THE FIRST INTERMEDIATE PERIOD: A TIME OF FAMINE AND CLIMATE CHANGE?

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Introduction

The theory about an abrupt climate change that caused severe droughts in the ancient Near East and a series of low Nile floods in Egypt as well as possibly triggering the collapse of the Old Kingdom state has been increasingly the focus of research, especially when dealing with the First Intermediate Period.[1] This theory, which has been first expressed by B. Bell in 1971,[2] seems to have obtained a widespread acceptance.[3] Only few doubts about have been expressed so far.[4] Bell argued that *a drought – widespread, severe, and prolongued – lasting for several decades and occurring more or less simultaneously over the entire eastern Mediterranean and adjacent lands*[5] was the cause for the collapse of several civilisations. Thus she touches a delicate topic, which has interested many and has led to much speculation.[6]

What is the evidence on which this theory is based? A problem common to such studies is the methodological approach. Archaeological data and historical sources, e.g. ancient Egyptian inscriptions are selected to be combined with geological and/or other environmental data, which in itself is a valuable approach but the problem that often arises is the lack of, or the inconclusive nature of proxy data. In such cases historical sources are used alone and interpreted according to preconceived ideas with references to outdated studies. The conclusions are then mainly based on general interpretations of ancient Egyptian history. It is extremely important to evaluate new and independent sources of information, without falling back on over-generalised concepts. However, this task is not easy. Archaeologists often have to face fundamental theoretical and methodological problems when dealing with topics in human ecology.[7] Another difficulty is the chronological correlation of absolute dates used in historical and environmental studies. Many of the latter have not a high enough resolution to allow conclusive association with historical data. Today, with environmental change being a key issue, there are many discussions about how climate change might have affected human culture in the past and what we can learn from this today.[8]

In 1994 an international workshop took place in Turkey with participants coming from many different disciplines in order to discuss the evidence for an abrupt climate change during the 3rd Millennium BC and a possibly related collapse of numerous

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1 In 2001 BBC 4 showed a documentary featuring F. Hassan who searches for evidence that the Old Kingdom collapsed because of a prolonged drought (http://www.bbc.co.uk/history/ancient/egyptians/apocalypse_egypt_01.shtml and see also the transcription of a live-interview with Hassan at http://www.bbc.co.uk/history/programmes/apocalypse/transcript.shtml).

2 B. Bell, The Dark Ages in Ancient History, I. The First Dark Age in Egypt, *AJA* 75 (1971), 1–26.

3 See for example N. Grimal, *The history of ancient Egypt*, Oxford 1992, 139; D.B. Redford, *Egypt, Canaan, and Israel in Ancient Times*, Princeton, New Jersey 1992, 61–62; F. Hassan, Nile floods and political disorder in Early Egypt, in: H. Nüzhet Dalfes, G. Kukla & H. Weiss, (eds.), *Third Millennium BC Climate Change and Old World Collapse, Proceedings of the NATO Advanced Research Workshop on Third Millennium BC Abrupt Climate Change, held at Kemer, Turkey, September 19–24, 1994*, NATO ASI series I: Global Environmental Changes, Vol. 49, Berlin-Heidelberg 1997, 2–3.

4 For example by S.J. Seidlmayer *Historische und moderne Nilstände*, Achet. Schriften zur Ägyptologie, A1, Berlin 2001, 129; R. Müller-Wollermann, *Krisenfaktoren im ägyptischen Staat des ausgehenden Alten Reiches*, Dissertation Universität Tübingen 1986, 106–112.

5 B. Bell, The Dark Ages in Ancient History, I. The First Dark Age in Egypt, *AJA* 75 (1971), 1.

6 See for example T. Niroma, The climax of a turbulent millennium: Evidence for major impact events in the late third millennium BC, see http://personal.eunet.fi/pp/tilmari/tilmari2.htm.

7 D.F. Dincauze, *Environmental Archaeology. Principles and practice*, Cambridge 2000, 65.

8 See for example J. Diamond, *Collapse. How societies choose to fail or survive*, London 2005.

civilizations in the Near East and the Eastern Mediterranean.[9] Many of the contributions, especially those made by archaeologists, try to make environmental data fit according to their interpretation of archaeological evidence and preconceived ideas instead of evaluating the source material independently and explaining possible problems. Often only certain aspects of the selected data are presented because they fit well to the preferred interpretation while others are omitted. Thus there is frequently no presentation of the full record available and also no objective assessment of the data. A problem concerning especially records from Egypt is the lack of conclusive proxy data with high chronological resolution. This situation could be ameliorated by the establishment of an absolute cedar-wood chronology for the region of the Lebanon, which could then be transferred to Egypt since many objects made of this raw material have been found there.[10] With regard to the First Intermediate Period we are looking at a time period of maximum 150 years (Fig. 1). Although the absolute chronology for ancient Egypt is one of the best in the world for ancient civilisations – it is especially well fixed for the 2nd and 1st millennia BC – we are still facing insecurities for the 3rd millennium.[11] The estimated error-range in terms of absolute dates has a length of 100 years for the Old Kingdom and the First Intermediate Period while it is much less (20–30 years) for the Middle Kingdom.[12]

Moreover, the general climatic and geographical conditions of Egypt need to be considered. It is has to emphasized that the weather cycles that affect Egypt are different from those responsible for the weather in Mesopotamia and only a climate change of global scale could have had an impact on both regions. Egyptian agriculture relied heavily on the annual Nile flood. The height of the yearly inundation was crucial and while low floods would leave much of the floodplain dry, exceptionally high floods could cause widespread destruction. The consequences of a flood with a height of 2 m below average are documented for example for the year A.D. 1877, which resulted in 35% of the land being unirrigated and affecting most severely the provinces of Qena and Girga where even 62–75 % of the fields were left without water.[13] The height of the annual inundation in Egypt depends almost entirely on the amount of summer monsoon rainfall over the catchment basin of the Blue Nile and the Atbara region in the highlands of Ethiopia including a minor component from the White Nile.[14] This summer

Reference	8th Dynasty	Length	9th/10th Dynasties	Length
J.von Beckerath, MÄS 46, 1997: 143–145.	2216/2166–2170/2120 BC	46 years	2170/2120–2025/2020 BC	100–145 years
K.A. Kitchen, in: CChEM 1, 47.	2176–2136 BC	40 years	2136–2023 BC	113 years
I. Shaw, *Oxford History of Ancient Egypt*, Oxford 2000, 479–483.	2181–2160 BC	21 years	2160–2055	105 years

Fig. 1 Table listing recent publications comparing the dates and lengths given for the First Intermediate Period

[9] *Third Millennium BC Climate Change and Old World Collapse, Proceedings of the NATO Advanced Research Workshop on Third Millennium BC Abrupt Climate Change, held at Kemer, Turkey, September 19–24, 1994,* ed. by H. Nüzhet Dalfes, G. Kukla & H. Weiss, NATO ASI series I: Global Environmental Changes, Vol. 49, Berlin-Heidelberg 1997.

[10] M. Bietak, Introduction to this project, in: M. Bietak (ed.), *The Synchronisation of Civilisations in the Eastern Mediterranean in the Second Millenium BC. Proceedings of an International Symposium at Schloß Haindorf, 15th–17th of November 1996 and at the Austrian Academy, Vienna, 11th–12th of May 1998,* CChEM 1, Wien 2000, 12.

[11] K.A. Kitchen, The chronology of ancient Egypt, *World Archaeology* 23, no. 2 (1991), 201–208; idem, The historical Chronology of ancient Egypt, a Current Assessment, in: M. Bietak (ed.), *The Synchronisation of Civilisations in the Eastern Mediterranean in the Second Millenium BC. Proceedings of an International Symposium at Schloß Haindorf, 15th–17th of November 1996 and at the Austrian Academy, Vienna, 11th–12th of May 1998,* CChEM 1, Wien 2000, 39–52.

[12] Kitchen, *op.cit.* (1991), 202, table 1.

[13] K.W. Butzer, *Early hydraulic civilization in Egypt*, Chicago-London 1976, 53.

