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The geoarchaeology of occupied Wadis in Egypt

Maciej Pawlikowski[a]

This work presents the results of geological and geomorphological research at excavations located in dried-up river beds at sites from Upper Egypt to the Nile Delta. The data obtained can be useful in reconstruction of climate and the natural environment from thousands of years ago, as well as in the investigation of new archaeological excavation sites.

KEY WORDS: geoarchaeology, mineralogy, climate reconstruction, occupation, wadis, Egipt

INTRODUCTION

Geological structure, and its influence on the lands geomorphology, is one of the main factors determining the location of archaeological sites. Both factors influence the lie of the land, such as the development of the river valleys which have always attracted settlement. A special case is provided by the valleys of dried-up rivers (wadi) which have periodically conducted water since the beginning of Holocene. Examination of these valleys and their fluvial deposits is a vital factor in the reconstruction of the local palaeoenvironment and human activity in the past. This article presents selected examples of such reconstructions from archaeological sites in dried-up river valleys of Egypt, based on 35 years of experience.

1. The Heraconpolis region

The site of this excavation is on the local delta, formed at the mouth of a big wadi stretching out from the west to the Nile Valley (Fig. 1). This wadi was active before the Nagada culture because the oldest archaeological layers present belong to Nagada II, confirming that the delta and wadi were dry at this time (Pawlikowski and Such 2008: 1–49).

The delta is cut through by modern irrigation canals. I it has an undisturbed structure of geological layers in its western part (Fig. 2), but closer to the Nile, in its eastern part. It has a complicated geological structure resulting from natural and human activity.

[a] Department of Mineralogy, Petrography and Geochemistry AGH University of Science and Technology, 30 Mickiewicza Ave., 30-059 Kraków, Poland; mpawlik@agh.edu.pl

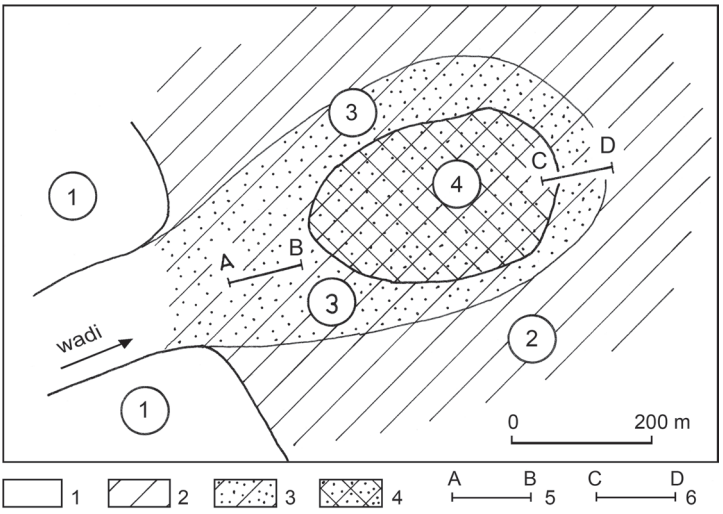

Fig. 1. Heraconpolis. Upper Egypt. Location of delta in front of big Wadi.
1 – old Nile bank just over flood zone; 2 – flood zone; 3 – sandy delta; 4 – location of archeological sites; A-B – geological cross section showed at fig. 2; C-D – geological cross section showed at fig. 3.

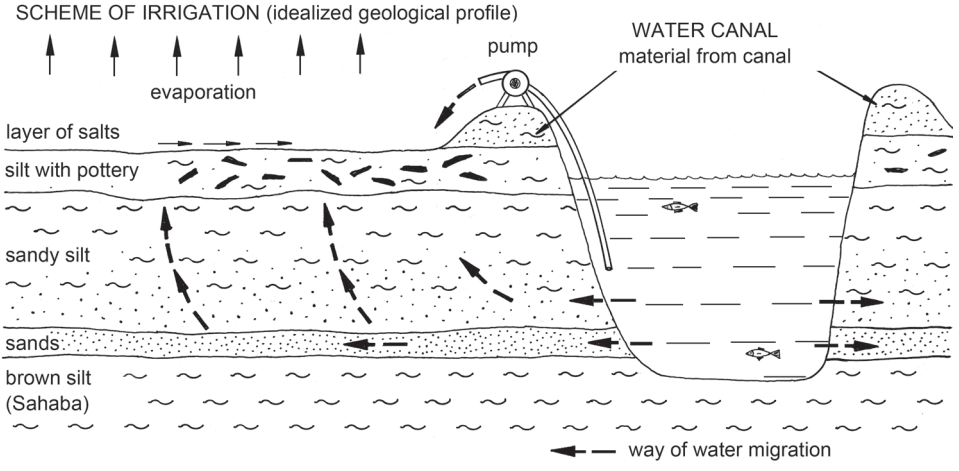

Fig. 2. Heraconpolis. Upper Egypt. Cross section (A-B) of delta at place showed at fig. 1.
Sandy delta cut with irrigation canal. Visible layers of sand and water circulation routes across old delta.

