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Early Eocene Nummulitids from Gebel Umm Russeies, El Galala El Bahariya, Eastern Desert, Egypt

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ABSTRACT

Seven larger foraminiferal species: *Nummulites* aff. *nemkovi* SCHAUB, 1966, *Nummulites partschi* DE LA HARPE, 1880, *Nummulites bassiounii* BOUKHARY & BLONDEAU, 1991, *Nummulites* cf. *campesinus* SCHAUB, 1966, *Assilina* aff. *major* HEIM, 1908, *Decrouezina aegyptiaca* Boukhary, 1994 and *Operculina* sp. are described from the Early Eocene Gebel Umm Russeies, Northern Galala, Eastern Desert, Egypt. These taxa are biostratigraphically evaluated and according to the standard shallow benthic zones, the identified biozones span SBZ 10 to SBZ 12 in the shallow benthic zones (SBZ) of SERRA-KIEL et al. (1998) which are assigned to the Late Ypresian.

Keywords: *Nummulites*, *Operculina*, Gebel Umm Russeies, El Galala El Bahariya, Ypresian, Egypt

1. INTRODUCTION

El Galala El Bahariya is a high flat topped plateau located between latitudes 28°50' N and 29°45' N and longitudes 31°40' E and 32°30' E and is one of the most impressive topographical features in the northern part of the north Eastern Desert. The plateau overlooks the Gulf of Suez rising 977 m above sea level at Gebel Umm Russeies, and extends between 50 km south of Suez city in the north and Wadi Araba in the south, a distance of about 60 km. Inland, the plateau stretches westwards where it merges into the Mokattam plateau overlooking Cairo in the west. The El Galala El Bahariya plateau is cut by some wadis, but the main tributaries from west to east are: Wadi El Qena, Wadi El Ghul, Wadi El-Khafouri, Wadi Abu Diaba, Wadi Ogila, El Wadi El-Abyad, Wadi Naoz, Wadi Umm Russeies and Wadi Haroz (Fig. 1). The studied area lies at the far north and east sides of El Galala El Bahariya, between latitudes 29°30' N and 29°40' N and longitudes 32°07' E and 32°25' E.

Near the North Eastern part of the El Galala Plateau, At Khashm El-Galala, Wadi Haroz and Wadi Umm Russeies, the lower part of the scarp is composed of Lower Cretaceous variegated sandstone and marl (Malha Formation), overlain by a thick series of marly limestone, marl and a thick band of dolomite of Late Cretaceous age (Galala Formation).

The following Turonian fossiliferous dolomite and conglomeratic beds (Umm Russeies Formation) are exposed and, with thickness overlain by marly limestone and shale of Palaeocene age (Esna Shale). These rocks are capped by Eocene carbonates rocks which are completely dolomitic in the east and gradually change westward to dolomitic limestone. To the west of Wadi Naoz, Eocene limestones form the foot of the scarp, Palaeocene and Cretaceous strata never crop out again west of Wadi Naoz. The general dip of the strata is towards the west and varies from 8° to 10°.

El Galala El Bahariya was affected by tectonic movements which took place during the Late Cretaceous, the Early Eocene and the Neogene. The dominating faults trend East–West, especially in the northernmost part, but other trends NW–SE (Gulf of Suez) and NE–SW are not uncommon.

* In the memory of the late Professor Abbas Kenawy

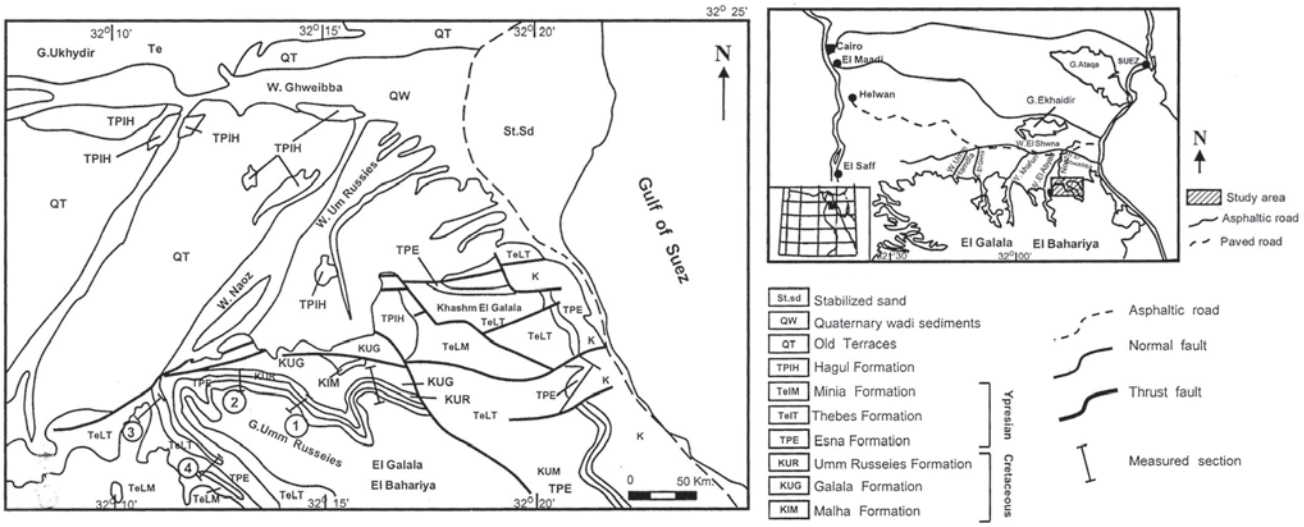

Figure 1: Geologic map of the study area and location of studied sections.

Many faults along the northern face of North Galala are arranged en echelon (Fig. 1).

El Galala El Bahariya, like other localities in the northern part of the Eastern Desert, is affected by volcanic intrusions. Sheet basalts can be seen at the top of the plateau, and also at the opening of Wadi Naoz, Wadi Umm Qena and Wadi Haroz (Fig. 1). As a consequence, the sediments are slightly metamorphosed at the contact and hence marblised limestone and calcite dykes are found at Wadi Haroz, Wadi Ghoul and Gebel Menedra.

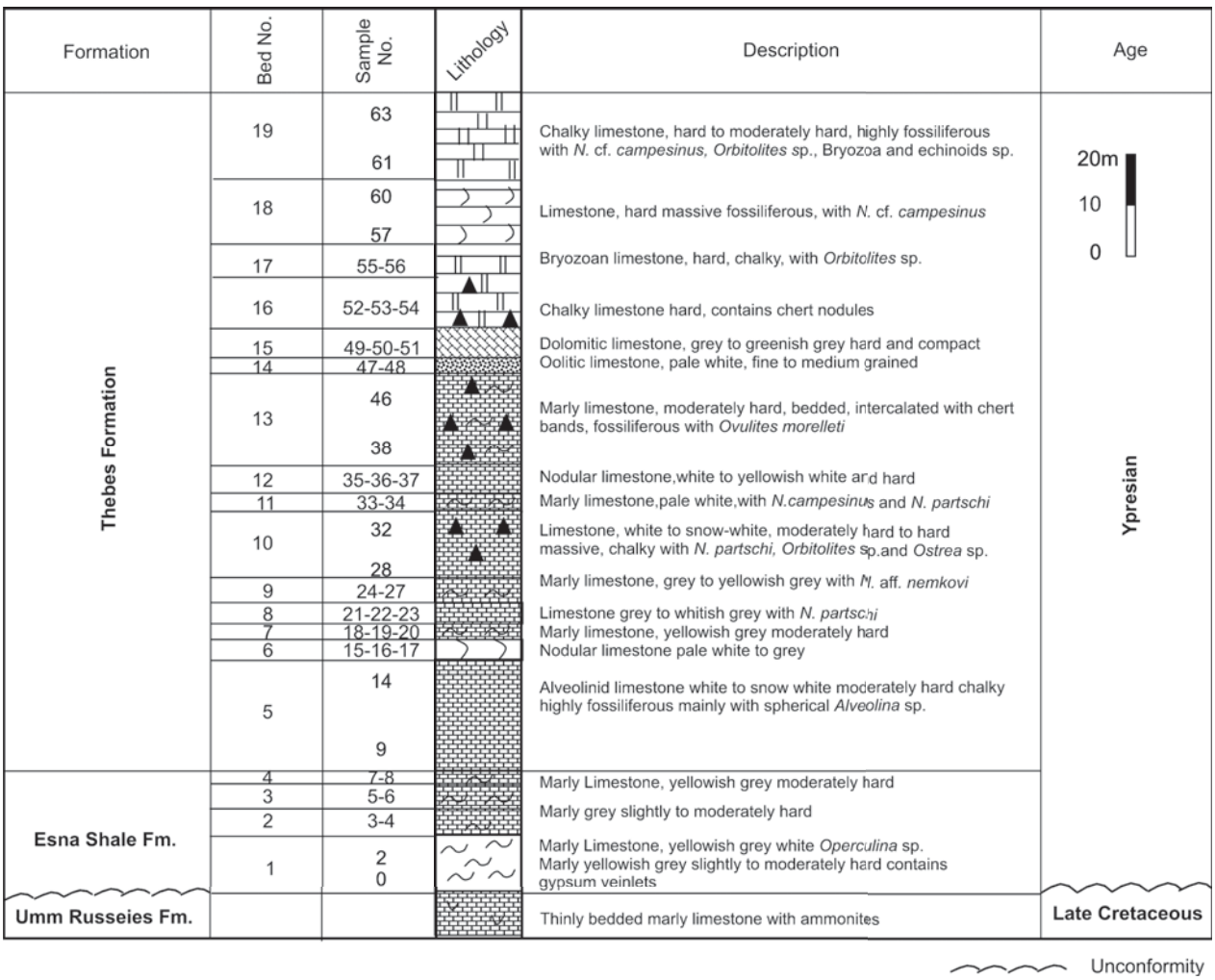

Figure 2: Stratigraphic section measured at Gebel Umm Russeies (section no. 1).

