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Biostratigraphy of Palaeocene to Miocene Foraminifera in Concession 65, SE Sirt Basin, Libya

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Highlights

- **Five wells were biostratigraphically examined from the Palaeocene to Miocene sequence in Concession 65, SE Sirt Basin, Libya.**
- **Study of the different foraminiferal faunae allowed the subdivision of the Palaeocene to Miocene sequence in Concession 65 into different foraminiferal zones.**
- **The recovered planktic foraminifera were used to subdivide the Palaeocene into the planktic foraminiferal zones of Berggren *et al.* (1995).**
- **The retrieved larger benthic foraminifera from the Late Palaeocene to Miocene, however, were examined biostratigraphically following the shallow benthic zones (SBZ) of Cahuzac and Poignant (1997) and Serra-Kiel, *et al.* (1998).**

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ABSTRACT

Palaeocene to Miocene planktic and larger benthic foraminifera retrieved from ditch cuttings samples taken from 5 wells drilled in Concession 65, SE of Sirt Basin, Libya, have been studied biostratigraphically.
This study indicates that the Palaeocene sequence is composed of a shale unit overlain by a carbonate unit. The shale unit contains a rich assemblage of planktic foraminifera indicating Early Palaeocene age (Danian Stage), which is equivalent to the planktic foraminiferal zones P1 and P2.
The overlying carbonate unit is Late Palaeocene in age (Selandian-Thanetian) based on the occurrence of several planktic foraminiferal species of the planktic foraminiferal zones P3-P5. The recovery of few species of larger benthic foraminifers from this carbonate unit provides an additional evidence that it was deposited during the Late Palaeocene, corresponding to the shallow benthic foraminiferal biozones SBZ3-SBZ6, which correspond to the (Selandian-Thanetian) stages.
The Early Eocene sequence is mainly barren anhydrites and dolomites with rare badly preserved nummulitids in the Ypresian. The Middle Eocene (Lutetian-Bartonian) limestones contain a nummulitic assemblage with variable species, including *Nummulites gizehensis*/*Nummulites lyelli* group, which represent the SBZ14-SBZ16 in the Lutetian and the SBZ17-SBZ18 in the Bartonian.
The Late Eocene interval is dated on the presence of few reticulate medium-sized nummulitic species, including *Nummulites fabianii*, and assigned to the SBZ19.
The lowermost part of the Oligocene sequence is attributed to the SBZ21 (Rupelian) based on the occurrence of *Nummulites vascus* and *Operculina complanata* in the limestones. This is overlain by the SBZ22 (Chattian), as indicated by the last occurrence of *Nummulites vascus* and the first appearance of *Borelis melo melo* and *Amphistegina* sp. The uppermost deposits of the studied successions, which are mainly sandstones with hardly any fossils, belong to the Miocene.

1. Introduction

Most of the oil production in Libya comes currently from the Sirt Basin, which has received, since the 1950's, a lot of attention in terms of geological and geophysical studies, but micropalaeontological data are relatively few. In this study, the Palaeocene to Miocene intervals of five exploration wells (A1, A2, C13, C14 and C19), drilled by different oil companies in Concession 65, of SE Sirt Basin during the 60's and 90's of last century, have been investigated for their foraminiferal contents. Concession 65 covers a huge area (about 8000 km^2) and broadly located between 27° to 28° N latitudes and 21° to 23° E longitudes (Fig. 1). The Sarir oil field represents the major oil field in Concession 65 where around 100 wells were drilled.

The field went on production in December 1966 at 100.000 bbl/day. Production was gradually increased up to about 330.000 bbl/day in 2010. Almost everywhere, in the Sirt Basin, the late Mesozoic and Tertiary structures developed on a Precambrian and Paleozoic eroded surfaces (Conant and Goudarzi, 1967). According to Sanford (1970), the majority of oil fields are on the horst ridges or high fault edges of the regional tectonic features of the Sirt Basin. Local oil accumulation generally is associated with sedimentary cover and cross-faulting of these main trends. The stratigraphic setting of the study area (Fig. 2) represents the succession throughout the Sirt Basin, although there are some important local variations. The stratigraphic successions penetrated by the studied wells are generally similar, the difference being only the relatively slight thickness variations of individual rock units.

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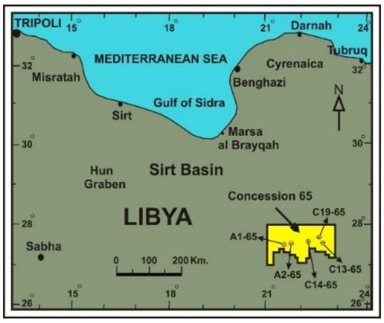

Fig. 1. Location map of Concession 65, SE Sirt Basin, and the studied wells

Previous studies by Sanford (1970), Gillespie and Sanford (1970), Lewis (1990), Ambrose (2000), Ahlbrandt (2001) and Hallett (2002) did help in explaining the geological, structural and development of the petroleum system in the region, but many stratigraphic aspects of the Cenozoic deposits remain poorly understood. Therefore, the objective of this paper is to refine the biochronostratigraphy of the Palaeocene-Miocene deposits in the region, based on planktic and larger benthic foraminiferal assemblages. A brief palaeoenvironmental assessment of the studied sequence was, however, presented by Abdulsamad *et al.*, (2008) and the main results are adopted here. They are summarized in Fig. 2:

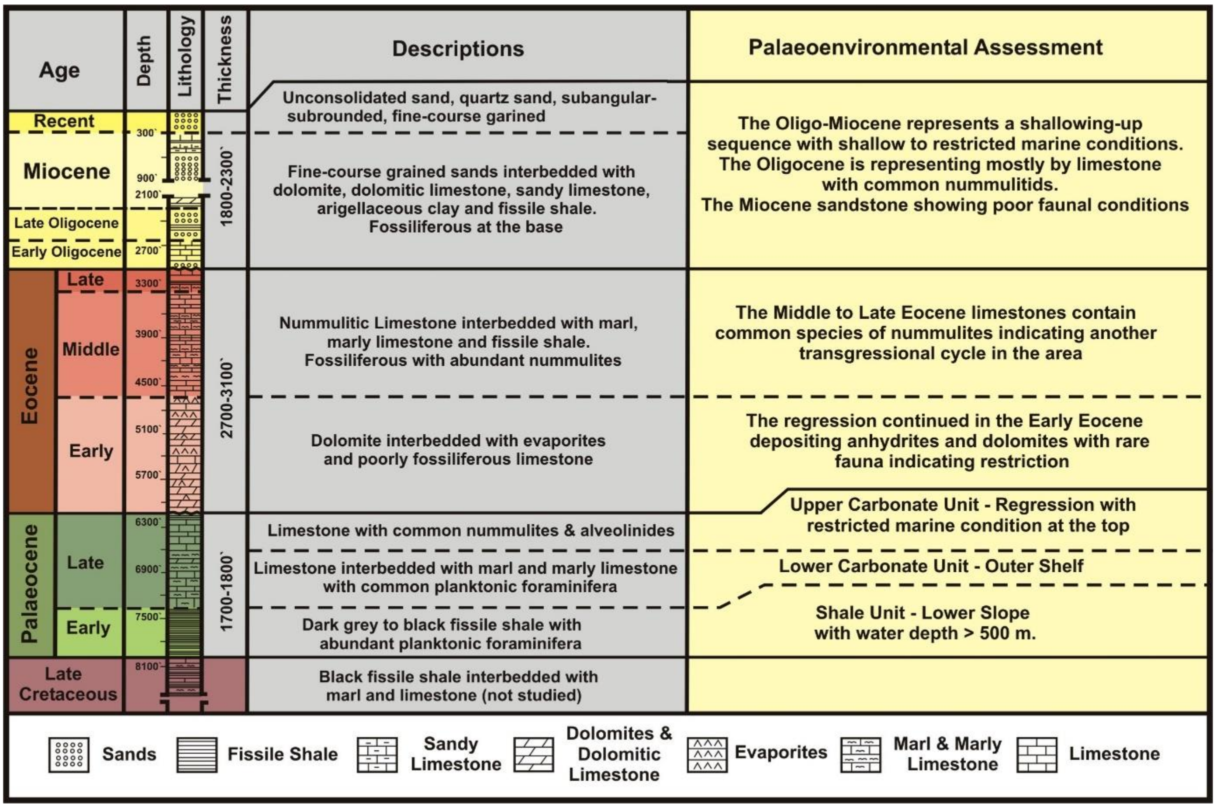

Fig. 2. General stratigraphy of Concession 65.

The Palaeocene sequence consists of a lower shale unit and an upper carbonate unit. The Lower Paleocene shale unit, overlying the Upper Cretaceous shales, contains very abundant deep marine planktic foraminifera indicating water depths in excess of 500 m. lower slope or deeper (Grimsdale and Van Morkhoven, 1955; Tipsword *et al.*, 1966). The carbonates of the lower part of the Upper Palaeocene unit contain rare planktic foraminiferal species with frequent to abundant nummulitic fauna, alveolinids and miliolids in the uppermost part of the Upper Palaeocene carbonates. This is an evidence of marine gradual regression introducing shallow to a restricted marine environment of deposition to the area during the Late Palaeocene time.

The regression continued throughout the Lower Eocene depositing anhydrites and dolomites with few badly preserved benthic microfauna, indicating restriction. The Middle to Upper Eocene limestone contains diverse and common species of nummulites, indicating another transgressional cycle in the area.

The Oligo-Miocene time interval represents a shallowing-up sequence with shallow to restricted marine conditions. Generally, the Oligocene sediments are represented, mostly, by limestone with common nummulitids, particularly at lower levels, whereas the uppermost sediments of the studied successions are mainly Miocene sandstones showing poor faunal habitat conditions. This is suggested by the occurrence of a few badly preserved specimens of alveolinids and miliolids.

2. Materials and Methods

About 350 ditch cuttings samples from five boreholes, provided by the Arabian Gulf Oil Company, were processed for micropalaeontological analysis. All samples were washed through a set of sieves (65-100 µm in diameter). Specimens were identified based on the overall morphology under a stereoscopic microscope and stored in reference slides. Isolated specimens of nummulites, however, were identified based on external and internal morphology. All laboratory analyses were undertaken at the Micropalaeontology Laboratory of the Earth Sciences Department of the Benghazi University, Benghazi, Libya. Scanning Electron Microscope (SEM) Photomicrographs, however, were taken at the Naturalis Biodiversity Center, Leiden, Netherlands.