The western part of the Heraconpolis delta, closer to the gebel, is built of sands, redeposited from higher morphological deposits dated to the Pleistocene (Said 1962: 1–377). The primary origin of these sands is connected with the weathering of Nubian (Cretecous) sandstones.

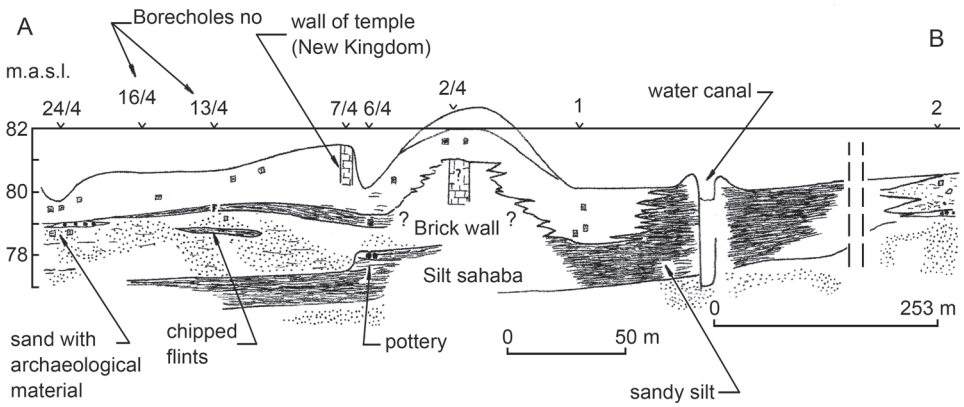

Fig. 3. Heraconpolis. Upper Egypt. Cross section (C-D) of delta at the place showed at fig. 1. Sands intercalated with Nile silts damaged by human activity during occupation by archaeological sites.

The eastern part of the delta, closer to the Nile, comprises an interbedding of the above sands (from the wadi) intercalated with Nile silts. This mixed structure of sand and Nile silt reflects the activity of the local wadi (sand) and the upper Nile (silt). This indicates local rains (sands from wadi) and rains in South (Nile silt).

Observation of structures and textures in the delta suggest that succeeding occupation sites were destroyed by the torrential rain which initiated the wadi. In this part of the area, the original sequence is often disturbed by primary human activity (the Nagadian period of the Old and the New Kingdom) as well as later activity (Fig. 3).

Occupation of the delta from the Neolithic Age to the present day (with gaps) proves that the wadi has not usually carried water since the Neolithic. This means that the area of Heracompolis had a dry and precipitation-free climate (Pawlikowski 1993: 335–337; Pawlikowski and Such 2008: 1–15).

2. The Armant region

In this area on the western bank of the Nile a number of the archaeological sites, mainly Neolithic and later in age, are located on the edge of the desert just above the fluvial terrace. Some of them are situated on banks at the wadi's mouth, where water issued from the gebel to the Nile. One these sites is "Armant" MA/21/86 (Fig. 4).

This site is on the southern bank of the dried-up wadi. On its northern bank, there is a cemetery of the pre- and protodynastic period that was examined by Mond and Mayers (1937: 235) and Ginter *et al.* (1985: 95–104; 1988: 15–42). The site was most probably occupied during the time when the wadi was active i.e. in Late Neolithic – Predynastic time. After this the climate slowly became dryer (Pawlikowski 1994a: 3–6; 1994b: 37–38; 1994c: 125–132).

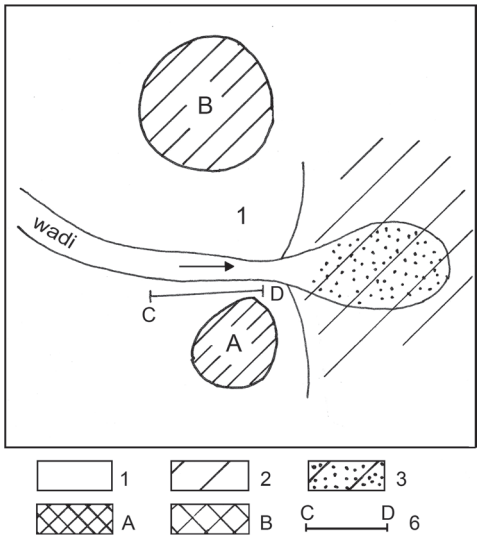

Fig. 4. Armant. Upper Egypt. Site MA21/83 located on left bank of Nile just over flood zone at outcome of dry wadi (coming down from gebel into Nile valley).
1 – old Nile bank just over flood zone; 2 – flood zone; 3 – sandy delta. A – pre-protodynastic site MA26/86; B – pre-protodynastic cemetery excavated by Mond and Mayers (1937); C-D – geological cross section showed at fig. 5.

