

## RESEARCH ARTICLE

ON THE VARIABILITY OF TETHYAN ROTALIID BENTHIC FORAMINIFERAL SPECIES OF THE GENUS *BOLIVINOIDESELLA* ANAN

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## ABSTRACT

Six Maastrichtian-Paleogene small Rotaliid benthic foraminiferal species of the genus *Bolivinoidesella* Anan are distributed in many localities in the Tethyan Atlantic and Pacific Oceans. This genus and its members differ from the other Bolivinoididae members in possessing numerous, delicate, irregularly anastomosing costae. This new assemblage are divided into two groups, *Bolivinoidesella pacifica* group and *Bolivinoidesella salimi* group. The first one includes four species: *B. pacifica*, *B. karimae*, *B. olae*, *B. hudae*, while the second group includes two species: *B. salimi*, *B. ameeri*. The modern taxonomic consideration of the six identified species, and the evolutionary trends of *Bolivinoidesella* spp. are presented and discussed. The prominent environment of the genus *Bolivinoidesella* and its members are most probably represents the lower bathyal-upper abyssal environment depth (~1500–2000 m).

## KEYWORDS

Rotaliid Foraminifera, *Bolivinoidesella*, Maastrichtian, Paleogene, Tethys

## 1. INTRODUCTION

Six diagnostic species of Maastrichtian-Paleogene Rotaliid benthic foraminiferal genus *Bolivinoidesella* Anan were recorded and described from wide sites in the Atlantic and Pacific Oceans (Figure 1). It is distinguished from other benthic foraminifera in its numerous, delicate, irregularly anastomosing costae, which has a very broad, nearly global distribution from Atlantic Ocean to Pacific Ocean.



Figure 1: The world map continent and oceans.

## 2. MATERIAL OF STUDY

Well preserved six Rotaliid benthic foraminiferal species of the genus *Bolivinoidesella* from four localities in the Atlantic and Pacific Oceans made it possible to elucidate them with its modern taxonomical consideration, following the Code of Zoological Nomenclature (CZN). This study provides taxonomic descriptions, illustrations, evolutionary lineages and stratigraphic ranges for the Maastrichtian-Paleogene genus *Bolivinoidesella* and its members from many different localities in the Tethyan Atlantic and Pacific Ocean.

## 3. STRATIGRAPHY OF THE IDENTIFIED SPECIES

Some stratigraphic remarks can be included:

- Three species are recorded from the Maastrichtian-Danian: *Bolivinoidesella pacifica*, *B. karimae* and *B. salimi*.
- Two species are recorded from Ypresian: *B. olae* and *B. ameeri*.
- One species is recorded from Oligocene-Middle Miocene: *B. hudae*.

## 4. SYSTEMATIC PALEONTOLOGY

The suprageneric classification of the genus *Bolivinoidesella* and its members outlined below is based on (Loeblich and Tappan, 1988). Species descriptions are introduced in stratigraphic order.

Order Foraminiferida (Eichwald, 1830)

Suborder Rotaliina (Delage and Hérouard, 1896)

Superfamily Bolivinacea (Glaessner, 1937)

Family Bolivinoididae (Loeblich and Tappan, 1984)

Genus *Bolivinoidesella* (Anan, 2024)

Type species *Bolivinoidesella pacifica* (Anan, 2024)

All representatives of the genus *Bolivinoidesella* are characterized by common features: Test elongate, wall finely perforate, only slightly compressed, periphery mainly broadly rounded, sides may parallel, chambers inflated and increasing gradually as added, sutures mostly indistinct due to the surface ornamentation with numerous, delicate, irregularly anastomosing costae, aperture mainly a slit extending from the base of the last chamber into the apertural face. Based on morphological differences as well as interpreted phylogeny, we include almost all representatives of *Bolivinoidesella* into two distinctive groups: the first *Bolivinoidesella pacifica* group, which includes four new species: *B. pacifica*, *B. karimae*, *B. olae* and *B. hudae*, and the second *Bolivinoidesella salimi* group, includes two new species: *B. salimi* and *B. ameeri* (Plate 1).

