A MICROFACIES STUDY OF
THE UPPER CRETACEOUS-PALEOCENE-LOWER EOCENE SEDIMENTS
AT DUWI AND GURNAH SECTIONS, SOUTHERN EGYPT

by
M. G. Баракат and A. S. El-Dawood

Geology Dept., Faculty of Science, Cairo University, Giza/Egypt

The Upper Cretaceous-Lower Tertiary sediments are widespread both on the surface and in the subsurface of Egypt. They are mainly developed in shale and marl facies with limestone interbeds. By and large, the Upper Cretaceous-Lower Eocene succession falls into well defined rock stratigraphic units. These units are studied in the present work through a profile in Southern Egypt, represented by Gebel Duwi along the Red Sea coast in the east and Gebel Gurnah in the Nile Valley against Luxor to the west (for location, see Fig. 1).


Stratigraphy

The Upper Cretaceous-Lower Tertiary succession along the studied profile is differentiated into six major rock stratigraphic units of mapable character and acquiring regional extent. These are arranged stratigraphically as: Nubia Sandstone and Quseir Variegated Shale, Duwi Phosphate, Dakhla Shale, Tarawan Chalk, Esna Shale and Thebes Formations.

The following is a brief account for the different rock units previously introduced. It deals mainly with their lithological characters, their stratigraphic relationships and variation in facies.
1. Nubia Sandstone and Quseir Variegated Shale

The term “Nubia Sandstone” was first introduced into the Egyptian stratigraphy by Russegger (1837) after the type locality Nubia in Southern Egypt. It was later recognized by Youssef (1957) in the Quseir area and named the Nubia Sandstone. Wherever the base is exposed, the transgressive Nubia Sandstone bed rests unconformably over the basement rocks. The
sandstones are mainly cross-bedded, variegated, brownish to yellowish white, violet with thin ferruginous bands. They are mostly unfossiliferous, medium to fine grained and well sorted. The thickness of these sandstones amounts to 200 mts. in Duwi section (Suppl. I).

They are overlain by a series of unfossiliferous variegated shales and clays, being multicolored and intercalated by fine grained sandstone bands particularly at the base. These shales were invariably considered by older authors as a part of the Nubia Sandstone rock unit. GHORBAB (1956) considered the variegated shales overlying the Nubia Sandstone and underlying the lowermost phosphatic bed in the Quseir area as a separate formation and named it the "Quseir Formation". Youssef (1957) introduced the name "Quseir Variegated Shales" for the same formation and assigned it to the Campanian age. The thickness of these shales amounts to 150 mts. at Gebel Duwi.

2. Duwi Phosphate Formation

A succession of phosphatic lenticular bands interbedded with shales, marls and limestones overlies conformably the Quseir Variegated Shales. This formation was named "Duwi Formation" in Quseir district by Youssef (1957). The Duwi Phosphate extends in a conspicuous scarp for about 40 kms. on the western side of Duwi Range, underlying the Dakhla Shale Formation with Ostrea vesicularis Zittel and Pecten farafrensis Zittel. It crops out also to the north, northwest and south of Gebel Duwi, attaining a thickness of about 150—170 mts.

3. Dakhla Shale Formation

These shales were first described by SAID (1961) at its type locality along the scarp north of Mut, Dakhla Oasis. They are formed of yellowish to greyish shales becoming marly at the base and attaining a thickness of about 130 mts. at the type locality. They are of remarkably constant lithological characters. Sometimes, however, they change laterally in facies almost entirely or at least in part to chalk or chalky limestones. This variation was pointed out by Kerdany (1969) and he called it as the "Khoman Chalk". This formation could be equated with the "Sudr Chalk" formation of GHORBAB (1961). The Dakhla Shale unit assumes a thickness of 150—170 mts. at Gebel Duwi.