3. Results and Discussion

To demonstrate the lateral variation of the studied deposits, a correlation of the investigated subsurface sections, based on stratigraphic criteria, is outlined in Fig. 3. Here, the stratigraphic successions penetrated by the wells are generally similar, the difference being only the relatively slight thickness variations of individual rock units. Fig. 4 represents a composite range chart for the studied wells and provides the stratigraphic distribution of most recovered foraminiferal species (Plates 1-6). The results were analyzed to have a biostratigraphic control based on the planktic foraminiferal zones of Berggren *et al.*, (1995) for the Palaeocene sequence. The recovered larger benthic foraminifera from the Late Palaeocene to Miocene were examined biostratigraphically according and assigned to the shallow benthic zones (SBZ) of Cahuzac and Poignant, (1997) and Serra-Kiel, *et al.*, (1998). Despite problems arising from using ditch-cuttings samples, facies changes, stratigraphic gaps, and barren intervals, analyses of the recovered foraminifera indicate that the studied sedimentary rocks show distinctive age-related foraminiferal content that can be described in the following order:

3.1 Palaeocene sequence

The Palaeocene sequence is about 550 m thick in the eastern part of the studied area. It is composed of a shale unit in the lower part overlain by a carbonate unit. The shale is dark grey to black with abundant planktic foraminifera. The recovered fauna from this unit (Fig. 4) includes *Eoglobigerina edita* (Subbotina), *Globoconusa daubjergensis* (Brönnimann), *Subbotina trivialis* (Subbotina), and *Praemurica inconstans* (Subbotina). This assemblage indicates an Early Palaeocene age (Danian Stage). Most of the Danian Stage, however, corresponds to the P1: *Parvularugoglobigerina eugubina-Praemurica uncinata* Interval Zone of Berggren *et al.* (1995). This zone has been subdivided into three subzones (P1a-P1c) based on the chronological appearances of *Subbotina triloculinoides* and *Globanomalina compressa/Praemurica inconstans* (Berggren and Miller, 1988). *Parvularugoglobigerina eugubina* has not been recovered from our samples and consequently the base of P1a zone can not be established. Although, the top of P1a and the base of P1b subzones can be established by the first occurrence datum (FAD) of *Subbotina triloculinoides* and the last occurrences (LAD) of *Praemurica inconstans*, we could not establish the boundary on the distribution chart (Fig. 4) due to caving problems, which make it very difficult to determine first occurrences. A similar conclusion has been reached for the overlying P1c subzone. The remaining time-interval of the Danian Stage is considered belonging to the P2: *Praemurica uncinata-Morozovella angulate* Interval Zone of Berggren *et al.* (1995). The biostratigraphic interval between the FAD of *Praemurica uncinata* and the FAD of *Morozovella angulate* can be recognized in Fig. 4.