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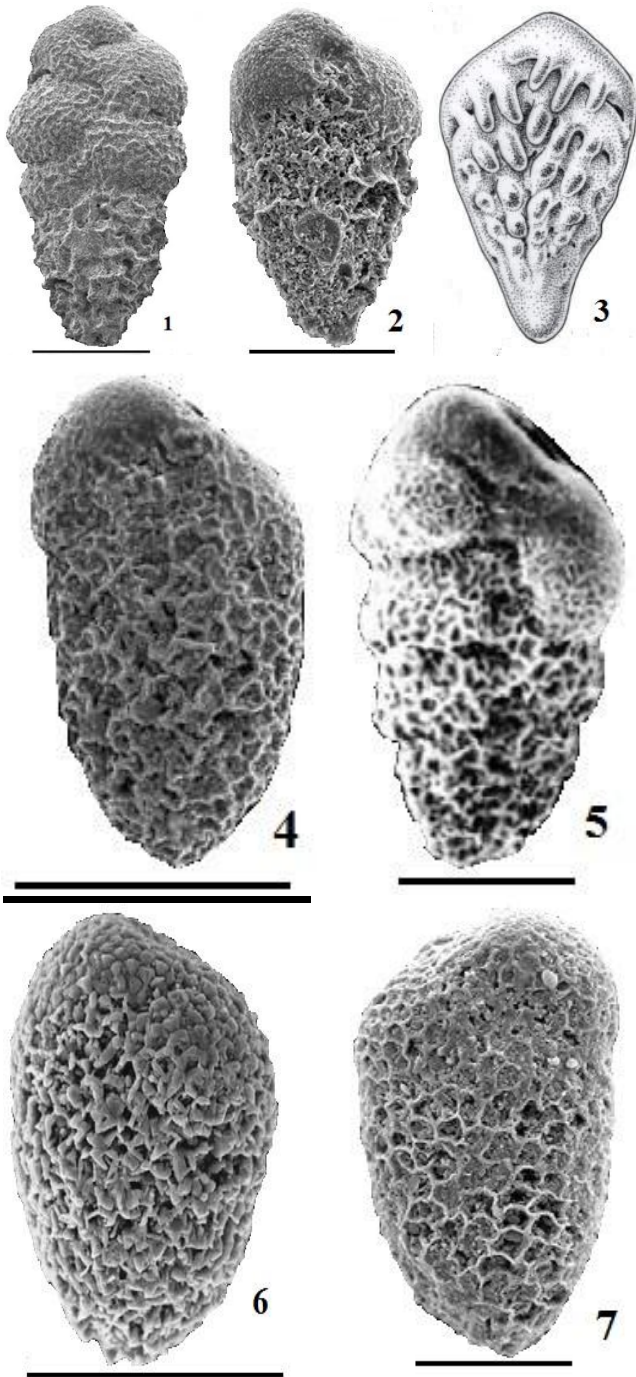
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**Plate 1** (All scale bars =100 μm): **Figure 1.** *Bolivinoidesella pacifica* (Anan, 2024), **2.** *Bolivinoidesella karimae* Anan, n. sp., **3.** *Bolivinoides decoratus* (Jones, 1886), **4.** *Bolivinoidesella olae* Anan, n. sp., **5.** *Bolivinoidesella huda* Anan, n. sp., **6.** *Bolivinoidesella salimi* Anan, n. sp., **7.** *Bolivinoidesella ameerii* Anan, n. sp.

**4.1 Bolivinoidesella pacifica group**

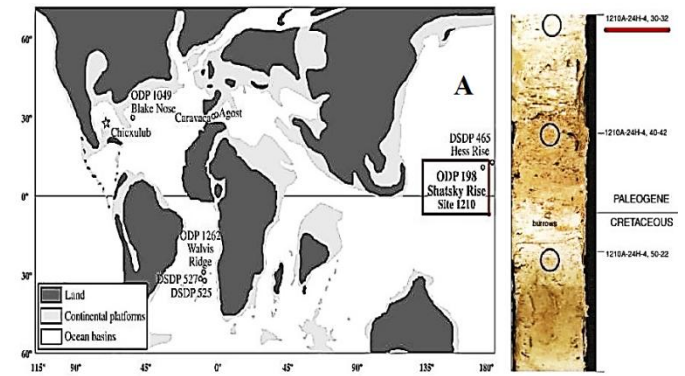
*Bolivinoidesella pacifica* Anan, 2024 (= *Bolivinoidesella pacifica* Anan, 2024, p. 38, pl. 1, fig. 4).

