

STRATIGRAPHY AND PALEOBATHYMETRY OF UPPER
CRETACEOUS-LOWER TERTIARY EXPOSURES IN
BERIS-DOUSH AREA, KHARGA OASIS,
WESTERN DESERT, EGYPT.

By

ABDEL GALIL HEWAIDY
Geology Department, Faculty of Science
University of Qatar, Doha - Qatar

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ABSTRACT

The detailed study of the Upper Cretaceous-Lower Tertiary succession exposed in Beris-Doush area enabled the subdivision of this succession into a number of rock units well known in the Nile Valley facies area in Egypt. Also present a thin part of the Kurkur Formation of the Garra-Arabian facies. 96 foraminiferal species were identified and used to classify the studied succession into a number of benthonic and planktonic foraminiferal biostratigraphic zones. This foraminiferal assemblage is composed mainly of arenaceous foraminifera with simple wall structure in addition to rare calcareous benthonic and planktonic elements. Thus, a littoral to inner shallow shelf environment with fresh water supply is suggested for the Late Cretaceous part of the succession and a littoral to shallow middle shelf environment for the early Tertiary part.

During Late Cretaceous-Early Tertiary times, over Berish-Doush area, three transgressive phases were detected: during the Middle Maestrichtian (*G. gansseri* Zone), at the early Middle Paleocene (*M. uncinata* Zone), and in the early Late Paleocene (*P. pseudomennardii* Zone).

The *Nummofallotia*, Barrier & Neumann, 1959 is recorded for the first time in Egypt in the Early Maestrichtian sediments in the studied area.

INTRODUCTION

This study gives the results of a detailed examination of the Upper Cretaceous and Lower Tertiary sediments of a part of the western scarp of the limestone plateau between Beris and Doush, south of the Kharga area (Fig. 1).

The western escarpment of the limestone plateau which extends for 350 km between Naqb Assiut in the north and Bir Abu El Husein in the south was the subject of a large number of investigations. Among the most significant are the works of Awad and Ghobrial (1966), Issawi (1968, 1971, 1972), El-Hinnawi *et al.*, (1978), Hewaidy (1983), Hewaidy and Cherif (1984), Hendricks *et al.*, (1984), Luger (1985), Cherif and Hewaidy (1986, 1988), Hewaidy and

Anan (1986) and Anan and Hewaidy (1986) on the stratigraphy and fauna of this part of the Kharga area.

Two sections were measured ; one to the east of Beris and the second to the northeast of Doush (Fig. 1), to carry out a detailed study of the stratigraphy, fauna and paleobathymetry of that part of the escarpment to delineate its lateral variations and correlate it with other parts of the escarpment and also with other parts of Egypt.

LITHOSTRATIGRAPHY

The lithologic succession exposed in the studied area includes a thick Upper Cretaceous-Lower Tertiary sequence reaching about 277 m in thickness in Beris section and about 286 m in Doush section. The lithostratigraphic

