ABUSIR XIII

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et al.

TOMB COMPLEX OF THE VIZIER QAR, HIS SONS QAR JUNIOR AND SENEDJEMIB, AND IYKAI

ABUSIR SOUTH 2

2 The geology of Abusir

Colin Reader

2.1 Introduction

An account of the geology of the Ancient Egyptian necropolis of Abusir needs to reflect the geological development of a much larger area of north east Africa. It is important to state, however, that the processes that have controlled this development are still not fully understood.[1]

The landforms of the Abusir area are largely the result of the erosion of Tertiary strata (Tertiary: ca. 65 to 2 million years ago, 65–2 Mya) originally laid down under shallow marine conditions. These Tertiary strata have subsequently undergone several phases of uplift and subsidence on a sub-continental scale. Furthermore, the solid strata have been modified to a significant extent by more recent erosion and the deposition of Quaternary deposits (Quaternary: ca. 2 Mya to present) including gravels, sands, silts and clays.

2.2 Pre-Quaternary Geology

2.2.1 General

The Tertiary strata that are exposed across much of Egypt rest uncomfortably on largely upper Cretaceous strata (Cretaceous: ca. 150–65 Mya). In only a few areas, such as at Abu Rawash, are the underlying Cretaceous strata exposed.

When considering the Tertiary strata of Egypt, it is useful to consider the two major tectonic regions of the country that have been identified.[2] Most of southern Egypt is referred to as the Stable Shelf, on the basis that this area does not appear to have been influenced to any great extent by tectonic activity during the upper Cretaceous. Across the Stable Shelf, the Cretaceous-Tertiary transition is generally marked by a thin conglomerate, derived from eroded Cretaceous strata and, generally speaking, the overlying Tertiary sequences are more complete than elsewhere.

The region of Egypt north of the approximate latitude of Asyut, which includes the Abusir area, is referred to as the Unstable Shelf, across which late Cretaceous tectonic compression produced a series of NE-SW trending folds.[3] Across the Unstable Shelf, the transition between the upper Cretaceous and the Tertiary is less easily defined than across the Stable Shelf, with the Tertiary strata superimposed on the variable relief of the underlying Cretaceous rocks. It is the variable thickness and nature of the Tertiary strata in the north of Egypt, that makes spatial correlation difficult.

2.2.2 The Development of Northern Egypt during the Tertiary

The oldest Tertiary strata exposed in the region of Abusir date from the late Eocene (Eocene: ca. 57–36 Mya) and are derived from sediments laid down in the Tethys Sea, a predecessor of the Mediterranean which, in a period before the formation of the Alps, covered an area extending across southern Europe and northern Africa.

The middle and late Eocene saw the Tethys Sea becoming increasingly shallow, as the North African plateau was lifted by regional tectonic processes. By the close of the late Eocene, much of the southern Stable Shelf area of Egypt had been elevated above sea level and the Unstable Shelf areas to the north had been reduced to shallow

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[1] K. W. Butzer, 'Nile Valley, geological evolution', in K. A. Bard, ed., *Encyclopaedia of the Archaeology of Ancient Egypt* (London – New York, 1999), 571.

[2] W. M. Meshref, 'Tectonic Framework', in R. Said, ed., *The Geology of Egypt* (1990), 114, fig 8.1.

[3] T. Aigner, 'A Pliocene Cliff-Line Around the Giza Pyramids Plateau, Egypt', *Palaeography, Palaeoclimatology, Palaeoecology* 42 (1983), 313–322.