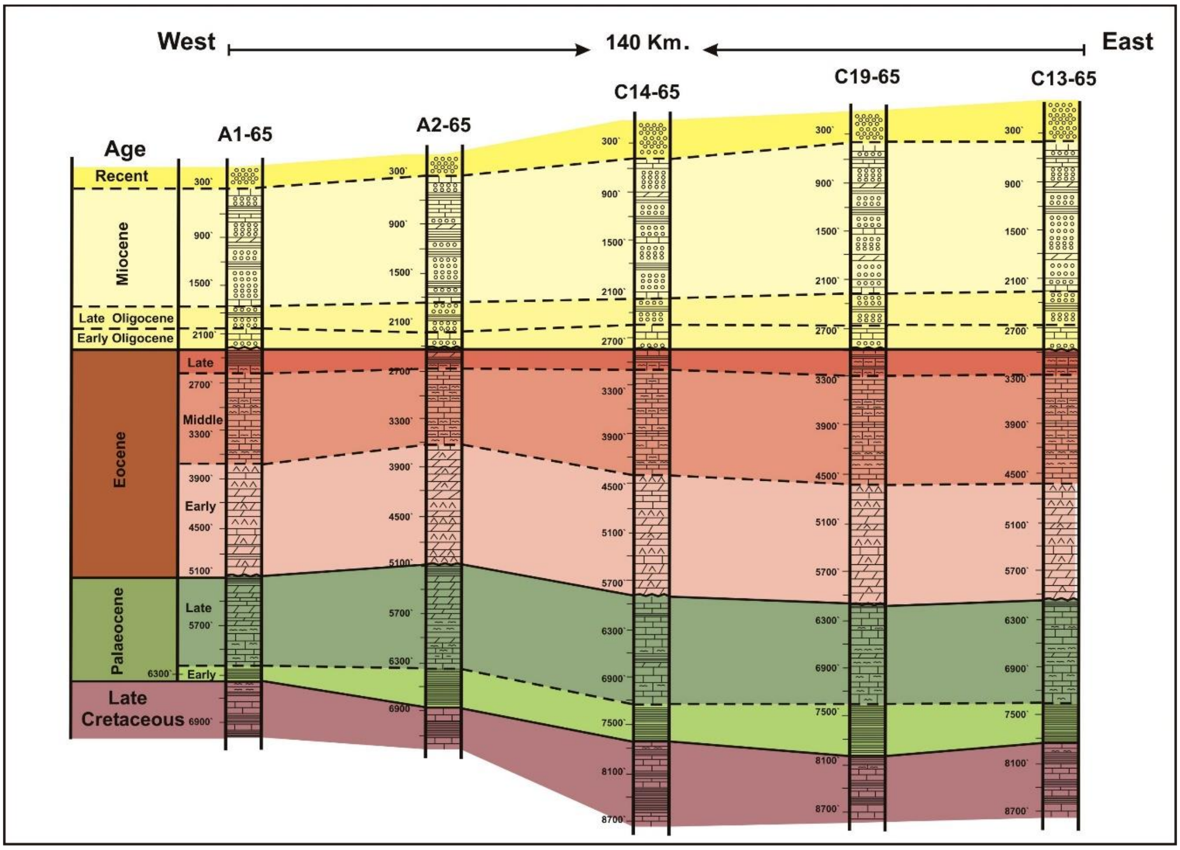

Fig. 3: Correlation chart of the studied w

The upper carbonate unit is mostly limestone interbedded with dolomite, dolomitic limestone and marl. This carbonate unit is considered here as Late Palaeocene based on the recovery of several planktic foraminiferal species including *Morozovella angulata* (White), *Igorina pusilla* (Bolli), *Globanomalina ehrenbergi* (Bolli), *Morozovella apanthesma* (Loeblich & Tappan), *Globanomalina chapmani* (Parr), *Morozovella parva* (Ray), *Morozovella aequa* (Cushman & Renz), *Acarinina soldadoensis* (Brönnimann), *Subbotina triangularis* (White), *Morozovella velascoensis* (Cushman) and *Morozovella subbotinae* (Morozova). This assemblage indicates broad Late Palaeocene age (Selandian-Thanetian). The Selandian Stage is equivalent to P3: *Morozovella angulata-Globanomalina pseudomenardii* Interval Zone of Berggren *et al.* (1995). The zone has been subdivided traditionally into a lower (a) subzone and an upper (b) subzone based on the (presumed) FAD of *Igorina pusilla* in the lower third of the biostratigraphic interval by Berggren and Miller (1988). Currently, the subdivision of zone P3 is based on FAD of *Igorina pusilla* descendant form *Igorina albeari* (= *Igorina pusilla laevigata*), which occurs about midway within Zone P3. This occurrence has been used to define the existing subdivision of Zone P3 (Berggren and Norris, 1993). Since we did not recover the latter species from our samples, we are not able to subdivide zone P3.

The Thanetian Stage corresponds to the P4: *Globanomalina pseudomenardii* Total Range Zone and P5: *Morozovella velascoensis* Interval Zone of Berggren *et al.* (1995). *Globanomalina pseudomenardii* has not been recovered and consequently no criteria can be used to recognize zone P4. The last occurrence of *Morozovella velascoensis* and associated planktic taxa has been used to establish the upper limit of the Late Palaeocene (see Fig. 4). The Early/Late Palaeocene boundary, however, has been established based on the last occurrence of *Praemurica inconstans* and the first appearance of *Morozovella angulata*.

The recovery of few species of larger benthic foraminifera, such as *Ovalveolina primaeva* (Reichel), *Chordoperculinoides* cf. *georgianus* Cole & Herrick, and *Nummulites deserti* de la Harpe from the upper carbonate unit are quite significant and provide additional evidence that the deposition was during the Late Palaeocene. This assemblage of larger foraminifera belongs to the Selandian-Thanetian stages and corresponds to the shallow benthic foraminiferal biozones SBZ3 to SBZ6 of Serra-Kiel *et al.* (1998). The total range of *Ovalveolina primaeva* (see Fig. 4) which corresponds approximately to the upper part of the Selandian and the lower part of the Thanetian stages defines the biozone SBZ3. According to Serra-Kiel *et al.*, (1998) the stratigraphic range of *Nummulites deserti* in the Tethyan realm is confined to biozones SBZ5 and SBZ6 which correspond to the uppermost Thanetian and lowermost Ypresian (Early Eocene). The presence of this species below this stratigraphical interval reflects the problem of ditch cuttings samples and the consequent contamination by caving. A similar conclusion has been noted for *Chordoperculinoides* cf. *georgianus*. According to Haynes *et al.* (2010), the latter species indicates an age close to the Palaeocene/Eocene boundary.

3.2 Eocene sequence

The Eocene sequence is 820-945 m thick. The Early Eocene interval consists of evaporates interbedded with some dark grey shale, off-white limestone and dolomites. The biotic components of this interval have low diversity and contain several fragments of small inflated, lenticular to biconical nummulites. This stratigraphic level has been dated broadly, as Early Eocene (Ypresian Stage) based on its stratigraphic position, since no taxa can be identified at species level. The boundary between the Early and Middle Eocene has been established based on the first occurrence of *Nummulites gizehensis* group (Fig. 4). The Middle Eocene interval, however, is represented by nummulitic and argillaceous limestone and marl. It carries numerous species of nummulites, including *Nummulites gizehensis* (Forskål), *Nummulites lyelli* d'Archiac & Haime, *Nummulites cyrenaicus* Schaub, *Nummulites beaumonti* d'Archiac & Haime, *Nummulites discorbinus* (Schlotheim) and *Nummulites bullatus* Azzaroli. This assemblage indicates Lutetian-Bartonian stages, which correspond to SBZ14-SBZ18 of Serra-Kiel *et al.* (1998). In general, the occurrences of *Nummulites gizehensis* and *Nummulites bullatus* in the lower and middle parts of the studied sections are indicative of the SBZ14-SBZ16 of Serra-Kiel *et al.* (1998). *Nummulites discorbinus* and *Nummulites beaumonti* have been also recovered from the same stratigraphic interval. The last occurrence of *Nummulites gizehensis* and first occurrences of *Nummulites lyelli* mark the contact between the Lutetian Stage (SBZ16) and Bartonian Stage (SBZ17). The boundary between Middle and Late Eocene (Bartonian/Priabonian), however, is defined by the last occurrences of *Nummulites lyelli* and *Nummulites cyrenaicus* and the first appearance of *Nummulites fabianii* (Fig. 4).

