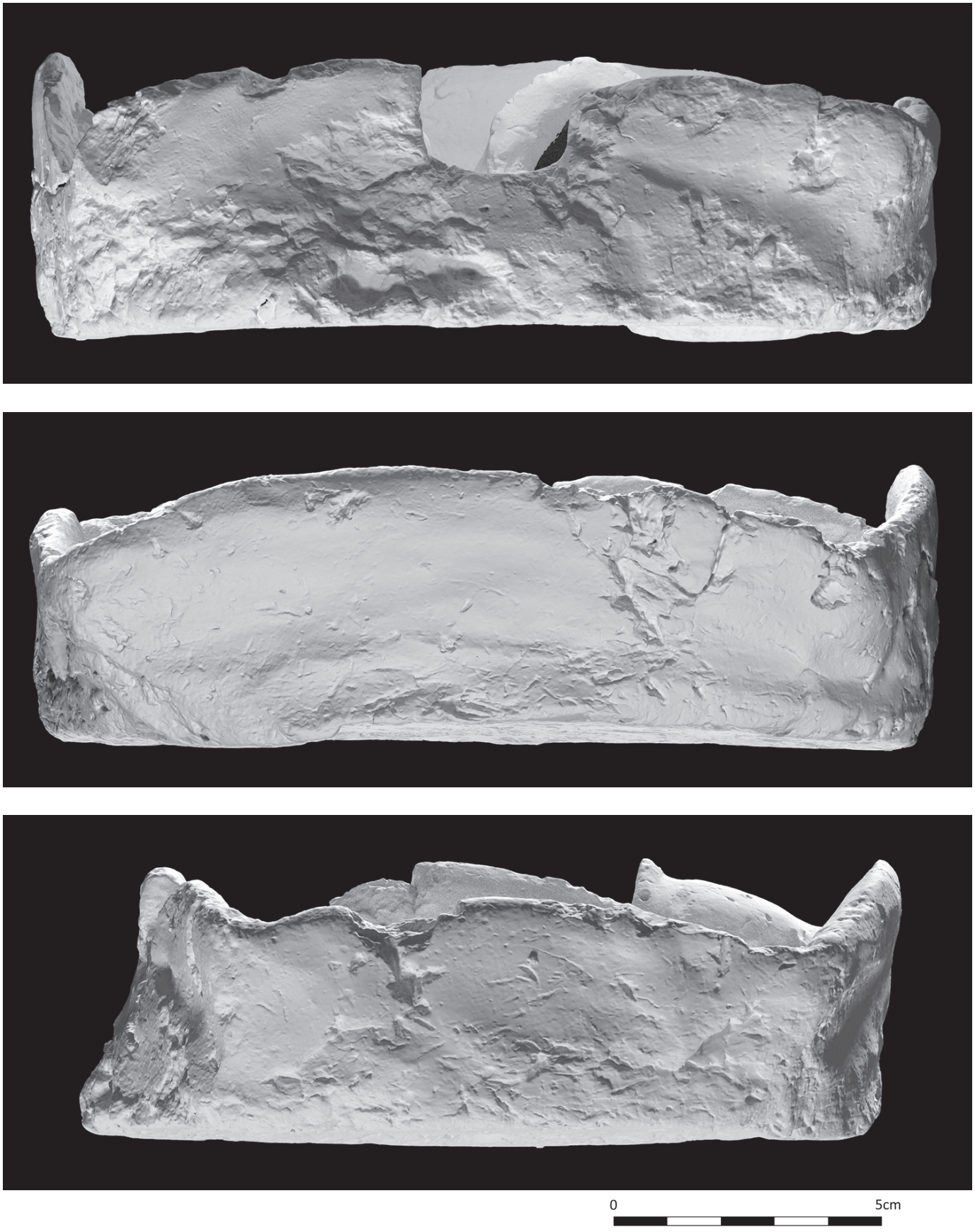



Fig. VI.37g PM0912. The open house model in an empty state, from BSPh VIIa
(3D-model: M. Börner)

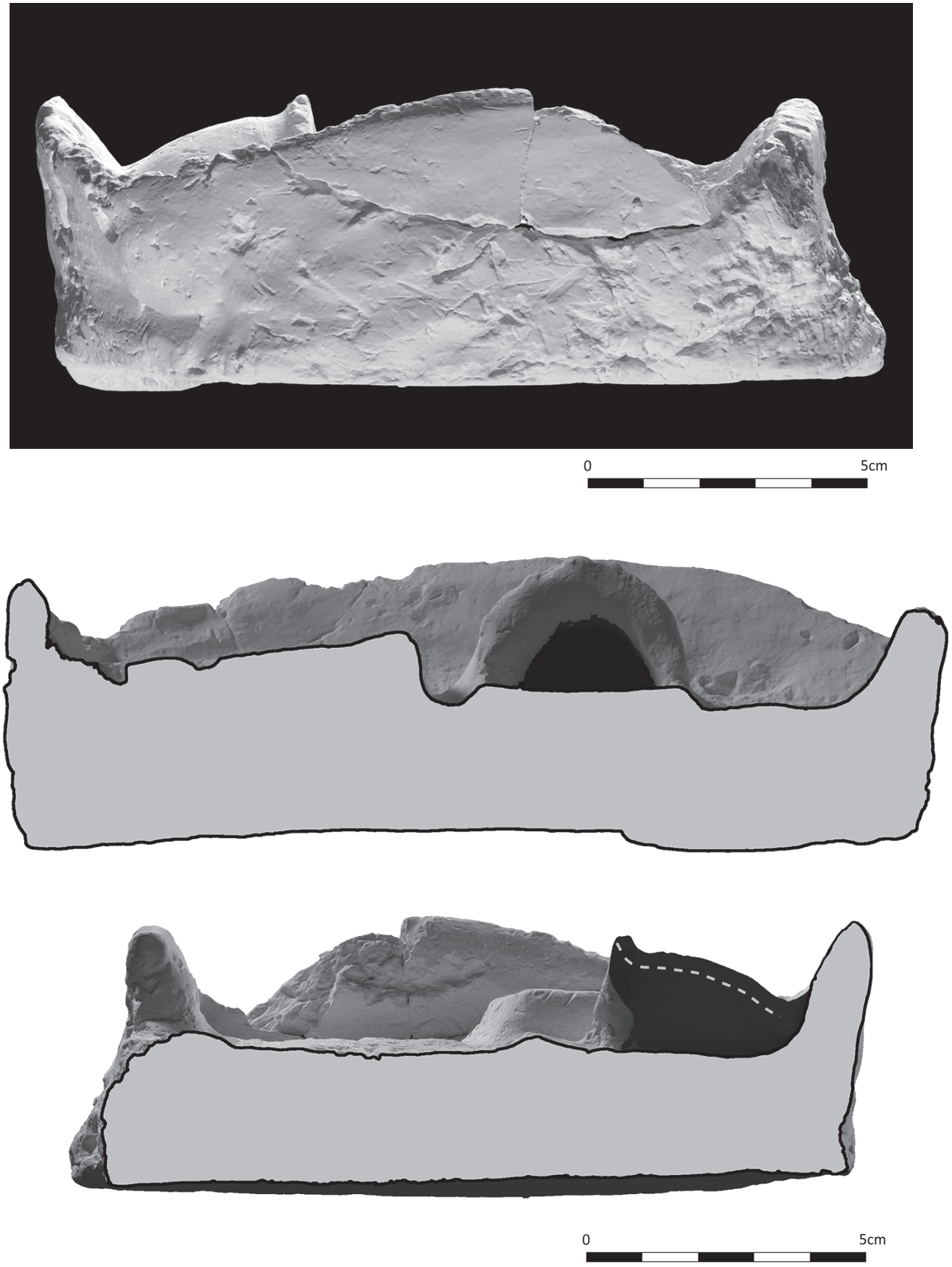
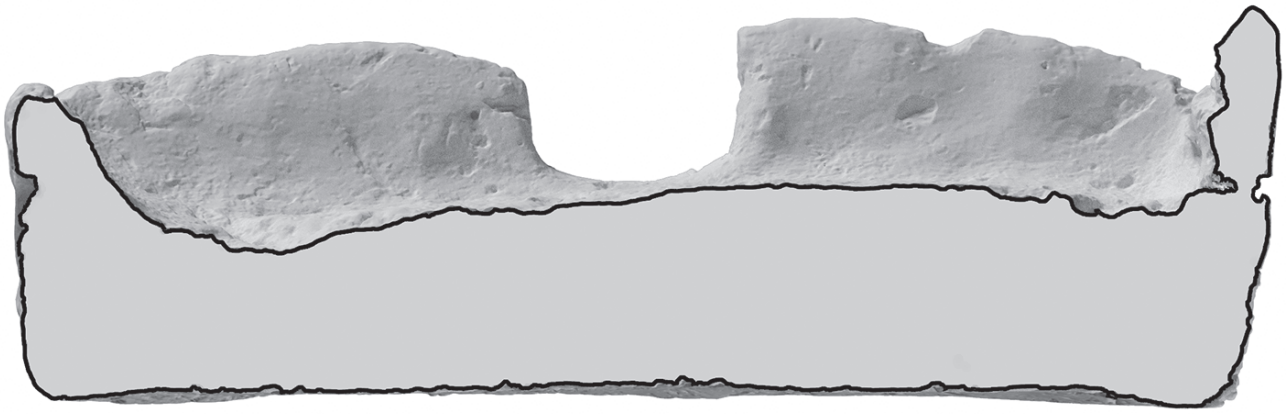



Fig. VI.37h PM0912. The open house model in an empty state, from BSPh VIIa
(3D-model: M. Börner)



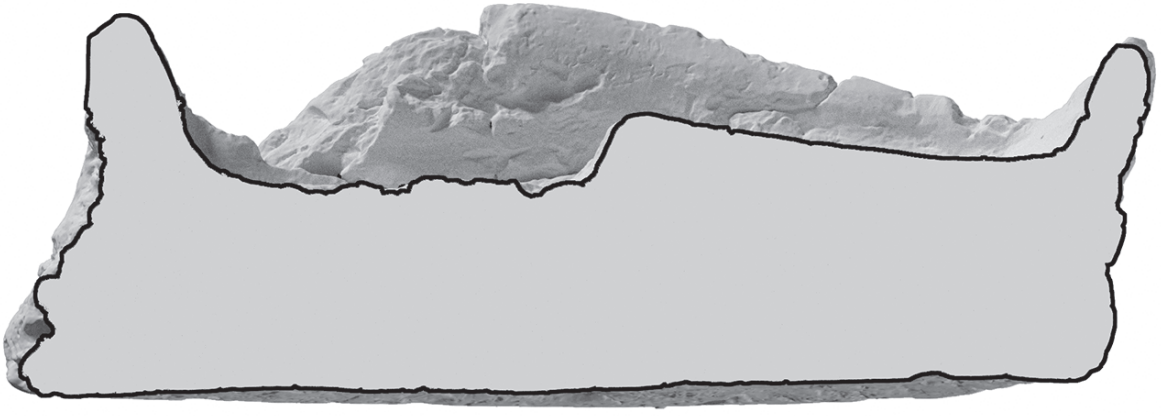
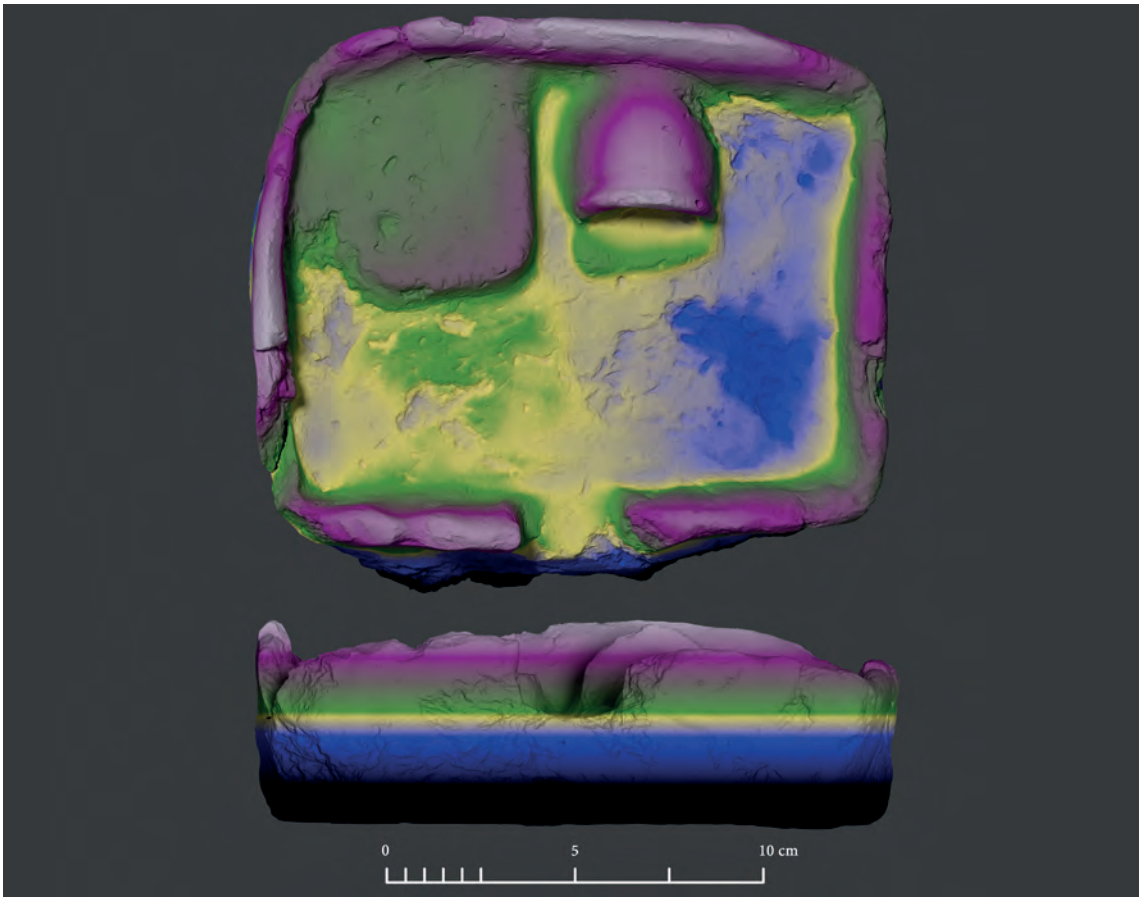


Fig. VI.37i PM0912. The open house model in an empty state, from BSPh VIIa
(3D-model: M. Börner)



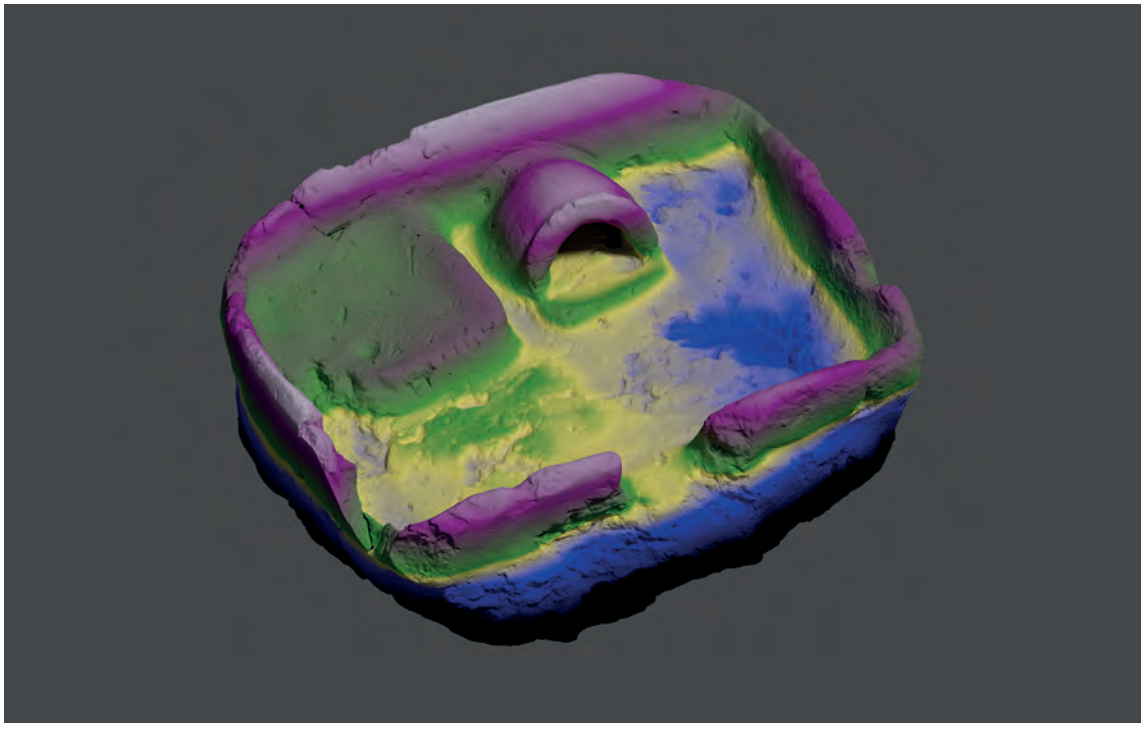



Fig. VI.37j PM0912. The open house model, empty, highlighting the depressions in its ground, from BSPh VIIa (3D-model: M. Börner)

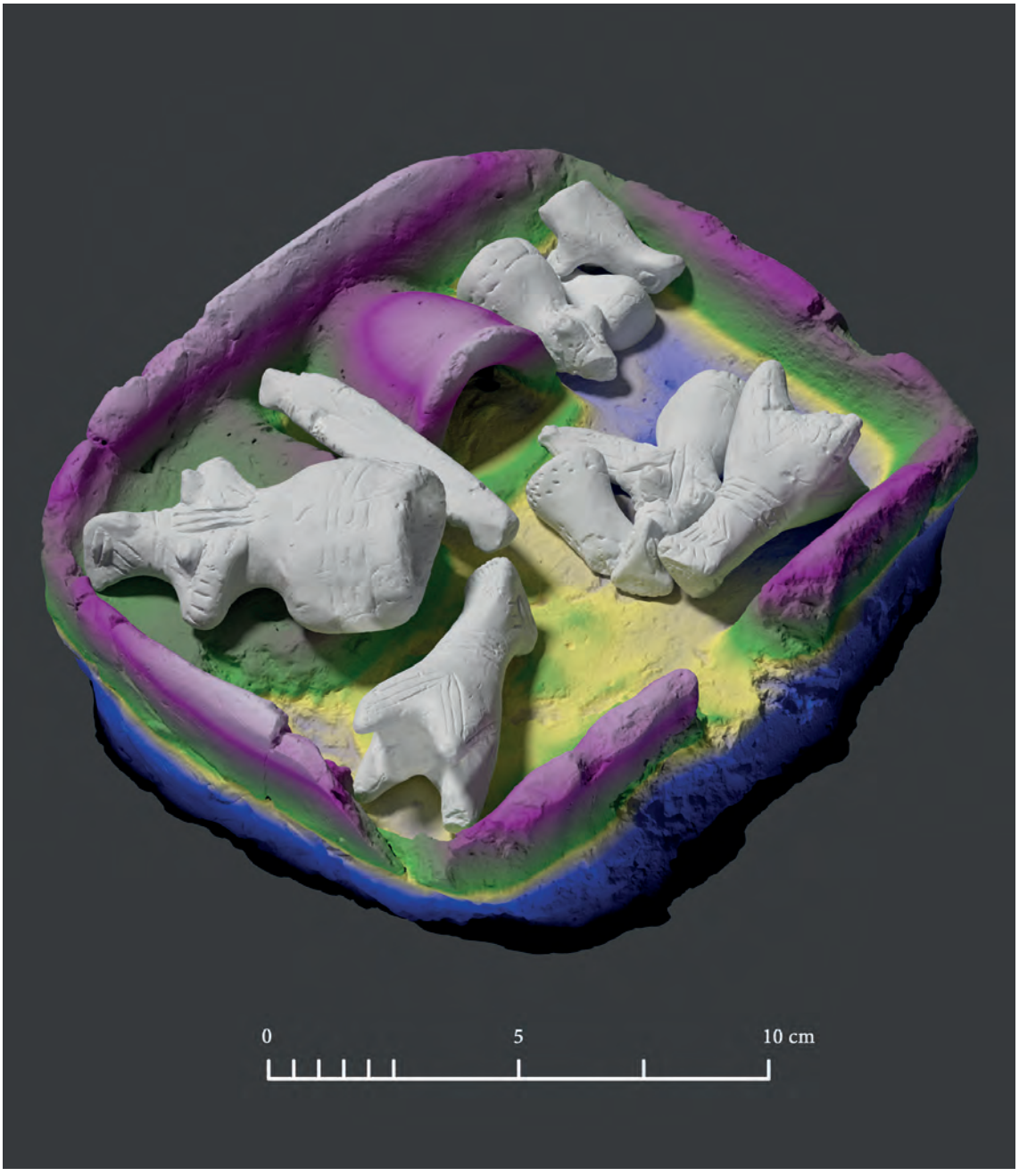



Fig. VI.37k PM0912. The open house model, highlighting the depressions in its ground and the position of the figurines in them (3D-model: M. Börner)

*Fig. VI.38a–b. PM0327.*
SU 168, filling of Early Bronze Age pit 167.
H (pres.) 5.2cm, Wd 2.15cm, Th 2.3cm.
Clay: 7.5YR 6/4 light brown, grey firing cloud, very well sorted, 7.5%, many small white and reddish-black rounded, few fine sparkling inclusions. Surface: 7.5YR 6/6 reddish yellow, wiped, back side burnished.
Standing female anthropomorphic figurine, head missing; quadrangular body; back flattened, sides and front slightly rounded; arms indicated faintly as horizontal protrusions along the sides of the body; breasts formed plastically; neck on its front side with parallel vertical lines (necklace?); underside slightly indented.
Cf. Gallis 1982, pl. 21, lower row, right (cemetery of PMZ, cluster ΣΤ 27); Alexiou 2018, 187–188, figs. 9, 10ε.

Fig. VI.38a PM0327. Standing female anthropomorphic figurine, from filling of Early Bronze Age pit (3D-model: M. Börner)

Fig. VI.38b PM0327. Standing female anthropomorphic figurine, from filling of Early Bronze Age pit (photos: K.-V. von Eickstett, 3D-model: M. Börner)

*Fig. VI.39. PM0329.*
SU 168, filling of Early Bronze Age pit 167.
H (pres.) 3.1cm, Wd 2.5–2.9cm, Th 2.1cm.
Clay: 7.5YR N4–6/2–5/2 dark grey to brown, well sorted, 5%, many fine sparkling inclusions, some small-large angular white inclusions. Surface: 7.5YR N4–6/2–5/2 dark grey to brown, worn, partly wiped, partly unfinished.
Lower part of an anthropomorphic figurine (?); cylindrical, slightly flattened leg, underside indented.
Cf. Kyparissi-Apostolika 2000b, 198, no. 1 (Theopetra Cave/Pref. Trikala).

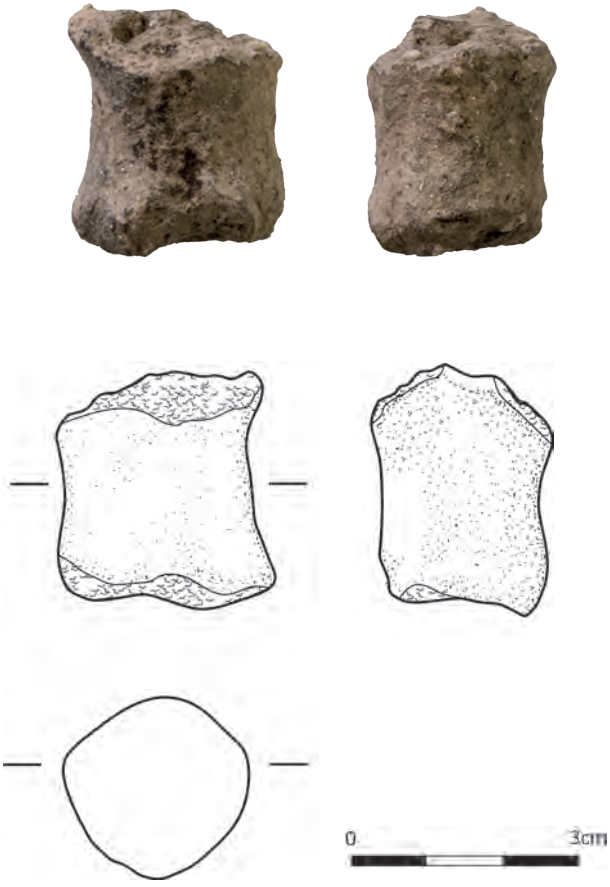



Fig. VI.39 PM0329. Lower part of an anthropomorphic figurine (?), from filling of EBA pit (photos: K.-V. von Eickstett, drawing: S. Horwath)

*Fig. VI.40a–b. PM0016.*
Topsoil.
H (pres.) 4.4cm, Wd 1.7–2.1cm, Th (upper body) 0.8cm, Th (legs) 0.9cm.
Clay: grey ware: 10YR 6/1 grey, very well sorted, 1%, fine sparkling silver inclusions, few fine white inclusions. Surface: 10YR 6/1 grey, burnished.
Half-standing, flat anthropomorphic figurine, upper part missing; clearly accentuated buttocks; belly slightly rounded and protruding; legs separated in front and in the back; column legs with broadened and flattened feet.
Forming detail: Breakage on neck shows that the surface layer was applied to an oblong core.
Cf. Hauptmann 1981 (Otzaki/Pref. Larissa); Phelps 2000, 202, SF219 (Servia/western Macedonia); Nanoglou 2004, I.80 (Paliambela/western Macedonia); Hansen 2007, pl. 101.16 (Rachmani/Pref. Larissa); Karamitrou-Mentessidi 2011, 86–87, fig. 10 (Grevena region/western Macedonia); Alexiou 2020, figs. 1e; 10 (Magoula Sykeon and Mavrachades/Sofades, Karditsa); Nancy Krahtopoulou, personal communication: all in grey ware (Mavrachades Tartaria in the Kambos region/Pref. Karditsa).

Fig. VI.40a PM 0016. Half-standing, flat anthropomorphic figurine, from topsoil (3D-model: M. Börner)

Fig. VI.40b PM 0016. Half-standing, flat anthropomorphic figurine, from topsoil (photos: K.-V. von Eickstett, 3D-model: M. Börner)

## VI.7.2 Table and Miniature Bowl

*Fig. VI.41. PM0935.*
BSPh Vc, SU 92, below Surface F28 (Fig. III.23).
H (pres.) 3.5cm, Wd (leg) 1.8cm, Th (leg) 1.4cm.
Clay: 5YR 7/6 reddish yellow, very well sorted, 5%, many small and fine white, many fine sparkling silver and golden inclusions. Surface: 5YR 6/4 light brown, burnished.
Leg of a circular table, leg with round-oval section, ending in the attachment to a probably circular bowl.
Cf. Theocharis 1973, fig. 13 after Wace – Thompson 1912, 99, 107, fig. 57g (Tsangli/Pref. Larissa); Gimbutas 1989, 207, fig. 7.65 (Achilleion/Pref. Larissa, Phase IIIb); Kyparissi-Apostolika 2000b, 225, fig. 14.11.1 (Theopetra Cave/Pref. Trikala); Fassoulas 2017, pl. 28, MT 6 (Magoula Theophani/Pref. Karditsa).

Fig. VI.41 PM 0935. Leg of a circular table, from BSPh Vc
(photos: K.-V. von Eickstett, drawing: S. Horwath)

*Fig. VI.42a–c. PM0641.*
BSPh VIb, SU 126; 2.18m from east, 1.07m from south, above Surface F24 (Fig. III.27).
Complete conical miniature bowl with thick walls and incision decoration; underside coarse.
Diam. (rim) 4.8cm, Diam. (base) 2.5cm, H 3.2, Th (upper part) 0.4cm.
Clay: thick core 5YR 5/1 grey, outer part 5YR 7/3 pink, very well sorted, 2.5%, small black and white, fine sparkling inclusions. Surface: 5YR 7/2 pinkish grey, firing cloud on the bottom, coarsely formed and slightly smoothed, in the outer, lower part of the bowl irregular, thin, short, vertical, incisions.

Fig. VI.42a PM0641. Complete conical miniature bowl, from BSPh VIb
(photos: K.-V. von Eickstett)

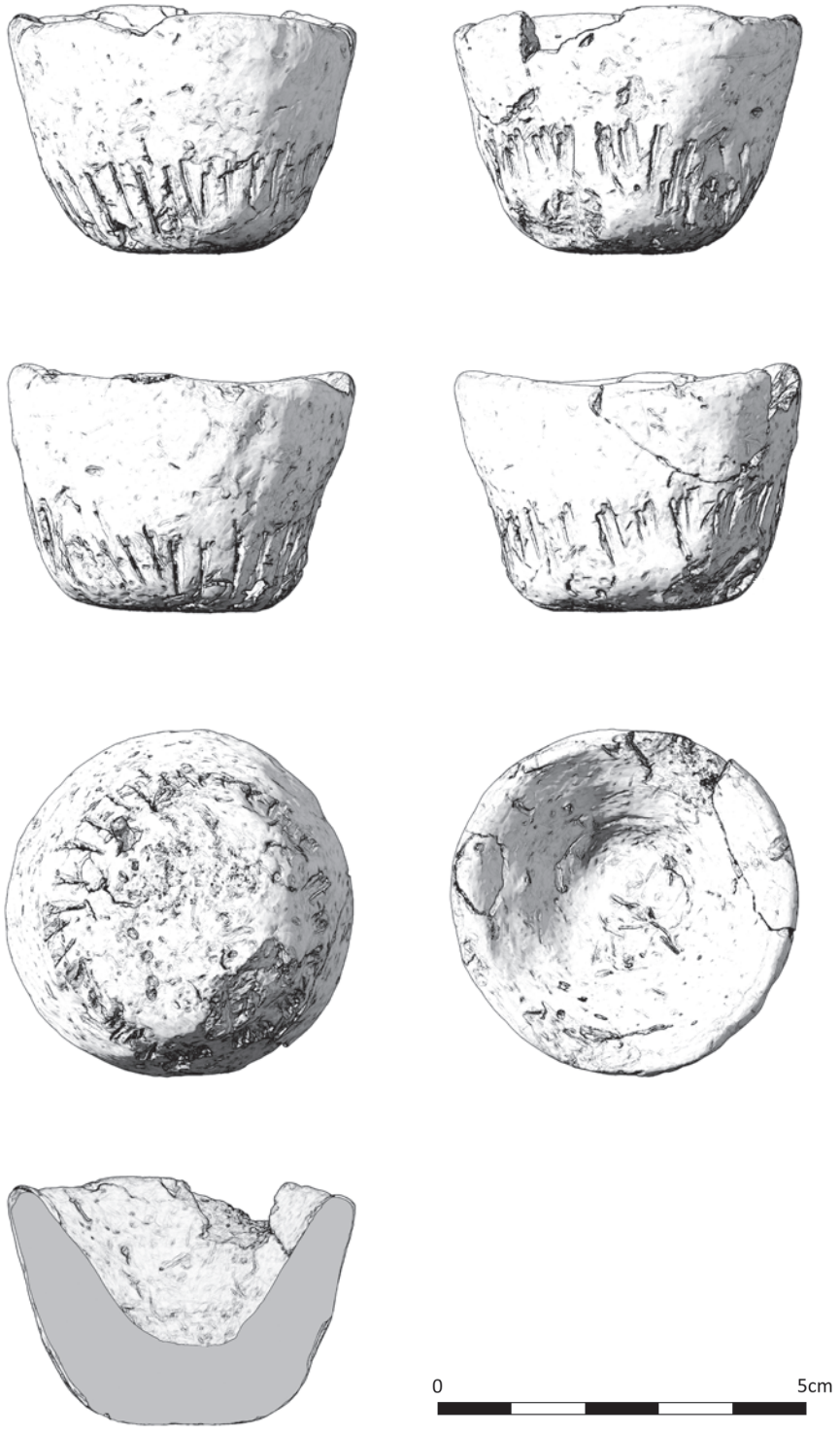



Fig. VI.42b PM0641. Complete conical miniature bowl, from BSPh VIb
(3D-model: M. Börner)

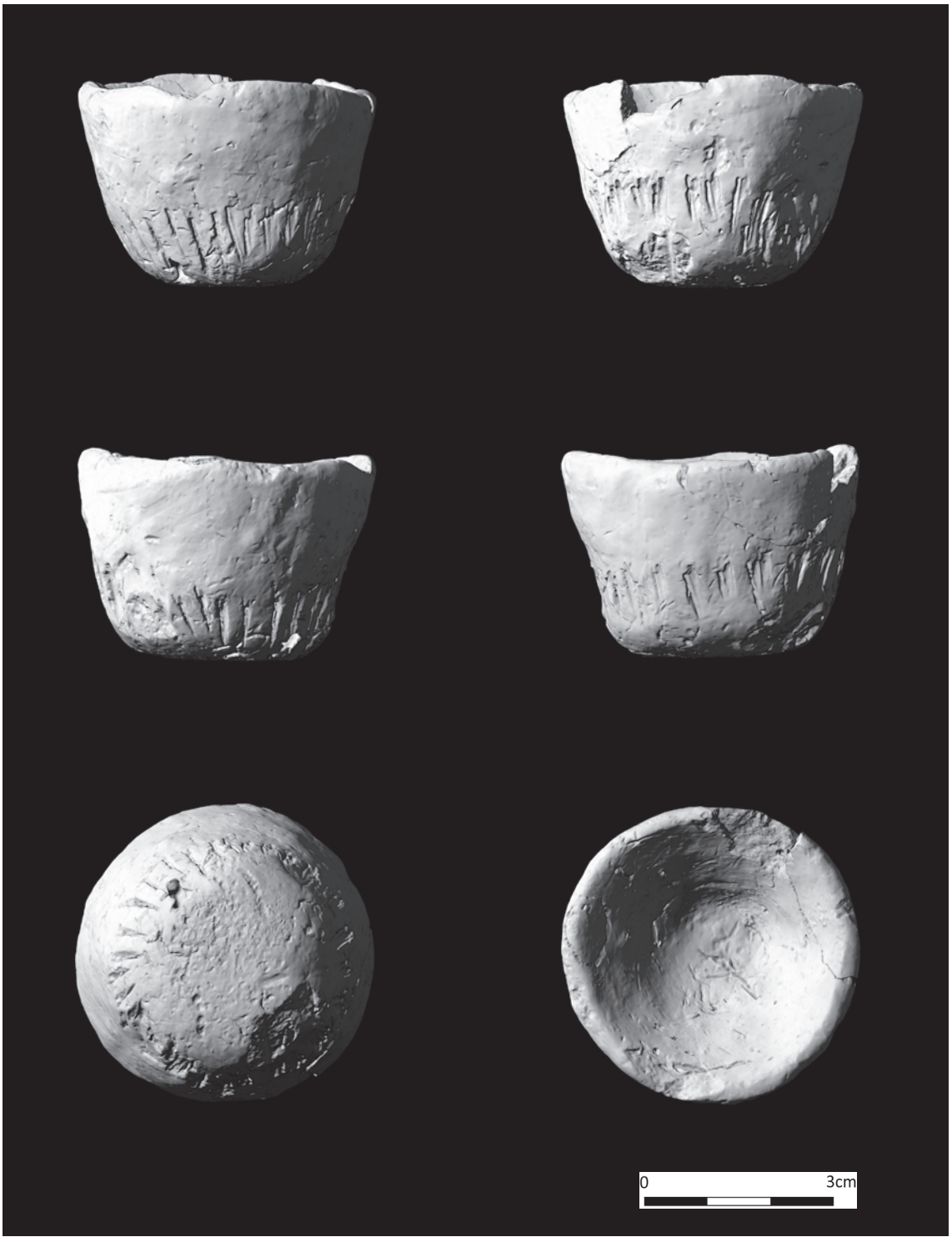



Fig. VI.42c PM0641. Complete conical miniature bowl, from BSPh VIb
(3D-model: M. Börner)

# VII. The Ornaments

*Nina Kyparissi-Apostolika*

## VII.1. Introduction

Ornaments usually constitute a limited category of small finds in most Neolithic excavations, apart from cases like Franchthi Cave, which was right by the seashore and a higher number of ornaments made from the shells collected there was found.[915] Late Neolithic Dimini, on the east Thessalian shores, is also an exceptional case, yielding ornaments (bracelets and beads) made from the shell *Spondylus gaederopus*.[916] The latter seem to travel to central Europe as exchanged products. The ornaments from PMZ constitute the smallest category of the total assemblage, but this is quite telling in its own right as regards the character of the site.[917] Of course, one should take into consideration that Trench A under examination is a very small part of the total settlement and, further, more extensive research could provide a different picture.

## VII.2. The Inventory

In our inventory, there are 11 ornaments coming from the Neolithic deposit.[918] Of these, three (PM0637, PM0638, PM0639) were not found in the storage boxes – but, as they are included in my dissertation,[919] we have information about them.

The ornaments in PMZ are made of shell, stone, and clay, and one example is from the tooth of a wild animal. Below we will present these ornaments shared according to their material.

### VII.2.1. Shell

Eight objects are made of seashell. Of these, the most distinctive are made from the shell *Spondylus gaederopus*:

PM0379 (Fig. VII.1). The pendant is made of one valve of an elaborated *Spondylus gaederopus* shell, where two symmetrical holes are preserved, while two others were initially opened closer to the periphery, but these were broken. Part of its curved top is missing. Dimensions: 6.1 × 6.7cm, thickness: 0.4cm. Find spot: In the intermediary deposits between Surfaces F20 and F19, location inside the trench (coordinates): 0.20m (east) × 2.30m (north). BPh VIII, LN I.

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915 Miller 1996; Perlès 2018, 5.

916 Kyparissi-Apostolika 2001.

917 I am grateful to Kostas Gallis, Eva Alram-Stern and Giorgos Toufexis for inviting me to participate in this publication, giving me the chance to see again, with a more experienced eye, the ornaments from PMZ after many years.

918 Ornaments which were found in the Bronze Age levels will be published in the volume on the Bronze Age stratigraphy and finds of PMZ.

919 Kyparissi-Apostolika 2001, cat. nos. 704–706.

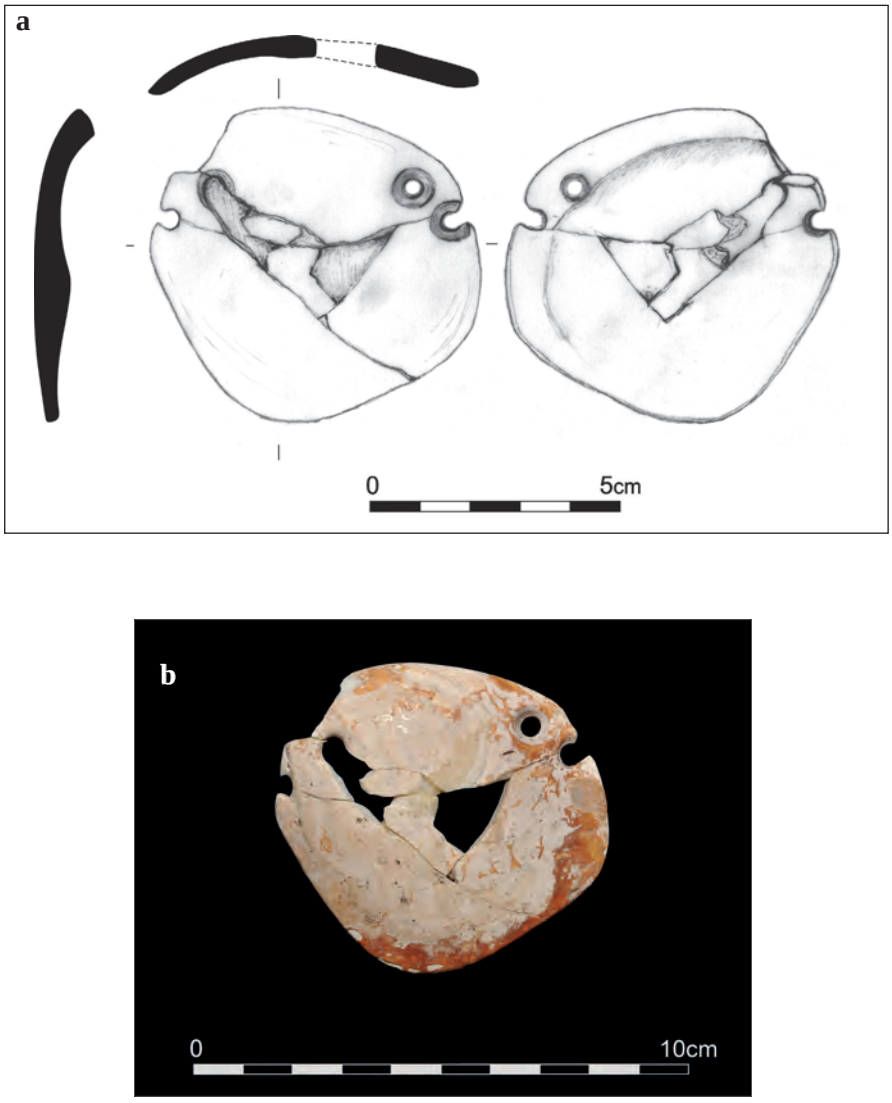


Fig. VII.1 PM0379: Pendant made of one valve of the shell Spondylus gaederopus, with two symmetrical holes for hanging. Two other holes, initially opened closer to the periphery, were broken (a. drawing: N. Kyparissi-Apostolika and C. Batzelas, b. photo: G. Dallas)

PM0637, PM0638 and PM0639 (Fig. VII.2). The three now-missing pendants mentioned above were consistent with the natural round and oval shape of the shell. They were found half broken. Each of them also had a pair of holes; in the third piece only one hole is preserved, but it is assumed that there were two. The valves used were much thinner than the one described above and almost flat. According to their natural characteristic features, namely the brightness of their interior surface, the size and the thinness of the walls, they could be made of shells of the family *Pteriidae*, possibly the *Pteria hirundo*, which live in Sporades close to Thessaly, in the north Euboean and the Saronic Gulf.[920] Since these three ornaments are now missing, for the moment we cannot securely identify the family of the shell. Dimensions: 3.2 × 3.8cm, 4.6 × 2.6cm, 1.9 × 1.5cm. Find spot: SU 126, from deposits containing highly burnt pieces of clay resulting from the destruction of a potential auxiliary roofed area belonging to a house, location inside the trench (coordinates): 0.39m (north) × 0.52m (west). BSPh VIb, MN III.

[920] Delamotte – Vardala-Theodorou 1994, 152, 246.