At the bottom of the wadi there are a number of small fluvial areas where sands and gravels have accumulated (Fig. 5). Variations in particle size within these fluvial deposits indicate the changes in velocity of river' flow in the wadi. Such variations are proportionate to the amount and speed of the water flow and, indirectly, to rainfall.

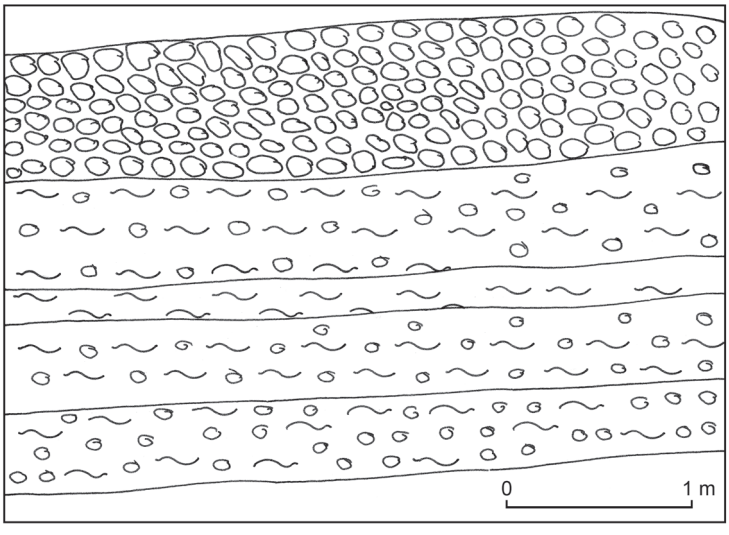

Fig. 5. Armant, Upper Egypt. Geological profile of sediments under archaeological layers of site MA21/83. This zone is place of mixed sedimentation of Nile and wadi coming down from Gebel. Layers of limestone gravels (material form Gebel) intercalated with Nile silts.