[14] *Ibidem*, 30; R. Said, *The river Nile. Geology, hydrology and utilization*, Oxford 1993, 7ff.

monsoon rainfall is reliant on the Indian Ocean monsoon and also on the position of the Inter-Tropical Convergence Zone (ITCZ).[15] The further north it lies and the stronger the monsoonal belt, the wetter it is in Upper Egypt and the stronger the Nile floods. The weather and climate between 30° N and 30° S over Africa, India and Asia are to some extent also influenced by seasonal reversals in the Indian monsoon. However, it is important to realise that these factors although affecting wider regions are part of a much more complex system which needs to take into account topographical variability and resulting microclimates being also responsible for weather and climate conditions. In Egypt, the southern part of the country is dominated by the ITZC and the Indian Ocean monsoon but the north is much more influenced by Mediterranean precipitation patterns.[16]

Evidence for climatic changes from Egypt

The most obvious source of information about climatic changes affecting Egypt comes from studying the long- and short-term variations in the height of the annual Nile flood. These trends might also be to some extent reflected in the Fayum lake levels since the lake is connected via the Bahr el-Yussef canal with the Nile. Further evidence comes from studies of fluvial sediments in the Delta, which can be used to determine the influx of minerals originating from the different Nile branches in the Sudan and Ethiopia. Additionally, the movement of dunes in the Memphite region at the end of the 3rd millennium BC provides information about changes in the aeolian activity.

1. Long and short term trends in Nile flood levels

Among ancient Egyptian sources recording the height of the annual Nile flood, such as the Palermo-stone[17] and the records of the White Chapel of Senusret I at Karnak,[18] it is now possible to combine this information with archaeological data from Elephantine where the excavations of the ancient town have provided important insights into the long-term flood trends.[19] The main assumption is that the buildings on this island were erected under consideration of the maximum inundation level in order to make sure houses would be safe from being flooded. Additionally it has been assumed that as much of the space available as possible had been used for settlement.[20] Thus it is feasible to estimate the changes in the mean flood heights for the Old Kingdom according to the archaeological evidence (Fig. 2).

However, it is also important to look at the specific architecture and function of the respective buildings. For a fortress, which was clearly planned and built by a central state authority and not by the indigenous population,[21] the strategically most

Period	Estimated mean flood level (in m above sea level)
1st Dynasty (fortress)	94.50–94.00
2nd Dynasty (town enclosure wall)	92.50–92.00
6th Dynasty (settlement remains in depression)	90.80–91.30
FIP (settlement remains in depression)	91.20–91.70

Fig. 2 Estimated maximum flood heights (after S.J. Seidlmayer, *Historische und moderne Nilstände*, Achet. Schriften zur Ägyptologie, A1, Berlin 2001, 90, Tab. 7.)

[15] The ITCZ is the region around the equator, where the winds of the Northern and Southern Hemispheres congregate. The warm water of the equator and the sun heat the air in the ITCZ, augmenting its humidity and causing it to rise. As the air rises it cools down and thereby releases the accumulated moisture in an almost continuous succession of thunderstorms. Changes in the location of the ITCZ northwards or southwards significantly affect precipitation in wider equatorial regions. For further information see http://earthobservatory.nasa.gov/Newsroom/NewImages/images.php3?img_id=4028.

[16] P.B. deMenocal & D. Rind, Sensitivity of subtropical African and Asian climate to prescribed boundary condition changes: Model implications for the Plio–Pleistocene evolution of low – latitude climate, 57–77, in: T.C. Johnson & E.O. Odada (eds.), *The Limnology, climatology and paleoclimatology of the East African lakes*, Amsterdam 1996.

[17] W. Helck, Nilhöhe und Jubiläumsfest, *ZÄS* 93 (1966), 74–79.

[18] P. Lacau & H. Chevrier, *Une chapelle de Sésostris Ier à Karnak*, Le Caire 1956.

[19] M. Ziermann, in: W. Kaiser *et al.*, Stadt und Tempel von Elephantine, 21./22. Grabungsbericht, *MDAIK* 51 (1995), 128–140; Seidlmayer, *Nilstände*, 81–92.

[20] Ziermann, *op.cit.*, 139.

[21] S.J. Seidlmayer, Town and state in the early Old Kingdom. A view from Elephantine, 112, in: J. Spencer (ed.), *Aspects of Early Egypt*, London 1996.

advantageous position on the island would be chosen demonstrating also the power and influence of the central government. This would have been the primary motive while the anticipated flood-height probably played only a secondary role. Further changes in the foundation level for buildings in the later times depended probably also on the need to use as much space as possible with taking the risk of occasional flooding. Even in modern times one can observe such motives of making most of the available space, when houses are built in an area that is likely to be flooded in certain intervals. While the 1st Dynasty fortress was built 96 m above sea level (a.s.l.), buildings of the 2nd Dynasty were erected lower, close to 94 m a.s.l., which has been interpreted as an indication of falling flood levels.[22] 4th and 5th Dynasty occupation is situated just a little bit lower at about 93.5 m a.s.l.. The most decisive evidence comes from the depression that divided Elephantine into two islands, a western and an eastern one. The recent excavation here showed that during the 6th Dynasty simple buildings were constructed on top of fluvial sediments, at about 92 m a.s.l.[23] These structures have not the character of permanent housing and were flooded at some point. Thereafter the area was filled up to about 93 m a.s.l. and an additional fortification was made of granite slabs.[24] This evidence suggests that the estimated or expected maximum flood height was considered to be not above this level. Nevertheless, the area was flooded despite its measures of protection, which could be an indication that there were floods of unexpected height during the First Intermediate Period, but it is equally possible that people were aware of the risk of flooding but continued to built there simply because the space was needed. Furthermore changes in erosion and deposition rates of the river need to be considered in this context, too. So far the erosion of the riverbed at Aswan has not been studied in detail. It has been noted that in Lower Nubia the riverbed remained stable since the New Kingdom.[25] Thus erosion probably played a minor role in the 1st Cataract region. On the other hand the sedimentation rates concerning the Nile riverbed and floodplain have never been constant in the Nile valley since they depend on several factors such as variations in the sea-level, human activities affecting the river-flow, changes in flood-volume etc.[26] It has been estimated that from about 3000 BC until Roman times the sedimentation rate was relatively low rising only thereafter.[27] Also important to consider is that the rate of deposition differs from the south to the north in Egypt. The thickness of these deposits is much higher in Memphite area than in the 1st Cataract region.[28]

Whatever the reason for using the area between the two islands at Elephantine as building ground, it provides firm evidence for relatively low flood levels during the 6th Dynasty. It also shows that the flood levels were rising thereafter, which is proven by the flooding and its consecutive artificial elevation in the critical area between the islands. By the early Middle Kingdom further deposits were used to fill up the site to 95–96 m a.s.l.. This does not necessarily mean that the flood levels were really that high during this time: it could simply be the result of large scale levelling of previous occupation levels at that time. However, high flood levels during the Middle Kingdom would fit well to the written records, such as the Semna inscriptions, which record exceptionally high floods during the late Middle Kingdom. The evidence from the Fayum lake levels seems to confirm this observation, too.[29]

The archaeological evidence from Elephantine corresponds also surprisingly well to the records from the Palermo stone which indicate high floods during the 1st Dynasty followed by a sharp decline of about 30% until the mid-2nd Dynasty, after which the flood height remained relatively constant until the 5th Dynasty.[30] Unfortunately no entries for the 6th Dynasty exist. The validity of the flood heights on the Palermo stone has been questioned by

[22] IDEM, *Nilstände*, 81–87; ZIERMANN, *op. cit.*, 139ff.

[23] ZIERMANN, *op. cit.*, 139.

[24] ZIERMANN, *op. cit.*, 131, 140.

[25] SAID, *op.cit.*, 55.

[26] SEIDLMAYER, *Nilstände*, 91.

[27] K.W. BUTZER, *Studien zum vor- und frühgeschichtlichen Landschaftswandel der Sahara, III. Die Naturlandschaft Ägyptens während der Vorgeschichte und der dynastischen Zeit*, Abh. der mathem.-naturwiss. Klasse, Jahrgang 1959, Nr. 2, 66.