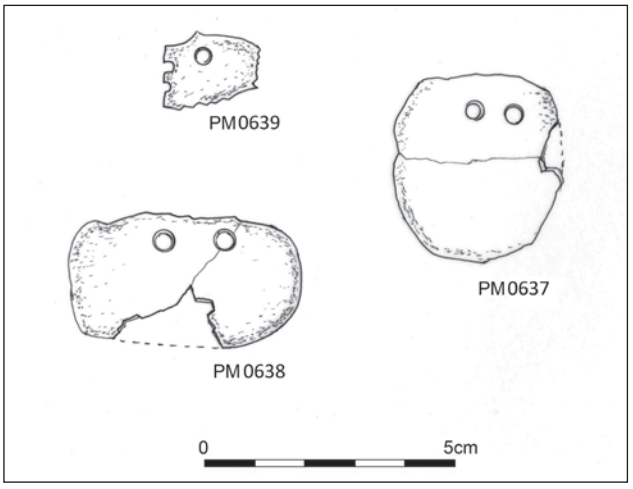


Fig. VII.2 PM0637, PM0638, PM0639: Drawing of the three missing-now pendants made on seashells with a couple of holes for hanging each (drawings: N. Kyparissi-Apostolika)

PM1001 and PM0467 (Figs. VII.3–4). Two parts of bracelets are made of the seashell *Spondylus gaederopus* but different:

PM1001 (Figs. VII.3a, VII.4b), made of the left valve of the shell, is thin with a trapezoidal section and decorative notches on both sides of the periphery. Length: 2.2cm, width: 0.6cm, thickness: 0.3cm. Find spot: SU 161, above Surface F20, depth: 4.65m. BPh VIII, LN I.

PM0467 (Figs. VII.3b, VII.4a) is less elaborate and could possibly come from a right valve. It retains small remnants of the natural cavities of the shell. Its broken edges are polished, and it probably continued to be used after it broke. Length: 5.1cm, width: 0.9cm, thickness: 0.5cm. Find spot: SU 152, in intermediary deposits between Surfaces F21 and F20, depth: 4.96m, location inside the trench (coordinates): 0.10m (north) × 0.72m (west). BSPh VIIc, LN I.

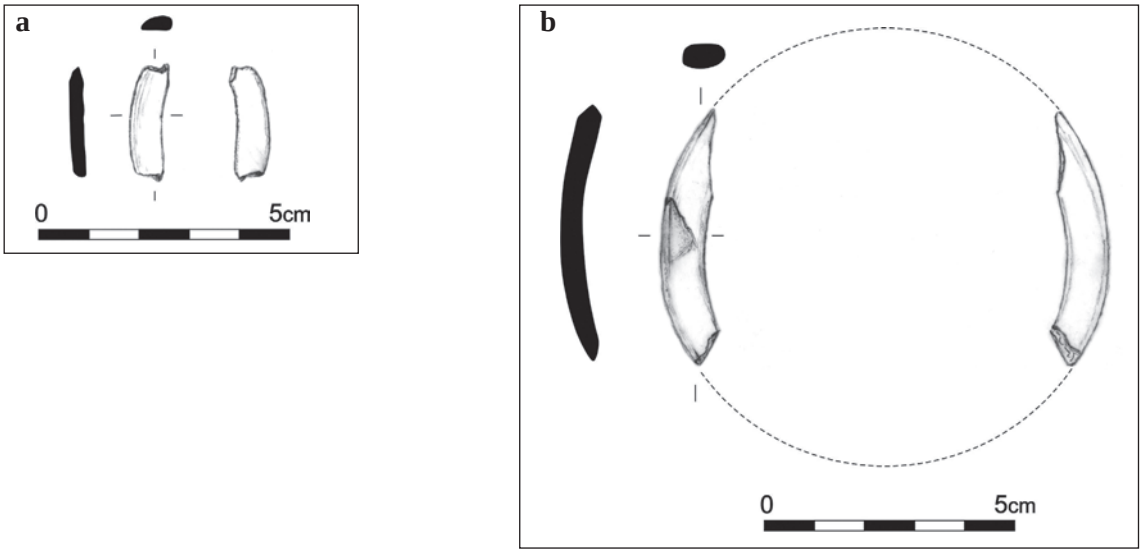


Fig. VII.3 a. PM1001, b. PM0467: Drawing of two bracelets made of the shell Spondylus gaederopus (drawing: N. Kyparissi-Apostolika and C. Batzelas, digital transformation: R. Exarhou)

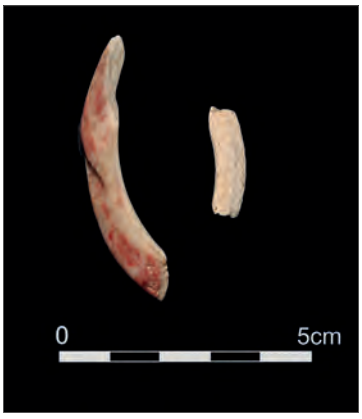


Fig. VII.4 a. PM0467, b. PM1001: Two bracelets made of the shell Spondylus gaederopus (photo: G. Dallas)

PM0581 (Fig. VII.5). A sizeable barrel-shaped bead is made of *Spondylus gaederopus*. It is half-broken and totally black from burning. A transversal axis runs along its length. Length: 3.4cm, preserved thickness: 1.9cm (the other dimension is broken), wall thickness: 0.6–1cm. Find spot: SU 134, in intermediary deposits between Surface F22 and F23 and probably in an open-air area east of a potential building,[921] depth: 5.25m, open-air firing, location inside the trench (coordinates): 1.40m (north) × 1.50m (east). BSPh VIIa, transition MN III/LN I.

The earliest known perforated shells made for adornment are known from Blombos Cave on the southern cape shoreline of the Indian Ocean, South Africa, and they are dated to 75.6 ± 3.4ka. Traces of fibre on the walls of the shell by the holes prove that they were hung.[922] More recently, perforated marine gastropod shells at the western Asian site of Skhul and the north African site of Oued Djebbana indicate the early use of beads by modern humans in these regions. The layer where the shells were found was dated between 90 and 135ka, about 25,000 years earlier than previous evidence for personal decoration by modern humans in South Africa.[923] The practice of gathering and circulating shells in prehistoric Greece dates back to the Upper Palaeolithic of Epirus (sites Kastritsa, Klithi, Boila), since c. 22,000 BP,[924] while from Klissoura Cave in the Argolid, shells are reported from a layer of the early Upper Palaeolithic dated to c. 40,000 BP.[925] Additionally, a bored freshwater shell in Theopetra Cave is dated at c. 16,000 BP, after the Last Glacial Maximum.[926]

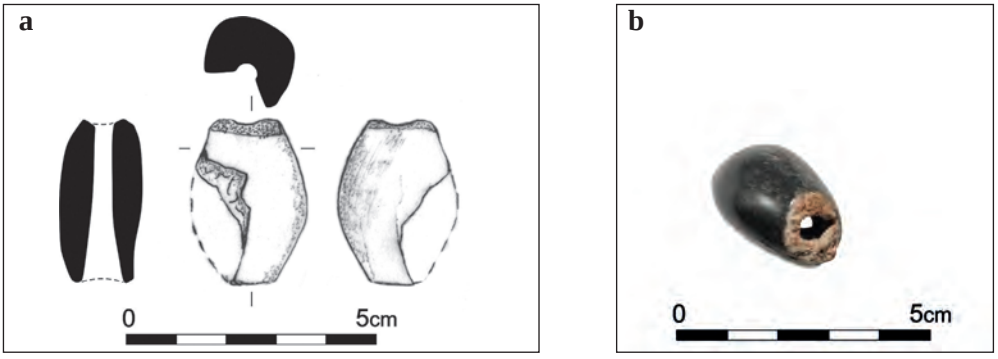


Fig. VII.5 PM0581. A barrel-shaped sizeable bead made of the shell Spondylus gaederopus, totally burnt. A traversal axis runs along its length (a. drawing: N. Kyparissi-Apostolika and C. Batzelas, b. photo: G. Dallas)

921 See also Toufexis – Batzelas, this volume, 113.

922 Hensilwood et al. 2004. The head of the research project, Christopher Hensilwood, believes that they had a symbolic meaning, while by others symbolism is estimated to be a characteristic of Homo Sapiens. Up to this discovery, the earliest undisputed African personal ornaments were 13 ostrich eggshell beads from Enkapune Ya Muto in Kenya at ~40ka, and 58 marine shell beads from the ~41ka layers of Üçağızlı Höhle, Turkey.

923 Vanhaeren et al. 2006. The comparison of these shells to natural shells indicate deliberates selection and transport by humans for symbolic use.

924 Kotjabopoulou – Adam 2004.

925 Stiner 2010.

926 Kyparissi-Apostolika 2001, pl. 49b.

### VII.2.2. Bone

PM0709 (Fig. VII.6). Only one ornament is made from animal tooth (wild boar?/suid family). It retains the natural gloss on one curved surface. The other surface is rather flat. On the latter there are five serial drop-shaped decorative incisions and a hole for hanging was opened from this to the front surface at the one end of the tooth. Both ends are broken. Length: 3.4cm, width: 0.7cm, thickness: 0.4cm. Find spot: SU 112, in intermediary deposits between Surface F25 and F26, depth: 6.47m. BSPh Ve, MN II.

Bored teeth of wild animals are already known since the Upper Palaeolithic from Willendorf, Austria, 30,000 BP,[927] as well as from the Cave of Bacho Kiro in Bulgaria dated ~43ka. Perforated teeth are also known from several other Neolithic excavations.

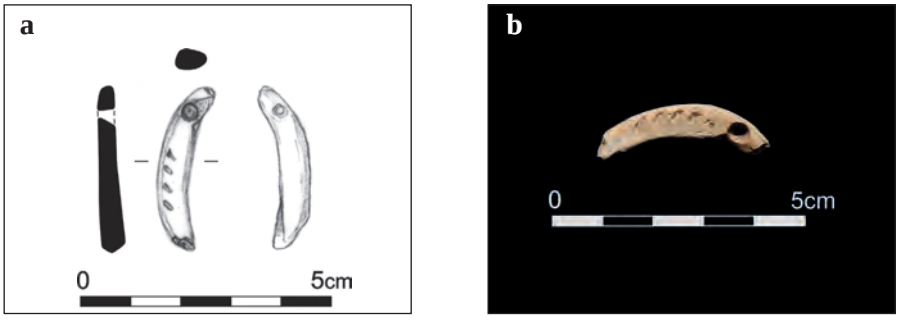


Fig. VII.6 PM0709. An animal tooth bored for hanging, with five serial drop-shaped decorative incisions (a. drawing: N. Kyparissi-Apostolika and C. Batzelas, b. photo: G. Dallas)

### VII.2.3. Stone

Only one ornament made from a small pebble has been found. It comes from Middle Neolithic layers.

PM0793 (Fig. VII.7). The Neolithic example has an almost triangular shape, greenish colour and is rather soft (steatite). A pair of holes has been opened from both sides on its wider edge, while on one side a channel connecting the holes is visible. On both sides there are linear decorative incisions. Dimensions: 2.8 × 2.2cm, thickness: 0.3cm. Find spot: SU 51c, in the interior of a house and apparently on its clay floor (Surface F32), near the northern wall (W38) and the thermal structure TS33,[928] location inside the trench (coordinates): 1.70m (west) × 3.15m (south), depth: 8.28m. BSPh IVa, MN I.

Perforated pebbles used as ornaments are known from Willendorf, Austria, from the Upper Palaeolithic, c. 30,000 BP,[929] and are very common finds at almost all Neolithic excavations, as the only necessary alteration was the opening of a hole. For this reason, soft stones were usually chosen, while there are examples with broken holes and even examples with second attempts at boring nearby.

927 Exhibited at the Natural History Museum, Vienna.
928 Toufexis – Batzelas, this volume, 143, 167.
929 Exhibited at the Natural History Museum, Vienna.

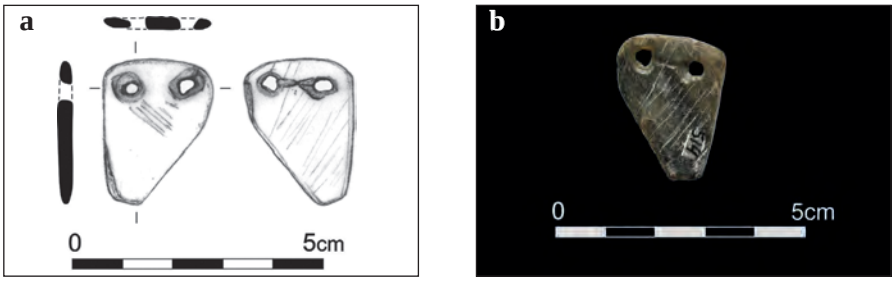


Fig. VII.7 PM0793. A greenish stone pebble shaped in a triangle with two holes for hanging and a shallow channel connecting them. Linear incisions on both sides (a. drawing: N. Kyparissi-Apostolika and C. Batzelas, b. photo: G. Dallas)

### VII.2.4. Clay

Five ornaments are made of clay, two of them come from the Neolithic deposit, while three others come from the Bronze Age deposit and will be presented in a future volume:

PM0614 (Fig. VII.8). The object is an almost cylindrical, long bead complete with round section. It is made of orange clay with greyish shadows/clouds, well baked. A transversal axis runs along its length. Length: 4.5cm, max. width: 1.5–1.6cm, width at the edges: 1.1–1.2cm. Find spot: SU 126, depth: 5.6m. BSPh VIb, MN III.

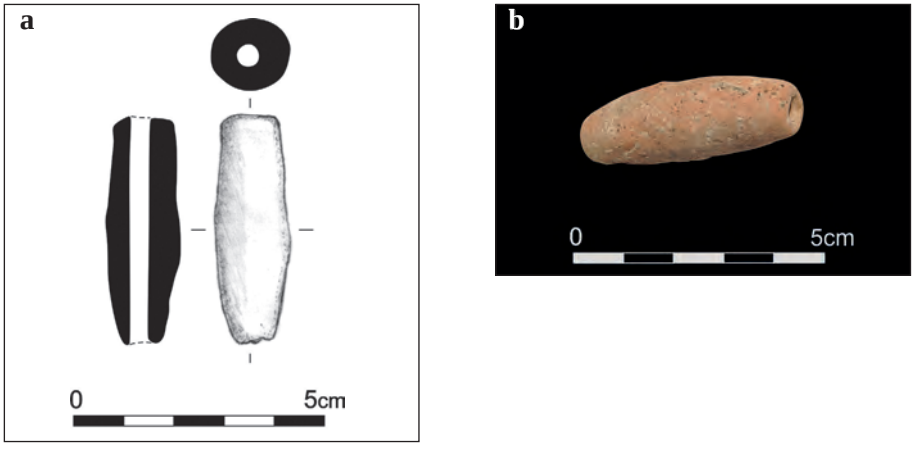


Fig. VII.8 PM0614. An almost cylindrical long bead, complete, made of orange clay. A traversal axis runs along its length (a. drawing: N. Kyparissi-Apostolika and C. Batzelas, b. photo: G. Dallas)

PM0403 (Fig. VII.9). One more object was identified by the excavators as a possible ornament; it has a round, slightly curved shape that is thinner at its periphery. Faint relief lines on both surfaces are rather decorative and random. There is no other kind of elaboration on it and no indication that it was used as an ornament. Intensive observation showed that the material is clay, burned hard. Diameter: 2.1–2.2cm, thickness: 0.8cm. Find spot: SU 161, in intermediary deposits between Surface F19 and F20 (SU 153), depth: 4.68m. BPh VIII, LN I.

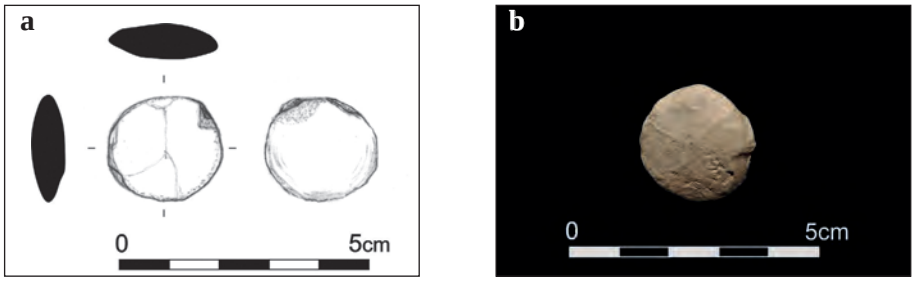


Fig. VII.9 PM0403. Clay object in a round, slightly curved shape. There is no kind of elaboration on it and no indication that it was used as an ornament (a. drawing: N. Kyparissi-Apostolika and C. Batzelas, b. photo: G. Dallas)

Small discoid objects without a hole, usually made of stone or shell, are known from Neolithic Thessaly.[930] Their shapes are man-made and in a few of them there is an unfinished hole, so that one could assume that they were destined to be ornaments. Alternatively, they could be sewn on clothes. Clay discoid objects without a hole are reported from Visviki Magoula as well as from PMZ.[931] Similar small discoid objects are also known from the Balkans[932] and Western Europe.[933] Usually their function remains unknown. In the case of PMZ, we do not have any safe indication for use as an ornament, but it seems reasonable.

Clay beads are mostly found in the early periods of the Neolithic (e.g. from Prodromos near Karditsa, where there are several examples with simple spherical and oval shapes, like lumps of earth);[934] they are rare finds in the Late Neolithic when the ornaments were produced more systematically, with shells dominating. In the examples from PMZ, indeed, the long bead from the Middle Neolithic layers has a simple shape, imitating natural fruits.

## VII.3. Where in the Deposit – In Space and Time

As is seen in Tab.VII.1 and in Pl. III.2, the ornaments were found in several spots and at various depths in the deposit of Trench A in PMZ. The earliest of them is the stone pebble with the twin holes (PM0793) at a depth of 8.28m. It was found in the interior of a house and apparently on its clay floor (Surface F32), near the northern wall (W38) and the thermal structure TS33,[935] BSPh IVa, MN I. The bored suid tooth (PM0709) follows at a depth of 6.47m, BSPh Ve, MN II. It was found near a small pit, far from any constructions or clay surfaces. The three now missing shell ornaments (PM0637, PM0638, PM0639) come from 0.72m over the latter, a depth of 5.75m, BSPh VIb, MN III, in deposits containing highly burnt pieces of clay coming from the destruction of what may have been an auxiliary roofed area belonging to a house. And the long cylindrical clay bead (PM0614) was found a bit higher but within the same context (depth 5.60m); they all belong to the BSPh VIb, MN III. The burnt shell bead (PM0581) was found in the eastern half of the trench, in intermediary deposits between Surface F22 and F23 and probably in an open area east of a potential building, BSPh VIIa, transition MN III/LN I, at a depth of 5.25m. Of the two *Spondylus* bracelets (PM0467, PM1001), the smaller one was found in a layer above the bigger

930 Kyparissi-Apostolika 2001, 117–118, tabs. 27, 48, nos. 735, 742, 743.
931 Alram-Stern 2015, 445–446, pl. 268; see also Alram-Stern, this volume, chapter V.5.3.
932 Gimbutas 1976.
933 Barge 1982.
934 Kyparissi-Apostolika 2001, cat. nos. 505–507.
935 Toufexis – Batzelas, this volume, Pl. III.2.

Tab. VII.1 Ornaments from PMZ in space and time (N. Kyparissi-Apostolika)

| PMZ number | Material | Dimensions [cm] | Find Spot | Depth [m] | BPh/BSPh (Date) |
|---|---|---|---|---|---|
| PM0793 | Stone | 2.8 × 2.2 | F32/26 | 8.28 | IVa (MN I) |
| PM0709 | Bone | 3.4 × 0.7 | F26/20 | 6.47 | MN II |
| PM0637 | Shell | 3.2 × 3.8 | F24/18 | 5.75 | VIb (MN III) |
| PM0638 | Shell | 4.6 × 2.6 | F24/18 | 5.75 | VIb (MN III) |
| PM0639 | Shell | 1.9 × 1.5 | F24/18 | 5.75 | VIb (MN III) |
| PM0614 | Clay | 4.5 × 1.6 | F24/18 | 5.60 | VIb (MN III) |
| PM0581 | Shell | 3.4 × 1.9 | F23/17 | 5.25 | VIIa (transition MN III–LN I) |
| PM0467 | Shell | 5.1 × 0.9 | F21/15 | 4.96 | VIIc (LN I) |
| PM0403 | Clay | 2.1 × 2.2 | F20/14 | 4.68 | VIII (LN I) |
| PM1001 | Shell | 2.2 × 0.6 | F20/14 | 4.65 | VIII (LN I) |
| PM0379 | Shell | 6.1 × 6.7 | F20/14 | 4.50 | VIII (LN I) |

one (depths of 4.65 and 4.96m, respectively, BSPh VIIc and BPh VIII, LN for both). The *Spondylus* valve with the pair of holes (PM0379) was found at a depth of 4.50m, BPh VIII, also LN I, near to a shallow pit filled with black, burnt soil.

In the same BPh VIII, LN I at a depth of 4.68m, the circular clay object (PM0403) was found in deposits where no architectural structures were encountered.

From the above, it is evident that the spots where the ornaments were found are rather random and, based on this limited sample, we cannot associate them to certain structures or even to any kind of practice.

## VII.4. Discussion – Conclusions: The Ornaments in the Thessalian Framework

Judging from the few examples of ornaments we have from PMZ, as was stressed from the beginning, we see only a limited amount of material from the settlement; and judging from this material, this big and distinctive site does not seem to be a place where ornaments were produced, like Late Neolithic Dimini for example, or possibly Ag. Sophia. Ornaments are rather rare finds at the excavation of PMZ, despite the size of the site and the rich assemblage of pottery that indicates a rich settlement. The ornaments seem to be products of exchange as precious goods.

This is further reinforced by the two quite different fragments of the bracelets, which probably had different origins. The materials from which they were made are similar to the ones found in almost all settlements of the period. Among them, the presence of shell objects should be stressed, as it is not a site close to the sea. The seashell *Spondylus gaederopus* was widely used for the fabrication of ornaments in eastern Thessaly: ornaments of this kind are also reported from excavations at Late Neolithic/Final Neolithic Mandra, Middle Neolithic Makrychori, Late Neolithic Rachmani and Late Neolithic Galini.[936] They were also found in Late Neolithic Visviki

[936] Toufexis 2017.

Magoula[937] and at other Neolithic settlements of the Eastern Thessalian Plain as surface finds,[938] then being a product for commerce that reached central Europe.[939] The procurement of this natural species could be achieved by hand or with small rakes in shallow waters, while in deeper waters more complicated tools were needed (long-handled rakes, oyster tongues, or a dredge). Coastal populations would probably have been familiar with the aforementioned methods and it is likely that these products were permeated with social and symbolic values. Such a skilled activity might have been even more valued by distant groups, to whom the objects were transmitted. Moreover, thanks to its natural properties (hard, dense, light) *Spondylus* is an excellent surface to work on.[940]

Bracelets made of *Spondylus gaederopus* shells are very rare finds in western Thessaly, despite the suggestion by Akira Tsuneki[941] that central Thessaly was the most suitable area for *Spondylus* objects to be transported to from Dimini. The excavations in western Thessaly since then have shown a quite different picture; three fragments of different bracelets were recovered in Theopetra Cave, all made from the left valve of the shell. The other sites from which a very limited number of shell bracelets are recorded in western Thessaly are Tsangli (three fragments), although no material is mentioned by the excavators;[942] PMZ now (actually this site is on the borders between eastern and western Thessaly); and the site of Sykeon,[943] which is located in the northeasternmost part of the prefecture of Karditsa, and therefore, much closer to the Larissa Basin and the eastern shores of Thessaly. Although the total number is not significant, they constitute the only known examples recovered from western Thessaly to date.

Evidence from Neolithic burials in Europe, where bracelets were found by the dozens, shows that they were possibly worn around the arms and the wrists, but they were also sewn onto clothes as ornaments. Sometimes even only parts of bracelets are found in graves, probably testifying to their great value.[944] The practice of using fragmented parts of *Spondylus* rings is also documented at the production site of Dimini, as an expression of partible relations and of social practices in the Late Neolithic Greek society.[945] In Greece, however, where Neolithic burials are scarce, no *Spondylus* rings have been recovered as burial offerings; but recently, at the Late Neolithic settlement of Makriyalos in northern Greece, a high concentration of *Spondylus* artefacts indicates the close relation of these objects to burial practices, and a large fragment of a *Spondylus* bracelet was found in a burial.[946]

The sizeable barrel-shaped bead from PMZ is a very rare find too. To my knowledge, there are only twelve others recorded from Theopetra Cave,[947] in sizes that range from 2.6cm to 5cm (six are 4.2–5cm long and 1.9–2.9cm thick), the weight of the larger ones ranging from 26 to 38g. Another larger one (4 × 2.5cm) comes from the Chouliaras private collection.[948] It obviously should be attributed to the Late Neolithic phase of the Damasi 4 settlement where it was found.[949] Interestingly, the bead from PMZ seems to belong to the early Late Neolithic, and if so, it is older than the similar beads from Theopetra Cave; the latter were dated based on a piece of charcoal

937 Galik 2015.
938 Georgios Toufexis, personal communication.
939 Séfériadès 2010.
940 Theodoropoulou 2011.
941 Tsuneki 1987; Tsuneki 1989.
942 Wace – Thompson 2012, 125, fig. 78a, c, d.
943 Chatziaggelakis 2007, 26–27.
944 Comşa 1973; for relevant bibliography: Ifantidis – Nikolaidou 2011.
945 Chapman et al. 2011.
946 Pappa – Veropoulidou 2011.
947 Kyparissi-Apostolika 2011.
948 Kyparissi-Apostolika 2001, tab. 36, cat. no. 78; no. XO 13, exhibited at the Museum of Larissa. It was found at Magoula Damasi 4 (Magoula Tloupa/Tourkogefyra, A.T.A.E. 13), about 10km away from PMZ, with Early and Late Neolithic material, as well as material attributed to posterior periods.
949 Gallis 1992a, 113.

from a consolidated deposit where some of them were found at 5485 ± 102 BP / 6468–5994 calBP (DEM 141) / 4520–4050 BC (but this is not the definite age of the beads). Nevertheless, this type of big shell bead is not known from other sites in Greece, while they are common finds in the Carpathian Basin.[950] The raw material source, however, is not from the area near the Carpathians, as was demonstrated by analyses,[951] most probably indicating a complex trade network as per the following scenario: the raw material was collected from the Mediterranean and Aegean coasts, transported to the Carpathian Basin, manufactured into these particular shapes, and could then have returned to Greece in the form of imported precious goods. This hypothesis of returning southwards as manufactured items sounds unreasonable at first glance, but, taking into consideration the extensive network system of exchange that took place in that period, no hypothesis can be excluded.[952]

In this respect, and because of the rarity of such sizeable beads, it seems reasonable that the bead from PMZ, dated to the early Late Neolithic, is rather an isolated product, not yet incorporated in the system of exchanges from the north.

The beads of this type were manufactured from the right, thick valve, of *Spondylus gaederopus*,[953] while the thinner left valves were primarily used for making bracelets. The deliberate distinction in the use of the two valves obviously indicates some kind of specialisation; this is most evidently illustrated in the settlement of Ag. Sophia, where this differentiation did not exist from the start, as its excavator Vladimir Milojčić writes, but was established in the course of the development of shell ornament manufacture.[954]

Shells were possibly collected even earlier: apart from PMZ, pieces of shells with symmetrical shapes possibly destined for decoration as well as a few bored shells in their natural form are also reported from Sesklo.[955] Additionally, Marja Gimbutas refers to one shell bead and two shells found at Achilleion.[956]

In the Early and the Middle Neolithic, ornaments were mainly made of stone and clay. Stone is used in all periods due to its durability, while clay is hardly found at all throughout the Late Neolithic. Bones were only rarely used for ornaments, probably because of the fragile nature of the material, or because the most durable parts of the available bones were destined for other uses, such as needles, polishers and spatulae.[957]

The ornaments from PMZ are few in number, so we do not have a safe statistic sample. They are also all different, and no 'commercial' types of ornaments have been recognised, apart from the two parts of bracelets and possibly the big barrel-shaped bead. Interestingly, the worked shells from PMZ are imported products acquired through exchange and not made on site. They are present early in time (early Late Neolithic, BPh VII and VIII) and they must be considered as belonging to the earlier phases in which these shell objects circulated, and not to the Late Neolithic Dimini phase, when beads, buttons and bracelets were systematically produced and exploited. Apart from the bracelets and the barrel-shaped bead, which belong to certain established types, the *spondylus* valve with the pair of holes and, even more so, the three missing shell ornaments, also with a pair of holes each, are the distinguishing ornaments of PMZ. What differentiates the latter from other pendants made of seashell, which are common in several settlements,[958] is the choice of this particular exceptional shell. And as all three were found together, they could really be local products without following any type, but

950 Siklósi 2004; Siklósi – Csengeri 2011.
951 Shackleton – Renfrew 1970; Bajnóczi et al. 2013.
952 Kyparissi-Apostolika 2018, 227.
953 Tsuneki 1987; Tsuneki 1989.
954 Tsuneki 1987, 13.
955 Theocharis 1967, 84.
956 Gimbutas et al. 1989, 252, fig. 8.2.2.
957 Kyparissi-Apostolika 2001, 133.
958 Kyparissi-Apostolika 2001; Ifantidis 2006; Ifantidis 2011.

their natural shape and size. As I wrote in my Ph.D. thesis in connection with these particular items, "one could say that they were made by the same hand … but rather not by a professional one."[959]

Summing up, although the ornaments from PMZ are limited in number, they can inform us about the cultural and chronological context in which this distinctive Neolithic site existed. And it is expected that if excavated further, the site would hopefully reveal many more ornaments. Such a worthy assemblage with information concerning the spatial distribution of ornaments at the site, would, of course, give a more complete picture about their role in the social and economic context of the settlement.

[959] Kyparissi-Apostolika 2001, 169.

# VIII. Archaeobotanical and Zooarchaeological Remains – Revisited

*Paul Halstead*

## VIII.1. Composition of the Archaeobotanical and Zooarchaeological Assemblages in Context

The charred plant remains from PMZ include concentrations of the following taxa: the pulse crop bitter vetch (*Vicia ervilia*), of Middle Neolithic, Late Neolithic and Early Bronze Age date; the cereal crops hulled (probably six-row) barley (*Hordeum vulgare*) and emmer (*Triticum dicoccum*), of Early Bronze Age date; and acorns (*Quercus* sp.), of Middle Bronze Age date. The material is typical of charred assemblages of this date range from Greece in the heavy predominance of crops over gathered fruits/nuts[960] and also in the relatively balanced representation among the former of cereals and pulses.[961] The apparently striking continuity in cultivation of just one pulse, bitter vetch, from the sixth to the third millennium BC (Middle Neolithic to Early Bronze Age) should be treated with caution: the number of samples is small; and, as previously noted,[962] the concentrations from the upper Middle Neolithic and lower Late Neolithic levels might be derived from the same charring episode, redistributed by later building activity.

The PMZ faunal assemblages are likewise fairly typical of those from mainland Greece:[963] in terms of numbers of identified specimens (NISP), remains of birds, fish and reptiles were few, perhaps partly due to lack of sieving during excavation; among mammals, domesticates far outnumbered wild species, although the latter increased from 3% in the Middle Neolithic to 5% in the Late Neolithic and 10% in the Early Bronze Age; and, among the domesticates, sheep/goats (mainly sheep) outnumbered cattle and pigs throughout (Tab. VIII.1).[964]

Tab. VIII.1 Taxonomic composition of mammalian faunal assemblages (numbers of identified specimens) (P. Halstead)

| | | MN* | LN** | EBA** |
|---|---|---|---|---|
| **Sheep/goats** | NISP<br>% of total domestic | 772<br>57.7 | 673<br>62.9 | 1893<br>53.7 |
| **Cattle** | NISP<br>% of total domestic | 226<br>16.9 | 198<br>18.5 | 796<br>22.6 |
| **Pigs** | NISP<br>% of total domestic | 312<br>23.3 | 182<br>17.0 | 793<br>22.5 |
| **Dogs** | NISP<br>% of total domestic | 28<br>2.1 | 17<br>1.6 | 46<br>1.3 |
| **Total domestic** | NISP | 1338 | 1070 | 3528 |
| **Wild** | NISP<br>% of total mammal | 46<br>3.3 | 56<br>5.0 | 405<br>10.3 |
| **Total mammal** | NISP | 1384 | 1126 | 3933 |

* after Becker 1999; ** after Becker 1991; NISP = numbers of identified specimens

960 Cf. Valamoti 2015.
961 Halstead 1994; Valamoti et al. 2011.
962 Jones – Halstead 1993, 3.
963 Cf. Halstead 1996; Cantuel et al. 2008.
964 After Becker 1991; Becker 2000.

## VIII.2. Land Use at Platia Magoula Zarkou in Context

Prior to major 20th century drainage works, the west Thessalian Basin was subject to frequent and widespread flooding,[965] following the early-spring snow melt in the surrounding mountains. Coring around PMZ and the neighbouring Early Neolithic site of Koutsaki Magoula has identified multiple flooding episodes, at least locally, in the northeast corner of the basin contemporary with Early Neolithic and Middle Neolithic habitation[966] and this, in turn, has underpinned controversial arguments concerning the nature of both early settlement[967] and early farming[968] in Thessaly and further afield.

Alasdair Whittle, seeking to downplay the traditional distinction between seasonally mobile Mesolithic foragers and sedentary Neolithic farmers, argued that thin occupation levels and flimsy architecture at Early Neolithic Achilleion and elsewhere in the same region represented short-lived residential episodes,[969] while the documented flooding at PMZ would have enforced seasonal abandonment of this site. Flimsy Neolithic 'huts' co-existed with more substantial 'houses', however, as within living memory in the same region, and this contrast in architectural forms has alternatively (and arguably more persuasively) been interpreted in terms of varying levels of household investment in claims to plots of land.[970] Furthermore, the evidence for flooding lacks the resolution necessary to determine its frequency, extent and duration and thus to confirm claims of enforced abandonment of PMZ. Cornelia Becker countered this circumstantial argument for seasonal abandonment, noting that evidence for the slaughter of young lambs/kids shortly after birth implied a human presence during the expected late-winter to spring season of likely flooding.[971] Of course these very young animals might represent deaths either during exceptionally dry years, when seasonal abandonment was not necessary, or during the expected dry season but of animals born atypically early or late. Such caution involves an element of 'special pleading', however, and Becker's counter-argument is, at worst, no weaker than the circumstantial case for regular seasonal flooding and abandonment.

For Tjeerd van Andel and Curtis Runnels, flooding round PMZ was less an obstacle to residence than an opportunity for a distinctive form of crop husbandry – 'floodwater farming' – in which crops were sown on the fertile alluvium exposed by receding floodwaters. In addition to obvious Near Eastern sources of inspiration, van Andel and Runnels, like Andrew Sherratt before them,[972] cited early modern travellers' reports of this practice yielding bumper harvests for minimal effort. In principle, the possibility of prehistoric floodwater farming at PMZ could be tested by carbon isotope analysis of the recovered charred grain,[973] although in practice interannual and longer-term variability in lowland precipitation would complicate definition of a baseline for rain-fed husbandry, thus posing considerable problems of equifinality in interpreting results. Anyway, closer examination of recent attempts at floodwater farming in central and northern Greece indicates that the extent and strength of flooding were too unpredictable for dependable sowing beforehand (in autumn) and that waters usually receded too late for secure sowing afterwards (in late spring) of Old World cereals or pulses and often even of New World grain crops with their more favourable summer growing season.[974] Even if flooding occurred annually around Middle

965 Piket 1959; Mimikou – Koustoyannis 1995.
966 Van Andel et al. 1995.
967 Whittle 1996b.
968 Van Andel – Runnels 1995.
969 Whittle 1996b.
970 E.g. Kotsakis 2006.
971 Becker 2000; also Halstead 2005.
972 Sherratt 1980.
973 Cf. Wallace et al. 2013.
974 Halstead 2014a, 26, 192–193.

Neolithic to Early Bronze Age PMZ, therefore, it is most unlikely to have supported regular and successful grain harvests, leaving rain-fed crops as the most likely subsistence base.

The present author has argued that rain-fed crop husbandry was relatively small-scale and intensive ('horticultural') in the Neolithic, but larger-scale and more extensive ('agricultural') in the Bronze Age.[975] Support for this proposed contrast was claimed in the even representation of cereals and pulses in the Neolithic, compared with the predominance of cereals in the Bronze Age,[976] on the grounds that harvesting was more difficult and labour-intensive for pulses than cereals and thus tended in the recent past to be restricted to small-scale crops on infield plots.[977] This argument, drawing on the charred grain data from (inter alia) PMZ, has now received more direct empirical support, albeit from Knossos and Kouphovouno in southern Greece, from nitrogen ($\delta^{15}N$) and carbon ($\delta^{13}C$) isotope analyses of Early and Middle Neolithic charred grain that imply manuring of wheat crops and possible watering of peas, respectively[978] – both management practices more typical of small-scale horticulture than large-scale agriculture.[979]

Understanding of Neolithic and Bronze Age animal husbandry has been significantly enriched in recent years by isotopic analyses of food residues adhering to or absorbed by ceramic cooking vessels, as a result of which we now know that Early Neolithic and later farmers in Greece, as elsewhere, exploited the milk of livestock as well as the carcasses of deadstock.[980] Traces of carcass fats are much more frequent than those derived from milk, but such relative frequencies are a very insecure basis for estimating the dietary importance of milk.[981] As Becker reported for PMZ,[982] however, the slaughter ages of domestic ruminants in the Neolithic of Greece are generally dominated by juvenile deaths, implying an emphasis on rearing for meat and limited potential for milk production, while greater survivorship of adult male ruminants at some Bronze Age sites suggests that any shift towards greater use of livestock 'secondary products' was focused on draught or fibre rather than milk.[983] While livestock were evidently exploited for their milk, therefore, this use was not intensive and thus is unlikely to have made a major contribution to human subsistence, unless livestock were kept in very large numbers.

The scale and also mobility of Neolithic and Bronze Age animal husbandry have been much debated.[984] In the recent past, these two variables were closely interrelated: seasonal mobility (e.g. between lowland winter and upland summer pasture) enabled maintenance of larger numbers of livestock and was usually not considered worthwhile for only small herds.[985] Becker addressed the issue of seasonal mobility in the case of Middle Neolithic PMZ, noting that deaths of very young sheep and goats implied human presence in late winter to spring when the site was supposedly vulnerable to flooding, although this does not preclude the movement of livestock to the uplands in summer.[986] Paul Halstead extended a similar approach to a range of Neolithic sites, including lowland tell 'villages' such as PMZ, but also mid-altitude 'hamlets' and caves.[987] The approach is far from foolproof, because it rests on the assumption of a fairly narrow birth season,[988] whereas a few individuals were probably born unusually early or late, and because only young deaths can be aged accurately enough to be informative, so lack of evidence for slaughter in a particular

975 Halstead 1981.
976 Halstead 1994, 204–205, tab. 7.1.
977 Halstead 2014a, 79, 103–105, 119.
978 Bogaard et al. 2013; Vaiglova et al. 2014; Halstead – Isaakidou 2020.
979 Halstead 2014a.
980 Evershed et al. 2008; Whelton et al. 2018a.
981 Halstead 2014b, 421.
982 Becker 1991, 20–24; Becker 2000, 11–12.
983 Halstead 1996; Isaakidou 2006; Cantuel et al. 2008.
984 E.g. Sampson 1992; Halstead 1996; Cavanagh 1999.
985 E.g. Halstead 1991.
986 Becker 2000.
987 Halstead 2005.
988 Cf. Balasse et al. 2020; Tornero et al. 2020.

season may be insignificant. Nonetheless, remains of infant sheep/goats, ostensibly representing deaths in late winter to early spring, are found at both lowland villages and mid-altitude hamlets and caves, offering no support for suggestions that the latter were occupied by seasonally mobile herders,[989] presumably as a base for exploiting, or *en route* to/from, upland summer pastures.

Conversely, recent isotopic analyses offer some support for Neolithic herding of limited mobility. First, strontium isotope analysis of a small sample of cattle, sheep, goat and pig teeth from Early Neolithic to Late Neolithic sites in northern Greece has, with one possible exception, yielded ratios compatible with local geology, thus offering no hint of distant grazing.[990] Secondly, in a larger-scale study of domestic animals at Late Neolithic Makriyalos, again in northern Greece, strontium isotope ratios likewise offered no evidence of long-distance movement, although $\delta^{13}C$ values do indicate movement of cattle to pastures, probably in coastal wetlands, beyond the immediate vicinity of the site.[991] Various circumstantial lines of evidence also point towards animal husbandry being of modest scale. First, neither pollen nor charcoal data, at least in central and northern Greece, reflect degradation or opening up of lowland vegetation, such as might be expected if domestic animals were kept in large numbers.[992] Secondly, both cattle and pigs declined in size through the Neolithic,[993] implying that domestic females did not regularly mate with the larger wild male aurochs and boar roaming the landscape and this, in turn, implies that the domesticates were kept in small enough numbers to be under close control. Thirdly, nitrogen isotope values of Neolithic human skeletons do not differ between lowland farming villages and cave/hamlet sites,[994] implying consumption of similar amounts of animal protein and thus contradicting suggestions that the latter sites were inhabited by more or less specialised pastoralists.

### VIII.3. Cultures of Food Consumption at Platia Magoula Zarkou in Context

In the recent past, bitter vetch was regarded solely as a fodder crop in Greece and its consumption as a starvation food during the World War II occupation of Greece caused the permanent incapacitation of some individuals.[995] Like the also toxic but frequently eaten food/fodder crops of the genus *Lathyrus*, however, bitter vetch can be de-toxified for human consumption. An interesting question, with far-reaching economic and cultural implications, is that of when bitter vetch and other obligate fodder crops achieved their currently low cultural status in the Mediterranean.[996] Unfortunately the grain finds from PMZ (and other Neolithic and Bronze Age sites in Greece) are, as yet, insufficient to answer this question.

Becker's reports on the PMZ animal bones presented the evidence for carcass butchery and bone fragmentation in greater detail than was usual. As has subsequently been observed for other sites in Greece,[997] the Neolithic assemblage from PMZ included a lower percentage of cut specimens than its Bronze Age counterpart, suggesting more intensive butchery of the latter. The fact that cut marks are much more frequent at PMZ on bones of wild (red deer, roe deer and especially boar) than of domestic animals[998] provides some empirical support for more recent arguments that the intensity of butchery is related to prevailing 'rules' on the sharing of carcasses as these

989 E.g. Sampson 1992.
990 Whelton et al. 2018b.
991 Vaiglova et al. 2018.
992 E.g. Bottema 1982; Marinova – Ntinou 2018.
993 E.g. von den Driesch 1987.
994 Papathanasiou 2015.
995 Halstead 1990.
996 Halstead 2012.
997 Halstead 2007; Isaakidou 2007.
998 Becker 1991, 35, tab. 18.

are likely to have differed between wild and domestic animals.[999] Becker's observation that Middle Neolithic bones are more intensively fragmented than those of Late Neolithic and especially Early Bronze Age date[1000] is also matched by subsequent comparisons of fragmentation at Early Neolithic to Middle Neolithic versus later Neolithic and Bronze Age sites – a contrast likewise tentatively attributed to the progressive relaxation over time of cultural obligations to share carcass products.[1001]

## VIII.4. Conclusions

Since the 1990s, the volume of published macroscopic archaeobotanical and zooarchaeological data from the Neolithic and Bronze Age of Greece has grown considerably. By and large, the accumulation of new macroscopic data has served to show that PMZ was, in terms of plant and animal exploitation, fairly typical of later prehistoric open-air village settlements in Greece. Indeed, additional macroscopic data, especially zooarchaeological data, have in several cases shown that observations reported for the PMZ assemblage exemplify more widespread patterns. What has plainly revolutionised understanding of plant and animal husbandry and consumption in later prehistoric Greece, however, is the development of new diagnostic tools, based on analysis of carbon, nitrogen and strontium isotopes. These have begun to shed radically new or more secure light on livestock diet and movement, the use of carcass and dairy fats, and human diet.