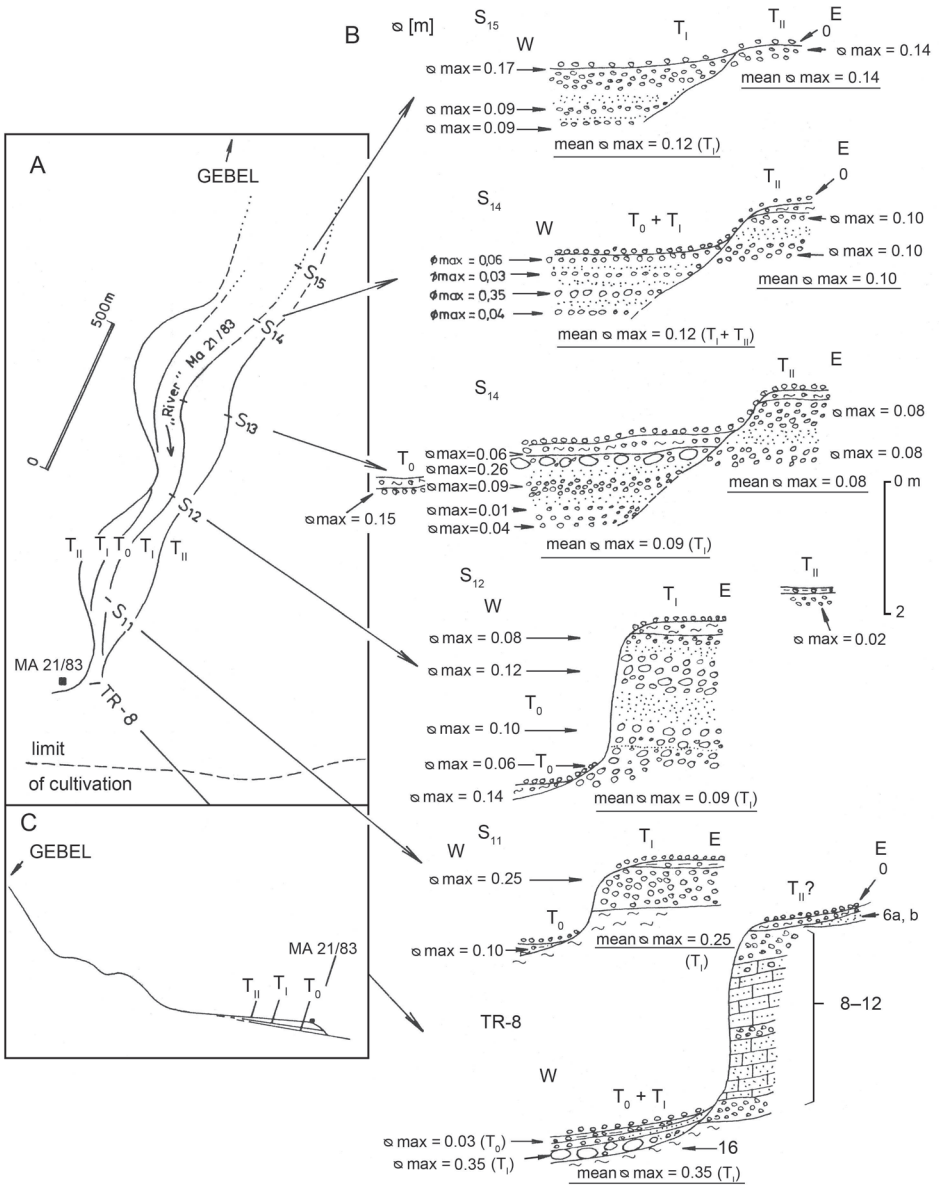

Fig. 6. Armant, left bank of Nile. Upper Egypt Scheme of Wadi – "River" (at present dry river bed) MA21/83 functioning in the past nearby the site. A – the map of Wadi MA21/83 – pre-protodynastic site; T – "old river" terrace. Arrows show location of examined profiles of "river" terraces. B – geological profiles of "river" MA21/83 terraces with measured medium size of gravels transported in the past by flowing water of the river. C – general morphological cross section of area; T – dry river terraces. MA21/83 – pre-protodynastic site.

The particle sizes of dated fluvial deposits can thus be used to establish variation in rainfall and hence in climatic conditions.

The deposits on which the MA/21/86 excavation site is located, and which are cut through by the wadi, are a complex of interbedded Nile silts and gravels deposited from the surrounding gebel. Prior to occupation the site was an area of calm deposition of Nile silts together with intensive fluvial deposition by rivers flowing off the gebel (Fig. 6).

3. The area between Armant and Qurna on the western bank of the Nile

This area encompasses the flattened right bank at the base of the gebel. In the past, streams and rivers flowing of the gebel into the Nile Valley changed from rushing mountain rivers into slower braided rivers (Fig. 7). The decrease in velocity was accompanied by a decrease in particle size.

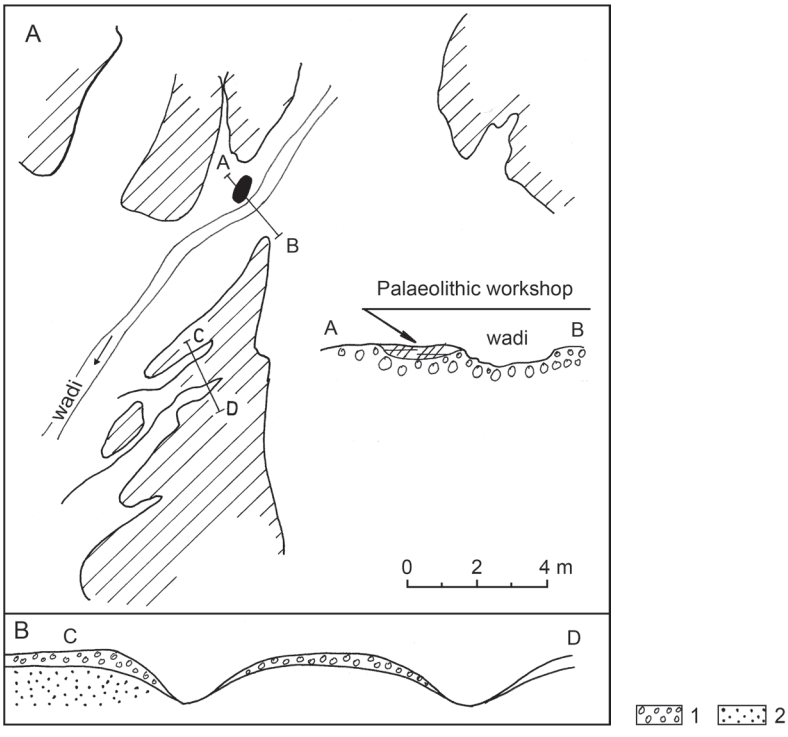

Fig. 7. Area between Armant and Qurna, left bank of Nile. Upper Egypt.
A – location of upper Palaeolithic site on the bank of wadi of small river coming down from Gebel into Nile valley. A-B – morphological cross section of upper Palaeolithic site (workshop) located on bank of "dry" river; hills – marked with lines; B – Cross section across the hills (see map A); 1 – gravels containing redeposited flints (from Theban limestones) and agates; 2 – Quena sands.

