Report on the Geology of Saqqara Area, Egypt

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[Abstract]

This report gives some information on the geology of Saqqara area, which has been described by several authors. The topography, geomorphology, stratigraphy and the structure framework of Saqqara area are outlined. The Saqqara plateau has an elevation about 17 m above the ground. It consists mainly of alternating light yellow, hard limestone and softer yellow marl. These rocks belong to the Upper Calcareous Beds of the Saqqara Member of Maadi Formation (Late Eocene age). Several faults and unconformities were proved in the succession exposed in Saqqara area.

1 Introduction

The geology of Saqqara area, a well known touristic site near Cairo, has been examined by several authors (e.g. Hume, 1911; Blanckenhorn, 1921; Cuvillier, 1930; Soliman and Korany, 1980; Youssef et al., 1984; Papa, 2003). They gave short or detailed studies on the geology and stratigraphy of Saqqara area and on possible correlation with similar better exposures around Cairo.

Hume (1911) classified the limestone and marl of Saqqara area as a separate rock unit and called it the Saqqara Limestone, which he assigned to Eocene age.

Blankenhorn (1921) reported that the limestone and marl of Saqqara area and the region of the pyramids in Abu Sir and Dahshur are equivalent to the Middle Eocene. He also recognized the presence of Quaternary gravels of Early Quaternary, which cap the Eocene marl in the area between Faiyum and Saqqara.

Cuvillier (1930) reported that the Eocene limestone of Saqqara belongs to the older beds of the Late Eocene. However, that he only mentioned a brownish siliceous limestone with *Lithothamnia* exposed some hundred meters to the west of the Serapeum of Saqqara.

On the other hand, Youssef et al. (1984), gave a detailed geological study on Saqqara area. This present report depends mainly on this work for outlining the geology of Saqqara area.

2 Topography and Geology of Saqqara Area

According to Youssef et al. (1984), topographically, Saqqara area exhibits in a low relief. However, when it is compared to the alluvial plain of the Nile Valley, it seems to form a relatively higher plateau. This plateau does not exceed more than 35 m of elevation above sea level, and when compared to the flat ground of the Nile Valley which has an average elevation of 18 m above sea level, it has an elevation about 17 m above the ground. But, because it constitutes the only elevated area in the vicinity of the valley, it gives the feeling of quite important high. The distribution and names of various topographic elements are illustrated on the map given by Youssef et al. 1984 (Fig. 1).

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According to Youssef et al. 1984 (Fig. 1) Saqqara area, geomorphologically, may be subdivided into 4 parts:

A) To the east, there is a flat alluvial plain of the Nile Valley, on which the Abu Sir Village was built.

B) Along this Valley there is a conspicuous limestone plateau and its face forms ridge, regionally sloping to the west. The scarp of this plateau faces the Nile Valley while its ridge slopes, which ends at the abandoned Rest House built by King Farouk, which runs in a slightly N-S direction. This limestone plateau is dissected by two main drainages passing to the north and south of Saqqara Pyramid site.

The northern part of this plateau, which faces Abu Sir Village, is called Abu Sir Plateau and the main southern block of this plateau, where Saqqara Pyramid and various archaeological sites are found, is called Saqqara Plateau. The Saqqara Plateau is formed mainly of hard limestone alternating with soft marl. These rocks form a characteristic lithostratigraphic unit known as Saqqara Member of Maadi Formation (also known as "Saqqara Limestone" according to Hume, 1911).

The top of the plateau is overlain by thick gravels often covering wide surfaces where many constructions of Old Kingdom can be found. These gravels can be related to the highest gravelly terrace of Nile River known as the Idfu Gravels of Early Pleistocene age. The oldest stratigraphical level of this area can be found exposed at the northwest foot of Abu Sir Plateau. It has been exposed, probably because of the presence of obvious fault in this area, which limits the plateau to the west.