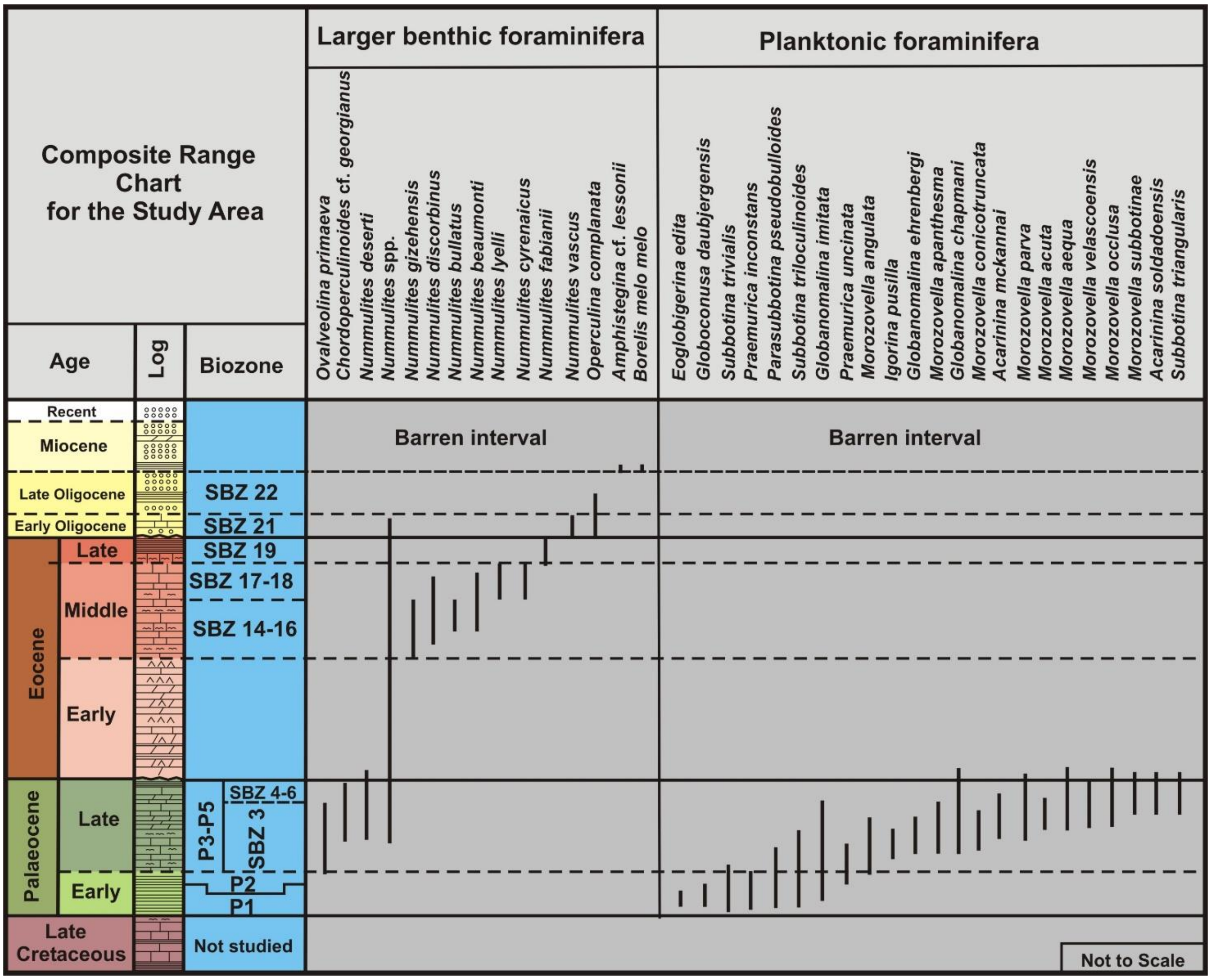

Fig. 4. Composite foraminiferal range chart for the studied area.

The Late Eocene is reduced (<90 m thick) throughout the studied subsurface sections and consists of interbedded limestone, dolomite, marl and shale. The sequence has been dated on the presence of a few medium sized and reticulate nummulites. The Eocene/Oligocene boundary is defined by the last stratigraphic occurrence of *Nummulites fabianii* and the first stratigraphic appearance of *Nummulites vascus* Joly & Leymerie (Fig. 4). This boundary (see Fig. 3) has been selected as a datum for correlation in Concession 65 since it coincides with high levels of gamma radiation on the studied logs.