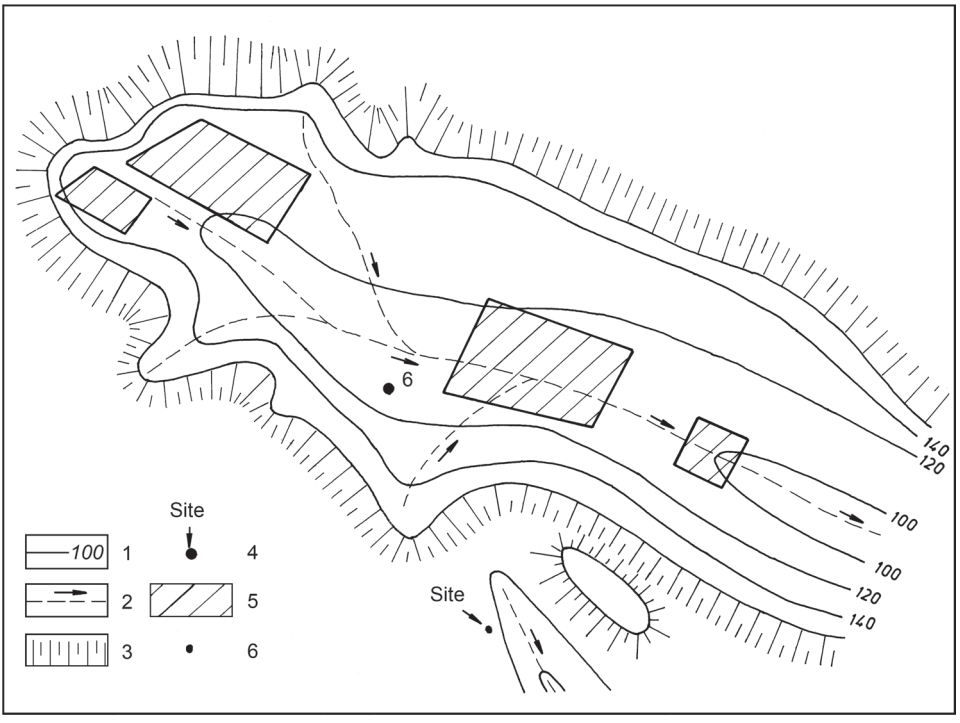

Fig. 8. Deir el Bahari. Upper Egypt. Scheme map of wadi.
1 – countur lines (m a.s.l); 2 – traces of flowing streams; 3 – steep slopes; 4 – location of Palaeolitic site; 5 – dynastic objects; 6 – tomb with examined sediments.

There are a number of occupation sites in this area, mainly of Paleolithic age, especially Late Paleolithic (Ginter *et al.* 1985: 15–42; 1987: 45–67). These are frequently situated on the banks of the wadi (Fig. 8), whose sizes and depth vary a lot. Geological and morphological observations suggest that at the end of the Palaeolithic, but before the deposition of the Sahaba formation, the wadi channelled a lot of water. The sites resemble flint workshops, some of which were probably occupied during a drying climate up until the start of the Holocene (Pawlikowski, 2013).

4. The Deir El Bahari region

In the Deir El Bahari wadi, many sites are located *in situ* on the floor of the valley, as well as on its higher edges. On the valley floor, dynastic sites predominate (Fig. 8), but have damaged older ones. The sites found on the edges of the valley are mainly Palaeolithic of different periods (Pawlikowski 1993: 355–357). Geological profiles suggest that the wadi at Deir el Bahari was active continuously up to the beginning of Holocene and occasionally even later (Pawlikowski 2007: 37–44, Pawlikowski, 2013).

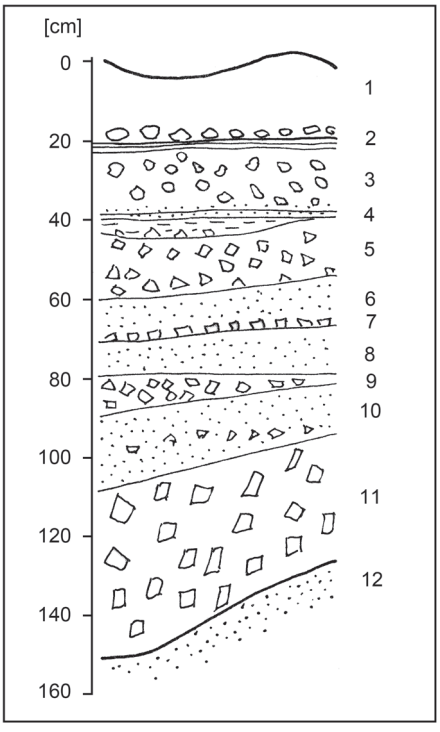

Fig. 9. Deir el Bahari. Upper Egypt. Geological profile of sediments under and above Palaeolithic site (see fig. 8), 1 – modern mixed sediments; 2 – small gravels mixed with sand; 3 – medium size pebbles mixed with sand and napped flints; 4 – aeolian sand with traces of lamination at the top; 5 – medium size pebbles; 6–8 – sand with thin intercalation of small pebbles (7); 9 – rounded pebbles; 10 – sand with rare pebbles; 11 – coarse gravel composed of rounded flints; 12 – sand.

The Paleolithic sites (workshops) are most frequently located on or in gravels of various ages built of flints eroded from the Theban limestone (Fig. 9). Their location, quite high above the base of the wadi, proves that the latter carried a lot of water, although the contemporary wadi base was probably at a higher level than it is now.

