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RESEARCH ARTICLE

TETHYAN LAGENID BENTHIC FORAMINIFERAL SPECIES OF THE GENUS *HEMIROBULINA*

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ABSTRACT

Sixteen Tethyan Lagenid foraminiferal species of the genus *Hemirobulina* are presented in the study. One species is believed to be new: *Hemirobulina abuhanii*. The identified *Hemirobulina* species mainly represent neritic-middle bathyal environmental conditions.

KEYWORDS

Paleontology, paleogeography, *Hemirobulina,* Lagenid benthic foraminifera, Tethys,

1. Introduction

This study presents the Tethyan Maastrichtian-Neogene species of *Hemirobulina*, which have wide geographic distributed in all continents of the world (Figure 1).

Figure 1: *Hemirobulina* in the world: North and South America, Europe, North Africa, SW Asia and New Zealand.

2. Material of Study

The genus *Hemirobulina* has treated by many authors (e.g.: d'Orbigny, **1846**; Reuss, 1851; Stache, 1864; Hantken 1875; Bandy, 1949; Anan, 1994; 2015; 2023). Sixteen Lagenid species of *Hemirobulina* are recorded from many localities in the Tethys: North and South America, Europe, Africa, Asia and New Zealand.

3. Systematic Paleontology

Many species of *Hemirobulina* had been previously included in other Lagenid taxa: *Vaginulinopsis, Marginulinopsis*, *Marginulina* or *Saracenaria*. *Hemirobulina* differs from *Vaginulinapsis* in the rounded cross section and curved but not distinctly enrolled early stage. It differs from *Marginulinopsis* in lacking an early coil part. It differs from *Marginulina* in having a smooth surfaces rather than longitudinally costate wall. It also differs from *Saracenaria* in the rounded test rather than triangular transverse section and absence of a peripheral carina. The taxonomy of Loeblich & Tappan (1988) is followed here, and the illustrated fauna are presented in Plate 1.

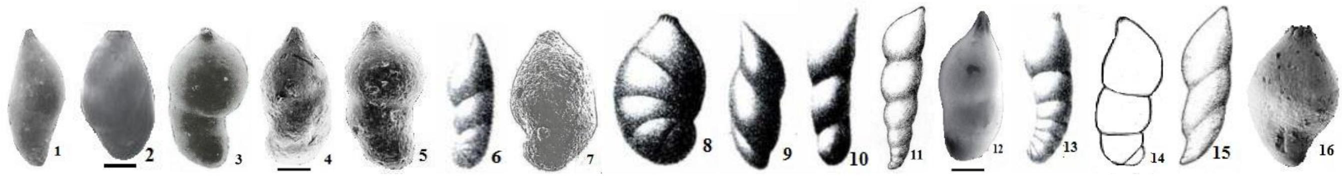

Plate 1(Scale bars 100 µm): **Figure 1.** *Hemirobulina abuhanii* n. sp., **2.** *H. angistoma* (Stache, 1864), **3.** *H. bassiounii* Anan (1994), **4.** *H. bullata* (Reu, 1845), **5.** *H. hantkeni* (Bandy, 1949), **6.** *H. minuta* (Hantken, 1875), **7.** *H. olae* Anan (2015), **8.** *H. ornata* (Hantken, 1875), **9.** *H. pauciloculata* (Hantken, 1875), **10.** *H. recta* (Hantken, 1875)**, 11.** *H. regularis* (d'Orbigny,**1846**), **12.** *H. similis* (d'Orbigny, 1846), **13.** *H. splendens* (Hantken, 1875), **14.** *H. subbullata* (Hantken, 1875), **15.** *H. tumida* (Reuss, 1851), **16.** *H. yehiai* Anan, 2023.

Order Foraminiferida Eichwald, 1830

Suborder Lagenina Delage and Hérouard, 1896

***Hemirobulina abuhanii* Anan, n. sp.**

Etymology: after Prof. Atta Abuhani, Dean of Faculty of Science, Al Azhar University-Gaza, Palestine (Figure 3A).

Stratigraphic level: Early (Relisian)-Middle (Luisan) Miocene (Figure 3B).

Diagnosis: Test wall finely perforate elongate with conical-shape, and

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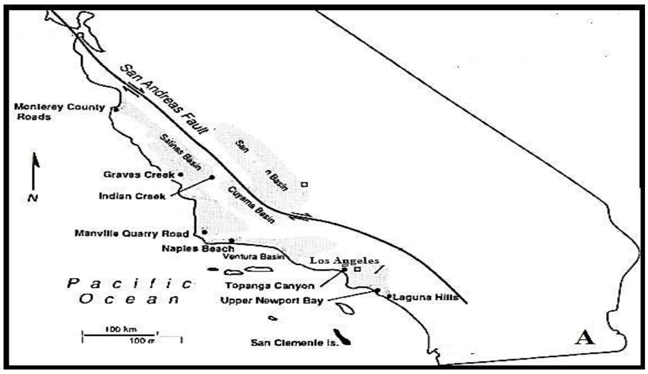
circular in section, early chambers added in a slight curve at the base, later becoming rectilinear and larger increase rapidly as added, chambers as high as wide, sutures oblique and nearly flush, surface smooth, aperture terminal, radiate, at the dorsal angle.

Remarks: This species is characterized by its elongate conical-shape, and nearly flush sutures.



GRAVES CREEK SECTION	SAUCESIAN			RELIZIAN												LUISIAN			
BENTHIC FORAMINIFERA	SL1	14	13	12	11	10	9	8	7	6	5	4	3	2	1	15a	15b	15c	15d
Marginulina crouchi								VR		R	VR	VR	R		VR				
Marginulina sp.							VR	VR										VR	

B

Figure 3: A. Location of California Miocene outcrop sections and depositional basins, **B.** Stratigraphic distribution of the new species *H. abuhanii* (=*Marginulina* sp.) (after Finger, 1992).

