Petrography, mineralogy and calcareous nanofossils of Shepses po ptah tomb, Titi and Unis pyramids building stones

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Petrographical, mineralogical, calcareous nanofossil studies have been achieved to through light on the geologic sources and unit age of the sarcophagus rock and the burial chamber casing wall rock of Shepses po ptah tomb and correlate them with rock samples from Titi and Unis pyramids in the Saqqara area of Egypt, which are hewn within Upper Eocene (Maadi Formation) sediments. The samples were analyzed by polarizing microscope, X-rays diffraction (XRD) techniques; along with calcareous nanofossil were examined using the microscope. The studies reveal that the quality of the sarcophagus and the burial chamber casing wall rock in Shepses po ptah tomb is particularly good pure limestone. The sarcophagus is composed of slightly dolomitic wackestone microfacies while the burial chamber casing wall and Titi pyramid are of grainstone microfacies. On the other hand Unis building stones composed mainly of sandy wackestone types. The XRD analysis of indicate that these rocks composed mainly of calcite in addition to little dolomite. The rock texture, mineralogical composition and diagenetic processes contribute, to a great extent, to source rock composition. The composition of the studied rocks do not show clear interaction between the exogenic (surrounding climate) and endogenic (related to the nature of the rock types) conditions over the thousands of years since their construction. The calcareous nanofossil of sarcophagus, burial chamber casing wall and Titi pyramid show (NP16), which is assigned Middle Eocene (Lutetian) with age about 41.94 (ma), while Unis pyramid building stones show (NP11) which is assigned to Early Eocene (yprésian) with age 54.17 (ma).

Keywords: Saqqara; Shepses po ptah; Rock Tombs; Titi; Unis pyramid.

Introduction

Saqqara is a part of the Memphis necropolis which extends about 80 Km, from Abu-Rawash in the north to Meidum in the south (Fig.1). The Saqqara arabic name is derived from Soker “God of the necropolis”, the god Soker, was an important deity from the first Dynasty and was assimilated with the god “Khenti – Amentiu” of Abydos1-2. Although Saqqara is the greatest necropolis of ancient Egypt, it had yielded so many treasures through the centuries and many secrets are still hidden under its sands. Kings were buried here even before the construction of the oldest pyramid of the world “The Step Pyramid of Djoser, the founder of the third Dynasty”3.

The Egyptian graves for, at least the five first kings of the Second Dynasty, were hewn in the rock near “The Step Pyramid at Saqqara”. From the mid 19th century, Saqqara has been the place of intensive excavations carried out by archaeological missions from various countries searching for the eternal rest of the ancient Egyptian kings. Egyptologists have been focusing their attention on the bordering areas. On the other hand, the western area remained so neglected by
the excavators until 1987, when the Polish archaeological mission started its excavations there. Three small trial pits made at three various points of the area encouraged them to continue. They have already discovered the tomb of the Vizier “Merefnebef” in season 1997, dating to 6th dynasty, old kingdom.

The tomb of the dentist “Qar” had been discovered by the Egyptian archaeologists at Saqqara. The tomb of Ptah Shepses is located to the west of Unis pyramid and about 400m south – west of the step pyramid, in a place called “Gisr el Mudir” (Figs. 2,3). Gisr el Mudir is a large rectangular enclosure of limestone masonry first observed by Perring, and indicated both by Lipsius and by de Morgan. The structure of Gisr EL Mudir was clearly first noticed with the emergence of an aerial photography in the mid last century. In 1990, The National Museum of Scotland obtained a concession to survey and excavates the desert structures at Saqqara to produce geophysical and topographical maps (Fig. 4), which will be used to point the direction for more detailed excavations. The new discovery of the tomb of the dentist “Qar” at Gisr el Mudir” in 2001 by the Egyptian team, and the tomb of Ni – ankh – Nefertem” by the polish – Egyptian mission season 2003, cleared that an important part of the Memphite necropolis extends at the western side of both Djoser’s and Unis’ pyramids, and there are many tombs in the area of Gisr el – Mudir, still awaiting to be discovered.

The site of Ptah Shepses (Fig. 5), is situated west of Saqqara, precisely, west of Unis pyramid its famous because it include the first pyramids texts inscribed on burial chambers walls, Unis who ruled for nearly 30 years. More than 150 shafts have been totally excavated during the first two seasons. The site comprises various mastabas, built either of limestone or mud-brick, and other tombs hewn in the rock.

