

Paleocene rotaliid benthic foraminifera of Jabal Mundassa, Al Ain area, United Arab Emirates

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Abstract

The micropaleontological taxa of Jabal Mundassa, Al Ain area, United Arab Emirates (UAE) indicates that the Paleocene succession bears prolific and well preserved benthic foraminifera index-species of the Danian, and its succession is considered the only outcrop that has Danian sediments in the Al Ain area, and most complete Danian rocks in UAE. The Danian succession is attributed to the shale marl neoautochthonous sediments belong to Mundassa Member (MM) of the Muthaymimah Formation (MF), which are unconformably overlying the pre-Maastrichtian allochthonous Semail Ophiolite (SO, serpentinites and serpentized peridotites). Forty six rotaliid benthic foraminiferal species belonging to twenty six genera are identified from fourteen samples collected from the Paleocene succession of the Mundassa section. Based on the planktic foraminiferal zonation, the duration of the hiatus at the Cretaceous/Paleogene (K/P) boundary includes the two early Danian biozones (P0 and Pa, about 0.02 Ma). This depositional gap is most probably due to submarine erosion (not to subaerial denudation), and correspond to an interval of tectonic activity that exists in most localities in the Middle East and other sites in the world.

In current study, an attempt is made to identify the rotaliid Danian calcareous benthic foraminifers of the Mundassa section, and it is possible to illustrate twenty eight of them in two plates (1, 2), for the first time, with some additional remarks on paleontology, stratigraphy and paleogeography in the UAE and other Tethyan localities.

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Keywords: Rotaliina, foraminifera, Danian, Paleocene, Mundassa, Al Ain area, United Arab Emirates, Tethys.

1. Introduction

The Late Maastrichtian to Paleogene post nappe rocks outcrop as a discontinuous belt in jabals (mountains) and qarns (hills) around the western front of the Northern Oman Mountains (NOM) in the United Arab Emirates (UAE). The folded anticlines of Jabal Mundassa and J. Malaqet in Al Ain area are a part of the (NOM) and located approximately 25 km due south of Al Ain city (UAE), and about 20 km to the east of J. Hafit (Figure 1). These jabals outcrops on the eastern side of the Al Jaww Plain, near the border with the Sultanate of Oman. The pre-Maastrichtian Semail Ophiolite Nappe (SO, gabbro and serpentinites) forms the core of the breached anticline of J. Mundassa and J. Malaqet. In the last stage of the emplacement of the SO onto the passive continental margin of the Arabian platform, several foredeep basins (Ras Al Khaima Basin and Mundassa Basin) were developed on the northwestern flank of the NOM. These basins hosted deposition of upper Cretaceous–Paleogene sedimentary successions, which unconformably overlying sequences were later deformed by thrust faults and folds in that time. The previous works of Nolan et al. (1990), Hamdan and Anan (1993), Anan and Hamdan (1992, 1993), Anan (1993a,b, 1995, 1996, 2015a,b, 2016, 2019b), Warrak (1996), Noweir and Eloutefi (1997), Boukhary et al. (2003) are pertinent to the present study. Current study in the Mundassa area aims to elucidate the paleontology and

paleogeography during the Danian and correlated with other Danian successions inside and outside of the UAE.

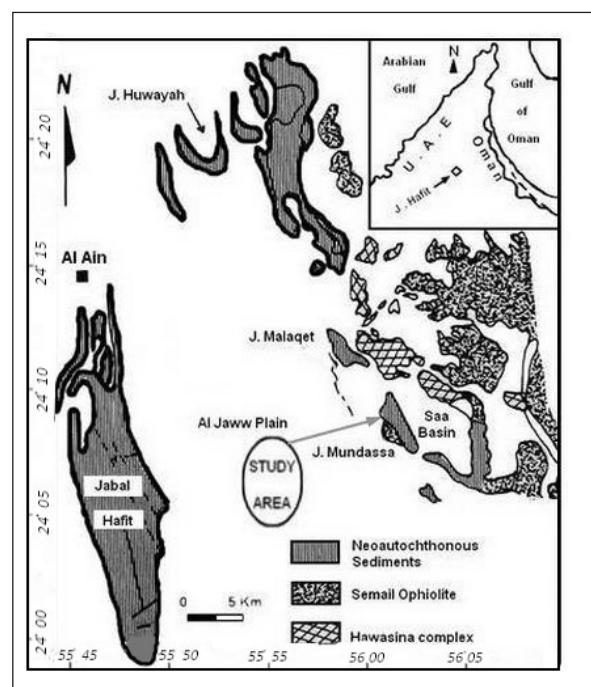


Figure 1. Location of the study section at Jabal Mundassa, Al Ain area, UAE.

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2. Geology and stratigraphy

The Paleocene post-nappe shaley marl sediments of J. Mundassa are attributed here to the Danian, but to the Late Paleocene by Noweir and Eloutefi (1997), while to the Early-Middle Paleocene based on the planktic foraminiferal biozonation (after Berggren and Pearson, 2005). On the other hand, the green shale in J. Malaqet (which unconformably overlies the Late Maastrichtian Simsima Formation, not SO) was attributed to the Middle Paleocene (Hamdan and Anan, 1993; Anan and Hamdan, 1993 and Anan, 1993a), or the Late Paleocene (Noweir and Eloutefi, 1997, and Boukhary et al., 2003).

During the last stage of the emplacement of the Semail Ophiolite onto the passive continental margin of the Arabian platform, some foredeep basins were developed including the Ras Al Khaima basin, in the north of UAE (Alsharhan and Nairn, 1995), and the Mundassa basin in the south (Anan, 2015a). These basins hosted deposition of a Paleocene sedimentary sequence, which is an unconformably overlying sequence that deformed later by thrust faults and folds. The Danian rocks are attributed to the shaley marl neoautochthonous sediments belong to the Mundassa Member (MM) of the Muthaymimah Formation (MF), which are unconformably overlying the Pre-Maastrichtian allochthonous SO. In current study, 46 rotaliid benthic foraminiferal species are recorded, and 28 of them are illustrated in Plates (1, 2) from the Danian (Early Paleocene, P1a-P3a) of the shaley marl succession in J. Mundassa.

Based on the planktic foraminiferal biozones (Anan, 2016), the duration of the hiatus at the Cretaceous/Paleogene (K/P) boundary includes the two earliest Danian biozones (P0 and Pa), about 0.02 Ma (Figure 2). This depositional gap is most probably due to submarine erosion, not to subaerial denudation, and corresponds to an interval of tectonic activity that exists in most localities in the world.

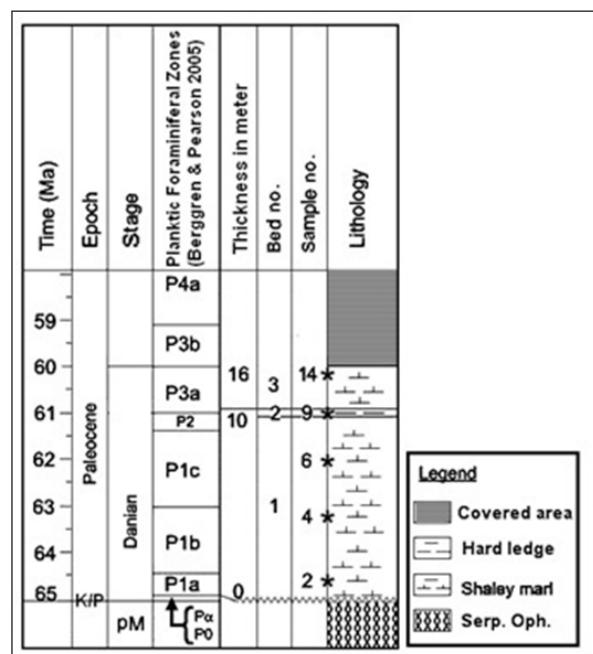


Figure 2. Stratigraphic log of the Danian on Stage the eastern limb of J. Mundassa anticline, Al Ain area, UAE. The standard earliest Danian zones (P0 and Pa) are absent from the study section (pM= pre-Maastrichtian, K/P= Cretaceous/Paleogene boundary, Serp. Oph.= serpentine Semail Ophiolite).

3. Material and methods

The present study is the fourth part from the series concerning the Paleocene foraminiferal assemblages of J. Mundassa: agglutinated and lagenid foraminifera (2015a, b, respectively), planktic foraminifera (Anan, 2016) and rotaliid foraminifera (current study). Fourteen samples of shaley marl were collected from the exposed neoautochthonous rocks of the J. Mundassa (beds 1, 3; samples 1-8, 10-14, about 26 m thick) (74-94% insoluble residue), except bed no. 2 (sample 9) is characterized by its yellow-brown hard ledge (99% insoluble residue). This succession belongs to the Paleocene MM of the MF and rests unconformably on a peniplanated allochthonous Pre-Maastrichtian SO (Figure 3).



Figure 3. View of the Paleocene (Danian) sediments (Mundassa Member of the Muthaymimah Formation) which nonconformably overlie the obducted Pre-Maastrichtian Semail Ophiolite.

4. Taxonomy

Forty six rotaliid benthic foraminiferal species in J. Mundassa are identified and 28 of them are illustrated in Plates 1, 2. The classification of Loeblich and Tappan (1987) and Bolli et al. (1994) are followed in current study.

Order Foraminiferida Eichwald, 1830

Suborder Rotaliina Delage and Hérouard, 1896

Superfamily Bolivinacea Glaessner, 1937

Family Bolivinoididae Loeblich and Tappan, 1984

Genus *Bolivinoides* Cushman, 1927

Type species. *Bolivina draco* Marsson, 1878

Bolivinoides curtus Reiss, 1954

(Pl. 1, fig. 1)

1954 *Bolivinoides curtus* Reiss, p. 158, pl. 30, figs. 15-16.

1956 *Bolivinoides curtus*; Said and Kenawy, p. 140, pl. 3, fig. 43.

1963 *Bolivinoides delicatulus curtus*; Hiltermann, p. 217, pl. 3, figs. 8-9.

1992 *Bolivinoides curtus*; Anan and Hamdan, p. 205, text-fig. 5.

1994 *Bolivinoides delicatulus curtus*; Bolli et al., p. 129, fig. 34, 36.

1993a *Bolivinoides curtus*; Anan, p. 316, pl. 2, fig. 15.

2011b *Bolivinoides curtus*; Anan, p. 134, pl. 1, fig. 1.

Remarks: This Paleocene species is closely related to *Bolivinoides delicatulus* Cushman but differs by its smaller and shorter test. Hiltermann (1963) noted that both species *B. delicatulus* and *B. curtus* start in the Upper Cretaceous rocks in Europe (France and Germany) and continue to the

Danian, but *B. curtus* is not recorded in the Upper Cretaceous at some Middle East localities, but only in Paleocene rocks: Negev (Reiss, 1954), Sinai (Said and Kenawy, 1956), J. Malaqet (Anan and Hamdan, 1992; Anan, 1993a) as well as J. Mundassa, UAE (current study).

- Superfamily Turrilinacea Cushman, 1927
- Family Turrilinidae Cushman, 1927
- Genus *Praebulimina* Hofker, 1953
- Type species. *Bulimina ovulum* Reuss, 1844

***Praebulimina carseyae* (Plummer, 1931)**

- 1931 *Buliminella carseyae* Plummer, p. 179, pl. 8, fig. 9.
- 1946 *Buliminella carseyae*; Cushman, p. 119, pl. 50, figs. 17, 20.
- 1956 *Buliminella carseyae*; Said and Kenawy, p. 142, pl. 4, fig. 8.
- 1968 *Praebulimina carseyae*; Sliter, p. 83, pl. 11, fig. 16.
- 1970 *Praebulimina carseyae*; Al-Omari, p. 85, pl. 3, fig. 29.
- 1993b *Praebulimina carseyae*; Anan, p. 659, pl. 3, fig. 5.

Remarks: This Maastrichtian–Paleocene species was recorded from the USA (Plummer, 1931), Mexico (Sliter, 1968), Egypt (Said and Kenawy, 1956), Iraq (Al-Omari, 1970), and also Qarn El Barr section, UAE (Anan, 1993b). It is recorded in the Paleocene of the studied section.

- Superfamily Buliminacea Jones, 1977
 - Family Siphogenerenoididae Saidova, 1981
 - Subfamily Siphogenerenoidinae Saidova, 1981
 - Genus *Orthokarstenia* Dietrich, 1935
 - Type species. *Orthocerina ewaldi* Karsten, 1858
- Orthokarstenia applinae* (Plummer, 1927)**
- 1927 *Bolivina applinae* Plummer, p. 69, pl. 4, fig. 1.
 - 1948 *Loxostoma applinae*; Brotzen, p. 69, pl. 10, fig. 11.
 - 1953 *Loxostomum applinae*; LeRoy, p. 27, pl. 8, fig. 1.
 - 1956 *Loxostomum applinae*; Haque, P. 134, pl. 15, figs. 24–25.
 - 1975 *Loxostomoides applinae*; Berggren and Aubert, p. 420, pl. 4, fig. 11.
 - 1976 *Loxostomoides applinae*; Futyan, p. 521.
 - 1985 *Loxostomoides applinae*; Luger, p. 106, pl. 7, fig. 1.
 - 1992 *Loxostomoides applinae*; Saint-Marc, p. 485, pl. 1, fig. 12.
 - 1993a *Loxostomoides applinae*; Anan, p. 316, pl. 2, fig. 14.
 - 1994 *Loxostomoides applinae*; Speijer, p. 109, pl. 1, fig. 11.
 - 1998 *Orthokarstenia aapplinae*; Anan, p. 371, fig. 3. 3.
 - 2012 *Orthokarstenia applinae*; Ismail, p. 48, pl. 4, fig. 7.
 - 2020 *Orthokarstenia aapplinae*; Anan, p. 6, pl. 2.2.

Remarks: The initial part of this species is, however, obscure. Plummer (1927) noted that the chambers are smooth except for distinct striae extended from the initial extremity upward over several chambers and its crenulated base of the biserial part and longitudinal striae. It has a triserial part that becomes biserial and uniserial, for this reason, it should belong to the genus *Orthokarstenia*. Anan (1998) regarded the species *applinae* is an evolutionary development from the Maastrichtian *O. oveyi* (Nakkady). He also added that all members of the latter genus in Egypt seem to be restricted to south Egypt (*Orthokarstenia* province of Hewaidy, 1997). This Paleocene–Early Eocene species was recorded from the USA (Plummer, 1927), Sweden (Brotzen, 1948), Tunisia

(Berggren and Aubert, 1975), Egypt (LeRoy, 1953), Jordan (Futyan, 1976), UAE (J. Malaqet, Anan, 1993a) and Pakistan (Haque, 1956). It is recorded in the Paleocene of the studied section.