4. Tarawan Chalk Formation

This formations was described formally by AWAD and GHOBRIAL (1966) in its type locality at Tarawan block in Kharga Oasis where it attains a thickness of about 45 mts. It is described as a thick bed of chalk, grading into chalky limestone or siliceous limestone which is dated back to the Upper Paleocene. It shows great lateral variation both in lithology and in thickness. To the south of Kharga Oasis, the chalk changes into an ochreous sandy limestone unit previously described by BLANCKENHORN (1900) under the term "Kurkurstufe" and was dated to the Lower Eocene. To the east in Quseir district, it represents a chalk unit, with few marl intercalations attaining a thickness of about 20 mts. at Gebel Duwi.

5. Esna Shale Formation

This rock unit was described fully by BEADNELL (1905) in its type locality at Gebel Oweina, opposite Esna in Upper Egypt, where it attains a thickness
of about 60 mts. It is sometimes referred to as the “Upper Esna Shale” (Hume 1911 and others), but mostly equated with both the Kharga paper-shale member of Ghorab (1956) and Upper Oweina Shale member of El-Naggar (1966). This unit has a very wide geographical distribution. It is well developed along the Nile Valley, in the Safaga-Quseir district as well as in Gebei Egna in Central Sinai (Saïd 1962). These shales were assigned to the Upper Paleocene (Saïd and Kerényi 1961, Saïd 1962). At Gebel Duwi, this rock unit assumes a thickness of about 50 mts., characterized by its grey to dark grey color, greenish in part, fissile and locally ferruginous. At Gebel Gurnah along the Nile Valley, against Luxor, the section is represented by shales of ±18 mts. thick, the base of which is unexposed. This part of the section represents the uppermost part of the Esna Shale Formation and corresponds to the uppermost part of the same formation at Gebel Duwi (Suppl. I).

6. Thebes Formations

The uppermost succession in the studied section is composed of calcareous shale, shaly limestone and limestone. It is designated by El-Naggar (1966) as the “Thebes Formation”. It is further differentiated into a lower “Thebes Calcareous Shale” and an upper “Thebes Limestone”. The former is distinguished from the latter by relative increase in the argillaceous matter. The Thebes Formation was originally described by Saïd (1960, 1962) as “limestone with flint and marls; basal beds with Operculina libyca Schwager”. Its type locality is at Gebel Gurnah, against Luxor where it attains a thickness of about 300 mts., overlying the Esna Shale. The Thebes Formation is introduced to indicate the open marine facies which is synchronous with the Alveolinid Farafra Limestone Formation representing a reefal facies of Early Eocene age.

This unit crops out along the Nile Valley and stretches eastwards forming the cliffs of Wadi Qena. It is developed to the east along the Red Sea Range in the Quseir-Safaga district and forming the table-land in Gebel Egna in Central Sinai. To the west of the Nile, this unit forms the plateau land at Kharga Oasis extending further south to the latitude of Aswan. In Duwi Range, Quseir area, the Thebes Formation forms conical hills extending NW—SE with dip slopes eastwards. It attains a thickness of about 160 mts., the basal

<table>
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<th>Rock unit</th>
<th>Gebel Duwi</th>
<th>Gebel Gurnah</th>
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<td>6. Thebes Formation</td>
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<tr>
<td>6a) Thebes Calcareous Shale</td>
<td>20</td>
<td>42</td>
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<td>6b) Thebes Limestone</td>
<td>140</td>
<td>250</td>
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<td>5. Esna Shale</td>
<td>±18</td>
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<td>4. Tarawan Chalk</td>
<td>20</td>
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<td>3. Dakhla Shale</td>
<td>170</td>
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<td>2. Duwi Phosphate</td>
<td>150</td>
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<tr>
<td>1. Quseir Variegated Shale and Nubia Sandstone</td>
<td>150</td>
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20 mts. of which are of the Thebes Calcareous Shale. The material upon which this study is based was described in detail by El-Dawoody (1970).

The occurrences of the previously mentioned rock stratigraphic units together with their thicknesses in meters are shown by Table 1.