Dynastic sites and structures, including tombs, are sometimes located in the deepest parts of the Deir El Bahari Valley, proving the complete lack of rainfall at the time of their construction. However, analyses of the material filling in some of the tombs indicates that rainwater periodically got inside, depositing rock material from the surroundings (Fig. 10).

The reconstruction of depositional history and thus of climate change during last thousand years is now impossible because of intensive destruction by natural events as well as past and present human activity has made.

5. The Qasr el Sagha region

In this area sites are located mainly on the shore of the Moeris Lake (Kozłowski 1983: 2–118). Because its shoreline has oscillated, the occupation sites have "wandered" as well. As the lake has no outflow, its size has been related directly to humidity with many high and low lake levels recorded as a result of variation in local rainfall.

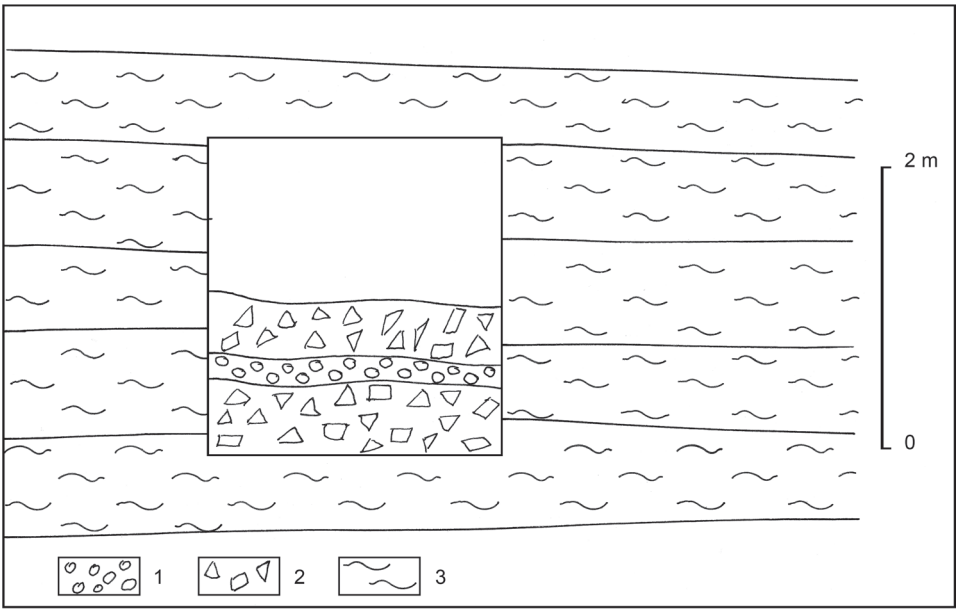

Fig. 10. Deir el Bahari. Upper Egypt. Geological profile of dynastic tomb (location – see fig. 8). 1 – stream gravels; 2 – irregular fragments of shales (fallen down from roof and walls of tomb); 3 – Esna schist.

Human activity has continued on the lake shore up to the present day (Fajum Oasis). Another problem concerns the sites located on the banks of the rivers supplying the lake, which represent various periods. At the time of the Middle Kingdom the lake level was high, with a harbour in the Qasr el Sagha region. This was located at the mouth of the wadi (Fig. 11). There was a big settlement on the southern bank of the wadi at its mouth, whereas workshops were located on the northern bank (Ginter *et al.* 1983: 1–127).

The wadi mouth at the Moeris Lake was filled with white sands and silts forming a delta (Fig. 12). The last phases of water activity in the wadi are seen at the transition from the Neolithic to the Dynastic periods, although the wadi occasionally held water during Dynastic times (Pawlikowski 1983: 9–16) as evidenced by the erosion of Dynastic sites (Middle Kingdom).

The delta that formed in front of the harbour is composed of sandy material redeposited from the upper plateau above Qasr el Sagha, and elsewhere, and carried quite far from the mouth of the wadi. This indicates considerable seasonal variation in water flow through the wadi, indicative of temporary but intensive rainfall in this area. A similar phenomenon has been observed at Sakkara (Mycielska-Dowgiałło and Woronko 1999: 107–112; Mycielska-Dowgiałło *et al.* 1999: 167–178).