[999] E.g. Halstead 2007; Isaakidou 2003; Isaakidou et al. 2018.
[1000] Becker 2000, 11.
[1001] Halstead – Isaakidou 2011; Isaakidou et al. 2018.

# IX. The Physical and Social Landscape of Neolithic Platia Magoula Zarkou

*Stella Souvatzi*

Platia Magoula Zarkou (henceforth PMZ) is among the most impressive tell formations of Neolithic Greece (Fig. IX.1) and a complex, spatially intriguing and materially elaborate site, including a long occupation, indications of frequent flooding in the surroundings, influential pottery, a rare cremation cemetery and the famous clay model of a house interior. The site therefore has good potential for shedding more light onto the Greek Neolithic and Neolithic life in general. Despite its limited horizontal exposure, the thorough excavation and vertical exposure of the site down to the sterile soil at a depth of 10.5m, in conjunction with a number of geophysical, geoarchaeological, geological and pedestrian investigations around it, allow an insight into the wider socio-spatial and temporal practices engaged in at PMZ. They also enable comparisons of settlement and habitation patterns between PMZ and other contemporary sites, and thus a placement of the site in its wider physical and social landscape.

This chapter focuses on this larger spatio-temporal scale and examines the ways in which PMZ's space was configured and conceptualised, taking a view of the landscape as a social and historical construct and of the human-environment relationship as dynamic and continuously interactive. Key features include the local landscape particularities; the mound itself and the type of settlement; the possible presence of surrounding ditches; and the existence of a separate cemetery. Throughout the chapter, comparisons and contrasts with other sites, with a focus on spatial patterns, situate PMZ within a broader picture of local, regional, and wider processes. My approach views space and landscape as the number of practices through which people engaged with places

Fig. IX.1 The Peneiada Valley with PMZ, the cemetery and Koutsaki Magoula. View from the south

as well as the history of those engagements. Some central questions include: what was the human-landscape interaction and what the settlement type, given also the flooding incidents during the Neolithic? Was the site defined by boundaries (enclosures or ditches), and if yes, what was their function? What is the relationship of the cemetery to the settlement and what does the existence of the former signify? How can PMZ contribute to our understanding of the meaning and significance of living in a mound in the particular landscape, and how the relationship between people, land and time may have been constituted? And finally, what was the position of PMZ within the broader landscape of newly and earlier excavated Neolithic settlements in Thessaly? My broader aim, in association with the wider aims of the project, is to gain new knowledge about the different ways in which PMZ engaged with society and the economy and interacted with other sites.

## IX.1. The Physical Landscape and Human Agency

Located at the northern edge of the Trikala alluvial basin, in the entrance of the Peneiada Valley, near the junction between the Zarkos and Revenia mountains and only 800m north of the Peneios River (see Map 2), PMZ was in proximity to a variety of environments and resources, both upland and lowland. The Peneiada Valley, a narrow inter-mountain alluvial plain, where the Peneios flows from the Western to the Eastern Thessalian Plain and from there to the Aegean Sea, is characterised by numerous meanders either active or abandoned.[1002] The hydrographic network of the Peneios River is the longest in Greece[1003] and perpetually active. Since the deep past and at least up to late antiquity, both of the two major Thessalian plains were partially covered by lakes and/or marshlands, especially the western one, which shows a much denser hydrographic network of Peneios and its tributaries.[1004]

Geoarchaeological research carried out by Tjeerd van Andel and colleagues revealed that the Neolithic settlement was established on the bank of a gully lying to the east at a time when the surroundings were still subject to frequent flooding, which continued throughout the Middle Neolithic.[1005] This led to the suggestion that the location of the site was specially selected so that it permitted post-flood cultivation or even floodwater farming and that the earliest habitation was intermittent and took place only outside the flood season (probably lasting from December through May).[1006] Additional support for these geological features is provided by the recent geophysical prospection around PMZ[1007] and the geological investigation of the broader Peneiada Valley.[1008] Both confirm the establishment of PMZ at the edge of an active floodplain and in a somewhat coastal setting of a narrow gulf, when the Peneiada Valley was characterised by lacustrine-to-marshy conditions. The geophysical prospection also identified another gully to the west. This indicates that PMZ was established between two gullies running from the north and circumnavigating the mound from the east and west.

Similar locales and arrangements occur at several other settlements in Neolithic Greece, for example, at Sesklo, where the tell (or Sesklo A) is flanked by two deeply cut rivulets; at Stavroupoli in Macedonia, which is found on a low hill between two creeks;[1009] and especially at the settlements that are situated in lowland regions in intense flooding zones near rivers or lakes. The 'Innovative Geophysical Approaches for the Study of Early Agricultural Villages of Neolithic Thessaly' (henceforth IGEAN) project for eastern Thessaly has shown that a considerable

[1002] Migiros et al. 2011.
[1003] Caputo et al., this volume, 36.
[1004] Sarris et al. 2017b; Caputo et al., this volume, 40.
[1005] Van Andel et al. 1995, 138.
[1006] Van Andel et al. 1995, 140–141; also, van Andel – Runnels 1995; contra Halstead, this volume, 584–585.
[1007] Sarris et al., this volume, chapter II.2.
[1008] Caputo et al., this volume, chapter II.1.
[1009] Grammenos – Kotsos 2002, 15.

number of the Thessalian Neolithic tells – such as Visviki, Rizomylos 2 and Karatzadagli in the Almyros Plain, and Almyriotiki, Almyros 2 and Perdika 1 – were found on active floodplains and/or were surrounded by numerous palaeochannels and that during flooding episodes the water level reached their foot.[1010] Neolithic and prehistoric settlements generally built on floodplains and demonstrating a close relationship between humans and rivers are fairly common across the whole of Europe and beyond.[1011]

The assumption of seasonal habitation at PMZ, however, is not confirmed by the archaeological data. The stratigraphy of deep Trench A, which was excavated down to the sterile soil and therefore enables diachronic observation, indicates permanence and continuity, while evidence for periodic, even short-term and occasional abandonment during the Neolithic life of the settlement is entirely absent.[1012] Uninterrupted occupation is further attested by the analysis of material culture, no category of which indicated any dramatic breaks or changes in the typological or technological sequence.[1013] The archaeozoological remains and specifically, the slaughter age recorded for young domestic animals, also points to a year-round presence at the settlement.[1014] Instead, the site was abandoned at the end of LN I, ostensibly when the settlement was at its peak and when the mound had risen sufficiently above ground level to not be threatened by flooding.[1015] It was not reoccupied until the Early Bronze Age, and specifically until the Early Helladic II period.[1016]

There are several important implications here. One is that rather than being enforced by environmental factors the rather intriguing abandonment of the site was intentional, likely reflecting a social choice. Secondly, contrary perhaps to what we may assume today, flooding susceptibility does not seem to have acted as a discouraging factor in settlement location, viability or attachment to a place. This serves to emphasise the flexibility and variability of Neolithic socio-economic practice. It also raises the question of the human-landscape interaction or of the relationship between the physical landscape on the one hand, and spatial continuity or long-term locality, habitual social practices, land uses and people's worldviews and perceptions of place, on the other.

While there is little doubt that the Peneios River and its activity considerably influenced people's lives and practices, there is no reason to assume that they passively subjected themselves to external conditions. Besides, the region has never ceased to be flooded regularly from the past to date due to intense rainfall and/or snow melting, or to experience frequent rises of the underground water table. During inundation events, recorded in cycle periods of 25–50 years,[1017] large areas in the vicinity of PMZ turn into a shallow lake. Yet neither habitation nor agricultural production in Thessaly has ever been abandoned since the onset of the early farming communities.

Nor should we envisage the off-tell areas as a space devoid of human activity and agency (see also next section). River incision gradually reduced the risk of flooding towards the end of the Middle Neolithic, while the gully and the surrounding plain were covered by a deep alluvium, allowing the settlement to rise above the level of the plain.[1018] It was also most likely during the Neolithic that the Peneios River established definitively its eastward flow, as well as the connection between the two major Thessalian plains, draining its water into the eastern one and from there to the Aegean Sea instead of to the south.[1019] Consequently, the flooded areas and flooding episodes within the Peneiada Valley began to reduce, exposing relatively drier land. In addition,

[1010] Sarris et al. 2015, 291–292; Kalayci – Sarris 2016, 12; Sarris et al. 2017b, 46.
[1011] E.g. Bailey et al. 2002; Vianello 2015; Parkinson et al. 2019.
[1012] Toufexis – Batzelas, this volume, 138.
[1013] See relevant chapters in this volume.
[1014] Becker 2000; Halstead, this volume, 584, 586.
[1015] Van Andel et al. 1995, 138; Caputo et al., this volume, 48.
[1016] Eva Alram-Stern, personal communication.
[1017] Migiros et al. 2011, 218.
[1018] Van Andel et al. 1995.
[1019] Caputo et al., this volume, 48.

the borehole drilled close to the tell indicated that flood water reached the foot of tell, although not necessarily the settlement, from the south (i.e. where Peneios flows), whereas the north and east sides were not subject to flooding (see Figs. II.1.8, II.2.1). It can also be no mere coincidence that the settlement was established on an elevation in the terrain.[1020] Such a location would be protected from flooding, especially if combined with enclosures, which may indeed be the case for PMZ.[1021] An additional possibility is the presence of causeways, earthworks, embankments, dams or irrigation canals. Such water management systems are known from a wide range of prehistoric settlements along floodplains all over the world, such as the settlements of the Hohokam of Arizona, who converted swamps by digging canals to create highly productive artificially-raised fields;[1022] those of the Bronze Age inhabitants of the Fenlands in England, who built a complex system of causeways to effectively transport goods across islets and marshes;[1023] and the settlements of the 'earthwork populations' of prehistoric Cambodia, who constructed concentric earthen embankments around their long-lived settlements for two thousand years.[1024]

The local landscape of PMZ offered manifold opportunities for a mixed economy. The farming fields were probably in the north of the mound, where the area was safe from inundation. Rain-fed crops rather than floodwater farming is the most likely subsistence base.[1025] At the same time, in contrast to the bare landscape that we see today due to intensive modernised agriculture, the situation in prehistoric times was much more diverse with thick vegetation and dense forests, especially of oak and chestnut, in the uplands – thus with a good potential for water-retaining –, wetlands and open grassland.[1026] The archaeobotanical and zooarchaeological data from PMZ suggest reliance of the subsistence economy on agriculture and animal husbandry.[1027] Relatively small-scale and intensive horticulture rather than large-scale agriculture and a modest scale of animal husbandry with little hints of distant grazing seem to have been the most likely practices. The latter implies the continuous co-existence of humans and animals at or around the site. The ground and chipped stone tool assemblages suggest a range of uses, from farming, herding and fishing to hide working and digging for clay, and from crushing or grinding grain to the processing substancessubstances. Best represented in both stone tool assemblages are cereal harvesting and woodworking.[1028] The chipped stone tools were mostly manufactured of radiolarite, which was derived from more distant sources, regionally rather than locally available, and specifically from the Portaikos River, flowing at a distance of approx. 40km west of the site.[1029] This implies not only that people used geographically different material sources for different stone tools, but that raw material acquisition involved choice, strategy and most likely social rather than merely practical considerations such as participation in social networks. I return to this point later.

The people of PMZ lived in a changing geography with major hydrographic transformations, a vacillation in the water table, alternating phases of dry and wet environmental conditions, and perhaps also of land availability, and related climatic fluctuations. They might have also witnessed the latest phases of the final infilling of the Peneiada Valley and the change of direction of the Peneios' water flow, as well as a progressive change in the absolute altitude of the aggrading alluvial plain and consequently of the extent of flood water.[1030] And although, to us, the frequency, extent and duration of flooding in Neolithic times remains unknown, Neolithic people would have

[1020] Van Andel et al. 1995; Caputo et al., this volume, 48.
[1021] See next section.
[1022] E.g. Ensor et al. 2003.
[1023] Malim 2015.
[1024] Dega – Latinis 2014.
[1025] Halstead, this volume, 584–585.
[1026] Halstead 1984, 2, 7; Sivignon 1992 [1975], 83–105.
[1027] Alram-Stern – Toufexis, this volume, 622.
[1028] Perlès – Papagiannaki, this volume, chapter V.1; Stroulia, this volume, chapter V.2..
[1029] Alram-Stern – Toufexis, this volume, 624.
[1030] Caputo et al., this volume, 55.

observed these phenomena over time and through generations, would have gained experience concerning their impact and would have developed an appreciation of the landscape,[1031] a landscape to which they became increasingly attached, with which they got increasingly entangled and which they finally socialised. When water tables rose, they would have perhaps relocated off-tell activities. Engagement with and use of diverse micro-environments is further indicative of a thorough knowledge of the landscape and available resources. For instance, the selection of specific materials for specific tool types reflects the experience acquired through long interaction with material sources.[1032] Intentionality, agency and landscape uses and associations are further exemplified in the following sections.

## IX.2. The Constructed Landscape

### IX.2.1. Around the Mound: Boundaries and Water Management Systems?

The geophysical prospection around the tell provided some significant new results,[1033] while confirming the results of the pedestrian survey[1034] and of the earlier geoarchaeological research[1035] with regard to the extent of Neolithic habitation. There are several linear, rectilinear and curvilinear features within the geophysics, including potential ditches or enclosures, gullies or palaeochannels and buildings. Architectural remains at the north foot of the tell and further to the northwest, including a cluster of buildings possibly surrounded by a thin circuit wall, date to the Bronze Age, as do the dense and extensive remains to the south.[1036] The Neolithic findings around the mound consist of only a few potsherds, all dated exclusively to the LN I Tsangli-Larissa phase, and some ground and chipped stone tools. They were almost entirely collected from the east and the south areas below the mound. Intensive Neolithic habitation therefore seems to have been circumscribed to the tell itself. The spatial extent of the Neolithic settlement is further implied by the presence, location and course of potential ditches (or pairs of ditches) that follow the contour of the mound in the west and the south, possibly demarcating its outer limits.[1037]

Given the time-depth of human occupation of the mound, the chronological association between all these features will need to be clarified through excavation. It is possible, however, that the curvilinear ones on the west and south sides may indeed represent sections of concentric ditches, probably double, surrounding the mound and that they date to the Neolithic. This inference is based on i) the position of these features closely around the foot of the tell; ii) their course, which seems to fit into a circular and consistent pattern; and iii) the absence of evidence for Neolithic habitation further away in those areas or anywhere else around the tell.

It is of further relevance that the excavation unearthed a ditch, located at the very bottom of the trench, at a depth of 10.00–10.20m below the surface, and dug into the sterile soil.[1038] A radiocarbon date on a bone from the bottom of the ditch falls between 5889 and 5805 calBC (1σ)[1039] i.e. in the early Middle Neolithic, coinciding with the beginning of the site's life. It is therefore highly likely that this ditch was associated with the earliest phases of habitation, although whether

[1031] Cf. Chapman 2020, 56, 156.
[1032] Cf. Stroulia 2005a; Stroulia 2017a; Bekiaris et al. 2017, 429.
[1033] Sarris et al., this volume, chapter II.2.
[1034] Christos Batzelas, personal communication.
[1035] Van Andel et al. 1995.
[1036] Eva Alram-Stern, Christos Batzelas and Giorgos Toufexis, personal communication.
[1037] See Fig. II.2.12 in Sarris et al., this volume, features highlighted in yellow.
[1038] Toufexis – Batzelas, this volume, Figs. III.6–7.
[1039] Weninger et al., this volume, Tab. IV.1.

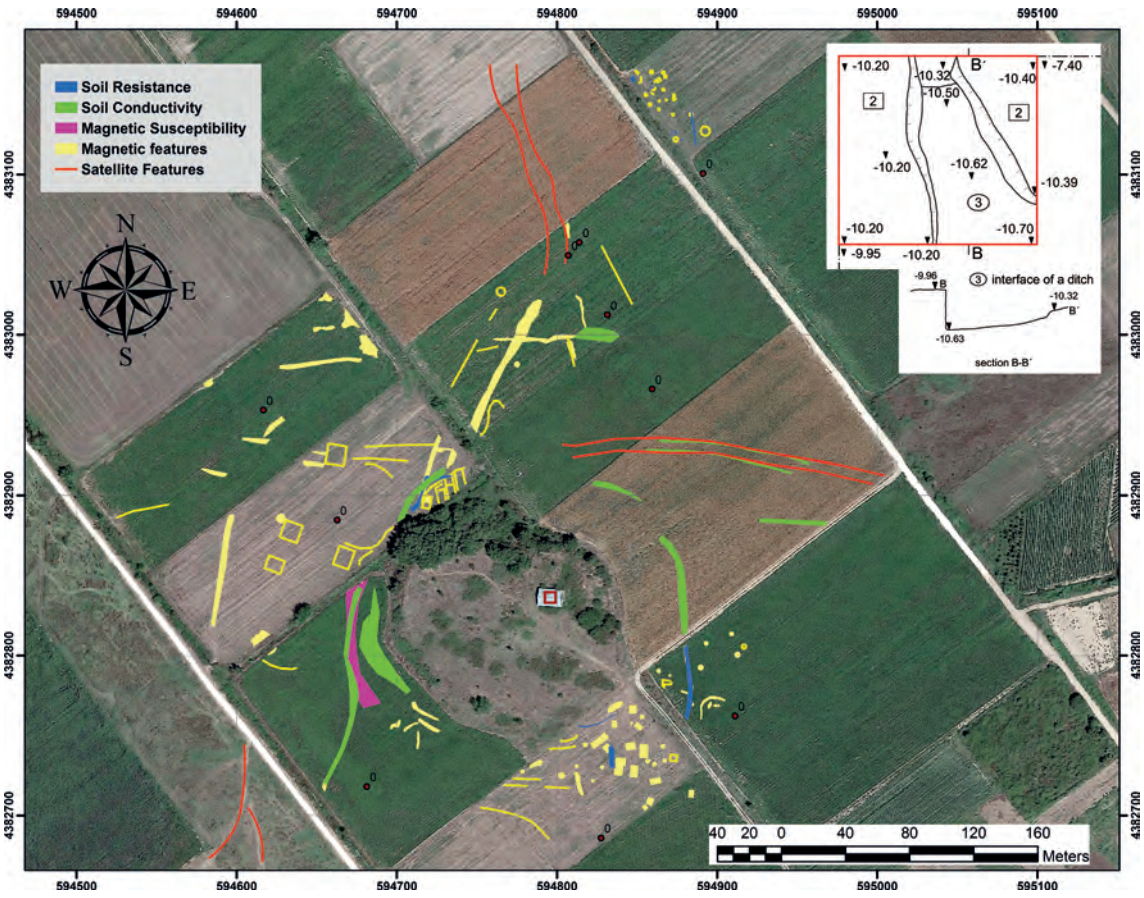


Fig. IX.2 The location of the excavated ditch (in the plan) in relation to the ditches detected geophysically (in the photo, depicted in yellow) (Geophysical picture: A. Sarris, plan: edited by C. Batzelas)

as a boundary or an internal space divider cannot be determined with certainty due to the limited spatial extent of the excavation at that depth. The ditch was exposed for 2.36m, was 0.75–1m wide and 0.40–0.60m deep and had a NNW-SE orientation and an uneven u-shaped profile.[1040] It contained a small amount of pottery, bones, burnt pieces of clay from building material and a few small finds, and it was naturally covered by sand. Interestingly, the orientation and course of the excavated ditch seem compatible with those of the ditches detected geophysically (Figs. II.2., IX.2). They all seem to follow the contour of the mound to the south and the west, and could have all potentially belonged to a unified system of boundaries, at least in the initial habitation phases. If this observation is correct, and assuming that all ditches co-existed at an early stage, the excavated ditch would encircle the east part of the site and would have served as a boundary rather than an intra-site space divider. In this case, it may provide indication of the eastern limit of the earliest settlement. In any case, the presence of the excavated ditch testifies that space marking and ditch-digging was a practice familiar to the people of PMZ from the start. By extension, it strengthens the possibility that the pairs of perimeter features detected below the tell were indeed ditches.

Such practices are very common in the Greek – and broadly European – Neolithic. They appear together with the first farming communities and continue throughout the Neolithic. In

[1040] For detailed description: Toufexis – Batzelas, this volume, 86–87; see also Toufexis 2017, 394.

southeast Europe in particular enclosure has been shown to be standard for many tells and flat settlements alike, contrary to what was previously believed.[1041] All over Greece and throughout the Neolithic, people divided parts of the physical and social landscape and marked out settlement from non-settlement space, and sometimes also intra-settlement space, in a variety of ways, ranging from concentric stone enclosures to partial perimeter ditches, and from habitation terraces to retaining walls.[1042]

Nor are ditches exclusively associated with flat settlements, as is usually thought. Excavated ditches surrounding tells in Thessaly include (in general chronological order): Souphli Magoula (EN or MN), Chalki near Larissa (EN), Achilleion (MN), Sesklo (MN), Otzaki (ditch 4, LN I), Arapi (layers 4–6, LN I), Mandra (LN 2) Argissa (ditch 4, 2), Vasilis near Pharsala (LN 2) and Magoula Sykeon (FN?).[1043] The five concentric ditches dug into solid rock at Makrychori[1044] remain unprecedented. One is dated to the Early Neolithic/early Middle Neolithic, and the other four to the LN I Tsangli-Larissa and Arapi phases, thus being contemporary with the last Neolithic phase of PMZ, as are the aforementioned ditches at Otzaki and Arapi. Excavated ditches surrounding flat settlements include Mavrachades-Tataria and Myrine-Ag. Varvara in Thessaly; and the double system of large concentric ditches at Makriyalos 1[1045] and the ditches probably combined with timber palisades and earthen banks at Promachonas-Topolniča I and II, Kleitos I, Thermi II and III, Toumba Kremastis-Koiladas and Paliambela in Macedonia.[1046] Most of these date to an early Late Neolithic phase.

Furthermore, complete geophysical plans of enclosed sites are now widespread in Thessaly. The IGEAN project detected a great variety of sites in eastern Thessaly, including new site-combinations such as a tell and a flat settlement component, with a diversity of concentric enclosures, both ditched and built, often with opposing entrances and radial passages.[1047] Several tells were both surrounded and internally divided by a series of concentric ditches and built enclosures of various sizes, functions and distances from each other and in various combinations – for example, in rough chronological order, Rizomylos 2 (EN–EBA), Almyros 2 (EN–MN), Almyriotiki (EN–LBA), Karatzadagli (LN), and Perdika 1 and 2 (EN–MN and MBA, and EN, respectively), Visviki[1048] and Koutroulou (MN).[1049] It appears that hardly any settlement existed without some type of boundaries and space divisions, although their particular spatial representation and social and symbolic significance might have varied considerably.

Returning to PMZ, a system of surrounding, concentric ditches would make sense throughout the life of the Neolithic settlement and especially during its early phases, before the mound took form and became more protected from flooding and more prominent in the landscape. It is important not to take the final form of a site to be its initial form. Completed site formations and settlement layouts represent the gradual and collective result of a number of people over considerable spans of time. Thus, no tell began as a fully-formed monument but started life as a 'flat' site,[1050] and PMZ is no exception.

The ditches may have served a variety of roles and functions, including drainage, small-scale irrigation, animal husbandry and storage of water, as well as the demarcation of site boundaries in

[1041] Chapman – Souvatzi 2020.
[1042] For syntheses and discussion: Souvatzi 2008, 175–178; Toufexis 2017, 307–327. For an analytical recording of all the available evidence: Toufexis 2017, 387–428.
[1043] Toufexis 2017, 28–30, 387–398.
[1044] Toufexis 2017.
[1045] Pappa – Besios 1999.
[1046] Data taken from Toufexis 2017, 307–327.
[1047] E.g. Kalayci et al. 2017; Sarris et al. 2017b.
[1048] Alram-Stern et al. 2017.
[1049] Hamilakis et al. 2017.
[1050] Chapman – Gaydarska 2019, 155. Recent research at Dikili Tash offers a very good example of the very slow transformation of a flat site into a tell, see Lespez et al. 2017, 51–52; L. Lespez, in: Darque et al. 2019, 493–548, n. 47.

material, social and symbolic terms, a means of community interaction and land use, and a claim to the surrounding territory. One interesting aspect at PMZ is the combination of the physical and the constructed landscape into a well-thought-out system of natural and symbolic protection of the site: the ditches to the west and the south would be complemented by the natural gullies identified to the west and the east of the mound. One likely function of this system might have been to minimise the impact of seasonal inundations. As mentioned earlier, such combinations of palaeochannels and constructed ditches have been detected in many lowland Thessalian Neolithic settlements located in floodplain environments. At Makriyalos I in western Macedonia thin layers of mud between the deposits of the inner and larger of the two concentric ditches suggest that the ditch might have been filled with water at times.[1051]

While general water management and protection against flooding could have been an important reason for the presence of ditches, it need not be the only one. In general, a solely functional, let alone a mono-functional, interpretation downplays the social and symbolic dimensions of such large-scale, collective constructions. Similarly, the traditional explanation of boundaries in terms of defence, fortification and territoriality[1052] presupposes hostility, territorial competition or social hierarchy, of which there is little evidence. Besides, a territorial demarcation primarily controls access to a site itself, physically or symbolically, rather than within the surrounding lands. With their peripheral distribution, the ditches would have defined and delineated the area of occupation on the tell, creating at the same time a sense of collective identity. They involved planning and communal decision-making, as they involved the entire site, as well as collective labour. Above all, they suggest investment in the construction of a sociocultural space, which incorporated, among other things, social perspectives about space divisions and landscape marking. In addition, boundaries – external or internal – cannot be seen independently of the wider social, cultural and economic landscape or of the areas they enclosed. Unlike the 'roundels', 'enclosures' or 'henges' of much of central, western and northern Europe, with their largely empty encircled areas and their occasional ritual function, in PMZ, as in Neolithic Greece and Southeast Europe in general, enclosures are closely associated with habitation, domestic space and everyday life. They create varying degrees of intimacy, visibility and movement, and reflect people's connections with the social landscape, with other communities and with their own community. In tells like PMZ the territorial demarcation, complemented by the houses and the gradual rise of the mound, would have eventually imposed them on the landscape.

Finally, as with any constructed environment, enclosures – either ditched or walled – incorporate history, temporality and transition. No settlement remained static over time, nor are boundaries and space divisions monolithic constructions. Instead, as most of the excavated examples of ditches and circuit walls clearly show, none of these works constituted a single act but rather a continuous process of building, maintenance and adaptation events. During the lifetime of a settlement, the addition of new enclosures, the abandonment or modification of old ones and the successive accumulation on the mound would have created a network of relationships, exchanges, and obligations.

### IX.2.2. The Settlement Type and its Significance

As already discussed in detail, the combined results of the geological, geophysical and pedestrian surveys suggest that the limits of Neolithic habitation lie close to the tell. In all probability therefore, the Neolithic settlement at PMZ was restricted to the mound, at least in its later phases. The post-Neolithic date of a pattern combining a tell and a flat site component at PMZ is attested by the co-occurrence of Bronze Age layers in the mound and building remains of a similar date around it. PMZ, then, apparently belongs to the tell type of settlement, and it seems that the

[1051] Pappa – Besios 1999.
[1052] E.g. Runnels et al. 2009; Alušik 2017.

combination of a tell and a flat site component, such as, for example, in the well-known case of Middle Neolithic Sesklo, was not developed here until after the end of the Neolithic. This, however, does not mean that the Neolithic tell of PMZ remained static over time. Given the location and depth of the excavated ditch discussed above, in conjunction with other stratigraphic data, it is not unlikely that the earliest settlement was slightly dislocated or even somewhat more extended or more dispersed in comparison to the restricted or more compact habitation pattern concentrated on the tell area later.[1053]

Given the many indications of human agency and a dynamic human-landscape interaction explained earlier, it would be too narrow-sighted to suggest that the main reason for spatial restriction at PMZ was the potential flooding episodes in the surroundings. Rather, people consciously decided to live within a well-defined and spatially restricted area, to accumulate successive layers of habitation despite potential problems with flooding and to develop the settlement vertically rather than horizontally and rather than shifting sites. This shows that PMZ, just like any tell, was created as much by social relations as by physical conditions.

The assumption of seasonal occupation of PMZ cannot be retained either. Apart from the stratigraphic, material and subsistence evidence discussed above, the architectural data also attest to an uninterrupted habitation throughout the Neolithic sequence. The mound layers are distinguished into nine building phases, some with sub-phases, spanning from the early Middle Neolithic to the end of LN I, i.e. c. four hundred years, without interruption.[1054] The repeated rebuilding, often on the same spot, of structural features such as hearths or ovens, and the frequent renewal of floors further indicate a concern to emphasise continuity of descent and/or place.

However, continuity of space is not the same as inflexibility or immobility. Although shifts in spatial and social organisation cannot be elucidated in detail for PMZ due to its limited horizontal exposure, they are standard for most sites and buildings of Neolithic Greece whose life exceeded one phase, even for tell sites.[1055] They seem to be present in PMZ too. Detailed examination of the architecture and intra-site use of space suggests that little remained the same over time: different construction techniques and types of floors and space divisions co-existed or were introduced at different times; interior and exterior space often changed location, alternating with one another over the different building phases; and levelling programmes seem to have taken place regularly.[1056] By rearranging house or settlement space, people recraft material conditions, social roles and social relationships.

A lack of fixity and a degree of residential mobility must have also been driven by numerous other reasons – for example, to ensure the reproductive viability of the population through marriage patterns; to work elsewhere; to acquire raw materials; and to exchange goods and visits. The various classes of material culture indicate that PMZ participated in multiple networks of communication and of circulation of materials, information and ideas. For example, the analysis of pottery conducted thus far has clearly shown that the site was a major production centre of distinctive wares throughout its Neolithic life, as well as enjoying a central position in pottery networks.[1057] The development of such networks suggests mobility of people, travel and possibly even seasonal relocation for certain traders or specialists. The presence of Melian obsidian at PMZ,[1058] even though low, attests to participation in the long-distance network of this exotic material,

[1053] Giorgos Toufexis, personal communication; Toufexis – Batzelas, this volume, 126; see also Lespez et al. 2017, 51–52 and Alram-Stern et al. 2017, 145 for early shifting patterns concerning the tells of Dikili Tash and Visviki Magoula, respectively. For instance, recent deep probes into the tell of Dikili Tash suggest that since its establishment in 6400/6300 calBC the settlement remained a large flat, and probably shifting site, for almost one thousand years before it consolidated and started to take its tell form (i.e. from 5400 BC onwards).

[1054] Toufexis – Batzelas, this volume, 137; Weninger, this volume, 195.

[1055] See Souvatzi 2008, 162–175 and Souvatzi 2020 for examples regarding tells.

[1056] Toufexis – Batzelas, this volume, 126, 135.

[1057] Schneider et al. 1991; Schneider et al. 1994; Pentedeka 2011; Pentedeka 2012; Pentedeka 2017a.

[1058] Karimali 1994; Karimali 2000; Perlès – Papagiannaki, this volume, 197–274.

if only through reception of certain specialists moving between sites, who would exchange their semi- or fully prepared cores to be processed by local specialists and depart.[1059] Of equal relevance is the fact that the raw materials used in the chipped and ground stone industries of PMZ were most likely collected at considerable distances from the site. It suggests specific expeditions and possibly also travel by boat on the Peneios River.[1060] Ornaments seem to have been imported almost in their entirety, attesting to a network of communication and exchange, despite their small number.[1061] The presence of *Spondylus* shell objects in particular indicates that PMZ was in contact with trading partners or itinerant specialists. It also implies that the site shared the wider perceptions of intercultural significance and the ideological and social value of raw materials and goods derived from distant origins.[1062] Regarding animal-related seasonal mobility, a combination of foddering and grazing practices in the form of small-scale mobility of herds at proximal distances is a likely scenario. Such mobility would have depended on the seasonal cycles of farming and livestock rearing,[1063] as well as on the fluctuating extent of dry and wet areas in the vicinity of the settlement. At PMZ not even the water table around the site remained static throughout the life of the tell.

Tells are also a material expression of time and history,[1064] and PMZ is no exception. Living directly where the previous generations lived; collectively deciding to build a tell (as well as ditches and a cemetery); reproducing basically the same type of settlement over time; and generally sharing the experience of daily interaction and of lived space over long periods of time – all monumentalised the history of the community. It is also worth noting that PMZ is a multi-temporal site, with substantial habitation remains of the Bronze Age. Given also its abandonment at an early stage of the Late Neolithic, the presence of these later remains shows that PMZ was an important mnemonic site for hundreds of years after its Neolithic habitation.

A common interpretation of the tell pattern in Thessaly is that the location of villages on good agricultural land (Fig. IX.3) inhibited horizontal expansion in favour of rebuilding on the same plots, which in turn created a sense of 'private' land ownership of both house and field plots.[1065] However, such an approach may embrace a narrow conception of land connections. Wider social relationships and dependencies might, in fact, shape the relationship between people and land, and we should also be very sceptical about the idea of 'private' land ownership at the individual house/household level.[1066] Rather, I agree with Chapman's argument that living on a tell,[1067] thus having to use the land outside the settlement for cultivation, allows for land ownership at a communal level. While tells can be seen as territorially-based communities, this does not necessarily mean that individual households can exclude others from the use of community land, or that they acted autonomously. I believe that such a hypothesis is far more likely for Neolithic tells and especially for sites like PMZ, where agricultural land may have been relatively limited spatially or temporally due to flooding, and where measures against flooding or the maintenance of the same settlement type over time would have required collective effort and cooperation as well as relationships and obligations at a wider, community level.

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1059 Karimali 1994, 379.
1060 Eva Alram-Stern, personal communication.
1061 Kyparissi-Apostolika, this volume, 578.
1062 Cf. Séfériadès 2000; Chapman et al. 2011.
1063 Cf. Koromila et al. 2017, 277.
1064 Souvatzi 2020.
1065 E.g. Halstead 1989; Demoule – Perlès 1993, 363; Halstead 1999b; Kotsakis 1999.
1066 Souvatzi 2013b.
1067 Chapman 1989.

Fig. IX.3 PMZ and surrounding cultivated land

In turn, collective land-use could have involved collective descent-group lands and resources. A key aspect of living at PMZ may relate to a particular form of kinship. Tells, unlike other site types, combine coresidence and genealogy in the same settlement form.[1068] Both of these factors meet some of the cross-cultural criteria for the identification of unilineal descent groups.[1069] Unilineal descent organisation may be an important reason for the maintenance of the specific settlement type. Collective continuity and the social space that 'covered' the whole mound remained key to the creation of social identities and can be seen as the material representation of stable lineages, as can the process of large-scale construction of the ditches and enclosures. The specific clustering of burials in the cemetery may also reveal lineages or descent groups.

### IX.2.3. The Cemetery and the Manipulation of History

The overall thinness of funerary records in Greece seems to indicate that either the full range of burial practices is not visible to us or there was generally no emphasis on the visibility of the dead. The general lack of emphasis on ritual elaboration and grave goods further illustrates this point. Beyond that, the vast majority of human burials are intra-mural and come from everyday contexts, although with a notable diversity in burial patterns, while separate mortuary sites have always been outnumbered. This scarcity of cemeteries, contrasted with the abundance of settlements suggests that independent funerary rituals (i.e. outside the settlement) were not a particularly important means of ancestor veneration or of social identification, integration or distinction. Within this wider social and cultural framework, the rare presence of a cemetery at PMZ deserves special attention.

[1068] Chapman – Gaydarska 2019, 155.
[1069] See Souvatzi 2017 for detailed discussion.

Fig. IX.4 Plan of the excavated part of the cemetery in relation to the present landscape (Geophysical picture: A. Sarris, plan: edited by A. Buhlke)

To date, it remains one of the extremely few cremation cemeteries in Neolithic Greece (another known example being the Early Neolithic and LN I one at Souphli Magoula)[1070] and one of the extremely few cases of association of a Neolithic settlement with a separate cemetery. Finally, it is noteworthy that no burial was found over the entire excavated area of the settlement.

The cemetery lies 300m to the north/northeast of the mound. It was partially excavated in the 1970s to an area of 324m², mostly alongside a modern irrigation ditch, with some trenches opened further away (Fig. IX.4).[1071] It dates exclusively to the LN I Tsangli-Larissa phase and it contained only cremations in pots placed in shallow pits.[1072] The cemetery seems to have been situated on top of a low elevation rise at the boundary of the flooding zone around the mound,[1073] which implies intentional selection of a protected location. At the same time, according to van Andel and colleagues,[1074] the loam into which the graves were dug defines the end of the floodplain stage of the region. Recent geophysical and pedestrian investigations were not able to trace the full original extent of the burial grounds. The pedestrian survey carried out directly above the excavated area yielded only a few sherds, highly worn and non-diagnostic, and no small finds. The geophysical survey was conducted 60m to the southeast of the excavated part of the cemetery and bore no clear information about structural remains. However, some isolated magnetic anomalies recorded at the same depth as the maximum depth of the burials excavated by Gallis (i.e. 1.50m below ground surface, see below) may indicate further burials.[1075]

[1070] Gallis 1982; Gallis 1996c. See also Stratouli et al. 2010 for a burial area with ten cinerary urns at the settlement of Avgi, dated to the early LN II, and Ziota 2014, 326 for scattered cremations in pots at the settlement of Kleitos I, dated to LN I. Although both of these cases from northwestern Greece suggest that the practice of cremation may be more widespread than previously thought, none of them can qualify as a separate cemetery, as is the case with PMZ.

[1071] Gallis 1982.

[1072] Gallis 1982.

[1073] Sarris et al., this volume, 74, 75.

[1074] Van Andel et al 1995, 134.

[1075] Sarris et al., this volume, Fig. II.2.4.

Fig. IX.5 LN I cemetery: cinerary urns in pits

The cemetery was found 0.30m under the land surface of that time and reached a depth of 1.50m.[1076] All burials lie within a layer 1.30–1.50m deep. The pits were c. 0.70m deep and 0.60–0.80m in diameter and usually contained one cinerary urn each (Fig. IX.5). The fire pit used for cremating the bodies was located in the cemetery in the form of scattered charcoal and stone and mudbrick remains over an area of 4 × 3m. The urns were usually placed upright (in 70% of the burials), but inverted examples also occur. They were sometimes surrounded by a few pebbles or placed on a layer of pebbles and were often covered with a small vase, obviously serving as a lid. As a rule, a small empty vessel, usually a bowl, was placed near the urn, perhaps as a kind of offering. In addition, a characteristic red-coloured sherd was commonly found near, over or inside many of the urns.

At least 67 individuals were recognised, usually placed singly in as many burial urns. They seem to include predominantly adults (61% of the identifiable sample), but also adolescents and juveniles, although only 40% of the burials (28 individuals) could be attributed to an age category with certainty due to the high fragmentation of the cremated bones.[1077] Only selected bones were buried, usually the skull and limbs, implying a preference in body part representation. Sometimes the cremated bones or the urn that contained them seem to have been wrapped in a cloth or a straw mat.[1078] Grave goods were virtually absent, consisting of a few flint and obsidian blades, potsherds and animal bones and two figurines in total.[1079]

[1076] Gallis 1982; for a summary in English: Gallis 1996c.
[1077] Fowler 2004, 54–56.
[1078] Gallis 1982, 113.
[1079] Gallis 1982, 78, 113.

However, the kind and type of the funerary ceramics as well as the entire burial practice observed illustrate a complex process and an emphasis on ritual elaboration. The process involved transportation and cremation of the deceased, selection and removal of the bones to be placed in the urns, digging of the pits, placement of the bones into the urn and of the urn into the pit and finally covering the whole grave. The pottery used for the cemetery belongs almost in its entirety to the black burnished and 'grey/grey on grey wares', both known for their high technical and aesthetic quality and their limited distribution and circulation within Thessaly,[1080] and falls into both local and imported fabric groups.[1081] For the rarer grey ware in particular, PMZ must have been a major production and circulation centre.[1082] Although such pottery is also found in the settlement, its exclusive selection for use in the cemetery remains of significance. The urns were large vessels of a variety of types, most commonly open bell-shaped bowls, cups or biconical jars with flat bases and one or two handles. With a single exception, all of the pots were undecorated.

There are many important aspects to the presence of the cemetery and to the particular burial pattern. The cemetery is related to a well-established tell settlement, whose monumentality expresses a collective continuity and an ancestral past upon which individual households were ideologically based. The cemetery itself, even though apparently single-period, further emphasises notions of ancestry and contributes to the construction of an ideologically significant cultural and social space. In fact, given its late date compared to the establishment of the settlement,[1083] the cemetery may be seen to represent a 'statement' of ancestry, locality and spatial importance. It would have acted as a locus of mortuary and ritual expression in a communal space outside the settlement and individual households, as well as a known focus in a landscape of rather dispersed settlements and virtually no other cemeteries.[1084] The probable existence of a demarcation stone wall further assigns importance to the cemetery as a landmark. This wall was traced for 5m in a north-east direction, it was 0.50–0.70m wide and it preserved a height of 0.50m.[1085] Regardless of its apparently short duration, the cemetery would have structured time and memory through the burial of ancestors or of descendants, the repetition of burial practices and the transmission of ritual, social and material knowledge concerning these practices. These actions not only generated memory and history, they also acted as a mechanism of social interaction.

Such interaction and, more importantly, a 'statement' of ancestry and locality might have been essential at the time that the cemetery was established and used, i.e. during the last phase of the Neolithic settlement and just before its abandonment. In other words, the late date of the cemetery, compared with the long life of the settlement, might not be coincidental. Given that all lines of evidence suggest a smooth transition rather than a dramatic break-off from the Middle Neolithic to the Late Neolithic, and therefore no radical changes in sociocultural practices, it is likely that the construction of the cemetery might have served as a means of keeping people together at a time when the pull towards fission, break-ups and abandonment was strong. In that case, a common or communal burial ground and rituals would have been used as a means for maintaining social solidarity and a mechanism not just for interaction but for integration.

These points are further supported by the remarkable homogeneity of the mortuary practices, including the distribution of urn types and the treatment of the deceased. As Fowler puts it,[1086] 'there was only one socially recognised burial type at PMZ'. This implies not only absence of social differentiation but also the downplaying, perhaps deliberate, of social identification or social

[1080] E.g. Gallis 1982; Vitelli 1994; Pentedeka 2011; Pentedeka 2012; Pentedeka 2017a; Pentedeka 2017b.
[1081] Pentedeka 2011, 114.
[1082] Schneider et al. 1994, 68; Pentedeka 2011; Pentedeka 2012; Pentedeka 2017a.
[1083] Unless, of course, there are more parts of the cemetery that still lie buried and which may date to an earlier phase. Even so, the presence of the cemetery would still emphasise continuity and the importance of ancestry, if in a more direct way.
[1084] Cf. Psimogiannou 2017 with regard to Final Neolithic cemeteries.
[1085] Gallis 1982, 88–89.
[1086] Fowler 2004, 58.

distinction. Although the burials tend to be single rather than multiple, thus appearing individualised, the very act of cremation, which made the body disappear; the high fragmentation of the bones, in other words, 'the lack of anatomically complete individuals';[1087] the absence of a clear pattern of sex or age; and the paucity of grave goods apart from the pots all imply that neither the body nor the individual were treated as bounded entities. As such, they further emphasise the primacy of the communal over the individual[1088] or a at least a concern to promote a collective rather than individual identity.