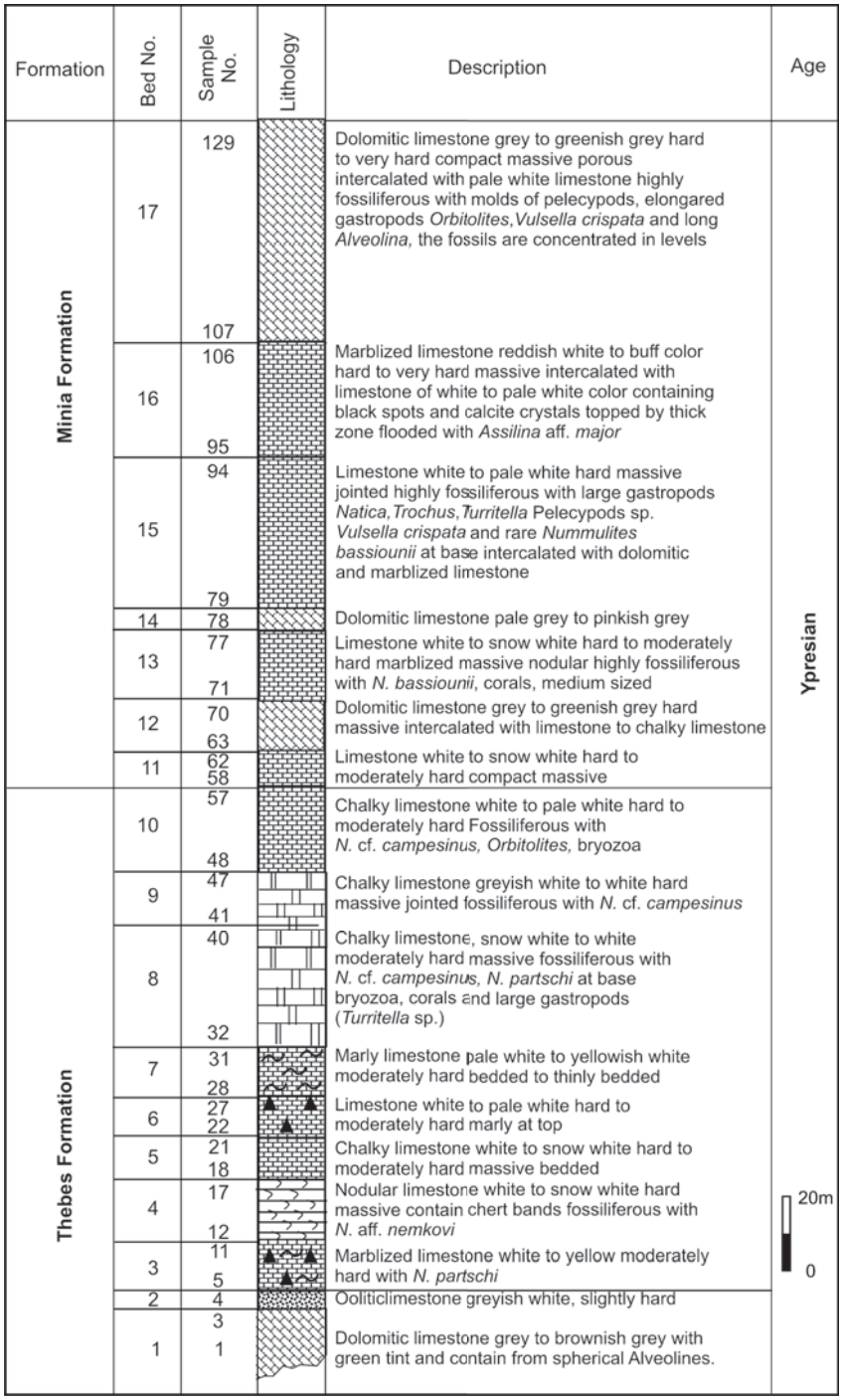

Figure 3: Stratigraphic section measured at Gebel Umm Russeies (section no. 2).

This paper deals with the study of larger foraminifera, mainly nummulitids, collected from the Lower Eocene rocks of Gebel Umm Russeies in an attempt to locate their exact stratigraphic position in the frame of the standard shallow benthic zones (SBZ of SERRA-KIEL et al., 1998) of the Eocene sequence.

2. STRATIGRAPHICAL SETTING

The Eocene rocks are widely distributed in Egypt, well exposed along the Nile Valley, Sinai Peninsula, Western Desert, and the Eastern Desert including Northern and Southern Galala. There is great lateral variation in both lithofacies and biofacies.

This study is based on four measured stratigraphic sections (Figs. 2–5) representing the exposed Eocene succession. A brief description and discussion of the rock units from base to top is as follows: Esna Shale Formation, Thebes Formation and Minia Formation.

2.1. The Esna Shale Formation

In the study area, the Esna Shale is composed of thinly bedded marl, marly chalk, grey-greenish to grey shale that unconformably overlies the Umm Russeies Formation (SWEDAN et al., 1991). The base of the Esna Shale is characterized by the presence of *Operculina* sp. and *Discocyclina* sp. while

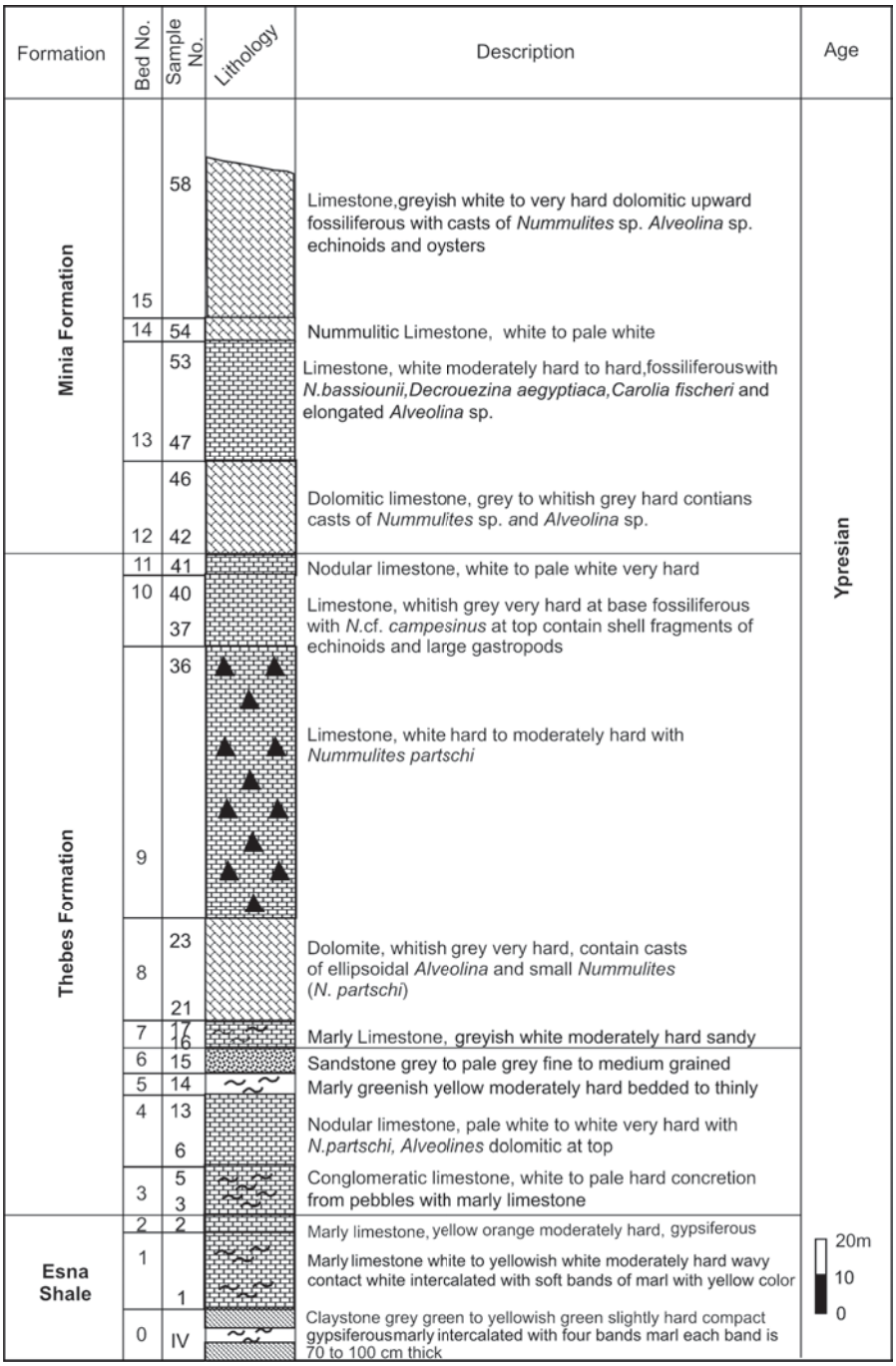

Figure 4: Stratigraphic section measured southwest of Wadi Naoz (section no. 3).

the *Morozovella velascoensis* and *Morozovella edgari* zones are recorded higher in the sequence. The Esna Shale disappears in the western part of the study area, east of Wadi Naoz due to the regional dip. In the eastern part (W. Haroz), it consists of thinly bedded marly chalk and has a thickness of 35 m. The Esna Shale attains a thickness that ranges from 60 m at section 1 to 80 m at section 4. The microfaunal assemblages recorded in this study from the Esna Shale indicate an Ypresian age for this Unit.

2.2. The Thebes Formation

The Thebes Formation was introduced by SAID (1960) for a massive unit of limestone with flint bands of Ypresian age. The type locality is at Gebel Gurnah, west of Luxor, near the site of the ancient Thebes Capital of Egypt, where it is about 300 m in thickness. The basal beds of this unit are rich in *Operculina libyca* Schwager (*Operculina* limestone), while the lower part is poor in megafossils, and is massive – thickly bedded with tabular and concretionary flint bands. The upper part includes several marl beds alternating with nummulitic limestone bands rich in *Nummulites* and megafossils. The micro fossils include *Nummulites praecursor* and *N. subramondi*, *Lucina thebaica*, *Conoclypeus delanouei*, indicating an Early Eocene age for this assemblage and formation.