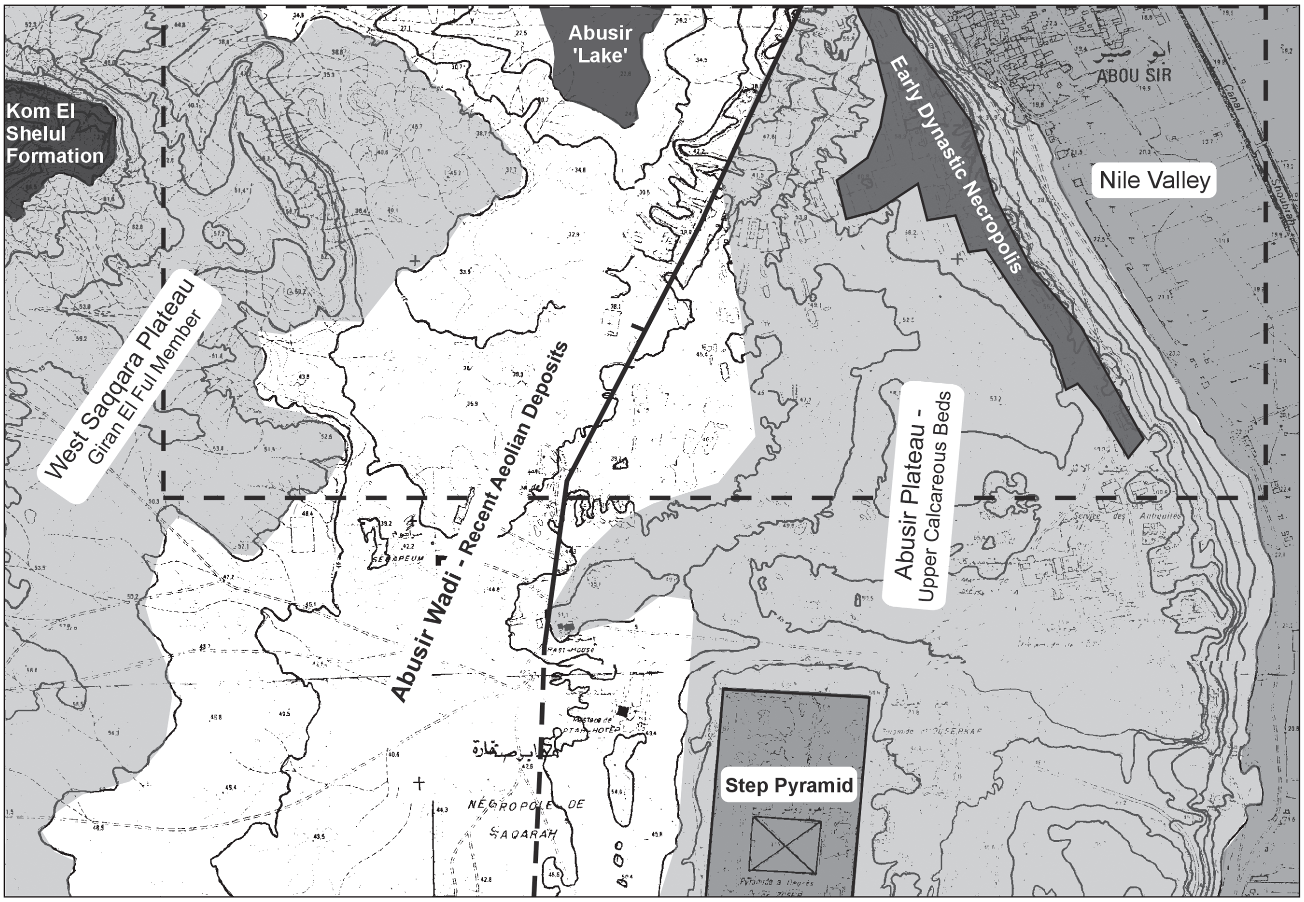

Fig. 2.1: North Saqqara and Abusir South

coastal waters.4 The sediments which were deposited into these relatively shallow marine waters tended to be coarser and more varied than had been the case previously, influenced as they were by material eroded from increasing areas of adjacent land, which mixed with the shallow marine deposits of the primitive Mediterranean. Within these complex strata is evidence for the presence of a large river delta to the west of the Fayum basin. This is amongst the earliest evidence for a river in this region. Despite the complexity of the Tertiary deposits across the Unstable Shelf area, the prolonged period of sedimentation lead to the formation of immense thicknesses of Eocene strata.