Microfacies and paleoecology

A microfacies may be defined as the complex of microscopical features of sedimentary rocks which permit interpretation and correlation of the conditions that prevailed during sedimentation and diagenesis. This recent method is now gaining importance in the field of local, regional and interregional stratigraphical correlations. Cuvillier and Sacal (1951) introduced this method of study and pointed out its value as a stratigraphic correlation tool. A series of monographs were published, dealing with the microfacies of many parts of the world (H. Hagn 1955, M. Rey and G. Nouet 1958, S. Hanzawa 1961, A. Ford and J. Houbolt 1963, M. B. Cita 1965, M. Misik 1966 etc.).

In Egypt, M. A. Ghorab and M. M. Ismail (1957) were the pioneers in microfacies studies. They described, identified and micro-photographed the different microfacies met with in the Eocene and Pliocene sediments to the east of Helwan. This was followed by a series of microfacies studies in many parts of Egypt, of which M. G. Barakat and N. M. Tewfik (1966), M. M. Ismail and A. A. Selim (1967), M. G. Barakat and S. E. Fahmy (1968) and M. M. Ismail and T. M. Abd El-Razik (1969) are the most important and very near to the present study. In this study, indurated interbeds were thin sectioned and microscopically examined. The terminology proposed by Folk (1959) in describing the different carbonate types is followed. The environmental conditions that prevailed during sedimentation were discussed, interpreted and a paleogeographic reconstruction was attempted.

A) MICROFACIES

Upper Cretaceous

1. Variegated shale (Pl. I, Fig. 1)

The rock is pale greenish yellow to yellowish brown argillaceous matter, microcrystalline, very fine grained, with ferruginous streaks and irregular patches, slightly arenaceous and poorly micaceous, unfossiliferous. This facies is found in the Variegated Shale unit at Gebel Duwi, sample no. 100.

This type reflects an inner neritic environment of relatively shallow water conditions not far from a nearby land-mass.

2. Sandy shale (Pl. I, Fig. 2)

Pale to dark brownish, highly siliceous, sand grains being angular to subrounded, ill-sorted, with phosphatic grains highly stained with iron oxides and few glauconitic granules, with no proper orientation. This association is recorded from Duwi Phosphate Formation, sample no. 3.

This type of facies reflects shallow marine environment where the phosphatic material has been accumulated and in which the derived clastics were deposited not far from the nearby land-mass.
3. *Fossiliferous micrite* (Pl. II, Fig. 1)

Dark greyish with pale brownish staining, cryptocrystalline, exhibiting more or less regular fine bands with undifferentiated organic remains together with phosphatic (?) grains arranged nearly parallel to the direction of lamination, with very fine quartz grains filling up fine veinlets. This facies is found in Duwi Phosphate formation, sample no. 3a. It is also known in samples 28/D, 29/D and 30/D of the uppermost phosphatic bed, but of rare faunal content together with its lack in banding. They also embrace fine carbonaceous dots haphazardly arranged.

Such a type of facies reflects a neritic environment with calm conditions of sedimentation “low agitated bottom conditions”.

4. *Phosphatic biosparite* (Pl. II, Fig. 2)

Pale yellowish brown, mainly composed of phosphatic remains in the form of plates, granules and rounded bodies embedded in a matrix of microcrystalline carbonates and in parts it is sparry calcite. Phosphatic granules are mostly well sorted and they exhibit straight extinction with micaceous inclusions. This facies is known in Duwi Phosphate Formation, sample no. 3b just below the uppermost phosphatic bed.

Such a type of association reflects an inner neritic environment that have been strongly affected by high level of energy caused by waves. Secondary crystallization may have taken place and gave rise to the sparry texture.

5. *Phosphatic biomicrite* (Pl. III, Fig. 1)

The rock is dark greyish, cryptocrystalline, highly fossiliferous, with bentonic fauna and phosphatic remains. Bentonic foraminifers are mainly represented by rotalid forms together with some *Clavulina* spp. Phosphatic remains are represented by well preserved vertebrae, ribs and undifferentiated fragments irregularly scattered through the whole facies. This biomicrite is recorded from Gebel Duwi, sample no. 27/D at the base of the Dakhla Shale Formation and just above the uppermost phosphatic bed.