C) In the north, a line of elongated elevations runs in an E-W direction. Among these elevations there is West Saqqara Plateau. These elevations are relatively steeply sloping to the north. They constitute a line of ridges or hills with a ridge scarp facing the south in general and a ridge slope inclined to the north. They were, probably, a single ridge now dissected by at least three main drainage lines running more or less from N-W to S-E possibly along a set of fractures in the original beds. The ridges are constituted, at base, of Upper Eocene clastics and calcareous beds, resting on the Saqqara Member that is exposed in some places in the flat plain to the south of these ridges. The basal beds of these ridges belong to the Giran el-Ful Member of Maadi Formation. These basal beds are unconformably overlain by Pliocene sandy limestone which is covered by a thin discontinuous layer of gravels and sands from Pleistocene age. These gravelly sands may be younger than the previously mentioned ones of Idfu Gravels present above the Abu Sir Plateau. To the east, these ridges are separated from the Abu Sir Plateau by a flat area covered with sands and gravels. Below that area the Saqqara Member is partially exposed. To the north, the ridges are limited by a low land covered with gravels and sands. To the south they are also limited by low lands (a wide plain).

D) The southwestern plain forms the southwestern quarter of this area. It is covered by sands and gravels which gradually reach the southwestern ridge slope of the Saqqara Plateau.

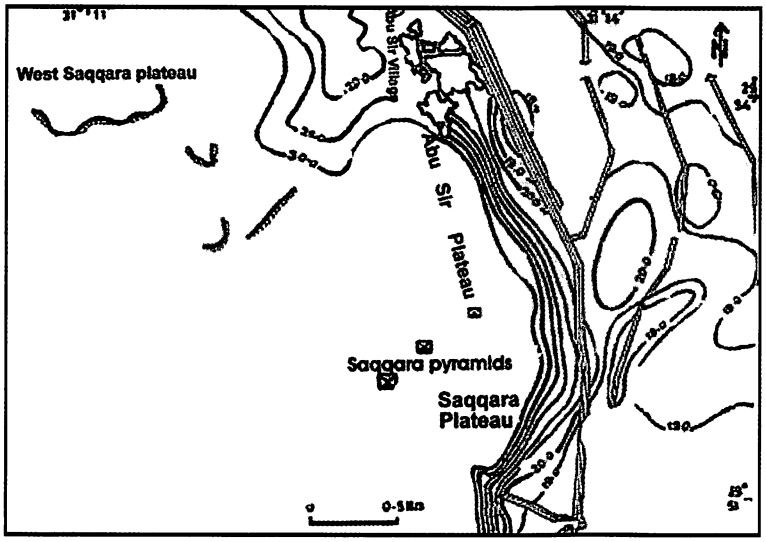

Fig. 1 Topographic Map of Saqqara Area (Youssef et al., 1984, revised by Adel Akarish)

4 Stratigraphy of Saqqara Area

This part is an account on the rock units recognized and mapped in Saqqara area by Youssef et al. (1984). Table 1 summarizes the stratigraphy of the area.

Epoch	Age	Rock unit	
	Recent		
Pleistocene	Middle-Late	Undifferentiated	
	Early	Undifferentiated Idfu Gravel	
Pliocene	Early	Undifferentiated Kom el-Shellul	
Eocene	Late	Maadi Formation	Giran el-Ful Member
			Saqqara Member

Table 1 Shows the stratigraphy of Saqqara area (after Youssef et al., 1984)

In the following pages, each of the successive rock units in Table 1 is described in details. They are listed from base to top.

4.1 Basal Shale Bed of the Saqqara Member (Lowermost Bed of Maadi Formation, Late Eocene)

This bed is the earliest rock unit recognized in the studied area. It is only exposed at the foot of the Abu Sir Plateau. It is a marly shale bed, grayish-green in color, with some gypseous veins. Its base is unexposed (the exposed thickness is about 4 m) and it is capped by the upper calcareous beds of the Saqqara Members.

4.2 Upper Calcareous Beds of the Saqqara Member of Maadi Formation, Late Eocene.

This rock unit forms the main bulk of Saqqara - Abu Sir Plateau. It consists of alternating light yellow, hard limestone and softer yellow marl. It overlies the Basal Shale Bed of the Saqqara Member and underlies the Giran el-Ful Member of Maadi Formation. Most of the masonry used to build Saqqara necropolis was extracted from the strata of the Upper Calcareous Beds. Eroded beds of limestone are still visible in many locations at the necropolis area. Their potential use is obvious as a source for undressed blocks or filling stones in the walls of the Gisr el-Mudir, Djoser, Sekhemkhet and other pyramids of the necropolis. The excavation on the east wall of Gisr el-Mudir has exposed the worked face of these limestone beds. Below the base of the wall, a soft marl layer appears between beds. This marl layer forms the basis of local desert clay, which was used in early structure as muddy mortar to compensate for roughly-cut and uneven blocks of limestone used in the masonry (Papa, 2003).