SNAVELY et al. (1979) divided the Thebes Formation in the Nile Valley into three informal members: lower, middle and upper. The first member (lower member) is a transitional contact with the laminated shales and marls of the Esna

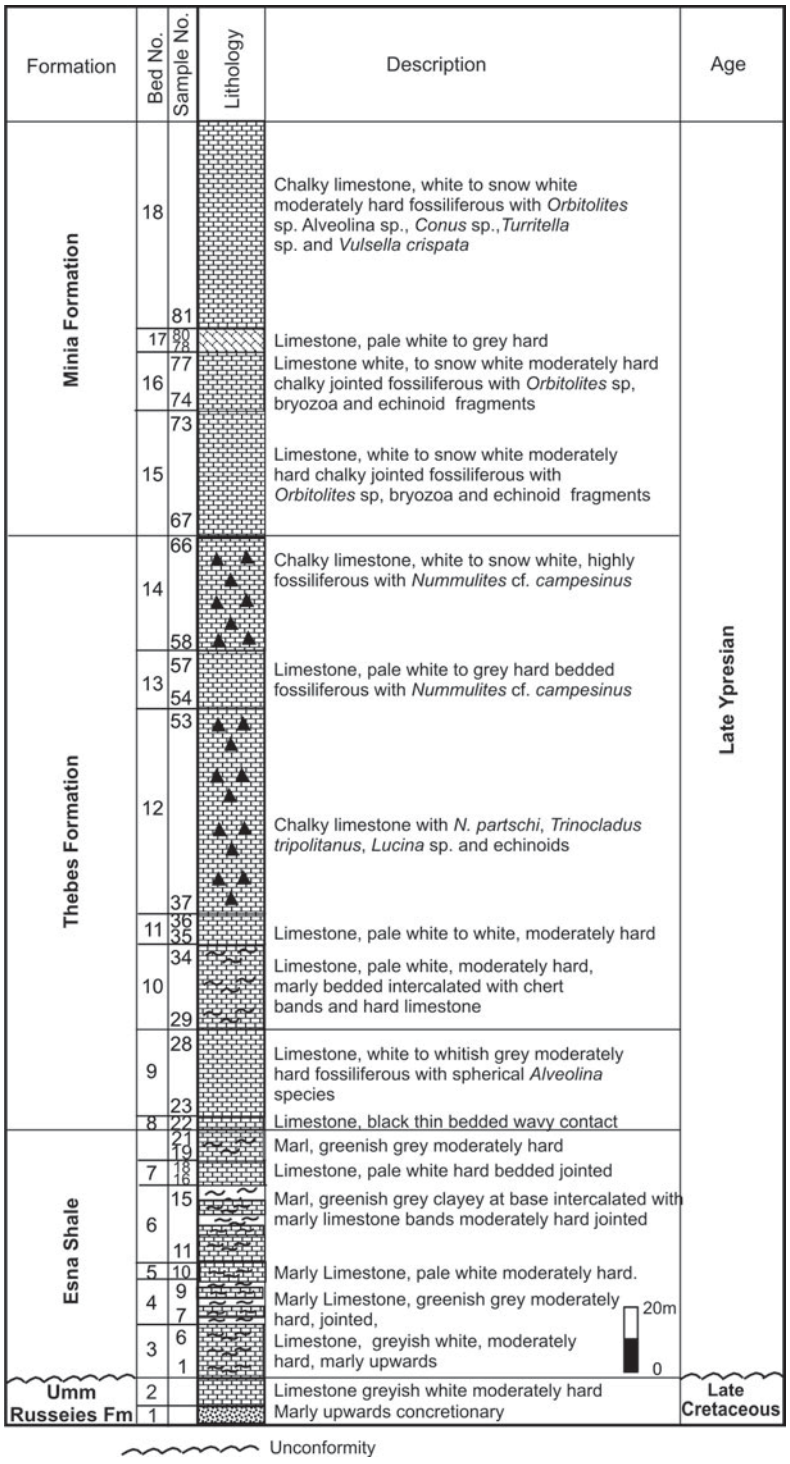

Figure 5: Stratigraphic section measured south of Wadi Naoz (section no. 4).

Shale Formation. It consists of laminated to thinly bedded fine grained limestone and chalk with scattered chert nodules. The middle member is 100–125 m thick, thinly bedded chalk with nodular limestone interbeds, rich with large benthonic foraminifera. The upper member reaches a maximum thickness of 50 m at Gebel Shaghab. It consists of interbeds of oyster-limestone and oyster shell-debris with *Alveolina* limestone.

In the study area, SADEK (1926) mentioned that the Lower Eocene in El Galala El Bahariya composed of clastic sediments in the lower part, whereas its upper part is a carbonate, which is quite different from the Nile Valley sequence. SAID (1962, 1990) later stated that the Farafra Formation in the north and south Galala is rich in Alveolinid fauna of Early Eocene age. ABDALLAH et al. (1971) recorded 48 m of sandy dolomitic bands rich in alveolinids, operculines and nummulitids overlying the chalky limestone of the Sudr Formation at Gebel Thelmet in the northeastern part of Southern Galala Plateau and named it the Southern Galala Formation SCHEIBNER et al. (2002).

Here, the Thebes Formation is classified lithological into lower, middle and upper members based on lithological and biological characters, that are as follows:

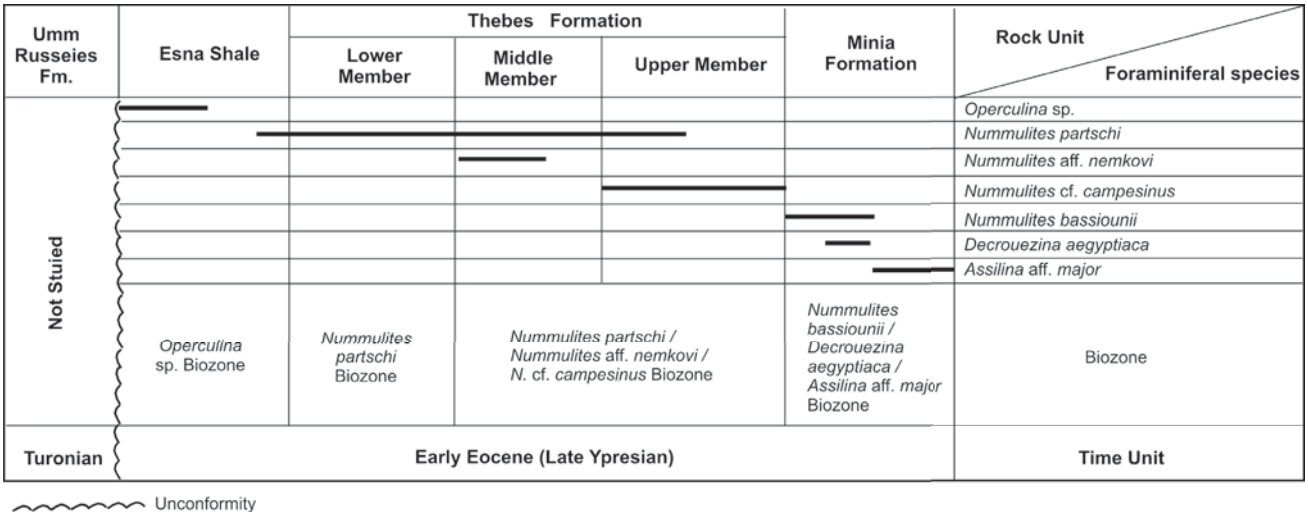

Figure 6: Distribution of larger foraminifera in the study area.

The Lower Member: This member is composed of white to pale white limestone and marl to marly limestone of yellowish white color, slightly hard, with rare chert nodules in the upper part. There are many horizons crammed with *Nummulites partschi*, *Nummulites* aff. *nemkovi*, small and medium sized *Orbitolites* and small specimens of *Lucina*. The thickness of this horizon ranges from 25 to 40 m and increases towards the western side of the study area. At the base of the Thebes Formation, Alveolines have been found southwest of Wadi Naoz (sections 3 and 4 respectively).

The Middle Member: This member is composed of a sequence of well bedded, white or cream limestone, with poorly lithified bands of chalky to marly limestone, rich with chert bands and nodules. It is also characterized by the cyclic presence of hard bands of limestone about 30–50 cm thick, and is overlain by thinner (10–15 cm) soft bands of a chalky to marly limestone. The top part is made of chert band; each band attains a thickness of a 5 to 8 cm including *Nummulites partschi* and rare medium to large sized *Nautilus* sp. The thickness of this member ranges from 50–90 m, increasing towards the west. The maximum thickness occurs at Wadi Ogila (90 m).

The Upper member: This is represented by massive white to snow white chalky limestone, and massive, hard to moderately hard limestone. Near the top, the member contains many bands full of *Nummulites* cf. *campesinus* SCHAUB, *Orbitolites* sp., Bryozoa, Pelecypods (*Lucina* sp., *Vulsella* sp. and *Ostrea* sp.), Gastropods (*Natica* sp., *Trochus* sp., *Turritella* sp.), and Echinoids.

The nummulitic limestone member measures about 100, 147, 115 and 132 m at sections 1, 2, 3 and 4 respectively. In the west at Wadi Oliga the member reaches its maximum thickness 160 m, whereas the thickness of this member is reduced to the East, measuring 80 m at Wadi Haroz.