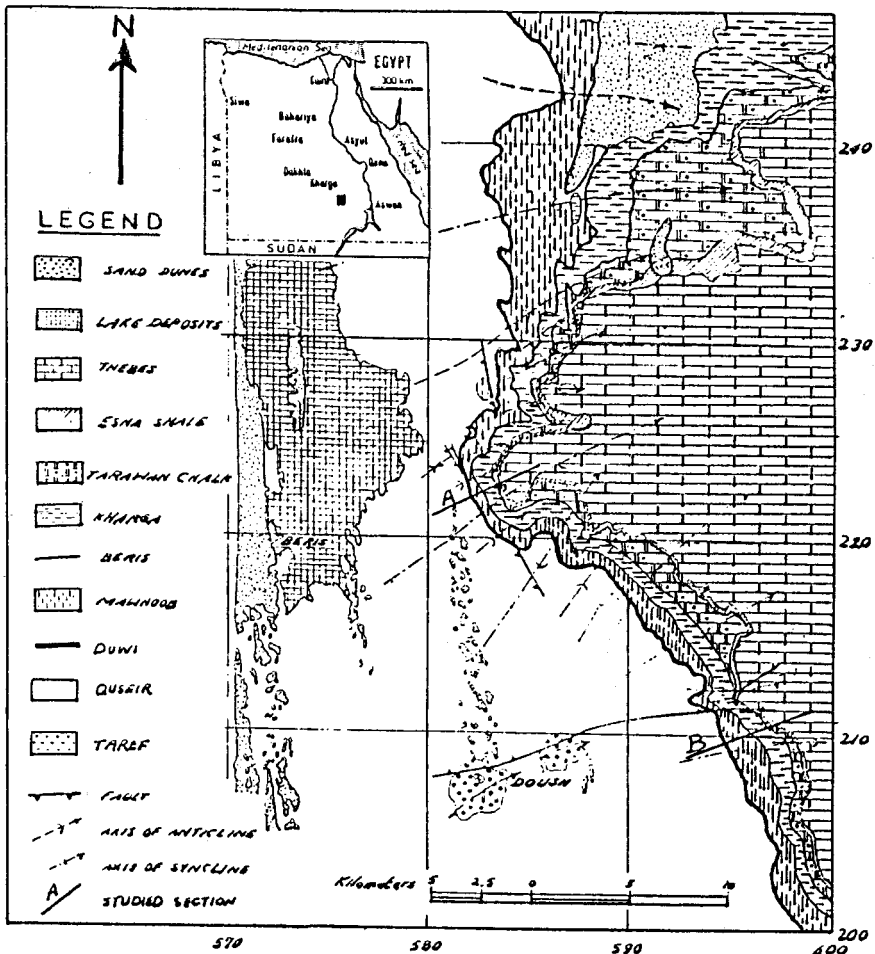


Fig. 1: Geological map of Beris-Doush area, south Kharga Oasis, Western Desert, Egypt (After Awad and Ghobrial, 1966).

classification used here is that of Said (1962), Awad and Ghobrial (1966) and partly of Hendricks *et al.*, (1984). In the following a brief description for the exposed units from top downwards is given:

Rock Unit		Description	Thickness in m.	
Formation	Member		Beris section	Doush section
Thebes		White cherty Limestone with chalk bands barren of mega and micro-fossils	18.7	19.70
Esna Shale		Yellow to light grey shale with gypsum veinlets.	35.10	32.30
Tarawan		Pink, massive, bedded dolomitic limestone with a rich mollusca fauna (especially <i>Osterea orientalis</i>) and echinoids.	5.10	5.40
Dakhla Shale	Upper Kharga	Yellow marl with some Paleocene drawfed mega-fossils.	31.5	Partly covered (17 m)
Kurkur		Light brown marl very rich in <i>Venericardia</i> , gastopods and cephalopods.	1.5	covered
Dakhla Shale	Lower Kharga	Light dark grey shale, barren of megafossils.	64.5	59.20
	Beris	Light yellow to reddish and greyish green shale intercalated with lumachellic rich horizons, generally rich in oysters and <i>Venericardia</i> .	68.6	42.30
	Mawhoob	Dark grey to black shale, devoid of mega-fossils.	33.0	62.0
Duwi		Dark green shale, intercalated with thin yellow phosphatic bands.	20.10	16.70
Quseir		Dark green shale with gypsum veinlets.	14.4	27.20

It is clear that the Cretaceous part of this sequence which includes the formations Quseir, Duwi and Dakhla (Mawhoob, Beris and Lower Kharga Members) is similar to those exposed in the northern Kharga depression of the Nile Valley facies. During Paleocene times intermediate environmental conditions (between the northern deep Nile Valley and southern shallow Garra-Arbian facies) prevailed in the studied area. These conditions lead to the deposition of a thin Kurkur, Dakhla (Upper Kharga Member), Tarawan and lower part of Esna Shale Formations. A Lower Eocene Nile Valley facies represented by the upper part of the Esna Shale and Thebes Formations were

deposited in the studied area similar to that found in the northern Kharga depression. The comparison between the two measured sections is illustrated by Fig. 2.

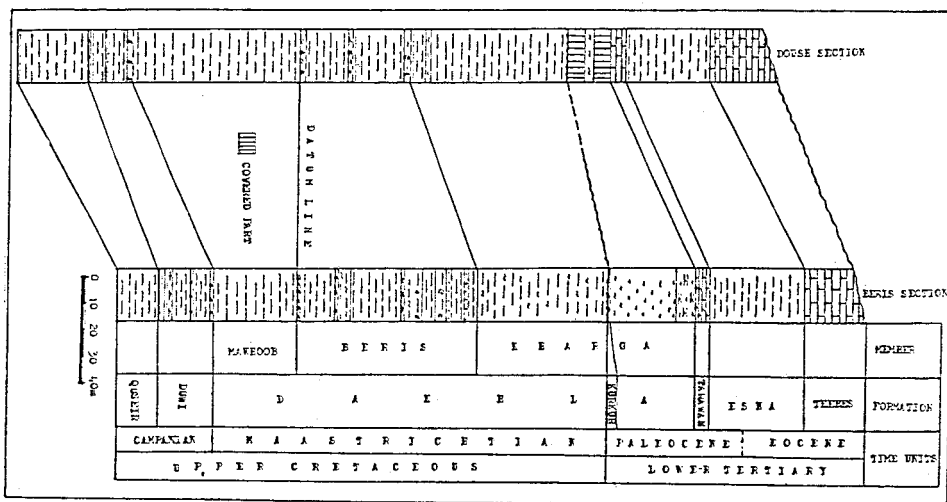


Fig. 2: Comparison between the two studied sections in Beris-Doush area, south Kharga, Oasis, Egypt.

FAUNAL ASSEMBLAGE

Out of 208 samples collected from the Upper Cretaceous -Lower Tertiary succession in Beris-Doush area (135 samples from Beris section and 73 samples from Doush section) only 70 yielded microfossils. 51 Foraminiferal species are found in the Upper Cretaceous part of the sequences and 47 in the Lower Tertiary parts, of which only two species extends from the Maestrichtian to the Paleocene (Figs. 3 & 4).