The location and distribution of the burials can also provide a clue to kinship patterns and degrees of social incorporation. The burials tend to be clustered in groups of two or more urns and pits and to be found in discrete areas within the cemetery (Fig. IX.6a–b). While the ubiquitous character of the mortuary practices suggests that all individuals inhumed were incorporated into one lineage or into some sort of integrated collective,[1089] the clustering of burials may reflect different family or descent groups. In one case a child burial was found placed inside a zoomorphic ceramic vessel, probably representing a goat, that was decorated with incised patterns.[1090] It constitutes the only exception in terms of cinerary vessel type and the only decorated example in the entire cemetery. It may provide a clue to the importance of children in physical and social reproduction. In any case, the dominant manifestations of social identity point to the community.

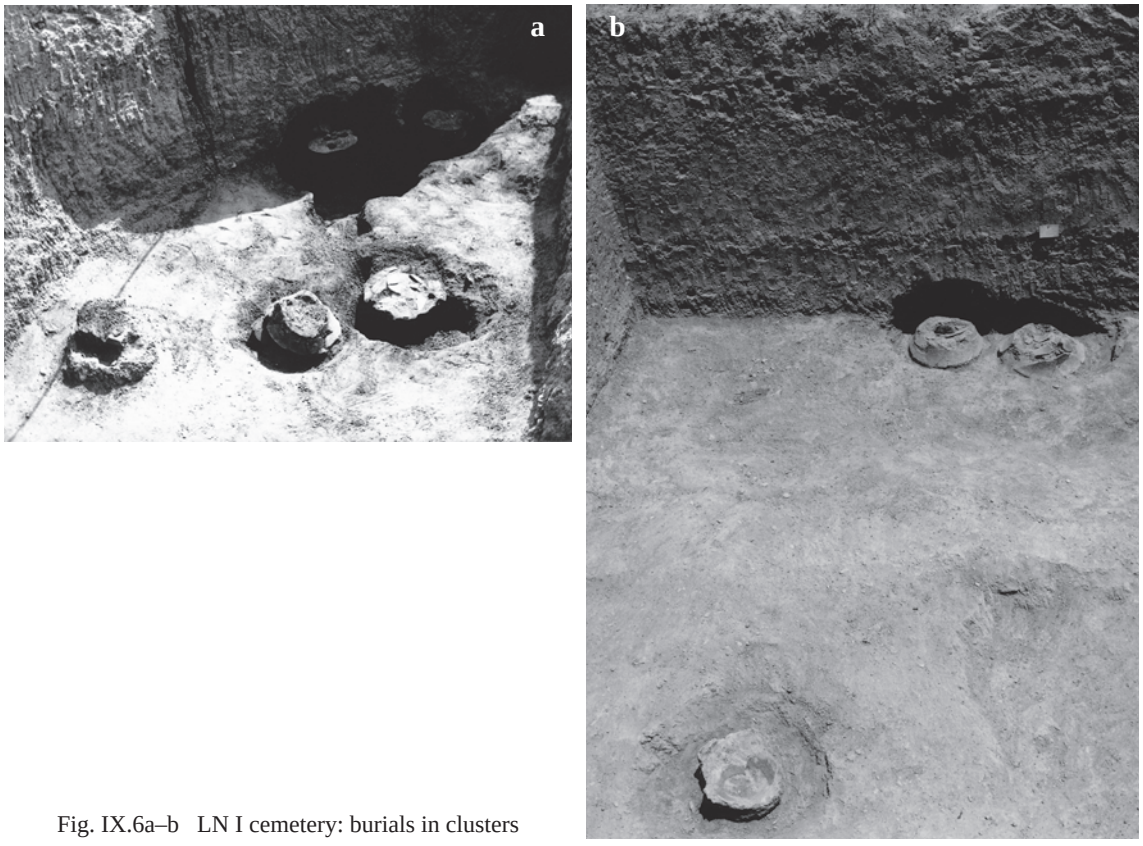


Fig. IX.6a–b LN I cemetery: burials in clusters

[1087] Fowler 2004, 58.
[1088] Cf. Triantaphyllou 1999, 131–132; see also Triantaphyllou 2008.
[1089] See Bloch 1971 for an ethnographic example.
[1090] Gallis 1982, 99–101.

## IX.3. The Wider Social Landscape

Situated at the northeastern edge of the Western Thessalian Plain and wedged between the Zarkos Mountains to the north and the Revenia Mountains to the east (Map 2; Fig. II.1.3a) PMZ seems rather isolated from the dense settlement networks in the Karditsa Basin to the south and the Larissa Basin to the east, in both of which dozens of Neolithic tells feature prominently. Only a handful of tells are currently known from the vicinity of PMZ, including Koutsaki Magoula 2.5km to the southeast, Farkadona c. 4km to the west and Peneiada 5km to the east. At present, with the exception of Petromagoula, lying 7km to the south, all other sites in the Western Thessalian Plain are found from 13km to over 20km to the south of PMZ, whereas in the Eastern Thessalian Plain to the east, Mandra at 13km is among the nearest sites.[1091] These are large distances, considering that elsewhere in Thessaly contemporary Neolithic settlements are often located only 2–3km apart. On the other hand, the location of PMZ in close proximity to the Peneios River and at a main connection point between western and eastern Thessaly (and between the regions north of Thessaly and the entire Thessalian plain) places the site in an ideal position for extensive networking and communication.

It is also essential to be aware of the unevenness of archaeological knowledge between western and eastern Thessaly: while eastern Thessaly has been the focus of attention since Tsountas' time, western Thessaly has been comparatively neglected until very recently, and therefore its archaeological record remains rather scanty, while extensive land reclamation in the 1970s caused the flattening of many of its tells.[1092]

### Settlement Patterns as Both a Unifying and Differentiating Factor

The Greek Neolithic settlements as a whole utilise a variety of locations, create different spatial and architectural patterns, exhibit multiple principles of organisation and reflect different connections with the physical and social landscape.[1093] Interestingly, the same variability is found across Thessaly alone, and much can be inferred about local and regional social relationships and organisation. Although mostly covered by the plain, Thessaly comprises a diverse physical landscape and a closed geographical unit with mountainous borders on three sides, direct access to the Aegean Sea in the east and several natural sub-divisions in between, including lower mountains, river valleys, coastal plains and lacustrine environments.

While few of the very large number of known sites have been excavated with a strategy that exposes their maximum area horizontally at a given time, in recent years big infrastructure projects have led to large-scale excavations and to possibilities of new intra-site spatial analyses,[1094] whereas remote sensing has brought to light considerable new information concerning the size, scale and complexity of sites in the landscape. The IGEAN project has systematically scanned about 16 tell sites in eastern Thessaly[1095] and, incorporating recent data from the local Ephorates of Antiquities, it has also updated the corpus of Neolithic tells in all of Thessaly to 342.[1096] A similar project, entitled 'Long Time, No See: Land Reclamation and the Cultural Record of the Central-Western Plain of Thessaly' (henceforth LTNS), is currently ongoing in western Thessaly, aiming specifically to digitally reconstruct the lost cultural landscape of the central Karditsa Plain.[1097] It has detected 891 previously unknown archaeological sites, of which 377 are mounds, as well as road networks, cemeteries (of classical antiquity) and fields. Many of the mounds were

[1091] Distances were calculated on the basis of the IGEAN map of sites: Sarris et al. 2017b.
[1092] See Krahtopoulou 2019a and Krahtopoulou et al. 2020 for previous and current research in western Thessaly.
[1093] See Souvatzi 2008, 161–175 for detailed discussion.
[1094] E.g. Toufexis 2017.
[1095] Sarris et al. 2017b.
[1096] See the project's website <https://igean.ims.forth.gr/> (last access 10 Feb. 2022); Sarris et al. 2017b.
[1097] Krahtopoulou 2019a; Krahtopoulou et al. 2020.

ascribed a Neolithic date and were interpreted as habitation sites. Although the explosion of these new data has not yet been fully analysed, the evidence is suggestive. The biggest change has been the revelation that i) flat sites, thus far considered typical of central Macedonia, also occur all over Thessaly, and ii) that enclosures were the norm for many tells as well as for flat settlements (see relevant section here).

Thus, although still predominant, the tell is no longer the only settlement type in Thessaly, as was believed until recently because previous research has always focused on the obtrusive tells. The well-known example of Middle Neolithic Sesklo combining a tell and a flat settlement component is no longer unique either. Makrychori also consists of a tell and a settlement spread below,[1098] as do Almyriotiki and Perdika 1[1099] and probably also Palioskala.[1100] Flat, inconspicuous settlements of an extended and shifting habitation pattern, characterised by numerous pits of varying size, shape, distribution and function and extensive open spaces in between include Galini, Amygdali, Omvria, and Kazanaki in eastern Thessaly,[1101] and Mavrachades-Tataria, Ag. Theodoros-Voulgarolakka and Myrini-Ayia Varvara in western Thessaly.[1102] Many of these sites are rather short-lived and they date exclusively to LN I, thus being contemporary with the last Neolithic phases of PMZ. They were located among the numerous contemporary tells. The co-occurrence of these two settlement types in the same region reflects differences in attachment to specific places and landscapes; in modes of land use; in notions of continuity and social memory; in modes of social integration; and in kinship patterns.[1103]

Many mounds seem to have been organised in habitation sectors defined by circuit walls, whereas the dwellings were often further separated by open spaces. In eastern Thessaly examples include Rizomylos 2 (EN–EBA), Almyros 2 (EN–MN), Almyriotiki (EN–LBA), Karatzadagli (LN) and Perdika 1 and 2 (EN–MN and MBA, and EN, respectively).[1104] In most cases, the central and uppermost part of the mounds was left largely empty. At Visviki Magoula an earlier more dispersed, and even shifting, habitation pattern to the east of the mound was followed by a more compact one concentrated on the central part of the mound, which was now internally organised by three concentric enclosures.[1105] Perdika 2 seems to have had a complex layout with at least three settlement cores, two spatially overlapping in part and one separate, all of which were surrounded by ditches.[1106]

There is also considerable inter-site diversity. For example, in western Thessaly, the excavated mounds of Sykeon, Orgozinos,[1107] Koutroulou and Imvrou Pigadi reflect variations in duration, internal organisation and probably also in economic specialisation. At Sykeon burnt mudbricks and postholes in the Middle Neolithic layers suggest more than one construction technique, whereas a v-shaped perimeter ditch seems to have encircled the tell during the Final Neolithic if not earlier.[1108] At Orgozinos the buildings were probably wattle-and-daub huts rather than overground rectangular structures and the site had a short life which lasted only during LN I.[1109] Judging from the chipped and ground stone industries and particularly the presence of specialised tool kits related to food, wood and hide processing, Orgozinos is interpreted as probably ‘a satellite agricultural

[1098] Toufexis 2017.
[1099] Sarris et al. 2015, 291–292.
[1100] Toufexis 2016.
[1101] Toufexis 2017.
[1102] Krahtopoulou 2019a.
[1103] See Souvatzi 2013a; Souvatzi 2017; Souvatzi 2020 for further discussion and interpretation of the two settlement types.
[1104] Sarris et al. 2015; Kalayci – Sarris 2016; Kalayci et al. 2017; Sarris et al. 2017b.
[1105] Alram-Stern et al. 2017, 145.
[1106] Kalayci et al. 2017.
[1107] Krahtopoulou (2019a, 77) has recently argued that Orgozinos may be a flat site rather than a tell.
[1108] Chatziaggelakis 2012a; Chatziaggelakis 2012b.
[1109] Nikolaou et al. 2008.

unit'.[1110] Middle Neolithic Koutroulou, on the other hand, is a large tell (c. 3.7ha and 6.6m high), typically characterised by a compacted layout and intense building activity on the same spot and showing evidence of investment in terracing, retaining walls and concentric ditches.[1111] Nevertheless, the surprisingly close clustering of AMS radiocarbon dates, even though they are far apart stratigraphically, makes the site a rather short-lived one within the time frame of the Neolithic.[1112] At Imvrou Pigadi (Middle Neolithic) remains of unusual thermal structures delineated by two thick clay walls were interpreted as pottery kilns, suggesting the presence of a specialised pottery workshop.[1113] A similar and contemporary workshop, attested by a complex of six closed ovens associated with large amounts of 'scraped' ware pottery and enclosed by a mudbrick wall, has recently been discovered at Middle Neolithic Magoula Rizava, located about 20km northwest of Magoula Imvrou Pigadi.[1114]

Two important implications from the new evidence concerning tells are i) the presence of considerable variation in intra-site organisation, and ii) the fact that temporally short and spatially shifting or more dispersed habitation is not exclusively associated with flat sites but can also apply to tells.

Regarding settlement size and density, the available data mostly account for tell-like sites. In eastern Thessaly Gallis has recorded 258 Neolithic tells,[1115] while in the IGEAN Neolithic site inventory the number rises to 288.[1116] The mean distance between neighbouring sites is less than 5km, with settlements often located only 2–3km apart.[1117] Tell size ranges from 2 to over 8m in height, and, where such data are available, from 60–300m in diameter, with an average of 150–200m.[1118] For western Thessaly the IGEAN inventory records only 55 tell-like sites, but this paucity may be due to the particular project's focus on eastern Thessaly. A study of prehistoric habitation patterns specifically in western Thessaly conducted by Ch. Papakosta reports 203 Neolithic sites,[1119] of which the vast majority again are tells. There is a clear concentration of sites in the Karditsa Plain and in the area between Pharsala and Domokos to the south, whereas in the Trikala Plain, i.e. in the local landscape of PMZ, the percentage of prehistoric sites of all periods reaches only 13%.[1120] The average tell heights are 3.4m and 7m[1121] and diameters range from 50–500m[1122] with an average of 200–300m. More recent research by the LTNS project further illustrates that site distribution in the Karditsa Plain, and particularly in the Kambos area, is much denser and more diverse than previously thought, although the habitation mounds seem to have a smaller diameter, i.e. from 30–90m.[1123] Interestingly, many of these mounds were found at the junction of radial road networks, such as the Neolithic site of Karnomagoula.[1124]

The temporal trends are equally interesting. According to Perlès,[1125] up to 75% of the Neolithic sites in eastern Thessaly were occupied already in the Early Neolithic and a high number of sites

[1110] Nikolaou et al. 2008, 391.
[1111] Hamilakis et al. 2017.
[1112] Hamilakis et al. 2017, 87.
[1113] Kyparissi-Apostolika 2012.
[1114] Krahtopoulou et al. 2018.
[1115] Gallis 1992.
[1116] Sarris et al. 2017b.
[1117] Halstead 1984; Gallis 1992; Perlès 2001, 121–151; Johnson – Perlès 2004.
[1118] Data calculated from the IGEAN database <https://igean.ims.forth.gr/> (last access 10 Feb. 2022): Sarris et al. 2017b.
[1119] Papakosta 2003, 68.
[1120] Papakosta 2003, 85.
[1121] Papakosta 2003, 81.
[1122] Sarris et al. 2017b.
[1123] Orengo et al. 2015, 307; see also, Krahtopoulou 2019a, 75–77.
[1124] Orengo et al. 2015, 307.
[1125] Perlès 2001, 131–134; see also, Johnson – Perlès 2004.

is also attested for western Thessaly,[1126] with some 120 sites recorded for the whole of Thessaly. The Middle Neolithic is a period of relative territorial expansion across both of the two major plains,[1127] with the single exception of the Trikala region, in which a considerable reduction in the number of sites takes place during this period: 8 earlier sites are abandoned and only 3 new ones founded.[1128] PMZ must have been one of those newly founded sites. In the Late Neolithic, inhabitation of previously uninhabited or sparsely inhabited areas continues and the number of sites increases slightly (although not everywhere),[1129] but around half of the earlier sites are abandoned permanently or temporarily. PMZ may be included in those since it was abandoned at an early stage of the Late Neolithic. Several, although certainly not all, of these new sites seem to be of the flat and rather short-lived type. One effect of this settlement abandonment/establishment pattern is that the number of settlements for each phase remained relatively stable. This, in turn, ensured balanced interaction, durability and sustainability right from the outset.[1130] In fact, in eastern Thessaly, analysis of the correspondence between abandonment of settlements and establishment of new ones as well as the regular spacing of sites implies widely accepted constraints on site size, number and territory.[1131] This long and stable settlement pattern broke in the Final Neolithic, when a dramatic reduction in the number of sites takes place throughout Thessaly and inter-site distances became much larger.[1132]

Based on the available data, the same kind of either homogeneity or variability in settlement types and patterns applies to both the Western and Eastern Thessalian Plains, and no considerable differences between them are observed. The old picture of a disproportionately small number of sites in western Thessaly is changing rapidly. Across Thessaly sites tend to show a general preference for lowland rather than upland regions. The temporal distribution of sites in the two plains largely belongs to the same diachronic pattern discussed above. Tell heights and diameters also seem to be largely analogous, although the smaller tell diameter in the Kambos area of western Thessaly implies smaller spatial extent or greater spatial restriction for the tells there. Three of the most important homogeneous elements in both plains are: i) the general preference for the creation of sedentary villages (though not always long-term); ii) the reliance of the subsistence economy on agriculture and animal husbandry; and iii) the shared concern for the creation of a structured sociocultural landscape, which included, among other things the construction of a variety of structural boundaries that marked out parts of the landscape by dividing the settlement from non-settlement space.

Variation in the degree of settlement density, continuity and abandonment can betray changes in territorial rights and land systems. Closely-spaced and continuous villages like PMZ may indeed have posed ‘a demanding subsistence challenge’,[1133] but this does not necessarily bring about divisions, competition, conflicts or even warfare, as is habitually assumed.[1134] Based on Thiessen polygons, Perlès reconstructs a typical (Early Neolithic) village territory as having 450ha of exploitable fields.[1135] The small calculated size of Thessalian tell territories (average radius is 1.25km), sufficient to feed a mixed-farming community of some 200 people, implies intensive land use for farming.[1136] However, territorial borders or units can differ considerably, depending on the social and temporal dimensions of different groups, the contemporaneity or discontempo-

[1126] Papakosta 2003, 138; Krahtopoulou 2019a, 76.
[1127] Johnson – Perlès 2004; Krahtopoulou 2019a, 76.
[1128] Papakosta 2003, 141.
[1129] Krahtopoulou (2019a, 76) reports a slight decrease in the number of sites in the Kambos area in the Late Neolithic.
[1130] Cf. Parkinson et al. 2018.
[1131] Johnson – Perlès 2004.
[1132] Halstead 1984, fig. 6.22; Papakosta 2003, 138–147; Johnson – Perlès 2004.
[1133] Isaakidou – Halstead 2018, 73.
[1134] E.g. Halstead 1989; Halstead 1999b; Runnels et al. 2009; Alušik 2017.
[1135] Perlès 2001, 137–139.
[1136] Bintliff in press.

raneity of sites and the local topographic particularities. At PMZ, for instance, the local hydrology may suggest a cyclical pattern of the extent of land availability.[1137] Across Thessaly villages are situated in fertile plains on alluvial deposits, thus having an unlimited amount of arable land at their disposal, and form a dense and homogeneous network, spreading in all directions. As Tomáš Alušik points out,[1138] in flat regions, such as Thessaly, territorial borders do not need to be clearly visible or set, but their disruption or crossing can be easily recognisable. Settlement mobility, discontinuity and fragmentation are all present in Neolithic Thessaly, in parallel to the wider social balance and stability, and say much about the nature and duration of territoriality. They imply regular migration and even conscious relocation of whole villages.

## IX.4. Conclusions

Integrated evidence from geology, geophysics, the environment, the architecture and settlement patterns, as well as from plants, animals and material culture suggests that PMZ was a complex and dynamic site that interacted intensely and diversely with its physical and social landscape, ranging from mountains to rivers, and from neighbouring sites to sites and places further away and in both the Western and the Eastern Thessalian Plains.

The formational complexity of PMZ's physical landscape, in conjunction with the settlement's long history, permanence and subsistence strategies, attests to a dynamic human-environment interaction that calls for greater awareness of human perception, agency, knowledge and sensory experience. Examination of the long-term configuration of the human-natural landscape at PMZ with an awareness of the spatio-temporal scales and dynamics of human ecology indicates that the people of PMZ had observed and developed an appreciation of local topographic particularities. They would probably have formed a seasonal worldview and perhaps a cyclical rather than strictly linear perception of time and history, at least a sense of repetitiveness and periodicity.

PMZ is also an inseparable part of the rich and diverse social landscape of Thessaly, in which the settlement pattern contributed to social stability and the maintenance of a well-organised social network throughout the Neolithic. Despite its rather remote location, the site participated actively in shared local, regional and longer-distance networks of communication and in shared habitation traditions and systems of signification. This serves to emphasise the fact that geographical or spatial distance is not synonymous with social isolation, nor is it the major factor in the formation of social relationships and networks.

With a height of 6–7m above its surroundings, a diameter of 200m, a total area of 30,000m² (although it is possible that the whole area was not occupied simultaneously) and Neolithic deposits almost 6m thick, PMZ forms an impressive landmark in the local, and probably also in the regional, sociocultural landscape. In this sense, the settlement as a whole served as a material manifestation of the community's history and identity. Overall, PMZ could be seen as a socially stable place in what in reality was a physical and social landscape in flux, characterised by variability and changes in how social groups defined themselves and how they might have been connected with land and place.

[1137] Cf. Bailey et al. 1998, 392.
[1138] Alušik 2017, 193–194.

# X. Platia Magoula Zarkou in Context: Summary and Conclusions

*Eva Alram-Stern – Giorgos Toufexis*

## X.1. The Area around the Tell

### X.1.1. The Geographical Setting and the Environment of the Tell

Platia Magoula Zarkou constitutes an impressive tell rising about 6.7m above the surrounding plain. As the name says, the shape of the tell is characterised by its flat surface of approximately 18,000m² at its base. Its steep sides show a step probably indicating the start of the Early Bronze Age settlement sequence after a hiatus which followed the early Late Neolithic period.

Platia Magoula Zarkou is located on the western fringes of western Thessaly in the Peneiada Valley which is situated between the two reaches that cross the wide Karditsa and Larissa plains. In this area, the Peneios River flows along a narrow alluvial plain, ranging from 0.5 to 3km in width and bordered by the rocky mountain slopes of the Zarkou Mountains, a prolongation of the Antichasia Mountains to the south and Mount Titanos, which during Neolithic times was covered by dense vegetation.[1139] The average slope of the alluvial plain is extremely low, and the Peneiada Valley is characterised by numerous, either active or abandoned meanders.[1140]

Due to river incision, during the Neolithic period the Peneiada Valley transformed from lacustrine-marshy conditions to the permanently established eastward water drainage, so that for a part of the year the Peneiada Valley was dry, while at least during the winter and early spring months, it was a marshy lake. Thus, PMZ was established on an active floodplain with frequent flooding of the surroundings, i.e. in a coastal setting of a temporary lake. In an area sloping from northwest to southeast, PMZ itself is located at the toe of the widest ejection cone formed along the northern flank of the Peneiada Valley, thus quite safe from flooding.[1141]

Furthermore, geophysical analyses proved that two flows of water in two gullies led from the northern mountain range into the plain, circumnavigating the magoula.[1142] In the initial phase of settlement of PMZ, the occupation was confined to the west bank of the gully and continued in spite of flooding episodes.[1143] However, in the course of the occupation and growing of the tell, these gullies were filled in.[1144] Although PMZ was generally quite safe, in the case of exceptional events like flash floods emanating from the northern mountain range, the destructive power of these natural phenomena could have been locally catastrophic and could have potentially forced the Neolithic community to move away from the site.[1145] However, such a scenario is not proven

[1139] Halstead 1984, 2, 7.
[1140] Caputo et al., this volume, 47–48.
[1141] Caputo et al., this volume, 75, 77–78; Sarris et al., this volume, Fig. II.2.13.
[1142] Sarris et al., this volume, 75; one of the gullies has already been recognised by van Andel et al. 1995, fig. 10.
[1143] Toufexis – Batzelas, this volume, 137.
[1144] Sarris et al., this volume, 78.
[1145] Caputo et al., this volume, 48.

by archaeological evidence, at least not to a sufficient extent to be registered in the archaeological findings of the site.[1146]

### X.1.2. The Constructed Area around the Tell

*The Cemetery*

PMZ is one of the few Neolithic settlements with a cemetery in its neighbourhood. It is a cremation cemetery, located about 300m north of the magoula. Excavations in 1974 and 1976 produced 67 cremation urns of individuals placed singly and dating to the beginning of the Late Neolithic period,[1147] according to the pottery, at that time synchronous with the tell settlement. Furthermore, the tell and the cemetery are connected by two figurines of the same type. Although the pottery points to synchronisms with Building Phase (BPh) VIII, i.e. LN I, one of the figurines from the cemetery is similar to the figurines in the house model,[1148] which was found in an earlier level, Building Subphase (BSPh) VIIa, and is dated to the transition from MN III to LN I.[1149] Therefore, if the figurine is not a heirloom, it could point to a longer use of the cemetery than previously estimated.

Like the tell, this burial ground was most likely located on an elevated geological formation at the border of the flooding zone.[1150] Furthermore, geophysical investigations showed round anomalies of 1–1.5m diameter or even larger about 60m southeast of the excavated cemetery.[1151] Unfortunately, it cannot be proven that these remains belong to the cemetery and point to an extension of the cemetery to the south. However, if these remains are attached to the burial ground this would mean that the number of graves was considerably larger than previously thought.

*The Enclosures of the Tell Settlement*

According to the geophysical prospection, a number of curvilinear structures on the west, south and east sides of the tell followed the contour of the magoula and may represent concentric ditches surrounding the tell and dating to the Neolithic period.[1152] According to the survey in the fields around the magoula, we do not expect any Neolithic habitation outside these ditches, and building activity in the zones below the magoula, mainly located north, northwest and south, probably dates to the Bronze Age period.

Another ditch was excavated in Trench A during the last year of the excavations.[1153] The structure is situated in the northern centre and in the lowermost layer of the tell, so that it must belong to the earliest settlement phase of the site, BPh I, with a calibrated absolute date of 5969–5754 calBC (2σ)/5889–5805 calBC (1σ). It is probably related to one of the geophysically detected ditches, and in that case encircled the eastern part of the site. In that case, the first settlement may have been slightly dislocated to the east, and perhaps more dispersed in comparison to the more compact habitation of the later settlement phases.[1154]

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1146 Toufexis – Batzelas, this volume, 137.
1147 Gallis 1982; for a comparative analysis see Fowler 2004, 54–58.
1148 Gallis 2001. Otherwise, this figurine could also represent an older object in the case of an heirloom. Alram-Stern, this volume, 538, Fig. VI.31.
1149 Cf. Alram-Stern, this volume, 468–470.
1150 Sarris et al., this volume, 72–75 in accordance with conclusions drawn by Caputo et al., this volume, 48; see also van Andel et al. 1995, 138–140.
1151 Sarris et al., this volume,72–75, Figs. II.2.10–11.
1152 Sarris et al., this volume, 79-80, Fig. II.2.12, Fig. II.2.13. Souvatzi, this volume, 593–594.
1153 For the stratigraphy of Trench A see below, 611.
1154 Souvatzi, this volume, 593–594.

The ditches may have fulfilled several functions, among other things acting as counter measures against flooding episodes, including drainage and irrigation,[1155] but also as demarcation boundaries of the site. These large-scale constructions also had a social and a symbolic character as markers of collective identity.[1156]

## X.2. Stratigraphy and Architecture

### X.2.1. The Excavations of Platia Magoula Zarkou: Premises and Procedure

When the Late Neolithic cremation cemetery of PMZ was excavated, it produced pottery types which belonged to the start of the Late Neolithic period (Tsangli phase) as well as pottery, which had originally been considered to belong to the end of the Late Neolithic sequence, i.e. to a phase which Milojčić had called the 'Larissa phase'.[1157] Therefore, in 1976 a stratigraphic excavation on the nearby tell of PMZ was planned to clarify the correct chronological position of the 'Larissa Culture'.[1158]

In consequence, a trench (A) of a comparatively small size of 5 × 8m was laid out on the highest point of the tell and was excavated to the virgin soil, step by step becoming as narrow as 2 × 2m at its deepest point. The trench showed that the tell consists of c. 10.00m human deposits, 5.8m of which are assigned to the Middle and early Late Neolithic (Tsangli) periods, the remainder to the Early and Middle Bronze Age. For the so-called Larissa pottery, it was proven that the pottery actually belonged to the Tsangli phase; in consequence, this first phase of the Late Neolithic in Thessaly was called the 'Tsangli-Larissa' phase.

### X.2.2. The Stratigraphic and Architectural Sequence

While the preliminary publications concentrated on the pottery,[1159] this final publication presents the stratigraphic sequence as the backbone for a better understanding of the site, as well as the change seen in the archaeological finds over time. Therefore, the development of pottery wares and shapes in particular, but also of all other find categories is fixed in this new framework. The excavation units and structural remains were restudied and attributed to 185 stratigraphic units (SU). Based on floors and/or activity surfaces referred to as 'surfaces' and destruction layers, as well as changes in the use of space and in the architectural features, nine building phases (BPh I–IX) are discerned, some of which, with two to five subphases (BSPh), correspond to Ceramic Horizons 1–6. The stratigraphic sequence shows no signs of interruptions throughout the thick Neolithic deposits, i.e., no gap in the settlement's occupation was observed.

To the earliest BPh I was attributed a part of a shallow ditch dug into the alluvial ground, whilst ditches were not encountered in other phases. According to the geophysical studies this ditch was possibly the eastern limit of the earliest settlement. According to pottery and radiocarbon data, this building phase did not start as early as the Early Neolithic[1160] but in an early phase of the Middle Neolithic period, i.e. MN I.[1161]

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[1155] For a discussion of the role of the ditches especially in Thessaly but also elsewhere in Greece and Balkans see Chondrogianni-Metoki 2009, 526–537; Toufexis 2017, 323–327; Pappa 2020, 267–269; for the role of such enclosures see also Souvatzi, this volume, 594–596.

[1156] Souvatzi, this volume, 596.

[1157] Milojčić 1960, 19; Hauptmann 1981, 99–110.

[1158] Gallis 1985a; Gallis 1987.

[1159] Demoule et al. 1988; Schneider et al. 1991.

[1160] In his first reports, Gallis has dated the earliest phase of PMZ to the end of the Early Neolithic period or at least into the transition from Early to Middle Neolithic: Gallis 1996, 523.

[1161] For radiocarbon chronology see below as well as Weninger, this volume, 183–195; for pottery see Pentedeka in press.

Above BPh II, in which there was no architectural evidence, a sequence of three building subphases was identified (BSPh IIIa–c) showing wall remains. BSPh IIIa produced a wall built with posts and abundant clay, probably in a combined *pisé* and timber technique; BSPh IIIb is defined by a sequence of layers originating mainly from fire and refuse dumping; and BSPh IIIc showed a posthole and a probable clay wall. BPh IV comprises remains of two superimposed houses. For BSPh IVa the northern wall of a house, built of mud/mudbrick on a single layer of field stones, and its interior with an oven, a pebbled working surface and a quern found in situ were revealed. Exactly above this wall, another wall of similar construction was erected (BSPh IVb), so that the two houses shared their orientation and alignment.

In contrast, BPh V consisted of five BSPh (Va–e) in which the excavated area has been considered as corresponding to open or semi-open spaces between houses. During all these subphases, the domestic spaces were equipped with thermal structures, i.e. fire pits, hearths and ovens, one of which was accompanied by a clay platform.

During BPh VI (BSPh VIa–b), the excavated area again corresponded to a roofed space, enclosed by thin walls defining areas in a kind of an auxiliary annex to a house used for cooking and storage.

From BPh VII onwards, a large part of the excavated area was destroyed by an Early Bronze Age pit. For BPh VII three building subphases were discerned (BSPh VIIa–c) on the basis of three corresponding 'surfaces'. The eastern part of the trench seemingly corresponded throughout the subphases to a roofed space, while the western part represented an open space. During BSPh VIIa, a thermal structure, a pit and two postholes were found. When the thermal structure ceased to be used and the pit was filled, another thermal structure was built above the pit and a storage vessel was placed very close to it. A potential thermal structure also existed in the opposite southern corner of the trench. The well-known house model was found in the uppermost part of the destruction layer of a house in BSPh VIIa and was associated with this subphase. Furthermore, its proximity to these thermal structures may highlight their symbolic significance in daily life. BSPh VIIb also produced a hearth, found a little bit higher than the house model but still close to it, and two postholes. To BSPh VIIc were assigned two shallow pits and a part of a post-built wall. All in all, this building phase was the richest with regard to small finds, and their relation to the built space will be discussed below.

BPh VIII was connected to very flimsy building remains, and only one thermal structure and two adjacent pits also cutting the 'surface' of the previous BSPh VIIc were encountered. The presence of these pits as well as the lack of architecture is evidence that this area was unroofed. The last BPh IX consisted of only one 'surface', but the overlying deposits contained mixed LN I and Early Bronze Age material and the Early Bronze Age deposits followed without the intervention of any sterile layer.

### X.2.3. Built and Open Space, Construction Techniques and Levelling Activities

For the ditch found in BPh I, it is not certain whether it constituted the external boundary of the initial settlement or divided its domestic space, nor could its contemporaneity to the other Neolithic ditches detected by the geophysical inspection be ascertained. Ditches and enclosures in general have had a significant role in the organisation of the domestic space in tells and flat sites in Thessaly and also elsewhere. Among their several functions, drainage and protecting the settlement from flooding were of primary importance, particularly in settlements located in floodplains, like PMZ.

Regarding the domestic space and the building methods used in PMZ, we were able to observe tendencies of variability and differentiation as well as stability and continuity, bearing in mind, though, that the excavated area was very small and the picture that thus emerged should not be extrapolated for the wider settlement. According to the existing evidence, the domestic space

was characterised throughout the building phases by an alternation of built and open/semi-open areas which were best exemplified in BPh III, IV and VI. In BSPh IIIb a seemingly open-air area in which open fires were repeatedly set, succeeded an area occupied by a house in the previous BSPh IIIa. Similarly, the house in BSPh IVa was erected in an area which showed little evidence of building in BSPh IIIc, while in BPh V open yards or semi-open-air areas were found above the houses of BPh IV. In BPh VI the use of space changed again and the excavated area was covered by buildings, as also happened in BPh VII. In BPh VIII the largely homogeneous deposits where no architecture was found except one thermal structure, succeeded the burnt buildings of BPh VII and probably marked broader changes in the organisation of the domestic space. On the other hand, the vertical building of houses in BPh IV (MN II) and VI (MN III), an otherwise common characteristic in tells, and the longevity of similar activities in the same area, whether open yards, roofed spaces or thermal structures, signified decisions for continuation and stability in the organisation of the domestic space.

The rectilinear lines of the walls indicate that houses were rectangular in plan but no house plans could be retrieved. However, in BPh VI (MN III) small auxiliary buildings associated with and/or annexed to houses were suggested. BPh VI and VII (MN III–LN I) were distinctive in that their buildings were burnt, while the houses of the previous phases were not. The known clay house model was found in BSPh VIIa and had been meticulously deposited in the burnt rubble of a house. Apart from other connotations, it might be related to abandonment rites referring to the end of the life cycle of the house as its specific analysis in this volume showed.

In a wider perspective, PMZ, like other Thessalian tells, is not characterised by the austere organisation of the domestic space and uniformity of the house plans encountered in the tells of Anatolia and the Balkans.

Thermal structures (hearths, ovens and fire pits) were found inside houses, potential auxiliary buildings and in open/semi-open areas or yards. If the latter did not constitute the private yards of individual houses, these thermal structures might have been used by several households, strengthening the esteem of social cohesion and communality among them. BPh V, where yards have been identified throughout all its subphases, yielded the majority of thermal structures sometimes grouped in small clusters of two, indicating functional complementarity to one another. The vertical building of several structures, their allocation in adjacent areas and the successive renewals of their floors imply an effort towards continuity in the use of the domestic space, as mentioned above.

When it comes to the building methods, variability and continuity was also attested, as for other MN tells in Thessaly. The most obvious changes were encountered in MN I, in which the houses in BSPh IIIa were probably built with a combined *pisé* and timber technique, whereas in BPh IV they were built with the 'stone and mud/mudbrick' technique. In MN II (BPh V) the few postholes found were probably associated with light wooden structures that existed in yards or semi-open areas, whereas in MN III (BPh VI) the wattle and daub technique was probably implemented for the construction of thin walls of potential small auxiliary buildings associated with and/or annexed to houses. The existing evidence shows that post-built houses also existed in the transitional phase between MN III and LN I as well as in LN I, namely in BSPh VIIa and VIIc, respectively.

With the exception of the MN I building phase, presenting a gentle inclination, the noticeably horizontal lay of the deposits throughout the building phases of MN II–LN I phases and the generally thin layers intervening between the successive indoor or outdoor floors indicate that levelling activities took place widely and systematically in the settlement due to the restricted habitation area of the tell. This might also account for the restricted concentrations of burnt pieces of clay found in buildings destroyed by fire as these were removed or spread around houses through levelling activities in order to provide space for new buildings or yards.

## X.3. Relative and Absolute Chronology

### X.3.1. Radiocarbon Dating and Relative Chronology

In the course of the PMZ project, twenty-one samples were taken and analysed at the REM laboratory in Mannheim.[1162] The aim of this sampling was to cover the sequence of all building phases, for their synchronisation with other parts of Thessaly in terms of absolute chronology. As a result, only eighteen samples were obtained, three samples, however, had too little collagen to be used. Of the remaining eighteen samples, five were taken from Early Bronze Age layers. Of the other thirteen samples, three from upper Neolithic strata are outliers, belonging to the Early Bronze Age and pointing to Early Bronze Age intrusions from the Neolithic levels of BSPh VIb onwards. In consequence, ten short-lived samples taken from animal bones are relevant for the Neolithic sequence, and the radiocarbon sequence for the last Neolithic layers is not complete, although the samples constitute a well-established sequence of data. For a sequencing of the ten new, short-lived data, Weninger used Gaussian Monte Carlo Wiggle Matching, which puts the data into a linear sequence through probability calculation and by following the stratigraphy.[1163] Previously, four samples of charcoal were analysed during the geological investigations by van Andel and re-evaluated by Reingruber et al.;[1164] these samples will be considered below.

Since the absolute chronology is always connected to a relative chronology, which is traditionally defined by the ceramic sequence, we have to consider our data in context with the pottery of PMZ. As Demoule has already pointed out,[1165] the sequence of PMZ also makes us rethink the relative chronology mainly based on the excavations in eastern Thessaly by Milojčić.[1166] In general, in Thessaly the Middle Neolithic period is defined by the occurrence of red pattern painted ware and 'scraped ware'[1167] as well as impressed wares,[1168] which already start during the Early Neolithic period and continue during the Middle Neolithic period.[1169] However, in contrast to eastern Thessaly, in western Thessaly a gradual development of monochrome and patterned grey on grey ware, starting as 'protogrey ware' already plays a decisive role during the Middle Neolithic period.[1170] With the start of the LN I phases, black and brown burnished wares[1171] as well as matt-painted, black on red and polychrome wares appear.[1172]

Within the framework of the PMZ publication project, Pentedeka has sequenced the stratigraphic 'building phases' into six Ceramic Horizons, based on these characteristic wares in their percentages within the contexts.[1173] Ceramic Horizon 1, which includes BPh I–IV, is characterised by red painted wares, including the so-called scraped ware.[1174] During Ceramic Horizon 2, including

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1162 REM – Klaus-Tschira-Archäometrie-Zentrum der Universität Heidelberg.
1163 See Weninger, this volume, Fig. IV.6.
1164 Van Andel et al. 1995, 137; Reingruber et al. 2017, 44.
1165 Demoule et al. 1988.
1166 Otzaki: Hauptmann 1981; Mottier 1981, 57–59; Arapi: Hauptmann – Milojčić 1969; Sesklo: Kotsakis 2006, 207–220.
1167 Demoule et al. 1988, 9–16; Otzaki: Mottier 1981, 28–36.
1168 Demoule et al. 1988, 41; Otzaki: Mottier 1981, 20–27.
1169 Milojčić – Milojčić-von Zumbusch 1971, 73–80.
1170 Demoule et al. 1988, 17–23.
1171 With the help of the stratigraphy of PMZ, Gallis was able to attribute the black burnished 'Larissa' ware to the start of the Late Neolithic period: Gallis 1985b; Gallis 1987.
1172 Demoule et al. 1988, 23–40; Arapi Magoula: Hauptmann – Milojčić 1969, 19–35.
1173 Pentedeka et al. 2019; Pentedeka in press. The results will be presented to the public in a separate volume of the PMZ publication series: Pentedeka in preparation.
1174 Renamed by Pentedeka as 'painted ware with blurred outline': Pentedeka et al. 2019; Pentedeka in press; Pentedeka in preparation.

BSPh Va–c, white-on-red painted wares appear. 'Protogrey wares' in various versions,[1175] already appear at the start of the Middle Neolithic sequence of PMZ, but they become more abundant from Ceramic Horizon 3 onwards, i.e. BSPh Vd–e. During Ceramic Horizon 4, i.e. BPh VI, of the red painted wares, the so-called scraped ware and flame patterned wares are still present, but this phase also shows for the first time very low numbers of those wares which are characteristic for the Late Neolithic period, i.e. black burnished ware and early versions of black on red and polychrome wares. During Ceramic Horizon 5, i.e. BSPh VIIa, interpreted as transitional MN III/LN I horizon, grey ware becomes of higher importance, and the Late Neolithic Ceramic Horizon 6, i.e. BSPh VIIb–c, BPh VIII and IX, includes all wares which we traditionally identify as early Late Neolithic ('Tsangli') phase pottery, including grey ware as well as matt-painted and bichrome wares.

In the course of the first study of the pottery, Gallis defined a separate chronological phase based on the appearance of the 'protogrey ware' from a depth of 8–5.60/5.15m, and called this period the 'Zarko Phase', to be characteristic for western Thessaly.[1176] However, the quantitative analysis of this project has shown the gradual appearance of the 'protogrey ware', and its abundance already during Ceramic Horizon 3 and subsequently during Ceramic Horizon 4. Therefore, the term 'Zarko Phase' would be appropriate for the layers of Ceramic Horizons 3 and 4, which are still of true Middle Neolithic character.[1177]

For absolute chronology, Reingruber has defined the start of the Middle Neolithic period with the appearance of red pattern painted pottery as well as a number of new pottery shapes in Greece in about 6000 BC.[1178] At PMZ the very first Ceramic Horizon 1 already includes all red pattern painted wares characteristic for the Middle Neolithic period as well as some impressed ware. The first date from the ditch, 5969–5754 calBC (2σ)/5889–5805 calBC (1σ) or, if we accept wiggle matching, even as early as 5896 ± 14 calBC, speaks in favour of this chronological classification, too. For Ceramic Horizon 1, this first date from the ditch is followed by a date of 5895–5742 calBC (2σ)/5876–5781 calBC (1σ) from the layer above the ditch, i.e. a little younger than the ditch. BSPh IIIb (5895–5742 calBC [2σ]; 5876–5782 calBC [1σ]) and (5867–5714 calBC [2σ]; 5799–5729 calBC [1σ]), wiggle matched 5825 ± 8 calBC and 5815± 8 calBC, respectively, also belong to the same ceramic horizon. When not wiggle-matched, the latter date is astonishingly young, also if we compare it to the following two dates, and we should not ignore the possibility that it comes from a higher level.