Family Buliminidae Hofker, 1951

Genus *Bulimina* d'Orbigny, 1826

Type species. *Bulimina marginata* d'Orbigny, 1826

***Bulimina mexicana* Cushman, 1922**

(Pl. 1, fig. 2)

- 1922 *Bulimina inflata* Seguenza var. *mexicana* Cushman, p. 95, pl. 21, fig. 2.
- 2006 *Bulimina mexicana*; Ortiz and Thomas, p. 114, pl. 4, figs. 15, 16.

Remarks: This Paleocene–Early Eocene species can be distinguished by its conspicuous well-developed costae extending downward as sharp spines and inflated chambers. It was recorded, so far, from the US and Spain. It is recorded from the Paleocene of the study section.

***Bulimina midwayensis* Cushman and Parker, 1936**

(Pl. 1, fig. 3)

- 1936 *Bulimina arkadelphiana* var. *midwayensis* Cushman and Parker, p. 42, pl. 7, figs. 9–10.
- 1956 *Bulimina arkadelphiana* var. *midwayensis*; Said and Kenawy, p. 142, pl. 4, fig. 11.
- 1975 *Bulimina midwayensis*; Berggren and Aubert, p. 175, pl. 14, fig. 8.
- 1976 *Bulimina midwayensis*; Aubert and Berggren, p. 422, pl. 5, fig. 7.
- 1983 *Bulimina midwayensis*; Tjalsma and Lohmann, p. 6, pl. 3, fig. 1.
- 1985 *Bulimina midwayensis*; Luger, p. 106, pl. 7, fig. 4.
- 1990 *Bulimina midwayensis*; Thomas, p. 539, pl. 2, fig. 8.
- 1993a *Bulimina midwayensis*; Anan, p. 316, pl. 2, fig. 16.
- 1993b *Bulimina midwayensis*; Anan, p. 659, pl. 3, fig. 7.
- 1994 *Bulimina midwayensis*; Bolli et al., p. 136, fig. 36. 19–21.
- 2003 *Bulimina midwayensis*; Ali, p. 118, pl. 8, fig. 17.
- 2005 *Bulimina midwayensis*; Sztrákos, p. 187, pl. 6, fig. 13.
- 2006 *Bulimina midwayensis*; Alegret and Ortiz, p. 440, pl. 1, fig. 22.
- 2007 *Bulimina midwayensis*; Valchev, p. 131, pl. 1, fig. 9.
- 2020 *Bulimina midwayensis*; Anan, p. 7.

Remarks: The Campanian–Paleocene *B. midwayensis* shows less distinct costae and more spines than *B. mexicana* and has re-entrants along the sutures. It was recorded from the USA (Cushman and Parker, 1936), Trinidad (Bolli et al., 1994), Atlantic Ocean (Tjalsma and Lohmann, 1983), France (Sztrákos, 2005), Bulgaria (Valchev, 2007), Tunisia (Aubert and Berggren, 1975), Egypt (Said and Kenawy, 1956) and the UAE (J. Malaqet and Qarn El Barr sections, Anan, 1993a,b), and also the Paleocene of J. Mundassa, UAE.

***Bulimina trinitatensis* Cushman and Jarvis, 1928**

(Pl. 1, fig. 4)

- 1928 *Bulimina trinitatensis* Cushman and Jarvis, p. 102, pl. 14, fig. 12.
- 1956 *Bulimina stokesi*; Said and Kenawy, p. 143, pl. 4, fig. 14.
- 1976 *Bulimina trinitatensis*; Aubert and Berggren, p. 423, pl. 5, fig. 12.

1978 *Bulimina trinitatensis*; Proto Decima and Bolli, p. 791, pl. 2, figs. 15-16.

1983 *Bulimina trinitatensis*; Tjalsma and Lohmann, p. 7, pl. 3, fig. 4.

1993a *Bulimina stokesi*; Anan, p. 316, pl. 2, fig. 17.

1994 *Bulimina stokesi*; Bolli et al., p. 136, fig. 36. 24-26.

1994 *Bulimina trinitatensis*; Speijer, p. 154, pl. 2, fig. 3.

Remarks: Tjalsma and Lohmann (1983) noted that this Paleocene-Early Eocene species has a wide bathymetric distribution during the Paleocene, becoming restricted to the shallow and intermediate sites during the Eocene. Speijer (1994) treated the Egyptian species *Bulimina stokesi* of Said and Kenawy (1956) as a junior synonym of *B. trinitatensis* Cushman and Jarvis. This species is distinguished from the similar *B. midwayensis* in its coarser ornamentation and somewhat larger size. It was recorded in the Early Eocene in Trinidad, but in the Paleocene in Egypt, and also the studied section J. Mundassa, UAE.

Family Buliminellidae Hofker, 1951

Genus *Buliminella* Cushman, 1911

Type species. *Bulimina elegantissima* d'Orbigny, 1839

***Buliminella grata* Parker and Bermúdez, 1937**

(Pl. 1, fig. 5)

1937 *Buliminella grata* Parker and Bermúdez, p. 515, pl. 59, fig. 6.

1982 *Praebuliminella grata*; Proto Decima and Bolli, p. 118, pl. 7, fig. 4.

1983 *Buliminella grata*; Tjalsma and Lohmann, p. 26, pl. 12, fig. 7.

1993 *Buliminella grata*; Boltovskoy and Vera Ocampo, p. 148, pl. 2, fig. 2.

1994 *Buliminella grata*; Bolli et al., p. 137, fig. 37. 3.

2000 *Elongobula grata*; Sztrákos, p. 110, pl. 15, fig. 8.

Remarks: This Paleocene-Oligocene species has a slender test, somewhat inflated chambers without costae or spine, but with a peculiar protuberance in the apertural face of the last chamber, while the genus *Elongobula* Finlay (1939) has an elongate test in a high troche spiral coil, circular to oval in section (Loeblich and Tappan, 1987, p. 570). *B. grata* was recorded from the Caribbean region (Bolli et al., 1994), Atlantic Ocean (Tjalsma and Lohmann, 1983), France (Sztrákos, 2000), Italy (Proto Decima and Bolli, 1982) and the Arabian Sea (Boltovskoy and Vera Ocampo, 1993). It is recorded in the Paleocene of the studied section, UAE.

Genus *Globobulimina* Cushman, 1927

Type species. *Globobulimina pacifica* Cushman, 1927

***Globobulimina suteri* (Cushman and Renz, 1946)**

(Pl. 1, fig. 6)

1946 *Bulimina (Desinobulimina) suteri* Cushman and Renz, p. 38, pl. 6, fig. 15.

1994 *Globobulimina (?) suteri*; Bolli et al., p. 137, figs. 34-36.

2007 *Globobulimina suteri*; Valchev, p. 132, pl. 1, fig. 11.

Remarks: Bolli et al. (1994) noted that this Campanian-Late Paleocene species presents an unusual combination of features of the Buliminidae (coiling mode) and the Pleurostomellidae (apertural characteristics). Our specimens have an oval test in outline and round in cross-section, triserial arrangement, inflated chambers, sharply increasing

in size, with a smooth surface. This species was recorded from the USA (Cushman and Renz, 1946), Caribbean region (Bolli et al., 1994), and Bulgaria (Valchev, 2007). It is recorded in the Paleocene of the studied section, UAE.

Family Fursenkoinidae Loeblich and Tappan, 1961

Genus *Coryphostoma* Loeblich and Tappan, 1962

Type species. *Bolivina platium* Carsey, 1926

***Coryphostoma midwayensis* (Cushman, 1936)**

(Pl. I, fig. 7)

1936 *Bolivina midwayensis* Cushman, p. 50, pl. 7, fig. 12.

1976 *Bolivina midwayensis*; Aubert and Berggren, p. 240, pl. 4, fig. 10.

1988 *Coryphostoma midwayensis*; Kaiho, p. 554, fig. 1.

1993a *Bolivina midwayensis*; Anan, p. 316, pl. 2, fig. 13.

1993b *Bolivina midwayensis*; Anan, p. 659, pl. 3, fig. 2.

1994 *Coryphostoma midwayensis*; Bolli et al., p. 138, fig. 37.13-15.

1995 *Coryphostoma midwayensis*; Nomura and Brohi, p. 227, pl. 1, fig. 10.

2001 *Coryphostoma midwayensis*; Shahin, p. 12, fig. 6. 18.

2004 *Coryphostoma midwayensis* (Cushman). - Anan, p. 44, pl. 1, fig. 4.

2007 *Bolivina midwayensis*; Valchev, p. 131, pl. 1, fig. 5.

Remarks: The test of the genus *Coryphostoma* has biserial arrangement with a tendency to become uniserial. This cosmopolitan Paleocene species *C. midwayensis* characterized by its elongate, very slightly tapering, much-compressed test, periphery rounded, biserial throughout. It is recorded from the Paleocene of the USA (Cushman, 1936), Trinidad (Bolli et al., 1994), Bulgaria (Valchev, 2007), Tunisia (Aubert and Berggren, 1975), Egypt (Shahin, 2001), J. Malaqet and Qarn El Barr sections, UAE (Anan, 1993a,b), Pakistan (Nomura and Brohi, 1995), and also in the studied section, UAE.

***Coryphostoma nekhliana* (Said and Kenawy, 1956)**

(Pl. 1, fig. 8)

1956 *Bolivina decurrens parallela* Said and Kenawy, p. 143, pl. 4, fig. 18.

1959 *Bolivina decurrens nekhliana*; Thalmann, p. 130.

Remarks: Thalmann (1959) presented new names for some foraminiferal homonyms. Consequently, this subspecies was assigned a new name: *Bolivina decurrens nekhliana* (non *B. parallela* Perner, 1892). This species has an elongate test and the sutures in the early portion not strongly oblique than *C. midwayensis*. It was originally recorded from the Maastrichtian of Sinai in Egypt (Said and Kenawy, 1956), but for the first time, from the Paleocene of the studied section.

Superfamily Pleurostomellacea Reuss, 1860

Family Pleurostomellacea Reuss, 1860

Subfamily Pleurostomellacea Reuss, 1860

Genus *Ellipsoglandulina* Silvestri, 1900

Type species. *Ellipsoglandulina laevigata* Silvestri, 1900

***Ellipsoglandulina arafati* Anan, 2009**

2009b *Ellipsoglandulina arafati* Anan, p. 111, fig. 2.

2011a *Ellipsoglandulina arafati*; Anan, p. 62, pl. 3, fig. 30.

Remarks: This species is characterized by its widest size in the middle portion of the test and pointed initial end. It

differs from the Italian Pliocene *E. laevigata* Silvestri (1900) by its lesser lunate aperture and more spherical test than the variable dimensional test of the latter, which have more elongated and wider tests. *E. arafati* was originally recorded from the Lower Eocene of the Abu Zenima section, Sinai of Egypt (Anan, 2009b). It is recorded also here, for the first time, from the Paleocene of the studied section, UAE.

***Ellipsoglandulina ellisi* Said and Kenawy, 1956**

1956 *Ellipsoglandulina ellisi* Said and Kenawy, p. 146, pl. 4, fig. 34.

Remarks: The Early Eocene *E. arafati* Anan differs from the Maastrichtian–Paleocene *E. ellisi* Said and Kenawy by its more spherical test with rapidly increasing nodosarian chambers, semilunate aperture to the longer elongate test with gradually increasing nodosarian chambers, and slit-like aperture of the latter. It was originally recorded from the Sinai in Egypt (Said and Kenawy, 1956). It is recorded here outside Egypt, for the first time, from the Paleocene of the studied section, UAE.

Genus *Nodosarella* Rzehak, 1895

Type species. *Lingulina tuberosa* Gümbel, 1870

***Nodosarella gracillima* Cushman, 1944**

1944 *Nodosarella gracillima* Cushman, p. 13, pl. 2, fig. 32.

1946 *Nodosarella gracillima*; Cushman, p. 134, pl. 55, figs. 19-21.

1956 *Nodosarella gracillima*; Said and Kenawy, p. 145, pl. 4, fig. 27.

Remarks: This Maastrichtian-Paleocene species is characterized by its slender and slightly tapering test, aperture semielliptical at one side of the end of the last-formed chamber. It was recorded from the USA (Cushman, 1944) and Egypt (Said and Kenawy, 1956). It is also found for the first time, in the Paleocene of the studied section, UAE.

***Nodosarella paleocenica* Cushman and Todd, 1946**

(Pl. 1, fig. 9)

1946 *Nodosarella paleocenica* Cushman and Todd, p. 60, pl. 10, fig. 23.

1951 *Nodosarella paleocenica*; Cushman, p. 46, pl. 12, fig. 38.

1956 *Ellipsonodosaria paleocenica*; Haque, p. 139, pl. 23, figs. 10, 11.

1994 *Nodosarella paleocenica*; Bolli et al., p. 142, fig. 37.43, 44.

Remarks: This Maastrichtian-Paleocene species is characterized by its slender and slightly tapering test, aperture semielliptical at one side of the end of the last-formed chamber. It was recorded from the USA (Cushman, 1944) and Egypt (Said and Kenawy, 1956). It is also found for the first time, in the Paleocene of the studied section, UAE.

***Nodosarella subnodososa* (Guppy, 1894)**

(Pl. 1, fig. 10)

1894 *Ellipsoidina subnodososa* Guppy, p. 650, pl. 41, fig. 13.

1945 *Nodosarella subnodososa*; Cushman and Stainforth, p. 53, pl. 9, fig. 3.

1956 *Nodosarella subnodososa*; Said and Kenawy, p. 146, pl. 4, fig. 31.

1992 *Nodosarella subnodososa*; Gawor-Biedowa, p. 135, pl. 26, fig. 5.

1993b *Nodosarella subnodososa*; Anan, p. 659, pl. 3, fig. 10.
1994 *Nodosarella subnodososa*; Bolli et al., p. 142, fig. 37.45, 46.

Remarks: This Maastrichtian–Oligocene species has a more compact test than *N. paleocenica*. It was recorded from Eocene-Oligocene of Trinidad (Bolli et al., 1994), the Maastrichtian from Poland (Gawor-Biedowa, 1992), the Paleocene-Eocene of Egypt (Said and Kenawy, 1956), and Maastrichtian–Paleocene of the Qarn El Barr section, UAE (Anan, 1993b). It is recorded also from the Paleocene of J. Mundassa, UAE.