2.3. The Minia Formation

In the studied area, the Minia Formation comformably overlies the Thebes Formation. It occupies the topmost part of the scarp face of El Galala El Bahariya as well as outcropping over the surface of the plateau. The formation is well exposed at Gebel Umm Russeies and extends beyond the study area. It also crops out on the western side of Wadi Naoz. The formation is composed of white to snow white limestone at the base, intercalated with dolomitic limestone in the middle which increases in thickness upwards where it is interbedded with thin beds of limestone and chalky limestone. This part of the section is very rich in larger foraminifera (Nummulites), algae and macrofossils. The following species were identified from this part of the formation: *Nummulites bassiounii* BOUKHARY & BLONDEAU, *Decrouezina aegyptiaca* (CUVILLIER), *Assilina* aff. *major* HEIM, *Orbitolites* sp., *Carolia fischeri* STROUGO, *Vulsella crispata* FISCHER, large size *Turritella* sp., *Natica* sp., *Trochus* sp. and *Pterolucina monosulcata* (STROUGO) and long *Alveolina* cf. *frumentiformis*.

The Minia Formation yields *N. bassiounii*, *D. aegyptiaca*, and *A.*aff. *major*.

The total thickness of this part of the sequence reaches 150 m in section 2, 90 m in section 3 and 170 m in section 4.

3. BIOSTRATIGRAPHY

The distribution of the different species of the larger foraminifera mainly (*Nummulites* and *Operculina*) in the studied succession of the studied area had enabled the identification of 4 biostratigraphic zones. These matched well with SBZ 10 to SBZ 12 of the Standard Shallow Benthic Zones of SERRA-KIEL et al. (1998). Figure 6 shows the distribution of the larger foraminifera in the studied area and the identified biostratigraphic zones, from top to base, as follows:

4. *Nummulites bassiounii/Decrouezina aegyptiaca/Assilina* aff. *major* Zone
3. *Nummulites partschi*/*Nummulites cf.campesinus*/*N.* aff. *nemkovi* Zone
2. *Nummulites partschi*
1. *Operculina* sp. Zone

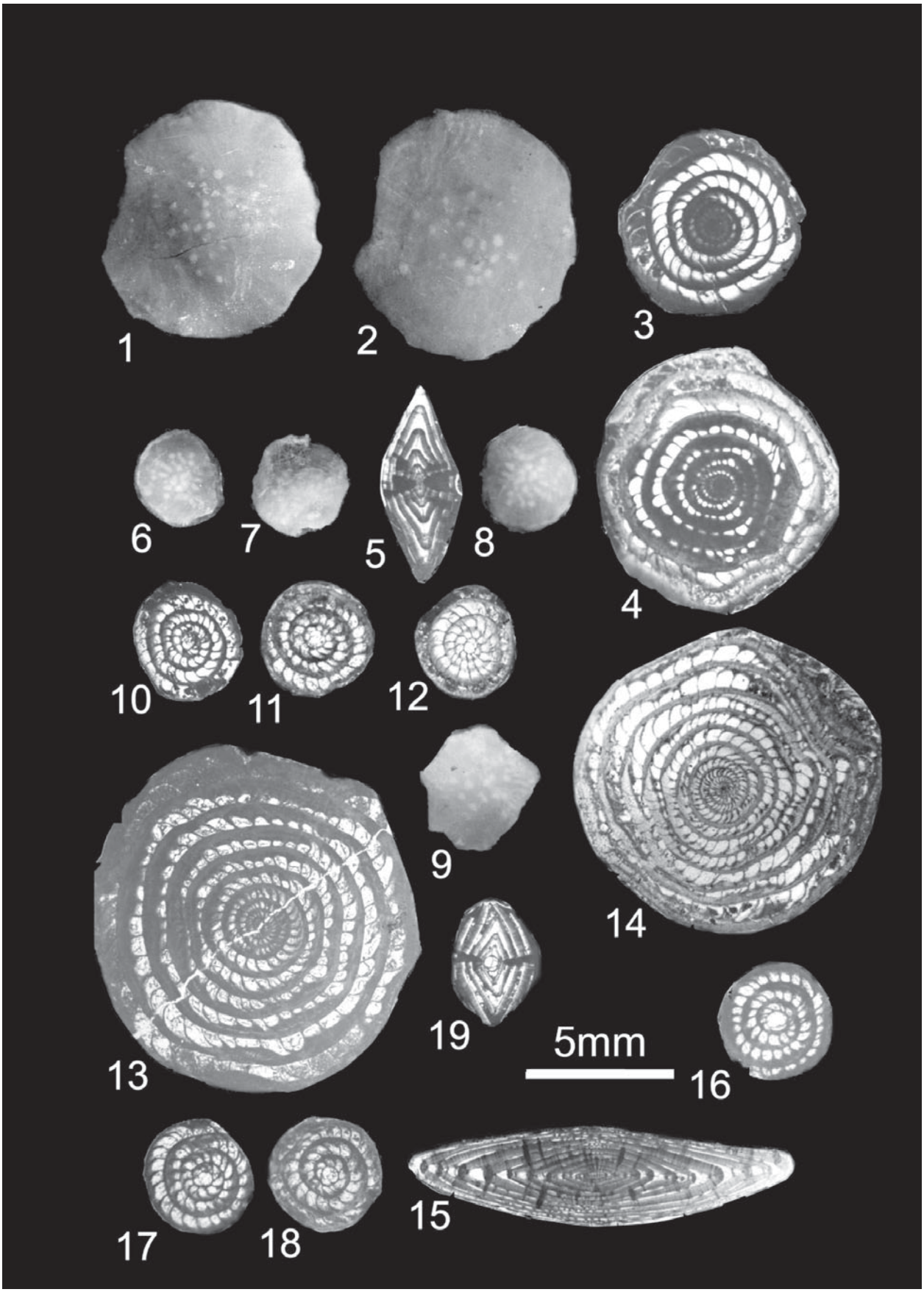

Plate 1
1–19 *Nummulites partschi* DE LA HARPE
1–12 Sample 22, Bed 8, Gebel Umm Russeies (section no. 1); Depository 22822–22833.
13–19 Sample 30, Bed 10, Gebel Umm Russeies (section no. 1); Depository 301034–301045.

Table 1: Measurements of *Nummulites partschi* (this study) in comparison with *Nummulites partschi* described by SCHAUB (1981).

Character	*Nummulites partschi* (after SCHAUB, 1981)	*Nummulites partschi* (this study)
	A-Form	
Diameter	2.2–4.7 mm	2.5–4.5 mm
Thickness	1.1–2.5 mm	1.5–2.6 mm
Granulation	granules condensed coarse and spirally arranged	granules concentrated in the polar region in juveniles, sometimes spirally arranged
Number of whorls and radius	3–4 whorls in a radius of 0.9–1.4 mm	3 whorls in 1.26–1.54 mm and 4 whorls in a radius of 1.75–1.89 mm
Protoconch size	0.3–0.6 mm	0.35–0.49 mm
	B-Form	
Diameter	5–13 mm	6.5–13.2 mm
Thickness	1.8–4.5 mm	2.8–3.3 mm
Granulation	granules on the whole surface of the test	granules concentrate only on the polar region
Number of whorls and radius	11 whorls in a radius of 5–5.3 mm and 13 whorls in a radius of 6 mm	8 whorls in a radius of 3.5 mm, 9 whorls in a radius of 3.99 mm 10–12 whorls in 5.06–6.72 mm

These bio zones are assigned to the Late Ypresian following the scheme of SCHAUB (1981) and SERRA-KIEL et al. (1998).

Depository: The material is deposited in the collection of BOUKHARY, Department of Geology, Faculty of Science, Ain Shams University, Egypt.

3.1. The Morphological Characteristics of Nummulitids Taxonomy

Superfamily Nummulitacea DE BLAINVILLE, 1827
Family Nummulitidae DE BLAINVILLE, 1825
Genus *Nummulites* LAMARCK, 1901
Type species: *Nummulites laevigatus* (BRUGUIERE) [*Camerina laevigata*, BRUGUIERE, 1792]
***Nummulites partschi* Group**
***Nummulites partschi* DE LA HARPE, 1880**
(Pl. 1, Figs. 1–19)

1880 *Nummulites partschi* DE LA HARPE, p. 33, pl. III/I, figs. 1–7(B)
1880 *Nummulites oosteri* DE LA HARPE, pl. 38, pl. III/II, fig. 1–6(A)
1951 *Nummulites partschi* DE LA HARPE – SCHAUB, p. 140, fig. 12, 159–183; pl. 3, fig.16–18; pl. 4, fig. 1–9, 13–15
1981 *Nummulites partschi* DE LA HARPE – SCHAUB, p. 108, figs. 80, 87; pl. 28, figs. 1–20; pl. 29, figs. 1–14, tab. 5/c

Microspheric Form (B-Form): Form lenticular or flat, slightly irregular rounded or truncated periphery, granulation visible on the surface especially near the periphery sometimes granules arranged on or between the septal filaments, surface with radial septal filament or curved diameter 6.5–13.2 mm, thickness 2.8–3.3mm.

Equatorial Section: With the characteristics of the *Nummulites partschi* group, the septa are inclined, particularly near the outer marginal cord, Spire more or less regular and loosly coiled laxer toward the periphery, marginal cord relatively thick and regular, approximately, 1/5th of the height of the whorls, septa straight and slightly curved or inclined, chamber quadrangular in the centre, while isometric in the centre becoming elongated (length greater than height) near the periphery.

Number of whorls in relation to the radius is as follows: 8 whorls in a radius of 3.5 mm, 9 whorls in a radius of 3.99 mm and 10 to 12 whorls in a radius of 5.6 to 6.72 mm.

Megalospheric Form (A-Form): Form lenticular more or less inflated, truncated or rounded pillars arranged around the centre. Diamater: 2.5–4.5 mm, thickness: 1.5–2.6 mm, number of whorls v. radius; 3 whorls in a radius of 1.26 mm to 1.54 mm and 4 whorls in a radius of 1.75–1.89 mm. Protoconch size ranges from 0.35 mm to 0.49 mm.

Remarks: Our species compares well with *Nummulites partschi*. It differs from *N. burdigalensis cantabricus* SCHAUB as being much larger and loosly coiled coiling (Table 1).