Type locality. ODP 198, Shatsky Rise, Site 1210, Pacific Ocean (after Alegret and Thomas, 2009), Figure 2A.

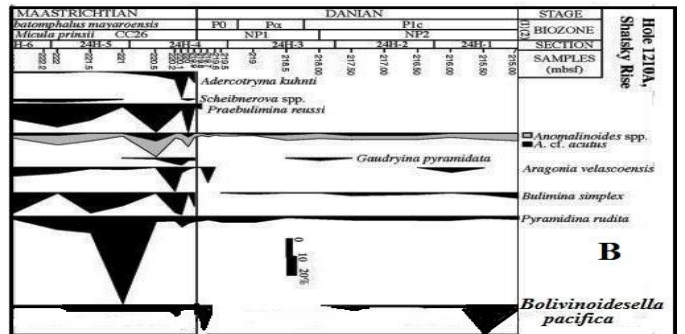
Age. Maastrichtian-Danian, Figure 2B.

Description. It is characterized by its finely perforate calcareous wall, elongate large biserial test, chambers nearly globular increasing rapidly as added, surface ornamented with wrinkles or irregularly anastomosing costae, periphery broadly rounded, sutures obscured in the lower part of the test, but slightly depressed in the upper part, narrow opening basal aperture.

Remarks. This species is characterized by elongate test, wrinkled ornamented surface and anastomosing costae than rhomboidal test with longitudinal costae may bifurcated distally as in the genus *Bolivinoides*.



**Figure 2 (a):** The type locality and stratigraphic position of *Bolivinoidesella pacifica* Anan (2024).



**Figure 2 (b):** The stratigraphic range of the new species *Bolivinoidesella pacifica* (= *Bolivinoides* sp. 1), (after Alegret and Thomas, 2009, with some modification).

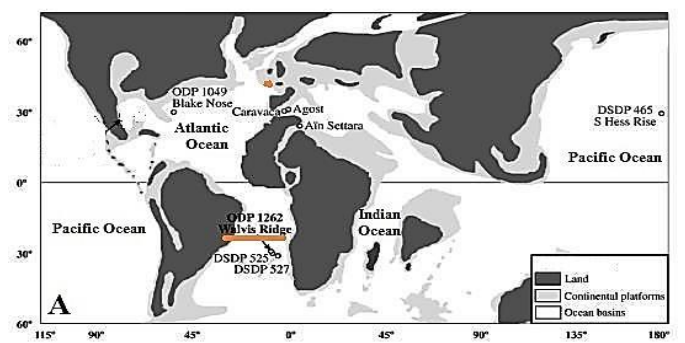
*Bolivinoidesella karimae* Anan, n. sp. (= *Bolivinoides decoratus* - (Alegret and Thomas, 2007, p. 13, pl. 1, fig. 2).

Holotype. Illustrated specimen in Plate 1, fig. 2.

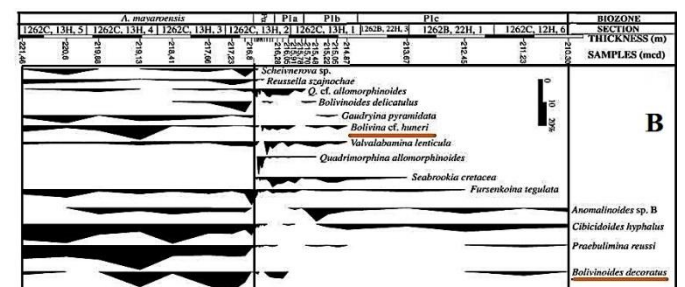
Etymology. After my wife Dr. Karima Mahdi Anan.