The Cretaceous part of this foraminiferal assemblage includes 21 arenaceous species (43.9%), mainly with simple wall structures. The number of individuals of these arenaceous forms is many times higher than the number of calcareous forms. The 47 foraminiferal species recorded in the Lower Tertiary succession are restricted to the Paleocene, of which 12 species (25.5%) are arenaceous.

The comparison between this foraminiferal assemblage and those recorded in other parts of Egypt indicates that the Cretaceous part of the studied fauna is similar to that recorded in G. Ghanima by Cherif and Hewaidy (in press).

The Paleocene faunal assemblage is generally different from any other Paleocene assemblages know from other parts of Egypt. The studied fauna is characterized by the prevalence of the arenaceous forms with simple wall structures, (Fig. 4).

The occurrence of the genus *Nummofallotia* BARRIER & NEUMANN in the studied area:

The *Nummofallotia* BARRIER & NEUMANN, 1959 was previously recorded in the Upper Cretaceous of the Mediterranean region; in Spain and France by Barrier and Neumann, 1959, in Italy by Leuperto-Sinni (1968), in Lebanon by Saint-Marc (1970), and in Greece by De Wever (1975) and Decrouez (1977).

In the studied area, a *Nummofallotia* sp is recorded in the two studied sections. It is recorded in two horizons in the early Maestrichtian Beris Member. The *Nummofallotia* sp is recorded in large number in the dark grey shale. In sample 53 (Fig. 3) it is found without any other foraminifera. In sample 41 (Fig. 3), on the other hand, it is found with arenaceous forms with simple wall structure.

BIOSTRATIGRAPHY

The faunal assemblage recorded in the Upper Cretaceous-Lower Tertiary succession is Beris-Doush area enabled its subdivision into a number of biostratigraphic zones.

A. Planktonic Foraminiferal Zonation

Rare planktonic foraminifera was recorded in the studied sequence. This assemblage enabled the subdivision of the sequence into three planktonic foraminiferal zones. These are from base upwards:

1. *Gansserina gansseri* Zone

This zone is represented in the basal part of the Kharga Member (7m thick in Baris section and 10m thick in Doush section). It is composed of grey calcareous shale. The planktonic elements recorded in this zone are *Gansserina gansseri* (Bolli), *Globotruncana aegyptiaca* Nakkady, *Globotruncana duwi* Nakkady, *Heterohelix striata* (Ehrenberg), *Pseudoguembelina costulata* Cushman and *Rugogobigerina rugosa* (Plummer). The *Gansserina gansseri* Zone is of Middle Maestrichtian age according to different authors. In the studied area the *G. gansseri* Zone is overlain by a thick shale sequence found barren of planktonic foraminifera and may represent the late Maestrichtian age.

2. *Morozovella uncinata* Zone

The basal 6.5 m of the Upper Kharga Member, directly overlying the Kurkur Formation, are found rich in planktonic foraminifera such as *Subbotina pseudobulloides* (Plummer), *S. triloculinoids* (Plummer), *S. varianta* (Subbotina), *Globoconosa daubjergensis* (Bronnimann), *Morozovella*