Nummulites partschi as mentioned in SCHAUB (1981) has a wide distribution in the Tethyan Province and is a guide species for the Ypresian. According to SCHAUB (1981), *Nummulites partschi* lays in the phylogenetic series between *Nummulites ornatus* "Upper Ilerdian" and *Nummulites tauricus* DE LA HARPE (Middle to Upper Cuisian).

Stratigraphic distribution: This species is recorded from the Thebes Formation of all the studied sections. In the stratigraphic section no. 1, it is recorded from Beds 8, 10 and 11. In the stratigraphic section 2, the species is recorded from Beds 3 and 8. In the stratigraphic section no. 3, the species is recorded from Beds 4, 8 and 9 and in the stratigraphic section no. 4 the species occurs in from Bed 12.

Age: Late Ypresian.

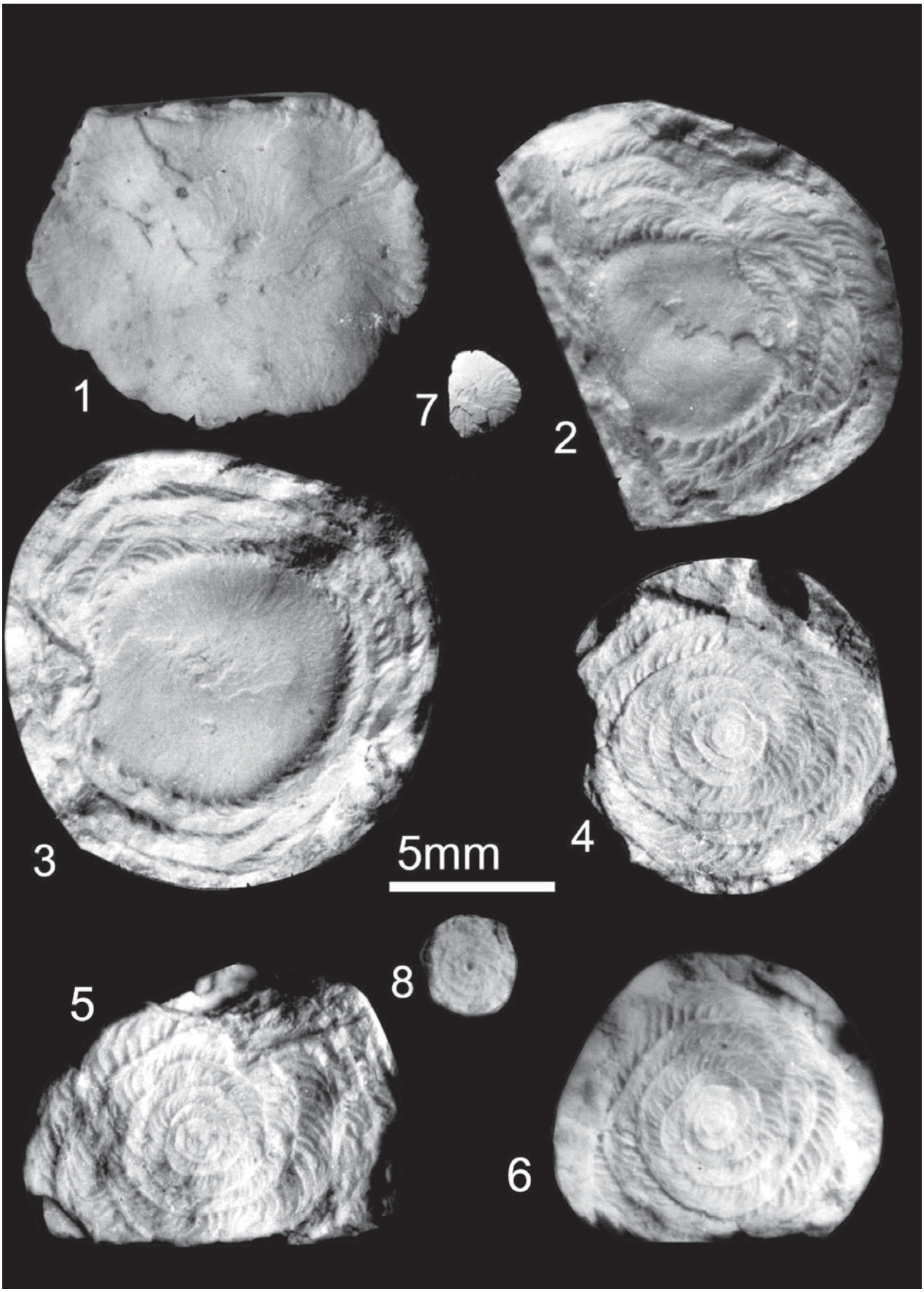

Plate 2
1–8 *Nummulites* aff. *nemkovi* SCHAUB, sample 24, Bed 9, Gebel Umm Russeies (section no. 1); Depository 2491–24914.

***Nummulites distans* Group**
***Nummulites* aff. *nemkovi* SCHAUB, 1966**
(Pl. 2, Figs. 1–9)

1961 *Nummulites nemkovi minor* D'ARCHIAC, NEMKOV & BARKHATOVA, p. 63, pl. IV, figs. 5–11

1966 *Nummulites nemkovi* SCHAUB sp. nov. – SCHAUB, p. 297, fig. 2

1981 *Nummulites nemkovi* SCHAUB, 1966, p. 183, fig. 108; pl. 66, figs. 6, 7, 20–31, 36, tab. 12/e

Microspheric Form: (B-Form): Form lenticular, flat with polar thickening, or somewhat planar with an undulating periphery, surface more or less smooth. Pillar can be seen only within the internal whorls when the external whorls are exfoliated, septal filaments curved or S-shaped and irregular, marginal cord rather thick. Diameter ranges from 17.3 to 18.5 mm and thickness from 2.1 to 2.5 mm.

Equatorial Section: Spire and septa are of the same character as the *Nummulites archiaci-pratti* group, the curved and broadly arched number of whorls v. radius is as follows: 13 whorls in a radius of 8.68 mm, 9 and 10 mm and 14 whorls in a radius of 9.60 mm.

Megalospheric Form (A-Form): Form lenticular, flat, septal filaments radial to undulate. A few granules occur around the centre. Diameter ranges from 3.8 to 5.5 mm, thickness is 1–1.5 mm.

Equatorial Section: Spire and septa exhibit the characteristics of the *Nummulites archiaci-pratti* group, number of whorls v. radius is as follows: 3 whorls in a radius of 1.8 mm, 4 whorls in a radius of 1.8 mm and 5 whorls in a radius of 2.8 mm. Protoconch size ranges from 0.5 to 0.57 mm.

Remarks and differences: *Nummulites* aff. *nemkovi* is compares and matches well with the description and figures given in SCHAUB (1981) except for a small difference in thickness, which seems to be lower in the present material. It is larger than *N. haymanensis* and smaller than *N. kaufmanni and N. distans*.

Stratigraphic distribution: This species is recorded from stratigraphic section no. 1, Bed 9 and 4 and in stratigraphic section no. 2, Bed 4.

Age: Late Ypresian.

***Nummulites burdigalensis* Group**
***Nummulites* cf. *campesinus* SCHAUB, 1966**
(Pl. 3, Figs. 1–14)

1966 *Nummulites campesinus* nov. sp. – SCHAUB (1966a), p. 361, figs. 3k–n; figs. 4, 5; pl. 1, figs. 22–27; pl. II, figs. 1–15

1973 *Nummulites campesinus* SCHAUB – KAPELLOS, p. 77, figs. 162–170; pl. 47, figs. 1–9; pl. 48, figs.1–4

1974 *Nummulites campesinus* SCHAUB – PAVLOVEC in CIMERMAN et al., p. 66 et 20, pl. 17, 18

1976 *Nummulites campesinus* SCHAUB – RAHAGHI & SCHAUB, p. 773, pl. III, figs. 1–6

1981 *Nummulites campesinus* SCHAUB – SCHAUB, p. 83, figs. 72, 74, 81; pl. 7:23–44; pl. 8:1–22; pl. 9:1–20; tab. 2: g, h

Microspheric Form (B-Form): Test lenticular to flat, septal radial or S-shape and wrinkled in a few specimens, granulated with granules covering the whole surface of the test. Diameter ranges from 5.8 to 9.8 mm, thickness is 1.8–3.1 mm.

Equatorial Section: Spire regular, as in the *Nummulites burdigalensiss* group, test lenticular with a more or less rounded periphery, marginal cord rather thick, number of whorls v. radius is as follows: 12 whorls in a radius of 4.3 mm and 13 whorls in a radius of radius 4.6 mm.

Megalospheric Form (A-Form): Form biconical lenticular thick in the middle of the test; surface with radial septal filaments or curved with developing granules in the pole. Diameter ranges from 2.5–3.6 mm, thickness is 1.0–1.9 mm.

Equatorial Section: Spire as in form B is regular with the character of *Nummulites burdigalensis* group. Number of whorls v. radius is as follows: 5 whorls in a radius of 1.4–1.8 mm, protoconch size ranges from 0.25 to 0.35 mm.

Remarks: *Nummulites* cf. *campesinus* is a primitive stage of *N. campesinus* SCHAUB; it falls into the lower part of the dimensional range of this species.

Stratigraphic distribution: Several occurrences of this species are recorded from the Thebes Formation, stratigraphic section no. 1, Beds 18 and 19; stratigraphic section no. 2, Beds 8, 9 and 10, stratigraphic section no. 3, Bed 10, and stratigraphic section no. 4, Beds 13 and 14.

Age: Late Ypresian.

Table 2: Comparison between *Nummulites* cf. *campesinus* and *Nummulites campesinus* (measurements from SCHAUB, 1981).