3.3 Oligocene-Miocene sequence

The Oligo-Miocene sequence is up to 800 m thick in the eastern part of the studied area, and consists of sands interbedded with some limestones, dolomites, shales, and clays. The Early Oligocene interval, however, is condensed (<90 m thick) and defined based on the total range of *Nummulites vascus*. *Operculina complanata* (Defrance) is also present, but has no stratigraphic value in this time-interval. According to Cahuzac and Poignant (1997), SBZ21 can be determined based on the occurrence of *Nummulites vascus* and *Nummulites fichteli*. Although, the latter taxon has not been recovered in the current research, the studied deposits have been tentatively assigned to SBZ21. This biozone corresponds to the Rupelian Stage and can be correlated with Berggren's *et al.* (1995) P18-P21a zones. The overlying deposits have been assigned tentatively to SBZ22 (Chattian). The Lower boundary of this zone is defined based on the last occurrence of *Nummulites vascus*, while the upper boundary (Oligo-Miocene boundary) is based on the first appearance of *Borelis* sp, (Fig. 4). The washed samples from the Oligocene period yield also several small benthic foraminifera of Oligocene to Miocene age, such as *Gyroidina soldanii* (d'Orbigny), *Textularia schencki* Cushman & Valentine and *Cancris oblongus* (Williamson).

The uppermost studied deposits belong to the Miocene period due to the occurrence of few badly preserved specimens of *Borelis melo melo*, *Amphistegina* sp and *Eliphidium* cf. *crispum* (Linnaeus) (Fig. 4). The stratigraphical distribution of the genus *Borelis* ranges from Eocene to Holocene (Jones *et al*., 2006). In the Miocene, however, the genus is largely distributed in the Mediterranean province and essentially represented by *Borelis melo melo* (Fichtel & Moll). Based on the stratigraphic data provided by Jones *et al.*, (2006), one can conclude that *Borelis melo melo* (Fichtel & Moll) is abundant from the Middle Miocene deposits of the Mediterranean region, whereas this subspecies is infrequent from the Upper Miocene in the same region (see Betzler and Schmitz, 1997). *Borelis melo melo* (Fichtel & Moll) has been observed in Libya by Berggren (1967) and Sherif (1991) from the Middle Miocene Al Khums Formation (northwest Libya), by Abdulsamad and Bu-Argoub (2006) from Ar Rajmah Group (northeast Libya) and more recently by Abdulsamad and El Zanati (2013) from the same rock units in the southeast of Benghazi City.

4. Conclusions

About 350 ditch cuttings samples from five wells were biostratigraphically examined from the Palaeocene to Miocene sequence in Concession 65, SE Sirt Basin, Libya. Study of the different foraminiferal faunae retrieved from these ditch cuttings allowed the subdivision of the Palaeocene to Miocene sequence in these five wells into different foraminiferal zones. The planktic foraminifers allowed subdividing the Palaeocene into the planktic foraminiferal zones of Berggren *et al.* (1995). The recovered larger benthic foraminifera from the Late Palaeocene to Miocene, however, were examined biostratigraphically following the shallow benthic zones (SBZ) of Cahuzac and Poignant (1997) and Serra-Kiel, *et al*. (1998).

The planktic foraminiferal taxa recovered from the Early Palaeocene interval (Danian) represent the planktic foraminiferal zones P1 and P2, whereas the Late Palaeocene (Selandian-Thanetian) foraminiferal taxa represent the planktic foraminiferal zones P3-P5 and the shallow benthic foraminiferal biozones SBZ3-SBZ6.

The Eocene sequence is represented mainly by *Nummulites gizehensis-Nummulites lyelli* group and has been ascribed to the SBZ14-SBZ16 in the Lutetian and the SBZ17-SBZ18 in the Bartonian.

The Late Eocene interval, however, has been dated based on the presence of *Nummulites fabianii* and ascribed to the SBZ 19.

The Oligocene sequence has been attributed to the SBZ 21 (Rupelian) and to the SBZ 22 (Chattian) based on *Nummulites vascus* and associated taxa. The uppermost deposits of the studied successions belong mostly to the Miocene with hardly any fossils.

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Explanation of plates 1-6

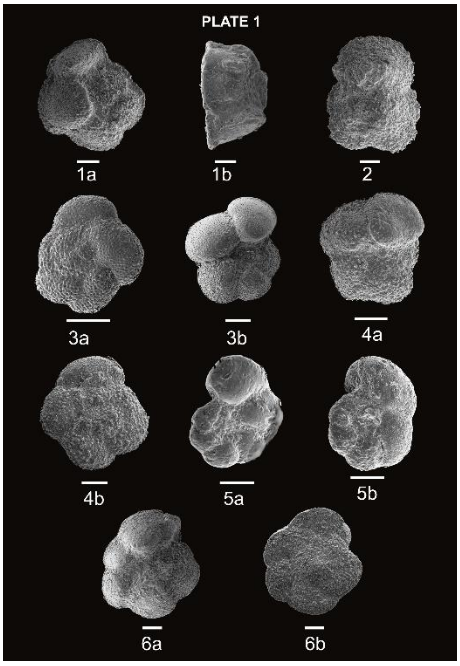

Plate 1 (Scale bars for all figures represent 100 µm; depths are in feet):
1a-1b: *Morozovella acuta* (Toulmin), 1a-umbilical view, 1b-side view - sample C13-65: 6650′
2: *Morozovella aequa* (Cushman & Renz), umbilical view - sample C19-65: 7450′
3a-3b: *Morozovella angulata* (White), 3a-Spiral view, 3b-umbilical view - sample C19-65: 7700′
4a-4b: *Morozovella apanthesma* (Loeblich & Tappan), 4a-umbilical view, 4b-spiral view - sample C19-65: 7450', 4b- sample C13-65: 6560′
5a-5b: *Globanomalina chapmani* (Parr), 5a-5b oblique Spiral views - sample C19-65: 7900′
6a-6b: *Morozovella conicotruncata* (Subbotina), 6a-umbilical view, 6b-spiral view - sample C19-65: 7450′