[28] SEIDLMAYER, *op.cit.*, 92.

[29] SEIDLMAYER, *op.cit.*, 80; J.K. KOZLOWSKI & B. GINTER, Holocene changes in the Fayum: Lake Moeris and the evolution of climate on Northeastern Africa, 327–336, in: KRZYZANIAK, M. KOBUSIEWICZ, and J. ALEXANDER (eds.), *Environmental change and human culture in the Nile Basin and northern Africa until the Second Millennium B.C.*, Studies in African Archaeology 4, Poznan 1993.

[30] SEIDLMAYER, *op.cit.*, 87.

O'Mara who regards especially the entries of the 1st and 2nd Dynasties as pure fiction.[31] Seidlmayer on the other hand pointed out, that there is no indication that the distribution of the flood-height numbers is entirely artificial[32] following the opinion of Helck.[33] Even if we cannot be sure about the accuracy of each individual entry on the Palermo stone,[34] the trend of lowering flood heights as a whole seems entirely plausible and, as has been outlined above, this is to some extent also reflected in the archaeological data. Ancient Egyptian annals have to be regarded within their context, which is foremost a religious one and therefore they should be used with caution because they are certainly not sources describing historical reality in their detail but recreating a mythological, somewhat idealised record of the past.[35]

This is certainly also true for the records inscribed on the base of the north-wall of the White Chapel of Senusret I at Karnak which were probably copied from an Old Kingdom original.[36] The provenance of annals in temples proves the existence of a tradition to keep such lists in the temple archives.[37] For several reasons it is most likely that the records of nomes and Nile flood heights of the White Chapel are not contemporary to the chapel itself but might date earlier. This is not only indicated by the entry for the flood height in Lower Egypt (for the region *Per-Hapi* to Balamun) which corresponds exactly to the number given in the Palermo-stone[38] but also by the entry for the 16th Upper Egyptian nome which mentions *Hebenu* as nome capital although it is now certain that during the Middle Kingdom *Hebenu* had lost this function and was replaced by a town near Beni Hassan.[39]

The long-term trend of declining flood levels have been often interpreted as being linked to the end of the 'Neolithic Wet Phase',[40] which was a period of moister climate conditions during Prehistoric times with a climate optimum around 6000 calBP.[41] Proxy data from north-western Sudan shows that during this period the desert was characterised by scrub-grassland[42] and sedimentological evidence from the today hyperarid desert (less than 5 mm annual precipitation) at the Gilf-Kebir in south-western Egypt indicates a 'contracted desert vegetation' with an annual precipitation of about 50–100 mm.[43] There is also archaeological evidence for human occupation along the wadis at Hierakonpolis, which now lie in the desert zone. These sites were abandoned around 3500 BC when it is surmised that the climate gradually shifted to drier conditions.[44] This shows how the general trend towards a more arid climate had severe affects on a rather fragile ecosystem.[45] It is nevertheless possible that the change from this moister climate to drier conditions did not occur progressively but as a series of weakening pulses.[46]

2. Analyses of Nile sediments from the Delta

Archaeological and several textual sources indicate a trend of lower Nile floods towards the end of the 3rd millennium BC as has been outlined above. Further independent data which could

[31] P.F. O'Mara, Was there an Old Kingdom historiography? Is it datable?, *Orientalia* 65 (1996), 201–203.

[32] Seidlmayer, *op.cit.*, 87 no. 58.

[33] W. Helck, *Untersuchungen zur Thinitenzeit*, ÄA 45, Wiesbaden 1987, 127–129.

[34] At least some numbers seems to be idealised, see M. Baud, Ménès, la mémoire monarchique et la chronologie du 3e millénaire, *Archéo-Nil* 9 (1999), 113.

[35] Baud, *loc. cit.*; J. Baines, Origins of Egyptian kingship, 131, in: D. O'Connor and D.P. Silverman (eds.), *Ancient Egyptian Kingship*, PÄ 9, Leiden 1995.

[36] Seidlmayer, *op.cit.*, 93–103.

[37] J. Osing, La science sacerdotale, 131, in: D. Valbelle and J. Leclant (eds.), *Le décret de Memphis, Actes du Colloque de la Fondation Singer-Polignac*, Paris 1999.

[38] Seidlmayer, *op.cit.*, 102; H. Jaritz & M. Bietak, Zweierlei Pegeleichungen zum Messen der Nilfluthöhen im Alten Ägypten, *MDAIK* 33 (1979), 58.

[39] N. Moeller, *The development of provincial towns in ancient Egypt from the end of the Old Kingdom to the beginning of the Middle Kingdom*, unpubl. PhD thesis, University of Cambridge 2003, 27; idem, An Ols Kingdom town in Zawiet Sultan (Zawiet el-Meitin) in Middle Egypt, in: A. Cooke, F. Simpson; Current Research in Egyptology II, BAR int.ser. 1380, Oxford 2005, 37 .

[40] K.W. Butzer, Environmental change in the Near East and human impact of the land, 123, in: J. Sasson (ed.), *Civilizations of the ancient Near East* I, York 1995.

[41] For the conversion of BP dates into BC dates, see http://www.rlaha.ox.ac.uk/O/calibration.php.

[42] W. van Zeist & S. Bottema, *Late Quaternary Vegetation of the Near East*, TAVO Beih. Reihe A, Nr. 18, Wiesbaden 1991, 128.

[43] W. van Zeist & S. Bottema, *op. cit.*, 130.

[44] M.A. Hoffman, H.A. Hamroush & R.O. Allen, A Model for Urban Development for the Hierakonpolis Region from Predynastic through Old Kingdom Times, *JARCE* 23 (1986), 175–187.

[45] B. Midant-Reynes, *Aux origines de l'Égypte*, Paris 2003, 128.

[46] Butzer, Environmental change, 123.

confirm this observation are still lacking. The main problem is that any study, whether geological or archaeological, takes the trend of lower Nile flood levels for granted and as base for any new observations. A good example for this is the study of sediment cores taken in the Nile delta.[47] This analysis is based on the assumption that climatic changes are reflected in the erosion rates of the White and Blue Nile catchment areas. It has been concluded that the highest rates of erosion including an increase in the proportion of sediments originating from the Blue Nile catchment occurred during periods of low flood levels ca. 4500–4200 calBP.[48] What were the underlying mechanism that triggered this inverse relationship of sediments from the White and Blue Nile catchment regions around 4200 calBP? Stanley *et al.* have pointed out that increasing amount of sediments from the Blue Nile source area is a sign for drier climatic conditions there.[49] However, other factors like grazing pressure and human activities are not taken into account.[50] Therefore it is difficult to fully understand these processes of erosion and their connection to high/low Nile floods. Doubts about this theory have also been raised by Said who points out that Stanley *et al.* did not consider changes in the tributaries of the Nile such as formerly active wadis which would have changed the composition of sediments deposited in the Nile delta, too.[51] Thus this study does not provide clear results with regard to a short-term climate change affecting Egypt at the end of the Old Kingdom even though this has been its actual objective. As pointed out above, more detailed research into erosion processes and sediment origins need to be carried out without relying exclusively on the trend of Nile flood levels.

3. The processes of dune encroachment

Further evidence that has been interpreted as indicator for a climatic change towards drier conditions at the end of the 3rd millennium BC comes from the western edge of the Nile valley in the region between Dahschur up to Ausim in the north where extensive drill core surveys have been carried out over the past fifteen years.[52] Thick layers of sterile drift sand that accumulated above Old Kingdom sites situated along the desert edge have been noted in several locations. The drill core survey at Dahschur had the main aim to locate the pyramid town connected to the Red Pyramid. The analysis of the cores taken in this region showed that the remains of this settlement are buried underneath a layer of sterile drift sand (with a varying thickness between 1 and 1.5 m) in a depth of 6–6.5 m underneath the present surface (Fig. 3).[53] Pottery fragments found in the cores date the settlement activity from the 4th to 6th Dynasty after which the site was abandoned and the sand accumulated. It was only re-occupied during the late 12th Dynasty. Thus the sand built-up occurred some time between the end of the Old Kingdom and the First Intermediate Period and was caused by the movement of dunes from the desert edge expanding up to 600 m eastwards into the floodplain.[54] It has also been noted that the Old Kingdom rock tombs, which are situated along the desert cliffs near the causeway of the Red Pyramid and the pyramid of Senusret III, are presently covered completely by large sand dunes.