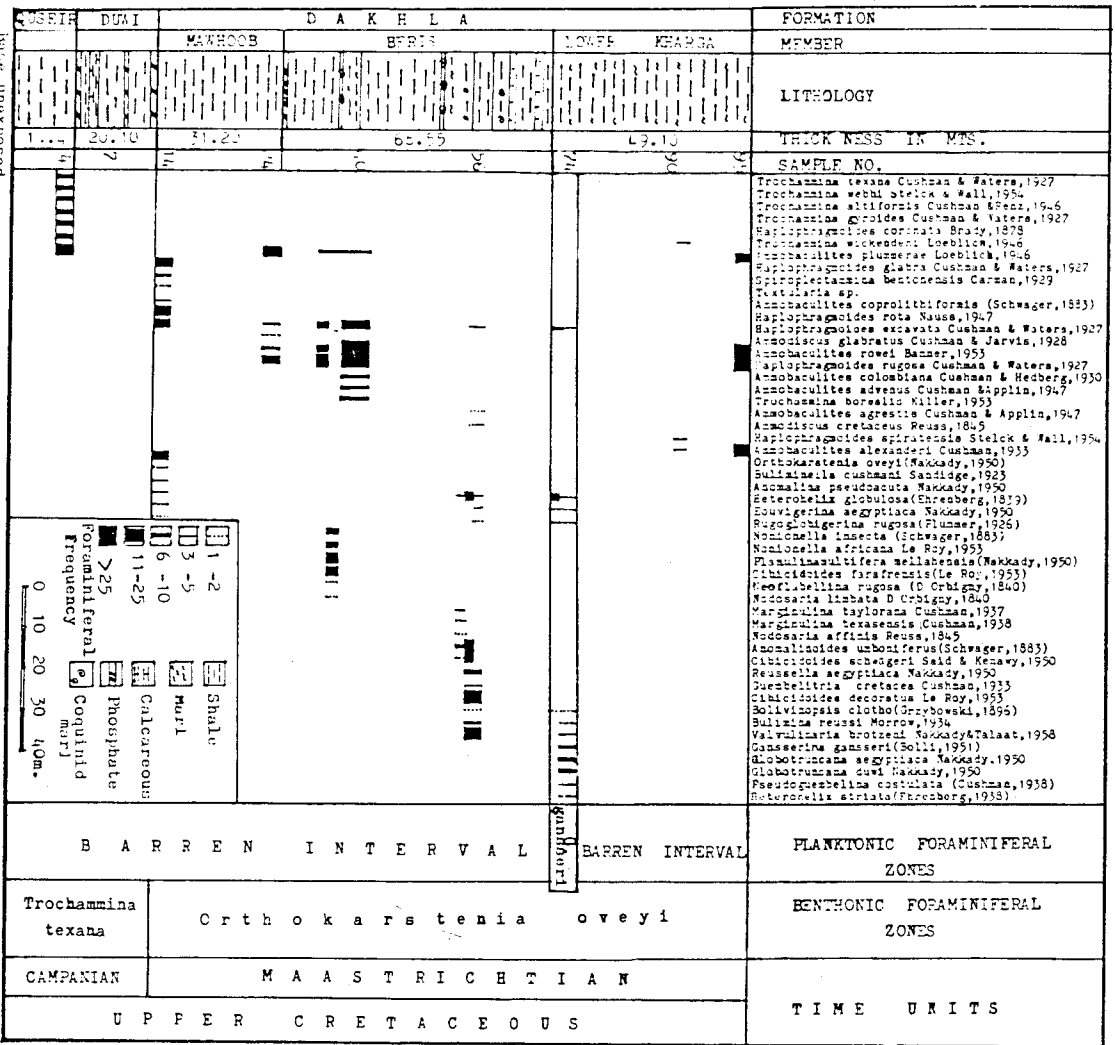


Fig. 3: Distribution chart of the foraminiferal species recorded in the Cretaceous rocks exposed in Beris-Doush area, Kharga Oasis, Egypt.

trinidadensis (Bolli), *M. inconstans* (Subbotina), *M. uncinata* (Bolli) and *Planorotalites compressa* (Plummer). This assemblage denotes a *M. uncinata* Zone of the early Middle Paleocene. This part is overlain in Beris section by a 25 m thick belonging to the Upper Kharga Member of the Dakhla Shale, followed by the Tarawan Formation, which are both devoid of planktonic foraminifera. The basal thin Kurkur Formation of this zone may be of early Paleocene age.

3. *Planorotalites pseudomenardii* Zone

The basal 5 m of the Esna Shale in the two studied sections include planktonic foraminifera such as: *Planorotalites pseudomenardii* (Bolli), *P. chapmani* (Parr) *Morozovella convexa* (Subbotina) and *Subbotina linaperta* (Finlay). This assemblage assigned this part to the *P. pseudomenardii* Zone of early Late Paleocene. This fossiliferous part is overlain by a 30.0 m thick sequence belonging to the Esna Shale, which is in turn conformably overlain by the Thebes Formation. The last mentioned two sequences are completely devoid of foraminifera (Fig. 4).

B. Benthonic Foraminiferal Zonation

The Upper Cretaceous-Lower Tertiary succession exposed in Beris-Doush area is subdivided according to its benthonic foraminiferal content into three zones. These are from base upwards:

1. *Trochammina texana* Zone

This zone is represented by the lower part of the studied succession which include the Quseir and Duwi Formations (34.5m thick in Beris section and 43.9 m thick in Doush section). It is rich in arenaceous foraminifera represented by 7 species of which 5 belong to the genus *Trochammina* in addition to *Haplophragmoides coronata* Brady and *Ammobaculites plummarae* Loeblich Fig. 3. This *Trochammina texana* Zone is of Campanian age. It is equivalent to the *Ammodiscus manqusi*, *Trochammina undulosa* and *Lituola difformis taylorensis* Zones of the Campanian age in G. Duwi and Abu Had sections (Kenawy *et al.*, 1976).

2. *Orthokarstenia oveyi* Zone

The conformable overlying part of the Dakhla Shale (185.0 m thick in Beris section and 164 m thick in Doush section) includes some fossiliferous horizons with mainly arenaceous assemblage in addition to rare calcareous species. The most important and widely distributed species in this part of the succession is *Orthokarstenia oveyi* (Nakkady). The main elements of the assemblage of this zone are : *Ammobaculites rowei* Banner, A.