Genus *Pleurostomella* Reuss, 1860

Type species. *Dentalina subnodososa* Reuss, 1851

***Pleurostomella naranjoensis* Cushman and Bermúdez, 1937**

(Pl. 1, fig. 11)

1937 *Pleurostomella naranjoensis* Cushman and Bermúdez, p. 16, pl. 1, figs. 59-60

1948 *Pleurostomella naranjoensis*; Cushman and Renz, p. 30, pl. 5, fig. 21.

1994 *Pleurostomella naranjoensis*; Bolli et al., p. 143, figs. 38. 6-7.

2019a *Pleurostomella naranjoensis*; Anan, p. 175, pl. 1, fig. 11.

Remarks: This species has a short test, but more width than *P. cubensis* Cushman and Bermúdez (1937) and its biserial portion has a rounded periphery. It was recorded from the Paleocene-Eocene of Cuba (Cushman and Bermúdez, 1937), Trinidad (Bolli et al., 1994), and now, for the first time, from the Paleocene of J. Mundassa, UAE.

***Pleurostomella subnodososa* Reuss, 1860**

(Pl. 1, fig. 12)

1860 *Pleurostomella subnodososa* Reuss, p. 204, pl. 8, fig. 2.

1946 *Pleurostomella subnodososa*; Cushman, p. 132, pl. 55, figs. 1-9.

1956 *Pleurostomella subnodososa*; Said and Kenawy, p. 145, pl. 4, fig. 26.

1968 *Pleurostomella subnodososa*; Sliter, p. 110, pl. 19, fig. 10.

1993b *Pleurostomella subnodososa*; Anan, p. 663, pl. 3, fig. 11. 2003 *Pleurostomella subnodososa*; Ali, pl. 7, fig. 21.

2019a *Pleurostomella subnodososa*; Anan, p. 177, pl. 2, fig. 18.

Remarks: This species slender, elongate and small to medium size smooth test with hooded aperture. It was recorded from the upper part of the Cretaceous in Europe (Reuss, 1860), USA (Cushman, 1946), Mexico (Sliter, 1968), but Paleocene of Egypt (Said and Kenawy, 1956), and Qarn El Barr section, UAE (Anan, 1993b). It is recorded also, for the first time, from the Paleocene of J. Mundassa, UAE.

Superfamily Stilostomellacea Finlay, 1947

Family Stilostomellidae Finlay, 1947

Genus *Orthomorphina* Stainforth, 1952

Type species. *Orthomorphina havanensis* (Cushman and Bermúdez, 1937)

***Orthomorphina rohri* (Cushman and Stainforth, 1945)**

1945 *Nodogenerina rohri* Cushman and Stainforth, p. 39, pl. 5, fig. 26.

1953 *Orthomorphina rohri*; Beckmann, p. 365, pl. 21, fig. 8.

1956 *Orthomorphina rohri*; Said and Kenawy, p. 142, pl. 4, fig. 4

- 1978 *Orthomorphina rohri*; Proto Decima and Bolli, p. 795, pl. 1, fig. 17.
- 1980 *Orthomorphina* sp.; Barr and Berggren, p. 187, pl. 3, fig. 5.
- 1989 *Orthomorphina rohri*; Hulbos et al., p. 272, pl. 3, fig. 1.
- 1994 *Orthomorphina rohri*; Bolli et al., p. 358, fig. 62. 17. 2000 *Nodogenerina rohri*; Sztrákos, p. 167.
- 2007 *Orthomorphina rohri*; Ozsvárt, p. 71, pl. 8, fig. 17.
- 2007 *Orthomorphina rohri*; Valchev, p. 133, pl. 1, fig. 13.
- 2010 *Orthomorphina rohri*; Anan, p. 163.
- 2020 *Orthomorphina rohri*; Anan, p. 8, pl. 2.8.

Remarks: The holotype of this Oligocene species from Trinidad was erected to belong to the genus *Nodogenerina*. Later on, this species was treated, by many authors, to belong to the genus *Orthomorphina* due to showing the characters of this genus in its irregular arranged chambers and the simple terminal aperture. It is also recorded from the Middle to Upper Eocene of J. Hafit, UAE (Anan, 2010), the Lower Eocene of Libya (Barr and Berggren, 1980), France (Sztrákos, 2000), Norwegian Sea (Hulbos et al., 1989), Bulgaria (Valchev, 2007), Hungary (Ozsvárt, 2007), Trinidad (Bolli et al., 1994), but from the Paleocene of Egypt (Said and Kenawy, 1956) and the studied Mundassa section.

Genus *Stilostomella* Guppy, 1894

Type species. *Stilostomella rugosa* Guppy, 1894

***Stilostomella paleocenica* (Cushman and Todd, 1946)**

(Pl. 1, fig. 13)

- 1946 *Ellipsonodosaria paleocenica* Cushman and Todd, p. 61, pl. 10, fig. 26.
- 1956 *Stilostomella paleocenica*; Said and Kenawy, p. 146, pl. 4, fig. 39.
- 1994 *Stilostomella paleocenica*; Bolli et al., p. 145, figs. 38. 29, 30.
- 1996 *Stilostomella paleocenica*; Aref and Youssef, p. 568, pl. 3, fig. 30.
- 2001 *Stilostomella paleocenica*; Khalil, p. 329, fig. 8. 12.
- 2003 *Stilostomella paleocenica*; Ali, p. 124, pl. 7, fig. 25.
- 2007 *Siphonodosaria paleocenica*; Valchev, p. 133, pl. 1, fig. 15.
- 2020 *Stilostomella paleocenica*; Anan, p. 8.

Remarks: Loeblich and Tappan (1987) treated the genus *Ellipsonodosaria* Silvestri (1900) as a junior synonym of the genus *Nodosarella* Rzehak (1895). The genus *Stilostomella* differs from the genus *Siphonodosaria* mainly by its straight test rather than slightly arcuate, not broadening initial chambers and arcuate aperture rather than phialine with a crenulated apertural lip. This Paleocene-Miocene species has a slim smooth elongated straight uniserial test, slightly tapered in the initial portion then slightly broadening with around 10 spherical chambers which gradually increase in size, straight horizontal deep sutures, and terminal aperture on a short neck with a lip. It was recorded from the USA (Cushman and Todd, 1946), Trinidad (Bolli et al., 1994), Bulgaria (Valchev, 2007) and Egypt (Said and Kenawy, 1956). It is recorded, for the first time, from the Paleocene of J. Mundassa, UAE.

Family Bagginiidae Cushman, 1927

Subfamily Baggininae Cushman, 1927

Genus *Valvulineria* Cushman, 1926

Type species. *Valvulineria californica* Cushman, 1926

***Valvulineria scrobiculata* (Schwager, 1883)**

(Pl. 2, fig. 1)

- 1883 *Anomalina scrobiculata* Schwager, p. 129, pl. 29, fig. 18.
- 1953 *Valvulineria scrobiculata*; LeRoy, p. 53, pl. 9, figs. 18-20.
- 1956 *Valvulineria scrobiculata*; Said and Kenawy, p. 147, pl. 4, fig. 42.
- 1976 *Valvulineria scrobiculata*; Salaj, pl. 8, figs. 1, 2.
- 2001 *Valvulineria scrobiculata*; Hewaidy and Strougo, p. 17, pl. 2, figs. 18, 19.
- 2003 *Valvulineria scrobiculata*; Ali, p. 125, pl. 9, figs. 17-19.
- 2006 *Valvulineria scrobiculata*; Ernst et al., p. 102, pl. 2, figs. c, d.
- 2012 *Valvulineria scrobiculata*; Stassen et al., p. 158, fig. 5. 3, 9.

Remarks: This Paleocene-Eocene species has a slightly longer than the broad test, slightly convex both dorsally and ventrally, with 7-8 chambers in the last whorl enlarging slowly as added, aperture ventral at the last chamber. It is recorded from Egypt (LeRoy, 1953) and Tunisia (Salaj, 1976), and now, for the first time, from the Paleocene of J. Mundassa, UAE.

Superfamily Discorbineillacea Sigal, 1952

Family Parrelloididae Hofker, 1956

Genus *Cibicidoides* Thalmann, 1939

Type species. *Truncatolina mundula* Brady, Parker and Jones, 1890

***Cibicidoides libycus* (LeRoy, 1953)**

(Pl. 2, fig. 2)

- 1953 *Cibicides libycus* LeRoy, p. 24, pl. 5, figs. 1-3.
- 1956 *Cibicidoides libycus*; Said and Kenawy, p. 156, pl. 7, fig. 17.
- 1980 *Heterolepa libyca*; Saperson and Janal, p. 404, pl. 2, fig. 4.
- 2005 *Heterolepa libyca*; Sztrákos, p. 189, pl. 9, fig. 9.
- 2008 *Cibicidoides libycus*; Anan, p. 365, pl. 1, fig. 8.
- 2019b *Cibicidoides libycus*; Anan, p. 268, pl. 3, fig. 81.

Remarks: According to Loeblich and Tappan (1987), the genus *Cibicidoides* Thalmann differs from the genus *Gavelinella* Brotzen by its biconvex, biumbonate test and angular periphery than rounded in the other. Moreover, the genus *Heterolepa* has a slit-like aperture extending about half of the distance to the umbilicus and extending a short distance across periphery on the dorsal side, but without biumbonate test. Both *C. allenii* and *C. libycus* have conspicuous biumbonate test and a low interiomarginal equatorial arch aperture. The Paleocene-Early Eocene *C. libycus* is characterized by its depressed sutures in both sides than elevated and taper sutures in the dorsal side and slightly in the ventral side in *C. allenii* (Plummer). *Cibicidoides libycus* was recorded from Egypt (LeRoy, 1953), France (Sztrákos, 2005) and Turkmenia (Saperson and Janal, 1980). It was originally recorded from Egypt (LeRoy, 1953), and now, for the first time, from the Paleocene of J. Mundassa, UAE.

***Cibicidoides pharaonis* (LeRoy, 1953)**

- 1953 *Cibicides pharaonis* LeRoy, p. 24, pl. 7, figs. 9-11.
 1988 *Cibicidoides pharaonis*; Anan and Sharabi, p. 215, pl. 2, fig. 20.
 1994 *Cibicidoides pharaonis*; Speijer, p. 156, pl. 4, fig. 3.
 2001 *Cibicidoides pharaonis*; Hewaidy and Strougo, p. 17, pl. 2, figs. 27, 28.
 2006 *Cibicidoides pharaonis*; Alegret and Ortiz, p. 440, pl. 1, fig. 24.
 2008 *Cibicidoides pharaonis*; Anan, p. 366, pl. 1, fig. 9.
 2016 *Cibicidoides pharaonis*; Orabi and Zaky, p. 188, pl. 3, fig. 18.
 2019b *Cibicidoides pharaonis*; Anan, p. 268, pl. 3, fig. 82.

Remarks: This Paleocene-Early Eocene species has a medium test with 8-10 chambers in the last whorl, ventrally more convex than dorsally, sutures flush with the surface. It is characterized by its moderately wide, curved ventral sutures and coarse punctuation. It was recorded by LeRoy (1953) from the Lower Eocene of the Maqfi section, and later from many sites in Egypt. This species is recorded for the first time outside Egypt, in the Paleocene of the studied Mundassa section, UAE.

***Cibicidoides pseudoacutus* (Nakkady, 1950)**

- 1950 *Anomalina pseudoacuta* Nakkady, p. 691, pl. 90, figs. 29-32.
 1953 *Anomalina pseudoacuta*; Le Roy p. 18, pl. 3, figs. 29-31.
 1994 *Cibicidoides pseudoacutus*; Speijer, p. 54, pl. 7, fig. 6.
 1996 *Anomalina pseudoacuta*; Aref and Youssef, p. 551, pl. 4, fig. 12.
 2001 *Cibicidoides pseudoacutus*; El-Dawy, p. 45, pl. 2, fig. 17
 2002 *Cibicidoides pseudoacutus*; Galeotti and Coccioni, p. 198, fig. 1.
 2002 *Cibicidoides pseudoacutus*; Alegret et al., p. 132, fig. 5. 3.
 2004 *Cibicidoides pseudoacutus*; Anan, p. 45, pl. 1, fig. 6.
 2005 *Gavelinella pseudoacuta*; Sztrákos, p. 214, pl. 9, fig. 14.
 2006 *Cibicidoides pseudoacutus*; Ernst et al., p. 95, pl. 1, figs. J, k.
 2006 *Cibicidoides pseudoacutus*; Alegret and Ortiz, p. 440, pl. 2, fig. 2.
 2007 *Cibicidoides pseudoacutus*; Anan, p. 306, pl. 1, fig. 6.
 2019b *Cibicidoides pseudoacuta*; Anan, p. 268, pl. 3, fig. 83.

Remarks: This Maastrichtian-Eocene species is distinguished by biconvex test, the central boss on the dorsal side, fine beads on the ventral side. It was described by Nakkady (1950) from the Abu Durba (Sinai) and Luxor section (Nile Valley). Later, it was recorded in different localities in Egypt: Farafra Oasis (LeRoy, 1953), Red Sea coast (Aref and Youssef, 1996; Anan, 2004), Dababiya section (Ernst et al., 2006), but Paleocene-Eocene (Alegret and Ortiz, 2006). It is interesting to note that it was also recorded in the Maastrichtian-Paleocene of Tunisia (Speijer, 1994), but in the Paleocene-Eocene of France (Sztrákos, 2005). It is recorded for the first time, from the Paleocene of J. Mundassa, UAE.

Superfamily Asterigerinacea d'Orbigny, 1839

Family Epistomariidae Hofker, 1954

Subfamily Nuttallidinae Saidova, 1981

Genus *Nuttallides* Finlay, 1939

Type species. *Nuttallides truempyi* Nuttall, 1930

***Nuttallides truempyi* (Nuttall, 1930)**

(Pl. 2, fig. 3)

- 1930 *Eponides truempyi* Nuttall, p. 274, 287, pl. 24, figs. 9, 13-14.
 1975 *Nuttallides truempyi*; Proto Decima and De Biase, p. 95, pl. 2, fig. 9.
 1976 *Nuttallides truempyi*; Berggren and Aubert, p. 315, pl. 2, figs. 12-13.
 1978 *Nuttallides truempyi*; Proto Decima and Bolli, p. 795, pl. 3, figs. 1, 2..
 1983 *Nuttallides truempyi*; Miller, p. 439, pl. 1, figs. 4-7.
 1983 *Nuttallides truempyi*; Tjalsma and Lohmann, p. 17, pl. 6, fig. 4, pl. 17, figs. 4-5, pl. 21, figs. 1-4.
 1988 *Nuttallides truempyi*; Kaiho, p. 554.
 1988 *Nuttallides truempyi*; Parisi and Coccioni, p. 103, pl. 2, figs. 12-17.
 1988 *Nuttallides truempyi*; Saint-Marc and Berggren, p. 110, pl. 4, figs. 7-9.
 1989 *Nuttallides truempyi*; Hulsbos et al., p. 272.
 1990 *Nuttallides truempyi*; Thomas, p. 594, pl. 3, figs. 1, 2.
 1993 *Nuttallides truempyi*; Boltovskoy and Vera Ocampo, p. 152, pl. 4, fig. 15.
 1993b *Nuttallides truempyi*; Anan, p. 665, pl. 3, fig. 14.
 1994 *Nuttallides truempyi*; Bolli et al., p. 370, fig. 88. 13.
 1996 *Nuttallides truempyi*; Anan, p. 154, fig. 4. 4.
 2005 *Nuttallides truempyi*; Sztrákos, p. 188, pl. 17, fig. 22.
 2007 *Nuttallides truempyi*; Anan, p. 76, pl. 1, fig. 7.
 2008 *Nuttallides truempyi*; Alegret et al., p. 96.
 2010 *Nuttallides truempyi*; Anan, p. 166.