Character	*Nummulites cf. campesinus* SCHAUB (this study)	*Nummulites campesinus* SCHAUB (from SCHAUB, 1981)
	B-Form	
Diameter	5.8–9.8 mm	5–12 mm
Thickness	1.8–3.1 mm	3–5 mm
No. or whorls v. radius	12–13 per radius 4.4–4.6 mm	11 whorls in 2.5–4.2 mm and 15 whorls in 2.4 to 4.6 mm
Granulation	granulated	granulated
	A-Form	
Diameter	2.5–3.6 mm	4–5 mm
Thickness	1.0–1.9 mm	2.5 mm
No. of whorls v. radius	5 whorls in a radius 1.4–1.8 mm	4–5 whorls in a radius of 1.7–2.0 mm
Protoconch size	0.25–0.35 mm	0.35–0.45mm

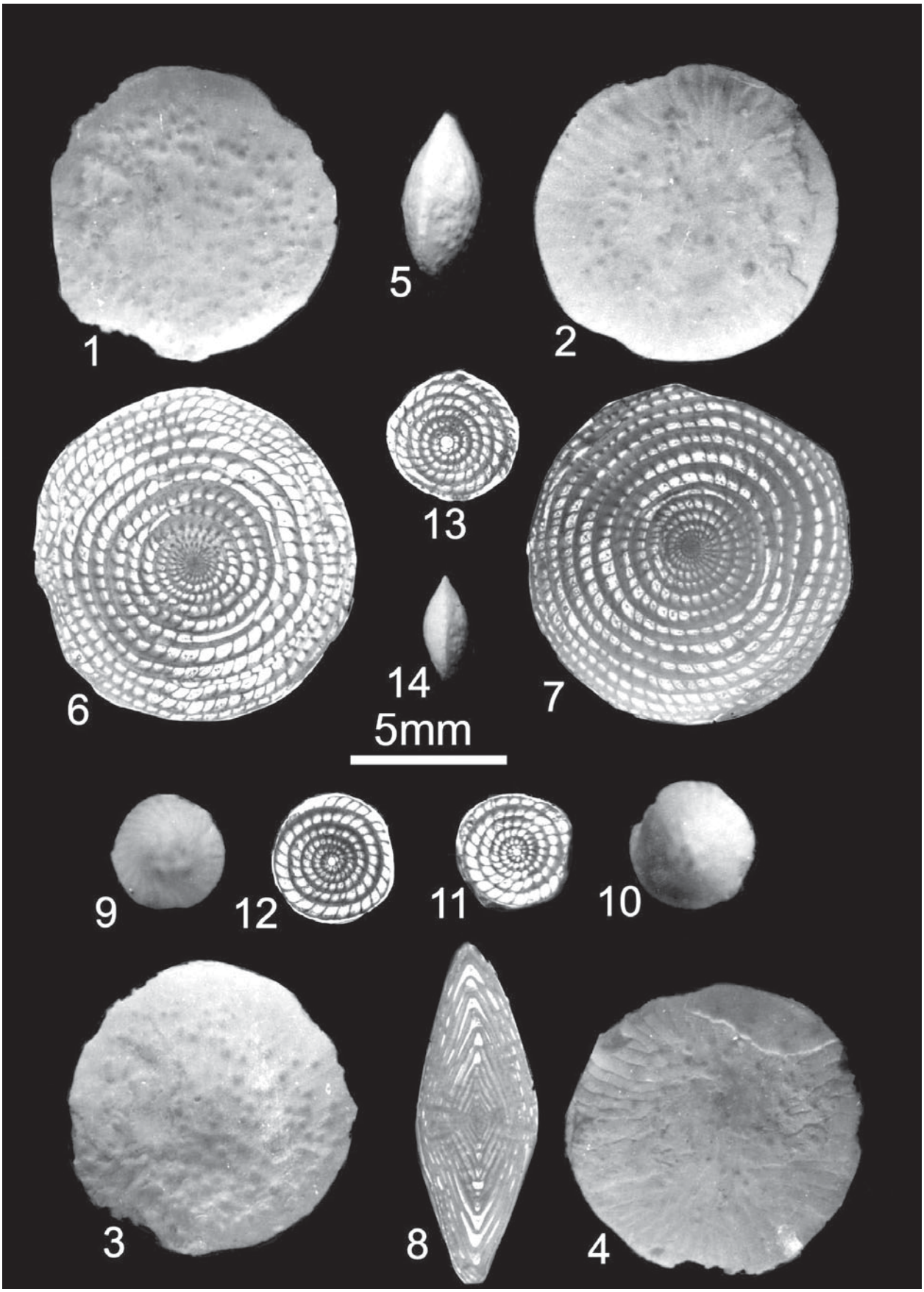

Plate 3
1–14 *Nummulites* cf. *campesinus* SCHAUB, sample 65, Bed 14, south of Wadi Naoz (section no. 4); Depository 65141–651414.

***Nummulites subramondi* Group**
Lineage of *Nummulites perplexus* SCHAUB, 1981
***Nummulites bassiounii* BOUKHARY & BLONDEAU, 1991**
(Pl. 4, Figs.1–14)

1883 *Nummulites lucasana* obsolete – DE LA HARPE, p. 208, pl. 4, figs. 11–14, Form-A (non *N. obsolete* DE LA HARPE, 1877), p. 824, pl. XL, figs. 8a, b)

1991 *Nummulites bassiounii* – BOUKHARY & BLONDEAU, p. 23, fig. 5 (1–9), (with the listed synonymy)

Microspheric Form (B-Form): Test of medium size, lenticular with truncated subangular margin, granulated in juveniles and non granular in adults as in this generation the granulation is a regressive feature. Septal filaments radial, S-shaped to broadly meandering or wrinkled. Diameter ranges from 8.5 mm to 16.2 mm and thickness ranges from 3 to 6 mm.

Equatorial section: Spire regular and the septa are typical of the *Nummulites subramondi* group, curved at the base while perpendicular at the top. Number of whorls against the radius: 10–14 whorls in a radius of 5.5–6.25 mm and 15–17 whorls in a radius of 6.30–7.7 mm.

Megalospheric Form (A-Form): Test small, lenticular to biconical with radial septal filaments slightly twisted at the pole. A few small granules on the pole are observed. Diameter ranges from 3.0 to 4.0 mm, thickness ranges from 1 to 2 mm. Number of whorls v. radius: 4 whorls in a radius of 1.7 to 1.89 mm. Protoconch diameter ranges from 0.49 to 0.6 mm.

Remarks: *Nummulites bassiounii* BOUKHARY & BLONDEAU (1991) was believed to be the ancestral form of *Nummulites perplexus* SCHAUB (1981). Both of these are related to the *Nummulites subramondi* group.

Stratigraphic distribution: It occurs in the Minia Formation stratigraphic section no. 2, from Bed 15 and section no. 3 from Bed 13.

Age: Late Ypresian.

Genus: *Assilina* D'ORBIGNY, 1839
Type Species: *Assilina spira* DE ROISSY, 1805
designated by D'ARCHIAC & HAIME, 1853
***Assilina* aff. *major* HEIM, 1908**
(Fig. 5, Figs. 1–10)

aff. 1908: *Assilina granulose* var. *major* HEIM, p. 247, fig. 24e; pl. 6, fig. 26

aff. 1963: *Assilina major* HEIM – SCHAUB, p. 294, fig. 5

aff. 1963: *Assilina major* SCHAUB – PAVLOVEC, p. 474, fig. 35

aff. 1966b: *Assilina major* HEIM – SCHAUB, p. 294, fig. 1

aff. 1974*: Assilina major* HEIM – PAVLOVEC in CIMERMAN et al., p. 56; pl. 10–12; pl. 13, fig. 1

aff. 1976: *Assilina major* HEIM – RAHAGI & SCHAUB, p. 799; pl. 7, figs. 8–10

Microspheric Form (B-Form): Discoidal, slightly undulated and highly granulated near the centre. Diameter ranges from 13 to 17 mm, thickness is 1.2–2.2 mm.

Equatorial Section: In keeping with the characteristics of the *Assilina spira* group, the number of whorls for given radius is as follows: 8 whorls in a radius of 7.35 mm, 6.51 mm, and 6.86 mm and 9 whorls in a radius of 7.1 mm and 7.91 mm.

Megalospheric Form (A-Form): Diameter ranges from 3.5–6.2 mm, thickness is 0.6–1.2. Number of whorls per radius is as follows: 3 whorls in a radius between 1.47–2.83 and 5 whorls in a radius of 2.975 mm, 3.08 mm, 2.94 mm, 3.01 mm and 2.94 mm. Diameter of protoconch ranges from 0.28 mm to 0.42 mm (Table 3).

Stratigraphic distribution: This species is only recorded only from stratigraphic section no. 2, Bed 16.

Remarks: Our species compares well with *Assilina major* of SCHAUB (1981).

Age: Late Ypresian.

Table 3: Comparison between *Assilina major* (this study) and *Assilina major* HEIM, of SCHAUB (1981).