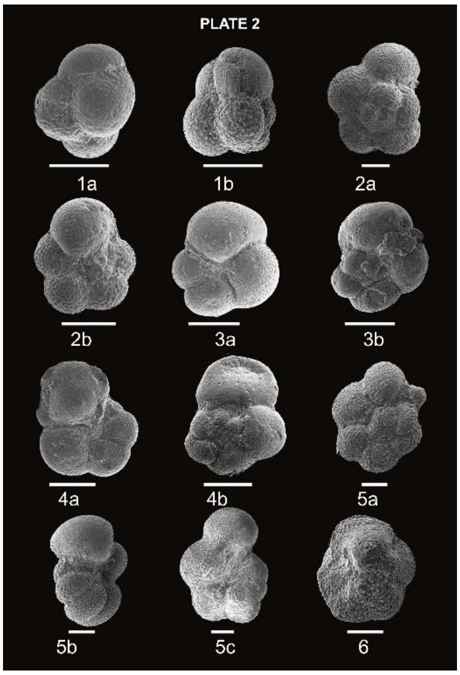

Plate 2 (Scale bars for all figures represent 100 µm; depths are in feet):
1a-1b: *Globoconusa daubjergensis* (Brönnimann), 1a-tilted umbilical view and 1b-side view of the same specimen - sample C19-65: 8010-70′
2a-2b: *Eoglobigerina edita* (Subbotina), 2a-spiral view, 2b-umbilical view - sample C19-65: 8010-70′
3a-3b: *Globanomalina imitata* (Subbotina), 3a-umbilical view - sample C19-65: 8010-70′; 3b-spiral view, sample A1-65: 6134′
4a-4b: *Globanomalina ehrenbergi* (Bolli), 4a-umbilical view - sample C19-65: 8000', 4b-spiral view, sample C19-65: 8010-70′
5a-5c: *Praemurica inconstans* (Subbotina), 5a-spiral view, 5b-side view, 5c-umbilical view - sample C19-65: 8000′
6: *Igorina pusilla* (Bolli), umbilical view, sample C19-65: 7700′

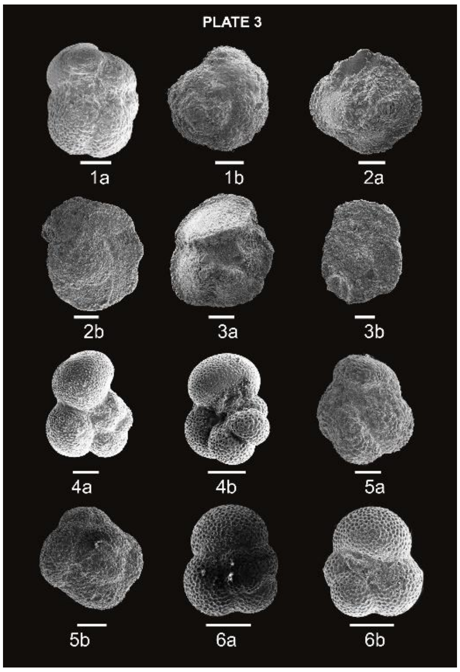

Plate 3 (Scale bars for all figures represent 100 µm; depths are in feet):
1a-1b: *Acarinina mckannai* (White), 1a-umbilical view, 1b-spiral view - sample C13-65: 7190′
2a-2b: *Morozovella occlusa* (Loeblich & Tappan), 2a-umbilical view, 2b-spiral view - sample C19-65: 7450′
3a-3b: *Morozovella parva* (Ray), 3a-umbilical view - sample C19-65: 7200’, 3b-spiral view, sample C13-65: 6650′
4a-4b: *Parasubbotina pseudobulloides* (Plummer), 4a-spiral view - sample C19-65: 8000’, 4b-tilted umbilical view, sample C19-65: 7550′
5a-5b: *Acarinina soldadoensis* (Brönnimann), 5a-umbilical view - sample C19-65: 7350’, 5b-spiral view, sample C19- 65: 7450′
6a-6b: *Subbotina trivialis* (Subbotina), 6a-spiral view, 6b-umbilical view, sample -C19-65: 7700′