4.3 Giran EI-Ful Member of Maadi Formation, Late Eocene

This is the main rock unit consisting of sandy to marly limestone and shale with a conspicuous bank of *Carolia placunoides* near its top. This rock unit overlies the Upper Calcareous Beds of the Saqqara Member, and unconformably underlies the Pliocene Kom el-Shellul Formation. It is highly fossiliferous and yields many fossils, characteristic of Maadi Formation, Late Eocene. Furthermore, the presence of the *Carolia* bank suggests that this sequence belongs to the upper part of Maadi Formation.

The rocks of Maadi Formation (located west of the Nile Valley) are considered among the most widely exposed strata in the area of Greater Cairo. Beds coeval to these of Saqqara Member are exposed in the north of Giza, overlying the Middle Eocene Mokkatam Formation on which pyramid complexes were built in Fourth Dynasty. The significant difference between the two sites is that the Maadi Formation at Giza is rich in fossil remains whereas the rocks at Saqqara are poor in fossil remains. This suggests that, during the late Eocene, the conditions in Saqqara area did not support an abundant of marine life. The shortage of the fossil remains in Saqqara led Hume to classify the limestone and marl of Saqqara area as a separate rock unit and called it the Saqqara Limestone.

4.4 Kom EI-Shellul Formation, Early Pliocene

The Kom el-Shellul Formation unconformably ovelies the Maadi Formation (upper part). It consists of fossiliferous sandy detrital limestone full of *Pecten benedictus* and *Ostrea cucullata* (mostly brown). It caps the hillock to the west of Saqqara. The mega-fossils are diagnostic of the marine Pliocene transgressive sedimentary cycle, which invaded the Nile Valley in Early Pliocene times.

4.5 The Idfu Gravels, Early Pleistocene

Above Abu Sir Plateau, rather thick gravel beds (about 10 m) overly the Upper Eocene limestone (Upper Calcareous Beds of Saqqara Member). These gravels frequently contain white Quartz pebbles (about 10%). These beds may be equated with the Idfu Gravels mention by Said (1975), which correspond to the pluvial phase of active transportation of sediments in the history of the Nile River. This seems to have occurred in Early Pleistocene times. This early River Nile was called the "Proto-Nile" by Said (1975).

4.6 Quaternary or Recent Soils

Above Idfu Gravels on top of Abu Sir Plateau, there are some red paleosoil that might be related to any period of Quaternary or of historical time.

Wadis or erosion valleys (that have been cut through the limestone beds in Saqqara) have formed low-laying areas in which superficial deposits have been accumulated. Gravel, about 10 m thick, has been accumulated above the Upper Calcareous Beds along the eastern edge of Saqqara - Abu Sir plateau. These gravels contained white quartz (approximately 10%) that may be deposited in early Quaternary age during an active phase in the history of the Nile River, when substantial rainfall was experienced in the region.

Extending westward from the eastern side of Saqqara Pyramid, a thick piles of sand and gravel of Quaternary and Recent have been accumulated in the lower laying areas. These overlie the beds of Maadi Formation. The surface deposits were formed mainly of aeolian sands, which have been blown across the area.

From Serapeum to Abu Sir area, the accumulation of sand in the valley is five to six meters in depth. This presents a major problem to archaeological investigation of the Pre- and Early Dynastic structures that may be found in the valley floor.

5 Structure of Saqqara Area

5.1 Faults

Only three faults can be detected in the area; the first fault runs SW-NE and limits Abu Sir Plateau to the west. This fault must have a throw of less than 20 m, as the Saqqara Member is exposed on both its sides and this member does not exceed 20 m in thickness in the studied area. This fault is probably post-Eocene as it affects Eocene beds and does not affect the Quaternary and Recent gravels of the western plain. The second fault is only inferred and seems to run NW-SE. It may be older than the previously mentioned fault as its extension seems to be transected by it (see Fig. 2). The fractures, which affected the drainage of West Saqqara Plateau, belong to a trend of fractures parallel to this NW-SE fault. The fault limiting Saqqara and Abu Sir Plateaus to the east and separating the Nile Alluvium from the exposures also belongs to this trend.