Continued fluvial and deltaic activity through into the Oligocene (Oligocene: 36–24 Mya) led to the development of extensive gravel deposits, which today cap many of the hills across the northern sections of the Western Desert in Egypt and across parts of Libya. The great age of these gravels has been determined on the basis of their composition, consisting as they do of eroded Lower Eocene limestones and Nubian sandstones. Also deposited in these Oligocene gravels were the trunks of trees, which must also have been washed down the ancient river and today, this petrified wood litters the high desert of the area.[5]

It is the subsequent development of north African geology that is perhaps the most difficult to reconstruct, being dominated by erosion rather than deposition, leading to a general absence of Oligocene and Miocene strata across much of Egypt. By the Oligocene, however, the progressive uplift of north Africa had led to the development of major fault systems, the opening of the Red Sea and a phase of large scale igneous intrusion.[6]

In the late Miocene, desiccation of the Mediterranean basin led to the withdrawal of the sea from across Egypt. With lowered sea levels in the Mediterranean, the evolving

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4 R. Said, 'Cenozoic', in Said, ed., *The Geology of Egypt*, 464.

5 K. S. Sandford, W. J. Arkell, *Palaeolithic Man and the Nile-Faiyum Divide* (Chicago, 1929), 7.

6 M. Y. Meneisy, 'Vulcanicity', in Said, ed., *The Geology of Egypt*, 167.

river systems of north east Africa began to erode deeply into the plateau of elevated Tertiary rocks. The resulting river system (the Eonile) was a precursor of the modern Nile, however, the scale of this river was vast, with a north/south gorge that was longer and deeper than the Grand Canyon, USA.[7]

In the early Pliocene (Pliocene: ca. 5–2 Mya) flooding of the Mediterranean basin via the straits of Gibraltar led to the inundation of the deep Eonile canyon, perhaps as far south as Aswan. In the north of Egypt, sea waters extended beyond the limits of the Eonile gorge, with the limit of these flood waters being preserved in the geological record as deposits of highly fossiliferous sandstones (the Kom el Shellul formation).[8] The Kom El Shellul formation can be identified at Abusir, capping the highest hills to the west of the necropolis, at a level of ca. 70 m above current mean seal level (amsl).[9]

2.3. Late Tertiary and Quaternary Geology

2.3.1 The Nile System

Since the deep erosion of the Eonile canyon in the late Miocene and the flooding of the canyon by the Pliocene sea, the evolution of the modern Nile has progressed through a series of stages, with the present river system representing the most recent stage.[10]

By the late Pliocene, the marine conditions in the Eonile canyon, were under increasing influence from fluvial conditions associated with tributary streams which, given the scale of this river system, were major rivers in their own right. Consequently, early Pliocene marine conditions gave way to brackish and then freshwater environments and it has been estimated that, by the late Pliocene, marine sediments had accumulated to fill approximately half of the Eonile canyon.[11]

In addition to deposition within the Eonile canyon, gravel deposits were also laid down in the tributary channels. Deposits from the most significant of these tributaries survive today as prominent ridges that form some of the highest points to the south of Abusir. That these valley-bottom deposits survive today as elevated ridges is a result of the durable nature of the ancient river gravels, which contrasted with the elevated plateau of softer Eocene strata into which these valleys had been cut. These ancient highlands have eroded into today's valleys, leaving the more durable gravel infill standing as prominent features of the present landscape.[12]

The earliest truly fluvial phase of the Nile, the Paleonile, was established during the Pleistocene (Pleistocene: 2 Mya–10,000 years ago) and is characterised by sediments consisting of red-brown clays with sand and silt laminae. These deposits, which appear to have been influenced strongly by erosion in the Eastern Desert, can still be seen along the banks of the modern river and in many of the wadis that flowed into it.[13]

The end of the Paleonile phase, as with all other phases of the Nile's evolution, was brought about by a period of regional aridity during which flow along the Nile appears to have ceased. By the end of the Paleonile, however, the deep Eonile canyon had become almost completely filled with marine, estuarine and fluvial sediments.

The arid event that brought an end to the Paleonile phase of Nile evolution was superseded by a wet phase, which introduced the subsequent Protonile phase and led to the deposition of extensive coarse quartz and quartzite gravels. These deposits, the Edfu Gravels, have been mapped in the more elevated areas to the east of Abusir, where they reach up to 10 m in thickness.[14]

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[7] R. Said, 'Cenozoic', in *ibid.*, 485.