These dates synchronize nicely with the charcoal samples from the same layers of PMZ, dating between 5840 BC and 5790 BC (oxcal median) used by Reingruber et al. for their definition of the Middle Neolithic sequence in Thessaly and provided to us for this chapter:[1179]

"Four dates were obtained on charcoal, all samples deriving from contexts assigned to phase III.[1180] Calibrated, they cover in the 1-sigma range a time span between 5900 and 5740 calBC – according to the median values, their best estimates are between 5840 and 5790 calBC. The upper limit is to be regarded as a terminus post quem, as there are no determinations of the wood species available. However, since the data on charcoal are in good agreement with the new data on bone, the old-wood effect may be negligible."

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[1175] The so-called 'protogrey ware' combines forms and designs which are mainly known from the pottery with red decoration and blurred outline, with the newly developed technologies resulting in a grey clay body and a grey surface, see Demoule et al. 1988, 17–19.

[1176] Demoule et al. 1988, 50; Gallis 1996, 525.

[1177] Pentedeka et al. 2019; Pentedeka in press; Pentedeka in preparation.

[1178] Reingruber 2008, 214–216.

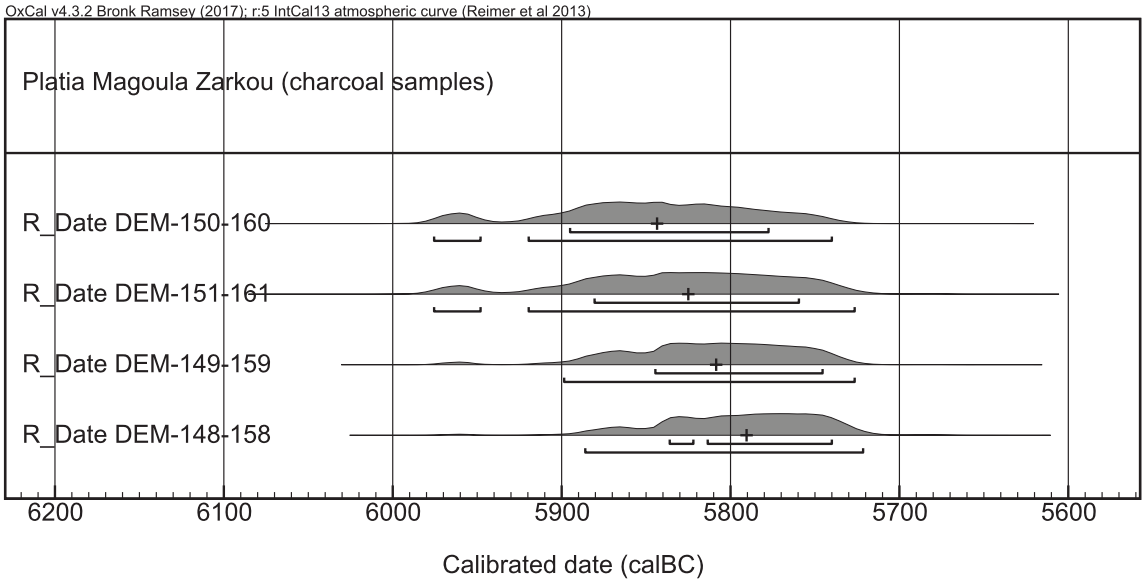
[1179] We are grateful to Agathe Reingruber to provide us with this personal communication (19/10/2019, after Reingruber et al. 2017, 44, fig. 13).

[1180] Gallis 1995, 214; Gallis 1996, 540, fig. 3.

Tab. X.1 Radiocarbon data on charcoal obtained from drilling by T. van Andel in the year 1990 in the oldest settlement phases of PMZ (after Gallis 1995)

| Lab. No. | BP | +/- | calBC 1σ | calBC 1σ | calBC 2σ | calBC 2σ | Oxcal median | Depth [cm] | Prov. Trench A | BPh | Material |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DEM-150-160 | 6963 | 43 | 5900 | 5770 | 5980 | 5740 | 5840 | 866 | BF27 | III | Charcoal |
| DEM-151-161 | 6945 | 51 | 5890 | 5760 | 5980 | 5720 | 5830 | 897 | BF28 | III | Charcoal |
| DEM-149-159 | 6932 | 39 | 5850 | 5740 | 5900 | 5720 | 5810 | 850 | BF27 | III | Charcoal |
| DEM-148-158 | 6912 | 40 | 5840 | 5740 | 5890 | 5720 | 5790 | 852 | BF27 | III | Charcoal |

Tab. X.2 Radiocarbon data on charcoal from the oldest settlement phases of PMZ, calibrated IntCal13 (after Reingruber et al. 2017, 44, fig. 13)




The youngest phase of this ceramic horizon is BSPh IVb (2σ: 5887–5740 calBC; 1σ: 5844–5759 calBC), wiggle matched 5759 ± 4 calBC. Therefore, Ceramic Horizon 1, and in consequence BPh I–IV, belong to the time from 5900 (5969–5754 calBC [2σ]/5889–5805 calBC [1σ] at the earliest until 5760 (5887–5740 calBC [2σ]/5844–5759 calBC [1σ]) at the latest. By comparing these data with the newly interpreted data from Achilleion IVa, these two phases should be synchronised and fit into the phase which has been called MN I. Furthermore, data from the Theopetra Cave, the Cyclops Cave, Koutroulou Magoula, Sykeon, Imvrou Pigadi and Lake Plastiras fit to the same horizon.[1181] However, for Achilleion a re-study of stratigraphy may produce a totally different picture of pottery types, and for the other sites, pottery is still unpublished.

For the following MN II, PMZ offers a more subtle chronology, since Pentedeka was able to distinguish two ceramic horizons (2 and 3). BSPh Va (Ceramic Horizon 2) has produced a single date of 5895–5732 calBC (2σ)/5845–5751 calBC (1σ), wiggle matched 5742 ± 4 calBC. This date for BSPh Va suspiciously coincides with the date of BSPh IVb, whilst there is a big difference

[1181] Reingruber et al. 2017, 42–45, fig. 10.

from the date of BSPh Vd (2σ: 5804–5667 calBC; 1σ: 5767–5709 calBC). However, when dealing with bone, we should consider the possibility that it might have been dislocated. For Ceramic Horizon 3 (including BSPh Vd and Ve) the date of BSPh Vd, 5804–5667 calBC (2σ)/5767–5709 calBC (1σ) is significantly younger than the previous one. However, if the date of BSPh Va is dislocated, the subsequent date of BSPh Vd 5733 ± 34 calBC would fit well with the sequence. Comparing the data of PMZ with data from Sesklo, Theopetra, Ag. Petros and Achilleion IVb, they start during the same period of time, as Reingruber et al. have suggested.[1182] In consequence, according to the PalCal calibration and Monte Carlo wiggle matching, MN II (Ceramic Horizon 2 and 3) dates between 5742 (± 4 calBC wiggle matched) and 5690 the latest (5733 ± 34 calBC). Processed by oxcal, BSPh Va–d dates (Ceramic Horizon 2 and 3) fall into 5730–5660 (2σ)/5770–5700 (1σ) calBC. Allowing for another 20–40 years for BSPh Ve, for which no date is available, the time span of the MN II phase in PMZ fits well with the estimation by Reingruber et al. (5750–5600 calBC),[1183] but according to our date it could also end earlier.

According to the pottery, Ceramic Horizon 4, including BPh VI, belongs to the MN III phase, and a sample from BSPh VIb is dated to 5837–5681 calBC (2σ)/5773–5720 calBC (1σ), wiggle matched 5657 ± 1 calBC. In relation to BSPh Vd this date is too high, and at least 50 years higher than proposed by Reingruber et al. For Ceramic Horizon 5 (BSPh VIIa), which, according to the pottery, should be the transitional Middle Neolithic/LN I phase of PMZ, no radiocarbon date is available. The date of the following BSPh VIIb, to be discussed below, is unexpectedly high, and we cannot exclude that is erroneous and that the MN III phase lasted longer than our sequence of radiocarbon data would suggest. So, the transitional BSPh VIIa may be closer to the start of LN I, as proposed by Reingruber et al. at about 5500 BC.[1184] This effect is also accentuated by the wiggle-matching as proposed by Weninger et al.[1185]

Ceramic Horizon 6 (BSPh VIIb–c, BPh VIII, IX) shows all characteristics of LN I ('Tsangli-Larissa phase') pottery. However, the earliest Late Neolithic BSPh VIIb of 5629–5531 calBC (2σ)/5620–5560 calBC (1σ), wiggle matched 5619 ± 2, has a comparatively high date and fits more into the time span of MN III in Reingruber et al. (5600–5500 calBC). When we look at the length of the curve, it could, however, be closer to the end date of our sequence from BSPh VIIc. In any case, with the date of BSPh VIIc of 5545–5472 calBC (2σ)/5513–5478 calBC (1σ) (probably the wiggle matching result of 5601 ± 4 is too high), we have a date which already fits to the start of LN I as defined by Reingruber et al. 2017. In consequence, we would suggest that LN I actually starts in 5520/5550 calBC, i.e. before 5500 BC, in contrast to what is suggested by the data from Makrychori, Theopetra and Prodromos-Ag. Ioannis.[1186]

Unfortunately, no significant data were taken for BPh VIII, which represents the last well-established early Late Neolithic building phase of PMZ, as this phase is already highly eroded, and Building Phase IX has no architectural remains at all.

The radiocarbon sampling of the site produced three outliers dating to the EH II, one from BSPh VIb (MAMS-32122: 2546–2351 calBC [1σ] on a seed), one from BSPh VIIa (MAMS-32121: 2487–2350 calBC [1σ]), and one from BPh VIII (MAMS-32118: 2448–2234 calBC [1σ]). Therefore, we have to argue that from BSPh VIb onwards Early Bronze Age disturbances occurred at the site. This picture is confirmed by the occurrence of a spindle whorl of Bronze Age type in BPh VIII (PM0348).

Since no Neolithic pottery dating later than LN I was uncovered in the entire site of PMZ, and the earliest pottery of the following phase comes from EH II, we argue that the interruption of strata between LN I and EH II, as documented in trench A, derives from a settlement hiatus.

[1182] Reingruber et al. 2017, 42–46, fig. 15.
[1183] Reingruber et al. 2017, 50.
[1184] Reingruber et al. 2017, 45.
[1185] Weninger et al., this volume, 194–195.
[1186] Reingruber et al. 2017, 45–46, fig. 15.

Tab. X.3 Chronological sequence of PMZ according to the radiocarbon data, stratigraphy and periodization of pottery, tools, figurines and ornaments (E. Alram-Stern, G. Toufexis)

| Thessaly, Neolithic periods (Reingruber et al. 2017) | Thessaly, absolute chronology calBC 1σ (Reingruber et al. 2017) | PMZ data, calBC 1σ (Reingruber et al. 2017) | PMZ MAMS data [calBC 2σ] | PMZ MAMS data [calBC 1σ] | PMZ Best Fit [calBC] 95% GaussWM | PMZ BPh/ BSPh | PMZ Ceramic Horizon | PMZ Lithic Phase | PMZ Figurine Horizon | Textile tools, tools of clay/sherd tools, chipped stone, ornaments |
|---|---|---|---|---|---|---|---|---|---|---|
| MN I | 5980 | | MAMS-32133 5969–5754 | MAMS-32133 5889–5805 | 5896 ± 14 | BPh I | 1 | 1 | | |
| | | | MAMS-32131 5895–5742 | MAMS-32131 5889–5805 | 5865 ± 12 | BPh II | | | 1 | Perforated sherd discs ornament of stone |
| | | | | | | BSPh IIIa | | | | |
| | | DEM-150-160: 5900–5770 DEM-151-161: 5890–5760 | MAMS-32130 5895–5742 MAMS-32129 5867–5714 | MAMS-32130 5876–5782 MAMS-32129 5799–5729 | 5825 ± 8 5815 ± 8 | BSPh IIIb | | | | |
| | | DEM-149-159: 5850–5740 DEM-148-158: 5840–5740 | | | | BSPh IIIc | | | | |
| | | | – | – | – | BSPh IIId | | | | |
| | | | – | – | – | BSPh IVa | | | | |
| | | | MAMS-32126 5887–5740 | MAMS-32126 5844–5759 | 5759 ± 4 | BSPh IVb | | | | |
| MN II | 5750 | | MAMS-32125 5895–5732 | MAMS-32125 5845–5751 | 5742 ± 4 | BSPh Va | 2 | | | |
| | | | – | – | – | BSPh Vb | | | | |
| | | | – | – | – | BSPh Vc | | | | |
| | | | MAMS-32124 5804–5667 | MAMS-32124 5767–5709 | 5693 ± 2 | BSPh Vd | 3 | | | |
| | | | | | – | BSPh Ve | | | | |

Tab. X.3 (continued)

| Thessaly, Neolithic periods (Reingruber et al. 2017) | Thessaly, absolute chronology calBC 1σ (Reingruber et al. 2017) | PMZ data, calBC 1σ (Reingruber et al. 2017) | PMZ MAMS data [calBC 2σ] | PMZ MAMS data [calBC 1σ] | PMZ Best Fit [calBC] 95% GaussWM | PMZ BPh/ BSPh | PMZ Ceramic Horizon | PMZ Lithic Phase | PMZ Figurine Horizon | Textile tools, tools of clay/sherd tools, chipped stone, ornaments |
|---|---|---|---|---|---|---|---|---|---|---|
| MN III | 5600 | | | | | BSPh VIa | 4 | 2 | 2 | |
| | | | MAMS-32123 5837–5681 | MAMS-32123 5773–5720 | 5657 ± 1 | BSPh VIb | | | | Perforated sherd discs<br>Shell ornaments |
| End of MN III / start of LN I | | | – | | – | BSPh VIIa | 5 | 3 | | Loom weight<br>Last perforated sherd disc<br>Spondylus shell ornaments incl. barrel-shaped bead<br>Chipped stone: arrowheads and tools for hide working |
| Earliest LN I | 5500 | | MAMS-32120 5629–5531 | MAMS-32120 5620–5560 | 5619 ± 2 | BSPh VIIb | 6 | 4 | | High number of unperforated sherd discs<br>Chipped stone: change of sickle type |
| LN I | | | MAMS-32119 5545–5472 | MAMS-32119 5513–5478 | 5601 ± 4 | BSPh VIIc | | | | Loom weights<br>Spindle whorls<br>High number of unperforated sherd discs<br>Spondylus shell ornaments |
| | | | – | | | BPh VIII | | 5 | 3 | |
| | 5300 (?) | | – | | | BPh IX | | | | |

Furthermore, we even cannot exclude the possibility that the settlement at PMZ in LN I (Tsangli-Larissa phase) did not survive until its end in about 5300 BC but may have ended considerably earlier.

### X.3.2. Chronology and Phasing Based on Various Artefact Groups

Of special interest is the fact that changes in the use of space and construction techniques were developed equally during the same or different chronological phases as defined above. MN I included the ditch and a sequence of open and built space also showing differentiation in the building techniques (BPh I–IV). MN II coincides with a change in the use of space, the excavated area being turned into an open space (BPh V) and equipped with thermal structures, which acquired a major importance in this phase. On the other hand, MN III yielded buildings probably accompanied by auxiliary annexes (BPh VI). Unfortunately, the transitional Middle Neolithic and earliest Late Neolithic strata (BPh VII–IX) were highly disturbed. During the MN III/LN I transition (BSPh VIIa) and LN I (BSPh VIIb–c and BPh VIII), the excavated area showed buildings next to open spaces or yards (BSPh VIIa–c), whereas in BPh VIII (LN I) a seemingly unroofed and largely homogeneous area was developed (Tab. X.3).

For the chipped stone tools, Perlès has differentiated five lithic phases: From BPh I–V no change in the toolkit is seen, and based on the abundance of flake inserts on sickles these phases are summed up as Lithic Phase 1. Lithic Phase 2 (BPh VI) is discerned by continuity with Lithic Phase I but also by gradual changes in the proportion of flakes, which still predominate over blades. The Lithic Phases 3 (BSPh VIIa) and 4 (BSPh VIIb–c) differ markedly from the previous phases through the emergence of new tool types, used for hide and woodworking as well as for hunting, although flakes continue to constitute the majority of the retouched tools. However, as pointed out by Perlès, in contrast to the pottery, the character of the material is still Middle Neolithic. In contrast to what has been observed in the preceding lithic phases, Lithic Phase 5 (BPh VIII) shows mostly qualitative differences. The raw material of the chipped stone tool kit is characterised by a systematic choice of high quality radiolarite/chocolate chert, the appearance of some new tool types and a drop off, if not disappearance, of obsidian, and the character of the toolkit is to be compared with other Late Neolithic materials in Thessaly. The differentiation in five lithic phases is largely based on quantitative differences. Therefore, alternatively to this scheme, Perlès proposes a tripartite scheme based on qualitative differences. This scheme unites phases 1 and 2 (BPh I–VI) and phases 3 and 4 (BSPh VIIa–c), and only leaves phase 5 (BPh VIII) as a single phase. In this way it coincides with the Middle Neolithic phases as defined by pottery, a transitional Middle Neolithic to LN I phase which, judging by the chipped stone toolkit is still of Middle Neolithic character, and a LN I phase.

A comparable technological change may also be seen in textile tools. While the BPh II–VI (MN I–III) produced perforated sherd discs, possibly used as spindle whorls, the first loom weight comes from BSPh VIIa, and the first spindle whorl is located in BSPh VIIc. Furthermore, unperforated sherd discs, which are tools of unknown use, appear in high numbers during BSPh VIIb, VIIc and BPh VIII. In consequence, we see a dynamic development of textile tools and related implements from BSPh VIIa onward, textile production acquiring major importance in LN I. However, while for the chipped stone tools there is a clear change from a Middle Neolithic to a Late Neolithic toolkit only from BSPh VIIc to BPh VIII, the textile instruments as well as the unperforated sherd discs show a major change with BSPh VIIa and again with VIIb. Therefore, these tools support a phasing which stresses a major change with BSPh VIIa and furthermore, with BSPh VIIb/c.

For the ornaments, during the same period there was a major change in the raw materials. From BSPh VIIa onwards *Spondylus* shell ornaments appear for the first time. Interestingly, from this phase also comes the rare find of a barrel-shaped bead made of *Spondylus* (PM0581) which has its parallels in Late Neolithic contexts. Further *Spondylus* bracelets come from BSPh VIIc

(PM0467) and BPh VIII (PM1001). In consequence, in terms of ornaments, the major change appears from BSPh VIIa onwards.

For figurines, a chronological scheme based on the appearance/disappearance of certain figurine types has been developed: the few fragments of figurines squatting on the floor (Figs. VI.2–3, VI.11) come from MN I and II, and also two fragments of figurines sitting on stools (Figs. VI.4, VI.8) were found in the MN I and II horizons, just one fragment of this type coming from MN III (Fig. VI.16). Therefore, according to our evidence, it seems likely that such figurines, which are abundant all over Thessaly, were typical for the previous Early Neolithic[1187] and the earlier Middle Neolithic phases, and may be summarized as Horizon 1. Subsequently, with MN III and the transitional MN III/LN I, figurines with incised decoration as well as schematic figurines appear: Three schematic figurines come from MN III (Figs. VI.18–19) as well as from transitional MN III/LN I (Fig. VI.25). To MN III belong the head of a figurine with incised decoration (Fig. VI.15), with parallels outside of Thessaly in the Starčevo-Körös-Cris complex, and the leg of a standing figurine (Fig. VI.21). The house model and its contents (Figs. VI.27–37) and a plaque with incised decoration (Fig. VI.26) were found in the transitional MN III/LN I phase. Therefore, from the point of view of sequencing figurines, MN III and the transitional phase MN III/LN I should be understood as Horizon 2, representing a period of new influences which were perhaps responsible for the dynamic cultural development of this period.[1188] The last development of figurines of the site, most probably dating to LN I (Tsangli-Larissa Phase), is only present in the upper, mixed context. It includes two figurines (Figs. VI.38, VI.40) and is summed up as Horizon 3.

## X.4. The Evidence for Subsistence

In general, as has been shown from archaeobotanical studies at other sites, agriculture at PMZ must have been based on domesticated plants,[1189] i.e. the cultivation of grains and pulses, and a rare use of collected plants.[1190] In the Neolithic layers of PMZ, charred plant remains are limited to small amounts of *Vicia ervilia* (bitter vetch) which may have been detoxified for human consumption. For PMZ the importance of grains has been proven by the abundance of sickle inserts in the chipped stone material.[1191]

During the 1990s van Andel et al. argued that seasonal flooding due to winter/early spring rains enforced a seasonal abandonment of the site and agriculture only took place outside the flood season. Instead of rain-fed agriculture, the seasonal flooding may have given the opportunity for post-flood cultivation or floodwater farming.[1192] However, new geological research points out that the magoula was situated in a safe location at the toe of the widest sloping ejection cone formed along the northern flank of the Peneiada Valley and was most probably not exposed to flood water,[1193] so that it was perennially inhabited. Farming land was probably established north of the settlement, in an area which was not affected by flooding.[1194] In addition, Halstead points out that pulses in particular point to a small-scale, horticultural economy.[1195] A year-round occupation of the site is further confirmed by the slaughter of young domesticated animals in late winter/early spring as well as by the stratigraphy of the tell, which does not point to any interruption in the use of the tell settlement.

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1187 Chourmouziadis 1994, 82.
1188 Alram-Stern, this volume, 460–462.
1189 Halstead, this volume, 583–587.
1190 Valamoti 2015.
1191 Perlès – Papagiannaki, this volume, 266–272; see also below.
1192 Van Andel et al. 1995, 138–140.
1193 Caputo, this volume, 48.
1194 Caputo, this volume, 48; Toufexis – Batzelas, this volume, 137.
1195 Halstead, this volume, 585.

For animal husbandry, the slaughter age of domesticated animals points to the consumption of meat and, to a limited extent, of milk. Furthermore, the presence of some young animals in late winter does not support the idea of mobile herding. This assumption is confirmed by the fact that humans from lowland villages seem to have consumed similar amounts of animal proteins as cave sites.[1196] Another argument against mobile herding in the context of PMZ is the marshy environment near PMZ which might also allow grazing in summer. Becker's studies on cut marks on domesticated and wild animals prove that there must have been rules in sharing carcasses.[1197]

## X.5. The Finds

### X.5.1. The Activities at the Site Based on the Evidence of the Toolkit

For subsistence activities, the toolkit of PMZ gives information on harvesting. The chipped stone tool assemblage is characterised by sickle elements made either of flakes (mostly in the Middle Neolithic BPh I–III) or of blades. According to use-wear analysis, they were used on low-cut, dry or semi-dry cereals,[1198] proving that they were used on domesticated cereals which were more profitably harvested in a ripe state. Such harvesting tools clearly dominate during the first four lithic phases, i.e. the Middle and transitional Middle to Late Neolithic phases, but are also present during the last Lithic Phase 5 (LN I). Therefore, we may argue that agriculture was of highest importance for the site. Two types of sickles are differentiated, which points to a change of sickle types during the late Middle Neolithic period: during Lithic Phases 1–3 the characteristic curved denticulated sickles were made of small flake inserts inserted obliquely into the haft. This type, quite similar to the so-called 'Karanovo sickle',[1199] is hardly comparable to other Thessalian sites. From Lithic Phases 4 and 5 onwards, sickle inserts made on larger, but still curved blades and belonging to larger sickles with a straight working edge became common. Since the larger sickles on blades need fewer inserts, this change of sickle type also explains the smaller number of (blade) inserts in the later phases in comparison to the larger number of (flake) inserts in the Middle Neolithic assemblage. The evidence on sickles coincides with the plant remains known from Neolithic settlements[1200] in Thessaly as well as with the environmental conditions, which were ideal for agriculture.[1201] According to the use-wear analysis, two inserts from Lithic Phases 1 and 5 may have been used as inserts of a threshing board. The presence of such innovation may be associated with the increased amount of grain to be processed, possibly in relation to the need for massive quantities of chopped stems.[1202]

Evidence for food preparation comes from grinding tools, i.e. grinding slabs and grinders. We observe certain differences between the Middle Neolithic toolkit and the one used during the Late Neolithic period: during the Middle Neolithic period both smaller and larger grinding stones are present, while the toolkit of the Late Neolithic period is limited to larger items. According to ethnographic parallels the larger tools were used for grinding grain, while the smaller toolkit was used for grinding condiments, spices, medical plants, salt, pigments and sometimes small grain types (e.g. millet). However, none of the grinding tools shows signs of colour. Furthermore, none of the pieces comes from a primary context, but they seem to have been moved around before their final deposition.

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1196 Papathanasiou 2015.
1197 Becker 1991, 35, tab. 18.
1198 Perlès – Papagiannaki, this volume, 267, 271–272; for the toolkit and changes during the chronological sequence see below.
1199 Gurova 2005; see Perlès – Papagiannaki, this volume, 269.
1200 Halstead 1994; Valamoti et al. 2011.
1201 Halstead, this volume, 584; see above, 621.
1202 N. Mazzucco, this volume: PM0845 from Lithic Phase 1, PM0441 from Lithic Phase 5.

Trapezes and transverse arrowheads first appear during Lithic Phases 3 and 4, i.e. in pottery terms during the transition from the Middle Neolithic to the Late Neolithic as well as the earliest Late Neolithic, and they point to hunting or warfare. Besides these, sling bullets of clay, mainly coming from Middle Neolithic and occasionally from Late Neolithic layers, may point to hunting or warlike activities; however, they have also been related to other uses, including their potential use in herding activities,[1203] or as loom weights.[1204]

Chipped stone tools used for perforation appeared in Lithic Phase 5, but a beak from Lithic Phase 1 may already have been used for boring mending holes on pottery. A bone scraper formed on a cattle rib may also point to activities related to clay and probably pottery making.

For all settlement periods, tree-felling, the cutting of wood and woodworking is proven by the existence of celts, which appear in larger and smaller versions, probably related to lighter and heavier woodworking, also attested by macroscopic analysis on similar tools from other Neolithic sites in Thessaly.[1205] Furthermore, percussive tools also exist, as well as ground stone tools with narrow grooves, which were probably used for shaft straightening or polishing. In addition, microscopic analysis of the chipped stone toolkit also provides evidence for woodworking, especially during Lithic Phase 4 (BSPh VIIb–c). However, specialisation and small-scale activities seem to be absent.[1206]

For hide working a number of tools were used: use-wear analysis of chipped stone flakes and blades points to hide working during Lithic Phase 4 (BSPh VIIb–c).[1207] Scrapers of clay with rough surfaces may have been used for cleaning hair from hides.[1208] According to use-wear analyses of bone tools, several of the pointed tools were used for punching holes into soft animal material like leather in a wet stage, and four tools were used as rotating instruments to perforate skin.[1209]

Textile production is documented by a number of tools. Spindle whorls for spinning threads are only present in small numbers in Late Neolithic layers,[1210] while pierced sherds may have been used as spindle whorls during the Middle Neolithic period. However, it has to be noted that many of the pierced sherds had their hole situated off-centre, so that their interpretation as spindle whorls is insecure. Furthermore, the pierced sherds are considerably lighter than the spindle whorls. So, if these items were spindle whorls, their lighter weight would point to their use for the production of a thinner thread or of a thread in a different material. Single loom weights were found in the Late Neolithic layers of PMZ. They speak in favour of a more intense or even specialised textile production during this period. This evidence shows that a large part of the textile tool assemblage is missing, so that it is impossible to reconstruct the textile production of the site.[1211] Pointed tools of bone, mostly from Middle Neolithic layers, were also used for textile production. Based on use-wear analysis, many of them were associated with plant materials. To these belongs a point which was probably used for weaving with vegetal material. A needle with a hole for holding a thread was used for sewing.

Rounded sherds with chipped or smoothed sides have been interpreted as a primary production stage of perforated sherds. However, in contrast to perforated sherds, their sizes show variation. Furthermore, since they are abundant in Late Neolithic layers, at a time when perforated rounded sherds disappear, such an interpretation is unlikely, and their purpose must have been different

[1203] Perlès 2001, 229–231.
[1204] Demoule – Perlès 1993, 375.
[1205] Stroulia, this volume, 328.
[1206] Stroulia, this volume, 337.
[1207] Perlès – Papagiannaki, this volume, 268.
[1208] Alram-Stern, this volume, 426–427.
[1209] Christidou, this volume, 379.
[1210] PM0348 from BPh VIII is probably an intrusion from the Bronze Age settlement strata of the site, see above, Britsch, this volume, 413–414.
[1211] Britsch, this volume, 413–414.

from the perforated sherds. However, as can be seen from x-rays of Egyptian balls of thread,[1212] they may have been used for winding thread around them. In this sense, they could have been connected with textile production. A connection with textiles is also supported by their linear arrangement on the 'surfaces' of BSPh VIIb and VIIc. Furthermore, the sherd material contained sherds with smoothed sides which were probably used as burnishing tools or as borers.[1213]

### X.5.2. Acquisition of Raw Material and Tool Production

Concerning the chipped and ground stone tools, the acquisition of raw materials differs considerably. For the chipped stone assemblage,[1214] four main raw materials were used, with only quartz – used in small amounts – being locally available. The most abundant materials are radiolarites/chocolate cherts (72%) coming from the Pindos Range (Koziakas Mountains). Radiolarites/chocolate chert sampling of raw material and its comparison with flakes from the site of PMZ point to their acquisition as cores from the Portaikos and Peneios rivers, with a preference for the Peneios River. Since both the Peneios and the Portaikos River flow too slowly to transport nodules close to the site of PMZ, we argue that the nearest exploitable sources were located 40km to the west of PMZ, i.e. their availability was on a regional scale. Based on fresh cortex, the primary sources in the Pindos were exploited to a lesser extent.[1215] According to the debitage on site, these tools were most probably produced on the site from the traded cores and blanks, which fits in with the pattern observed for eastern Thessaly. So, there existed domestic production of flakes with a hard hammer, to be attributed to unspecialised people living at the site. Aside from this, blades and bladelets were produced by indirect percussion or pressure flaking, possibly executed by itinerant specialists. This suggests different levels of expertise among the knappers and a complex, but stable, organisation of production. Regarding the flakes, they were produced through two distinct technological *chaînes opératoires* i.e. the shaping of blades or bladelets cores, and the deliberate production of flakes on discoid cores.

Obsidian in small quantities (11.4%) was imported to the site as already prepared cores from the Cycladic island of Melos. Both blades and flakes come from pressure flaking or indirect percussion, techniques, pointing to specialists who possibly travelled with the material.

Honey chert, which makes up just a small percentage of the entire chipped stone material (7%), was most probably imported as finished chert blanks from western Greece (Epirus) or Albania.

By contrast, ground stone tools were produced of material obtained either on a local or on a microregional scale. Grinding stones were made of cobbles and boulders of gneiss (54% of the assemblage) or schist (20%), which are locally available, as well as sandstone (20%) from sources situated 12 or 18km from the site. There is no evidence of production within the excavated area, but unfinished specimens point to fashioning in other parts of the settlement or just outside the site.

For large celts, gabbro cobbles, which are found in the fields around the site, point to the collecting of local material. Furthermore, marble cobbles were used. The smaller celts were made of serpentine, which probably comes from a local outcrop just 8km southeast of the site. The manufacture process of the larger and smaller celts does not seem to have been a specialised craft at this site. Two different manufacturing processes, i.e. pecking and grinding for the mostly larger gabbro tools and only grinding for the mostly small serpentinite specimens, are associated with them.

For percussive tools quartz and gabbro were used, while schist, chlorite schist and serpentine were taken for specimens with narrow grooves. In consequence, for ground stone tools a certain

[1212] Cartland 1918, 139, pl. 22.
[1213] Alram-Stern, this volume, 448–450.
[1214] Perlès – Papagiannaki, this volume, 201–202.
[1215] Brandl et al., this volume, 309. According to Catherine Perlès, PMZ 5 (Brandl et al., this volume, 299, 306, 309) would be such a candidate.

selection of raw material, depending on tool categories as well as on their sizes, is visible. For their production, five techniques – pecking, grinding, flaking, sawing, and splitting – were used.[1216]

For bone tools, mainly long bones from small ruminants, particularly caprines, and occasionally from domestic cattle and pig were used. Just one metatarsal comes from a red deer. The total absence of red deer antlers is astonishing. Overall, the production was local and two main techniques, scraping and grinding, were observed.[1217]

### X.5.3. Figurines and Objects of Ritual Connotation and their Relation to the Site

PMZ offers various insights into Neolithic society and ritual: the most important find of the excavations is the unique open house model and its contents found in situ, giving insight into the Neolithic society of PMZ, and probably of the southern Balkans in general. First of all, the house model indicates the importance of the house as the social entity of the Neolithic village society. In contrast to the roofed house models which constitute the majority of the house models in the Middle Neolithic, it represents the relevant persons of such a house. They comprise three generations of an extended family living together as well as females connected to the house by their function, their relation to each other indicated by similar dress and body decoration.

Except two figurines, which represent males, the relevant figurines are females. These females are functionally connected to the objects shown in the rear of the room, a platform, an oven and what may be a grinding stone. Two of the female figurines are taller than the males, demonstrating their importance inside the house. In contrast, the males are smaller, but their important role is indicated by their position on stools as well as by their decoration with necklaces and pendants. Furthermore, their position close to the door points to their connection to the area outside the house.

The house model was deposited in the destruction layer of BSPh VIIa before the ground was levelled for the surface of BSPh VIIb. In this sense, it represents a buried household, illustrated by the arrangement of the figurines in a lying position. The deposition of the house model was performed in the course of a ritual, probably by the residents of either the house connected to the burial or the newly built house.

Aside from this most important assemblage, the stratigraphic context of the figurines of PMZ enabled us to reconstruct their chronological sequence.[1218] MN I and II are characterised by fragments of figurines squatting on the ground or sitting on stools well-known all over Thessaly and beyond. From them, we may argue that a similar symbolic language was used during this period all over Thessaly. Besides the house model, MN III and the transitional phase MN III/LN I produced three schematic figurines[1219] not paralleled in other areas so that they may point to a local figurative component characteristic for PMZ. Other figurines, such as the figurines from the house model and a figurine with quite schematically indicated breasts,[1220] have analogies in the neighbouring site of Sykeon. Therefore, we argue that these sites that share similar figurines had similar cultural and ritual perceptions and point not only to regional networks, but, more specifically, to common beliefs.

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[1216] Stroulia, this volume, 343.
[1217] Christidou, this volume, 358.
[1218] For the relative chronology see above, 620.
[1219] Alram-Stern, this volume, PM0591 (Fig. VI.25), PM0621 (Fig. VI.18), PM0645 (Fig. VI.19).
[1220] Alram-Stern, this volume, PM0327 (Fig. VI.38).

### X.5.4. Prestigious Objects

The eleven ornaments[1221] found at PMZ are assigned to objects emphasising the importance of their owner. The fact that such ornaments underline the social position of their owner is also seen by their representation on figurines, such as the male figurines of the house model.[1222] The Middle Neolithic objects consist of beads of stone, bone and clay as well as three pendants of shell. The latter items, coming from an MN III layer (BSPh VIb), are of *Pteria hirundo*, which is present on the Sporades as well as in the northern Euboean Gulf, and therefore of exogenous material. From the Middle/Late Neolithic transition onwards, *Spondylus gaederopus* is used for two items representing bracelets, as well as a pendant and a barrel-shaped bead. *Spondylus* production is well-known from Late Neolithic Thessaly and especially from Dimini, and rarely from Middle Neolithic sites. In western Thessaly Spondylus bracelets are rare. Of special interest is the barrel-shaped Spondylus bead,[1223] coming from the transitional BSPh VIIa, which has parallels in the Theopetra Cave and Late Neolithic Damasi 4, and therefore belongs to the earlier items circulating in Thessaly. In any case, Spondylus ornaments seem to be prestigious, imported products of exchange, not made at the site.[1224]

Among the stone objects there is a so-called macehead of marble.[1225] It was found on the surface of Floor F22 that probably represents an indoor space with a thermal structure and two postholes.[1226] It belongs to the BSPh VIIb, i.e. the very first phase which has been dated to the Late Neolithic period, and most maceheads known from literature date to the Late Neolithic period, too. At the same time, it was found above the area where the house model was deposited. However, due to its fragmentation we cannot be sure if it was used in this area or has been dislocated. There are a number of interpretations of maceheads, such as their use as weights, weapons, gaming pieces, or symbols of authority ('sceptres').[1227] In any case, as its manufacture of marble tells us, all these interpretations point to its social value.

Interestingly, the barrel-shaped *Spondylus* bead PM0581 was found in the same building horizon as the house model (i.e. BSPh VIIa) and near it. At the same time, the macehead was found on a floor set above the house model right after its deposition, and therefore could be related to the same people who followed those who had deposited the house model. Therefore, the potential association of the barrel-shaped bead and the macehead with the house model, or more broadly with the destruction of the house, might be taken as another indication of the significance the owners of this house might have had in the community of PMZ.

## X.6. The Distribution Networks

### X.6.1. Distribution and Consumption of Goods

Besides various other aspects, the study of the finds from PMZ gives insight into the provenance of the goods, their distribution and consumption, so that we learn more about the exchange networks, in which PMZ was involved. For this, we have to be aware that distribution and exchange has, in addition to an economic framework, rather a social one, and that we have to expect a variety of exchange practices. Otherwise circulation of objects is always connected with the mobility

[1221] Kyparissi-Apostolika, this volume, 571.
[1222] Alram-Stern, this volume, 472.
[1223] Kyparissi-Apostolika, this volume, 574 (PM0581).
[1224] Kyparissi-Apostolika, this volume, 579.
[1225] Stroulia, this volume, 340–341.
[1226] Toufexis – Batzelas, this volume, 115.
[1227] Stroulia, this volume, 340–341.

of people, and especially of craftsmen.[1228] In consequence, a relative distance between producers and consumers, based on kinship and social ties, such as marriage networks, existed.[1229] Furthermore, the analyses of sites under study does not show the exact routes, but we can only see the sites as nodes interlinked to each other, and persons and things as the agents of this interaction.[1230]

For the distribution networks in which PMZ was involved, we shall consider the chipped stone tools, the ornaments and the figurines, published in this volume, comparing them with pottery which will be published in a separate volume.[1231] For the chipped stone material, there existed three main materials, radiolarite/chocolate chert deriving from the Pindos Mountains, obsidian from the island of Melos and honey flint with a possible northwestern source.[1232] While figurines can only be included in this survey based on a stylistic analysis, the provenance of radiolarite has been studied by chemical analyses.[1233] Otherwise, the sources of the ornaments are known from various publications.[1234] However, bone tools are not included, since they are made of bones available from domesticated animals or from the fauna of the environment of the tell and therefore were most probably produced locally.[1235] The raw material for the ground stone tools was also available locally,[1236] and only the sources of the sandstone used for grinding tools was situated 12–18km away from the site. Therefore, a local production is also argued for them.[1237] The provenance studies of pottery are based on petrographic and chemical analyses and offer a detailed picture of its distribution. However, since its final publication will be presented in a separate volume, still in preparation, and only preliminary publications are available, this topic can only be considered here in a very preliminary way.[1238]

### X.6.2. Platia Magoula Zarkou and the Distribution Network of Western Thessaly

At PMZ, by far the largest percentage of chipped stone tools was made of radiolarite/chocolate chert. According to core preparation, there was little direct procurement from the primary sources in the Pindos mountains, but already prepared cores and blanks coming from the Peneios and the Portaikos rivers, i.e. from regional sources, were distributed. The production of blades of radiolarite/chocolate chert by hard hammer points to non-specialised local production by the inhabitants of the site. Otherwise, there are also blades produced by indirect percussion or by pressure flaking, pointing to the existence of specialists, who were most probably not inhabitants of the site, but may have come to the site as itinerant knappers. Therefore, exchange of radiolarite/chocolate chert was not limited to the exchange of raw material, but most probably connected to the movement of people who brought new knowledge to the village of PMZ.[1239] Furthermore, it seems that the raw material coming from the Peneios River was preferred to that from Portaikos River, although the Portaikos River produced better raw material. So, the connection to northwestern Thessaly was probably stronger than to the area of Portaikos.[1240] Also, at other western Thessalian sites, radiolarite/chocolate chert represents a higher percentage so that it has been argued that its

[1228] Perlès – Vitelli 1999; Perlès 2007; Perlès 2012; Perlès – Papagiannaki, this volume, 265.
[1229] Karimali 2005, 53.
[1230] Knappett 2006, 242. For the theoretical background see Pentedeka 2017b.
[1231] Pentedeka in preparation.
[1232] See above, 624.
[1233] Brandl et al., this volume, 297, 302, 308; Tab.V.1.21; Perlès – Papagiannaki, this volume, 201.
[1234] Kyparissi-Apostolika, this volume, 578–581.
[1235] Christidou, this volume, 355.
[1236] In addition to the field survey undertaken by Vasilios Melfos and Anna Stroulia, Giorgos Toufexis, Christos Batzelas and Michael Brandl have checked potential sources in the surroundings of the site.
[1237] Stroulia, this volume, 315.
[1238] Pentedeka 2008; Pentedeka 2011; Pentedeka 2012; Pentedeka 2017a; Pentedeka 2017b; Pentedeka in press.
[1239] Perlès – Papagiannaki, this volume, 266.
[1240] Perlès – Papagiannaki, this volume, 263–264.

sites were incorporated into a dense regional distribution network.[1241] If the other sites were also at least partly supplied by knappers coming to the sites, we have to argue a constant movement of people between the sites, not only bringing technical input but also connecting them by social ties. As Karimali has pointed out, the geographical distance between these sites was less important than their social distance, which may have been based on kinship.[1242]

For the figurines, a few transitional Middle Neolithic and early Late Neolithic types, such as the figurines known from the house model and figurines with an accented belly on the flat upper part produced in grey ware, are shared by western Thessalian sites at a closer distance to PMZ, such as Magoula Sykeon, Mavrachades (Sophadon) and Mavrachades Tataria.[1243] Therefore, a more regional distribution pattern is visible for these figurines, and they indicate an interconnectivity of these communities on the Western Thessalian Plain.[1244] If we consider figurines as points of reference for the conceptualisation of communal identities, they are a defining trait for a group of people.[1245] So, we may argue that these sites, which shared similar figurines, had similar cultural and ritual perceptions and shared some sort of identity, most probably as social groups related to each other by kinship and by other social ties.

For pottery, petrographic analyses show a complex pattern of Thessalian sites producing, distributing and consuming pottery. Furthermore, it has been demonstrated that only a small number of pots circulated, and that the distribution of pottery intensified during the Late Neolithic period.[1246] For the reconstruction of a distribution pattern of pottery in western Thessaly, it is an important fact, that at or near the site of PMZ during the Middle Neolithic 'scraped ware', and during early Late Neolithic grey on grey ware, were produced.[1247] During the Middle Neolithic period they were distributed in the Western Thessalian Plain as far north as far as the Theopetra Cave.[1248] During the Late Neolithic period a large number of sites in the Western Thessalian Plain were consumers, from the Theopetra Cave in the north and to Magoula Tsapocha in the south. Otherwise, according to our current knowledge there also exist western Thessalian sites which did not receive this pottery.[1249] In this sense, the pottery produced at PMZ was distributed in the same area as the radiolarite/chocolate chert cores originating from the Peneios area.