Remarks: Berggren and Aubert (1976) noted that the extinction of *Nuttallides truempyi* serves as a useful marker in determining the approximate position of the Eocene/Oligocene boundary, which is confirmed by Proto Decima and Bolli (1978), Alegret et al. (2008). Tjalsma and Lohmann (1983) added that this extinction is diachronous, and it is frequent abundant during the Paleocene and rare to abundant in the Middle-Late Eocene (MLE). Miller (1983) noted that the Eocene *N. truempyi* is replaced by the Oligocene *N. umbonifera*. Saint-Marc and Berggren (1988) recorded it from the Paleocene of Tunisia and UAE (Qarn El Barr section). Berggren and Miller (1989) considered the last appearance of this species is at the end of Late Eocene. Bolli et al. (1994) noted that it ranges in Trinidad from Maastrichtian through Late Eocene. It was recorded also by Sztrákos (2005) from the Paleocene-Upper Eocene in France. It is recorded in the Upper Eocene of J. Malaquet and MLE of J. Hafit, UAE. It is recorded here for the first time, from the Paleocene of J. Mundassa, UAE.

Family Alfreдинidae S. N. Singh and Kalia, 1972

Genus *Epistomarioides* Uchio, 1952

Type species. *Discorbina polystomelloides* Parker and Jones,

- Epistomaroides spissiformis* Cushman and Stainforth, 1945**
- 1945 *Anomalina alazanensis* Nuttall var. *spissiformis* Cushman and Stainforth, p. 71, pl. 14, fig. 5.
 - 1951 *Anomalina alazanensis* Nuttall var. *spissiformis*; Cushman and Stainforth, p. 162, pl. 28, fig. 6.
 - 1975 *Anomalina alazanensis spissiformis*; Proto Decima and De Biase, p. 97, pl. 2, fig. 24.
 - 1978 *Anomalina alazanensis spissiformis*; Proto Decima and Bolli, p. 789, pl. 5, figs. 12-13.
 - 1983 *Anomalina spissiformis*; Tjalsma and Lohmann, p. 23, pl. 20, fig. 4.
 - 1988 *Anomalina spissiformis*; Parisi and Coccioni, p. 104, pl. 4, figs. 4-9.
 - 1994 *Anomalina alazanensis spissiformis*; Bolli et al., p. 373, pl. 59, figs. 10-12.
 - 2006 *Anomalinoidea spissiformis*; Ortiz and Thomas, p. 112, pl. 3, fig. 7.
 - 2010 *Epistomaroides spissiformis*; Anan, p. 167, pl. 2, fig. 2.

Remarks: Loeblich and Tappan (1987) noted that the type specimen of *Anomalina* was lost, and a petition was submitted to the IZN for the suppression of the genus *Anomalina* d'Orbigny (1826) and retention of the genus *Epistomaroides* Uchio (1952) as a valid genus. This Paleocene-Oligocene species was recorded from Oligocene of Trinidad (Cushman and Stainforth, 1945), Ecuador (Cushman and Stainforth, 1951), Trinidad (Bolli et al., 1994), Atlantic (Tjalsma and Lohmann, 1983), Italy (Parisi and Coccioni, 1988), and J. Hafit, UAE (Anan, 2010). It is recorded here from the Paleocene of J. Mundassa, UAE.

Superfamily Nonionacea Schultze, 1854
Family Nonionidae Schultze, 1854
Subfamily Pulleniinae Schwager, 1877
Genus *Pullenia* Parker and Jones, 1862

Type species. *Nonionina bulloides* d'Orbigny, 1846

***Pullenia angusta* Cushman and Todd, 1943**

(Pl. 2, fig. 4)

- 1943 *Pullenia quinqueloba* (Reuss) *angusta* Cushman and Todd, p. 10, pl. 2, fig. 3.
- 1956 *Pullenia quinqueloba angusta*; Said and Kenawy, p. 157, pl. 7, fig. 23.
- 1994 *Pullenia angusta*; Bolli et al., p. 151, fig. 41. 21, 22.

Remarks: This Maastrichtian-Early Eocene species has a closed coiled test, periphery rounded, flush suture, aperture a long narrow slit extending over the periphery at the base of the septal face with some deep umbilical extending to the periphery. It was recorded from the USA (Cushman and Todd, 1943), Caribbean (Bolli et al., 1994), Egypt (Said and Kenawy, 1956). It is recorded for the first time, from the Paleocene of J. Mundassa, UAE.

***Pullenia coryelli* (White, 1929)**

(Pl. 2, fig. 5)

- 1929 *Pullenia coryelli* White, p. 58, pl. 5, fig. 22.
- 1946 *Pullenia coryelli*; Cushman, p. 147, pl. 60, figs. 10-11.
- 1956 *Pullenia cf. coryelli*; Said and Kenawy, p. 156, pl. 7, fig. 24.
- 1988 *Pullenia coryelli*; Kaiho, p. 554, fig. 1.
- 1990 *Pullenia coryelli*; Thomas, p. 594, pl. 3, fig. 6.
- 1993b *Pullenia coryelli*; Anan, p. 665, pl. 3, fig. 15.
- 1994 *Pullenia coryelli*; Bolli et al., p. 151, fig. 41. 23, 24.

- 2002 *Pullenia coryelli*; Alegret et al., p. 132, fig. 5. 9.
- 2005 *Pullenia coryelli*; Waśkowska-Oliwa, p. 312, fig. 9. 9.
- 2006 *Pullenia coryelli*; Valchev, p. 44, pl. 2, fig. 18.
- 2012 *Pullenia coryelli*; Drobne et al., p. 222, pl. 4, fig. 56.
- 2020 *Pullenia coryelli*; Anan, p. 10.

Remarks: Tjalsma and Lohmann (1983) noted that *P. coryelliana* can be differentiated from *P. eocenica* mainly by its lobulate periphery. This late Maastrichtian-Eocene species was recorded from Mexico (White, 1929), the USA (Cushman, 1946), Trinidad (Bolli et al., 1994), Bulgaria (Valchev, 2006), Slovenia (Drobne et al., 2012), Poland (Waśkowska-Oliwa, 2005), Tunisia (Alegret et al., 2002), Egypt (Said and Kenawy, 1956), Qarn El Barr, UAE section (Anan, 1993b), Japan and New Zealand (Kaiho, 1988). It is recorded here from the Paleocene of J. Mundassa, UAE.

***Pullenia eocenica* Cushman and Siegfus, 1939**

- 1939 *Pullenia eocenica* Cushman and Siegfus, p. 31, pl. 7, fig. 1.
- 1975 *Pullenia eocenica*; Proto Decima and De Biase, p. 97, pl. 3, fig. 1.
- 1978 *Pullenia eocenica*; Proto Decima and Bolli, p. 795, pl. 4, figs. 7-8.
- 1983 *Pullenia eocenica*; Miller, p. 439, pl. 4, fig. 11.
- 1983 *Pullenia eocenica*; Tjalsma and Lohmann, p. 36, pl. 16, fig. 1.
- 1985 *Pullenia eocenica*; Boltovskoy and Watanabe, p. 299, pl. 3, fig. 26.
- 1988 *Pullenia eocenica*; Parisi and Coccioni, p. 104, pl. 3, figs. 8, 9.
- 1994 *Pullenia eocenica*; Bolli et al., p. 152, fig. 41. 29, 30.
- 2000 *Pullenia eocenica*; Sztrákos, p. 170, pl. 16, fig. 8.
- 2010 *Pullenia eocenica*; Anan, p. 168.

Remarks: This Maastrichtian-Eocene species is characterized by its non-lobate equatorial periphery. It was recorded from the USA (Cushman and Siegfus, 1939), Trinidad (Bolli et al., 1994), Atlantic (Tjalsma and Lohmann, 1983), Spain (Miller, 1983), France (Sztrákos, 2000), Italy (Proto Decima and De Biase, 1975), and J. Hafit, UAE (Anan, 2010). It is recorded here from the Paleocene of J. Mundassa, UAE.

***Pullenia quinqueloba* (Reuss, 1851)**

(Pl. 2, fig. 6)

- 1851 *Nonionina quinqueloba* Reuss, p. 47, pl. 5, fig. 31.
- 1953 *Pullenia quinqueloba*; Le Roy, p. 45, pl. 11, figs. 10-11.
- 1956 *Pullenia quinqueloba*; Haque, p. 171, pl. 34, fig. 5.
- 1978 *Pullenia quinqueloba*; Proto Decima and Bolli, p. 795, pl. 4, fig. 9.
- 1980 *Pullenia quinqueloba*; Ingle et al., p. 142, pl. 5, fig. 8.
- 1983 *Pullenia quinqueloba*; Miller, p. 439, pl. 4, figs. 9, 10.
- 1983 *Pullenia quinqueloba*; Tjalsma and Lohmann, p. 36, pl. 16, fig. 2.
- 1985 *Pullenia quinqueloba*; Boltovskoy and Watanabe, p. 299, pl. 3, fig. 16.
- 1988 *Pullenia quinqueloba*; Parisi and Coccioni, p. 104, pl. 3, figs. 10-11.
- 1989 *Pullenia quinqueloba*; Hulbos et al., p. 273, pl. 3, fig. 8.
- 1993a *Pullenia quinqueloba*; Anan, p. 316, pl. 3, fig. 7.
- 1993b *Pullenia quinqueloba*; Anan, p. 665, pl. 3, fig. 16.

- 1994 *Pullenia quinqueloba*; Bolli et al., p. 152, fig. 41. 31-32.
 2000 *Pullenia quinqueloba*; Sztrákos, p. 170.
 2006 *Pullenia quinqueloba*; Cimerman et al., p. 38, pl. 10, figs. 10.
 2006 *Pullenia quinqueloba*; Ortiz and Thomas, p. 128, pl. 10, 10.
 2010 *Pullenia quinqueloba*; Anan, p. 168.
 2020 *Pullenia quinqueloba*; Anan, p. 10.

Remarks: This cosmopolitan species is characterized by its 5-chambers in the last whorl, with semi-compressed test and semi-lobate periphery. Tjalsma and Lohmann (1983) included the 4-chambers in this species, while Hulsbus et al. (1989) include 5-6 chambers in the last whorl. On the other hand, this species was recorded from Maastrichtian-Paleocene in the Qarn El Barr section, UAE (Anan, 1993b), but the Paleocene in J. Malaqet (Anan, 1993a), in Pacific (Boltovskoy and Watanabe, 1985), but from Eocene in Egypt (LeRoy, 1953), in Atlantic (Tjalsma and Lohmann, 1983) in the Norwegian Sea (Hulsbus et al., 1989) and at J. Hafit, UAE (Anan, 2010). It is recorded here in the Paleocene of J. Mundassa, UAE.

***Pullenia reussi* Cushman and Todd, 1943**

(Pl. 2, fig. 7)

- 1943 *Pullenia reussi* Cushman and Todd, p. 4, pl. 1, figs. 10-13.
 1956 *Pullenia reussi*; Said and Kenawy, p. 156, pl. 7, fig. 22.
 1993a *Pullenia reussi*; Anan, p. 317.

Remarks: This Cretaceous-Eocene species has few chambers (4 chambers), a broadly rounded periphery, and a low convex apertural face. It was recorded from the USA (Cushman and Todd, 1943), Egypt (Said and Kenawy, 1956) and J. Malaqet, UAE (Anan, 1993a). It is recorded here in the Paleocene of J. Mundassa, UAE.

Superfamily Chilostomellidae Brady, 1881

Family Quadrimorphinidae Saidova, 1981

Genus *Quadrimorphina* Finlay, 1939

Type species. *Valvulina allomorphinoides* Reuss, 1860

***Quadrimorphina esnehensis* (Nakkady, 1950)**

- 1950 *Valvulinaria esnehensis* Nakkady, p. 689, pl. 90, figs. 11-13.
 1953 *Valvulinaria esnehensis*; LeRoy, p. 53, pl. 7, figs. 29-30.
 1956 *Valvulinaria esnehensis*; Said and Kenawy, p. 147, pl. 4, fig. 41.
 1994 *Valvulinaria esnehensis*; Hewaidy, p. 55, fig. 4.
 1976 *Quadrimorphina esnehensis*; Futyana, p. 521.
 2009a *Quadrimorphina esnehensis*; Anan, p. 42.
 2020 *Quadrimorphina esnehensis*; Anan, p. 10.

Remarks: Anan (2009a) regarded this species to the genus *Quadrimorphina* (non *Valvulinaria*, as originally described by Nakkady, 1950), due to its biconvex test, not flattened to moderately umbilical side, with 5-6 chambers in the last whorl and inflated ventral chambers. This Maastrichtian-Early Eocene species was recorded from many sites in Egypt (Nakkady, 1950; LeRoy, 1953; Anan, 2009a), and Jordan (Futyana, 1976). It is recorded from the Paleocene of J. Mundassa, UAE.

Family Alabaminidae Hofker, 1951

Genus *Alabamina* Toulmin, 1941

Type species. *Alabamina wilcoxensis* Toulmin, 1941

***Alabamina midwayensis* Brotzen, 1948**

- 1948 *Alabamina midwayensis* Brotzen, p. 99, pl. 16, figs. 1, 2.
 1976 *Alabamina midwayensis*; Aubert and Berggren, p. 428, pl. 8, fig. 3.
 1976 *Alabamina midwayensis*; Salaj, pl. 15, figs. 1, 2.
 1993a *Alabamina midwayensis*; Anan, p. 317.
 1994 *Alabamina midwayensis*; Bolli et al., p. 155, fig. 42. 33, 34.
 2001 *Alabamina midwayensis*; Alegret and Thomas, p. 276, pl. 1, fig. 2.
 2003 *Alabamina midwayensis*; Ali, p. 118, pl. 12, figs. 4-6.
 2020 *Alabamina midwayensis*; Anan, p. 10.