Type locality. ODP 1262, Walvis Ridge, south Atlantic Ocean, Figure 3A (after Alegret and Thomas, 2007).

Age. Maastrichtian-Danian (Fig. 3B).



**Figure 3 (a):** The type locality ODP 1262 of the new species *Bolivinoidesella karimae* (= *Bolivinoides decoratus* of Alegret & Thomas, 2007).



**Figure 3 (b):** The stratigraphic range of the new species *Bolivinoidesella karimae* (= *Bolivinoides decoratus* of Alegret and Thomas, 2007).

Description. Test large elongate large biserial test, tapering initial test, nearly triangular in outline, chambers nearly globular increasing rapidly as added, surface indistinct due to the surface ornamentation with wrinkles or irregularly anastomosing costae in the most part of the test extending to all but the last chambers of the test, aperture basal, narrow opening extending from the base of the last chamber.

Remarks. This species *Bolivinoidesella karimae* with irregularly anastomosing costae, differs from *Bolivinoides decoratus* (Jones) (Pl. 1, Figure 3) with 4-5 loosely connected, longitudinal, broad, irregular costae extensions on each chamber merging into ornamental lobes.

*Bolivinoidesella olae* Anan, n. sp. (= *Bolovina huneri* Howe - (D'haenens et al., 2012, p. 18, pl. 1, fig. 4).

Holotype. Illustrated specimen in Plate 1, figure 3.

Etymology. After my daughter Eng. Ola Haidar Anan.

Type locality. OSDP Site 401, Bay of Biscay-NE Atlantic (after D'haenens et al., 2012), Figure 4a.

Age. Ypresian, ~53 Ma (Figure 4b) .