### X.6.3. Platia Magoula Zarkou and its Connection to the Eastern Thessalian Plain

Furthermore, we have to pay attention to the fact that the distribution of radiolarite as well as pottery produced at PMZ was, of course, not limited to western Thessaly, but also extended to northeastern Thessaly. However, compared to western Thessaly, radiolarite/chocolate cherts are found in a much lower percentage, obsidian being the main material for chipped stone tool production.[1250]

For figurines, eastern and western Thessaly share a number of types, especially those current during the earlier phases of the Middle Neolithic period. These similarities most probably point to common beliefs and practices shared by the social groups of both areas, and are probably also related to social ties.

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1241 Karimali 2009.
1242 Karimali 2005, 53.
1243 Alram-Stern, this volume, 565, Fig. VI.40.
1244 Alexiou 2020, 140, fig. 1e; 154, fig. 10 (Magoula Sykeon and Mavrachades Sophadon); Nancy Krahtopoulou, personal communication (Mavrachades Tataria in the Kambos region).
1245 Nanoglou 2009, 292.
1246 Pentedeka 2017a, 347.
1247 The 'scraped ware' has been renamed by Pentedeka as 'ware with blurred outlines'. For the definition of these wares see Demoule et al. 1988, 12–23.
1248 Pentedeka 2017a, 345, fig. 2.
1249 Pentedeka 2008; Pentedeka 2011; Pentedeka 2012; Pentedeka 2017a; Pentedeka 2017b; Pentedeka in press.
1250 Karimali 2009.

Concerning pottery, pottery produced at PMZ is known for the Late Neolithic period from various sites in northeastern Thessaly like Otzaki, Chalki and Soufli Magoula. However, it seems that southeastern Thessaly, with the exception of Tsangli, is widely excluded from this network.[1251] In this sense, PMZ was a source of pottery circulating in a wider area. At the same time, during the early Late Neolithic, PMZ was a recipient site of black burnished pottery produced at northeastern Thessalian sites, such as Otzaki or Makrychori 2 to a much a lesser extent.

Therefore, the networks for the distribution of radiolarite/chocolate cherts and pottery reached as far as eastern Thessaly. However, in eastern Thessaly radiolarite played a less important role than in western Thessaly, probably due to the availability of obsidian, which was preferred for its high quality for blade and tool production.[1252] For pottery we need to know the percentage of imported pottery at the various sites of western Thessaly compared to eastern Thessaly to get a better understanding of the differences or similarities of these distribution networks.

Considering radiolarite and pottery as part of a cross-craft interaction system,[1253] we have to keep in mind that the production and distribution of the chipped stone tools made of radiolarite/chocolate cherts mainly had an economic motivation, although most probably with a strong social component. For pottery, we have to consider that the distributed wares were mostly vessels for food/drink consumption made of fine wares, i.e. used at consumption ceremonies on social, or even ritual occasions,[1254] so that their distribution was probably connected to individuals involved in such rituals and events strengthening social ties. The same is argued for figurines used in ritual actions in which a larger number of people or even the community may have been involved. For such distribution the 'social distance', i.e. the connection of people via kinship, social affinity or common belief from various sites was of higher importance than the geographical situation of a site.[1255] Therefore we should keep in mind that the networks for the distribution of chipped stone tools and pottery may either have overlapped or coexisted side by side, and we still have to learn more about their social organisation.[1256]

By its geographical position, PMZ, situated at the eastern edge of the Western Thessalian Plain, at a crossing point between the Eastern and Western Thessalian Plains, probably played an important role in the distribution of goods. This nodal situation probably produced social contacts and shared beliefs as is demonstrated by the distribution of pottery and the occurrence of comparable types of figurines. So, it seems that PMZ was connected to northeastern Thessaly by social networks, although the procurement with radiolarite as a raw material playing a less important role, probably due to the higher importance of obsidian.

### X.6.4. Platia Magoula Zarkou and its Connection to the World outside Thessaly

At PMZ, obsidian, coming from the Cycladic island of Melos, is scarce in comparison to radiolarite (11.4%). Blades and cores were probably produced by itinerant specialists by pressure flaking and indirect percussion. The scarcity of obsidian is strange, since sites like Otzaki or Ag. Sophia in northeastern Thessaly, at a comparable distance from the coast, have a considerably higher proportion of obsidian. On the other hand, sites at a comparable distance from the Gulf of Lamia, like Magoula Koutroulou, are also characterised by a higher proportion of obsidian. Therefore, instead of a single east-west diffusion of obsidian from the sea to inland sites,[1257] Perlès suggests two distinct obsidian networks, one from the Gulf of Lamia to western Thessaly and one from the Gulf of Volos to eastern Thessaly. In such distribution networks, PMZ, situated west of the

[1251] Pentedeka 2017a, 346–348.
[1252] Karimali 2009.
[1253] See already Pentedeka 2011, 106–107, 114–120.
[1254] Perlès – Vitelli 1999, 102–103; Pentedeka 2011, 117.
[1255] Karimali 2000, 18–20.
[1256] Pentedeka 2011, 120.
[1257] Karimali 2009.

Eastern Thessalian Plain and at the entrance of the Western Thessalian Plain, would have been in a marginal position, with little contact to sites closer to the sea.[1258]

The connection of PMZ to the sea is also illustrated by the occurrence of a few ornaments of sea-shell, which had the Gulf of Euboea and the Pagasetic Gulf as their source. In contrast to procurement with obsidian, which may have included the movement of people specialised in their production, the ornaments came to the site as finished, prestigious objects. Maybe they entered the site with the obsidian chippers or other people connected to the sea. Otherwise, we have to be aware that such objects need not have entered the site in a direct way, but that they could have been brought to PMZ via various intermediate sites.

Honey chert was produced at the sources and traded as already finished blanks, probably coming from a source in northwestern Greece or further north. Their percentage does not differ from other Thessalian sites so that we argue that they were dispersed as prestigious objects along long-distance networks.[1259] For figurines, we have argued that a few single pieces exist, which stylistically coincide with items from northwestern Macedonia. Possibly these figurines point to the same social connectivity as is reflected in the honey chert blades.

## X.7. The Society of Platia Magoula Zarkou

When people founded the village of PMZ they decided to live within a well-defined and spatially restricted area, which was encircled by enclosures, most probably ditches. Besides their functional character, these large-scale collective constructions have important social and symbolic dimensions, constructing sociocultural space, space divisions and landscape marking. While the first settlement might have had a slightly extended character, the subsequent settlements were densely occupied, and the decision for this settlement type was possibly due to regular flooding episodes. In the settlement, the division of space changed over time, and different construction techniques coexisted. By rearranging house or settlement space, people recraft material conditions, social roles and social relationships.[1260]

PMZ belongs to the few sites with extramural graves organised in a cemetery. Such an arrangement may be understood as a statement of ancestry, locality and spatial importance, maybe a means of keeping people together during the last phase of the Neolithic settlement, when the pull towards fission, break-ups and abandonment was strong. At the same time, the very act of cremation, as well as the high fragmentation of the bones, may further emphasise the primacy of the communal over the individual.[1261]

A view on space and landscape characterises the people of PMZ living in proximity to a variety of environments and resources, both upland and lowland, as well as close to a river. The most probably modest animal husbandry shows few hints of distant grazing. Living on a tell means having to use the land outside the settlement for cultivation and most probably land ownership at a communal level.[1262] The plain was temporarily flooded, and perennial, rain-fed fields were probably situated in the north of the site. At the same time, the local hydrology may suggest a cyclical pattern of the extent of land availability.[1263] From the raw materials, such as radiolarite/chocolate chert from the riverbanks of the Peneios and the Portaikos rivers, we may conclude multiple networks of communication and of circulation of materials, information and ideas. These networks suggest the mobility of people, perhaps including seasonal relocation of traders and specialists as well as, according to obsidian, their participation in long-distance networks.

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[1258] Perlès – Papagiannaki, this volume, 264.
[1259] Perlès – Papagiannaki, this volume, 264–265, 269.
[1260] Souvatzi, this volume, 597.
[1261] Cf. Triantaphyllou 1999, 131–132; see also Triantaphyllou 2008.
[1262] Chapman 1989.
[1263] Cf. Bailey et al. 1998, 392.

The site was left at the start of the Late Neolithic period when the site had risen in such a way that the seasonal flooding did not affect the settlement itself. Therefore, this act was a social choice, implying regular migration and even conscious relocation of whole villages.

### X.8. Platia Magoula Zarkou and Cultural Change: Questions for Future Research

Based on its toolkit and figurines, we have characterised PMZ as a typical site of the Western Thessalian Plain, with a strong interconnectivity within the Western Thessalian Plain and connections with the northeastern Thessalian Plain. Differences from the northeastern Thessalian sites are mainly seen in the chipped stone toolkit which, according to its main raw material, radiolarite/chocolate chert from the Pindos Mountains, is highly connected with exchange networks of the Western Thessalian Plain throughout the lifetime of the settlement. Otherwise, the social component of the settlement, seen in figurines and pottery,[1264] also has a high connectivity with the northeastern Thessalian Plain, and even higher with the Western Thessalian Plain.[1265]

From its size and its active production of pottery, we argue that PMZ was a nodal point in the distribution of goods and knowledge, and hence of higher importance than various other sites of the Western Thessalian Plain. However, a number of Neolithic western Thessalian sites are under study, and analysis and evaluation of these various sites is to be expected in near future. Therefore, we are not able to determine the exact social and economic position of PMZ within this network of sites, and we have to wait for publications bringing to the public sites comparable to PMZ, i.e. sites of higher connectivity than other sites of this area.

PMZ shows a continued occupation for a limited period of time, from the early Middle Neolithic throughout this period till the early Late Neolithic, i.e., not longer than 400 to 500 years. According to our knowledge of Early Neolithic Thessaly, the founding of the settlement in the early Middle Neolithic is not exceptional, since many Thessalian sites are not founded before the late Early Neolithic, and there seems to be an augmentation of sites during the Middle Neolithic period.[1266] Furthermore, it seems that settlement distribution within an area did not change much during the Early and Middle Neolithic period, but a shift of settlement took place on a local scale.[1267] For PMZ we may argue that the predecessor was Koutsaki Magoula.[1268] According to new research, several sites in western Thessaly seem to have been abandoned during or at the end of the Tsangli phase, and before the start of the Arapi phase. However, since these sites are still unpublished, future research will teach us whether this impression reflects reality. If this is the case, research is needed to find out if these important changes in settlement are caused by environmental changes or by human impact.

The study of the stratigraphy as well as the $^{14}C$ dating showed that the settlement was uninterruptedly settled by the same community, so that variation in pottery and stone tools are not to be expected. However, as one of the first sites studied, through its continuous settlement, PMZ offers a new view on the transition from Middle Neolithic to the early Late Neolithic period. For this time, i.e. at least from BSPh VIIa onwards, a change and diversification in the toolkit and figurines is perceptible.[1269] The chipped stone tools include new types not known before. In addition, new types of figurines, ornaments and objects of prestige, which have social connotations, appear. Via these objects PMZ is linked to western Thessalian settlements and beyond, so that we argue an intensification of contacts. For the textile tools, this development continues throughout the early Late Neolithic phases of the site, and with BPh VIII, the character of the chipped stone

[1264] Pentedeka 2008; Pentedeka 2011; Pentedeka 2012; Pentedeka 2017a; Pentedeka 2017b; Pentedeka in press.
[1265] Pentedeka 2017b.
[1266] Reingruber 2008, 316–317.
[1267] Johnson – Perlès 2004, 69–70.
[1268] For its location see Caputo et al., this volume, 49, Fig. II.1.8.
[1269] For a summary see above, 622–626.

toolkit finally has a pure Late Neolithic character. PMZ is the first site in which these in some cases gradual, in other cases quite sudden, transformations are visible. However, PMZ is also the first site with a continuous Middle Neolithic to Late Neolithic settlement which has been extensively studied and presented to the public. Therefore, we have to ask if this image is specific to PMZ as a pottery-producing site and a nodal point in the network of settlement, or if we should expect similar developments in other Thessalian sites, which are uninterruptedly settled from the Middle Neolithic to the Late Neolithic, and are going to be studied and published in future.

# Abstracts

## I. Introduction: Chronicle of Excavations and Research 1974–1990

*(Kostas Gallis)*

After the discovery of a cremation cemetery, excavations at the tell site of PMZ were undertaken with the aim of correcting the Neolithic chronology of Thessaly. The study of the pottery proved that the 'Larissa phase' previously dated to the end of the Neolithic sequence actually coincides with the 'Tsangli phase' at the start of the Late Neolithic period. Furthermore, the material showed a progressive development of the pottery as well as a rich local pottery tradition. Another most important find of this excavation is an open house model including figurines, which shed light on the Neolithic society. Further research included an archaeometry and geoarchaeological programme on the relation of the site to its environment.

## II. The Environment and its Evolution around the Tell

### II.1. The Latest Quaternary Evolution of the Peneiada Valley, Central Greece, and its Effects on Neolithic and Historical Settlement Distribution

*(Riccardo Caputo – Bruno Helly – Dimitra Rapti – Sotiris Valkaniotis)*

In order to reconstruct the Neolithic environmental and geographic conditions at PMZ and its surroundings, we investigated the geological and geomorphological evolution of the broader Peneios River system and particularly of the Peneiada Valley, where the archaeological site was settled. The analysis and re-interpretation of geological and historical/modern topographic data clearly indicate a division of Thessaly into two separate endorheic hydrographic networks, the Karditsa and Larissa realms. These two basins were partially covered by lake waters and/or marsh areas up to late antiquity and locally even in recent historical periods. Between them is the Peneiada Valley, where a detailed geophysical survey allowed us to map in detail the pre-infilling bottom morphology, suggesting it likely represented the lower reach of the Titarissios River draining into the Karditsa Basin. It was so up to the Late Pleistocene, when tectonic activity along the Tyrnavos and Larissa faults diverted it into the Larissa area. Accordingly, during Neolithic times, the western sector of the Peneiada Valley was characterised by lacustrine-to-marshy conditions and PMZ was settled in a sort of coastal setting of a narrow gulf. In the meantime, the prograding 'western' rivers were progressively infilling the Karditsa basin, starting to form a hydrographic network in the plain. However, only during historical times was the Peneiada Valley affected by fluvial aggradation, causing the alluvial plain to expand eastwards, finally reaching the altimetric threshold of the Kalamaki Gorge. This last phenomenon definitely established a permanent hydrographic connection from western to eastern Thessaly.

### II.2. Geophysical Investigations

*(Apostolos Sarris – Tuna Kalayci – James Donati)*

Geophysical prospection surveying was able to highlight various details regarding the habitation area around PMZ. It confirmed that the settlement was established at the edge of an intense flooding zone and, during the Middle Neolithic period, it was encircled by two gullies flowing from the north towards the western and eastern sides of the magoula. The burial grounds of the cemetery to the

north, previously identified through excavations, were most likely located on an elevated geological formation at the border of the flooding zone, in accordance with conclusions drawn by Caputo et al.[1270] Surveying found evidence for enclosure walls (or ditches) that encircled the magoula, acting, among other things, as counter measures against flooding episodes. Anthropogenic activity was generally limited to zones immediately below the magoula, with the exception of the northwestern sector, where a number of thermal structures are sparsely spread within a distance of 70m from the mound. A denser distribution of (Early Bronze Age?) structural residues spreads along a low elevation relief towards the southeast, confirming the continuation of habitation in this area.

## III. Stratigraphy and Architecture

*(Giorgos Toufexis – Christos Batzelas)*

Platia Magoula Zarkou constitutes an impressive magoula (tell) consisting of c. 10.00m human deposits, more than half of which are dated to the Middle and early Late Neolithic period (deposits c. 5.80m thick) while the remainder date to the Early and Middle Bronze Age. The excavations were carried out in 1976–1990 and had a stratigraphic orientation, aiming at clarifying the chronology of the so-called 'Larissa phase'. Vessels of that period had previously been found in the cemetery of the settlement together with grey vessels of the 'Tsangli phase'. Nevertheless, the analysis of the settlement's stratigraphy and architecture, albeit too fragmentarily, was able to cast some light on the building practices and aspects of the use of intra-settlement space as well. Overall, nine building phases (BPh I–IX) with several subphases were discerned corresponding to Ceramic Horizons 1–6. Based on the pottery, the BPh I–VI were assigned to the Middle Neolithic I–III, the BSPh VIIa to the transition from the Middle to the Late Neolithic and the BSPh VIIb to BPh IX to the Late Neolithic, spanning a period of approx. 400 years according to the radiocarbon dates. The stratigraphic sequence was continuous throughout the thick Neolithic deposits and no stratigraphic hiatus was observed. To the earliest phase (BPh I) belonged part of a shallow ditch dug into the alluvial ground, but no ditches were encountered in other phases. The houses were built with posts and abundant clay, probably in a combined *pisé* and timber technique, but there were also buildings with mudbricks and stone foundations and post-built walls. The houses in BPh IV and VI were rebuilt one on top of the other. In BPh IV and VII the buildings were burnt, whilst the well-known house model was found in the burnt debris of a house in BSPh VIIa. In BPh VI potential 'auxiliary' buildings connected with houses were encountered. Thermal structures were mostly found in open spaces and yards and less inside buildings and they primarily served for cooking purposes. Levelling works seemed to have played a significant role in the formation of the stratigraphy of the settlement and were frequent due to the restraints in the available habitation space, as would be expected in the tell settlements. Alternation of built and open/semi-open areas or yards was also attested. The analysis has also sought certain analogies and differentiations with the neighbouring and more distant settlements.

## IV. The Absolute Chronology of the Excavations: Radiocarbon Dating and Stratigraphic Age Modelling

*(Bernhard Weninger – Giorgos Toufexis – Christos Batzelas)*

In this chapter, the radiocarbon data shown in Tab. IV.2.1 will be used to develop an absolute (calendric-scale) chronology of the Neolithic layers of PMZ. The analysis covers a total of ten radiocarbon measurements processed on short-lived samples of (exclusively) animal bone. The results of stratigraphic age-depth modelling of the $^{14}C$ data are shown in Fig. IV.2.5. The analysis

[1270] Caputo et al., this volume, 48.

was based on application of Gaussian Monte Carlo Wiggle Matching (GMCWM), as implemented in CalPal software (Version 2019.5). As it turned out, due to the largely wiggle-free shape of the $^{14}C$ age calibration curve in the period under study (5900–5500 calBC) in combination with the exceptional linearity of the Neolithic sediment accumulation at PMZ and the high precision of the $^{14}C$ ages as measured by the Heidelberg AMS laboratory, the GMCWM-modelling application has also provided some unusually precise chronological results. Nevertheless, although the calculated dating uncertainties based in extensive Monte Carlo age-depth modelling are in the range of 1–14yrs (95% confidence), we critically argue that the true (realistic) dating errors are more likely to be in the order of 20–50yrs (95% confidence). Such caution in error interpretation would appear advisable, in particular to allow for our lack of any basic (quantitative) understanding of the cultural, geophysical, and sedimentological processes underlying the observed (metric) regularities (at least) in the vertical tell-accumulation.

## V. The Tools

### V.1. The Flaked Stone Assemblages
*(Catherine Perlès – Lygeri Papagiannaki)*

The Platia Magoula Zarkou flaked stone assemblages were studied simultaneously from a technological and a traceological perspective, aiming at documenting diachronic changes in raw material procurement strategies, techniques of production, tool types and tool uses throughout the Middle Neolithic and during the Middle to Late Neolithic transition. Five phases have been identified on this basis. The first four show indisputable continuity in all aspects, although long-term trends can also be observed. The last phase, dated to the early Late Neolithic, differs more markedly. The assemblages are small in number, which can be attributed to the absence of local raw materials, and to the fact that, despite a location that could have appeared as favourable, PMZ seems to have remained in a marginal position vis-à-vis radiolarite and obsidian exchange networks in Thessaly. Three modes of procurement of the tools can be identified: first, a domestic, unskilled production of flakes from river pebbles. The high proportion of flakes and flake tools compared with blades and bladelets is indeed one of the specificities of the PMZ assemblages. Second, a restricted local production of obsidian bladelets by itinerant specialists; third, a limited trade in chert and honeyflint blades. Given the limited access to raw materials, the rate of retouched tools is high, and the tools were often intensely curated. Sickle inserts predominate in the first three phases but decrease afterwards, as do inserts on flakes, predominant in the earliest phases. A progressive diversification of the toolkit can be observed throughout the sequence. Hide working is the best-represented activity after harvesting, but the tools used are varied – end-scrapers, flakes, blades – and unspecialised. In phase 5 the proportion of obsidian becomes insignificant but the typological composition is more balanced and the range of materials worked more diversified: cereals, wood, hide. Weapons are also rare, with only a few trapezes and transverse arrowheads in phases 3 and 4, and tools related to butchery are absent. All the tool types found at PMZ are known from other sites in Thessaly, albeit often rare: for instance, the transverse arrowheads, the sickle blades shaped with an end-scraper front and the sickle inserts on thick-backed flakes. The good representation of these rare tool types at PMZ, together with the absence of others such as splintered blades, sets it apart from the other settlements and contributes to reinforce the impression of a marked idiosyncratic continuity, especially in the Middle Neolithic. The interplay between raw material availability, the activities performed at PMZ and the tool types that were chosen to perform these technical tasks gives a strong and distinct personality to the PMZ flaked stone tool assemblages.

#### V.1.11. Appendix 3: Geochemical Sourcing of Chipped Stone Tools from Platia Magoula Zarkou *(Michael Brandl – Christoph A. Hauzenberger – Peter Filzmoser – Maria M. Martinez)*

Provenance studies of lithic raw materials for tool production are one of the keys for reconstructing prehistoric economic behaviour. Establishing the geological origin of lithic artefacts allows fur-

ther investigations and hypothesis testing the framework of resource management by addressing questions relating to procurement strategies. In a case study from PMZ, we show that the Multi Layered Chert Sourcing Approach (MLA) achieves a clear differentiation of siliceous rocks (chert and radiolarite) from Thessaly combining petrographic investigations, geochemical trace element analyses using LA-ICP-MS and statistical data evaluation by means of compositional data analysis (CODA). At PMZ, chert and radiolarite were extensively used for chipped stone tool production; however, systematic provenance studies of the chipped stone industry have never before been undertaken. Our pilot project was able to reveal the origin of selected stone tools from the site, identify primary and secondary sources of the enigmatic 'Pindos radiolarite', and establish the Koziakas Mountain range with its adjacent rivers as an extensive source area for early farming communities in the Western Thessalian Plain.

### V.2. The Platia Magoula Zarkou Macrolithics: A Thessalian Industry in its Aegean Neolithic Context
*(Anna Stroulia)*

Despite the recent dramatic growth within the field of Aegean Neolithic macrolithics (also known as ground stones), still little is known about the relevant industries of the region of Thessaly. By focusing on the assemblage from PMZ, this chapter aims to address this gap. The excavation of the site's Neolithic deposits yielded approximately 130 specimens. The majority are dated to the Middle Neolithic, about one quarter are Late Neolithic, with a few specimens assigned to the transition between these two phases. On the basis of technomorphological characteristics, five categories were distinguished: grinding and abrading tools; celts; percussive tools; tools with narrow grooves; miscellanea. This chapter represents a three-pronged endeavour that: i) offers a systematic presentation of each category, following the main stages in the tools' biographies; ii) discusses the tools along a synchronic and diachronic axis; iii) places this Thessalian industry in its broader Aegean Neolithic context.

### V.3. Bone Tools
*(Rozalia Christidou)*

Nineteen stratified bone artefacts from the Middle and early Late Neolithic layers at Platia Magoula Zarkou in Thessaly were analysed from a morphological and technological point of view to complement a previous report on the worked bone of the site. The state of preservation of the artefacts was also examined. Weathering, burning and animal chewing were associated, where possible, with particular features of the excavated deposits. A single artefact represented reduction waste; the rest, with one exception, were finished products, mostly pointed and cutting-edge tools, thirteen and two specimens, respectively, which displayed use wear. Four preserved marks of rejuvenation of the active end. A central fragment of tool made from a cattle rib showed that this zone of the tool was active. It does not bear shaping marks. This artefact, unique in the Neolithic collection, was classified as a smoother. The bones from which most of the tools were made pointed to raw material availability in the site's bone refuse, which was dominated by small ruminants, mainly caprines, and pig. The reduction of a red deer metatarsal accords with evidence for transport of selected body parts of this species for use in the settlement. Apart from two ad hoc tools, selectivity of skeletal elements or parts of elements was observed and tied to shaping modalities. As a rule, scraping determined the forms of the tools with little effort. Grinding using fine-grained abrasives aimed at limited modifications, while coarse materials had, in some cases, been used to reduce the bone considerably. This latter option was related to particular processes of tool production from caprine metapodials, known from the Neolithic bone industries in the wider region of Thessaly. The use of tibial fractures for making tools, observed at PMZ, appears to be another characteristic of these industries. There is not enough evidence on which to base site comparisons regarding the anatomical and morphological characteristics of the splinters derived from shattered

bones and used as tool blanks, a noteworthy feature of the sample examined here. Otherwise, splinter use is known from the Thessalian Neolithic. Overall, variability in blanks, shaping processes, tool types and sizes could be observed despite the limited number of artefacts analysed. This evidence was compared to tool use data. Scraping and perforation of soft animal materials and working with plant fibres were recorded. Hide working seems to have been more common, which concurs with the findings of the analysis of the chipped stone industries. Variations in tool damage were observed. In the perforators of animal materials, discard could be related to apex wear and likely difficulties in repairing tools without major modification of their shapes and sizes. Use data helped examine choices made with regard to the types and dimensions of tools used for similar tasks. The main elements of the local bone technology are summarised at the end of the chapter.

V.4. Clay Spinning and Weaving Implements
*(Christopher Britsch)*
V.5. Various Clay and Sherd Tools
*(Eva Alram-Stern)*

These chapters deal with objects formed of clay or sherds modified for secondary use. In addition to two spindle whorls dating to the early Late Neolithic settlement strata, pierced sherd discs, mainly from Middle Neolithic contexts, are examined for their potential use as spindle whorls. Four loom weights deriving from early Late Neolithic strata point to a more specialised textile production during this period at the site. Sling bullets coming from Middle Neolithic and early Late Neolithic contexts were exclusively formed of clay. Ovoid instruments of coarse and gritty clay are interpreted as scrapers. Rounded sherds of various sizes are most abundant during the early Late Neolithic settlement strata. According to their variation in size and their abundance in these later strata, they are not considered as intermediate products of pierced sherd discs, and various suggestions for their purpose are given. Eight-shaped sherd tools may have had the same purpose. Several sherds with smoothed breaks may have been used as burnishers.

## VI. Figurines, House Model and Ritual Vessels

*(Eva Alram-Stern)*

Following the stratigraphic sequence of Trench A of PMZ, the figurines are analysed concerning their manufacture, decoration, typology, find circumstances and fragmentation, showing major typological and depositional changes during the later Middle Neolithic period. While steatopygous figurines are characteristic for the earlier Middle Neolithic periods (BPh II–V), MN III and the transitional phase of the Middle/Late Neolithic period (BPh VI to BSPh VIIa) are dominated by schematic figurines. LN I figurines are only defined by finds in post-Neolithic layers and are characterised by their production in typical Late Neolithic pottery wares. By comparing them with other finds in Thessaly and beyond, the figurines of PMZ show long-distance relations, but also regional similarities, especially visible during MN III and the transitional Middle/Late Neolithic periods, which point to the existence of networks connecting PMZ with the neighbouring western Thessalian sites. One of the most important finds from PMZ is the house model and its figurines and miniatures found in situ. They are evaluated in a separate part of this chapter in their context by relating the figurines to each other. In summary, the house model is connected to the destruction layer of the MN III/LNI stratum (BSPh VIIa) and therefore to the burial of its house. Thus, the lying position of the figurines, which was planned from the very beginning, demonstrates that the figurines were thought of as being put to sleep, probably forever. Furthermore, the house model is an effigy of a social group consisting of an extended family as well as a woman connected to them by her activities in the household. This effigy illustrates that the role of women was more active in the house, while males play only a minor role here, having their main task outside the house. The material presented here is supplemented by animal figurines, vessel attachments, anthropomorphic vessels, a table and a miniature bowl.

## VII. The Ornaments
*(Nina Kyparissi-Apostolika)*

The inventory of ornaments from PMZ is limited, consisting of only 16 items, 11 of which come from the Neolithic deposit. Despite their limited number, all the usual materials found in other Neolithic sites, such as shell, stone, clay and one animal tooth were used. Included among these are two bracelets of different type, one big barrel-shaped bead and one perforated valve of *Spondylus gaederopus* seashell; additionally, three pieces, now missing, with a pair of holes each were also made from shell. Two ornaments are made from pebbles that were also perforated. In the group of the clay ornaments, namely beads, the one that comes from the deep Neolithic deposit has a natural curved shape, while others found in the Bronze Age depot have more artificial shapes, but these fall outside the remit of this publication. One perforated animal tooth has decorative incisions, while there is one round-shaped object without a hole, whose use is debatable. Judging by the small number of ornaments found, we can assume that they were not fabricated in situ, but they were rather imported to the site as precious goods. The exception could be the three missing pieces, which were found all together, they are stylistically similar but different from the rest and they could have been made by a local 'artist'. Despite their rarity, the ornaments from PMZ can give important information about their origin and the period in which they circulated. Of course, as very little of this settlement is excavated so far, a more extensive excavation in the future could overturn this evaluation.

## VIII. Archaeobotanical and Zooarchaeological Remains – Revisited
*(Paul Halstead)*

The archaeobotanical and (more abundant) zooarchaeological remains recovered from Neolithic and Bronze Age levels at PMZ were studied and reported in the 1990s. The former, identified by Helmut Kroll and Glynis Jones, were reported by Cornelia Becker[1271] and Glynis Jones – Paul Halstead,[1272] respectively. The latter were analysed and reported by Becker.[1273] Neither assemblage has been re-examined for the present brief contribution, the purpose of which is to review the original publications in the light of relevant subsequent discoveries and debates. This review begins by considering how typical or atypical the PMZ data are in the context of Neolithic to Bronze Age Greece, before discussing broader issues of land use and food consumption.

## IX. The Physical and Social Landscape of Neolithic Platia Magoula Zarkou
*(Stella Souvatzi)*

This chapter examines the physical and social landscape of PMZ during the Neolithic period and the ways in which space was configured and conceptualised, through analysis of integrated evidence from geology, geophysics, the environment, the stratigraphy, the architecture and settlement patterns, as well as from plants, animals and material culture. The chapter approaches the landscape as a social and historical construct and the human-environment relationship as dynamic and continuously interactive. Key issues include: i) the human-physical landscape interaction, with special attention to the local particularities and the indications of frequent flooding in the surroundings of the tell during the Neolithic; ii) the possible presence of surrounding ditches and their function and meaning; iii) the settlement type attested for PMZ and its social and historical

[1271] Becker 1991, 77–78, tab. 14.
[1272] Jones – Halstead 1993.
[1273] Becker 1991; Becker 2000.

significance; iv) the existence of a rare cremation cemetery and its relationship to, and meaning for, the settlement; and v) the position of PMZ within the wider physical and social landscape of newly and previously excavated Neolithic settlements in Thessaly, through detailed analysis of local and regional settlement patterns and through comparisons, contrasts and ways of interaction between PMZ and other contemporary sites. The physical, socio-spatial and temporal practices analysed in the chapter suggest that, despite its rather remote location and the potential problems with flooding, PMZ was a complex and dynamic site that interacted intensely and diversely with its physical and social environment and that it could be seen as a socially stable place within a wider landscape characterised by variability and changes. The results shed new light onto how the relationship between people, land and time may have been constituted and call for greater awareness of human perception, agency and knowledge.

### X. Platia Magoula Zarkou in Context: Summary and Conclusions

*(Eva Alram-Stern – Giorgos Toufexis)*

This chapter summarises the results of the contributions of this volume. By putting them together, a new picture of this permanently settled tell emerges. In particular, the integration of the finds with the absolute and the relative chronology of the settlement sequence gives a new understanding of the cultural change taking place during the Middle Neolithic (5969–5754calBC [2σ]) and early Late Neolithic (latest absolute date: 5545–5472calBC [2σ]) phases of the tell: By comparing the six ceramic horizons with the five lithic phases (developed for chipped stone tools) and the three figurine horizons, we realise that all artefact groups show a continuous development during MN I and II. However, a distinct cultural change is evident for MN III, the transition from MN III to LN I (Ceramic Horizon 5) and LN I (Ceramic Horizon 6). In all these artefact groups the changes in style and type are related to a different chronological phase. For LN I, a new style (pottery, figurines) and new artefact types (chipped stone tools) are evident. Therefore, we should consider this time as a phase representing new cultural dynamics. This picture is confirmed by the change seen in textile tools, rounded sherds and ornaments. Furthermore, for PMZ, western Thessalian regional distribution networks are defined by the circulation of radiolarite (from the Pindos Mountains) as well as by figurines indicating interconnectivity of communities on the Western Thessalian Plain. Interregional contacts with the sea are confirmed by the occurrence of obsidian from Melos and a few ornaments of seashell. In summary, we consider PMZ as a nodal point connecting the Western and the Eastern Thessalian Plain. However, since many western Thessalian sites are still being studied, we are not able to determine the exact social and economic position of PMZ within this exchange network. Furthermore, its cultural development still has to be considered in relation to these sites.

# Περιλήψεις

## I. Εισαγωγή: Χρονικό ανασκαφών και ερευνών 1974–1990

*(Κώστας Γαλλής)*

Μετά την ανακάλυψη ενός νεκροταφείου με ταφές καύσεων, οι ανασκαφές στην Πλατιά Μαγούλα Ζάρκου διενεργήθηκαν με στόχο τη διόρθωση της νεολιθικής χρονολόγησης της Θεσσαλίας. Η μελέτη της κεραμικής απέδειξε ότι η «φάση Λάρισα» που χρονολογούνταν παλαιότερα στο τέλος της Νεολιθικής περιόδου, συμπίπτει στην πραγματικότητα με τη «φάση Τσαγγλί» στην αρχή της Νεότερης Νεολιθικής περιόδου. Επιπλέον, το υλικό φανέρωσε μια προοδευτική εξέλιξη της κεραμικής καθώς και μια πλούσια τοπική κεραμική παράδοση. Ένα άλλο πολύ ενδιαφέρον εύρημα της ανασκαφής αποτελεί το ανοικτό ομοίωμα σπιτιού που περιέχει ειδώλια, το οποίο ρίχνει φως στη μελέτη της Νεολιθικής κοινωνίας. Περαιτέρω έρευνα περιελάμβανε ένα γεωαρχαιολογικό πρόγραμμα για τη σχέση της θέσης με το περιβάλλον της.

## II. Το περιβάλλον και η εξέλιξή του γύρω από τη μαγούλα

### II.1. Η εξέλιξη της Κοιλάδας της Πηνειάδας στην Κεντρική Ελλάδα κατά το ύστερο Τεταρτογενές και οι επιδράσεις της στην κατανομή των οικισμών της νεολιθικής και ιστορικής περιόδου

*(Riccardo Caputo – Bruno Helly – Δήμητρα Ράπτη – Σωτήρης Βαλκανιώτης)*

Για να αναπαραστήσουμε το Νεολιθικό περιβάλλον και τις γεωγραφικές συνθήκες στην Πλατιά Μαγούλα Ζάρκου και στο περιβάλλον της, ερευνήσαμε τη γεωλογική και γεωμορφολογική εξέλιξη του ευρύτερου συστήματος του Πηνειού Ποταμού και ειδικότερα της Κοιλάδας της Πηνειάδας, όπου βρίσκεται ο αρχαιολογικός οικισμός. Η ανάλυση και εκ νέου ερμηνεία των γεωλογικών και ιστορικών/σύγχρονων τοπογραφικών δεδομένων δείχνουν καθαρά μια διαίρεση της Θεσσαλίας σε δύο χωριστά ενδορροϊκά υδρογραφικά δίκτυα, τις περιοχές Καρδίτσας και Λάρισας. Αυτές οι δύο λεκάνες καλύπτονταν εν μέρει από λιμναία ύδατα και/ή ελώδεις περιοχές μέχρι την ύστερη Αρχαιότητα, κατά τόπους δε ακόμη και στις πρόσφατες ιστορικές περιόδους. Ανάμεσα τους βρίσκεται η Κοιλάδα της Πηνειάδας όπου η λεπτομερής γεωλογική έρευνα επέτρεψε να χαρτογραφήσουμε λεπτομερώς τη μορφολογία του πυθμένα πριν την προσχωσιγενή πλήρωσή της, υποδεικνύοντας ότι πιθανώς αντιπροσώπευε την κατώτερη εμβέλεια του Τιταρήσιου ποταμού που αποστραγγιζόταν στη λεκάνη της Καρδίτσας. Αυτό συνέβαινε μέχρι το Ύστερο Πλειστόκαινο όταν η τεκτονική δραστηριότητα κατά μήκος των ρηγμάτων του Τυρνάβου και της Λάρισας, εξέτρεψαν τον ποταμό προς την περιοχή της Λάρισας. Κατά συνέπεια, στη Νεολιθική εποχή το δυτικό τμήμα της Κοιλάδας της Πηνειάδας χαρακτηριζόταν από ποταμολιμναίες προς ελώδεις συνθήκες και κατά συνέπεια ο οικισμός της Πλατιάς Μαγούλας Ζάρκου ιδρύθηκε σε ένα είδος παράκτιου περιβάλλοντος ενός στενού κόλπου. Εν τω μεταξύ, τα «δυτικά» ποτάμια πληρούσαν με τις προσχώσεις τους προοδευτικά τη λεκάνη της Καρδίτσας και άρχισαν να σχηματίζουν ένα υδρογραφικό δίκτυο στην πεδιάδα. Παρόλα αυτά, μόνον κατά τους ιστορικούς χρόνους η κοιλάδα της Πηνειάδας επηρεάστηκε από ποτάμιες προσχώσεις αναγκάζοντας την αλλουβιακή πεδιάδα να επεκταθεί προς τα Ανατολικά φθάνοντας μέχρι το υψόμετρο της αναβαθμίδας στο φαράγγι Καλαμακίου. Το τελευταίο αυτό φαινόμενο καθόρισε οριστικά τη συνεχή υδρογραφική σύνδεση ανάμεσα στη Δυτική και Ανατολική Θεσσαλία.

### II.2. Γεωφυσικές έρευνες
*(Απόστολος Σαρρής – Tuna Kalayci – James Donati)*

Η γεωφυσική διασκόπηση μπόρεσε να επισημάνει διάφορες λεπτομέρειες σχετικά με την οικιστική έκταση γύρω από την Πλατιά Μαγούλα Ζάρκου. Επιβεβαίωσε ότι ο οικισμός ιδρύθηκε στο άκρο μιας έντονης πλημμυρικής ζώνης και ότι στη διάρκεια της Μέσης Νεολιθικής περιόδου περιβαλλόταν από δύο ρέματα που έρρεαν από Βορρά προς τις δυτικές και ανατολικές πλευρές της μαγούλας. Οι ταφές του νεκροταφείου προς Βορρά που είχαν αποκαλυφθεί παλαιότερα με ανασκαφές, βρίσκονταν πιθανότατα σε ένα υπερυψωμένο γεωλογικό σχηματισμό στο όριο της πλημμυρικής ζώνης σε συμφωνία με τα συμπεράσματα των Caputo κ. ά.[1274] Η έρευνα παρέσχε ενδείξεις για κτιστούς περιβόλους (ή τάφρους) που περιέβαλαν τη μαγούλα λειτουργώντας, μεταξύ άλλων, ως αντίμετρα κατά των πλημμυρικών επεισοδίων. Η ανθρωπογενής δραστηριότητα σε γενικές γραμμές περιοριζόταν σε ζώνες αμέσως κάτω από τη μαγούλα, με εξαίρεση το Βορειοδυτικό τομέα όπου ένας αριθμός θερμικών κατασκευών απλώνονται αραιά σε απόσταση 70μ. από τη μαγούλα. Μια πυκνότερη διασπορά με κατάλοιπα κατασκευών (της Πρώιμης Εποχής του Χαλκού;) απλώνεται κατά μήκος ενός χαμηλού αναγλύφου προς Νοτιοανατολικά, επιβεβαιώνοντας τη συνέχιση της κατοίκησης σ΄ αυτήν την περιοχή.

## III. Στρωματογραφία και Αρχιτεκτονική
*(Γιώργος Τουφεξής – Χρήστος Μπατζέλας)*

Η Πλατιά Μαγούλα Ζάρκου αποτελεί μια εντυπωσιακή μαγούλα (tell) με αρχαιολογικές επιχώσεις πάχους περ. 10μ., εκ των οποίων πάνω από τις μισές χρονολογούνται στη Μέση και πρώιμη Νεότερη Νεολιθική περίοδο (επιχώσεις πάχους περ. 5.80μ.), ενώ οι υπόλοιπες στην Πρώιμη και Μέση Εποχή του Χαλκού. Οι ανασκαφές διεξήχθησαν το διάστημα 1976–1990 και είχαν στρωματογραφικό προσανατολισμό με στόχο τη χρονολογική αποσαφήνιση της λεγόμενης «φάσης Λάρισα». Αγγεία αυτής της περιόδου βρέθηκαν νωρίτερα στο νεκροταφείο του οικισμού μαζί με γκρίζα αγγεία της «φάση Τσαγγλί». Παρόλα αυτά, η ανάλυση της στρωματογραφίας και της αρχιτεκτονικής του οικισμού αν και διατηρήθηκε πολύ αποσπασματικά, θα μπορούσε να διαφωτίσει κάπως τις πρακτικές δόμησης καθώς και κάποιες πτυχές για τη χρήση του ενδοκοινοτικού χώρου. Συνολικά διακρίθηκαν εννέα οικοδομικές φάσεις (BPh I–IX) με διάφορες υποφάσεις που αντιστοιχούν στις κεραμικές φάσεις 1–6. Με βάση την κεραμεική, οι φάσεις BPh I–VI χρονολογήθηκαν στη Μέση Νεολιθική I–III, η φάση BPh VIIa στη μετάβαση από τη Μέση στη Νεότερη Νεολιθική και οι φάσεις BPh VIIb–IX στη Νεότερη Νεολιθική, καλύπτοντας συνολικά μια περίοδο περ. 400 χρόνων σύμφωνα με τις ραδιοχρονολογήσεις. Η στρωματογραφική ακολουθία ήταν συνεχής σε όλο το πάχος των Νεολιθικών επιχώσεων και δε διαπιστώθηκε διακοπή. Στην αρχαιότερη φάση BPh I αποδόθηκε μόνον ένα τμήμα ρηχής τάφρου που σκάφτηκε στο φυσικό αλλουβιακό έδαφος, ενώ τάφροι δε βρέθηκαν σε άλλες φάσεις. Τα σπίτια ήταν κτισμένα με πασσάλους και άφθονο πηλό πιθανόν σε συνδυασμό πασσάλων και στοιβαχτού πηλού (τεχνική *pisé*)·υπήρχαν, επίσης, σπίτια με τοίχους με χαμηλή λίθινη θεμελίωση και ανωδομή με πλιθιά καθώς και πασσαλόπηκτοι τοίχοι. Στις φάσεις BPh IV και VI τα σπίτια κτίστηκαν το ένα πάνω στο άλλο. Στις φάσεις BPh IV και VII τα σπίτια είχαν καεί, ενώ το γνωστό ομοίωμα σπιτιού βρέθηκε στα καμένα ερείπια ενός σπιτιού της φάσης BPh VIIa. Στη φάση BPh VI βρέθηκαν πιθανόν «βοηθητικά» κτίσματα σπιτιών. Οι θερμικές κατασκευές βρέθηκαν κυρίως σε ανοικτούς χώρους και αυλές καθώς επίσης και στο εσωτερικό κτισμάτων και εξυπηρετούσαν κυρίως μαγειρικές δραστηριότητες. Οι ισοπεδώσεις φαίνεται ότι έπαιξαν σημαντικό ρόλο στη στρωματογραφία του οικισμού και ήταν συχνές εξαιτίας των περιορισμών του οικιστικού χώρου, όπως είναι αναμενόμενο στους οικισμούς τύπου μαγούλας. Επίσης, διαπιστώθηκε εναλλαγή δομημένων και ανοικτών/ημιϋπαίθριων τους ή αυλών. Η ανάλυση αναζήτησε, επίσης, αναλογίες και διαφοροποιήσεις με τους γειτονικούς και πιο μακρινούς οικισμούs.