Remarks: This Paleocene species was recorded from Sweden (Brotzen, 1948), Trinidad (Bolli et al., 1994), Tunisia (Aubert and Berggren, 1975), Egypt (Ali, 2003) and J. Malaqet, UAE (Anan, 1993a). It is also recorded from the Paleocene of J. Mundassa, UAE.

Genus *Valvalabamina* Reiss, 1963

Type species. *Rotalina lenticula* Reuss, 1845

***Valvalabamina planulata* (Cushman and Renz, 1941)**

(Pl. 2, fig. 8)

- 1941 *Gyroidina planulata* Cushman and Renz, p. 23, , pl. 4, fig. 1.
 1953 *Gyroidina planulata*; LeRoy, p. 35, pl. 11, figs. 1-3.
 1956 *Gyroidina planulata*; Said and Kenawy, p. 149, pl. 5, fig. 8.
 1994 *Valvalabamina planulata*; Speijer, p. 160, pl. 7, fig. 3.
 2001 *Valvalabamina planulata*; Hewaidy and Strougo, p. 17, pl. 2, figs. 31, 32.

Remarks: This Paleocene-Eocene species has a flattened smooth test, rounded periphery, more convex ventral side than dorsal side, flush spiral and ventral sutures and slightly curved, and narrow elongate umbilical-extraumbilical slit aperture, and less peripheral lobulation than *V. depressa* (Alth). These species characters belong to the genus *Valvalabamina* more than the planoconvex test and nearly radial sutures of the genus *Gyroidina* with its low interiomarginal slit aperture. It was recorded from the USA (Cushman and Renz, 1941), Egypt (LeRoy, 1953; Speijer, 1994). It is recorded here, for the first time, from the Paleocene of J. Mundassa, UAE.

Family Osangulariidae Loeblich and Tappan, 1946

Genus *Osangularia* Brotzen, 1940

Type species. *Osangularia lens* Brotzen, 1940

***Osangularia plummerae* Brotzen, 1940**

- 1940 *Osangularia plummerae* Brotzen, p. 30, text-fig. 8.
 1976 *Osangularia plummerae*; Aubert and Berggren, p. 429, pl. 8, fig. 5.
 1976 *Osangularia plummerae*; Salaj, pl. 8, fig. 4.
 1985 *Osangularia plummerae*; Luger, p. 110, pl. 8, fig. 6.
 1988 *Osangularia plummerae*; Keller, pl. 1, figs. 1-3.
 1993a *Osangularia plummerae*; Anan, pl. 317, pl. 3, fig. 9.

- 1994 *Osangularia plummerae*; Speijer, p. 56, pl. 7, fig. 5; p. 161, pl. 4, fig. 1.
- 2005 *Osangularia plummerae*; Sztrákos, p. 189, pl. 9, fig. 1; pl. 16, fig. 19.
- 2006 *Osangularia plummerae*; Alegret and Ortiz, p. 441, pl. 2, fig. 41.
- 2006 *Osangularia plummerae*; Ortiz and Thomas, p. 124, pl. 9, fig. 4.
- 2011 *Osangularia plummerae*; Sprong et al., p. 179, pl. 1, fig. 15.

Remarks: This Paleocene species is characterized by its biconvex test and distinct aperture. It was recorded from Sweden (Brotzen, 1940), Spain (Ortiz and Thomas, 2006), France (Sztrákos, 2005), Tunisia (Aubert and Berggren, 1975), Egypt (Luger, 1985) and J. Malaqet, UAE (Anan, 1993a). It is recorded from the Paleocene of J. Mundassa.

Superfamily Chilostomellacea Bandy, 1881
Family Heterolepididae González-Donoso, 1969

Genus *Anomalinoïdes* Brotzen, 1942

Type species. *Anomalinoïdes plummerae* Brotzen, 1942

***Anomalinoïdes acutus* (Plummer, 1927)**

- 1927 *Anomalina ammonoides* Reuss var. *acuta* Plummer, p. 149, pl. 10, fig. 2.
- 1948 *Anomalinoïdes acuta*; Brotzen, p. 87, pl. 14, fig. 2.
- 1976 *Anomalinoïdes acuta*; Aubert and Berggren, p. 430, pl. 9, fig. 1.
- 1993a *Anomalinoïdes acuta*; Anan, p. 317, pl. 3, fig. 10. 276, pl. 1, fig. 9.
- 2006 *Anomalinoïdes acutus*; Alegret and Ortiz, p. 438, pl. 1, fig. 12.
- 2011 *Anomalinoïdes acutus*; Aly et al., p. 116, pl. 8, fig. 1.

Remarks: This Paleocene–Late Eocene species was recorded from the USA (Plummer, 1927), Sweden (Brotzen, 1940), Tunisia (Aubert and Berggren, 1975), Egypt (Alegret and Ortiz, 2006), and J. Malaqet, UAE (Anan, 1993a). It is recorded from the Paleocene of J. Mundassa, UAE.

***Anomalinoïdes rubiginosus* (Cushman, 1926)**
(Pl. 2, fig. 9)

- 1926 *Anomalina rubiginosa* Cushman, p. 607, pl. 2, fig. 6.
- 1940 *Cibicides danica* Brotzen, p. 31, pl. 25, text-fig. 2.
- 1948 *Anomalinoïdes danica*; Brotzen, p. 87, pl. 14, fig. 13.
- 1953 *Anomalinagranaosa*; LeRoy, p. 17, pl. 6, figs. 1-3.
- 1956 *Anomalina dorri aragonensis*; Haque, p. 191, pl. 33, fig. 1.
- 1975 *Gavelinella danica*; Berggren and Aubert, p. 155, pl. 6, fig. 3.
- 1976 *Gavelinella rubiginosa*; Aubert and Berggren, p. 433, pl. 12, fig. 3.
- 1982 *Gavelinella rubiginosa*; Beckmann, p. 111, pl. 5, fig. 26.
- 1983 *Gavelinelladanica*; Tjalsma and Lohmann, p. 13, pl. 5, fig. 7.
- 1988 *Anomalinoïdes rubiginosus*; Kaiho, p. 554, fig. 1.
- 1993a *Gavelinelladanica*; Anan, p. 317, pl. 3, fig. 12.
- 1993b *Gavelinelladanica*; Anan, p. 666, pl. 3, fig. 18.
- 1994 *Anomalinoïdes rubiginosus*; Bolli et al., p. 158, fig. 44. 18,19.
- 2001 *Anomalinoïdes rubiginosus*; Shahin, p. 14, fig. 7. 18.

- 2001 *Anomalinoïdes rubiginosus*; Alegret and Thomas, p. 276, pl. 2, fig. 6.

- 2001 *Gavelinella rubiginosa*; El-Dawy, p. 46, pl. 3, figs. 15, 16.

- 2004 *Anomalinoïdes rubiginosus*; Anan, p. 45, pl. 1, figs. 7, 8.

- 2005 *Anomalinoïdes rubiginosus*; Sztrákos, p. 214, pl. 9, fig. 7.

- 2012 *Gavelinella rubiginosa*; Ismail, p. 41, pl. 3, fig. 27.

- 2012 *Gavelinella rubiginosa*; Youssef and Taha, pl. 5, fig. 7, 8.

- 2016 *Anomalinoïdesgranosa*; Orabi and Zaky, p. 188, pl. 3, fig. 21.

- 2020 *Anomalinoïdes rubiginosus*; Anan, p. 11, pl. 2.16.

Remarks: Berggren and Aubert (1975) noted that this Campanian–Eocene species has been recorded under several names in the literature. They also noted that the early Eocene *Gavelinelladanica* appears to have evolved into another species which the majority of workers have identified as *Gavelinella* or *Anomalinoïdes*. This form has been identified as the species *rubiginosa* and variously ascribed to the genus *Anomalinoïdes* or *Gavelinella*. These two species *danica* and *rubiginosus* have slightly differing morphology due to a function of depth. Bolli et al. (1994) noted that the shape variation from moderately planoconvex (predominant in the Late Cretaceous) to thick biconvex and pseudoplanispiral (mostly in the Paleocene) and the coiling are usually nearly involute. They also added that Cushman's *rubiginosus* may indicate a relationship to the *A. dorri aragonensis* group. The author believes that: 1) *A. danica* is a junior synonym of *A. rubiginosus*, 2) the shape of Late Cretaceous *A. rubiginosus* with moderately planoconvex and closely coiled test varies to a thick biconvex pseudo-planispiral Paleocene test, 3) the different shapes of the two forms are most probably related to water depth, 4) some Paleogene forms have slightly raised sutures in the early chambers. Anan (2004) proposed six benthic foraminiferal lineages, and one of them is the Maastrichtian–Paleocene *Anomalinoïdes rubiginosus* (Cushman) to Paleocene *A. midwayensis* (Plummer). This cosmopolitan species was recorded from the USA (Cushman, 1926), the Caribbean sea (Bolli et al., 1994), North and South Atlantic (Tjalsma and Lohmann, 1983), Sweden (Brotzen, 1948), Italy (Beckmann, 1982), Tunisia (Aubert and Berggren, 1975), Egypt (Shahin, 2001), J. Malaqet and Qarn El Barr sections, UAE (Anan, 1993a,b), Pakistan (Haque, 1956), New Zealand (Kaiho, 1988). It is recorded here from the Paleocene of J. Mundassa, UAE.

***Anomalinoïdes umboniferus* (Schwager, 1883)**

- 1883 *Discorbina praecursoria* var. *umbonifera* Schwager, p. 126, pl. 27 (4), fig. 14.

- 1953 *Anomalina umbonifera*; LeRoy, p. 18, pl. 7, figs. 15-17.

- 1985 *Anomalinoïdes umboniferus*; Luger, p. 111, pl. 8, figs. 10, 11.

- 2003 *Anomalinoïdes umboniferus*; Ali, p. 118, pl. 9, figs. 11-14.

- 2011 *Anomalina umbonifera*; Aly et al., p. 117, pl. 8, fig. 6.

- 2016 *Anomalinoïdes umboniferus*; Orabi and Zaky, p. 188, pl. 3, fig. 17.

Remarks: This Eocene species was recorded originally from Egypt. It is recorded here for the first time, outside Egypt from the Paleocene of J. Mundassa, UAE.

Family Gavelinellidae Hofker, 1956
Subfamily Gyroidinoidinae Saidova, 1981

Genus *Gyroidinoides* Brotzen, 1942
Type species. *Rotalia nitida* Reuss, 1844

***Gyroidinoides bollii* (Cushman and Renz, 1946)**

- 1946 *Eponides bollii* Cushman and Renz, p.44, pl. 7, fig. 23.
1988 *Gyroidinoides bollii*; Kaiho, p. 554, fig. 1.
1994 *Gyroidina bollii*; Bolli et al., p. 165, fig. 47. 20-22.

Remarks: According to Said and Kenawy (1956, p. 149), Reuss's original *Rotalia nitida*, which represents the type species of the genus *Gyroidinoides* Brotzen (1942) has been removed to a new generic name *Gyroidinoides*. Bolli et al. (1994) noted that the Maastrichtian '*Eponides*' *sigali* Said and Kenawy (1956) is a possible junior synonym of this Campanian–Paleocene species. It was recorded from the USA (Cushman and Renz, 1946), the Caribbean area (Bolli et al., 1994) and Japan (Kaiho, 1988). It is recorded for the first time in the Middle East, from the Paleocene of J. Mundassa, UAE.

***Gyroidinoides depressus* (Alth, 1850)**

- 1850 *Rotalina depressa* Alth, p. 266, pl. 13, fig. 21.
1946 *Gyroidina depressa*; Cushman, p. 139, pl. 58, figs. 1, 2.
1956 *Gyroidina depressa*; Said and Kenawy, p. 149, pl. 5, fig. 11.
1985 *Gyroidinoides depressus*; Luger, p. 109, pl. 8, fig. 1.
1993b *Gyroidinoides depressus*; Anan, p. 666.
2001 *Gyroidinoides depressus*; Alegret and Thomas, p. 286, pl. 6, fig. 9.
2012 *Gyroidinoides depressus*; Ismail, p. 40, pl. 3, fig. 22.

Remarks: This Maastrichtian–Early Eocene species is characterized by its compressed trochoid test with the rounded periphery, 10-12 chambers in the last-formed whorl, sutures curved and nearly flush in the dorsal side, but nearly radial in the ventral side. It was recorded from western Ukraine (Alth, 1850), the USA (Cushman, 1946), Mexico (Alegret and Thomas, 2001), Egypt (Said and Kenawy, 1956) and the Qarn El Barr section, UAE (Anan, 1993b). It is recorded from the Paleocene of J. Mundassa, UAE.

***Gyroidinoides girardanus* (Reuss, 1851)
(Pl. 2, fig. 10)**

- 1851 *Rotalia girardana* Reuss, p. 73, pl. 5, fig. 34.
1946 *Gyroidina girardana*; Cushman, p. 140, pl. 58, fig. 9.
1951 *Gyroidina girardana*; Cushman and Stainforth, p. 158, pl. 27, fig. 24.
1953 *Gyroidina girardana*; LeRoy, p. 35, pl. 5, figs. 10-12.
1956 *Gyroidina girardana*; Haque, p. 149, pl. 17, fig. 2.
1956 *Gyroidina girardana*; Said and Kenawy, p. 148, pl. 5, fig. 7.
1985 *Gyroidinoides girardanus*; Luger, p. 110, pl. 8, figs. 2, 3.
1988 *Gyroidinoides girardanus*; Kaiho, p. 554, fig. 1.
1993a *Gyroidinoides girardanus*; Anan, p. 317.
1994 *Gyroidinoides girardanus*; Speijer, p. 118, pl. 3, fig. 3.
2002 *Gyroidinoides girardanus*; Al-Hitmi, 49, pl. 3, fig. 15.
2004 *Gyroidinoides girardanus*; Anan, p. 47, pl. 1, figs. 11, 12.

- 2006 *Gyroidinoides girardanus*; Ortiz and Thomas, p. 119, pl. 7, fig. 4.
2011 *Gyroidinoides girardanus*; Aly et al., p. 117, pl. 8, fig. 8.
2012 *Gyroidinoides girardanus*; Ismail, p. 40, pl. 3, fig. 23.
2020 *Gyroidinoides girardanus*; Anan, p. 11.