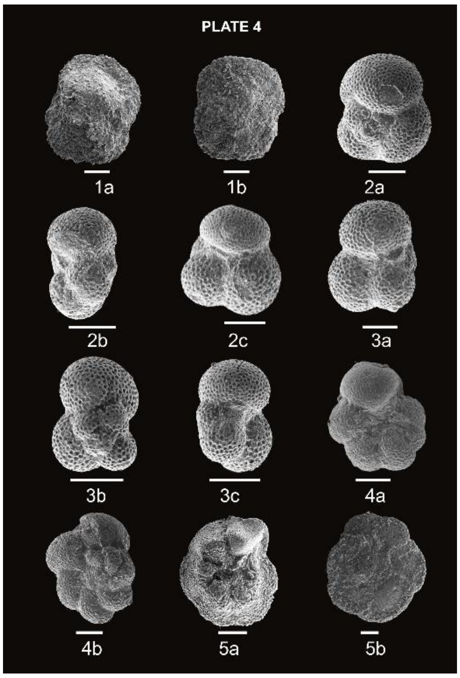

Plate 4 (Scale bars for all figures represent 100 µm; depths are in feet):
1a-1b: *Morozovella subbotinae* (Morozova), 1a-umbilical view - sample C19-65: 7350′ 1b-spiral view, sample C13-65: 6650′.
2a-2c: *Subbotina triangularis* (White), 2a- spiral view, 2b-side view, 2c-umbilical view - sample C19-65: 8010-70′.
3a-3c: *Subbotina triloculinoides* (Plummer), 3a-umbilical view, 3b-spiral view - sample C19-65: 8010-70′, 3c-side view - sample C19-65: 7300′.
4a-4b: *Praemurica uncinata* (Bolli), 4a- umbilical view, 4b-spiral view - sample C19-65: 8000′.
5a-5b: *Morozovella velascoensis* (Cushman), 5a-umbilical view, 5b-spiral view - sample C19-65: 7550′.

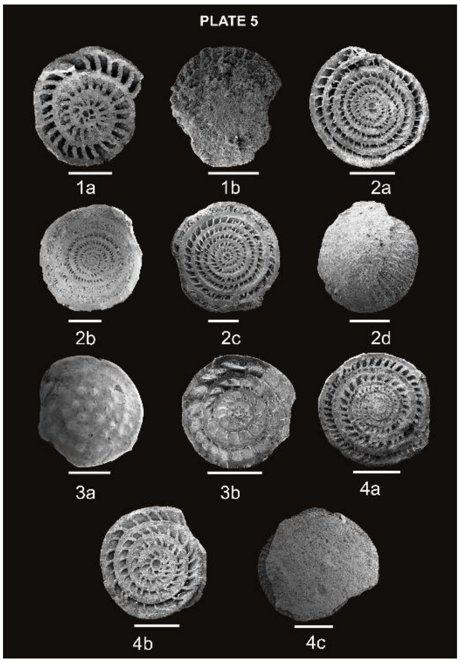

Plate 5 (Scale bars for all figures represent 1mm; depths are in feet; all sections are natural):
1a-1b: *Chordoperculinoides* cf. *georgianus* Cole & Herrick, equatorial section and surface of A-forms - sample C13-65: 6900′.
2a-2d: *Nummulites beaumonti* d' Archiac & Haime, 2a, 2c-equatorial sections of A- forms, 2b-equatorial section of B-form, 2d-surface of A-form, all from core sample A2-65: 2791-2806′
3a-3b: *Nummulites bullatus* Azzaroli, 3a- surface of A-form - sample C19-65: 3900′, 3b-equatorial section of A-form sample C19-65: 3650′.
4a-4c: *Nummulites cyrenaicus* Schaub, 4a, 4b- equatorial sections of B- and A-forms, 4c-surface of B-form, all from sample A1-65: 3527′ (core sample).

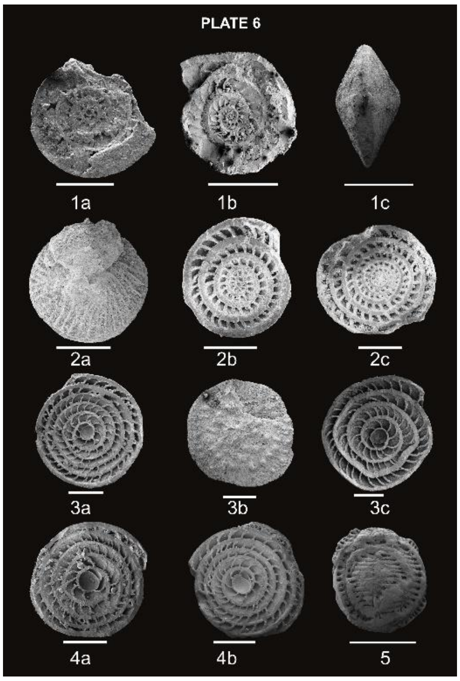

Plate 6 (Scale bars for all figures represent 1mm; depths are in feet; all sections are natural):
1a-1c: *Nummulites deserti* de la Harpe, 1a- equatorial section of A-form - sample A1-65: 6300′, 1b-equatorial section of B-form, 1c-axial view of A-form, both from sample C13-65: 6560′.
2a-2c: *Nummulites discorbinus* (Schlotheim), 2a, 2b-surface, and equatorial section of A-forms, 2c-equatorial section of B-form, all from core sample A1-65: 3593′.
3a-3c: *Nummulites gizehensis* (Forskål), 3a, 3c-equatorial sections of A-forms - sample A2-65: 3690′, 3b-surface of A-form, sample C13-65: 4400′.
4a-4b: *Nummulites lyelli* d 'Archiac & Haime, equatorial sections of A-forms - sample A2-65: 3490′.
5: *Ovalveolina primaeva* (Reichel), partly broken specimen - sample C13-65: 6700′.