Such a type of facies reflects a mixed environment in which marine transgression gently overlapped the phosphatic bioherms resulting in this peculiar association.

6. *Heterohelix biomicrite* (Pl. III, Fig. 2)

Pale brownish yellow, microcrystalline, highly fossiliferous, with planktonic and bentonic foraminifers. The planktonic foraminifers are mainly represented by *Heterohelix* spp., *Globotruncanina* spp., *Globigerinas* and *Globorotalias*. Bentonic foraminifers are represented by *Bolivina* spp., together with some lagenid and rotalid forms. Typical biomicrites of the genus Heterohelix are recorded from the Dakhla Shale Formation at Gebel Duwi, samples 23/D, 24/D and 25/D.

Such a type of association reflects deep water conditions of warm sea with normal salinity where planktonic elements are the most abundant and coarser terrigenous materials is completely absent.
Paleocene

7. *Globorotalia biomicrite (A)* (Pl. IV, Fig. 1)

Pale brownish yellow, with argillaceous matter, fine grained and cryptocrystalline, highly fossiliferous, with planktonic foraminifers particularly *round-keeled Globorotalia* together with *Globigerina* spp. They are completely replaced by fine grained calcite filling up their interior cavities. Benthonic foraminifers are also common and they are haphazardly distributed in the rock section. This facies in known in the Dakhla Shale Formation at Gebei Duwi, sample no. 21/D.

Such a type of facies reflects deep water deposit of at least semi-pelagic character with abundance of planktonic calcareous microfauna.

8. *Globorotalia biomicrite (B)* (Pl. IV, Fig. 2)

Pale brownish yellow, with argillaceous matter, fine grained and cryptocrystalline, highly fossiliferous, with planktonic Foraminifera such as *sharp-keeled Globorotalia* together with *round-keeled Globorotalia*, also with few benthonic foraminifers. This biomicrite represents a transitional phase between the round-keeled and the sharp-keeled Globorotalias which characterize the advent of the Upper Paleocene fauna. It is known in the Dakhla Shale Formation at Gebei Duwi, samples 16/D?, 17/D, 18/D and 19/D. The last three samples are of a relatively poor faunal content.

This association reflects an outer neritic to bathyal environment.

9. *Globorotalia biomicrite (C)* (Pl. V, Fig. 1)

Pale yellowish brown, with argillaceous matter more than those observed in the previous older biomicrites (A) and (B), fine grained and cryptocrystalline, highly fossiliferous, with planktonic foraminifer particularly *sharp-keeled Globorotalia* together with few benthonic foraminifers. This facies is recorded from the Tarawan Chalk Formation at Gebei Duwi, samples 13/D, 14/D and 15/D.

Such an association reflects deep water deposition with predominance of planktonic elements (neritic environment), without contribution of coarser terrigenous material.

10. *Marly micrite* (Pl. V, Fig. 2)

The rock is dark brownish, very fine grained, with dense argillaceous matrix. Moderately coarse grained euhedral calcite is scattered allover, stained by iron oxides and devoid of any organic remains. This association is only recorded from sample no. 10/D, intercalating the Esna Shale Formation at Gebel Duwi. It is similar to that recorded by ISMAIL and SELIM (1967) from the Cretaceous strata of Gebei Ataqa scarp.

This facies indicates deposition under fairly deep marine conditions of the neritic zone receiving no terrigenous material.

11. *Marly foraminiferal biomicrite* (Pl. VI, Fig. 1)

The rock is pale brownish, stained with iron oxides, microcrystalline and highly fossiliferous, foraminiferal fauna rich in planktonic species together with some roatalid forms, all embedded in an argillaceous matrix. Microfossils
are completely replaced by fine grained calcite. This biomicrite is known in samples 9/D, 11/D and 12/D at the base of the Esna Shale formation at Gebel Duwi.