5.2 Unconformities

Several unconformities may be proved in the succession exposed in Saqqara area. There is a conspicuous change in the direction of dip in the strata of the Saqqara Member exposed in Abu Sir and Saqqara Plateaus (which dip to the west) and that of the beds exposed at the West Saqqara Plateau (which dip to the North). This may account for an angular unconformity between the Saqqara Member and Giran el-Ful Member of Maadi Formation. However, it is impossible to accurately estimate the dip of the sub-horizontal Giran el-Ful Member in the field, and only the dip of the Pliocene (Kom el-Shellul Formation) has been recorded. Thus the dip of the beds in the West Saqqara Plateau may be only an expression of the dip of the Pliocene sequence, which lies unconformably over the Upper Eocene (Giran el-Ful Member). The unconformity between these rock units, if further well defined in the field by a pebbly layer lying at the contact between the two rock units, by the stratigraphical gap suggested by paleontological methods (the

gap comprises the upper most Eocene, the Oligocene and the Miocene). The stratigraphical analysis further suggests that there is probably no unconformity between the Saqqara and Giran el-Ful Member of Maadi Formation and that the difference in dip of the beds capping the two plateaus (West Saqqara and Abu Sir) is rather an expression of the Eocene/Pliocene unconformity surface.

The geology of the area and the distributions of the recorded rock units are illustrated in a geologic map which are shown on Fig. 2 and the structural and stratigraphical relations between the studied rock units are shown in profile section showing stratigraphical and structural relations in Saqqara area (Fig. 3).

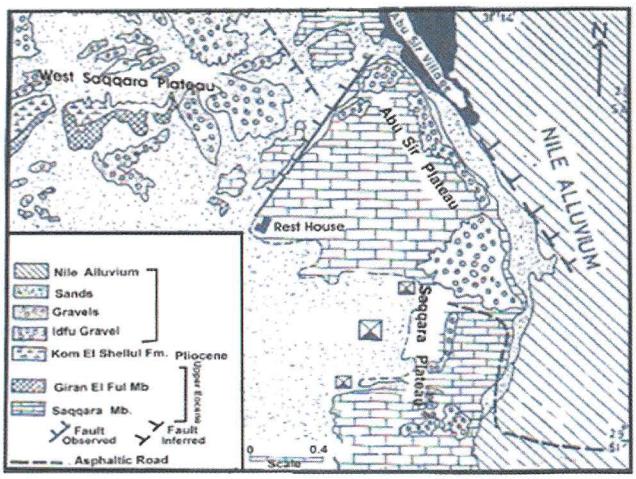

Fig. 2 Geologic Map of Saqqara Area (Youssef et al., 1984, revised by Adel Akarish)

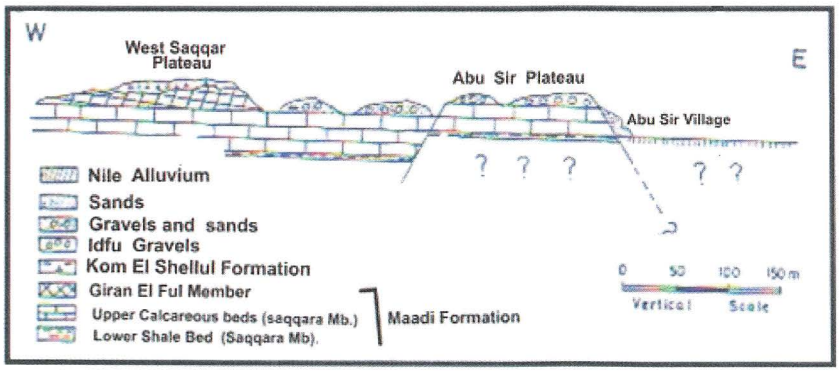

Fig. 3 Profile Section Showing Stratigraphical and Structural Relation in Saqqara Area
(Youssef et al., 1984, revised by Adel Akarish)

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