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47 M.D. Krom, J.D. Stanley, R.A. Cliff & J.C. Woodward, Nile river sediment fluctuations over the past 700 yr and their key role in sapropel development, *Geology* 30, no. 1 (2002), 71–74; J.-D. Stanley, M.D. Krom, R.A. Cliff & J.C. Woodward, Short contribution: Nile flow failure at the end of the Old Kingdom, Egypt: Strontium Isotopic and Petrologic evidence, *Geoarchaeology* 18, no. 3 (2003), 395–402.

48 Krom, Stanley, Cliff & Woodward, *op. cit.*, 73; Stanley, Krom, Cliff & Woodward, *op. cit.*, 397.

49 *Ibidem*, 398.

50 There is not much information available for Ethiopian cultures dating to the 3rd millennium BC (see for example D.W. Phillipson, *Ancient Ethiopia: Aksum, its antecedents and successors*, London1998) which could shed light on possible human exploitation of the environment in the region of the Blue Nile catchment.

51 Said, *op.cit.*, 75ff.

52 N. Alexanian, & S.J. Seidlmayer, Die Residenznekropole von Dahschur: Erster Grabungsbericht, *MDAIK* 58 (2002) 1–28; D. Jeffreys, Fieldwork 1994–5, *JEA* 81(1994–5), 1–4; idem, Fieldwork 1997: Excavations and survey east of the Saqqara-Abusir escarpment, *JEA* 83 (1997), 2–4; Jeffreys & Tavares, *op. cit.*, 143–173; M. Jones, A new Old Kingdom settlement near Ausim: Report of the archaeological discoveries made in the Barakat Drain Improvements Project, *MDAIK* 51 (1995), 85–99; M. Lehner, *The Giza Plateau Mapping Project: 1999–2000 Annual report*, see http://oi.uchicago.edu/OI/AR/99-00/99-00_Giza.html.

53 Alexanian & Seidlmayer, *loc. cit.*; idem, Survey and excavations at Dahschur, *EA* 20 (2002), 3–5.

54 Alexanian & Seidlmayer, *MDAIK* 58, 26.

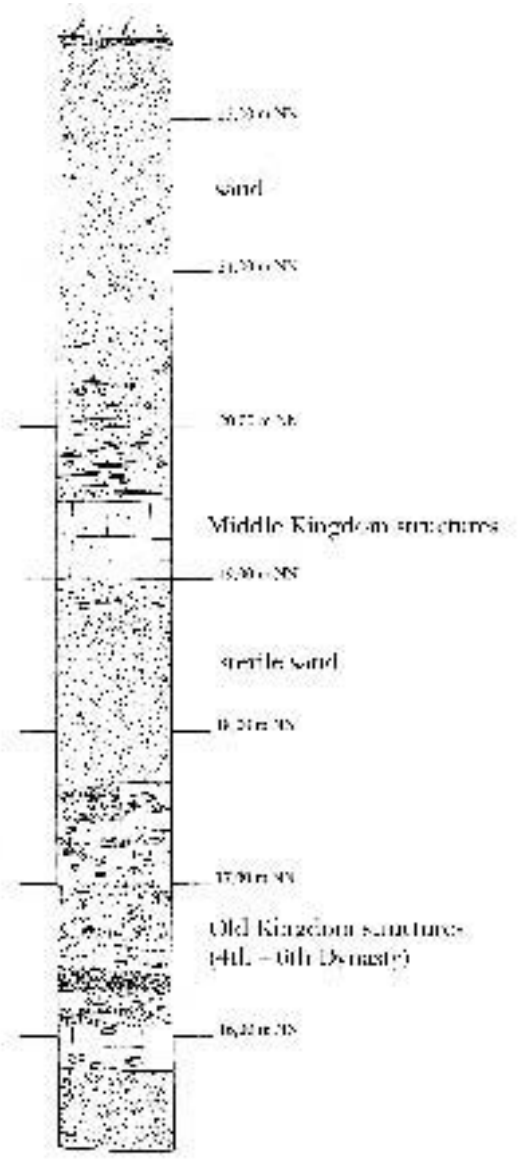

Fig. 3 Drill-core taken in the area of the pyramid town belonging to the Red Pyramid at Dahshur (after N. ALEXANIAN & S.J. SEIDLMAYER, Die Residenznekropole von Dahschur: Erster Grabungsbericht, *MDAIK* 58 (2002) 24, Abb. 15)

They must have been clearly visible and accessible in the Old Kingdom.[55] At other sites, for example at Saqqara and Abusir, similar observations have been made.[56] The survey of the Saqqara-Abusir escarpment showed that several metres of sand accumulated above the Old Kingdom levels indicating the same date for the dune encroachment as in Dahshur.[57] Here the dunes also advanced about half a kilometre from the desert eastwards into the Nile valley. This area seems not to have been re-occupied after the Old Kingdom.[57a] The few artefacts, which were found among the different layers of sand, could be signs of a seasonal use of the desert margins in this area marking the attempt to adapt to the ecological change.[58]

There is further evidence for the movement of dunes further towards the Nile valley at Giza, where an extensive Old Kingdom settlement has been excavated.[59] The sand that covers the 4th Dynasty remains seems to have accumulated not long after the end of this Dynasty, when the site was demolished.[60] So far this is the only evidence for an accumulation of large amounts of sand dating that early in the Old Kingdom. It could mean that increased aeolian activity causing the movement of dunes eastwards already begun at the end of the 4th Dynasty. North of Giza, between the villages of Abu Rawash and Ausim, comparable sand deposits have been noted.[61] Here they cover Old Kingdom settlement remains dating to the second half of the Old Kingdom, according to the recorded pottery samples.

The archaeological evidence shows that there were numerous settlements situated below the western desert escarpment in the region of Dahshur in the south up to Abu Rawash/Ausim in the north. Many of these sites have been connected to the important cemeteries in this area and were purpose-built for people who were responsible for the maintenance of funerary cults, building projects and safeguarding. There were of course also naturally grown settlements in this area for example the Old Kingdom site near Ausim whrere no direct connection with royal cemeteries is to be expected. As it has been pointed out in the different studies summarised above, their main period of occupation lasted from the 3rd/4th Dynasties until the 6th Dynasty. Thereafter

[55] *Ibidem*, 26f.

[56] L. GIDDY & D. JEFFREYS, Memphis 1991, *JEA* 78 (1992), 1–11; IDEM, Memphis 1992, *JEA* 79 (1993), 11–16; JEFFREYS, *JEA* 83, 2–4.

[57] GIDDY & JEFFREYS, *JEA* 78, 2.

[57a] JEFFREYS, *op.cit.*, 2.

[58] JEFFREYS, *op.cit.*, 2–3.

[59] LEHNER, *loc. cit.*; IDEM, The pyramid age settlement of the Southern Mount at Giza, *JARCE* 39 (2002), 27–74.

[60] IDEM, http://oi.uchicago.edu/OI/AR/99-00/99-00_Giza.html.

[61] JONES, *op. cit.*, 85ff.

this landscape seems to have changed completely because most of the sites were either abandoned and never reoccupied or resettled only in the Middle Kingdom. Thus it needs to be asked whether it was really the dune encroachment that led to the abandonment of these settlements or whether other factors played a more important role here. As indicated by the observations made during the excavations at Giza, the process of dune-encroachment had probably started already during or after the 4th Dynasty and seems to have been a rather slow process. At the end of the 4th Dynasty the Giza settlement was demolished and abandoned, but this does not necessarily need to be related to the sand accumulation. As outlined above other sites in the same region existed until the end of the Old Kingdom. By the advanced First Intermediate Period most of the Old Kingdom structures were probably covered in sand but some features must have remained visible since the choice of the same place for new occupation during the Middle Kingdom is likely to be related to the reuse of existing infrastructures.[62] Reasons for such changes in settlement patterns are most likely to be linked to economic and political factors rather than exclusively to environmental changes, which might have played a role but not necessarily the decisive one.