Stratigraphy of Upper Cretaceous-Lower Tertiary

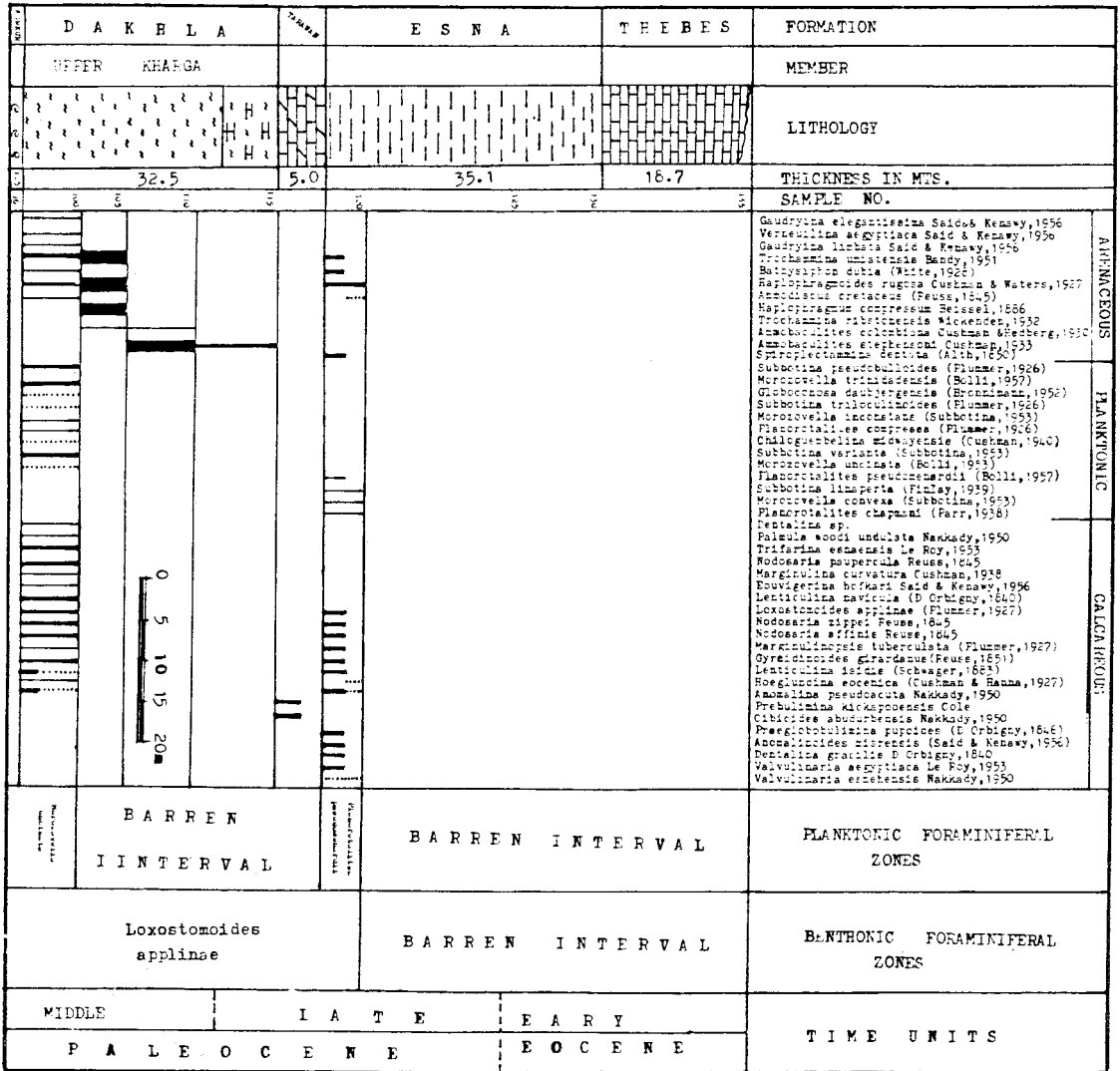


Fig. 4: Distribution chart of the foraminiferal species recorded in the Tertiary rocks exposed in Beris-Doush area.

alexanderi Cushman, *A. colombiana* Cushman, *Haplophragmoides rugosa* Cushman & Waters, *H. excavata* Cushman & Waters, *Eouvigerina aegyptiaca* Nakkady, *Reussella aegyptiaca* Nakkady, *Cibicidoides farafrensis* (Le Roy) and others Fig. 3. The *Orthokarstenia oveyi* Zone is of Maestrichtian age.

3. *Loxostomoides applinae* Zone

The lower Tertiary succession in Beris-Doush area is subdivided into a fossiliferous horizon overlain by a barren interval. This fossiliferous part includes the Kurkur Formation, the Upper Kharga Member, the Tarawan Formation and the basal part of the Esna Shale. The basal and top parts of this zone are found rich in foraminiferal species such as *Trochammina umiatensis* Bandy, *Ammodiscus cretaceus* (Reuss), *Loxostomoides applinae* (Plummer), *Nodosaria zippei* (Reuss), *Marginulinopsis tuberculata* (Plummer), *Gyroidinoides girardanus* (Reuss), *Lenticalina isidis* (Schwager), *Hoeglundina eocenica* (Cushman), and many others Fig. 4. The *Loxostomoides applinae* Zone is included in the Middle and early Late Paleocene in the studied area. The latest Paleocene and the Early Eocene sediments are devoid of foraminifera, their age has been estimated after stratigraphic considerations.