In mid season 2010, the Egyptian expedition discovered a tomb of a decorated burial chamber for a person named (Shepses Po Ptah) (Fig. 6) which date back to the end of 5th dynasty to the beginning of 6th dynasty. We should refer that Shepses po ptah who lived in the time of Unis and died in the time of Teti “The first king and founder of the 6th dynasty who killed by one of his guards.
Shepses Po Ptah has got his sarcophagus and the land of his tomb (Fig. 7) from king Unis and he also recorded the name of Teti on the last built wall in his burial chamber$^9$.

**Aim of study**

The present study aims to investigates the stones of burial chamber casing, sarcophagus rock Shepses Po Ptah, building stones of Unis and Teti pyramid to determine their rock lithological, mineralogical characteristics and their rock unit age to through light on the probable mining sources of these rocks. Petrographical, mineralogical and calcareous nanofossils analyses were achieved to reach this target.

**Geologic Setting of Saqqara Plateau**

The Saqqara plateau has been investigated by several workers$^{11-14}$. According to Youssef et al.$^{13}$, the Saqqara area necropolis is located on a plateau, at 17m elevation from the alluvial plain.
of the Nile Valley. This plateau is formed mainly of Upper Eocene limestone, marl and claystone. These rocks (Fig.1) constitute a characteristic lithostratigraphic unit, the Saqqara Member, of the Maadi Formation, which was previously referred to as the Saqqara Limestone by Hume. The area around the Saqqara Pyramid, as well as the bulk of the Saqqara plateau, is formed mainly of an alternating succession (22 m thick) of hard, light yellow limestone and semi-hard, yellow marl, exposed along the steep eastern face of the Saqqara plateau. This succession belongs to the upper unit of the Saqqara Member, termed the Upper Calcareous Beds. The Upper Calcareous Beds overlie the Basal Shales Unit (the lower unit of the Saqqara Member). The Basal Shales Unit (4m of exposed thickness) consists of marls and shales with gypsum veins, representing the well-exposed older strata, which can be seen only in the north, at the foot of the Abusir plateau, alongside the remnant Abusir Lake. In the area to the northwest of the plateau and west of Abusir village; the lithologies differ from those around the Saqqara pyramids. Here, the upper member of the Maadi Formation (Gerain El-ful Member) is exposed. It is about 17.5m thick and formed of highly fossiliferous, sandy and marly limestones and shale. Locally, this member unconformably underlies the early Pliocene Kom El Shallul Formation. The plateau has a cover of Quaternary and Recent gravels, sands and conglomerates of varying thicknesses. The gravels lying above the Calcareous Beds along the eastern edge of the Abusir-Saqqara plateau contain frequent white quartz pebbles (about 10%) and are equated to the highest gravelly terrace of the River Nile, and are known as the Idfu Gravels (Lower Pleistocene). They were deposited during the active phase of transportation of sediments in the history of the River Nile, when substantial rainfall was experienced in the region.

Structurally, the Saqqara plateau has been little affected by faulting. The general location of the faults can be recorded on the basis of adjacent features, rather than that the faults themselves are exposed. The fault along the foot of the Saqqara-
Abusir plateau may be considered as one of a system of parallel faults that often define the limits of the Nile. All faults recorded in the Saqqara area are the result of geologically ancient ground movements and not currently active. Therefore, they pose no significant hazard to the monument sites in the area.

Materials and methods

For the present study thin sections, representing the sarcophagus rock and the burial chamber casing wall rock of Shepses po ptah tomb. Also rock samples from Unis and Teti pyramids, were petrographically examined using a polarizing microscope. The samples were subjected to X-ray diffraction analysis to determine their mineralogical composition. The powder diffraction patterns of the samples were obtained using Cu kα radiation and a Ni filter. The scanning speed is 2° 4 1 degree/min at constant voltage 40kV, and 30mA using PW 1390 X-ray diffractometer. Identification of the minerals was carried out using data given in the ASTM cards by measuring the d-values of the diffraction planes and their relative intensities

For calcareous nanofossils content, smear slides were prepared directly from untreated rock samples in order to retain the original sample composition unaltered, and permanently mounted using Canada Balsam as adhesive. Quantitative analyses were performed using a light polarizing Olympus microscope at 2000 X magnification. For each smear slide, at least 100 specimens were counted to perform an analysis of the assemblage composition, but investigation was extended to complete 100 fields of view in order to report the presence of rare species. For each slide; counts of simple species diversity were performed and considering all taxa encountered. Individual abundances for each species encountered were recorded as follows: A - abundant (1-10 specimens /field of view); C- common (1 specimen / 2-10 fields of view); R- rare (1 specimen /more than 10 fields of view).