This association reflects deep water conditions of middle neritic environment in a warm sea with normal salinity where planktonic elements are the most abundant, and coarser terrigenous materials are completely absent.

**Lower Eocene**

12. *Foraminiferal biomicrite* (Pl. VI, Fig. 2)

The rock is dark greyish yellow, cryptocrystalline, fine grained, highly argillaceous, fossiliferous with planktonic species and undifferentiated organic remains. This biomicrite occurs in the Thebes Formation, represented by samples H/GH and I/GH at Gebel Gurnah and sample no. O/D at Gebel Duwi.

Such a type of facies reflects an outer neritic environment where no coarser terrigenous material is accumulated.

**B) PALEOECOLOGY**

This study aims to throw more light on the conditions under which sedimentation took place. The included fossil organisms are good indicators for their adaptation to conditions that prevailed during their life (HECKER 1965). Since this study is based on two wide spaced stratigraphic sections, it is preferred to treat each of them separately. Through comparison of these sections, the whole sequence is elucidated.

The Duwi section embraces the stratigraphic interval between the Upper Cretaceous and the Lower Eocene. The Gurnah section includes the stratigraphic interval represented by the Lower Eocene only.

**Upper Cretaceous:** It is composed of multicolored shales, unfossiliferous, slightly to moderately sandy and phosphatic in part. These lithological characters indicate deposition in a relatively shallow and stagnant water under toxic bottom conditions during the Campanian time. Shortly after the outset of the Maestrichtian in Duwi district, further shallowing took place resulting in a lacustrine environment. This was strongly affected by waves and undertow on a beach and participated in the accumulation of phosphatic remains. Shallowing of the basin continued, and the phosphatic beds were deposited. Next to this, inundation took place and outer neritic conditions prevailed resulting in the formation of fine grained calcareous deposits rich in planktonic elements without contribution of coarse grained material.

**Paleocene:** By the advent of Early Tertiary in Duwi district, rapid shallowing took place and a slight break is observed. This faunal break between the Upper Cretaceous (Maestrichtian) and the Lowermost Tertiary (Danian) is not accompanied by any facies change. Open marine facies dominated in both ages. This is probably attributed to sudden uplift followed by a short period of erosion and abrupt inundation which led to open marine facies in both Maestrichtian and Danian sediments. Similar sequence of facies, irrespective of aging, was recorded in Ezz El-Orban area (BARAKAT and FAHMY 1968).
The Danian sediments are characterized by abundant planktonic elements, particularly Globigerinas and round-keeled Globorotalias. This type of outer neritic facies dominated also in the Upper Paleocene (Landenian) with the sharp-keeled Globorotalias embedded in a fine argillaceous groundmass. Intertonguing of medium grained carbonates were met with, however it was found unfossiliferous. Open marine facies persisted throughout the Paleocene characterizing the continuously subsiding basin during this epoch.

**Lower Eocene:** The Lower Eocene of both Duwi section in the east and Gurnah outcrop in the west is represented by open marine facies with planktonic fauna, few benthonics and undifferentiated organic remains. This type of facies dominated the vast region extending between the Red Sea and the Nile Basin and probably farther to the west during this lapse of time.

**Conclusions**

The Upper Cretaceous — Lower Tertiary sediments at Duwi/Gurnah sections comprise six major well defined rock stratigraphic units. These are arranged from top to base as:

1. Quseir Variegated Shale and Nubia Sandstone
2. Duwi Phosphate Formation
3. Dakhla Shale Formation
4. Tarawan Chalk Formation
5. Esna Shale Formation
   b) Thebes limestone member
   a) Thebes calcareous shale member
6. Thebes Formation

(Lower Eocene)

(Upper Paleocene — Lower Eocene)

(Upper Paleocene)

(Maestrichtian — Paleocene)

(Campanian — Maestrichtian)

(Campanian and ? Pre-Campanian)

Through the analyses of microlitho- and microbiofacies assemblages, it was possible to recognize the depositional environments in the different formations.