PALEOBATHYMETRY

The distribution of the 96 foraminiferal species identified in the Upper Cretaceous-Lower Tertiary succession exposed in Beris-Doush area, their total frequency, the number of arenaceous forms, the amount of calcareous and planktonic species were used to subdivide this succession into 14 ecozones (10 ecozones in the late Cretaceous and 4 ecozones in the early Tertiary) in addition to 8 barren intervals (7 in the late Cretaceous and one in the early Tertiary). In the following, a brief description for the different paleoecologic ecozones recorded in Beris-Doush area:

1. Quseir Formation

The Quseir Formation includes one ecozones (E1) Fig. 5, which is underlain by a thick barren interval. This barren interval is composed of dark grey and dark brown shale without any foraminifera. It is marked by a rich simple wall structure arenaceous assemblage including five *Trochammina* species, one *Haplophragmoides* species and one *Ammobaculites* species. Bandy and Arnal (1960) believed that the simple wall structure arenaceous genera tend to be abundant in shoal brackish waters. Luger (1985) considered these elements as mixohaline assemblages (indicating brackish water influence). Thus, a littoral environment with some fresh water supply is suggested for the Quseir Formation.

2. Duwi Formation

The Duwi Formation is found devoid of foraminifera and thus the same environmental conditions prevailing during the deposition of the Quseir Formation may be suggested for the Duwi Formation.

3. Dakhla Formation

3.a Mawhoob Member

The Mawhoob Member includes two ecozones in addition to a barren interval, between them. The lower ecozone (E2) (see Fig. 5) includes 6 arenaceous species: 3 *Haplophragmoides* species and 3 species belonging to the genera *Spiroplectamina*, *Textularia* and *Ammobaculites* respectively, 4 calcareous species belong to the genera *Orthokarstenia*, *Buliminella*, *Anomalina* and *Eouvigerina* and two planktonic species belonging to *Heterohelix* and *Rugoglobigerina* suggesting a still shallow marine environment. The presence of some arenaceous species with complex wall structures, some calcareous forms and some rare planktonic species denote deeper marine condition and an open sea (Bandy, 1956 and Bandy & Arnal, 1957, 1960). Luger (1985) assigned a similar assemblage to shallow inner shelf conditions. Thus, deeper marine conditions (shallow inner shelf with normal marine salinity) was prevailing during the deposition of the basal part of the Mawhoob Member. This part is overlain by a barren interval which is overlain by a thin horizon (E3) with only simple walled arenaceous forms (2 species of the genus *Haplophragmoides* and 3 species of the genus *Ammobaculites*). Thus a littoral environment with fresh water supply is suggested for the barren interval and the overlying (E3) of the Mawhoob Member.

3.b Beris Member

This member is subdivided into eight intervals. These are: three barren intervals, two with only simple walled arenaceous genera, two with only calcareous genera and one interval with mixed arenaceous and calcareous genera. The basal part of Beris Member is found devoid of foraminifera and is overlain by a fossiliferous part which is subdivided into three ecozones, the lower one (E4) includes only 4 simple walled arenaceous species (2 *Haplophragmoides* species and 3 *Ammobaculites* species), thus a littoral environment with fresh water supply is suggested for this ecozone. It is directly overlain by ecozone 5 which include only 6 calcareous species (2 *Nonionella* species and one species for each of the following genera *Planulina*, *Cibicidoides*, *Neoflabellina* and *Nodosaria*). This assemblage denotes a shallow inner shelf environment. The ecozone

5 is directly overlain by ecozone 6 which includes only simple walled arenaceous forms (4 *Ammobaculites* species, 2 *Haplophragmoides* species and one *Trochammina* species). This assemblage denotes a littoral environment for the ecozone 6. This ecozone is directly overlain by a fossiliferous horizon. This fossiliferous horizon is subdivided into two ecozones, the lower one (E7) includes a foraminiferal assemblage composed of 7 calcareous species (2 species for each of the genera *Marginulina* and *Nodosaria*, and one species for the genera *Heterohelix*, *Anomalinoides* and *Cibicidoides*). An inner shelf environment is suggested for ecozone 7. This is overlain by ecozone 8 which includes an assemblage composed of 14 species (one species for each one of the following genera *Heterohelix*, *Eouvigerina*, *Rugoglobigerina*, *Anomalinoides*, *Reussella*, *Bolivinopsis*, *Valvulinera*, *Praebulimina*, *Haplophragmoides*, *Ammobaculites*, *Ammodiscus*, *Guembeliteria* and two species of the genus *Cibicidoides*). This is more diverse faunal