Furthermore, this dune encroachment is not restricted to the Memphite region, it has also been noted in parts of Middle Egypt.[63] Thick aeolian deposits of desert sand cover areas along the west bank of the Nile, which previously formed the floodplain border. The exact date of this dune encroachment and whether it was a gradual process or a rapid event is not known and only further studies will shed more light on this matter. How does this sand movement relate to climate change? The accumulation of sand, several meters thick, is evidence for increased aeolian activity.[64] Three factors influence the large-scale movement of sand: strong wind activity, moisture level and existing vegetation cover.[65] It is however not entirely clear how changes in any one of these three factors determine the character of sand movement. The time scale of how quickly such sand can move is also highly variable,[66] and only a specialist study of the characteristics of these dunes in Egypt can provide more precise information of how they accumulated and how long it took. At Dahshur we have a period of about 330 years between the end of the 6th Dynasty (Pepi II) and Senusret III during which the large amount of sand accumulated.[67] Anyhow the increased aeolian activity responsible for the movement of dunes is not in any way directly related to low Nile floods. It is simply an indication for drier and windier weather conditions.

4. Variation in Fayum lake levels

Variations in the Fayum lake level have been regarded as an additional source of information about long-term Nile flood variations and climate change in Egypt.[68] The lake level was directly affected by the height of the annual Nile flood via the Bahr el-Yussef, a subsidiary branch of the Nile feeding the lake.[69] An investigation of the sediments taken from the lakeshore and their association with archaeological remains in the vicinity of Qasr el-Sagha temple have provided important information about lake level fluctuations. The Palaeolithic and Neolithic lake levels have been established by analysing sediment cores from the lake, for which a number of ^{14}C dates have been obtained.[70] For the Dynastic period less well-dated information is available, as it is indicated by the marked gap between the Early Dynastic Period and the Middle Kingdom in the curve of suggested lake-level changes (Fig. 4).[71] Almost no radiocarbon dating

[62] Alexanian & Seidlmayer, *MDAIK* 58, 27.

[63] Butzer, *Studien*, 70ff.; idem, Archäologische Fundstellen Ober- und Mittelägyptens in ihrer geologischen Landschaft, *MDAIK* 17(1961), 63f.

[64] Idem, *Studien*, 111.

[65] K. Pye, H. Tsoar, *Aeolian sand and sand dunes*, London 1990, 148.

[66] *Ibidem*, 135.

[67] Alexanian & Seidlmayer, *MDAIK* 58, 26.

[68] See for example K.W. Butzer, Sociopolitical discontinuity in the Near East c. 2200 B.C.E.: Scenarios from Palestine and Egypt, in: *Third Millennium BC Climate Change, op.cit.*, 245–296; Hassan, *loc. cit.*; idem, Holocene lakes and prehistoric settlements of the western Fayum, Egypt, *JAS* 13 (1986), 483–501.

[69] Butzer, *Early hydraulic civilization*, 36f.; Said, *op. cit.*, 78ff.

[70] Hassan, *JAS* 13, 483ff.; Kozlowski & Ginter, *op. cit.*, fig. 1.

[71] B. Ginter, W. Heflik, J.K. Kozlowski & J. Sliwa, Excavations in the region of Qasr el-Sagha, 1979. Contributions to the Holocene Geology, the Predynastic and Dynastic settlement in the northern Fayum desert, *MDAIK* 36 (1980), fig. 13; Hassan, *op. cit.*, fig. 6.

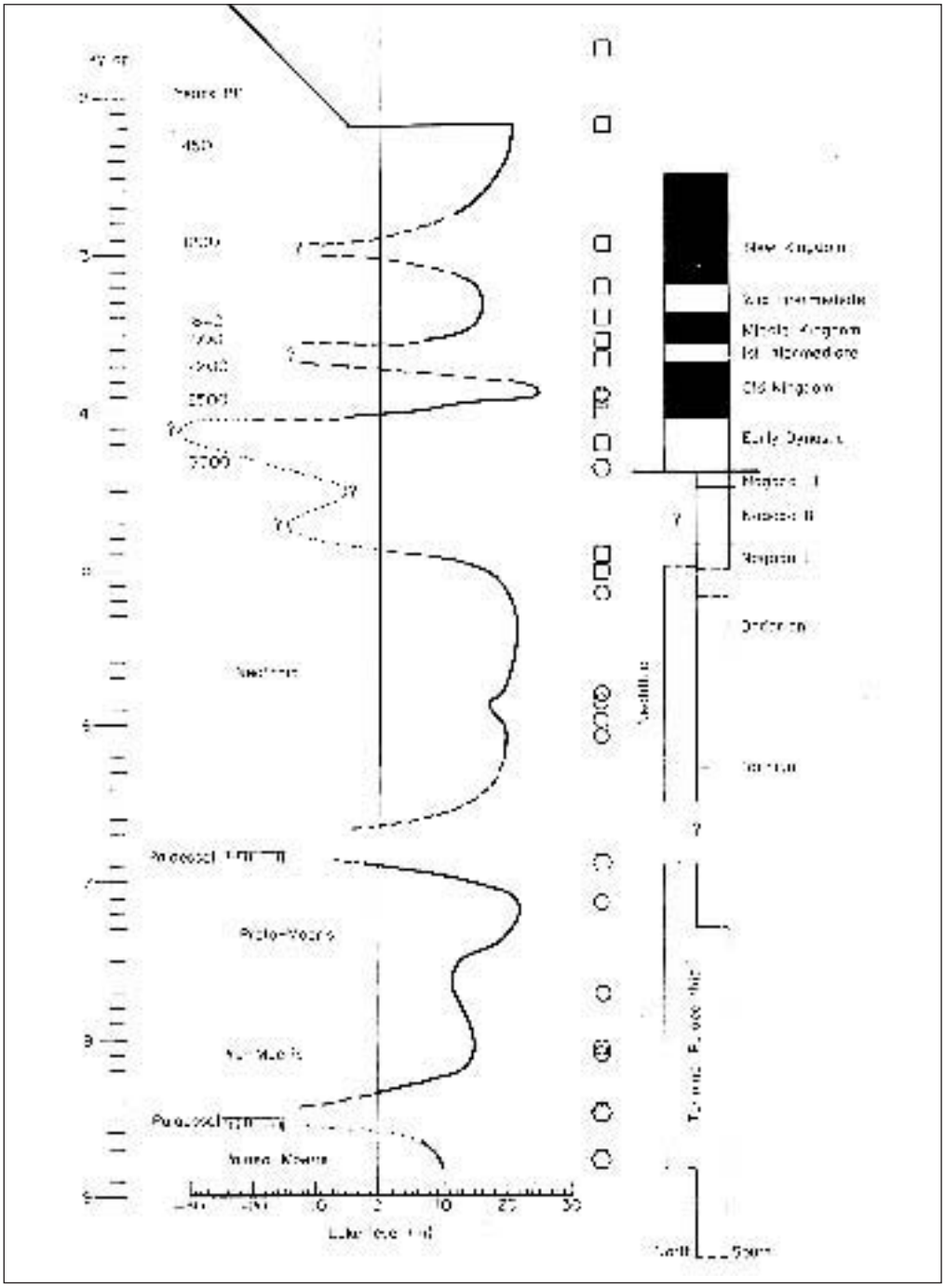

Fig. 4 Variations of the Fayum lake levels which are reconstructed from elevation of lake deposits relative to sea level and from historical accounts of lake levels and Nile floods. Circles show the radiocarbon dates on lake deposits, hexagons show stratigraphic age estimates and rectangles indicate historical dates (after F.A. HASSAN, Holocene lakes and prehistoric settlements of the western Fayum, Egypt, *Journal of Archaeological Science* 13 (1986), 492, fig. 6)

has been carried out for samples of this period.[72] It has been proposed that from the end of the 4th to the end of the 3rd millennium BC, the lake level was marked by a long period of recession, which was followed by several phases of transgression, indicated by four episodes of 'Brown Sand' deposi-

[72] Except for one reported sample dating to 3890±45 BP (see *ibidem*, Table 1).