Remarks: This Maastrichtian–Oligocene species has a planoconvex and high trochospiral test. It is easily distinguished from other *Gyroidinoides* species by its conspicuous concave apertural face and by the overhanging lower edges of the ventral chambers. Anan (2004) proposed six benthic foraminiferal lineages, and one of them is the Maastrichtian–Oligocene *G. girardanus* (Reuss) to Paleocene *G. luterbacheri* Anan. This cosmopolitan species was recorded from Germany (Reuss, 1851), the USA (Cushman, 1946), Ecuador (Cushman and Stainforth, 1951), Trinidad (Cushman and Stainforth, 1945), Egypt (LeRoy, 1953), J. Malaqet, UAE (Anan, 1993a), Qatar (Al-Hitmi, 2002), Pakistan (Haque, 1956) and New Zealand (Kaiho, 1988). It is recorded here from the Paleocene of J. Mundassa, UAE.

***Gyroidinoides globosus* (Hagenow, 1842)**

(Pl. 2, fig. 11)

- 1842 *Nonionina globosa* Hagenow, p. 574.
1946 *Gyroidina globosa*; Cushman, p. 140, pl. 58, figs. 6-8.
1956 *Gyroidina globosa*; Said and Kenawy, p. 149, pl. 5, fig. 5.
1968 *Gyroidinoides globosus*; Sliter, p. 675, pl. 10, figs. 7, 8.
1983 *Gyroidinoides globosus*; Tjalsma and Lohmann, p. 58, pl. 7, fig. 5.
1988 *Gyroidinoides globosus*; Kaiho, p. 556, fig. 2.
1993b *Gyroidinoides globosus*; Anan, p. 666.
1994 *Gyroidinoides globosus*; Bolli et al., p. 159, fig. 45. 1-3.
1995 *Gyroidinoides globosus*; Nomura and Brohi, p. 220, fig. 4.
2005 *Gyroidinoides globosus*; Alegret and Thomas, p. 61, 72.
2011d *Gyroidinoides globosus*; Anan, p. 303, pl. 1, fig. 10.
2012 *Gyroidinoides globosus*; Youssef and Taha, pl. 6, fig. 1.

Remarks: The Maastrichtian–Eocene cosmopolitan species *globosus* differs from other species of the genus *Gyroidinoides* by its very broadly rounded periphery, tight umbilical area and very rounded test. It was recorded from Germany (Hagenow, 1842), the USA (Cushman, 1946), Atlantic Ocean (Tjalsma and Lohmann, 1983), Trinidad (Bolli et al., 1994), Mexico (Sliter, 1968), Egypt (Said and Kenawy, 1956), the Qarn El Barr section, UAE (Anan, 1993b), Pakistan (Nomura and Brohi, 1995), and Japan (Kaiho, 1988). It is recorded here for the first time, from the Paleocene of J. Mundassa, UAE.

***Gyroidinoides reussi* (Said and Kenawy, 1956)**

(Pl. 2, fig. 12)

- 1956 *Gyroidina reussi* Said and Kenawy, p. 149, pl. 5, fig. 10.

Remarks: This Paleocene species has a plano-convex smooth test, periphery broadly rounded, sutures slightly curved, aperture a low slit at the base of the last chamber from the 6 chambers in the last whorl. This species was originally recorded from Egypt (Said and Kenawy, 1956). It is recorded for the first time outside Egypt, from the Paleocene of J. Mundassa, UAE.

- Gyroidinoides subangulatus* (Plummer, 1927)**
 (Pl. 2, fig. 13)
- 1927 *Rotalia soldanii* (d'Orbigny) var. *subangulata* Plummer, p. 154, pl. 12, fig. 1.
- 1953 *Gyroidina subangulata*; LeRoy, p. 35, pl. 3, figs. 23-25.
- 1956 *Gyroidina subangulata*; Said and Kenawy, p. 149, pl. 5, fig. 9.
- 1976 *Gyroidinoides subangulatus*; Aubert and Berggren, p. 429, pl. 8, fig. 6.
- 1976 *Gyroidinoides subangulatus*; Salaj, pl. 8, fig. 5.
- 1993b *Gyroidinoides subangulatus*; Anan, p. 666.
- 1994 *Gyroidinoides subangulatus*; Bolli et al., p. 159, fig. 45. 25-27.
- 2001 *Gyroidinoides subangulatus*; El-Dawy, p. 46, pl. 3, fig. 10.
- 2003 *Gyroidinoides subangulatus*; Ali, p. 120, pl. 11, figs. 1-3.
- 2005 *Gyroidinoides subangulatus*; Sztrákos, p. 189, pl. 17, fig. 9.
- 2005 *Gyroidinoides subangulatus*; Clemmensen and Thomsen, p. 358, pl. 3, figs. 20-22.
- 2006 *Gyroidinoides subangulatus*; Karoui-Yaakoub, p. 584, pl. 2, figs. 13, 14.
- 2016 *Gyroidinoides subangulatus*; Orabi and Zaky, p. 188, pl. 3, fig. 20.
- 2020 *Gyroidinoides subangulatus*; Anan, p. 11, pl. 2.18.

Remarks: This Paleocene species has a plano-convex smooth test, with 8-9 chambers in the final whorl, and sutures slightly depressed. It was recorded from the USA (Plummer, 1927), North Sea Basin (Clemmensen and Thomsen, 2005), France (Sztrákos, 2005), Tunisia (Aubert and Berggren, 1976), Egypt (Said and Kenawy, 1956) and the Qarn El Barr section, UAE (Anan, 1993b). It is recorded here, from the Paleocene of J. Mundassa, UAE.

Genus *Stensiöeina* Brotzen, 1942

Type species. *Rotalia exsculpta* Reuss, 1860
Stensiöeina esnehensis Nakkady, 1950

1950 *Stensiöeina esnehensis* Nakkady, p. 689, pl. 90, figs. 8-10.

2009a *Stensiöeina esnehensis*; Anan, p. 43.

2011c *Stensiöeina esnehensis*; Anan, p. 23, pl. 2, fig. 14.

Remarks: This species has plano-convex test with 10 chambers, dorsal side flat, but dome-shaped ventral side, curved, raised and ornate dorsal sutures, but slightly raised and gently curved ventral side. It was recorded originally from the Maastrichtian rocks of Wadi Danili and Abu Zenima sections, Sinai, Egypt. It is recorded here for the first time outside Egypt, from the Paleocene of J. Mundassa, UAE.

Subfamily Gavelinellinae Hofker, 1956

Genus *Angulogavelinella* Hofker, 1957

Type species. *Discorbis gracilis* Marsson, 1878

***Angulogavelinella abudurbensis* (Nakkady, 1950)**
 (Pl. 2, fig. 14)

1950 *Cibicides abudurbensis* Nakkady, p. 691, pl. 90, figs. 35-38.

1956 *Cibicides* cf. *abudurbensis*; Said and Kenawy, p. 154, pl. 7, fig. 7.

1993b *Cibicidoides abudurbensis*; Anan, p. 663, pl. 3, fig. 13.

- 1994 *Cibicidoides abudurbensis*; Speijer, p. 54, pl. 4, fig. 6.
- 2003 *Angulogavelinella abudurbensis*; El-Dawy and Hewaidy, p. 79, pl. 1, figs. 4-6.
- 2004 *Cibicidoides abudurbensis*; Anan, p. 44, pl. 1, fig. 5.
- 2005 *Gavelinella abudurbensis*; Sztrákos, p. 230, pl. 17, fig. 11.
- 2009a *Cibicidoides abudurbensis*; Anan, p. 40, pl. 1, fig. 12.
- 2016 *Cibicidoides abudurbensis*; Orabi and Zaky, p. 188, pl. 3, fig. 15.

Remarks: The genus *Cibicidoides* Thalmann differs from *Gavelinella* Brotzen by its biconvex and biumbonate test and angular periphery than rounded in the other (Loeblich and Tappan, 1987). Weidich (1995) referred the species *abudurbensis* to the genus *Angulogavelinella* due to its apertural characteristics, functional morphology and bilamellar wall ultrastructure of the test. Nakkady (1950) originally recorded his species *abudurbensis* from the Maastrichtian of Abu Durba and Wadi Danili sections, Sinai, Egypt. It was also recorded from the Qarn El Barr section, UAE (Anan, 1993b), Tunisia (Speijer, 1994), France (Sztrákos, 2005). It is recorded here from the Paleocene of J. Mundassa, UAE.

***Angulogavelinella avnimelechi* (Reiss, 1952)**

(Pl. 2, fig. 15)

- 1952 *Pseudovalvularia avnimelechi* Reiss, p. 269, text-fig. 2.
- 1976 *Angulogavelinella avnimelechi*; Aubert and Berggren, p. 431, pl. 8, figs. 8, 9.
- 1988 *Angulogavelinella avnimelechi*; Saint-Marc and Berggren, p. 111, pl. 4, figs. 13-16.
- 1993a *Angulogavelinella avnimelechi*; Anan, p. 317, pl. 3, fig. 11.
- 1994 *Angulogavelinella avnimelechi*; Bolli et al., p. 161, fig. 45. 34-36.
- 2001 *Angulogavelinella avnimelechi*; Hewaidy and Strougo, p. 17, pl. 2, fig. 35.
- 2003 *Angulogavelinella avnimelechi*; Ali, pl. 10, figs. 18-20.
- 2004 *Angulogavelinella avnimelechi*; Anan, p. 49, pl. 1, fig. 14.
- 2005 *Angulogavelinella avnimelechi*; Sztrákos, p. 214, pl. 9, fig. 13.
- 2006 *Angulogavelinella avnimelechi*; Alegret and Ortiz, p. 442, pl. 1, figs. 10, 11.
- 2012 *Angulogavelinella avnimelechi*; Youssef and Taha, pl. 6, figs. 14, 15.
- 2020 *Angulogavelinella avnimelechi*; Anan, p. 12.

Remarks: This Maastrichtian-Paleocene species is characterized by its high conical planoconvex test, with flat dorsal side, keeled periphery, limbate ventral sutures with irregular depressions radiating from the umbilicus. Many authors, i.e., Berggren and Miller (1989), Anan (1993a; 2004), Alegret and Ortiz (2006), considered the last occurrence of the *avnimelechi* species marks the Paleocene/Eocene boundary. Anan (2004) proposed six benthic foraminiferal lineages, and one of them is the Maastrichtian *Angulogavelinella nekhiana* (Said and Kenawy) to Maastrichtian-Paleocene *A. avnimelechi* (Reiss). It was recorded in the Caribbean region (Bolli et al., 1994), France (Sztrákos, 2005), Tunisia (Saint-Marc and Berggren, 1988), Egypt (Alegret and Ortiz, 2006),

J. Malaqet, UAE (Anan, 1993a). It is recorded here from the Paleocene of J. Mundassa, UAE.

Genus *Paralabamina* Hansen, 1970

Type species. *Eponides lunata* Brotzen, 1948

***Paralabamina lunata* (Brotzen, 1948)**

1948 *Eponides lunata* Brotzen, p. 77, pl. 10, figs. 17, 18.

1953 *Eponides lunatus*; LeRoy, p. 30, pl. 9, figs. 24-26.

1956 *Eponides lunatus*; Said and Kenawy, p. 148, pl. 5, fig. 3.

1987 *Paralabamina lunata*; Loeblich and Tappan, p. 641, pl. 721, figs. 1-7.

1990 *Neoepnides lunata*; Thomas, p. 593, pl. 2, figs. 5, 6.

2011 *Eponides lunata*; Aly et al., p. 109, pl. 6, fig. 4.

2020 *Paralabamina lunata*; Anan, p. 12, pl. 2.20.

Remarks: This Paleocene-Middle Eocene species has biconvex test, 5-6 chambers in the last whorl with a low slit aperture at the base of the last chamber. According to Loeblich and Tappan (1987), the species *lunata* was treated as the type species of the genus *Paralabamina* Hansen (1970). It was recorded from Sweden (Brotzen, 1948), Antarctica (Thomas, 1990), Egypt (LeRoy, 1953). It is also recorded here from the Paleocene of J. Mundassa, UAE.

5. Eustatic changes and tectonism in the Al Ain area

The deposition of the Paleocene Mundassa Member (MM) of the Muthaymimah Formation (MF) at both J. Mundassa and J. Malaqet in the Al Ain area reflect the effects of tectonic movements and sea-level changes. The pattern of sediments was driven by relatively rapid subsidence punctuated by eustatic sea-level variation.

1. The Tertiary sea began with the deposition of the neoautochthonous sediments of the lower Danian shaly marl succession (about 20 meters thick) in the Mundassa Basin, while the Malaqet area was still land. The Mundassa Basin hosted deposition of a Danian sedimentary sequence, which rests nonconformity on the obducted pre-Maastrichtian Semail Ophiolite (SO) that was deformed later by thrust faults and folds (Anan, 1993a).
2. The duration of the hiatus at the Cretaceous/Paleogene

(K/P) boundary in Mundassa section includes the two earliest Danian biozones: P0 and Pa, about 0.02 Ma (Figure 2), while at J. Malaqet a marked basal conglomerate bed (about 0.50 cm) between the obducted pre-Maastrichtian SO and the upper Maastrichtian neautochthonous limestone sediments of the Simsima Formation (SF) is observed. This depositional gap in the Al Ain area corresponds to an interval of tectonic activity that existed at most localities throughout the Middle East and other parts of the world (Anan, 2016).

3. The eustatic sea-level rise more and more in the Mundassa area and deposited the Selandian succession (covered area). The seawater also covered the Malaqet area (north of the Mundassa area) which rests on the shallow environment upper Maastrichtian neautochthonous limestone sediments SF, and the deposition of the upper Danian MM exposed sediments in J. Malaqet took place with about 6 m thick (*Morozovella angulata* Zone) which may represent continued subsidence below sea level (Anan, 1993a; 2014).
4. After that, an intraformational bed (about 10 meters thick) in the Malaqet area accumulated upon the 6 m of upper Danian sediments, which represents rapid tectonics (Anan, 2015a).

6. Temporal distribution of the Paleocene species in J. Mundassa

Table 1 shows the distribution of forty six rotaliid benthic foraminiferal species belonging to twenty six genera from the Paleocene (Danian) in J. Mundassa. The following remarks can be presented:

1. Ten species are recorded in the Paleocene sediments of three exposed sections in the UAE (J. Mundassa, J. Malaqet and Qarn El Barr sections): *Pleurostomella subnodosa*, *Nuttallides truempyi*, *Pullenia coryelli*, *P. quinqueloba*, *Alabamina midwayensis*, *Osangularia plummerae*, *Anomalinoides rubiginosus*, *Gyroidinoides subangulata*, *Angulogavelinella abudurbensis* and *A. avnimelechi*.