[8] M. Youssef, O. Cherif, M. Boukhary, A. Mohamed, A., 'Geological Studies on the Saqqara Area, Egypt', *Neues Jahrbuch für Geologie und Paläontologie Abhandlungen* 186/1 (Stuttgart, 1984), 125–144.

[9] I. Mathieson, E. Bettles, J. Dittmer, C. Reader, 'The National Museums of Scotland Saqqara Survey Project, Earth Sciences, 1990- 1998', *JEA* 85 (1999), 24.

[10] R. Said, 'Quaternary' in Said, ed., *The Geology of Egypt*, 487.

[11] B. M. Sampsell, A traveller's guide to the geology of Egypt (New York, 2003), 30.

[12] Sandford, Arkell, *Palaeolithic Man*, 16.

[13] Said, 'Quaternary', in Said, ed., *The Geology of Egypt*, 490.

[14] Youssef, Cherif, Boukhary, Mohamed, *Neues Jahrbuch für Geologie und Paläontologie Abhandlungen* 186/1 (Stuttgart, 1984), 136, fig 4.

Deposits laid down during the next phase of Nile development, the Prenile, included for the first time material eroded from the Ethiopian highlands. Whilst this may be regarded as marking the onset of the modern Nile system, the Prenile stage ended in yet another period of relative aridity, in which flow from Ethiopia was interrupted, to be replaced by deposits carried from the Red Sea hills via the system of wadis that flow through the Eastern Desert. It was only in the final (and current) stage of Nile evolution (the Neonile) that the connections with drainage from Ethiopia were re-established, though on a much smaller scale than for any of the earlier river stages.

2.4 The Geology and Landscape of South Abusir

As shown on Figure 2.1, the area of the current study straddles the rather indistinct 'boundary' between northern Saqqara and Abusir South. In the east, the steep Abusir plateau rises from the Nile valley to a level approaching 60 m amsl. This prominent area is the site of Saqqara's Early Dynastic necropolis, which was extensively excavated by Emery between 1935 and 1939.[15]

The western limit of the Abusir Plateau is defined by a roughly north-south trending fault to the west of which is the low lying area of the Abusir Wadi. At the northern end of the wadi, is the 'Abusir Lake' which is the lowest part of the current study area, at approximately 25 m amsl. Further west, ground levels rise progressively out of the wadi, to a series of isolated hills, which have formed from the dissection of prominent ridges by surface drainage features and reach levels of 90 m amsl or thereabouts.

The solid geology of Abusir and north Saqqara has been discussed by Youssef et al. and is summarised in Table 2.1, below[16]:

<table>
<tr><td>Age</td><td colspan="3">Rock Unit</td><td>Approx. Age (Mya)</td></tr>
<tr><td rowspan="3">Late Eocene</td><td rowspan="3">Maadi Formation</td><td colspan="2">Giran El Ful Member</td><td rowspan="3">Eocene: 57–36</td></tr>
<tr><td>Saqqara</td><td>Upper Calcareous Beds</td></tr>
<tr><td>Member</td><td>Basal Shale Beds</td></tr>
<tr><td>Early Pliocene</td><td colspan="3">Kom El Shellul Formation</td><td>Pliocene: 5–2</td></tr>
<tr><td>Early Pleistocene</td><td colspan="3">Edfu Gravels</td><td>Pleistocene: 2–0.01</td></tr>
</table>

Table 2.1: Solid geology of North Saqqara

The elevated Abusir plateau consists almost entirely of strata of the Upper Calcareous Beds of the Saqqara Member. The Upper Calcareous Beds are an alternating sequence of yellow/grey sandy limestones with interbedded yellow/orange marls, which dip to the west. The interbedded nature of these rocks is consistent with deposition in shallow lagoon or coastal marine conditions in a climate characterised by alternating wet and dry periods.

The underlying Basal Shale Beds are exposed only at the base of the eastern escarpment of the Abusir Plateau, adjacent to the modern village of Abusir, and on the low-lying flanks of the Abusir Lake. These rocks consist of grey green marls (calcareous shales) with evaporite veins and were probably laid down under relatively uniform low energy conditions such as within a shallow bay or estuary.