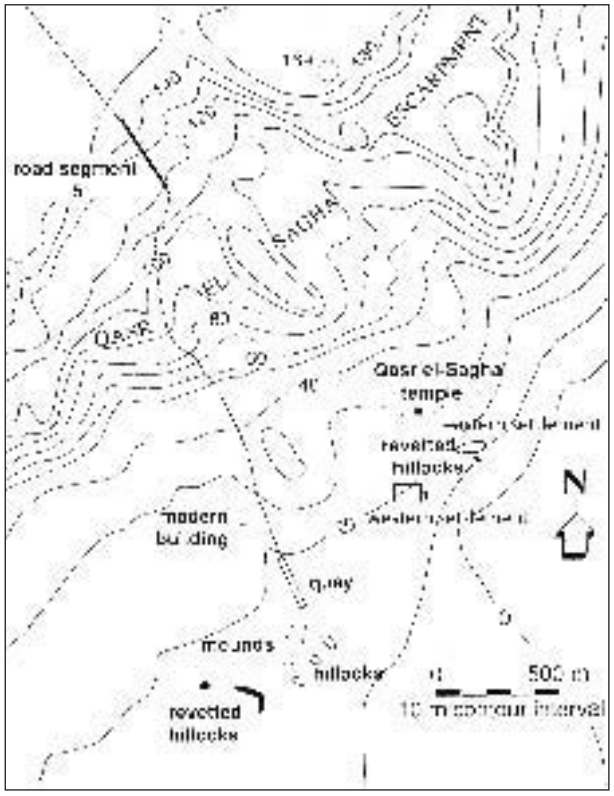

Fig. 5 Map of the Qasr el-Sagha region showing location of various hillocks, Middle Kingdom temple and settlements and quay structure (adapted after the original published by J.A. HARRELL & T.M. BOWN, An Old Kingdom Basalt Quarry at Widan el-Farras and the Quarry Road to Lake Moeris, *JARCE* 32 (1995), 85, fig. 18)

tion.[73] According to this theory, the water level gradually declined from late Predynastic times onwards until the early Middle Kingdom when it rose again.[74] An alternative theory suggests that the lake stood high until the 4th Dynasty, and only decreased afterwards until the Middle Kingdom.[75] Latter has been rejected on the grounds that it was based on a false dating of Qasr el-Sagha temple to the 4th Dynasty instead to Middle Kingdom.[76] Another shortcoming is that the date of the transgression period called 'first Brown Sand episode' which is crucial for the determination of the first Dynastic high lake level has so far not been established. Additionally the attempts to date sediments in association with archaeological remains of the Qasr el-Sagha region are highly disputable. Some of the features such as the Middle Kingdom temple and the two settlement sites of the same period have been investigated in detail[77] while many other remains have been left unexcavated such as the stone revetted hillocks which have been interpreted as quay structures and their date and function is thus far from being clear (Fig. 5).[78]

As a result it is important to point out that the diagramms reconstructing Fayum lake levels in the 3rd millennium BC are uncertain and repeated references to the close relation between lake level fluctuations and Nile flood variation which are supposed to follow the same trends do not provide new data but are a circular argument. Again, there are no independent data for reconstructing the lake levels in the Fayum and thus they cannot be used to shed light on climate conditions during the First Intermediate Period!

OTHER SOURCES INDICATING DRIER WEATHER TRENDS AROUND 4200 CALBP

The following two studies have been chosen because of their high chronological resolution and complete sedimentological record which provide more precise information about climate change than many other studies focusing for example on lake level changes and pollen diagrams.[79] They are also interesting evidence for changes of Near Eastern climate conditions pointing towards a drying

[73] B. GINTER, J.K. KOZLOWSKI, M. PAWLIKOWSKI & J. SLIWA, El-Tarif and Qasr el-Sagha. Forschungen zur Siedlungsgeschichte des Neolithikums, der frühdynatischen Epoche und des Mittleren Reiches, *MDAIK* 38 (1982), 111.

[74] GINTER, HEFLIK, KOZLOWSKI & J. SLIWA, *MDAIK* 36, 156.

[75] See for example HASSAN, op. cit., 483ff.; IDEM, The dynamics of a riverine civilisation: A geoarchaeological perspective on the Nile Valley, Egypt, *World Archaeology* 29 no. 1 (1997), 51–74, BUTZER, Sociopolitical discontinuity, 245ff.

[76] KOZLOWSKI & GINTER, *op. cit.*, 331f.

[77] DI. & DO. ARNOLD, *Der Tempel von Qasr el-Sagha*, AV 27, Mainz 1979; J. SLIWA, Die Siedlung des Mittleren Reiches bei Qasr el-Sagha. Grabungsbericht 1983–1985, *MDAIK* 42 (1986), 167–179; IDEM, *Die Siedlung des Mittleren Reiches bei Qasr el-Sagha. Grabungsbericht 1987 und 1988*, *MDAIK* 48, 1992, 177–191.

[78] J.A. HARRELL, T.M. BOWN, An Old Kingdom Basalt Quarry at Widan el-Farras and the quarry road to the lake Moeris, *JARCE* 32 (1995), 85–89.

[79] G. HENDERSON (University College, Oxford), pers. com.. The shortcomings of such publications for the current question have also been pointed out by F. GASSE, Hydrological changes in the African tropics since the last glacial maximum, *Quaternary Science Reviews* 19 (2000), 190.

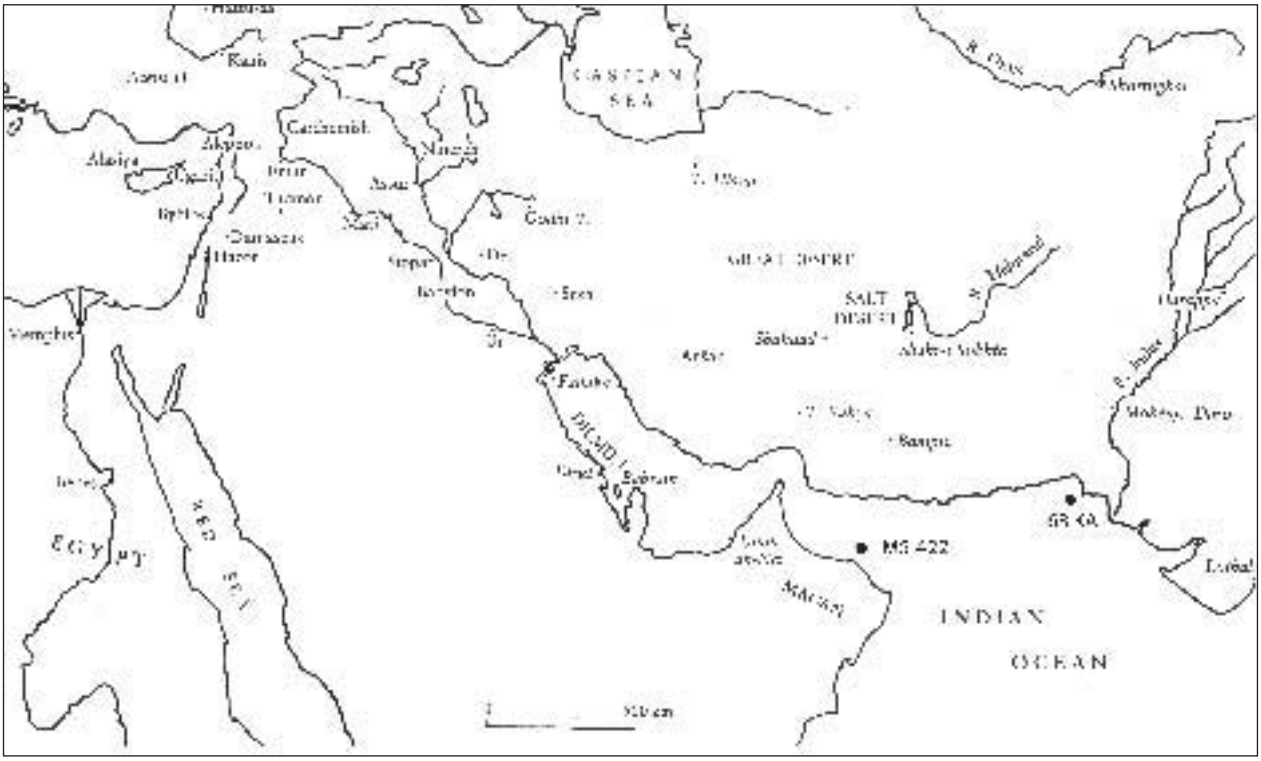

Fig. 6 Map showing the location of two deep-sea cores M5-422 and 63 KA (map adapted after the original published by J.N. POSTGATE, *Early Mesopotamia. Society and Economy at the Dawn of History*, London-New York 1992, 209, fig. 11:2)