Table 1. The distribution of the rotaliid Paleocene benthic foraminiferal species in Jabal Mundassa section, Al Ain area, UAE (samples number 1-14), x = recorded, Θ = illustrated.

p. No.	Paleocene rotaliid benthic foraminiferal species	Sample no	Jabal Mundassa section													
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	<i>Bolivinoides</i>	<i>curtus</i>	-	-	-	-	-	-	-	-	-	-	-	x	Θ	x
2	<i>Praebulimina</i>	<i>carseyae</i>	-	-	-	-	-	-	-	-	-	x	-	x	x	-
3	<i>Orthokarstenia</i>	<i>applinae</i>	-	-	-	x	-	-	x	x	x	-	-	-	-	-
4	<i>Bulimina</i>	<i>mexicana</i>	-	-	-	-	-	-	-	x	-	x	x	-	x	Θ
5		<i>midwayensis</i>	x	-	x	-	-	x	-	x	-	Θ	x	-	-	-
6		<i>trinitatensis</i>	-	-	-	-	-	-	-	x	-	x	Θ	-	-	x
7	<i>Buliminella</i>	<i>grata</i>	-	-	-	-	-	-	-	-	Θ	-	-	x	x	x
8	<i>Globobulimina</i>	<i>suteri</i>	-	-	-	-	-	-	-	-	-	-	-	x	-	Θ

Continue Table 1

p. No.	Paleocene rotaliid benthic foraminiferal species	Sample no	Jabal Mundassa section													
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
9	<i>Coryphostoma</i>	<i>midwayensis</i>	-	-	-	-	-	-	x	-	-	-	-	-	x	Θ
10		<i>nehliana</i>	-	-	-	-	-	-	-	-	-	-	-	x	Θ	x
11	<i>Ellipsoglandulina</i>	<i>arafati</i>	-	-	-	-	-	-	-	-	-	-	x	x	-	x
12		<i>ellisi</i>	-	-	-	-	-	-	x	-	-	-	-	-	-	x
13	<i>Nodosarella</i>	<i>gracillima</i>	-	-	-	-	-	-	-	-	-	x	-	-	-	Θ
14		<i>paleocenica</i>	-	-	-	-	-	-	-	-	-	-	-	-	x	x
15		<i>subnodososa</i>	-	-	-	-	-	-	-	-	-	-	-	Θ	-	-
16	<i>Pleurostomella</i>	<i>naranjoensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	Θ
17		<i>subnodososa</i>	-	-	-	-	-	-	-	-	-	-	-	x	Θ	x
18	<i>Orthomorphina</i>	<i>rohri</i>	-	-	-	x	-	-	-	-	x	x	-	-	-	x
19	<i>Stilostomella</i>	<i>paleocenica</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	Θ
20	<i>Valvulineria</i>	<i>scrobiculata</i>	x	-	-	x	x	-	-	-	-	-	x	x	x	Θ
21	<i>Cibicidoides</i>	<i>pharaonis</i>	-	-	-	x	x	-	-	x	x	x	x	x	x	x
22		<i>pseudoacutus</i>	x	x	-	x	x	-	x	x	-	x	-	-	-	-
23	<i>Nuttallides</i>	<i>truempyi</i>	-	-	-	-	-	-	Θ	-	-	-	-	x	-	-
24	<i>Epistomaroides</i>	<i>spissiformis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	x
25	<i>Pullenia</i>	<i>angusta</i>	-	-	-	-	-	-	-	-	-	-	-	Θ	-	-
26		<i>coryelli</i>	-	-	-	-	-	-	-	-	-	-	Θ	-	-	-
27		<i>eocenica</i>	-	-	-	x	-	-	-	-	-	-	-	-	-	-
28		<i>quinqueloba</i>	-	-	-	-	-	-	-	-	-	Θ	-	-	-	-
29		<i>reussi</i>	-	-	-	-	-	-	-	-	-	-	-	Θ	-	-
30	<i>Quadrimorphina</i>	<i>esnehensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	x
31	<i>Alabamina</i>	<i>midwayensis</i>	-	-	-	-	-	-	x	-	-	-	x	x	-	-
32	<i>Valvalabamina</i>	<i>planulata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	Θ
33	<i>Osangularia</i>	<i>plummerae</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	x
34	<i>Anomalinoides</i>	<i>acutus</i>	-	-	-	-	-	-	-	-	-	-	-	x	x	-
35		<i>rubiginosus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	Θ
36		<i>umbonifera</i>	-	-	x	-	-	-	-	-	-	-	-	-	-	-
37	<i>Gyroidinoides</i>	<i>bollii</i>	-	-	-	-	-	-	-	-	-	-	x	-	-	-
38		<i>depressus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	x
39		<i>girardanus</i>	-	-	x	-	-	-	Θ	-	-	x	-	-	-	-
40		<i>globosus</i>	-	-	-	-	-	-	Θ	-	-	-	-	-	-	x
41		<i>reussi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	Θ
42		<i>subangulatus</i>	-	x	-	-	-	-	Θ	-	x	-	-	-	-	-
43	<i>Stensiöeina</i>	<i>esnehensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	x
44	<i>Angulogavelinella</i>	<i>abudurbensis</i>	x	x	-	x	-	-	x	x	x	x	x	x	x	Θ
45		<i>avnimelechi</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	Θ
46	<i>Paralabamina</i>	<i>lunata</i>	-	-	-	-	-	-	x	x	-	x	-	x	x	x

2. The UAE Paleocene benthic foraminiferal species are of the Midway type is suggested (according to Berggren and Aubert, 1975) and characteristic of essentially middle to outer shelf depth varying from 50–200 meters in the Danian, which due to variations in the depositional conditions throughout the Paleocene time.

Table 2 shows the paleogeographic distribution of the Paleocene rotaliid benthic foraminiferal species in the UAE and some other Tethyan localities. The following remarks can be presented:

- 1- The diversity of the identified rotaliid species gradually increased upward throughout the Paleocene of J. Mundassa, which may be explained by an increase in water depth.
- 2- The Paleocene succession of UAE yields 59 rotaliid species compared with 46 species from J. Mundassa, 27 species from J. Malaqet, and 21 species of Qarn El Barr section (Anan, 1993a,b)

3- The identified rotaliid Paleocene species from UAE (59 species) compared with 50 species that recorded from Egypt (LeRoy, 1953; Said and Kenawy, 1956), 27 species from the USA (Plummer, 1927; Cushman, 1922, 1927, 1936, 1946, 1951), 26 species from Tunisia (Berggren and Aubert, 1975), 24 species from Caribbean (Bolli et al., 1994), 15 species from each of EU (Reuss, 1851, 1860; Sztrákos, 2000, 2005; Proto Decima and Bolli, 1982) and Atlantic Ocean (Tjalsma and Lohmann, 1983), 9 species from Pakistan (Haque, 1956; Nomura and Brohi, 1995), 7 from Japan and New Zealand (Kaiho, 1988), 5 species from Iraq (Al-Omari, 1970), 4 species from the Arabian Sea (Boltovskoy and Watanabe, 1985) and only 3 species from Jordan (Futyan, 1976). The unclosed number of Paleocene rotaliid species in the different localities in the Tethys may due to lack of available study, different latitudes, differences in paleoenvironmental conditions (depth, salinity, temperature, dissolved oxygen, nutrients).

Table 2. Paleogeographic distribution of the Paleocene rotaliid benthic foraminifera in the United Arab Emirates = UAE (MN = Mundassa and MQ = Malaqet, QB = Qarn El Barr sections) and some other Tethyan localities: USA = United States of America and Mexico, C = Caribbean region (Trinidad, Cuba), AO = Atlantic Ocean, EU = Europe (Sweden, Spain, France, Germany, Italy, Poland, Bulgaria, Slovenia, Czech), T = Tunisia, E = Egypt, J = Jordan, I = Iraq, AS = Arabian Sea, P = Pakistan, JZ = Japan and New Zealand (x = recorded species, - = not recorded).

Sp. No.	Paleocene rotaliid Benthic foraminiferal species	United Arab Emirates				Some Tethyan localities											
		MN	MQ	QB	UAE	USA	C	AO	EU	T	E	J	I	AS	P	JZ	
1	<i>Bolivinoides</i>	<i>curtus</i>	x	x	-	x	-	-	-	x	-	x	-	-	-	-	-
2	<i>Aragonina</i>	<i>velascoensis</i>	-	-	x	x	x	-	x	x	x	-	-	-	-	-	-
3	<i>Eouvigerina</i>	<i>aegyptiaca</i>	-	x	x	x	-	-	-	-	-	x	-	-	-	-	-
4	<i>Praebulimina</i>	<i>carseyae</i>	x	-	x	x	x	-	-	x	-	x	-	x	-	-	-
5	<i>Orthokarstenia</i>	<i>applinae</i>	x	x	-	x	x	-	-	x	x	x	x	-	-	x	-
6	<i>Bulimina</i>	<i>mexicana</i>	x	-	-	x	x	-	-	x	-	x	-	-	-	-	-
7		<i>midwayensis</i>	x	x	-	x	x	x	x	x	x	x	-	-	-	-	x
8		<i>quadrata</i>	-	-	x	x	x	-	-	x	x	-	-	-	-	-	-
9		<i>trinitatensis</i>	x	x	-	x	x	x	-	x	-	x	-	-	-	-	-
10	<i>Buliminella</i>	<i>grata</i>	x	-	-	x	-	x	x	-	-	-	-	-	x	-	-
11	<i>Globobulimina</i>	<i>suteri</i>	x	-	-	x	-	x	-	-	x	x	-	-	-	-	-
12	<i>Trifarina</i>	<i>esnaensis</i>	-	x	-	x	-	-	-	-	x	-	-	-	-	-	-
13	<i>Coryphostoma</i>	<i>midwayensis</i>	x	-	-	x	x	x	-	x	x	x	-	-	-	x	-
14		<i>nekhliana</i>	x	-	-	x	-	-	-	-	x	-	-	-	-	-	-
15	<i>Ellipsoglandulina</i>	<i>arafati</i>	x	-	-	x	-	-	-	-	-	x	-	-	-	-	-
16		<i>ellisi</i>	x	-	-	x	-	-	-	-	x	-	-	-	-	-	-

Continue Table 2

Sp. No.	Paleocene rotaliid Benthic foraminiferal species	United Arab Emirates				Some Tethyan localities										
		MN	MQ	Q B	UAE	USA	C	AO	EU	T	E	J	I	AS	P	JZ
17	<i>Nodosarella</i>	<i>gracillima</i>	x	-	-	x	x	-	-	-	x	-	-	-	-	-
18		<i>paleocenica</i>	x	-	-	x	x	x	-	-	x	-	-	-	x	-
19		<i>subnodososa</i>	x	-	-	x	x	x	x	x	-	x	-	-	-	-
20	<i>Pleurostomella</i>	<i>naranjoensis</i>	x	-	-	x	-	x	-	-	x	-	-	-	-	x
21		<i>subnodososa</i>	x	x	x	x	x	-	-	-	x	x	-	x	-	-
22	<i>Orthomorphina</i>	<i>rohri</i>	x	-	-	x	-	x	x	x	-	-	-	-	-	-
23	<i>Stilostomella</i>	<i>paleocenica</i>	x	-	-	x	x	x	-	x	x	x	-	-	-	x
24	<i>Valvulineria</i>	<i>aegyptiaca</i>	-	x	-	x	-	-	-	-	x	-	-	-	-	-
25		<i>scrobiculata</i>	x	-	-	x	-	-	-	-	x	x	-	-	-	-
26	<i>Discorbis</i>	<i>newmanae</i>	-	x	-	x	-	-	-	-	-	-	-	-	-	-
27	<i>Cibicidoides</i>	<i>allenii</i>	-	x	x	x	-	-	x	x	x	x	-	-	-	-
28		<i>howelli</i>	-	x	x	x	-	-	-	-	x	x	-	-	-	-
29		<i>mellahensis</i>	-	-	x	x	-	-	-	-	-	-	-	-	-	-
30		<i>pharaonis</i>	x	-	-	x	-	-	-	-	x	x	-	-	-	-
31		<i>pseudoacutus</i>	x	-	-	x	-	-	-	x	x	x	-	-	-	-
32	<i>Nuttallides</i>	<i>truempyi</i>	x	x	x	x	-	x	x	x	x	x	-	-	-	x
33	<i>Epistomaroides</i>	<i>spissiformis</i>	x	-	-	x	x	x	x	-	x	-	-	-	-	-
34	<i>Pullenia</i>	<i>angusta</i>	x	-	-	x	-	x	-	-	x	-	-	-	-	-
35		<i>coryelli</i>	x	x	x	x	x	x	x	-	x	-	x	-	-	x
36		<i>eocenica</i>	x	-	-	x	x	x	x	-	x	-	-	x	-	-
37		<i>quinqueloba</i>	x	x	x	x	-	x	x	x	x	x	-	-	-	x
38		<i>reussi</i>	x	x	-	x	-	-	-	-	-	-	-	-	-	-
39	<i>Quadrrimorphina</i>	<i>allomorphinoides</i>	-	x	x	x	x	x	-	-	x	x	x	-	-	-
40		<i>esnehensis</i>	x	-	-	x	-	-	-	-	-	-	x	-	-	-
41	<i>Alabamina</i>	<i>midwayensis</i>	x	x	x	x	x	-	-	-	x	x	-	-	-	-
42	<i>Valvalabamina</i>	<i>planulata</i>	x	-	-	x	x	x	-	x	x	x	-	-	-	-
43	<i>Osangularia</i>	<i>plummerae</i>	x	x	x	x	-	-	-	x	x	x	-	-	-	-
44	<i>Anomalinoides</i>	<i>acutus</i>	x	x	-	x	x	-	-	x	x	x	-	-	-	-
45		<i>rubiginosus</i>	x	x	x	x	x	x	-	x	x	x	-	-	x	x