Character	*Assilina major* HEIM (this study)	*Assilina* aff. *major* HEIM in SCHAUB, 1981
	B-Form	
Diameter	13–17 mm	17–26 mm
Thickness	1.2–2.2 mm	1.2–2.5 mm
No. or whorls v. radius	8 whorls in a radius of 6.5–7.0 mm 9 whorls in a radius of 7.1–8.0 mm	10 whorls in a radius of 8.5–11.5 mm 11 whorls in a radius of 10.4–13.0 mm 12 whorls in a radius of 11.9 mm
No. of whorls	8–9 whorls	10–12 whorls
Diameter	Present	Present
	A-Form	
Diameter	3.5–6.2 mm	6–10 mm
Thickness	0.60–1.2 mm	0.8–1.5 mm
No. of whorls v. radius	3 whorls in a radius of 1.5–2.5 mm 5 whorls in a radius of 2.9–4.3 mm	5 whorls in a radius of 3.5–5.0 mm 6 whorls in a radius of 4.5–5.5 mm
Protoconch size	0.28–0.42 mm	0.5–0.9 mm

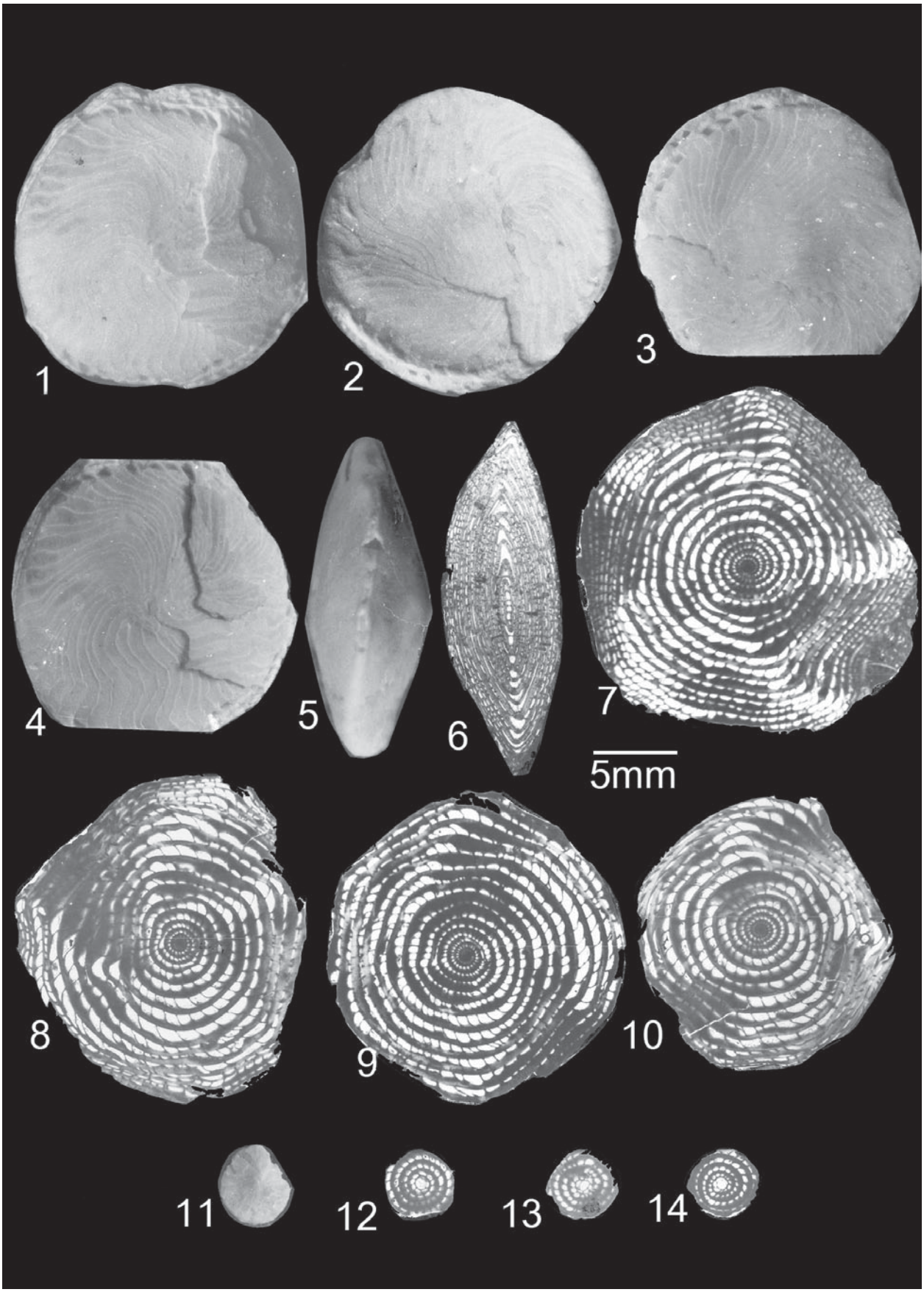

Plate 4
1–14 *Nummulites bassiounii* BOUKHARY & BLONDEAU, sample 47, Bed 13, Gebel Umm Russeies; Depository 741–7414.

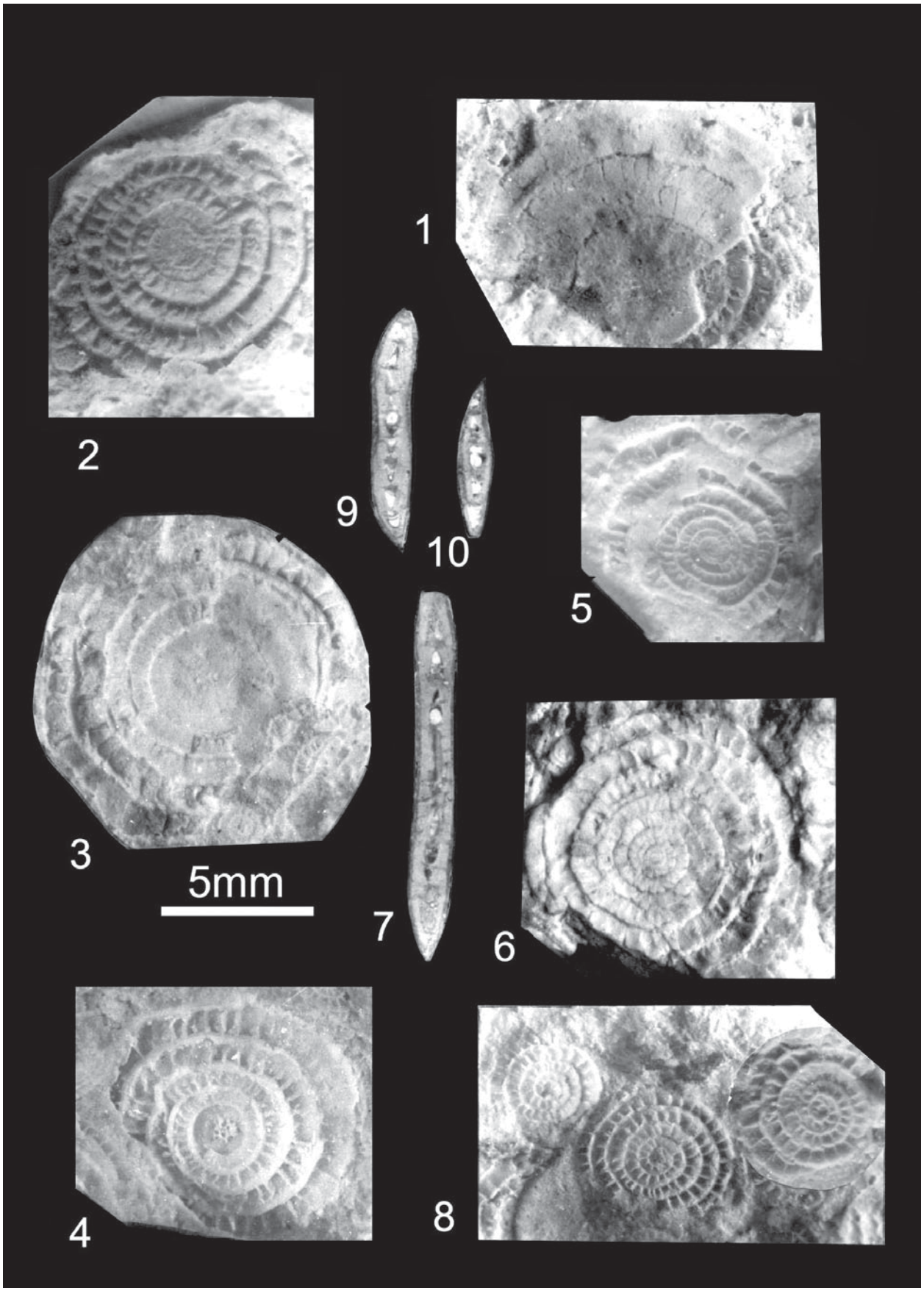

Plate 5
1–10 *Assilina* aff. *major* HEIM, sample 98, Bed. 16 (section no. 2); Depository 98161–981610.