Petrography

Thin-sections of the studied limestone from Shepses po ptah sarcophagus, burial chamber casing wall and Teti pyramid rock samples revealed three microfacies; bioclasts, pellooidal packstone and grainstone. The bioclasts and peloids are present in varying proportions (Fig. 8). The bioclasts constituent is formed of foraminiferal tests embedded in microsparite groundmass (Figs. 8A), mollusc fragments, echinoid debris and nummulites (Figs. 8B-F). Some of the fossil tests are recrystallized and in filled with ferruginous sparite (Figs. 8C). Peloids are composed of micrite, rounded, ovoid, well-sorted and organic rich (Fig. 8B and C). The allochems are embedded in sparitic matrix that is generally sub-translucent with a faint brownish cast in thin section. Pore spaces (both inter- and intraskeletal) are abundant, having various size and shape (Figs.8B, D & E). They may have developed as a result of diagenetic processes (dissolution). The non-carbonate components are represented by clays and fine detrital quartz grains (Fig. 8F).

The Unis pyramid samples can be classified as sandy marlstones, with different grain-sizes. They have a higher percentage of terrigenous material represented by clays and quartz grains that are admixed with the micritic matrix. The latter is composed of very fine microcrystalline carbonate that is commonly recrystallized into microsparite. The quartz grains randomly scattered throughout the recrystallized micrite matrix, and so can be tentatively classified as sandy micrite, (Fig. 8F) or sandy-wackestone.

Mineralogy:

X-ray analysis indicated that calcite, dolomite and terrigenous material represented by wollastonite (CaSiO₃), are the constituents of Shepses po ptah sarcophagus and the burial chamber casing wall (Fig.9).
Fig. 8. A-F: A- Bioclastic Wackestone, limestone litho tope, P.P.L. B- Biopeloidal Grainstone with rounded peloids embedded in sparite matrix, P.P.L. C- Biopeloidal Wackestone D- E Bioclastic Grainstone with pore spaces (both inter- and intraskeletal) having various size and shape, P.P.L. F- Sandy-Wackestone with high percentage of terrigenous material represented by clays and quartz grains that admixed with the micritic matrix C.N.
The distinguishing calcareous nannoplankton species from Shepses po ptah sarcophagus, burial chamber casing wall and Teti pyramid rock samples include: *Reticulofenestra dictyoda*, *Zygrhablithus bijugatus*, *Cyclicargolithus luminis*, *Sphenolithus moriformis*, *Cribrocentrum reticulatum*, *Discoaster saipanensis*, *Dictyococclites scrippsa*. *Helicosphaera seminulum*, *Ericsonia Formosa*, *Dictyococclites bisecta*, *Reticulofenestra umbilica* and *Chiasmolithus consuetus* (Fig. 10). The studied samples according its contents of calcareous nannoplankton indicate the calcareous nannoplankton zone *Discoaster tanii nodifer* zone.
Fig.(10): Calcareous nannoplankton species in the present study. All figures X 2500.
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(NP16)\textsuperscript{17}, which is assigned Middle Eocene (Lutetian) with age about 41.94 (ma)\textsuperscript{18}. Unis pyramid samples is characterized by the following calcareous nannoplankton taxa: *Discoaster elegans*, *Ericsonia eoplagicus*, *Sphenolithus primus*, *Pontosphera ocellata*, *Tribrachiatus braslettei* and *Tribrachiatus orthostylus*, (Fig. 10). According to the calcareous nannoplankton contents and the absence of *Tribrachiatus contotus*; this indicate the *Discoaster binodosus* zone (NP11)\textsuperscript{17} which is assigned to Early Eocene (ypresian) with age 54.17 (ma)\textsuperscript{18}.  

**Conclusions**

Petrographical and mineralogical studies have been used to shed light on the characteristics and composition of Shepses po ptah sarcophagus rock, burial chamber casing wall rock, Teti and Unis pyramids building stones in the Saqqara area. It consists mainly of limestone, (mostly slightly dolomitic).

Petrography and mineralogy of the studied rock samples indicate that, their composition are, to some extent hard to resist the interaction between exogenic and endogenic factors of alteration which worked together and causing decay.

The confirmation between Petrographical, mineralogical and calcareous nanofossil studies of Shepses po ptah sarcophagus rock, burial chamber casing wall rock and Teti and Unis pyramids building stones rocks indicate that, it was derived from the same rock unit of Early to Middle Eocene. This means, may be derived from the same source mine.

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**References**