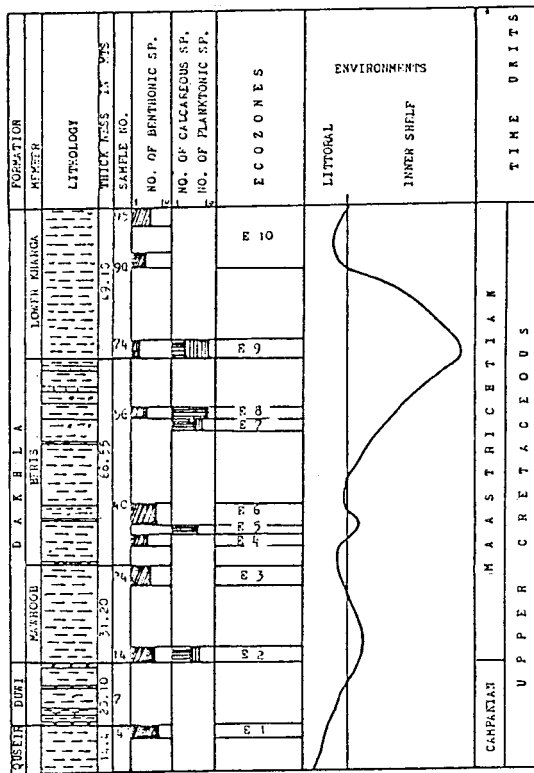


Fig. 5: The ecozones and environments of the Upper Cretaceous succession in Beris-Doush area.

assemblage and the presence of some planktonic elements denote a deeper inner shelf environment. The ecozone 8 is overlain by a barren interval which may have been deposited in the same environment as ecozone 8.

3.c Lower Kharga Member

The Lower Kharga Member represents the Maestrichtian part of the Dakhla Formation. The basal part of this member (E9) includes a foraminiferal assemblage consisting of eleven species; two species of the genera *Globotruncana* and *Heterohelix* and one species of the genera *Gansserina*, *Rugoglobigerina*, *Pseudoguembelina*, *Eouvierina*, *Valvuleneria* in addition to the arenaceous genera *Haplophragmoides* and *Bolivinopsis*. The presence of planktonic genera (63.6% of the assemblage) of the open and deep marine nature (*Globotruncana* and *Gansserina*) and the high diverse assemblage denote a deep inner shelf environment for this part which is the deepest environment recorded in the late Cretaceous of the studied area. This part is overlain by a thick barren interval which is overlain by an interval yielding only simple walled arenaceous genera (E10) as *Ammobaculites*, *Trochammina* and *Haplophragmoides* which denotes a littoral environment with fresh water supply, during the late Maestrichtian.

4. Kurkur Formation

The Kurkur Formation is represented in the studied area by a light brown marl with rich *Venericardia* - *Turritella* and cephalopods and devoid of foraminifera. An inner shelf environment is suggested for this formation (Fig. 6).

3.d Upper Kharga Member

The Upper Kharga Member covers conformably the Kurkur Formation and it is of Paleocene age. It is subdivided sharply into two ecozones. The lower one (E11) is marked by the presence of the well known Midway Fauna Type (Berggren and Aubert, 1975). This ecozone is equivalent to the *Morozovella uncinata* Zone and includes 31 foraminiferal species of which 29% planktonics. The association of the MFT assemblage with about 30% planktonics denote a shallow middle shelf environment, (Luger, 1985). This overlain by ecozone (12) which is represented by the upper part of the Upper Kharga Member and is marked by the complete absence of any calcareous forms and the presence of a frequent simple walled arenaceous genera such as *Trochammina*, *Haplophragmoides* and *Ammobaculites*. This assemblage denote a littoral environment for the ecozone 12 (Fig. 6).

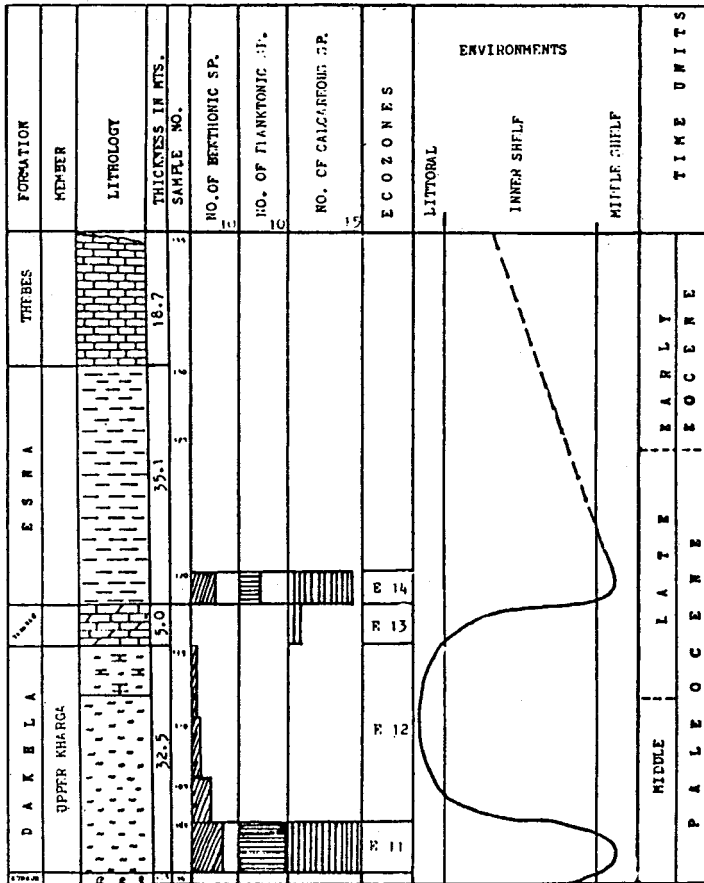


Fig. 6: The ecozones and environments of the Lower Tertiary succession in Beris-Doush area.