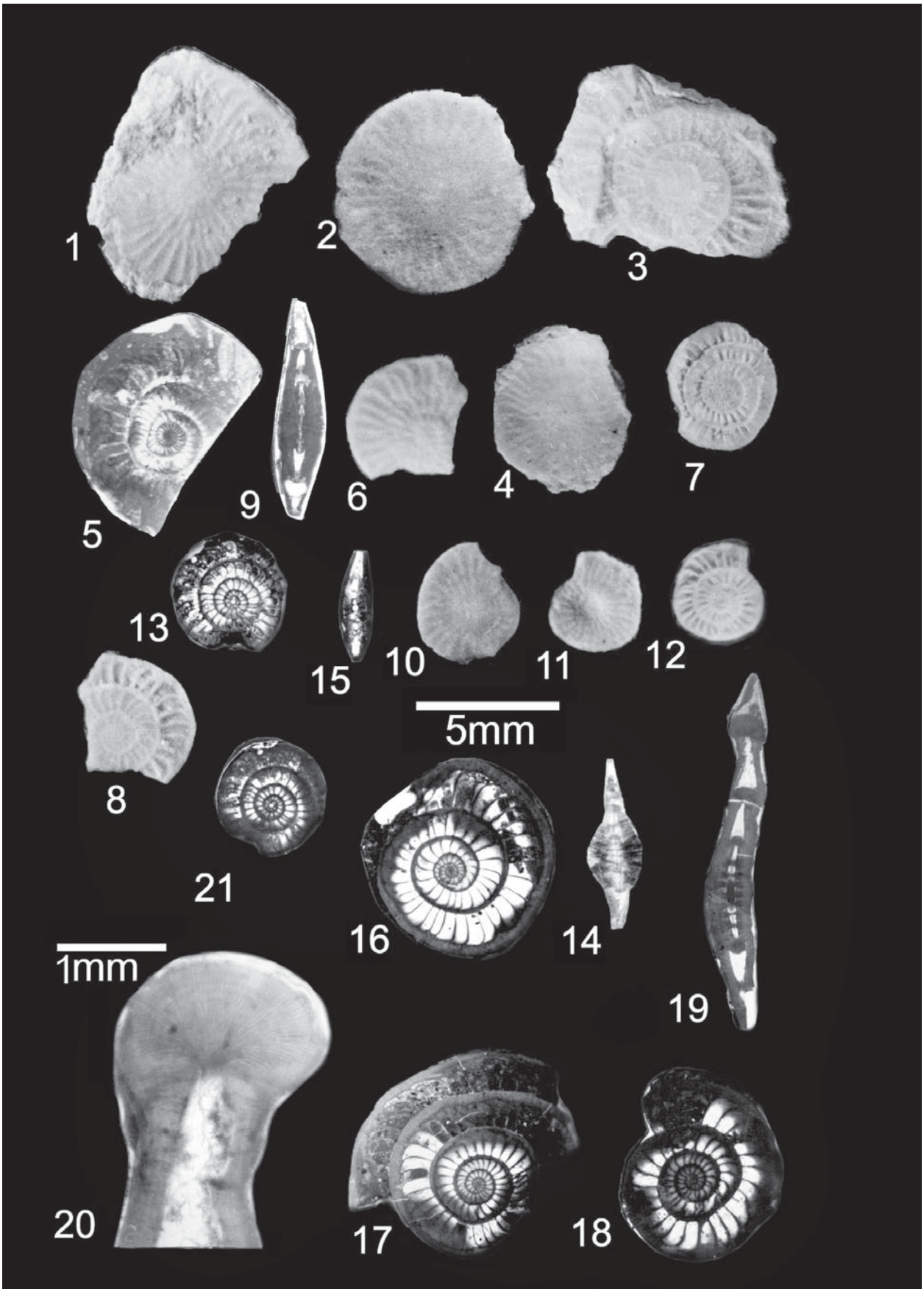

Plate 6

1–15 *Operculina* sp., sample 2, Bed 1, Esna Shale, Gebel Umm Russeies (section no. 3); Depository 211–2115.

16–21 *Decrouezina aegyptiaca* (CUVILLIER), sample 52, Bed 13, southwest of Wadi Naoz (section no. 3); Depository 521316–251321.

Table 4: Comparison between Nummulitic zonations in Paleogene of Crimea with those in Galala Plateau Egypt, (after KAPELLOS, 1973).

Paleogene stratigraphic commission of Soviet Union after BERGGREN (1971)			WADE (1964)	XII Europaeisches mikropalaeontologisches Kolloquium 1971		KAPELLOS (1973)		This study (Northern Galala Plateau, Egypt)	SERRA-KIEL et al. (1998) scheme	Time Unit	
Crimea Bakhchissaray			KRIM NW KAUKASUS	Crimea		Crimea	Stage after HOTTINGER (1960) & SCHAUB (1964)				
BODRAKIAN	*Acarinina rotundi marginata* zone	*Nummulites incrassatus* zone	*Discaster lodoensis* zone	BODRAKIAN unteries	*Acarinina rotundi marginata* zone	*Chiphragmalithus quadratus* zone	Lutetian			Lutetian	
SIMFEROPOLIAN	*Acarinina crassaformis* zone	*Nummulites polygratus* zone		SIMFEROPOLIAN	The small Nummulites zone	*Discaster sublodoensis* zone	Upper Cuisian	*N.bassiounii / Decrouezina aegyptiaca / Assilina* aff. *major* Biozone	*SBZ 12*	Late	Ypresian
	Globorotalia aragonensis caucasica zone	*Nummulites distans* zone			*Nummulites polygyratus* zone						
		Nummulites distans minor zone			*Nummulites distans* zone	*Discaster lodoensis* zone	Middle Cuisian	*Nummulites partschi / N.*aff. *nemkovi / N.* cf. *campesinus* Biozone	*SBZ 11*	Middle	
BAKHCHISARAIAN	*Globorotalia marginodentata* zone	*Assilina placentula* zone	*Discaster lodoensis Marthasterites tribrachiatus* zone	BAKHCHISARAIAN	*Nummulites nemkovi* zone						
	Globorotalia subbotinae zone	*Nummulites crimensis* zone			*Assilina placentula* zone	*Marthasterites tribrachiatus* zone	Lower Cuisian	*Nummulites partschi* Biozone	*SBZ 10*	Early	
	Globorotalia aequa zone	*Operculina semiinvoluta* zone	*Marthasterites tribrachiatus* zone		*Nummulites crimensis* zone						
					Operculina semiinvolu'a zone	*Discaster binodosus* zone	Ilerdien	Not exposed			
						Discaster multiradiatus zone					
KACHIAN	*Acarinina acarinata* zone		*Heliolithus riedeli* zone	KACHIAN	*Acarinina acarinata* zone	*Heliolithus riedeli* zone	Middle Paleocene				
	Acarinina subsphaerica zone				*Acarinina subsphaerica* zone	*Heliolithus kleinpellii* zone					
	Acarinina tadjikistanensis djanensis zone				*Acarinina tadjikistanensis djanensis* zone	*Fasciculithus tympaniformis* zone					

Genus *Decrouezina* BOUKHARY, 1994
***Decrouezina aegyptiaca* (CUVILLIER, 1930)**
(Pl. 6, Figs. 16–21)

1883 *Operculina* cf. *canalifera* D'ARCHIAC – SCHWAGER, p. 144, pl. 19, fig. 3
1930 *Assilina praespira* DOUVILLE var. *aegyptiaca* CUVILLIER, p. 139, pl. 13, fig. 4
1990 *Operculina praespira* var. *aegyptiaca* CUVILLIER – STROUGO et al., p. 64
1994 *Decrouezina aegyptiaca* CUVILLIER – BOUKHARY, p. 97, pl. 1, figs. 1–7

Microspheric Form (B-Form): Test flat with central swelling. Test of medium size, assilinoid in shape with thick marginal cord. Test evolute except for the central part (about 3 whorls) which is involute. Diameter is up to 25 mm, 5–6 whorls in 12 mm.

Megalospheric Form (A-Form): Test small and flat, diameter ranges from 3.7 to 5.5 mm; protoconch ranges from 0.35 to 0.42 mm.

Remaks: *Decrouezina* (type-species: *Assilina praespira* var. *aegyptiaca* CUVILLIER, 1930) was believed by BOUKHARY (1994) as the descendant taxon of *Ranikothalia*, for the presence of common characters between both, such as the thick marginal cord, presence of plexus marginalis. The phylogeny of this group of taxa is from tight open.

Stratigraphic distribution: This species occurs in Gebel Umm Russeies in stratigraphic section no. 3, bed 13.

Age: Late Ypresian.

***Operculina* sp.**
(Pl. 6, Figs. 1–15)

Microspheric Form (B-Form): Test flat loose spire with a rather thick marginal cord. Test granulated and granulation concentrated in the central part of the test. Septa in the last whorl are upright, oblique in the first part. Chambers are high and narrow. Diameter 2.38 to 5.6 mm, thickness: 0.84 to 1.12 mm.

Megalospheric Form (A-Form): Test small, in axial section the first and second chambers are rounded, isolepidine, the middle part is triangular. In equatorial section the septa are perpendicular at the base while arched at the top.

Diameter: 0.63 to 1.62 mm, thickness: 0.21 to 0.77 mm. Protoconch ranges from 0.12 to 0.17 mm.

Stratigraphic distribution: *Operculina* sp. is recorded from the Esna Shale, stratigraphic section no. 3, Bed 1.

Age: Late Ypresian.

Table 4 shows the comparison between the biozones recorded from Gebel Umm Russeies, and Northern Galala with those recorded from the Palaeogene of the Crimea after (KAPELLOS, 1973), and the standard shallow benthic zones (SBZ) identified by SERRA-KIEL et. al., 1998.

4. CONCLUSIONS

At Gebel Umm Russeies, the Ypresian sediments unconformably overlie Upper Cretaceous rock; the Palaeocene is completely missing. However, at Wadi Naot (Northern Galala) a nearby section to the Gebel Umm Russeies study area, the Palaeocene section is well represented between the Upper Cretaceous and the Ypresian units. Further north in the Gebel Ataqa area, the Palaeocene is also missing (OSMAN, 2003).

In the Southern Galala Plateau where the Lower Eocene rocks are exposed, the following foraminifera have been observed: *Nummulites praeatacicus, N. saharaensis* and *Bassiounina sanctipauli* (BOUKHARY et al., 1998). At Gebel Umm Russeies this assemblage is missing, instead the microfauna here includes ?*Operculina* sp. The different faunas in the two locations belong to the same time (Early Ypresian), yet the conditions of deposition varied greatly from a reefal shallow environment in the south hence the flourishing of *Nummulites* to an open platform in the north where these fossils are replaced by ?*Operculina*.

The Gebel Umm Russeies area seems to have been uplifted after the Upper Cretaceous sediments namely the Adabiya Formation were deposited (EL AKKAD & ABDALLAH, 1971) for the whole of the Palaeocene. To the south, the blocks were submerged during this time span hence Palaeocene sediments were deposited. Over many blocks in both the Northern and Southern Galala, the sedimentary basin became more shallow because of infilling by these sediments, hence the environment of deposition of the next sediment (Early Ypresian, Esna Shale) includes shallow marine fauna i.e. *Nummulites* spp. In contrast, at the Gebel Umm Russeies section, the platform was relatively deeply drowned and a different fauna (*Operculina* sp.) flourished.

The Thebes Formation (Ypresian) covers a huge stretch of Egypt to the latitude of 22° 40' in the south. An extensive Tethyian transgression during the Ypresian was recorded over many parts of Egypt. Marine waters transgressed over the Gulf of Suez blocks regardless of their locations. All the blocks are capped by Lower Eocene rocks, representing different environmental conditions, but all belonging to the Ypresian.

At Gebel Umm Russeies, the Thebes Formation is represented by Carbonate beds, partly marly, chalky and dolomitic. Nodular limestones are common – whereas oolites are of limited occurrence.

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