Continue Table 2

Sp. No.	Paleocene rotaliid Benthic foraminiferal species	United Arab Emirates				Some Tethyan localities										
		MN	MQ	Q B	UAE	USA	C	AO	EU	T	E	J	I	AS	P	JZ
46	<i>sinaensis</i>	-	-	X	X	-	-	-	-	-	X	-	-	-	-	-
47	<i>umboniferus</i>	X	-	-	X	-	-	-	-	-	X	-	-	-	-	-
48	<i>velascoensis</i>	-	-	X	X	X	-	-	-	-	X	-	X	-	-	-
49	<i>Gyroidinoides</i>	<i>bollii</i>	X	-	-	X	X	X	-	-	-	X	-	-	-	X
50		<i>depressus</i>	X	X	-	X	X	-	-	-	X	-	-	-	-	-
51		<i>girardanus</i>	X	X	-	X	-	X	X	-	-	X	-	-	-	X
52		<i>globosus</i>	X	X	-	X	X	X	-	X	X	-	-	X	X	X
53		<i>nitidus</i>	-	-	X	X	X	-	-	X	X	X	-	X	-	-
54		<i>reussi</i>	X	-	-	X	-	-	-	-	X	-	-	-	-	-
55		<i>subangulatus</i>	X	X	X	X	X	X	X	X	X	X	-	-	-	-
56	<i>Stensiöeina</i>	<i>esnehensis</i>	X	-	-	X	-	-	-	-	X	-	-	-	-	-
57	<i>Angulogavelinella</i>	<i>abudurbensis</i>	X	X	X	X	-	-	-	-	X	-	-	-	-	-
58		<i>avnimelechi</i>	X	X	X	X	-	X	X	X	X	X	-	-	X	X
59	<i>Paralabamina</i>	<i>lunata</i>	X	X	-	X	-	-	-	X	-	X	-	-	-	-

- 4- The close resemblance of the Paleocene rotaliid species of the UAE (59 species) with the synchronous age assemblage from Egypt (50 species) shows that they most probably were parts of the same paleogeographic province at that time.
- 5- Twenty five species have wide geographic distribution, having been found at more than four localities): *Aragon iavelascoensis*, *Praebulimina carseyae*, *Orthokarstenia applinae*, *Bulimina midwayensis*, *Coryphostoma midwayensis*, *Nodosarella paleocenica*, *N. subnodososa*, *Pleurostomella subnodososa*, *Stilostomella paleocenica*, *Cibicidoides allenii*, *Nuttallides truempyi*, *Epistomarooides spissiformis*, *Pullenia coryelli*, *P. eocenica*, *P. quinqueloba*, *Quadrrimorphina allomorphinoides*, *Valvalabamina planulata*, *Anomalinoides acutus*, *A. rubiginosus*, *Gyroidinoides bollii*, *G. girardanus*, *G. globosa*, *G. nitidus*, *G. subangulata* and *Angulogavelinella avnimelechi*.
- 6- The wide geographic distribution of the recorded rotaliid assemblage emphasizes the interpretations that have been presented by some authors (i.e. Berggren, 1971; Adams et al., 1983; Rögl, 1999; Meulenkamp and Sissingh, 2003) about the extended realms of the Indo-Pacific with the Atlantic via the Tethys during the Paleocene.

7. Summary and Conclusions

- The studied section Jabal Mundassa represents the only outcrop in the Al Ain area (UAE) containing Danian sediments (Fig. 3, samples 1-14).
- Forty six rotaliid benthic foraminiferal species belonging to twenty six genera are identified and most of them (28 species, about 60 %) are illustrated.
- The K/P boundary in J. Mundassa is represented by a nonconformity, which is located between the pre-Maastrichtian allochthonous igneous rocks (SO) and the neoautochthonous Danian sedimentary rocks of the MM of the MF. The missing horizon includes the two early Danian biozones: *G. cretacea* (P0) and *P. eugubina* (Pa) as documented by Anan (2015a, b, 2016 and current study). This missing horizon at K/P boundary was most probably controlled by active tectonic (mainly synsedimentary faulting) and eustatic sea-level changes at that time (Vail et al., 1977).
- The studied section (J. Mundassa) has the only Danian outcrop in the Al Ain area, UAE (*Parasubbotina pseudobulloides* (P1a), *Subbotina triloculinoides* (P1b), *Globanomalina compressa/Praemurica inconstans*

(P1c) *Praemurica uncinata* (P2) Zones, and *Morozovella angulata* Zone (P3a) rest unconformably on the pre-Maastrichtian Serpentine Semail Ophiolite (Anan, 2016). On the other hand, the Paleocene sediments in the Qarn El Barr section (located about 6 km southwest of Al Dhayd city, in eastern Sharjah Emirate, UAE) is represented by the latest Danian *Morozovella angulata* Zone (P3a) (Anan, 1993b).

- The Cenozoic history of the Arabian Gulf area began with regression at the K/P boundary, which left most of Arabia emergent, except for the basinal areas in the northern UAE (Ras Al Khaima Basin) and in the southern UAE (Mundassa Basin), which left a Danian marine basin.

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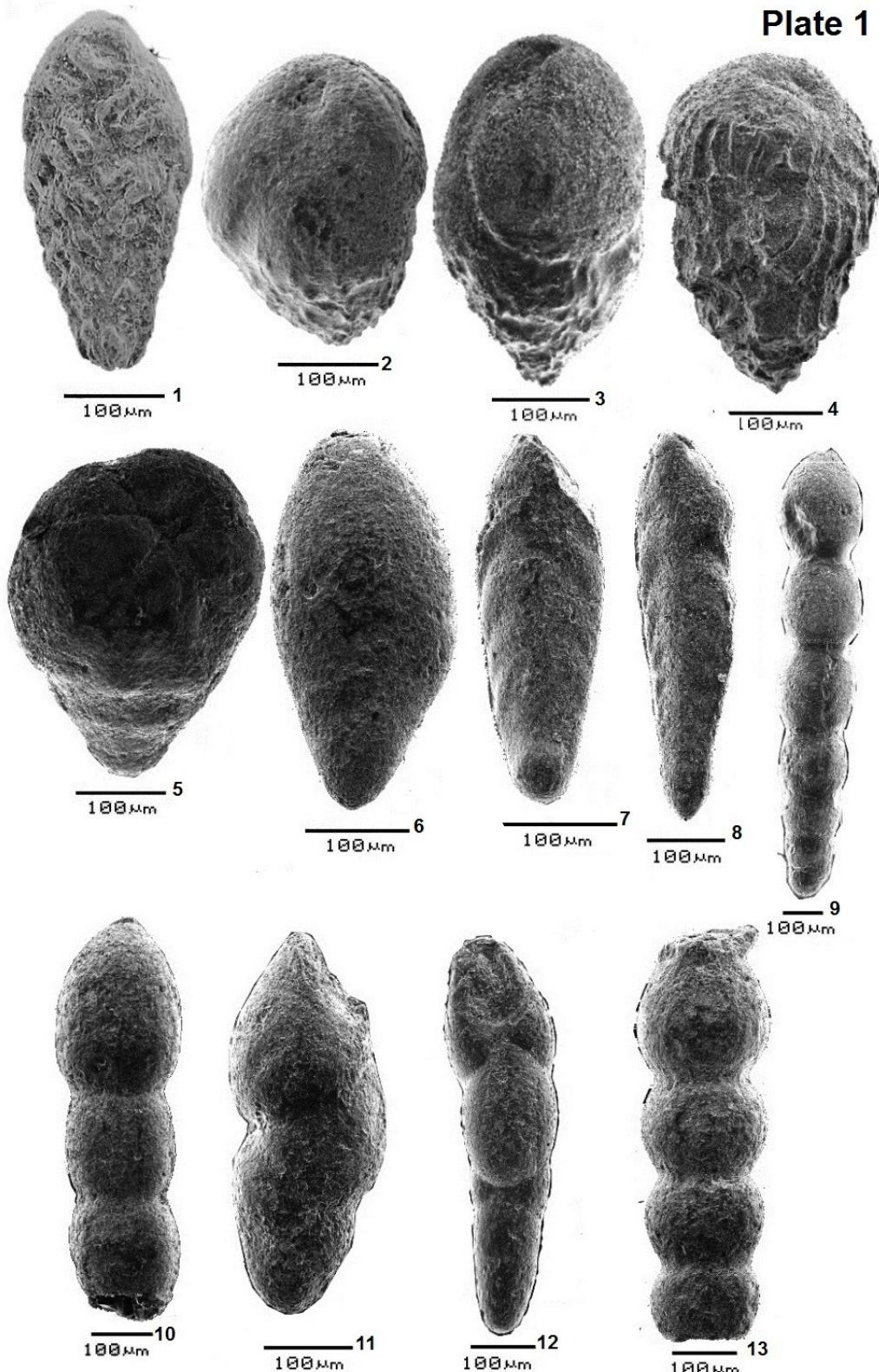
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Plate 1

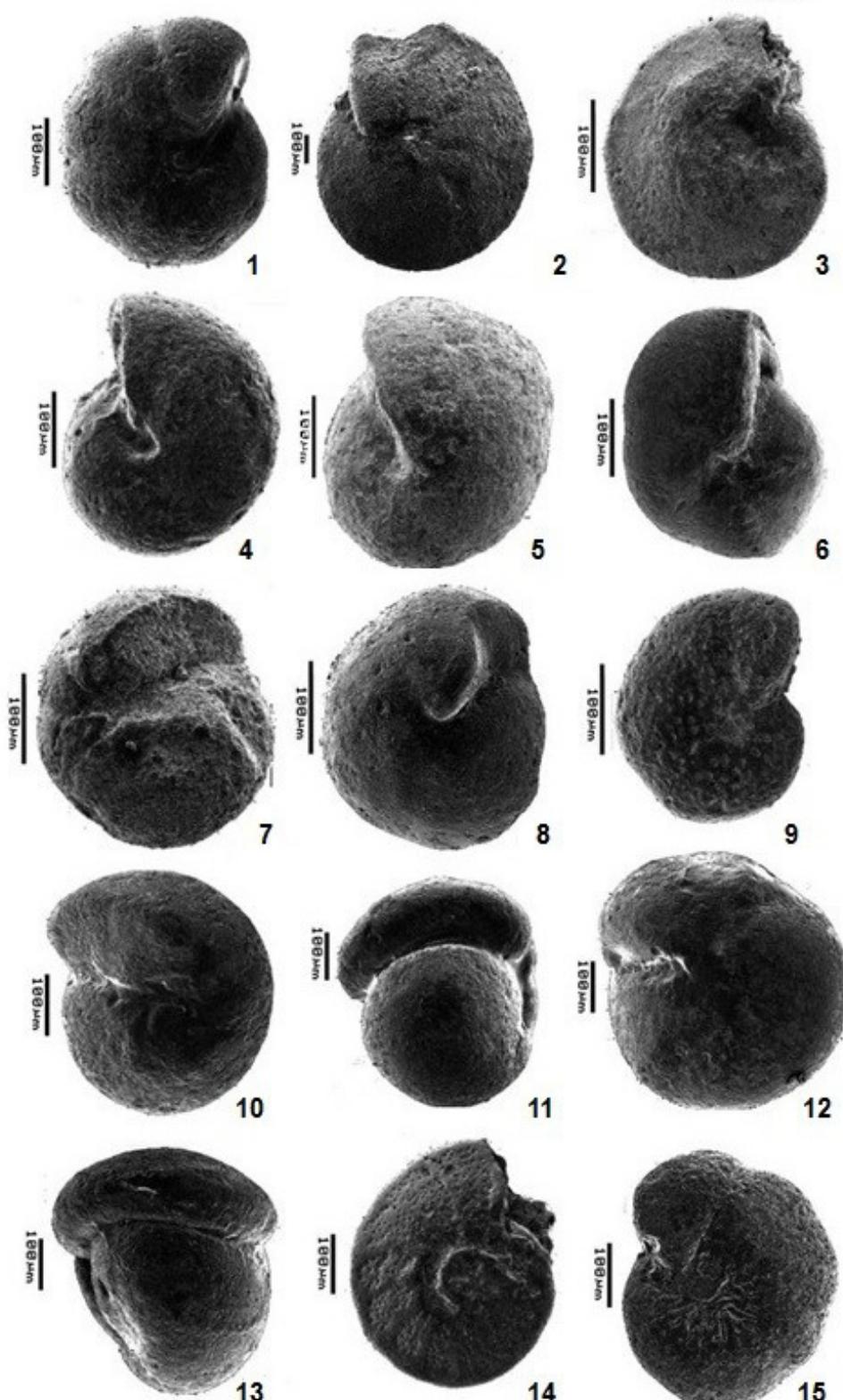


Explanation of Plate 1

- Fig. 1. *Bolivinoides curtus* Reiss, 1954, Sample 13, Danian of J. Mundassa, UAE.
 Fig. 2. *Bulimina mexicana* Cushman, 1922, S. 14.
 Fig. 3. *Bulimina midwayensis* Cushman and Parker, 1936, S. 10.
 Fig. 4. *Bulimina trinitatensis* Cushman and Jarvis, 1928, S. 11.
 Fig. 5. *Buliminella grata* Parker and Bermúdez, 1937, S. 9.
 Fig. 6. *Globobulimina suteri* (Cushman and Renz, 1946), S. 14.

- Fig. 7. *Coryphostoma midwayensis* (Cushman, 1936), S. 14.
 Fig. 8. *Coryphostoma nekhliana* (Said and Kenawy, 1956), S. 13.
 Fig. 9. *Nodosarella gracillima* Cushman, 1944, S. 14.
 Fig. 10. *Nodosarella subnodososa* (Guppy, 1894), S. 12.
 Fig. 11. *Pleurostomella naranjoensis* Cushman and Bermúdez, 1937, S. 14.
 Fig. 12. *Pleurostomella subnodososa* Reuss, 1860, S. 13.
 Fig. 13. *Stilostomella paleocenica* (Cushman and Todd, 1946), S. 14.

Plate 2



Explanation of Plate 2

- Fig. 1. *Valvularineria scrobiculata* (Schwager, 1883), Sample 14, Danian of J. Mundassa, UAE.
 Fig. 2. *Cibicidooides libycus* (LeRoy, 1953), S. 14.
 Fig. 3. *Nuttallides truempyi* Nuttall, 1930, S. 7.
 Fig. 4. *Pullenia angusta* Cushman and Todd, 1943, S. 12.
 Fig. 5. *Pullenia coryelli* (White, 1929), S. 11.
 Fig. 6. *Pullenia quinqueloba* (Reuss, 1851), S. 10.
 Fig. 7. *Pullenia reussi* (Cushman and Todd, 1943), S. 12.

- Fig. 8. *Valvalabamina planulata* (Cushman and Renz, 1941), S. 12.
 Fig. 9. *Anomalinooides rubiginosus* (Cushman, 1926), S. 14.
 Fig. 10. *Gyroidinoides girardanus* (Reuss, 1851), S. 7, Danian.
 Fig. 11. *Gyroidinoides globosus* (Hagenow, 1842), S. 7, Danian.
 Fig. 12. *Gyroidinoides reussi* (Said and Kenawy, 1956), S. 14.
 Fig. 13. *Gyroidinoides subangulatus* (Plummer, 1927), S. 8, Danian.
 Fig. 14. *Angulogavelinella abudurbensis* (Nakkady, 1950), S. 14.
 Fig. 15. *Angulogavelinella avnimelechi* (Reiss, 1952), S. 14, Danian of J. Mundassa, UAE.