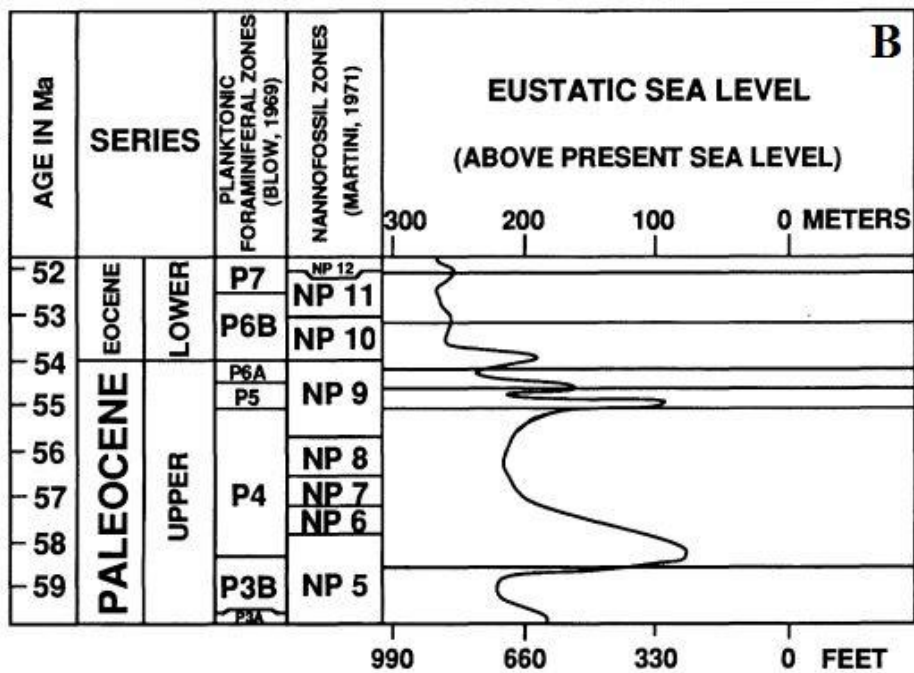
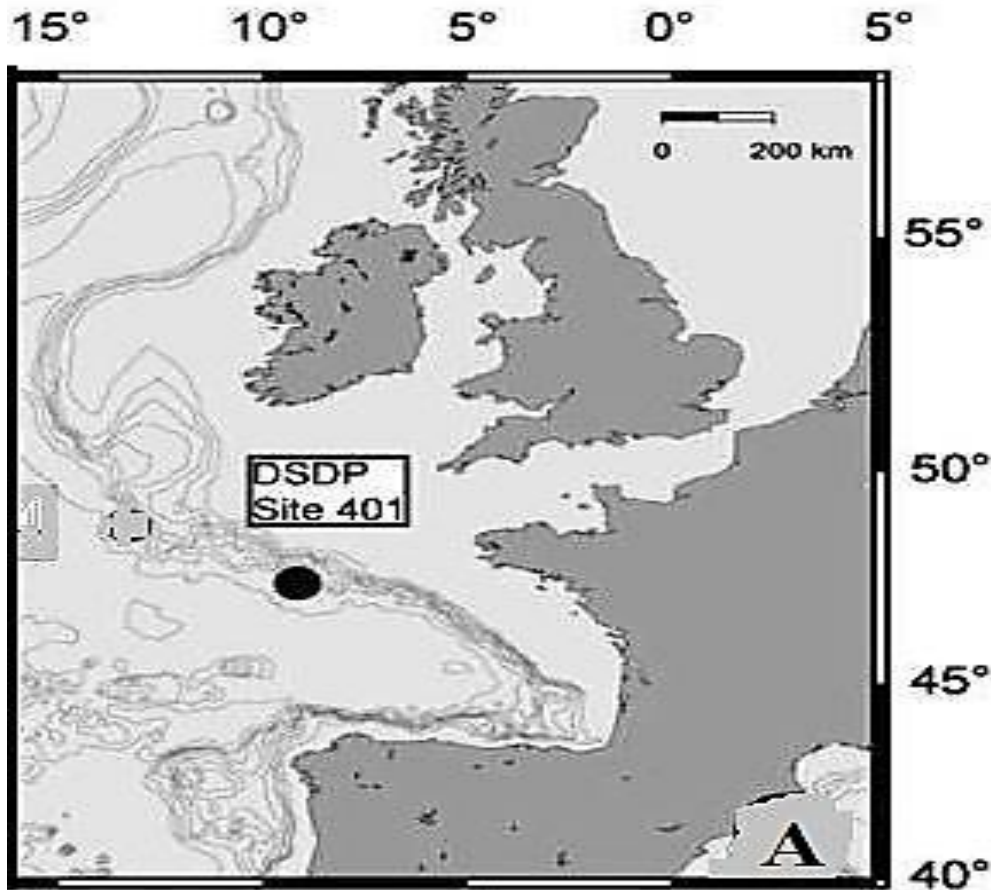


Figure 4: a) The type locality OSDP Site 401 (Bay of Biscay) of the new species *Bolivinoidesella olae* (= *Bolovina huneri* of D'haenens et al, 2012); b) Eustatic Sea level of the Paleocene-Early Eocene (after Haq et al., 1987).

Description. Test calcareous and finely perforated, elongate biserial series with nearly parallel sides; slightly and oval in cross-section with a subrounded initial portion, and a rounded apertural end, slightly inflated chambers, sutures are mostly obscured by surface ornamentation of anastomosing costae extending to all but the last chambers of the test. Aperture is a loop-shaped opening, extending from the base of the last chamber.

Remarks. The cylindrical test of the Ypresian new species *Bolivinoidesella olae* differs from the nearly triangular outline of the Paleocene new species *B. karimae* with nearly tapering initial portion of the test. The latter species *B. karimae* may evolved to the younger species *B. olae*.

*Bolivinoidesella hudaie* Anan, n. sp. (= *Bolivina huneri* Howe – (Miller and Katz, 1987, p. 118, pl. 1, fig. 7).

Holotype. Illustrated specimen in Pl. 1, figure 4.

Etymology. After my daughter Dr. Huda Haidar Anan.

Type locality. Site 563, North Atlantic, between N. America and W. Africa, Fig. 5A (after Miller and Katz, 1987).