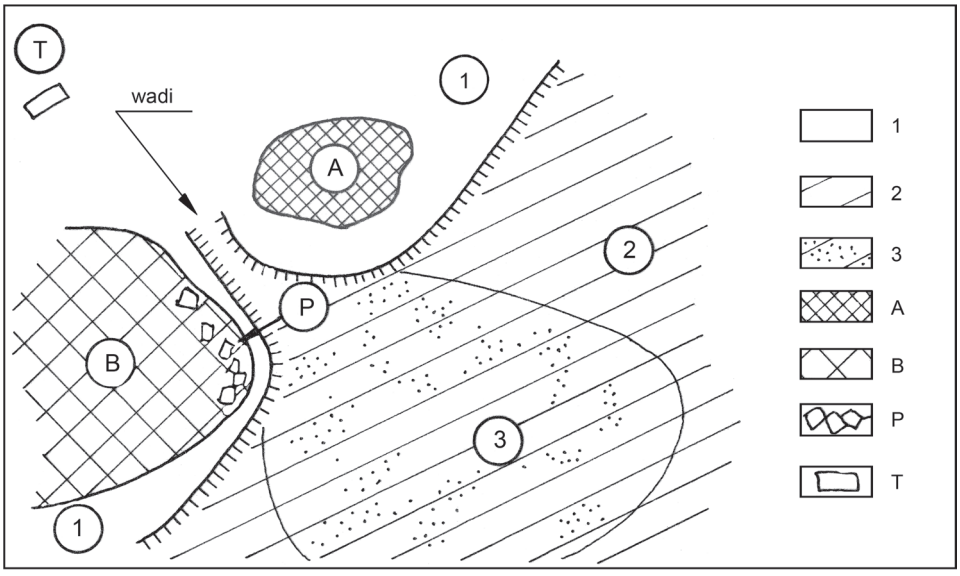

Fig. 11. Qasr el Sagha. Fayum depression. Location of Middle Kingdom sites near of outcome of wadi coming down from gebel. 1 – old shore of lake Moeris; 2 – lake Moeris; 3 – sandy delta; A – Middle Kingdom workshops; B – Middle Kingdom settlement; P – rests of harbor; T – temple.

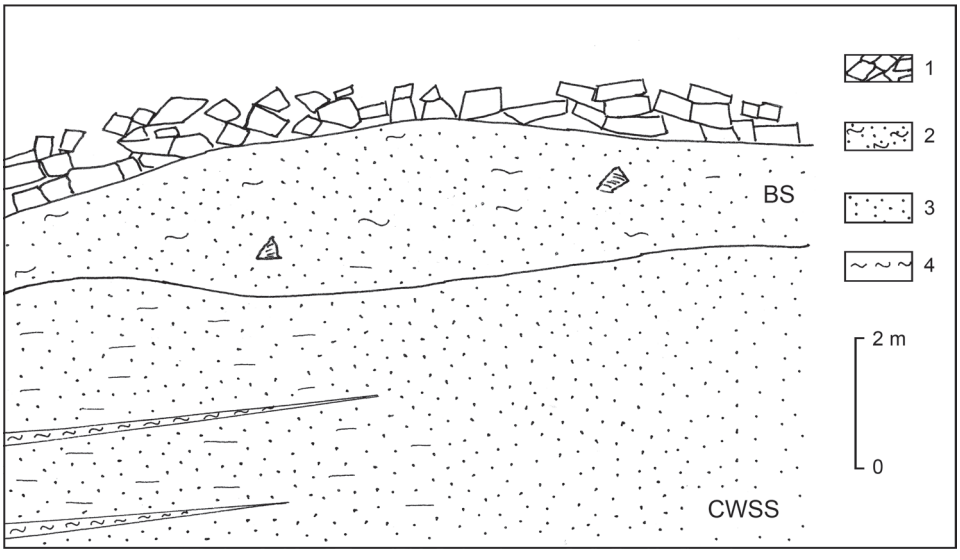

Fig. 12. Qasr el Sagha. Fayum depression. Geological profile of sediments of SE part of harbor. 1 – baslat block (rest of harbor); 2 – brown sands (in part anthropogenic); 3 – white sands of delta; 3 – thin intercalations of lade sediments (marls).