[1274] Caputo et al., this volume, 48.

## IV. Απόλυτη χρονολόγηση των ανασκαφών: Ραδιοχρονολόγηση και μοντέλα στρωματογραφικής ηλικίας

*(Bernhard Weninger – Γιώργος Τουφεξής – Χρήστος Μπατζέλας)*

Στο κεφάλαιο αυτό, τα δεδομένα των ραδιοχρονολογήσεων του Πίνακα IV.2.1, θα χρησιμοποιηθούν για τον καθορισμό της απόλυτης (ημερολογιακής) χρονολόγησης των Νεολιθικών στρωμάτων της Πλατιάς Μαγούλας Ζάρκου. Η ανάλυση περιλαμβάνει ένα σύνολο δέκα ραδιοχρονολογήσεων σε βραχύβια δείγματα από (αποκλειστικά) οστά ζώων. Τα αποτελέσματα του χρονικού εύρους της στρωματογραφίας με χρονολογήσεις΄Ανθρακα-14 ($^{14}C$) παρουσιάζονται στην Εικόνα IV.2.5. Η ανάλυση βασίστηκε στην Gaussian Monte Carlo Προσομοίωση Κυμάνσεων (GMCWM), όπως εφαρμόστηκε στο πρόγραμμα CalPal (Έκδοση 2019.5). Όπως αποδείχθηκε, εξαιτίας της έλλειψης σε μεγάλο βαθμό αυξομειώσεων στην καμπύλη βαθμονόμησης με $^{14}C$ στην υπό μελέτη περίοδο (5900–5500 calBC), σε συνδυασμό με την εξαιρετική γραμμικότητα που παρουσιάζει η συσσώρευση των νεολιθικών επιχώσεων της Πλατιάς Μαγούλας Ζάρκου και την υψηλή ακρίβεια των χρονολογήσεων με $^{14}C$ που πραγματοποιήθηκαν στο Εργαστήριο της Χαϊδελβέργης-AMS, η εφαρμογή του μοντέλου GMCWM παρήγαγε, επίσης, ασυνήθιστα ακριβή χρονολογικά αποτελέσματα. Ωστόσο, αν και οι αποκλίσεις στις ηλικίες που βασίζονται στην επεξεργασία με το μοντέλο Monte Carlo κυμαίνονται από ένα 1 έως δέκα τέσσερα έτη (πιθανότητα 95%), υποστηρίζουμε, ωστόσο, ότι τα αληθινά (πραγματικά) σφάλματα χρονολόγησης είναι πιθανότερο της τάξης των 20–50 ετών (95% πιθανότητα). Η επιφύλαξη αυτή στην ερμηνεία των σφαλμάτων χρονολόγησης θα ενδεικνυόταν, ιδιαιτέρως, προκειμένου να προληφθεί η έλλειψη (ποσοτικής) κατανόησης των πολιτισμικών, γεωφυσικών και ιζηματολογικών διαδικασιών που εμπεριέχονται στις παρατηρούμενες (μετρικές) κανονικότητες (τουλάχιστον) στην κατακόρυφη συσσώρευση των επιχώσεων της μαγούλας.

## V. Τα εργαλεία

### V.1. Τα σύνολα εργαλείων λαξεμένου λίθου

*(Catherine Perlès – Λυγερή Παπαγιαννάκη)*

Οι λιθοτεχνίες λαξεμένου λίθου από την Πλατιά Μαγούλα Ζάρκου μελετήθηκαν παράλληλα από τεχνολογική και ιχνολογική σκοπιά, με σκοπό να διαπιστωθούν διαχρονικές αλλαγές στις στρατηγικές προμήθειας των πρώτων υλών, στις τεχνικής κατασκευής καθώς και στους τύπους και τις χρήσεις των εργαλείων στη διάρκεια της Μέσης Νεολιθικής και στη μετάβαση από τη Μέση στη Νεότερη Νεολιθική. Βάσει των παραπάνω, προσδιορίστηκαν πέντε φάσεις. Οι πρώτες τέσσερις παρουσιάζουν αδιαμβισβήτητη συνέχεια από όλες τις απόψεις, αν και μπορούν να παρατηρηθούν, επίσης, πιο μακροπρόθεσμες τάσεις. Η τελευταία φάση που χρονολογείται στην πρώιμη Νεότερη Νεολιθική διαφέρει πιο έντονα. Τα σύνολα των εργαλείων είναι μικρά σε αριθμό, γεγονός που μπορεί να αποδοθεί στην απουσία τοπικών πρώτων υλών και στο ότι παρά την τοποθεσία της που θα φαινόταν ευνοϊκή, η Πλατιά Μαγούλα Ζάρκου φαίνεται ότι παρέμεινε σε περιθωριακή θέση όσον αφορά τα δίκτυα ανταλλαγών του ραδιολαρίτη και οψιανού στη Θεσσαλία. Τρεις τρόποι παραγωγής εργαλείων μπορούν να αναγνωριστούν: πρώτον, μια τοπική μη ειδικευμένη παραγωγή φολίδων από ποταμίσια βότσαλα. Το υψηλό ποσοστό επεξεργασμένων και μη φολίδων σε σύγκριση με τις λεπίδες και τις μικρολεπίδες είναι πράγματι μία από τις ιδιαιτερότητες των συνόλων εργαλείων της Πλατιάς Μαγούλα Ζάρκου. Δεύτερον, μια περιορισμένη τοπική παραγωγή μικρολεπίδων οψιανού από πλανόδιους τεχνίτες και τρίτον, μία περιορισμένη διακίνηση λεπίδων από «κοινούς» πυριτόλιθους (chert) και μελί πυριτόλιθο. Δεδομένης της περιορισμένης πρόσβασης σε πρώτες ύλες, ο βαθμός επεξεργασίας των εργαλείων είναι υψηλός και τα εργαλεία ήταν συχνά εντόνως επεξεργασμένα. Τα ένθετα στοιχεία δρεπανιών επικρατούν στις πρώτες τρεις φάσεις αλλά στη συνέχεια ελαττώνονται, όπως συμβαίνει και στα στοιχεία δρεπανιών σε υπόβαθρο φολίδας που επικρατούν στις πιο πρώιμες φάσεις. Στον εργαλειακό εξοπλισμό μπορεί να παρατηρηθεί μία προοδευτική διαφοροποίηση. Η επεξεργασία

δερμάτων είναι η καλλίτερα αντιπροσωπευόμενη δραστηριότητα μετά το θερισμό αλλά τα εργαλεία που χρησιμοποιήθηκαν ήταν ποικίλα -ξέστρα , φολίδες, λεπίδες- και μη εξειδικευμένα. Στη φάση 5 το ποσοστό του οψιανού είναι ασήμαντο αλλά η τυπολογική σύνθεση είναι πιο ισορροπημένη και το εύρος των υλικών που επεξεργάζονται είναι περισσότερο διαφοροποιημένο: δημητριακά, ξύλο, δέρματα. Τα όπλα είναι, επίσης, σπάνια με λίγες τράπεζες και αιχμές βελών με εγκάρσια επεξεργασία στις φάσεις 3 και 4, ενώ απουσιάζουν τα κοπτικά εργαλεία για την επεξεργασία κρέατος. Όλοι οι τύποι εργαλείων που βρέθηκαν στην Πλατιά Μαγούλα Ζάρκου είναι γνωστοί από άλλους οικισμούς της Θεσσαλίας, αν και συχνά είναι σπάνιοι: για παράδειγμα, οι αιχμές βέλους με εγκάρσια επεξεργασία, οι λεπίδες-δρεπάνια που φέρουν μπροστινή απόληξη ξέστρου και τα ένθετα στοιχεία δρεπανιών σε φολίδες με απότομη πλευρική επεξεργασία. Η καλή αντιπροσώπευση αυτών των σπάνιων τύπων εργαλείων στη λιθοτεχνία λαξεμένου λίθου της Πλατιάς Μαγούλας Ζάρκου σε συνδυασμό με την απουσία άλλων τύπων, όπως οι σφηνίσκοι σε υπόβαθρο λεπίδων, τη διακρίνει από τα σύνολα λιθοτεχνίας άλλων οικισμών και ενισχύει την εντύπωση μιας αξιοσημείωτης ιδιοσυγκρασιακής συνέχειας, ιδιαίτερα στη Μέση Νεολιθική. Η αλληλεπίδραση μεταξύ της διαθεσιμότητας των πρώτων υλών, των δραστηριοτήτων που λάμβαναν χώρα στην Πλατιά Μαγούλα Ζάρκου και των τύπων των εργαλείων που επιλέχθηκαν για τη διεκπεραίωσή τους, προσδίδει μια ισχυρή και ξεχωριστή προσωπικότητα στις λιθοτεχνίες λαξεμένου λίθου της Πλατιάς Μαγούλας Ζάρκου.

### V.1.11. Παράρτημα 3. Γεωχημική προέλευση των εργαλείων λαξεμένου λίθου της Πλατιάς Μαγούλας Ζάρκου

*(Michael Brandl – Christoph A. Hauzenberger – Peter Filzmoser – Maria M. Martinez)*

Οι μελέτες για την προέλευση των λίθινων πρώτων υλών για την παραγωγή εργαλείων, αποτελεί ένα από τα κλειδιά για την ανασύσταση της προϊστορικής οικονομίας. Η εξακρίβωση της γεωλογικής προέλευσης των λίθινων τέχνεργων επιτρέπει περαιτέρω έρευνες και έλεγχο υποθέσεων στο πλαίσιο ή τη διαχείριση των πόρων διατυπώνοντας ερωτήματα σχετικά με τις στρατηγικές προμήθειάς τους. Στην περίπτωση μελέτης από την Πλατιά Μαγούλα Ζάρκου η Πολυεπίπεδη Προσέγγιση Προμήθειας Πυριτόλιθου (Multi Layered Chert Sourcing Approach – MLA) οδήγησε σε μια σαφή διαφοροποίηση των πυριτικών πετρωμάτων (πυριτόλιθου και ραδιοαλαρίτη) της Θεσσαλίας συνδυάζοντας πετρογραφικές έρευνες, γεωχημικές αναλύσεις ιχνοστοιχείων με τη χρήση LA-ICP-MS και τη στατιστική αξιολόγηση δεδομένων με τη Συνθετική Ανάλυση Δεδομένων (Compositional Data Analysis-CODA). Στην Πλατιά Μαγούλα Ζάρκου ο πυριτόλιθος και ο ραδιολαρίτης χρησιμοποιήθηκαν ευρέως για την παραγωγή εργαλείων λαξεμένου λίθου, αλλά ποτέ στο παρελθόν δεν είχαν διεξαχθεί συστηματικές έρευνες για την προέλευσή τους. Το πιλοτικό πρόγραμμά μας μπόρεσε να αποκαλύψει την προέλευση επιλεγμένων λίθινων εργαλείων του οικισμού, να εντοπίσει πρωτογενείς και δευτερογενείς πηγές του αινιγματικού «ραδιολαρίτη της Πίνδου» και να προσδιορίσει την οροσειρά του Κόζιακα με τα γειτονικά ποτάμια της ως μια εκτεταμένη πηγή προέλευσής του για τις πρώιμες γεωργοκτηνοτροφικές κοινότητες της Δυτικής Θεσσαλικής πεδιάδας.

## V.2. Τα μακρολιθικά εργαλεία της Πλατιάς Μαγούλας Ζάρκου: μια Θεσσαλική λιθοτεχνία στο Αιγαιακό Νεολιθικό της πλαίσιο

*(Άννα Στρούλια)*

Παρά την σημαντική πρόοδο που έχει σημειωθεί πρόσφατα στη μελέτη των μακρολιθικών (γνωστών και ως τριπτών) αντικειμένων του Νεολιθικού Αιγαίου, οι γνώσεις μας για τις σχετικές λιθοτεχνίες της Θεσσαλίας είναι πολύ περιορισμένες. Εστιάζοντας στο υλικό της Πλατιάς Μαγούλας Ζάρκου, το συγκεκριμένο κεφάλαιο έχει ως στόχο να συμβάλει στην αντιμετώπιση αυτού του ερευνητικού κενού. Η ανασκαφή των Νεολιθικών επιχώσεων της θέσης απέδωσε περίπου 130 *μακρολιθικά* τέχνεργα. Η πλειονότητά τους ανήκει στη Μέση Νεολιθική περίοδο, περίπου το ένα τέταρτο χρονολογείται στη Νεότερη Νεολιθική, ενώ ένας μικρός αριθμός αποδίδεται στη μεταβατική περίοδο ανάμεσα στις δύο φάσεις. Με βάση τεχνομορφολογικά

χαρακτηριστικά, το υλικό διακρίθηκε σε πέντε κατηγορίες: 1) εργαλεία τριβής και λείανσης 2) εργαλεία με κόψη 3) εργαλεία κρούσης 4) εργαλεία με στενές αυλακώσεις και 5) διάφορα. Το κεφάλαιο κινείται σε τρεις κατευθύνσεις καθώς παρουσιάζει συστηματικά τα εργαλεία της κάθε κατηγορίας ακολουθώντας τα κύρια στάδια της βιογραφίας τους, συζητά τα συγχρονικά/διαχρονικά συμφραζόμενά τους και θέτει τη συγκεκριμένη Θεσσαλική λιθοτεχνία στο ευρύτερο Αιγαιακό Νεολιθικό της πλαίσιο.

### V.3. Οστέινα εργαλεία
*(Ροζαλία Χρηστίδου)*

Δεκαεννέα οστέινα αντικείμενα από τα στρώματα της Μέσης και πρώιμης Νεότερης Νεολιθικής της Πλατιάς Μαγούλας Ζάρκου στη Θεσσαλία μελετήθηκαν από μορφολογική και τεχνολογική άποψη, για να συμπληρώσουν την προηγούμενη παρουσίαση των επεξεργασμένων οστών από αυτή τη θέση. Εξετάστηκε επίσης η διατήρηση των αντικειμένων. Οι αλλοιώσεις τους από τη μάσηση από ζώα, την αποσάθρωση και την καύση συσχετίστηκαν, όταν ήταν δυνατό, με τα ιδιαίτερα χαρακτηριστικά των ανασκαμμένων επιχώσεων. Μόνον ένα αντικείμενο, ένα μετατάρσιο κόκκινου ελαφιού, που αυλακώθηκε με σκοπό τον κατά μήκος τεμαχισμό του, κατατάσσεται στα κατάλοιπα επεξεργασίας των οστών·τα υπόλοιπα είναι ολοκληρωμένα από κατασκευαστική άποψη και χρησιμοποιημένα εργαλεία, από τα οποία δεκατρία είχαν αιχμηρό ενεργό άκρο και δύο απέληγαν σε κόψη. Τέσσερα διατηρούν ίχνη επιδιόρθωσης του ενεργού άκρου. Μοναδικό στη Νεολιθική συλλογή είναι μεσαίο θραύσμα λειαντήρα από πλευρά βοδιού, το οποίο έδειξε ότι αυτό το τμήμα του εργαλείου ήταν ενεργό. Το αυλακωμένο μετατάρσιο κόκκινου ελαφιού συσχετίστηκε με ζωοαρχαιολογικά δεδομένα που δείχνουν τη σφαγή αυτού του είδους θηράματος εκτός του κατοικημένου χώρου και τη μεταφορά επιλεγμένων μερών του σώματός του στον οικισμό. Τα περισσότερα αντικείμενα ήταν κατασκευασμένα από θραύσματα σπασμένων οστών που απαντούν συχνά στα απορρίμματα του οικισμού και προέρχονται κυρίως από αιγοπρόβατα και χοίρους. Υποδεικνύουν επάρκεια των πρώτων υλών των οστέινων εργαλείων. Οι τύποι των θραυσμάτων έδειξαν επιλεκτικότητα εκ μέρους των κατασκευαστών των εργαλείων. Συσχετίστηκαν επίσης με τους τρόπους διαμόρφωσης αυτών των αντικειμένων. Αυτή γινόταν συνήθως χωρίς μεγάλη προσπάθεια, ξύνοντας με την κόψη λίθινου εργαλείου. Η τριβή με λεπτόκοκκα υλικά αποσκοπούσε σε μικρής έκτασης επεμβάσεις. Αδρή επεξεργασία παρατηρήθηκε κατά την αφαίρεση μεγαλύτερης ποσότητας οστού και μεγαλύτερης μεταβολής της μορφής του. Αφορούσε συγκεκριμένες διαδικασίες κατασκευής οπέων από μεταπόδια αιγοπροβάτων, οι οποίες είναι γνωστές και από άλλα σύνολα Νεολιθικών οστέινων εργαλείων από τη Θεσσαλία. Η χρήση θραυσμάτων που προήλθαν από σπειροειδείς και λοξές τομές των κνημών των ίδιων ζώων αποτελεί ακόμη ένα χαρακτηριστικό αυτών των συνόλων. Δεν υπάρχουν αρκετά δημοσιευμένα στοιχεία για να γίνει σύγκριση της προέλευσης και της μορφολογίας των παρασχίδων από επιμήκη οστά, οι οποίες συνιστούν ένα αξιοσημείωτο χαρακτηριστικό των οστέινων εργαλείων από την Πλατιά Μαγούλα Ζάρκου. Αλλιώς η χρήση παρασχίδων είναι γνωστή από τη Νεολιθική Θεσσαλία. Παρά το μικρό αριθμό αντικειμένων που εξετάστηκε, διαφάνηκε ποικιλία στις πρώτες ύλες, τους τρόπους διαμόρφωσης, τους τύπους και το μέγεθος των εργαλείων. Τα δεδομένα από την ανάλυση των ιχνών χρήσης των εργαλείων έδειξαν ότι αυτά χρησιμοποιήθηκαν για την απόξεση και τη διάτρηση μαλακών υλικών ζωικής προέλευσης και την επεξεργασία φυτικών ινών. Η επεξεργασία δερμάτων ήταν συχνότερη, δεδομένο που συμφωνεί με τα αποτελέσματα της ανάλυσης των εργαλείων από αποκρουσμένο λίθο. Διαπιστώθηκαν διαφορές στο βαθμό φθοράς των οστέινων εργαλείων. Μάλιστα, η απόρριψη των οπέων που χρησίμευσαν στην επεξεργασία ζωικών πρώτων υλών συσχετίστηκε με δυσκολίες στην αποκατάσταση της αιχμής αυτών των εργαλείων χωρίς σημαντική τροποποίηση της μορφής και του μεγέθους τους. Η μελέτη της χρήσης των εργαλείων συνέβαλε στην καλύτερη κατανόηση των τύπων και των διαστάσεών τους. Τα συμπεράσματα της ανάλυσης παρουσιάζονται στο τέλος του κεφαλαίου.

V.4. Πήλινα εργαλεία γνεσίματος και υφαντικής
*(Christopher Britsch)*
V.5. Διάφορα εργαλεία από πηλό και όστρακα
*(Eva Alram-Stern)*

Το κεφάλαιο αυτό πραγματεύεται πήλινα αντικείμενα ή όστρακα που τροποποιήθηκαν για δευτερογενή χρήση. Εκτός από τρία σφοντύλια που προέρχονται από οικιστικά στρώματα της πρώιμης Νεότερης Νεολιθικής, δισκοειδή διάτρητα όστρακα κυρίως από στρώματα της Μέσης Νεολιθικής εξετάζονται για την πιθανή χρήση τους ως σφοντύλια. Τέσσερα πήλινα υφαντικά βάρη από στρώματα της πρώιμης την Νεότερης Νεολιθικής δείχνουν μια πιο εξειδικευμένη υφαντουργία στον οικισμό κατά διάρκεια αυτής της περιόδου. Τα βλήματα σφενδονών από στρώματα της Μέσης και πρώιμης Νεότερης Νεολιθικής κατασκευάστηκαν αποκλειστικά από πηλό. Αντικείμενα με ωοειδές σχήμα από αδρό χαλικώδη πηλό ερμηνεύτηκαν ως ξέστρα. Τα αποστρογγυλεμένα όστρακα διαφορετικών μεγεθών είναι περισσότερα στα στρώματα της πρώιμης Νεότερης Νεολιθικής. Με βάση την ποικιλία ως προς το μέγεθος και το μεγάλο αριθμό τους σ' αυτά τα μεταγενέστερα στρώματα, τα αντικείμενα αυτά δε θεωρούνται ως ημιτελή προϊόντα των διάτρητων δισκοειδών οστράκων και δίνονται διάφορες ερμηνείες για τη χρήση τους. Τα οκτώσχημα εργαλεία από όστρακα είχαν πιθανόν την ίδια χρήση. Αρκετά όστρακα με λείες ακμές ίσως χρησιμοποιήθηκαν ως λειαντήρες.

## VI. Ειδώλια, ομοίωμα οικίας και τελετουργικά σκεύη
*(Eva Alram-Stern)*

Ακολουθώντας τη στρωματογραφική ακολουθία της Τομής Α της Πλατιάς Μαγούλας Ζάρκου, τα ειδώλια αναλύθηκαν ως προς την κατασκευή, τη διακόσμηση, την τυπολογία, τις συνθήκες εύρεσης και τη θραύση τους, φανερώνοντας σημαντικές αλλαγές στην τυπολογία και την εναπόθεσή τους στη διάρκεια της ύστερης Μέσης Νεολιθικής περιόδου. Ενώ τα στεατοπυγικά ειδώλια είναι χαρακτηριστικά για τις φάσεις της πρώιμης Μέσης Νεολιθικής περιόδου (BPh II–V), στη Μέση Νεολιθική III καθώς και στη μεταβατική φάση της Μέσης/Νεότερης Νεολιθικής περιόδου κυριαρχούν τα σχηματοποιημένα ειδώλια. Τα ειδώλια της Νεότερης Νεολιθικής I προσδιορίζονται μόνον από ευρήματα σε μετα-νεολιθικά στρώματα και χαρακτηρίζονται από την παραγωγή τους σύμφωνα με τα τυπικά κεραμικά σκεύη της Νεότερης Νεολιθικής περιόδου. Συγκρίνοντάς τα με άλλα ευρήματα της Θεσσαλίας και πέραν αυτής, τα ειδώλια της Πλατιάς Μαγούλας Ζάρκου φανερώνουν μακρινές σχέσεις αλλά και περιφερειακές ομοιότητες που είναι ορατές κυρίως κατά τη Μέση Νεολιθική III και τη μεταβατική φάση της Μέσης/Νεότερης Νεολιθικής περιόδου, οι οποίες δείχνουν την ύπαρξη δικτύων που συνδέουν την Πλατιά Μαγούλα Ζάρκου με τις γειτονικές θέσεις της Δυτικής Θεσσαλίας. Ένα από τα σπουδαιότερα ευρήματα της Πλατιάς Μαγούλας Ζάρκου είναι το ομοίωμα σπιτιού με τα ειδώλια και τις μινιατούρες του που βρέθηκαν in situ, τα οποία αξιολογούνται σε ξεχωριστό μέρος του παρόντος κεφαλαίου στα συμφραζόμενά τους συσχετίζοντας τα ειδώλια μεταξύ τους. Συνοπτικά, το ομοίωμα σπιτιού σχετίζεται με το στρώμα καταστροφής της Μέσης Νεολιθικής III/Νεότερης Νεολιθικής I (BPh VIIa) και επομένως με την ταφή του σπιτιού του. Έτσι, η ξαπλωμένη στάση των ειδωλίων που είχε σχεδιαστεί εξ΄ αρχής, δείχνει ότι τα ειδώλια προσλαμβάνονταν ως να είχαν τοποθετηθεί για να κοιμηθούν, πιθανόν για πάντα. Επιπλέον, το ομοίωμα σπιτιού είναι ένα ομοίωμα μιας κοινωνικής ομάδας που αποτελείται από μια εκτεταμένη οικογένεια καθώς και από μια γυναίκα που συνδέεται μαζί τους με τις δραστηριότητές της στο νοικοκυριό. Αυτό το ομοίωμα δείχνει ότι ο ρόλος των γυναικών ήταν πιο ενεργός στο σπίτι, ενώ οι άνδρες έπαιζαν δευτερεύοντα ρόλο έχοντας τα κύρια καθήκοντά τους εκτός σπιτιού. Το υλικό που παρουσιάστηκε εδώ συμπληρώνεται από ειδώλια ζώων, προσαρτήματα σκευών, ανθρωπόμορφα σκεύη, μία τράπεζα και ένα μικύλλο αγγείο.

## VII. Τα κοσμήματα
*(Νίνα Κυπαρίσση-Αποστολίκα)*

Ο κατάλογος κοσμημάτων της Πλατιάς Μαγούλας Ζάρκου είναι περιορισμένος, αποτελούμενος μόνον από 16 αντικείμενα, 11 από τα οποία προέρχονται από Νεολιθικές επιχώσεις. Παρά τον περιορισμένο αριθμό τους, χρησιμοποιήθηκαν για την κατασκευή τους όλα τα συνήθη υλικά που συναντώνται σε άλλες Νεολιθικές θέσεις, όπως τα όστρεα, ο λίθος και ένα δόντι ζώου..Μεταξύ αυτών υπάρχουν δύο βραχιόλια διαφορετικού τύπου, μια μεγάλη βαρελόσχημη χάντρα και μία διάτρητη θύρα από το θαλάσσιο όστρεο *Spondylus gaederopus*·επιπλέον, από όστρεο ήταν κατασκευασμένα και τρία αντικείμενα με ένα ζευγάρι οπών το καθένα, τα οποία τώρα λείπουν. Δύο κοσμήματα από βότσαλα ήταν επίσης διάτρητα. Από την ομάδα των πήλινων κοσμημάτων δηλαδή των χαντρών, ένα που βρέθηκε σε βαθιά Νεολιθική επίχωση παρουσιάζει φυσικό καμπύλο σχήμα, ενώ τα άλλα από την επίχωση της Εποχής του Χαλκού είχαν πιο έντεχνα σχήματα και δεν περιλαμβάνονται στη δημοσίευση. Ένα διάτρητο δόντι ζώου φέρει διακοσμητικές εγχαράξεις, ενώ υπάρχει ένα κυκλικό αντικείμενο χωρίς οπή με αμφίβολη χρήση. Κρίνοντας από τον μικρό αριθμό των κοσμημάτων που βρέθηκαν, μπορούμε να υποθέσουμε ότι αυτά δεν κατασκευάστηκαν in situ αλλά μάλλον είχαν εισαχθεί στον οικισμό ως πολύτιμα αντικείμενα. Εξαίρεση θα μπορούσαν να αποτελέσουν τα τρία αντικείμενα που λείπουν και βρέθηκαν όλα μαζί, καθώς είναι όμοια στυλιστικά, ενώ διαφέρουν από τα υπόλοιπα, και θα μπορούσαν να είχαν κατασκευαστεί από ένα ντόπιο «καλλιτέχνη». Παρά τη σπανιότητά τους, τα κοσμήματα της Πλατιάς Μαγούλας Ζάρκου μπορούν να προσφέρουν σημαντικές πληροφορίες για την προέλευση και την περίοδο στην οποία κυκλοφόρησαν. Χωρίς αμφιβολία, καθώς πολύ μικρό τμήμα του οικισμού ανασκάφηκε μέχρι τώρα, μια πιο εκτεταμένη ανασκαφή στο μέλλον θα μπορούσε να αναιρέσει αυτήν την εκτίμηση.

## VIII. Αρχαιοβοτανικά και ζωοαρχαιολογικά κατάλοιπα – Επανεξέταση
*(Paul Halstead)*

Τα αρχαιοβοτανικά και (πιο άφθονα) ζωοαρχαιολογικά κατάλοιπα που βρέθηκαν σε στρώματα της Νεολιθικής και της Εποχής του Χαλκού της Πλατιάς Μαγούλας Ζάρκου μελετήθηκαν και παρουσιάστηκαν στη δεκαετία του 1990. Τα πρώτα ταυτίστηκαν από τους Helmut Kroll και Glynis Jones και παρουσιάστηκαν από τη Becker[1275] και τους Jones – Halstead[1276] αντιστοίχως. Τα δεύτερα μελετήθηκαν από την Cornelia Becker.[1277] Κανένα από τα σύνολα αυτά δεν εξετάστηκε εκ νέου για το παρόν σύντομο, άρθρο σκοπός του οποίου είναι να αξιολογήσει τις αρχικές δημοσιεύσεις υπό το φως των σχετικών μεταγενέστερων ανακαλύψεων και συζητήσεων. Αυτή η ανασκόπηση ξεκινά εξετάζοντας πόσο τυπικά ή άτυπα είναι τα δεδομένα της Πλατιάς Μαγούλας Ζάρκου στο πλαίσιο της Νεολιθικής και της Εποχής Χάλκου στην Ελλάδα, πριν συζητηθούν γενικότερα θέματα για τη χρήση γης και την κατανάλωση τροφής.

## IX. Το φυσικό και κοινωνικό τοπίο της Πλατιάς Μαγούλας Ζάρκου
*(Στέλλα Σουβατζή)*

Η μελέτη εξετάζει το φυσικό και κοινωνικό τοπίο της Πλατιάς Μαγούλας Ζάρκου (ΠΜΖ) κατά τη Νεολιθική περίοδο και τους τρόπους με τους οποίους οι άνθρωποι διαμόρφωναν και προσλάμβαναν τον χώρο, μέσα από συνδυαστική ανάλυση γεωλογικών, γεωφυσικών, περιβαλλοντικών, στρωματογραφικών, αρχιτεκτονικών και οικιστικών δεδομένων, καθώς επίσης

[1275] Becker 1991, 77–78 tab. 14.
[1276] Jones – Halstead 1993.
[1277] Becker 1991; Becker 2000.

και στοιχείων από τα διατροφικά κατάλοιπα και τον υλικό πολιτισμό. Το τοπίο προσεγγίζεται ως κοινωνική και ιστορική κατασκευή και η σχέση του ανθρώπου με το περιβάλλον ως δυναμική και σε διαρκή αλληλεπίδραση. Κεντρικά ζητήματα της μελέτης περιλαμβάνουν: α) την αντενέργεια ανθρώπων και περιβάλλοντος, με ιδιαίτερη έμφαση στις τοπικές ιδιαιτερότητες και τις ενδείξεις για συχνά πλημμυρικά επεισόδια στον περιβάλλοντα χώρο της μαγούλας, β) την πιθανή παρουσία περιμετρικών τάφρων και της λειτουργίας τους, γ) τον τύπο οικισμού που διαπιστώνεται στην ΠΜΖ και την κοινωνική και ιστορική σημασία αυτού του τύπου, δ) την ύπαρξη ενός σπάνιου νεκροταφείου καύσεων, της σχέσης του με τον οικισμό και της συμβολικής του νοηματοδότησης, και ε) τη θέση της ΠΜΖ στο ευρύτερο κοινωνικο–πολιτισμικό τοπίο της Νεολιθικής Θεσσαλίας, μέσα από διεξοδική ανάλυση των οικιστικών τύπων και διατάξεων, καθώς και των ομοιοτήτων, διαφορών και σχέσεων μεταξύ της ΠΜΖ και άλλων σύγχρονών της θέσεων. Οι φυσικές, κοινωνικές, χωρικές και χρονικές πρακτικές που αναλύονται στη μελέτη καταδεικνύουν ότι παρά τη μάλλον απομακρυσμένη θέση της και τα πιθανά προβλήματα με τις πλημμύρες, η Πλατιά Μαγούλα Ζάρκου ήταν ένας σύνθετος και δυναμικός οικισμός. Αντενεργούσε ποικιλοτρόπως με το φυσικό και κοινωνικό του περιβάλλον και πιθανόν αποτελούσε έναν κοινωνικά σταθερό χώρο μέσα σε ένα ευρύτερο τοπίο που χαρακτηριζόταν από ποικιλομορφία και αλλαγές. Τα αποτελέσματα της μελέτης προσφέρουν νέα οπτική στη σχέση των ανθρώπων με τη γη και τον χρόνο και υποστηρίζουν μια πιο δυναμική θεώρηση της ανθρώπινης αντιληπτικότητας, ενέργειας και γνώσης κατά το παρελθόν.

## Χ. Η Πλατιά Μαγούλα Ζάρκου στο ευρύτερο πολιτισμικό της πλαίσιο: Ανακεφαλαίωση και Συμπεράσματα

*(Eva Alram-Stern – Γιώργος Τουφεξής)*

Το κεφάλαιο συνοψίζει τα συμπεράσματα και τις εισηγήσεις αυτού του τόμου. Από τη συνδυαστική εξέτασή τους προκύπτει μια νέα εικόνα για αυτή τη μαγούλα που παρουσιάζει συνεχή κατοίκηση. Ειδικότερα, η ενσωμάτωση των ευρημάτων στην απόλυτη και σχετική χρονολογική ακολουθία του οικισμού, επιτρέπει μια νέα κατανόηση της πολιτισμικής αλλαγής που συντελέστηκε στη διάρκεια της Μέσης Νεολιθικής (5969–5754 π.Χ. [βαθμονομημένες ηλικίες [2σ]] και της πρώιμης Νεότερης Νεολιθικής (τελευταία απόλυτη χρονολόγηση: 5545–5472 π.Χ. [βαθμονομημένες ηλικίες [2σ]]: συγκρίνοντας τους έξι κεραμικούς ορίζοντες με τις πέντε λιθοτεχνικές φάσεις (οι οποίες καθορίστηκαν για τα εργαλεία λαξεμένου λίθου) και τους τρεις ορίζοντες ειδωλίων, αντιλαμβανόμαστε ότι όλες οι ομάδες των τεχνέργων παρουσιάζουν συνεχή εξέλιξη στη διάρκεια της ΜΝ Ι και ΙΙ. Ωστόσο, μια ευδιάκριτη πολιτισμική αλλαγή είναι εμφανής στη ΜΝ ΙΙΙ, στη μετάβαση από τη ΜΝ ΙΙΙ προς τη ΝΝ Ι (Κεραμικός Ορίζοντας 5) καθώς και στη ΝΝ Ι (Κεραμικός Ορίζοντας 6). Σε όλες αυτές τις ομάδες τεχνέργων, οι αλλαγές στην τεχνοτροπία και στους τύπους σχετίζονται με μια διαφορετική χρονολογική φάση. Για τη ΝΝ Ι, είναι εμφανής μια νέα τεχνοτροπία (κεραμική, ειδώλια) και νέοι τύποι τεχνέργων (εργαλεία λαξεμένου λίθου). Επομένως, θα πρέπει να θεωρήσουμε αυτήν την περίοδο ως μια φάση που αντιπροσωπεύει νέες πολιτισμικές δυναμικές. Η εικόνα αυτή επιβεβαιώνεται από την αλλαγή που παρατηρείται στα υφαντικά εργαλεία, στα αποστρογγυλεμένα όστρακα και στα κοσμήματα. Επιπλέον, για την ΠΜΖ, τα περιφερειακά δίκτυα κατανομής της Δυτικής Θεσσαλίας καθορίζονται από την κυκλοφορία του ραδιολαρίτη (από την οροσειρά της Πίνδου) και από τα ειδώλια που υποδεικνύουν τη διασύνδεση των κοινοτήτων της Δυτικής Θεσσαλικής πεδιάδας. Οι διαπεριφερειακές επαφές με τη θάλασσα επιβεβαιώνονται από την ύπαρξη οψιανού από τη Μήλο και λίγα κοσμήματα από θαλάσσια όστρεα. Συνοψίζοντας, θεωρούμε την ΠΜΖ ως ένα κομβικό σημείο που συνδέει τη Δυτική και Ανατολική Θεσσαλική πεδιάδα. Καθώς, ωστόσο, πολλές θέσεις της Δυτικής Θεσσαλίας βρίσκονται ακόμη σε στάδιο μελέτης, δεν είμαστε σε θέση να προσδιορίσουμε με ακρίβεια την κοινωνική και οικονομική θέση της ΠΜΖ μέσα σ΄ αυτό το δίκτυο ανταλλαγών. Επιπλέον, η πολιτισμική ανάπτυξή της πρέπει να εξεταστεί σε σχέση με αυτές τις θέσεις.

# Abbreviations

| | |
|---|---|
| AMS | High resolution mass spectrometry technique |
| AT | active tool |
| BC | Before Christ |
| BP | Before Present |
| BPh | (Platia Magoula Zarkou) Building Phase |
| BSPh | (Platia Magoula Zarkou) Building Subphase |
| C | Carbon |
| c | complete |
| c- | nearly complete |
| calcul. | calculated |
| CalPal | Cologne Radiocarbon Calibration & Paleoclimate Research Package |
| CH | Ceramic Horizon |
| CODA | Compositional data analysis |
| CP | Chronological Phase |
| CSNDF | Chisquared cumulative distribution function |
| CTR | Centre for Textile Research Copenhagen |
| cu | cut |
| DA | Discriminant analysis |
| DEM | Digital elevation model |
| Diam. | diameter |
| Dim. | dimension |
| DLR | Deutsches Zentrum für Luft- und Raumfahrt (German Aerospace Center) |
| EBA | Early Bronze Age |
| EMI | Electromagnetic induction |
| EN | Early Neolithic |
| ENE | East-northeast(ern) |
| ESE | East-southeast(ern) |
| EU | Excavation unit |
| ext. | exterior |
| F | Floor |
| f | fragmented |
| fl | flaking |
| Frag. | fragment/fragmented |
| GPR | Ground penetrating radar |
| GPS | Global Position System |
| GMCWM | Gaussian Monte Carlo Wiggle Matching |
| H | height |
| HAGS | Hellenic Army Geographical Service |
| HVSR | Horizontal to vertical spectral ratio |
| IGEAN | Project ‘Innovative Geophysical Approaches for the Study of Early Agricultural Villages of Neolithic Thessaly’ (Sarris et al. 2017b) |
| INAA | Instrumental neutron activation analysis |
| int. | interior |
| IntCal | Radiocarbon calibration curve |
| Inv. no. | Inventory number |
| ka | thousands of years (kilo annum) |
| KOU | Koziakas Ophiolitic Unit |
| LA-ICP-MS | Laser ablation inductively coupled mass spectrometry |
| Lg | length |
| Lg/Wd | length/width ratio |
| LGM | Last glacial maximum |
| LN | Late Neolithic |

| | |
|---|---|
| LP | Lithic Phase |
| LTNS | Project 'Long Time, No See: Land Reclamation and the Cultural Record of the Central-Western Plain of Thessaly' (Orengo et al. 2015; Krahtopoulou 2019a) |
| Ma | Mega annum |
| MAMS | Mainz accelerator mass spectrometry |
| m asl | metres above sea level |
| MBA | Middle Bronze Age |
| meas. | measured |
| MED | Multi-coil Electromagnetic Device |
| MLA | Multi Layered Chert Sourcing Approach |
| MN | Middle Neolithic |
| Myr | Mega year |
| N | Nitrogen |
| n/a | not applicable |
| no./s. | number/s |
| NE | Northeast(ern) |
| NISP | Numbers of identified specimens |
| NNE | North-northeast(ern) |
| NNW | North-northwest(ern) |
| NW | Northwest(ern) |
| PM No./s. | Platia Magoula Zarkou Inventory Numbers |
| PMZ | Platia Magoula Zarkou, Πλατιά Μαγούλα Ζάρκου |
| Pref. | Prefecture |
| Pres./pres. | preservation/preserved |
| Prov. | provenience |
| PT | passive tool |
| PT+AT | tool used both passively and actively |
| pub. | published |
| PVP | Peneiada Valley Project |
| ODBC | Open database connectivity |
| R/CC | Radiolarite/chocolate chert |
| SE | Southeast(ern) |
| SSE | South-southeast(ern) |
| SSW | South-southwest(ern) |
| SU | Stratigraphic unit |
| SW | Southwest(ern) |
| Th | thickness |
| TS | Thermal structure |
| Und. | undetermined |
| W | wall |
| Wd | width |
| Wd/Th | width/thickness ratio |
| WNW | West-northwest(ern) |
| ΠΜΖ | Πλατιά Μαγούλα Ζάρκου |

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*The original plans and photos are kept in the archives of the Ephorate of Antiquities of Larissa. The plans Figs. III.1 and III.3 were edited by A. Buhlke, the plans Figs. III.5, 8, 10, 12, 15, 17, 19, 21–27, 29, 32, 34, 37 and 39 by C. Batzelas and A. Buhlke. The photos of the excavations Figs. III.4, 6, 7, 9, 11, 13, 14, 16, 18, 20, 28, 30, 31, 32, 33, 35, 36, 38, 40 were edited by A. Buhlke. Figs. III.41–43: photos by C. Batzelas, drawings by R. Exarhou.*

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*The figures for chapter IV were produced by B. Weninger.*

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## Chapter V. The Tools

### *Chapter V.1. The Flaked Stone Assemblages* (Catherine Perlès – Lygeri Papagiannaki)*; Appendix 1: Table of Wear Traces* (Lygeri Papagiannaki – Sylvie Beyries)*; Appendix 2: The Flaked Stone Assemblages – A Brief Note on Agricultural Tools* (Niccolò Mazzucco)*; Appendix 3: Geochemical Sourcing of Chipped Stone Tools from Platia Magoula Zarkou* (Michael Brandl – Christoph A. Hauzenberger – Peter Filzmoser – Maria M. Martinez)

*The chipped stone tools are kept in the storerooms of the Ephorate of Antiquities of Larissa. Figs V.1.1–19: illustrations by C. Perlès, drawings by M. Ballinger. Fig. V.1.20 by N. Mazzucco. Figs. V.1.21–33 by M. Brandl.*

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Fig. V.1.10 Lithic Phase 4. a: sickle insert with an end-scraper, b–e: sickle inserts on blades, f–g: end-scraper on blades, h: side-scraper, i: bitruncated blade, j: inversely retouched crested blade, k: inversely retouched flake, l: bilaterally retouched blade, m–n: transverse arrowheads, o–p: truncated blades, q: obliquely truncated flake, r: arched backed bladelet, s: splintered piece. a–d, g–h, m, p–r: R/CC. e, i: honey chert. f, k, o: light-coloured cherts. l, n, p: obsidian. a: PM0503, b: PM0453, c: PM0530, d: PM0498, e: PM0495, f: PM0505, g: PM0514, h: PM0523, i: PM0489, j: PM0515, k: PM0490, l: PM0549, m: PM0512, n: PM0476, o: PM0502, p: PM0527, q: PM0556, r: PM0490, s: PM0457