Age. Oligocene-Middle Miocene (Figure 5b).

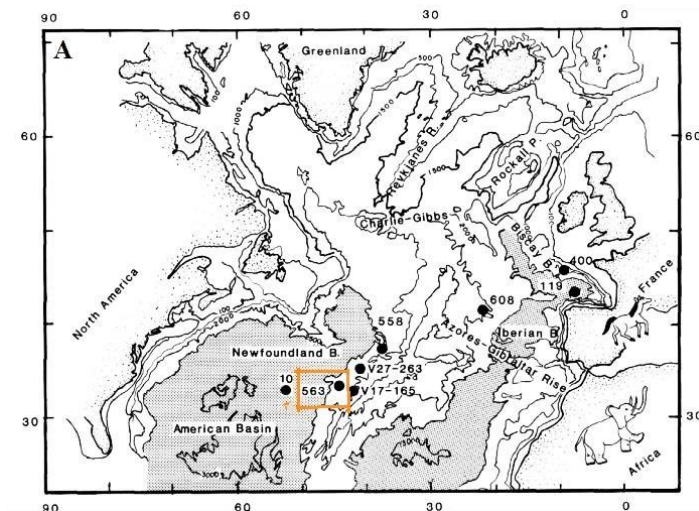


Figure 5 (a): The type locality Site 563, North Atlantic of the *Bolivinoidesella hudaie* Anan,

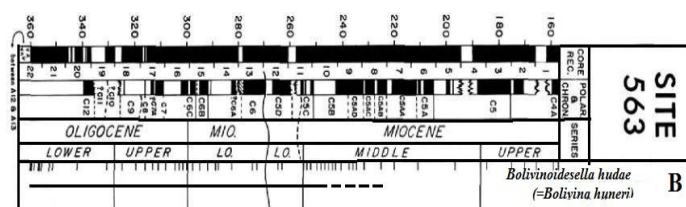


Figure 5 (b): The stratigraphic range of the *Bolivinoidesella hudaie* Anan n. sp. (= *Bolivina huneri* of Miller and Katz, 1987).

Description. Test elongate, wall ornamented with numerous delicate finely perforate, periphery broadly rounded, sides nearly parallel, sutures distinct inspite to the irregularly anastomosing costae surface ornamentation, aperture a wide semi-rounded extending from the base of the last chamber into the apertural face.

Remarks. This new species differs from the other members of the genus *Bolivinoidesella* by its distinct depressed sutures all over the test, inspite to the irregularly anastomosing costae surface ornamentation along the most test. This Oligocene-Middle Miocene species may developed from the Eocene *Bolivinoidesella olae* Anan.

#### 4.2 *Bolivinoidesella salimi* group

*Bolivinoidesella salimi* Ana, n. sp. (= *Bolivina huneri* Howe – (Alegret and Thomas, 2009, p. 108, pl. 1, fig. 12).

Holotype. Illustrated specimen in Pl. 1, figure 6.

Etymology. Etymology. After my late son Salim Haidar Anan.

Type locality. ODP 198, Shatsky Rise, Site 1210, Pacific Ocean after

(Alegret and Thomas, 2009), see Figure 3a.

Age. Maastrichtian-Danian, Figure 6.

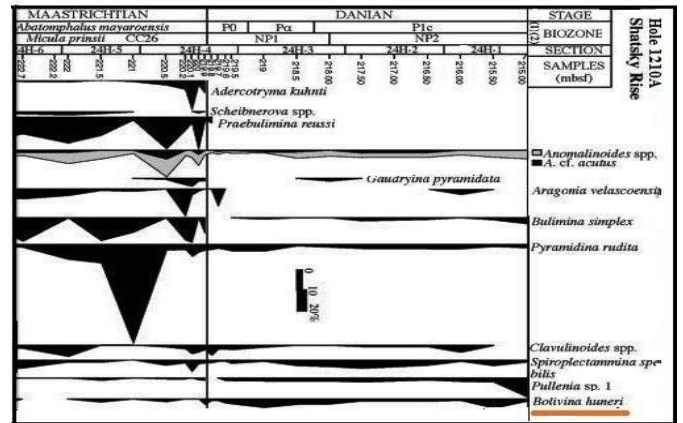


Figure 6: The stratigraphic range of the new species *Bolivinoidesella salimi* (= *Bolivina huneri*, after Alegret and Thomas, 2009, with some modification).