trend at the end of the 3rd millennium BC. The analysis of deep-sea cores taken in the Golf of Oman and the Arabian Sea[80] showed a marked change to drier weather conditions with a peak around 4200 and 4025 ± 150 calBP.[81]

The sediment core taken in the Golf of Oman (M5-422) comes from an area where wind-blown dust of Mesopotamian origin gets deposited in the seabed (Fig. 6). Diagrams plotting variations in aeolian dolomite and calcium carbonate ($CaCO_3$) proportion showed a marked increase between 4194 and 3626 calBP.[82] Their peak values were reached at about 4025±150 calBP. Further analysis into their provenance proved that the Zagros mountain region is the main source area for these terrigenous sediments. Drier weather conditions leading to an increase in aeolian activity and therefore a higher rate of sediment deposition were probably responsible for this phenomenon. This evidence has been associated with the so-called collapse of the Akkadian Empire at about 2200 BC and the Tell Leilan collapse in northern Syria.[83] However, criticism has been lately raised on this theory because the archaeological evidence indicates far more complex processes initiating change than drier climate conditions alone. Most notably there seem to have been large-scale changes in urban sites, such as the abandonment of important centres for example Tell Leilan, Beydar and Chuera in

[80] H.M. CULLEN, P.B. DEMENOCAL, S. & G. HEMMING, F.H. BROWN, T. GUILDERSON & F. SIROCKO, Climate change and the collapse of the Akkadian empire: Evidence from the deep sea, *Geology* 28 no. 4 (2000), 379–382; M. STAUBWASSER, F. SIROCKO, P.M. GROOTES & M. SEGL, Climate change at the 4.2 ka BP termination of the Indus Valley civilization and Holocene south Asian monsoon variability, *Geophysical Research Letters* 30 no. 8 (2003), 7–1 – 7–4.

[81] CalBP dates can be directly converted to calendar dates by subtracting 1950 (see also http://www.rlaha.ox.ac.uk/O/calibration.php).

[82] CULLEN ET AL., *op. cit.*, fig. 2.

[83] *Ibidem*, 379ff.; H. WEISS, M.-A. COURTY, W.WETTERSTROM, F. GUICHARD, L. SENIOR, R. MEADOW & A. CURNOW, The genesis and collapse of third millennium north Mesopotamian civilization, *Science* 261 (1993), 995–1004.

north-eastern Syria, but other cities continued to prosper. For example, there is evidence that Tell Brak flourished in the post-Akkadian era as well as Mari.[84] Further evidence comes from a detailed archaeo-botanical study involving three Syrian sites. The results provide a first glimpse into agricultural practices and adaptation to environmental changes which are sometimes self-inflicted such as deforestation and over-exploitation of arable land due to population increase during the early and mid- third millennium BC which seems to have led to an increase in the use of alternative fuel materials such as animal dung.[85] Miller also points out that there is no evidence for deforestation as a result of a severe drought affecting the Near East,[86] a theory that has been proposed by Weiss *et al.*[87] In fact, people adapted their agricultural practices to the changing climate conditions and even bringing their own farming techniques with them when moving to new places.[88] Thus much of the evidence brought forward for the collapse of the Akkadian empire due to a drastic short-term climate change which have been proposed by Weiss *et al.* can be proven incorrect. There is also new evidence concerning the layer of tephra fall that has been associated with the Tell Leilan abandonment and also linked to a short-term climate anomaly.[89] During the excavations at Tell Brak, the same anomalous dust layer has been identified and reanalysed proving that it actually dates earlier as previously assumed namely to the early Akkadian period. It is clear now that this is not a volcanic tephra fall-out and thus cannot be linked to a short-term, abrupt climate change.[90]

Comparable results have also been obtained for the second deep-sea core (63 KA) which comes from the region of the former Indus-discharge off the coast of Pakistan (Fig. 6).[91] Similar to the deep-sea core taken in the Arabian Sea, the sediment records are very valuable because they have a high chronology resolution and provide a complete sequence for the Holocene period. The analysis focused on a plankton species that seems to have increased around 4200 calBP indicating higher salt concentration in the seawater and thus a decrease of the Indus discharge during this period. This result has been related to the changes in the Indus Valley culture. People belonging to this early civilisation abandoned many sites in the southern region moving further north around this time. Although there is relatively limited data available concerning the Indus Valley civilisation, archaeological evidence shows signs of the society's disintegration and migration. Again more than one factor seems to have been responsible for these developments, ranging from environmental changes like moving river beds[92] to political changes in ruling elites affecting urban development.[93] There are also indications for adjustments in subsistence patterns which might have initiated a process of decentralisation, that is an increase in smaller settlement numbers and a decrease in large ones.[94] Although major changes

[84] P.M.M.G. Akkermans & G.M. Schwartz, *The archaeology of Syria. From complex hunter-gatherers to early urban societies (ca. 16,000–300 BC)*, Cambridge World Archaeology, Cambridge 2003, 285f.

[85] N.F. Miller, Farming and herding along the Euphrates: Environmental constraint and cultural choice (fourth to second millennia BC), 123–132, in: R.L. Zettler (ed.), *Subsistence and settlement in a marginal environment: Tell es-Sweyhat, 1989–1995 Preliminary Report*, MASCA Research Papers in Science and Archaeology 14, Philadelphia 1997.

[86] *Ibidem*, 130.

[87] Weiss *et al., loc. cit.*

[88] Miller, *op.cit.*, 131.

[89] M.-A. Courty, Evidence at Tell Brak for the Late EDIII /early Akkadian Air Blast event (4 kyr BP), 367–372, in: D. Oates, J. Oates, H. McDonald (eds.), *Excavations at Tell Brak, Vol. 2: Nagar in the third millennium BC*, McDonald Institute Monographs, Cambridge 2002.

[90] *Ibidem*, 367, 371–2.

[91] Staubwasser *et al., loc. cit.*, fig. 2.

[92] V.N. Misra, Climate, a factor in the rise and fall of the Indus Valley civilization-Evidence from Rajasthan and beyond, 461–490, in: B.B. Lal, S.P. Gupta (eds.), *Frontiers of the Indus civilization: Sir Mortimer Wheeler commemoration volume*, New Delhi 1984.

[93] J.M. Kenoyer, Urban processes in the Indus tradition: A preliminary model from Harappa, 29–60, in: R.H. Meadow (ed.), *Harappan excavations 1986–1990 – A multidisciplinary approach to third millennium urbanism*, Monographs in World Archaeology 3, 1991.

[94] S.N. Reddy, Complementary approaches to the late Harappan subsistence: An example from Oriyo Timbo, 127–135, in: R.H. Meadow (ed.), *Harappan excavations 1986–1990 – A multidisciplinary approach to third millennium urbanism*, Monographs in World Archaeology 3, 1991.

in the Indus valley civilisation started at the end of the 3rd millennium BC, it did not come to an end and collapsed. There is much information about new developments affecting settlement development thereafter.[95]

As a result of these two studies there can be little doubt that drier climate conditions were affecting parts of the Near East at the end of the 3rd millennium BC. The main problem is the association of these results with the 'collapse' of societies and/or civilisations. Although it seems logical to link certain developments to climate change, this approach is often too simplistic. When looking at the archaeological evidence some of changes that can be identified might be related to environmental changes but in most cases a combination of different factors played a role. As indicated above, the data for northern Syrian settlement sites are much more complicated than previously assumed and changes in settlement patterns are linked to political, economic as well cultural changes. It is impossible that climate change alone can trigger all these developments.