Along the upper northern and eastern margins of the Abusir Plateau, shallow but extensive depressions in the Upper Calcareous Beds are filled with deposits of Edfu Gravels. These early Pleistocene deposits, which consist of approximately 10% white quartz, are associated with the Protonile phase of Nile evolution and, at Abusir, reach up to 10 m thick.[17]

The strata which form the bed of the Abusir Wadi, can not be directly observed because of the covering of recent aeolian sand and other superficial deposits, such as the sediments in the 'Abusir Lake', which will be discussed below. As yet unpublished geological mapping undertaken as part of the Saqqara Geophysical Survey Project,

[15] W. B. Emery, *Archaic Egypt*, (London, 1961).
[16] *Ibid.*, 125–144.

[17] *Ibid.*, 131.

Fig. 2.2: Sparse scrub vegetation with coarse grasses and palms

however, suggests that rocks of the Saqqara Member sub-crop beneath much of the northern end of the Abusir Wadi, with the Giran el Ful Member forming the more elevated western flanks of the wadi.

Where exposed in the area, the Giran El Ful Member is typically a moderately strong to strong grey sandy limestone with interbedded grey shales and occasional weak orange brown sandy beds. The rocks contain frequent fossils, with the upper beds in the formation readily identified in the field by a layer of abundant bivalves (*Carolia placunoides)*. In addition to the *Carolia*, however, other faunal types, principally bivalves, are encountered.

An angular unconformity separates the Giran El Ful Member from the underlying Saqqara Member, with the younger beds having a dominant southerly component of dip. The Giran El Ful beds are considered to have been deposited under higher-energy (less sheltered) coastal- or shallow sea conditions than the earlier rocks, which suggests that sea levels may have risen slightly at the time that these rocks were laid down.

In the extreme west of the concession, the most elevated hills are capped by rocks of the Pliocene Kom El Shellul Formation, which marks the former margins of the Pliocene inundation of the Eonile canyon (see above). Where exposed at Abusir, the Kom El Shellul Formation consists of a grey and grey brown moderately strong coarse sandy detrital limestone with abundant whole and fragmentary *Pecten benedictus*.

Although the Kom El Shellul generally appear to dip to the north, the as yet unpublished geological field work of the Saqqara Geophysical Survey Project has identified an apparently anomalous dip in the east of the Kom El Shellul outcrop, closest to Abusir, where the apparent dip of the beds is steeper and to the east, or slightly north of east.

2.5 The 'Lake of Abusir'

Topographically the area referred to as the Lake of Abusir is the lowest-lying area of the concession, generally lying below 22 metres amsl at the northern end of the Abusir wadi. The area is characterised by sparse scrub vegetation which, from south to north, trends from a thin, low-lying cover, through more abundant coarse grasses to stands of palms (*fig. 2.2*). Extending to the north and east from the study area, are the well-vegetated areas of the cultivated Nile Valley.

A preliminary hand auger investigation of the extent and nature of the soil deposits in this area, established that, beneath a cover of recent wind-blown sand, the soils of the Abusir 'lake' are predominantly granular. However, this granular matrix contains varying proportions of dark humic material, together evidence for mudbrick structures and occasional fragments of red/black pot.

These deposits suggest that this area was subject to a complex history of flooding and that, rather than a true lake (i.e. a body of permanent standing water) the area may represent an inundation basin, affected by seasonal flooding of the Nile. Within the dark deposits, the areas of permanent standing water appear to be limited in extent and, for the area investigated, are not sufficiently extensive to indicate the presence of a true 'lake'. It is possible, however, that areas to the north, closer to the pyramids of Abusir, were occupied by more extensive areas of standing water and the presence of a 'lake' further to the north can not be ruled out.

2.6 Summary

The area of interest for this publication, occupies a relatively small area of the Saqqara/Abusir necropolis, across which, late Eocene strata dominate. Faulting has defined the prominent limestone escarpment to the east, and fluvial activity has further influenced the topography of the site by eroding both the principal former waterway in the area – the Abusir Wadi – and a number of tributaries which have dissected prominent ridges to the west of the concession, leaving a series of isolated hills capped with Pliocene strata.

The area of the former Abusir lake appears to have been an inundation basin with only limited areas in which standing water was maintained for any significant period of time. The evidence of built-development using mudbrick, within the former lake area, suggests that as conditions varied, the extent and height of the inundation also changed.