Hemirobulina angistoma (Stache, 1864) (=*Marginulina agnistoma*), p. 241. New Zealand.

Hemirobulina bassiounii Anan (1994), p. 223, fig. 8.16. Bartonian, Egypt (Anan, 1994; Hewaidy et al., 2017), UAE (Anan, 2019).

Hemirobulina bullata (Reuss, 1845)(=*Marginulina bullata*), p. 29, pl.13, figs. 34-38. Coniacian -Ypresian: Germany, USA (Cushman, 1946), Mexico (Sliter, 1968), Caribbean (Bolli et al., 1994), UAE (Anan, 2015), Romania (Neagu, 2014).

Hemirobulina hantkeni (Bandy, 1949) (=*Marginulina hantkeni*), p. 46, pl. 6, fig. 9.1. USA (Bandy, 1949), Austria (Cicha et al., 1998), Hungaria (Horváth, 2003; Ozsvárt, 2007).

Hemirobulina minuta (Hantken, 1875) (=*Cristellaria minuta*), p. 50, pl. 14, fig. 7. Hungaria (Hantken, 1875; Horváth, 2003).

Hemirobulina olae Anan, 2015, p. 71, pl. 1, fig. 8. Paleocene, UAE.

Hemirobulina ornata (Hantken, 1875) (=*Cristellaria ornata*), p. 54, pl. 13. fig. 19. Hungaria (Hantken, 1875; Horváth, 2003).

Hemirobulina pauciloculata (Hantken, 1875) (=*Marginulina pauciloculata*), p. 47, pl.14, fig.1. Hungaria (Hantken, 1875).

Hemirobulina recta (Hantken, 1875) (=*Marginulina recta*), p. 47, pl. 5, fig. 15. Hungaria (Hantken, 1875; Horváth, 2003).

Hemirobulina regularis (d'Orbigny, 1846 (=*Marginulina regularis*), p. 68, pl. 3, figs. 9-12. Paleocene. France (d'Orbigny, 1846), USA (Plummer, 1927)

Hemirobulina similis (d'Orbigny, 1846) (*Marginulina similis*), p. 69, pl. 3, figs. 15-16. Paleocene-Neogene. France (d'Orbigny, 1846), Chile (Finger, 2013), Austria (Rupp & Ćorić, 2015).

Hemirobulina splendens (Hantken, 1875) (=*Marginulina splendens*), p. 87, pl. 4, fig. 11. Eocene. Hungaria (Hantken, 1875), France (Sztràkos, 1979), Austria (Rupp & Ćorić, 2015).

Hemirobulina subbullata (Hantken, 1875) (=*Marginulina subbullata*), p. 39, pl. 4, figs. 9, 10. Hungaria (Hantken, 1875).

Hemirobulina tumida (Reuss, 1851) (=*Marginulina tumida*), p. 64, pl. 3, fig. 14. Germany (Reuss, 1851), France (Sztrákos, 1979).

Hemirobulina yehiai Anan, 2023, p. 56, pl. 1, fig. 41. Lutetian, Argentina (Jannou, 2009).

4. Paleogeography

More than one species have wide geographic distribution around the world, and some remarks can be added:

- Six species from Hungaria (37%), four from France (25%), three from each of USA, Austria, UAE (20%), two from Germany (13%), but one only from each of Mexico, Caribbean, Romania, Chile and Argentina (06%).
- *H. bullata* is recorded from six localities: Germany, USA, Mexico, Caribbean, UAE, and Romania.
- Some species are recorded from three localities: *H. hantkeni* from USA, Austria and Hungaria, while *H. similis* from another three localities: France, Chile and Austria, but *H. splendens* from Hungaria, France and Austria.
- *H. regularis* is recorded from two localities: France and USA, but *H. tumida* from another two localities: Germany and France, and *H. bassiounii* from Egypt and UAE.
- Some species are endemic: *Hemirobulina abuhanii* (USA), *H. angistoma* (New Zealand), *H. minuta*, *H. ornata*, *H. pauciloculata*, *H. recta*, *H. subbullata* (Hungaria), *H. olae* (UAE), and *H. yehiai* (Argentina).
- This study proved that the paleogeographic distribution of the genus *Hemirobulina* and its species are expanded into many different parts of the Tethys: from Chile in the west, to New Zealand in the east, which means that the ancestral Tethys is connected with the ancestral Atlantic, Indian and Pacific Oceans via Mediterranean Sea, which were presented by many authors (e.g. Zachos et al., 1993; Abed, 2013).

5. Paleoenvironment

A researcher noted that the time control is strong among Paleogene faunas of widely differing geographic origin, at least at the Epoch level (Schnitker, 1979). In other study, researchers noted that close to the end of Bartonian (the locality of *H. bassiounii* in the UAE), the previously arid climates became markedly wetter and seems accompanied by a cooling of the water temperature, and the climatic changes inferred the Hafit area seem widespread, at least in parts of the Middle East (Cherif and El Deeb, 1984). A group researchers noted that the peak sea surface temperatures of 24ø-25øC occurred in the earliest Eocene, followed by a rapid cooling of 3-6øC in the late early Eocene and stable through the middle Eocene, but the surface water temperatures in the late Eocene decreased further (Bralower et al., 1995). Horváth noted that *H. splendens* may range through the neritic zone (Horváth, 2003). The sporadic distribution of *Hemirobulina* may due to one or more parameters: lack of detailed studies, different latitudes, miss identification, land barriers, physically isolated areas, and/or certain paleoenvironmental conditions during the in the Maastrichtian-Neogene time in the Tethys.

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