Description. Test biserial series, chamber walls are calcareous and finely perforate, pyriform shape and oval in cross-section with a subrounded initial portion, but rounded apertural end, slightly inflated chambers, sutures that are mostly obscured by surface ornamentation and ornamented by a pattern of anastomosing costae extending to all test.

Remarks. This new species is characterized by a pattern of anastomosing costae surface ornamentation extending to all test, and pyriform test.

*Bolivinoidesella ameeri* Anan, n. sp. (= *Bolivina huneri* Howe – (D'haenens et al., 2012, p. 18, pl. 1, fig. 4).

Holotype. Illustrated specimen in Pl. 1, fig. 7.

Etymology. Etymology. After my late son Ameer Haidar Anan.

Type locality. OSDP Site 401, Bay of Biscay - NE Atlantic (after D'haenens et al, 2012), see Figure 4a.

Age. Ypresian, ~53 Ma, see Figure 4b.

Description. Test biserial series, chamber walls are calcareous and finely perforate, cylindrical shape and oval in cross-section with a subrounded initial portion, but rounded apertural end, slightly inflated chambers, sutures that are mostly obscured by surface ornamentation and ornamented by a pattern of anastomosing costae extending to all test.

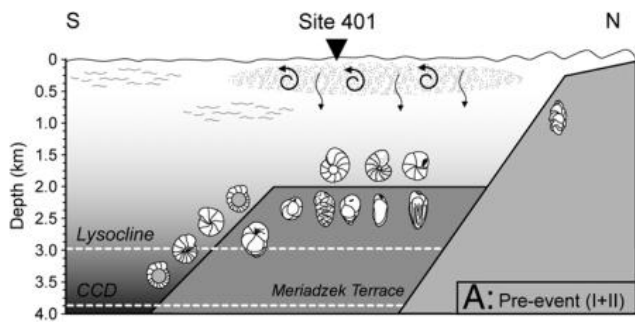
Remarks. This new species differs from the other species *Bolivinoidesella salimi* Anan in its cylindrical shape than pyriform shape.

## 5. PALEOBIOGEOGRAPHY

The representatives of the Rotaliid genus *Bolivinoidesella* have wide geographic distribution in the Tethys, from west to east: to the west North Atlantic (OSDP Site 401, Biscay Basin and 563, south Newfoundland Basin) and South Atlantic Ocean (ODP 1262, Walvis Ridge), and to the east Pacific Ocean (ODP 198, Shatsky Rise Site 1210). Some authors, concluded that the extended realms of the Tethys have extended from the Indo-Pacific to the Atlantic Oceans, mainly throughout the Mediterranean Sea during the Late Cretaceous to Paleogene times, and the fauna exhibit pronounced similarities (Adams et al., 1983; Abed, 2013; Anan, 2022).