The Upper Cretaceous succession of Duwi Range was accumulated under variable conditions. It commenced with multicolored shales of shallow and stagnant or toxic bottom conditions. This is followed by lacustrine environment whereby phosphatic remains settled down building up the Duwi Phosphates. Next to this phase, deepening took place and resulted in the formation of fine grained calcareous deposits.

The Lower Tertiary of Duwi started with a slight break whereby no change in facies is observed. The Lower Eocene of both Gebel Duwi and Gebel Gurnah was deposited in an outer neritic environment whereby planktonic elements predominate. This environment is synchronous with the Alveolinid Farafa Limestone Formation representing a reeval facies.

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REFERENCES


KÉT DÉL-EGYPTOMI SZELEVNYI MIKROFÁCÉS-VIZSG.


Plate I — I. Tábla

1. *Variegated shale:* very fine grained, slightly arenaceous, with ferruginous streaks and irregular patches, unfossiliferous. × 60
   Environment: inner neritic, with relatively shallow water conditions not far from a nearby land-mass.
   Campanian, Gebel Duwi, sample no. 100

2. *Sandy shale:* highly siliceous, sand grains being angular to subrounded, with some phosphatic grains, unfossiliferous. × 60
   Environment: shallow marine, where phosphatic materials have been accumulated.
   Campanian—Maestrichtian, Gebel Duwi, sample no. 3

* * *

1. *Tarka pala:* nagyon finom szemcséjű, gyengén homokos; vasas erekkel és szabálytalan vasas foltokkal; ősmaradványmentes. 60×
   Környezet: belső neritikus, viszonylag sekélyvízi, partközeli.

2. *Homokos pala:* erősen kovás; homokszemcséi szögletesek, ill. gyengén koptatottak, néhány foszfátsgemcsével; ősmaradványmentes. 60×
   Környezet: sekélytengeri; foszfátos anyagok felhalmozódásához kedvező.
Plate II — II. Tábla

1. Fossiliferous micrite: very fine grained, exhibiting more or less regular fine bands, with undifferentiated organic remains together with some phosphatic (?) grains arranged nearly parallel to the direction of lamination. \( \times 100 \)
   Environment: neritic, with calm conditions of sedimentation.
   Campanian—Maestrichtian, Gebel Duwi, sample no. 3a

2. Phosphatic biosparite: medium grained, fossiliferous mainly composed of phosphatic remains in the form of plates, granules and rounded bodies embedded in a sparry calcite matrix. \( \times 30 \)
   Environment: inner neritic, affected by high level of energy caused by waves.
   Campanian—Maestrichtian, Gebel Duwi, sample no. 3b

* * *

1. Ősmaradványos mikrit: nagyon finom szemcséjű, többé-kevésbé szabályos finom sávozottsággal, meghatározhatatlan szerves maradványokkal és foszfát-(?) szemcsékkel, amelyek a lemezesség irányával közel párhuzamos elrendeződésűek. 100×
   Környezet: neritikus; nyugodt üledékképződési viszonyokkal.

2. Foszfátos biopát: közepes szemcséjű, Ősmaradványos, főleg foszfátos maradványokból áll, melyek lemezek, szemcsék és gömbölyded testek alakjában pátos kalcit alapanyagba ágyazódnak. 30×
   Környezet: belső neritikus; a nagy energiaszintű hullámverés hatókörében.
Két dél-egyiptomi szelvény mikrofácies-vizsg.
Plate III — III. Tábla

1. **Phosphatic biomicrite**: fine grained, highly fossiliferous, with benthonic foraminifers mainly represented by rotalid forms, together with well preserved phosphatic remains such as vertebrae and ribs. $\times 30$

*Environment*: mixed environment in which marine transgression gently overlapped the phosphatic bioherms.
Maestrichtian, Gebel Duwi, sample no. 27/D