Fig. V.1.11 Lithic Phase 4. a–f: trimming and preparation flakes, g, i–k: bladelets (i with proximal retouch), h: pressure-flaked microcore, l: sickle blade, m: end-scraper on sickle blade, n: sickle insert on blade, o: sickle insert on bladelet. All in R/CC except l in honey chert. a: PM0568, b: PM0463, c: PM0473, d: PM0511, e: PM0477, f: PM0465, g: PM0499, h: PM0487, i: PM0536, j: PM0556, k: PM0470, l: PM0495, m: PM0503, n: PM0453, o: PM0498

Fig. V.1.12 Lithic Phase 4. a–b: end-scraper on blades, c: side-scraper on flake, d: inversely retouched crested blade, e: reflaked secondary crested blade, f: bitruncated blade, g: retouched blade, h–i: retouched flakes, j–k: transverse arrowheads, l: truncated blade, m: obliquely truncated flake, n: arched backed bladelet. a, c, e, k, m–n in R/CC. b, i–j in obsidian. d, g–h, l in translucent cherts. f in honey chert. a: PM0514, b: PM0505, c: PM0523, d: PM0515, e: PM0534, f: PM0489, g: PM0541, h: PM0468, i: PM0497, j: PM0476, k: PM0512, l: PM0502, m: PM0556, n: PM0556

Fig. V.1.13 Lithic Phase 5. a–g: unretouched flakes, h: bladelet core, i–j: secondary crested bladelets, k–s, u: unretouched blades and bladelets, t: core rejuvenation flake. a–l, n, r: R/CC. m, p–q: light coloured cherts. s: honey chert. t–u: obsidian. a: PM0384, b: PM0390, c: PM0449, d: PM0380, e: PM0448, f: PM0389, g: PM0381, h: PM0378, i: PM0440, j: PM0397, k: PM0351, l: PM0448, m: PM0382, n: PM0363, o: PM0391, p: PM0422, q: PM0385, r: PM0357, s: PM0384, t: PM0405, u: PM0334

Fig. V.1.14 Lithic Phase 5. a–c: sickle inserts, d–f: borers, g–i: laterally retouched blades, j: end-scraper, k–m: splintered pieces, n: bitruncated triangle, o–p: utilised bladelet and flake. All in R/CC except o: light-coloured chert. a: PM0342, b: PM0351, c: PM0441, d: PM0366, e: PM0334, f: PM0340, g: PM0399, h: PM0452, i: PM0358, j: PM0338, k: PM0337, l: PM0346, m: PM0404, n: PM0386, o: PM0341, p: PM0451

Fig. V.1.15 Lithic Phase 5. a: exhausted flake and bladelet core, b–c: secondary crested blades, d–g: pressure-flaked bladelets and blade, h–i: indirect percussion bladelet and blade, k: proximal fragment of obsidian blade. All in R/CC except i–j in translucent chert and k in obsidian. a: PM0378, b: PM0440, c: PM0397, d: PM0357, e: PM0363, f: PM0385, g: PM0391, h: PM0392, i: PM0382, j: PM0422, k: PM0339

Fig. V.1.16 Lithic Phase 5. a–c: sickle inserts, d–f: beaks/borers, g–i: laterally retouched bladelet and blade, h: end-scraper, i: retouched flake, j: reflaked retouched flake, k–m: splintered pieces and fragment of splintered piece, m: splintered piece, n: bitruncated triangle. All in R/CC. a: PM0342, b: PM0351, c: PM0441, d: PM0366, e: PM0334, f: PM0399, g: PM0358, h: PM0338, i: PM0364, j: PM0421, k: PM0346, l: PM0337, m: PM0404, n: PM0386

Fig. V.1.17 Typological continuity through Lithic Phases 1–4. L.p.: Lithic Phase. B.p.: Building Phase. a–d: bilaterally used and retouched sickle inserts on blades, e–f: retouched honey chert blades, g–h: sickle inserts on backed flakes, i–k: sickles inserts on blades shaped with an ‘end-scraper’ front, l–n: end-scrapers on large blades, o–p: transverse arrowheads

Fig. V.1.18 Retouched tools directly associated with identified ‘surfaces’ (‘floors’). a: PM0838, b: PM0833, c: PM0764, d: PM0723, e: PM0845, f: PM0836, g: PM0686, h: PM0652, i: PM0575, j: PM0502, k: PM0476, l: PM0497, m: PM0495, n: PM0498, o: PM0503, p: PM0506, q: PM0441

Fig. V.1.19 Oblique and parallel hafting of sickle inserts. The models represent the two modes of hafting for sickle elements. The visible part of the tool represents the active zone, whereas the part hidden behind the dotted triangle represents the hafted edge

Fig. V.1.20 Two possible threshing inserts from PMZ. On the top PM0845, below PM0441. Note the dulled edge and the use-wear pattern characterised by abrasions and striations

Fig. V.1.21 Map indicating the sampled locations

Fig. V.1.22 Selected source locations documented during the geological field survey

Fig. V.1.23 Artefacts from PMZ investigated for this study. Length of the bar: 1cm

Fig. V.1.24 Microphotographs of the artefacts from PMZ. PM0870 was not analysed

Fig. V.1.25 Microphotographs of representative samples from the geological sources. A–D: PMZ 2; E–H: PMZ 5; I–L: PMZ 8; M and N: PMZ 4

Fig. V.1.26 Barium (Ba) versus magnesium (Mg) concentration plot of the geological samples

Fig. V.1.27 Aluminium (Al) versus strontium (Sr) concentration plot of the geological samples

Fig. V.1.28 Calcium (Ca) versus aluminium (Al) concentration plot of the geological samples

Fig. V.1.29 Calcium (Ca) versus magnesium (Mg) concentration plot of the geological samples

Fig. V.1.30 Calcium (Ca) versus strontium (Sr) concentration plot of the geological samples

Fig. V.1.31 Aluminium (Al) versus strontium (Sr) concentration plot of the archaeological artefacts

Fig. V.1.32 Calcium (Ca) versus strontium (Sr) concentration plot of the archaeological artefacts

Fig. V.1.33 Fisher resolution plot of the geological source data

## *Chapter V.2. The Platia Magoula Zarkou Macrolithics: A Thessalian Industry in its Aegean Neolithic Context* (Anna Stroulia)

*The macrolithics are kept in the storerooms of the Ephorate of Antiquities of Larissa. Photos by A. Stroulia, drawings by R. Exarhou.*

Figs. V.2.1–3 1. Active grinding tool PM0740 (gneiss): work face and sections; 2. Active grinding tool PM0795 (schist): one of the work faces and both sections; 3. Active grinding tool PM0492 (sandstone): work face and sections

Fig. V.2.4–6 4. Active grinding tool PM0760 (gneiss): work face B and sections; 5. Active grinding tool PM0946 (gneiss): one of the work faces and both sections; 6. Active grinding tool PM0699 (gneiss): work face and sections

Fig. V.2.7–11 7. Passive grinding tool PM0691 (schist): work face and sections; 8. Passive grinding tool PM0518 (gneiss): work face and sections; 9. Passive grinding tool PM0893 (schist): work face and sections; 10. Passive grinding tool PM0677 (schist): one work face and sections; 11. Passive grinding tool PM0989 (sandstone): work face and sections

Fig. V.2.12–15 12. Small celt PM0333 (serpentinite): one face and sections; 13. Small celt PM0692 (gabbro): one face and sections; 14. Small celt PM0771 (serpentinite): one face and sections; 15. Small celt PM0675 (serpentinite or possibly jadeitite): one face and sections

Fig. V.2.16–20 16. Larger celt PM0741 (gabbro): one face, one side and transverse section; 17. Larger celt PM0706 (gabbro): one face, one side, and transverse section; 18. Recycled larger celt PM0716 (gabbro): one face and ends; 19. Larger celt PM0722 (serpentinite): faces and edge; 20. Recycled larger celt PM0766 (gabbro): one face, one side, and one end

Fig. V.2.21–23 21. Percussive tool PM0643 (quartz): one view and section; 22. Percussive tool PM0697 (quartz): faces and one section; 23. Percussive tool PM0710 (quartz): faces and one side (middle)

Fig. V.2.24–27 24. Percussive tool PM0791 (gabbro): one face and ends; 25. Percussive tool PM0532 (gabbro): one face, one side, and ends; 26. Percussive tool PM0895 (gabbro): one face, one side, and ends; 27. Percussive tool PM0656 (marble): one view and section

Fig. V.2.28–30 28. Specimen with two narrow grooves PM0747 (chlorite schist): work face and transverse section; 29. Specimen with one narrow groove PM0763 (schist): work face and transverse section; 30. Specimen with one narrow groove PM0555 (serpentinite): work face and transverse section

Fig. V.2.31–33 31. Miscellanea specimen PM0508 (flint): one face and sections; 32. Miscellanea specimen PM0680 (limestone): one face and one side (right); 33. Miscellanea specimen PM0995 (marble): one face and transverse section

Fig. V.2.34–36 34. Miscellanea specimen PM0455 (marble): one view and transverse section; 35. Miscellanea specimen PM0538 (marble): one face and section; 36. Miscellanea specimen PM0345 (serpentinite): one face and sections

## *Chapter V.3. Bone Tools* (Rozalia Christidou)

*The bone tools are kept in the storerooms of the Ephorate of Antiquities of Larissa. Illustrations by R. Christidou.*

Fig. V.3.1 Pointed tools: (1) PM0468; (2) PM0658; (3) PM0700; (4) PM0717; (5) PM0767; (6) PM0798

Fig. V.3.2 Pointed tools: (1) PM0661; (2) PM0854; (3) PM0617; (4) PM0835

Fig. V.3.3 Needle: PM0865. Drawing: caudal and internal views (left and right, respectively). (1) Semicircular striations (arrows) along the margin of the unfinished caudal perforation (25×). (2) Facet (arrow) with slightly curving striations on the margin of the finished caudal perforation (40×). (3) Cranial view of the proximal part of the tool (8×). The internal hole is also visible

Fig. V.3.4 Unclassified partial bone tools: (1) PM0805; (2) PM0810; (3) PM0928. The photograph of specimen 2 shows use-worn oblique grinding striations (25×). These marks are macroscopic. Sketch in rectangle used to show fracture profile of the same specimen. Dashed line used to indicate thick crust on specimen 3. Sketched outlines are only provided for this specimen; dimensions are approximate. Oblique and transverse lines on the drawings indicate grinding

Fig. V.3.5 Cutting-edge tools and smoother: (1) PM0414; (2) PM0785; (3) PM0930. Dashed line used to indicate weathered surface on specimen 3

Fig. V.3.6 Reduction waste: PM0929. Outline of bisected metatarsal (left) reconstructed from fragments (middle). Dimensions are approximate. Shallow medullary grooves (right) cut to guide motion for quartering the bone. Their location is indicated by rectangle (a). Rectangles (b) and (c) locate details shown in Fig. V.3.7

Fig. V.3.7 PM0929: post-discard damage. (1) Cracking and removal of surface bone as a result of weathering (20×). For image location see rectangle (b) in Fig. V.3.6. (2) Chewing marks (10×). For image location see rectangle (c) in Fig. V.3.6. Note also the thin dark-coloured crust

Fig. V.3.8 (1) Comparison of artefact lengths (measurements in millimetres). Specimens PM0800 and PM0929 are excluded from comparison because of extreme fragmentation. PM0785 is analysed as a complete specimen since flaking affects the superior face away from the extremities. Diamond: complete; blank square: nearly complete; triangle: old fragment; blank circle: recent fragment. (2) Greatest width/thickness of complete and nearly complete pointed tools (measurements in millimetres)

Fig. V.3.9 Ground flat metatarsal: Bone 167. Oblique lines on the sketch locate grinding marks on the anterior side of the bone (not presented in scale). The photograph shows striations of longitudinal grinding and exposure of cancellous tissue on the posterior face (50×)

Fig. V.3.10 Points: (1) Width/thickness measured at a distance of 10mm from the apex. Four tools are excluded from comparison: PM0617 and PM0658 because the length of the broken point is not calculated (Appendix, Tab. V.3.A3), PM0800 because it is shattered and PM0835 because it is a proximal fragment. (2) Width/thickness measured at a distance of 30mm from the apex. To the five tools excluded from comparison in Fig. V.3.8.1 is here added PM0468 because it is broken and its form and dimensions at 30mm from the distal tip are not reconstructed

Fig. V.3.11 PM0468: point, superior highest relief (ridge). Grinding marks obliterated from the ridge, preserved on the slopes (arrow). Upper and lower images captured at 100× and 200× magnifications, respectively

Fig. V.3.12 PM0468: point, inferior central facet above the medullary cavity. (1) Grinding marks severely worn. They are best preserved away from the broken tip, above the dark flake negative (left), which represents post-discard damage (arrows). (2) Grinding marks nearly completely worn down on facet intersection (middle); narrow use striations running in various directions. Images captured at 100× magnification

Fig. V.3.13 PM0468: inferior proximal shaft. Advanced prehension wear. Upper and lower images captured at 100× and 200× magnifications, respectively

Fig. V.3.14 PM0658: point, inferior side. (1) Polishing and rounding following the surface contours near the distal break located farther to the right. The polishing of the depressed area on the left is superficial. (2) Image captured immediately below image 1. Similar wear. Incompletely smoothed plateaus are visible. Unpolished pits in the middle (arrow) represent post-discard damage. (3) Scraped topography unmodified, light polishing and striations. Images 1 and 2 captured at 200× magnification, image 3 captured at 100× magnification

Fig. V.3.15 (1) PM0617: point, middle of superior face. The arrow indicates polished streaks and shallow striations with flat polished bottoms. (2) PM0617: left edge of the marrow cavity, shaped facet. Outer edge of the facet rounded and polished (cf. Fig. V.3.13). Cracking postdates use. The arrow indicates a worn grinding striation on the interior of the facet. (3) PM0717: point, superior face. Wear following surface contours near the distal break (right). (4) PM0717: base margin, superior side. Flaky outer surface of the metaphysis portion preserved on the tool. Images captured at 200× magnification

Fig. V.3.16 PM0700: (1–4) Point, superior highest relief (ridge). Gradual wear pattern. (5) Left edge of the marrow cavity, shaped facet. Undetermined wear on the outer edge and the interior of the facet. Images 1–4 captured at 200× magnification, image 5 captured at 100× magnification

Fig. V.3.17 PM0805: superior highest relief (crest rounded by manufacture). Irregular ground topography unmodified, polishing and rounding of plateaus and ridges (cf. Fig. V.3.15.4). Images captured at 200× magnification

Fig. V.3.18 PM0767: inferior side. (1) Point, high central ridge. Striated used surface. (2–3) Ground topography preserved, upper relief altered. (4) Scraped topography preserved, upper relief altered. Images captured at 200× magnification

Fig. V.3.19 PM0854: point, inferior side along the facet of the right side of the point. (1) Homogenisation. The large deep concavity in the middle probably belongs to the initial, scraped, topography. It was perhaps the result of an accidental surface removal. (2) Distal (i.e. right) to the concavity shown in image 1. (3) Remnants of the deep scraped valleys (arrow) preserved on the facet of the right edge of the point. (4) Original valleys preserved on the facet captured in image 3. Image 1 captured at 100× magnification, images 2–4 captured at 200× magnification

Fig. V.3.20 PM0854: point, inferior side. (1) Scraped relief altered, polished. (2) Scraped topography, superficial wear. (3) Natural surface, weak polish. Images 1–2 captured at 200× magnification, image 3 captured at 100× magnification

Fig. V.3.21 PM0865: external side. (1) Distal tip to external face transition. Complete polishing. (2) Individual striations and smoothing of the upper natural relief. (3) Frequent transverse striations. Images captured at 200× magnification

Fig. V.3.22 PM0865: external side. (1) Spot 4 on the drawing of Fig. V.3.21. (2) Spot 5 on the drawing of Fig. V.3.21. (3) Spot 6 on the drawing of Fig. V.3.21. Note superficial polishing and smoothing on image 2. Images captured at 200× magnification

Fig. V.3.23 PM0865: caudal side of the finished hole. Edge rounding and polishing. The arrow indicates a groove cut during the perforation. Images captured at 200× magnification

Fig. V.3.24 PM0835: (1–2) Left edge of the marrow cavity, facet scraped to flatten. Rough polished plateaus, deep original valleys preserved. Note also the flat discontinuous polished streaks in image 2. (3–4) Superior left ridge rounded. Images 1 and 3 captured at 100× magnification, images 2 and 4 captured at 200× magnification

Fig. V.3.25 PM0810: ground topography preserved, altered upper relief. Upper and lower images captured at 100× and 200× magnifications, respectively

Fig. V.3.26 PM0798: (1) Point, inferior side, non-flaked area. Wear following surface contours. The wide deep unpolished valleys on the left represent weathering damage. (2) Middle superior shaft. Loss of polished outer bone, furrowing and cracking as a result of weathering. Image 1 captured at 200× magnification, image 2 captured at 50× magnification

Fig. V.3.27 PM0414: (1–2) Inferior surface, (3) superior surface below the flaked zone. Images captured at 200× magnification

Fig. V.3.28 PM0785: (1–2) Superior slope of the working edge. The arrow indicates a polished streak. Images captured at 200× magnification

Fig. V.3.29 PM0785: shaft, superior side. (1) Ground, (2) natural and (3) scraped topographies altered by use. Images captured at 200× magnification

Fig. V.3.30 PM0930: external surface. Image 3 shows light, superficial, wear. Cracks and extensive deposits represent post-discard damage. Images captured at 100× magnification

Fig. V.3.31 PM0930: external surface. Images captured at 200× magnification. The spots are the same as those captured at 100× magnification in Fig. V.3.30

## *Chapter V.4. Clay Spinning and Weaving Implements* (Christopher Britsch)

*The spinning and weaving implements are kept in the storerooms of the Ephorate of Antiquities of Larissa. Photos by K.-V. von Eickstett, drawings by C. Britsch.*

Fig. V.4.1–3 Pierced sherds: (1) PM0876, (2) PM0882, (3) PM0886 from BPh II (MN I)

Fig. V.4.4 Pierced sherd PM0960 from BSPh IIIc (MN I)

Fig. V.4.5 Pierced sherd PM0919 from BSPh IVb (MN I)

Fig. V.4.6 Pierced sherd PM0765 from BSPh Va (MN II

Fig. V.4.7 Pierced sherd PM0933 from BSPh Vb (MN II)

Fig. V.4.8–9 Pierced sherds (8) PM0739, (9) PM0939 from BSPh Vd (MN II)

Fig. V.4.10 Pierced sherd PM0718 from BSPh Ve (MN II)

Fig. V.4.11 Pierced sherd PM0993 from BSPh VIa (MN III)

Fig. V.4.12–13 Pierced sherds (12) PM0650 and (13) PM1017 from BSPh VIb (MN III)

Fig. V.4.14–15 Pierced sherd (14) PM1011 and loom weight (15) PM1023 from BSPh VIIa (transition MN III–LN I)

Fig. V.4.16–17 Loom weight (16) PM0456 and spindle whorl (17) PM0478 from BSPh VIIc (LN I)

Fig. V.4.18–20 Loom weight (18) PM0347, spindle whorl (19) PM0348, loom weight (20) PM0377, all from BPh VIII (LN I, PM0348 possibly intrusive)

## *Chapter V.5. Various Clay and Sherd Tools* (Eva Alram-Stern)

*The clay and sherd tools are kept in the storerooms of the Ephorate of Antiquities of Larissa. Figs. V.5.1–2: photos by M. Börner, drawings by S. Horwath;. Figs. V.5.3a–i: photos by K.-V. von Eickstett; Fig. V.5.4: photos by K.-V. von Eickstett, drawings by S. Horwath; Fig. V.5.5: photos by M. Börner, drawings by S. Horwath.*

Fig. V.5.1 Sling bullets: (1) PM0881, (2) PM0888, (3) PM0779 BPh II and BSPh IVb (MN I); (4) PM0727, (5) PM0726, (6) PM0711 from BSPh Vd and Ve (MN II); (7) PM0655, (8) PM0653, (9) PM0646, (10) PM0996 from BSPh VIb (MN III); (11) PM0578, (12) PM0632 from BSPh VIIa (transition MN III/LN I); (13) PM0332, (14) PM0435 from BPh VIII (LN I)

Fig. V.5.2 Scrapers from BSPh IIIc, Ve and BPh VIII: (1) PM0917 + 0961, (2) PM0690, (3) PM0698, (4) PM0444

Fig. V.5.3 a. Rounded sherds: (1) PM0319, (2) PM0913, (3) PM0915, (4) PM0916, (5) PM0921, (6) PM0922, (7) PM0937, (8) PM0941, from BSPh IIIa–c, IVb and Ve (MN I)

Fig. V.5.3 b. Rounded sherds: (9) PM0676, (10) PM0990, (11) PM0961, (12) PM1002, (13) PM1008, (14) PM1009, (15) PM1015, (16) PM0553 from BSPh VIa and VIb (MN III)

Fig. V.5.3 c. Rounded sherds: (17) PM1016, (18) PM1022, (19) PM1025, (20) PM1026, (21) PM1027 from BSPh VIIb (LN I: SU 135 and 136)

Fig. V.5.3 d. Rounded sherds: (22) PM1028, (23) PM1029, (24) PM1030, (25) PM1031, (26) PM1032, (27) PM1033, (28) PM1034, (29) PM1035 from BSPh VIIb (LN I: SU 141)

Fig. V.5.3 e. Rounded sherds: (30) PM1036, (31) PM1037, (32) PM1038, (33) PM1039, (34) PM1040, (35) PM1041, (36) PM1046 from BSPh VIIb (LN I: SU 141); (37) PM1042, (38) PM1043, (39) PM1044 from BSPh VIIc (LN I: SU 142)

Fig. V.5.3 f. Rounded sherds: (40) PM1047, (41) PM1048, (42) PM1049, (43) PM1050, (44) PM1051, (45) PM1052, (46) PM1053, (47) PM1054, (48) PM1055, (49) PM1056, (50) PM1057 from BSPh VIIc (LN I: SU 151 and 152)

Fig. V.5.3 g. Rounded sherds: (51) PM0407, (52) PM0415, (53) PM0425, (54) PM0426, (55) PM0427, (56) PM1058, (57) PM1059, (58) PM1060, (59) PM1061, (60) PM1062, (61) PM1063 from BPh VIII (LN I: SU 153)

Fig. V.5.3 h. Rounded sherds: (62) PM1064, (63) PM1065, (64) PM1066, (65) PM1067, (66) PM1068, (67) PM1073, (68) PM1074, (69) PM1075, (70) PM1076, (71) PM1077, (72) PM1078, (73) PM1079, (74) PM1080 from BPh VIII (LN I: SU 160 and 161)

Fig. V.5.3 i. Rounded sherds: (75) PM1081, (76) PM1082, (77) PM1083, (78) PM1084, (79) PM1085, (80) PM1086, (81) PM1087, (82) PM1088, (83) PM1089, (84) PM1090, (85) PM1091 from BPh VIII (LN I)

Fig. V.5.4 Eight-shaped sherd tools: (1) PM0925, (2) PM0997

Fig. V.5.5 Sherd burnishers: (1) PM0914 from BSPh IIIa, (2) PM0920, (3) PM0923, (4) PM0926 from BSPh IVb, (5) PM0940 from BSPh Ve, (6) PM0944 from BSPh VIa, (7) PM1012, (8) PM1018, (9) PM1021 from BSPh VIIa, (10) PM1045 from BSPh VIIc

## Chapter VI. Figurines, House Model and Ritual Vessels *(Eva Alram-Stern)*

*The house model as well as some figurines are on exhibition in the Diachronic Museum of Larissa; all the other items are kept in the storerooms of the Ephorate of Antiquities of Larissa. The digital recording of the figurines was executed with a structured-light 3D scanner, using the programme 'Blender', edited with a non-photorealistic (NPR) shader and exported as graphics (3D ortho-photographs and drawings partly indicating the colours) by M. Börner.*

*Photos: Figs. VI.1, VI.27–37 by M. Börner; Figs. VI.2–26, VI.38–42 by K.-V. von Eickstett. Drawings: Figs. VI.1, 9, 11, 17, 39, 41 by S. Horwath; Figs. VI.6, 20, 22 by R. Exarhou. All 3D-models by M. Börner.*

Fig. VI.1 PM0898. Leg or lower part of an anthropomorphic figurine, from BPh I

Fig. VI.2 PM0892. Leg of a seated anthropomorphic figurine, from BPh II

Fig. VI.3 PM0873. Leg of a seated anthropomorphic figurine, from BPh II

Fig. VI.4 PM0878. a–b. Right leg of a seated anthropomorphic figurine, from BPh II

Fig. VI.5 PM0819. Upper part of an anthropomorphic figurine, from BSPh IIIb

Fig. VI.6 PM0830. Triangular head attached directly under the rim of a closed, narrow-mouthed vessel, from BSPh IIIb

Fig. VI.7 PM0847. Head of an animal figurine or animal protome of a zoomorphic vessel, from BSPh IIIb

Fig. VI.8 PM0792. Left leg of a seated anthropomorphic figurine, from BSPh IVa

Fig. VI.9 PM 0924. Arm of an anthropomorphic figurine, from BSPh IVb

Fig. VI.10 PM0753. a–c. Standing female anthropomorphic figurine, from BSPh Vb

Fig. VI.11 PM 0936. Possibly leg of an anthropomorphic figurine seated on the ground, from BSPh Vc

Fig. VI.12 PM0725. Standing female anthropomorphic figurine, from BSPh Vd

Fig. VI.13 PM0733. a–b. Right lower part of a leg of an anthropomorphic figurine, from BSPh Vd

Fig. VI.14 PM0737. Back part of the head of an animal figurine, from BSPh Vd

Fig. VI.15 PM0657. Flat head of an anthropomorphic figurine, from BSPh VIa

Fig. VI.16 PM0651. Left leg of a seated anthropomorphic figurine, from BSPh VIb

Fig. VI.17 PM0640. Cylindrical, slightly oval leg of an anthropomorphic figurine, from BSPh VIb

Fig. VI.18 PM0621. a–b. Complete flat schematised anthropomorphic figurine, from BSPh VIb

Fig. VI.19 PM0645. a–c. Complete (?) anthropomorphic figurine, without head, from BSPh VIb

Fig. VI.20 PM1014. Lower part of an animal head attachment, from BSPh VIb

Fig. VI.21 PM0620. Thin left leg of an anthropomorphic figurine, from BSPh VIb

Fig. VI.22 PM 1013. Body sherd of an anthropomorphic vessel, from BSPh VIIa

Fig. VI.23 PM0577. Upper body of a female anthropomorphic figurine, from BSPh VIIa

Fig. VI.24 PM0590. a–b. Right leg of an anthropomorphic figurine, from BSPh VIIa

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*The plans are kept in the archive of the Ephorate of Antiquities of Larissa. Pl. III.1 edited by G. Toufexis, C. Batzelas, A. Buhlke; Pls. III.2–3 edited by C. Batzelas, A. Buhlke.*

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# List of Authors

Alram-Stern, Eva, Austrian Archaeological Institute, Austrian Academy of Sciences, Hollandstraße 11–13, A-1020 Wien, Austria. eva.alram@oeaw.ac.at

Batzelas, Christos, Ephorate of Antiquities of Larissa, Diachronic Museum of Larissa, GR-41500 Larissa, Greece. chrisbatzelas@yahoo.gr

Bellesis, Alexandros, Ermogenous str. 6, GR-41500 Larissa, Greece

Beyries, Sylvie, CEPAM, UMR 7264 – Cultures et Environnements Préhistoire, Antiquité, Moyen Âge, Université Côte d'Azur, 24, avenue des Diables Bleus, F-06300 Nice, France. Sylvie.Beyries@cepam.cnrs.fr

Brandl, Michael, Austrian Archaeological Institute, Austrian Academy of Sciences, Hollandstraße 11–13, A-1020 Wien, Austria. michael.brandl@oeaw.ac.at

Britsch, Christopher, Stettiner Str. 52, D-48147 Münster, Germany. chris.britsch@posteo.de

Caputo, Riccardo, 1) Department of Physics and Earth Sciences, University of Ferrara, Via Saragat 1, I-44122 Ferrara, Italy; 2) Centro interuniversitario per la ricerca sismotettonica, CRUST-UniFE, Italy. rcaputo@unife.it

Christidou, Rozalia, UMR 5133-Archéorient, Université Lyon 2-CNRS, 5/7 rue Raulin, F-69365 Lyon, France. rozalia.christidou@gmail.com

Donati, James, GeoSat ReSeArch Lab, Foundation for Research and Technology, Hellas (F.O.R.T.H.), Institute for Mediterranean Studies, Nikiforou Foka 130 & Melissinou, P.O. Box. 119, GR-74100 Rethymno, Greece.

Filzmoser, Peter, Institute of Statistics & Mathematical Methods in Economics, TU Wien, Wiedner Hauptstraße 8–10/E105, A-1040 Wien, Austria.

Gallis, Kostas, Ephorate of Antiquities of Larissa, Diachronic Museum of Larissa, GR-41500 Larissa, Greece.

Halstead, Paul, Emeritus Professor, Department of Archaeology, University of Sheffield, Sheffield S1 3NJ, UK. plj.halstead@icloud.com

Hauzenberger, Christoph, Department of Earth Sciences, University of Graz, Universitätsplatz 3, A-8010 Graz, Austria.

Helly, Bruno, 1) Maison de l'Orient Mediterraneen Jean-Pouilloux, 5–7, rue Raulin, F-69007 Lyon, France, 2) Université Lyon-II, F-69007 Lyon, France.

Kalayci, Tuna, Faculty of Archaeology, Leiden University, NL-2333 CC Leiden, the Netherlands.

Kyparissi Apostolika, Nina, Emerita Director of the Ephorate of Palaeoanthropology and Speleology, Greek Ministry of Culture and Sports, Ardittou 34B, GR-11636 Athens, Greece. nkyparissi@hotmail.com

Martinez, Maria Magdalena, Department of Anthropology, The University of Texas at Austin, 2201 Speedway, Austin, TX 78712, U.S.A.

Mazzucco, Niccolò, Department of Civilizations and Forms of Knowledge, University of Pisa, Via dei Mille 19, I-56126 Pisa, Italy. nicco.mazzucco@gmail.com

Papagiannaki, Lygeri, 7 Rue de la Gare, 01800 Meximieux, France. ligeri.papagiannaki@zoho.eu

Perlès, Catherine, Université Paris-Nanterre, CNRS, UMR TEMPS, 21 allée de l'Université, 92023 Nanterre Cedex, France. catherine.perles@cnrs.fr

Rapti, Dimitra, 1) New Energies And Environment – NEA Ltd., c/o Department of Physics and Earth Sciences, University of Ferrara, Via G. Saragat, 1, I-44122 Ferrara, Italy, 2) Department of Chemical, Pharmaceutical and Agricultural Siences, University of Ferrara, Via L. Borsari, 46, I-44121 Ferrara, Italy.

Sarris, Apostolos, Digital Humanities GeoInformatics Lab, Archaeological Research Unit (ARU), Department of History and Archaeology, University of Cyprus, 12 Gladstone Street 1095, P.O. BOX 20537, CY-1678 Nicosia, Cyprus. asarri01@ucy.ac.cy

Souvatzi, Stella, Department of History, Archaeology and Social Anthropology, University of Thessaly, GR-38221 Volos, Greece. stellasouvatzi@hotmail.com

Stefani, Marco, Department of Architecture, University of Ferrara, Via della Ghiara 36, I-44121 Ferrara, Italy.

Stroulia, Anna, Department of World Languages and Cultures, University of Southern Indiana, 8800 University Boulevard, Evansville, IN 47712, U.S.A. astroulia@usi.edu

Syrides, George, Department of Structural, Historical and Applied Geology, School of Geology, Aristotle University of Thessaloniki, GR-54124 Thessaloniki, Greece.

Toufexis, Giorgos, Ephorate of Antiquities of Larissa, Diachronic Museum of Larissa, GR-41500 Larissa, Greece. gtoufexis@culture.gr

Valkaniotis, Sotiris, Koronidos str., 9, GR-42131 Trikala, Greece.

Weninger, Bernhard, Institut für Ur- und Frühgeschichte, Universität zu Köln, Weyertal 125, D-50931 Köln, Deutschland. b.weninger@uni-koeln.de

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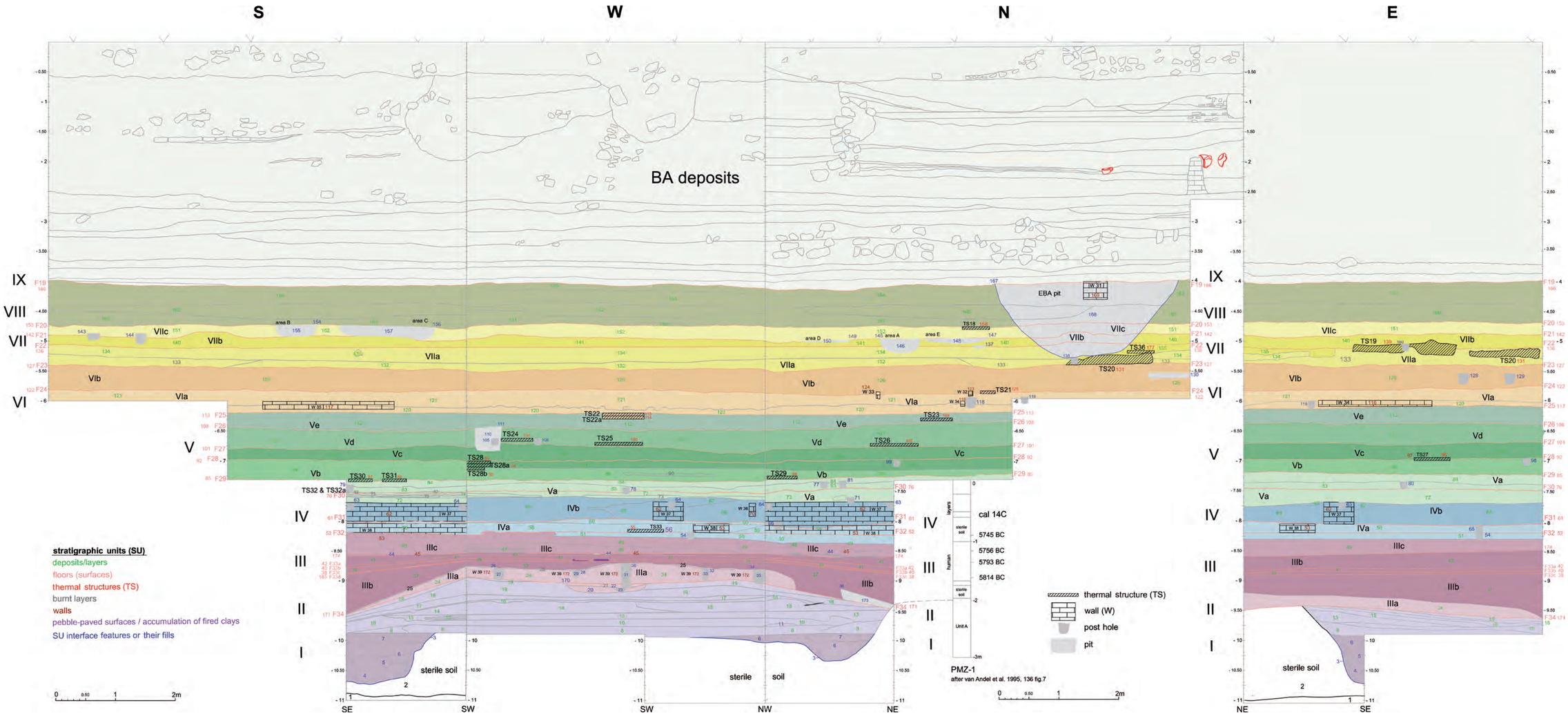
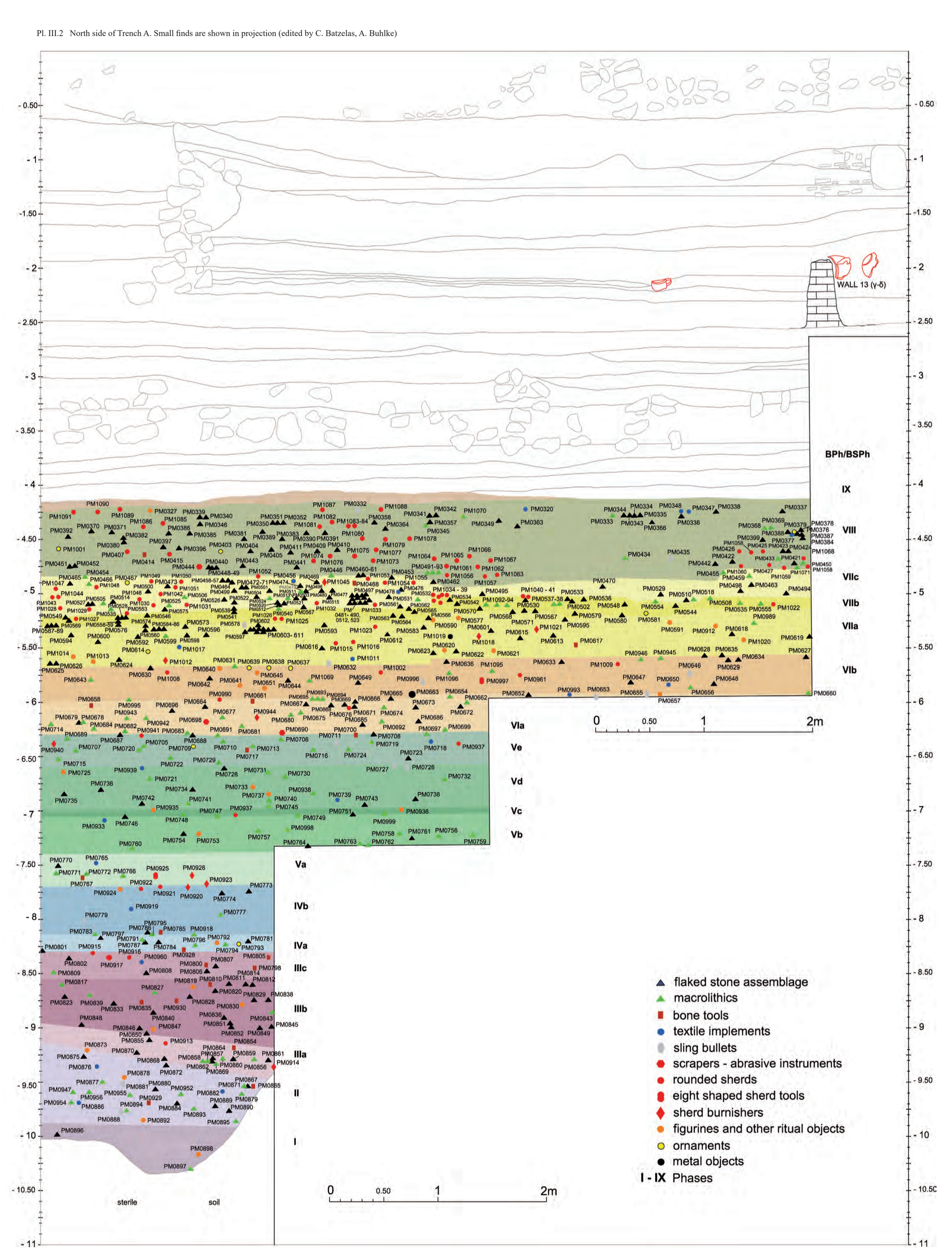
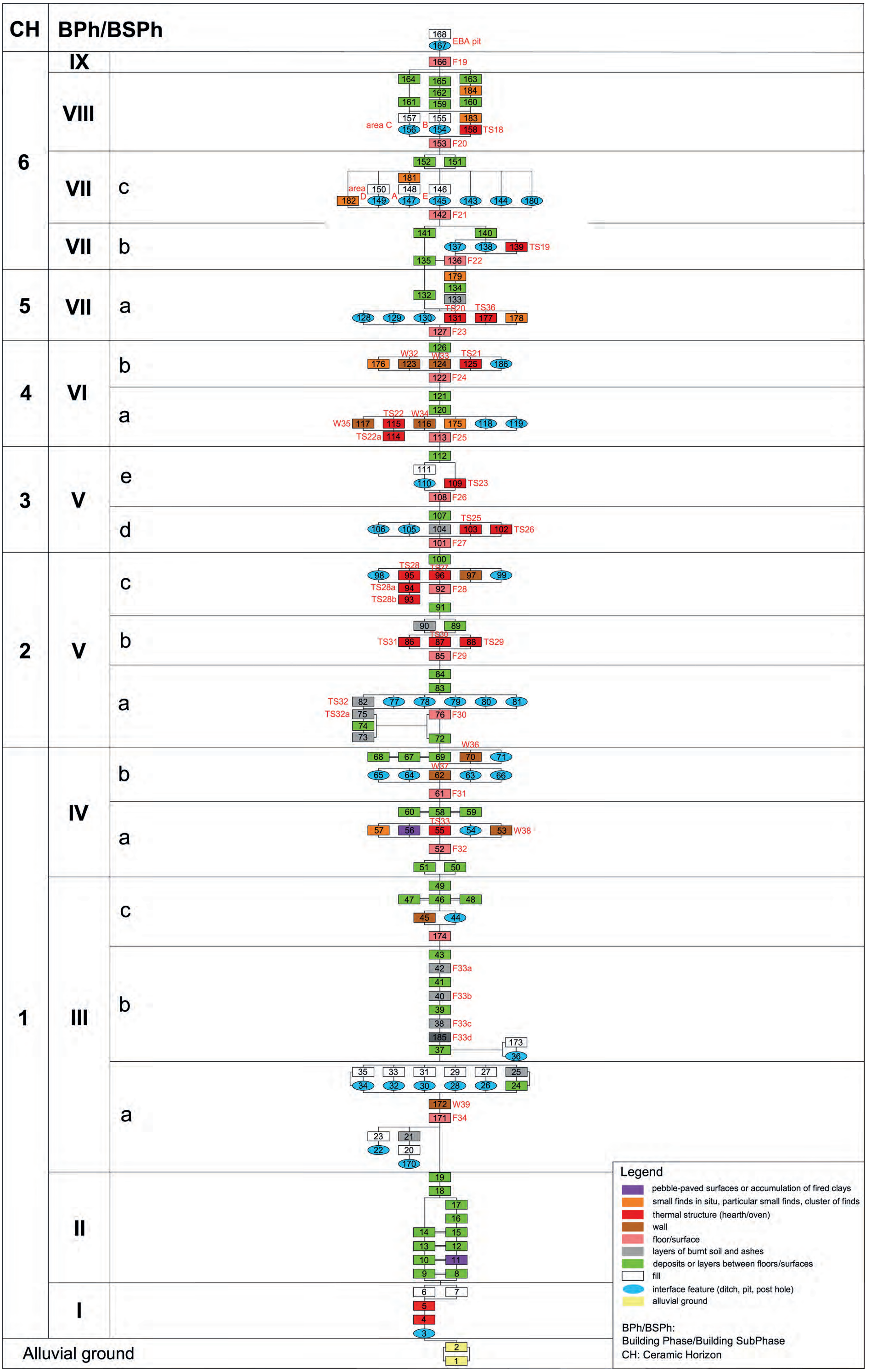
Pl. III.1 Stratigraphy of Trench A (four sides) (edited by G. Toufexis, C. Batzelas, A. Buhlke)



Pl. III.2 North side of Trench A. Small finds are shown in projection (edited by C. Batzelas, A. Buhlke)



Pl. III.3 The stratigraphic sequence of Trench A according to Harris matrix modelling (edited by C. Batzelas, A. Buhlke)