5. Tarawan Formation

The Tarawan Formation is mainly composed of dolomitic limestone with some echinoids and frequent occurrence of *Ostrea orientalis*. Only *Praeulimina* and *Cibicides* were recorded here. This denote a deep inner shelf environment for this ecozone (E13).

6. Esna Shale and Thebes Formations

The basal part of the Esna Shale in the studied area is marked by the presence of a richy fossiliferous horizon representing ecozone 14. This ecozone is equivalent to the *Planorotalites pseudomenardii* Zone. It includes a Midway Fauna Type assemblage consisting of 22 foraminiferal species of which 18% planktonics (Fig. 6). A Shallow middle shelf environment is suggested for ecozone 14.

This ecozone is overlain by a thick barren interval included in the upper part of the Esna Shale and the whole measured part of the Thebes Formation. This interval is found barren of micro- or megafossils. Thus, an inner shelf environment may be suggested for this interval.

CONCLUSIONS

The Upper Cretaceous-Lower Tertiary succession exposed in Beris-Doush area is subdivided into Quseir, Duwi, Dakhla, Kurkur, Tarawan, Esna and Thebes Formations and the Dakhla Formation is subdivided into Mawhoob, Beris, Lower Kharga and Upper Kharga Members. 96 foraminiferal species are identified of which 21 are planktonics. In addition to these species the *Nummofallotia* sp. is recorded for the first time in Egypt. This planktonic assemblage enables the recognition of three planktonic foraminiferal zones; one in the middle Maestrichtian (*G. gansseri* Zone) and one in the early middle Paleocene (*M. uncinata* Zone) and one in the early late Paleocene (*P. pseudomenardii* Zone). The benthonic foraminiferal assemblage was used for the recognition of three benthonic foraminiferal zones; *Trochammina texana* Zone of Campanian age, *Orthokarstenia oveyi* Zone of Maestrichtian age and *Loxostomoides applinae* Zone of Paleocene age, while the Eocene is found barren of foraminifera.

The lithologic characters, the distribution of the fauna in the studied sequence, the type of the faunal elements, the number of benthonic, calcareous and planktonic species were used to subdivide the studied sequence into 14 ecozones in addition to 8 barren intervals in between them. These ecozones and their faunal characters denote generally shallow environmental conditions, ranging between littoral to inner shelf environments in the late Cretaceous and littoral to shallow middle shelf environments in the early Tertiary.

Finally, during late Cretaceous-Early Tertiary time, three major transgressions over Egypt generally and southern Egypt specially, were clearly detected in the studied area. The peaks of the transgressions are equivalent to the times represented by the three planktonic foraminiferal zones; in the middle Maestrichtian, early middle Paleocene and early late Paleocene.

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الإستراتيجية والعمق القديم لتتابع الطباشيري العلوي - الثلاثي
السفلي في منطقة باريس - دوش الواقعة جنوب واحة الخارجة
الصحراء الغربية - مصر

عبد الجليل عبد الحميد هويدي

أمكن تقسيم تتابع الطباشيري العلوي - الثلاثي السفلي في منطقة باريس - دوش إلى عدد من الوحدات الصخرية التي توجد مثيلاتها في مناطق سحنة وادي النيل ، بالإضافة لتواجد محدود لسحنة جارة الأربعين الضحلة يتمثل بمكون الكركر مما يشير إلى أن منطقة الدراسة تقع في موضع إنتقالي بين السحنتين . كما أمكن تعريف ستة وتسعين نوعاً من الفورامنيفرا تمثل الفورامنيفرا الرملية المجمعمة بسيطة التركيب الداخلي الجزء الأكبر منها ، كما أنها تفوق عددياً لعدة مرات الفورامنيفرات الأخرى . أمكن التعرف على ثلاث نطاقات تعتمد على الفورامنيفرا الطافية كما قسم التتابع لثلاث نطاقات تعتمد على الفورامنيفرا القاعية . وقد استعمل المحتوى الحفري والصخري في وضع تصور للبيئة القديمة في المنطقة المدروسة حيث ثبت أن البحر خلال الفترة الزمنية المدروسة كان ضحلاً - تراوح في الطباشيري المتأخر بين البيئة الشاطئية والبحرية الضحلة . بينما في الثلاثي المبكر فقد تراوح بين البيئة الشاطئية والبحرية الوسيطة . كما أثبتت الدراسة أنه خلال فترة الطباشيري المتأخر - الثلاثي المبكر حدث ثلاث فترات مد بحري على منطقة الدراسة إحداها في المسترختي الأوسط والثانية في الجزء المبكر من الباليوسين الأوسط والثالثة في الجزء المبكر من الباليوسين المتأخر . وفي النهاية فقد سجل جنس *Nummofallotia* لأول مرة في مصر في صخور المسترختي المبكر من التتابع المدروس .