2. **Heterohelix biomicrite**: fine grained, highly fossiliferous, with abundant planktonic foraminifers represented by *Heterohelix* spp., *Globotruncana* spp., *Globigerinas* and *Globorotalias*, loosely packed in a carbonate matrix. $\times 100$

*Environment*: outer neritic, no coarser terrigenous material accumulated.
Maestrichtian, Gebel Duwi, sample no. 25/D

* * *

1. **Foszfátos biomikrit**: finomszemcséjű, ősmaradványdús, bentosz Foraminiferákkal (főleg Rotalida alakok), valamint jó megtartású, foszfát anyagú maradványokkal (csigolyák és bordák). $30 \times$

*Környezet*: vegyes környezet, melyben a tenger transzgressziója kissé túlterjedt a foszfátos biohermákon.

2. **Heterohelixes biomikrit**: finomszemcséjű, ősmaradványdús, sok plankton Foraminiferával, melyek *Heterohelix* spp., *Globotruncana* spp., *Globigerina* és *Globorotalia* maradványokból állnak és lazán, karbonátos alapanyagba ágyazódnak. $100 \times$

*Környezet*: külső neritikus; durvább terrigén anyag felhalmozódásától mentes.
Két dél-egyiptomi szelvény mikrofácies-vizsg.
Plate IV — IV. Tábla

1. *Globorotalia* biomicrite (*A*): fine grained, highly fossiliferous, with abundant planktonic foraminifers particularly round-keeled *Globorotalia*, together with *Globigerina* spp. Benthonic foraminifers are common. $\times 100$
   Environment: deep marine, of at least semi-pelagic character.
   Lower Paleocene (Danian), Gebel Duwi, sample no. 21/D

2. *Globorotalia* biomicrite (*B*): fine grained, highly fossiliferous, with abundant planktonic foraminifers such as sharp-keeled *Globorotalia* together with round-keeled *Globorotalia*. Benthonic foraminifers are rare. $\times 100$
   Environment: outer neritic to bathyal.
   Upper Paleocene (Landenian), Gebel Duwi, sample no. 19/D

* * *

1. *Globorotalias* biomikrit (*A*): finomszemcséjű, ősmaradványdús, sok plankton Foraminifera maradvánnyal, elsősorban gömbölyded taréjú *Globorotaliák*kal *Globigerina* spp. társaságában. Általánosan elterjedtek a bentosz Foraminiferák. 100×
   Környezet: mélytengeri, legalábbis hemipelágikus jellegű.

2. *Globorotalias* biomikrit (*B*): finomszemcséjű, ősmaradványdús, sok plankton Foraminiferával, nevezetesen éles taréjú *Globorotaliák*kal és gömbölyded taréjú *Globorotaliák*kal. Bentosz Foraminifera ritka. 100×
   Környezet: külső neritikustól batiálisig.
Plate V — V. Tábla

1. **Globorotalia biomicrite (C):** fine grained, highly fossiliferous, with abundant planktonic foraminifers particularly sharp-keeled Globorotalias. Bentonic foraminifers are rare.  × 100
   Environment: neritic, no coarser terrigenous material accumulated. Upper Paleocene (Landenian), Gebel Duwi, sample no. 13/D

2. **Marly micrite:** medium grained euhedral crystals of calcite, scattered allover a dense argillaceous matrix, devoid of any organic remains. × 60
   Environment: neritic, no terrigenous material accumulated. Upper Paleocene (Landenian), Gebel Duwi, sample no. 10/D

* * *

1. **Globorotaliás biomikrit (C):** finomszemcséjű, ősmaradványdús, sok plankton Foraminiferával, elsősorban éles taréjú Globorotaliákkal. Bentosz Foraminiferára ritka. 100×
   Környezet: neritikus; durvább terrigén anyag felhalmozódásától mentes.