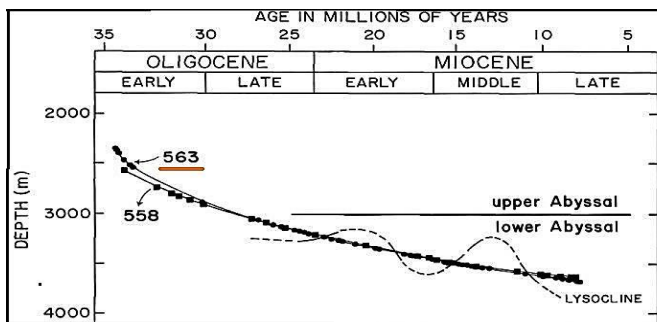
## 6. PALEOENVIRONMENT

Some researchers noted that benthic foraminiferal assemblage data as well as benthic foraminiferal accumulation rates at Pacific Ocean Site 1210 present strong evidence for a high food supply to the seafloor just after the K/Pg extinction event, and during the time of high food supply the faunas had a low diversity and heterogeneity, indicative of stressed environmental conditions (Alegret and Thomas, 2009). A group researcher noted that the benthic foraminiferal assemblage including *Bolivina huneri* (= *Bolivinoidesella olae*, *B. hudaie*, *B. salimi* and *B. ameeri* in this study) indicated well-oxygenated and oligo-to mesotrophic setting that displays a well-developed seasonality of productivity (D'haenens et al., 2012). They figured the faunal assemblage with *Bolivina huneri* (= *Bolivinoidesella* spp.) higher than the Lysocline depth (2-2.5 km), which the rate of dissolution of calcite increases dramatically because of a pressure effect (Figure 7).



**Figure 7:** Postulated paleoceanographic condition of the faunal assemblage in Site 401, including *B. olae* (after D'haenens et al., 2012)

Some researchers noted that the levels of dissolution indices at Site 563 are less than 2% benthic foraminifera, and the dissolution intervals >5% occur at the base of Oligocene, and a sharp increase percent benthics is associated with the foraminiferal Lysocline in the modern oceans (Figure 8) (Miller and Katz, 1987).



**Figure 8:** The paleodepths of Site 563, south Newfoundland Basin, North Atlantic (after Miller and Katz, 1987).

## 7. CONCLUSION

The six identified species of the Rotaliid genus *Bolivinoidesella* are recorded from different localities in the Tethys, from west, Atlantic Ocean: *B. karimae*, *B. olae*, *B. hudaie* and *B. ameeri*, to east: Pacific Ocean: *B. pacifica* and *B. salimi*. One species was originally recently recorded from Pacific Ocean: *B. pacifica*, while the other four new species are recorded Atlantic Ocean: *B. karimae*, *B. olae*, *B. hudaie* and *B. ameeri*, and the fifth species from

Pacific Ocean: *B. salimi*. The rare number of the members of *Bolivinoidesella* in another sites of the world may be due to lack of available literature, differences in paleoenvironmental conditions, or misidentification. The prominent environment of the genus *Bolivinoidesella* and its members are most probably representing the lower bathyal-upper abyssal environment (~1500–2000 m depth).

## ACKNOWLEDGMENTS

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## REFERENCES

- Abed, A.M., 2013. The eastern Mediterranean phosphorite giants: An interplay between tectonics and upwelling. *GeoArabia*, 18 (2), Pp. 67-94.
- Adams C.G., Gentry, A.W., Whybrow, P.J., 1983. Dating the terminal Tethys event. *Utrecht Micropaleontological Bulletin*, 30, Pp. 273–298.
- Alegret, L., Thomas, E., 2007. Deep-Sea environments across the Cretaceous/Paleogene boundary in the eastern South Atlantic Ocean (ODP Leg 208, Walvis Ridge). *Marine Micropaleontology*, 64, Pp. 1 – 17.
- Alegret, L., Thomas, E., 2009. Food supply to the seafloor in the Pacific Ocean after the Cretaceous /Paleogene boundary event. *Marine Micropaleontology*, 73, Pp. 105–116.
- Anan, H.S., 2022. On the variability of benthic foraminiferal species of the genus *Ramulina* in the Tethys. *Journal of Foraminiferal Research*, 52 (3), Pp. 1-7.
- Anan, H.S., 2024. *Bolivinoidesella*: A new Rotaliid benthic foraminiferal genus. *Science Heritage Journal*, 8 (1), Pp. 38-41.
- D'haenens, S., Bornemann, A., Stassen, P., Speijer, R.P., 2012. Multiple early Eocene benthic foraminiferal assemblage and  $\delta^{13}C$  fluctuations at DSDP Site 401 (Bay of Biscay-NE Atlantic). *Marine Micropaleontology*, 88-89, Pp. 15-35.
- Miller, K.G., Katz, M.E., 1987. Oligocene to Miocene benthic foraminiferal and abyssal circulation changes in the North Atlantic. *Micropaleontology*, 33 (2), Pp. 97-149.