However, it also cannot be coincidence that similar conclusions have been reached in both studies. Cullen et al. proposed that this change to drier conditions was abrupt and lasted for about 400 years, a relatively short period in terms of climate change.[96] Could there be any link between these regions, Mesopotamia and the Indus Valley, and possibly Egypt? As pointed out above, the weather cycles affecting Egypt and Mesopotamia are quite different so that only a globally effective climate change would show up in all records. It seems that Egypt in the 3rd millennium BC was more likely to have been affected by a long-term transformation of the climate whereas the deep-sea cores taken in the Gulf of Oman and the Arabian Sea indicate a rather abrupt change. It is not possible to detect such a short-term anomaly in Egypt with regard to the current evidence available. Another important consideration is the exact correlation of climate change with historical events and developments especially over wider regions. Up to now the synchronisation of Egyptian and the Near Eastern chronologies for the 3rd Millennium BC are problematic because of missing overlapping archaeological records. Even for the 2nd millennium BC, a period when much more evidence is available due to much more interaction between the different cultures, there have been considerable difficulties to do so.[97]

Egyptian texts mentioning famines

As a last point I would like to come back to the much-discussed famine texts dating to the First Intermediate Period in Egypt. The perception that the history of the First Intermediate Period is characterised by frequent famines has persisted throughout Egyptology from the first study about famines published by Vandier.[98] The topic reappears on a regular basis and has been used as evidence for a short-term climate change at the end of the 3rd millennium BC.[99] The main problem is the interpretation of these ancient texts and to what extent they reflect historical reality. The discussion whether the famine topic was a purely literary theme or based on historical facts has been critically reviewed in a recent study by Moreno Garcia.[100] Already Old Kingdom inscriptions frequently include the phrase of having provided food for the hungry, which is developed into more elaborate statements during the First Intermediate Period. Local rulers expand the descriptions of pious acts and put a real emphasis on depicting themselves as a benefactor for his town and/or nome.[101]

Furthermore, one has to ask what was the exact purpose of these inscriptions. They were written for the afterlife and surely they had relatively little to do with legitimization in the world of the living, but to gain a good position in the next world, and people also liked (and still like

[95] Kenoyer, *loc.cit.*

[96] Cullen *et al.*, *op.cit.*, 381.

[97] See the discussions in the different contributions in: M. Bietak (ed.), *The synchronisation of civilisations in the Eastern Mediterranean in the second millennium B.C, Proceedings of an International Symposium at Schloß Haindorf, 15th–17th of November 1996 and at the Austrian Academy, Vienna, 11th–12th of May 1998,* CChEM 1, Wien 2000.

[98] J. Vandier, *La Famine dans l'Égypte ancienne*, Cairo 1936.

[99] See for example Bell, *op.cit.*, 1ff.

[100] J.C. Moreno Garcia, *Études sur l'administration, le pouvoir et l'idéologie en Égypte, de l'Ancien au Moyen Empire*, Aegyptiaca Leodiensia 4, Liège 1997.

[101] *Ibidem*, 46ff.

today) to leave a good reputation. In this context it was also important to show visitors passing by the tomb that the deceased could be a good mediator between both worlds encouraging them to recite the offering prayer. The establishment and continuity of the funerary cult played a major role, too. The local ruler wanted to make sure he would continue to live in the memory of his people and be remembered as a virtuous administrator. These aspects are often entirely missed or neglected when dealing with tomb inscriptions, but they are of major importance for our understanding of ideological processes inherent in Egyptian society. Nevertheless, it is also clear that these issues, which are addressed in the texts, are based on some real life experiences but whether this is typical only for the First Intermediate Period is questionable.

In this context it is important to clarify the exact definition of famine. Garnsey analysed famines in antiquity and explained the differences between 'food-shortage' and 'famine'.[102] He defined the latter as 'a critical shortage of essential foodstuffs leading through hunger to starvation and a substantially increased mortality rate in a community or region', while food shortage is 'a short-term reduction in the amount of available foodstuffs as indicated by rising prices, popular discontent, hunger and in the worst cases bordering on starvation'.[103] The textual sources from ancient Egypt describe in most cases crises in food supply, and put an emphasis on how the situation was improved, for example, by cutting rations or acquiring grain from other parts of Egypt where it was available. A good example for the occasional problem of food-shortages comes from the Heqanakhte papers, which date to the early 12th Dynasty.[104] Periods of deficiency in food supply arise usually at the moment when the stored commodities are used up and one is waiting for the new harvest. This critical period can differ considerably in length depending on the amount of provisions that were stored in the previous year.

Studies about long and short-term Nile flood trends up to modern times demonstrate that a certain variation in the annual flood height had to be expected and low Nile floods or even a consecutive number of such floods were occurring on a regular basis.[105] With the exception of a few rhetorical declarations of having provided food for the hungry, there is no information about the provision of food supply by the central government during times of crises[106] for example caused by low Nile floods, spoiled harvests or vermin infested storage.[107] Irrigation was probably managed entirely on a local level and the redistributive aspect of ancient Egyptian economy might have been less dominant than usually assumed.[108] Distribution of food in critical times is more likely to have been organised by local people in charge of certain districts, such as the village headmen, mayors and nomarchs.[109] This is also the reason why the topic of food supply starts to turn up in private inscriptions, first in tombs of high officials during the Old Kingdom and later in those belonging to powerful provincial governors and not in any official decrees issued by the central government. In this respect one has to dismiss the suggestion that the increase in the number of texts mentioning famine during the First Intermediate Period is a consequence of the dissolution of the Egyptian state and resulting economic decline. Thus the occurrence of this topic in the autobiographical inscriptions only indicates that food-supply and food-shortages were important issues in ancient Egyptian society, and the ability to provide provisions was regarded as an important virtue and had nothing to do with an abrupt climate change or long-term economic problems.

[102] P. Garnsey, *Famine and Food supply in the Graeco-Roman world. Responses to risk and crisis*, Cambridge 1988, 3–16.

[103] *Ibidem*, 6.

[104] J.P. Allen, *The Heqanakht papyri*, New York 2002, 127ff. A food-shortage is mentioned in Letter II, 26–28, see *ibidem*, 135.

[105] Seidlmayer, *Nilstände,* 104–105.

[106] Moreno Garcia, *op.cit.*, 15.

[107] For further details see P.B. Adamson, Problems over storing food in the ancient Near East, *Die Welt des Orients* 16 (1985), 5–15.

[108] C.J. Eyre, Village economy in Pharaonic Egypt, 33–60, in: A.K. Bowman, E. Rogan (eds.), *Agriculture in Egypt from Pharaonic to modern times*, Proceedings of the British Academy 96, 1999.

[109] It is also feasible that those persons were able to acquired help from the central government, if they stood close enough to the royal court but textual sources seem to be rather silent about that. The existence of large storage areas within urban centres hint at a locally organised redistribution of goods and food which was controlled by the town's administration.

Conclusions

The critical review of the available data relating to climate change in Egypt shows that there is currently no evidence for a short term, abrupt anomaly, which would have led to the collapse of the Old Kingdom state in Egypt. So far, the evidence of Nile flood trends suggests a long-term, gradual development towards generally drier conditions. Therefore the cultural, economic and political changes, which characterise the First Intermediate Period does not seem to have been triggered by a natural catastrophe as has often been implied. Furthermore the ability of people to adapt must not be underestimated. Evidence from Syria and Pakistan shows that a rather dry climate period affected parts of the Near East, which might have led to changes in agricultural practices and settlement patterns but not necessarily to the collapse of civilisations. However, further studies are needed to correlate this evidence with data from Egypt as well as the evaluation of possible global effects of such short-term climate changes.