2. **Márgás mikrit:** közepes szemcséjű idiomorf kalcit kristályok tömött, agyagos, szerves maradványtól mentes alapanyagban hintve. 60×
   Környezet: neritikus; terrigén anyagfelhalmozódás nélkül.
Két dél-egyiptomi szellvény mikroszarvész vizsga.

1. [Image]

2. [Image]
Plate VI — VI. Tábla

1. *Marly foraminiferal biomicrite*: fine grained, highly fossiliferous, with abundant planktonic foraminifers together with some rotalid forms embedded in an iron-stained argillaceous matrix. × 60

Environment: middle neritic, no coarser terrigenous material accumulated.
Upper Paleocene (Landenian), Gebel Duwi, sample no. 9/D

2. *Foraminiferal biomicrite*: fine grained, highly argillaceous, fossiliferous, with planktonic foraminifers and undifferentiated organic remains. Benthonic foraminifers common. × 60

Environment: outer neritic, no coarser terrigenous material accumulated.
Lower Eocene, Gebel Gurnah, sample no. I/Gh

* * *

1. * Márgás, foraminiferás biomikrit*: finomszemcséjű, ősmaradványdús, sok plankton Foraminiferával néhány Rotalida alak társaságában, amelyek vasas festésű agyagos alapanyagba ágyazódnak. 60×

Környezet: közép-neritikus; durvább terrigén anyagfelhalmozódástól mentes.

2. *Foraminiferás biomikrit*: finomszemcséjű, erősen agyagos, ősmaradványos; plankton Foraminiferákkal és meghatározhatatlan szerves maradványokkal. Általánosan elterjedtek a bentosz Foraminiferák. 60×

Környezet: külső neritikus; durvább terrigén anyagfelhalmozódástól mentes.
Két dél-egyiptomi szelvény mikrofációs vizsg.

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KÉT DÉL-EGYIPTOMI FELSŐKRÉTA—PALEOCÉN—ALSÓEOCÉN
SZELVÉNY (DUWI ÉS GURNAH) ÜLEDÉKEINEK
MIKROFÁCIES-VIZSGÁLATA

Írta: Barakat, M. G. és El-Dawoody, A. S.
Kairói Egyetem, TTK, Földtani Tanszék, Giza, Egyiptom

A szerzők által vizsgált két szelvény földrajzi helye az 1. ábrán, rétegoszlopa pedig az I. mellékleten látható. Összesen hat kőzetrétegtani egységet különböztetnek meg. Ezek (alulról felfelé) a következők:

1. a Quseir-i Tarka Pala és Núbiai Homokkő (kampani, részben idősebb?)
2. a Duwi-i Foszfát-Formáció (kampani—maastrichti)
3. a Dakhla-i Pala-Formáció (maastrichti—paleocén)
4. a Tarawan-i Kréta-Formáció (felsőpaleocén)
5. az Esna-i Pala-Formáció (felsőpaleocén—alsóeocén)
6. a Tébai Formáció (alsóeocén)
   a) tébai meszes pala rétegtagozat
   b) tébai mészkő rétegtagozat.

Ezek vastagságát az 1. táblázat tünteti fel.

Mikroszkópos vizsgálattal, a kőzetrétegtani és őslénytani jellegek tekintettelével, 12 mikrofácies volt megkülönböztethető; ezek leírását a szöveg tartalmazza, fényképei pedig az I—VI. táblákon találhatók.

A Duwi-hegyvonulat felsőkretá képződményei változó üledékképződési viszonyok között rakódtak le. A Tarka Pala sekély, stagnáló vagy toxikus vízben képződött. Ezt követően a Foszfát-Formáció tavi környezetben rakódott le. Majd mélyülés, neritikus meszes—palás plankton-foraminiferás üledékképződés következett. A kréta—paleocén határon gyors és rövid kiemelkedés volt, amely után az üledékképződés ugyancsak nyílt neritikus fáciesben folytatódott végig a paleocén és az alsóeocén folyamán, az utóbbiban már a Gurnah-i területen is.