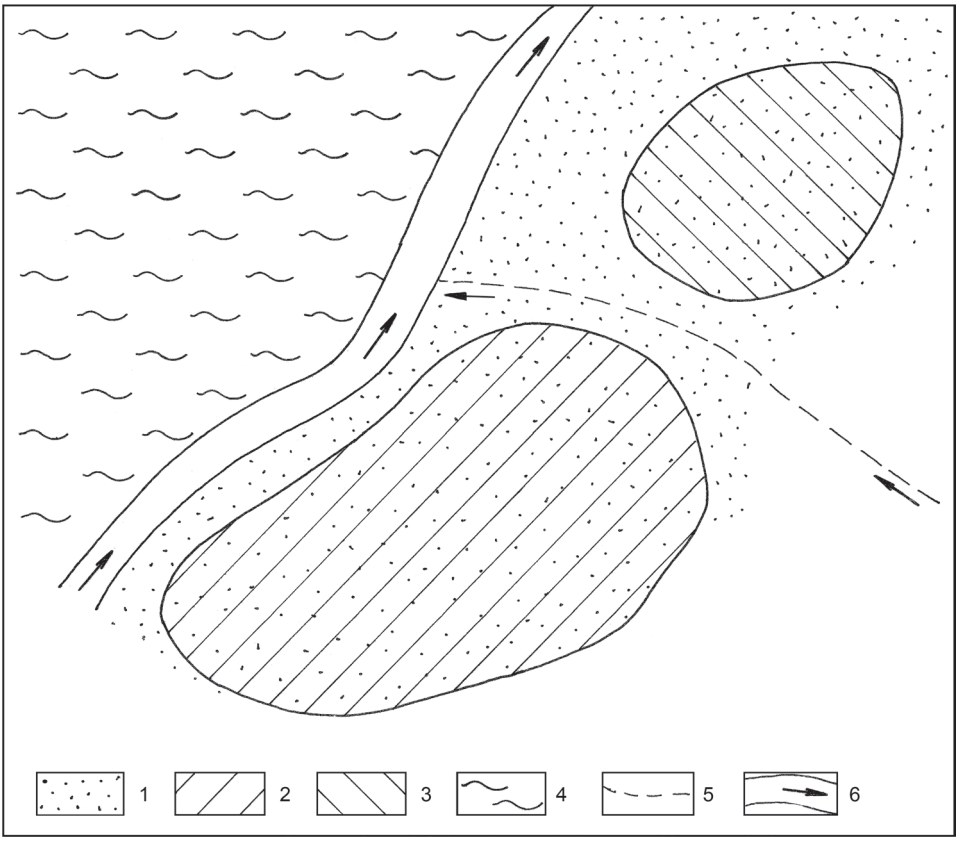

Fig. 13. Tel el Farha. Delta. Location of early Dynastic site on bank of old branch of Nile.
1 – sandy gezira; 2 – zone of human occupation (settlement); 3 – cemetery; 4 – Nile silts; 5 – stream, (?); 6 – river – branch of Nile (now canal).

6. The Tel el Farkha region

This site, in the Nile Delta, is situated on a hill called Gezira, at the bottom of which flows one of the Nile tributaries (Fig. 13), now an irrigation canal. Human occupation on Gezira dates from the end of Neolithic and the beginning of the Dynastic period. The hill was originally natural and composed of sands with a grass cover (Pawlikowski 2010: 1–15; Pawlikowski and Wasilewski 2010: 1–22; Ciałowicz *et al.* 2011: 25–36).

The canalized branches of the Nile here have banks built of two kinds of sediment. The northern bank is built of Nile delta silts and the southern bank is built of sands (Gezira).

Most of the sites in the delta are on sandy hills near the Nile, situated to avoid flooding. Such locations are valuable for the geoarchaeological interpretation as they

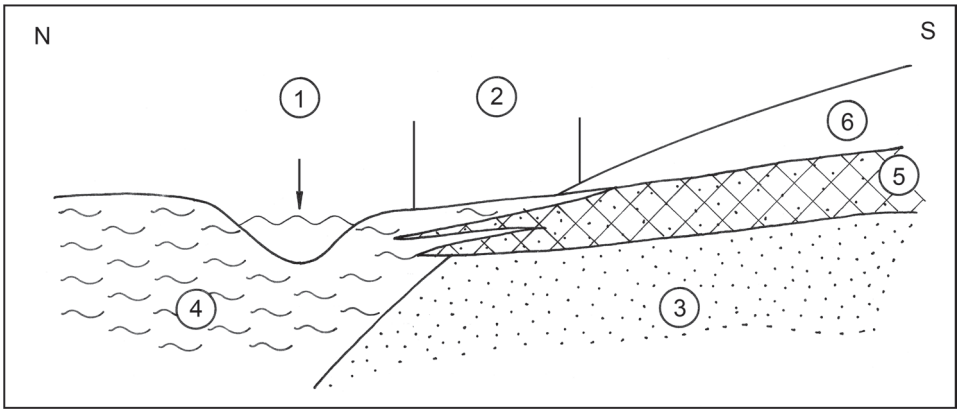

Fig. 14. Tel el Farha. Delta. The scheme. Geological cross section (NS) at the contact of Nile sediments and sands of gezira. 1 – river – old branch of Nile (now canal); 2 – zone of mixing Nile silts and gezira sand containing archaeological material; 3 – gezira sand; 4 – Nile silts; 5 – archaeological layers; 6 – mixed archaeological and modern material.

preserve an intercalation between Nile sediments and anthropogenic sediments on the Gezira hillslopes (human activity – Fig. 14).

SUMMARY

Geological research at these archeological sites, as well as in their surroundings, can provide vital information towards the reconstruction of climate, environment, and human activity. Climate and weather conditions are decisive factors for human activity, can thus for the history of human activity. Studies at archaeological sites of various periods on the deltas indicate that the climate was dry and that rivers were not active in them (Pawlikowski 1993: 355–357; 1994d: 132–141, 2004: 919–922).

On the other hand, the location of sites on the banks of the wadis confirms that they were active at the time of occupation. These observations partly confirmed by other scientists working on problems concerning eolization (Mycielska-Dowgiałło and Woronko 1999: 107–112; Mycielska-Dowgiałło *et al.* 1999: 167–178).

These complex problems require the use of additional mineralogical, petrographical and geochemical research methodologies. Therefore, experts in various scientific fields need to cooperate during archeological research, recognizing that such research can be destructive of finite source materials.

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