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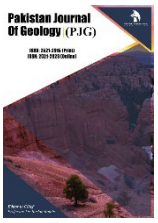

REVIEW ARTICLE

MARGINULINOIDES: A NEW LAGENID BENTHIC FORAMINIFERAL GENUS

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ABSTRACT

This study describes a new Eocene Lagenid genus *Marginulinoides* from the Eocene of many localities in the Northern and Southern Tethys. The test close coiled has early stage test, later elongate uncoiled uniserial and rectilinear, 3-5 chambers semiglobular, periphery rounded, surface ornamented by heavily spinose, aperture terminal with neck, may be shifted slightly to the dorsal angle. This new genus differs from the other related genera (e. g. *Marginulina, Marginuliopsis, Percultazonaria, Percultalina*) by its heavily hispid to spinose ornamented surface.

KEYWORDS

Benthic foraminifera, Lagenid, *Marginulinoides*, Eocene, Middle East, Europe

1. INTRODUCTION

The present study aims at throwing light on the modern paleontological consideration of the new Eocene Lagenid genus *Marginulinoides* from different localities in the Southern Tethys (Egypt, United Arab Emirates, UAE) and Northern Tethys (Spain, Austria, Hungaria, Romania) figure 1.

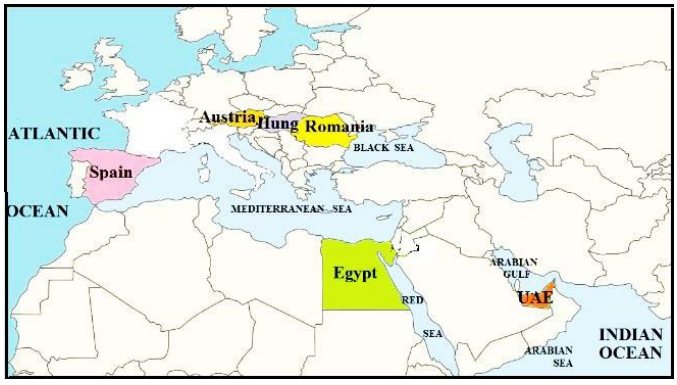

Figure 1: Location map of some Northern and Southern Tethys which recorded the new genus *Marginulinoides.*

2. FAUNAL DISCUSSION

The new genus *Marginulinoides* Anan and its members were identified from many countries in the Northern and Southern Tethys, which has heavily spinose surface, not longitudinal ribs as in *Marginulina* and *Marginulinopsis,* or broken costate into a row of nodes as in *Percultazonaria*, or heavily ornamented surface and in part covered by short spines as in *Percultalina* with large planispirally coiled early stage test (Table 1). It has been necessary to give new name to the genus and its members after comparison with the holotypes of the other known genera, which are applies in this study (Plate 1).

Table 1: The synoptical diagram of five recorded genera and main their morphocharacters.

Characters / Genus	arrangement of chambers	ornamentation	sutures	aperture
Marginulina	close coiled to uncoiled	longitudinal costae	depressed	terminal at dorsal angle
Marginulinopsis	small coiled to uncoile	=	depressed	=
Percultazonaria	=	broken costate into nodes on sutures	elevated	=
Percultalina	large coiled to uncoile	heavily spines on test and sutures	depressed	=
Marginulinoides	closed coiled to uncoiled	heavily spines on test only	depressed	terminal at centre or dorsal angle

Plate 1 (Scale bars 100 µm)

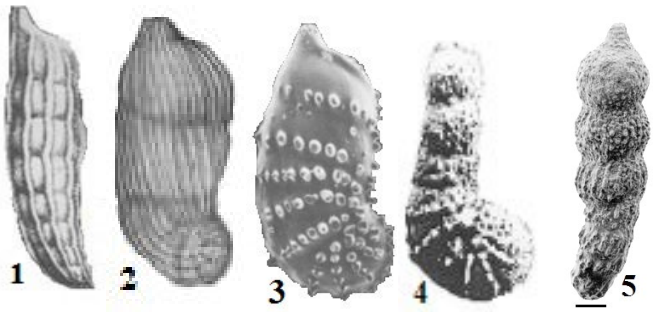

Figure 1: *Marginulina* (d'Orbigny, 1826), 2. *Marginulinopsis* (Silvestri , 1904), 3. *Percultazonaria* (Loeblich and Tappan, 1986), 4. *Percultalina* (Anan, 2022), 5. *Marginulinoides* (Anan, n. sp).

3. TAXONOMY

The taxonomic classification of Loeblich and Tappan (1988) of the new genus *Marginulinoides* as well as the other four related known genera of the Lagenid benthic foraminiferal genera (Loeblich and Tappan, 1988). The illustration of the holotype and other paratypes species have been shown in Plate (2).

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Plate 2 (Scale bars 100 μm)

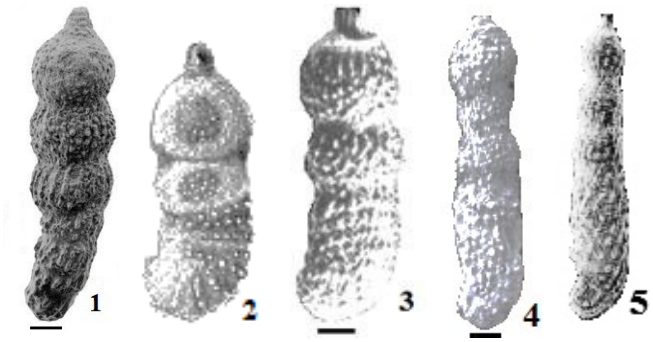

Figure 1: *Marginulinoides arabica* Anan, n. sp. (Holotype), **2-5.** *Marginulinoides arabica* Anan, n. sp. (Paratypes).

Order Foraminiferida Eichwald, 1830

Suborder Lagenina Delage and Hérouard, 1896

Superfamily Nodosariacea Ehrenberg, 1838

Family Vaginulinidae Reuss, 1860

Subfamily Marginulininae Wedekind, 1937

Genus *Marginulinoides* Anan, n. gen.

Type species *Marginulinoides arabica* Anan, n. sp.

Marginulinoides arabica Anan, n. sp.

Holotype: Plate 2, figure 1(=*Marginulinopsis infracompressa*-Anan, 2009, p. 6, pl. 1, fig. 6; *Wignallyia infracompressa* - Anan & Hewaidy, 2023, p. 23, plate 1, figure 17). UAR, Egypt.

Paratypes: Plate 2, figures. 2-5 (=*Marginulina hirsuta* d'Orbigny - Verdenius, 1970, p. 91, plate 3, figure 5. Spain; Popescu and Crihan, 2000, p. 394, plate 3, figures. 24-27. Romania; Harzhauser et al., 2018, p., plate 6, figure I. Austria; *Vaginulinopsis fragaria* (Gümbel)-Ozsvárt, 2007, p. 56, plate 6, figure 1 Hungaria)

Etymology: after the United Arab Emirates, UAE (Figure 2A).

Stratigraphic level: early Late Eocene, E15 (Figure 2B,C).

Diagnosis: Test close coiled early stage, later elongate uncoiled uniserial and rectilinear, 3-5 semiglobular uniserial chambers, periphery rounded, surface ornamented by heavily spinose and knobs, aperture central terminal with neck, may be shifted slightly to the dorsal angle.

Remarks: The new genus *Marginulinoides* Anan differs from the Lagenid fauna by its closed coiled early stage, followed by uniserial chambers, and spinose and knobs ornamented surface.

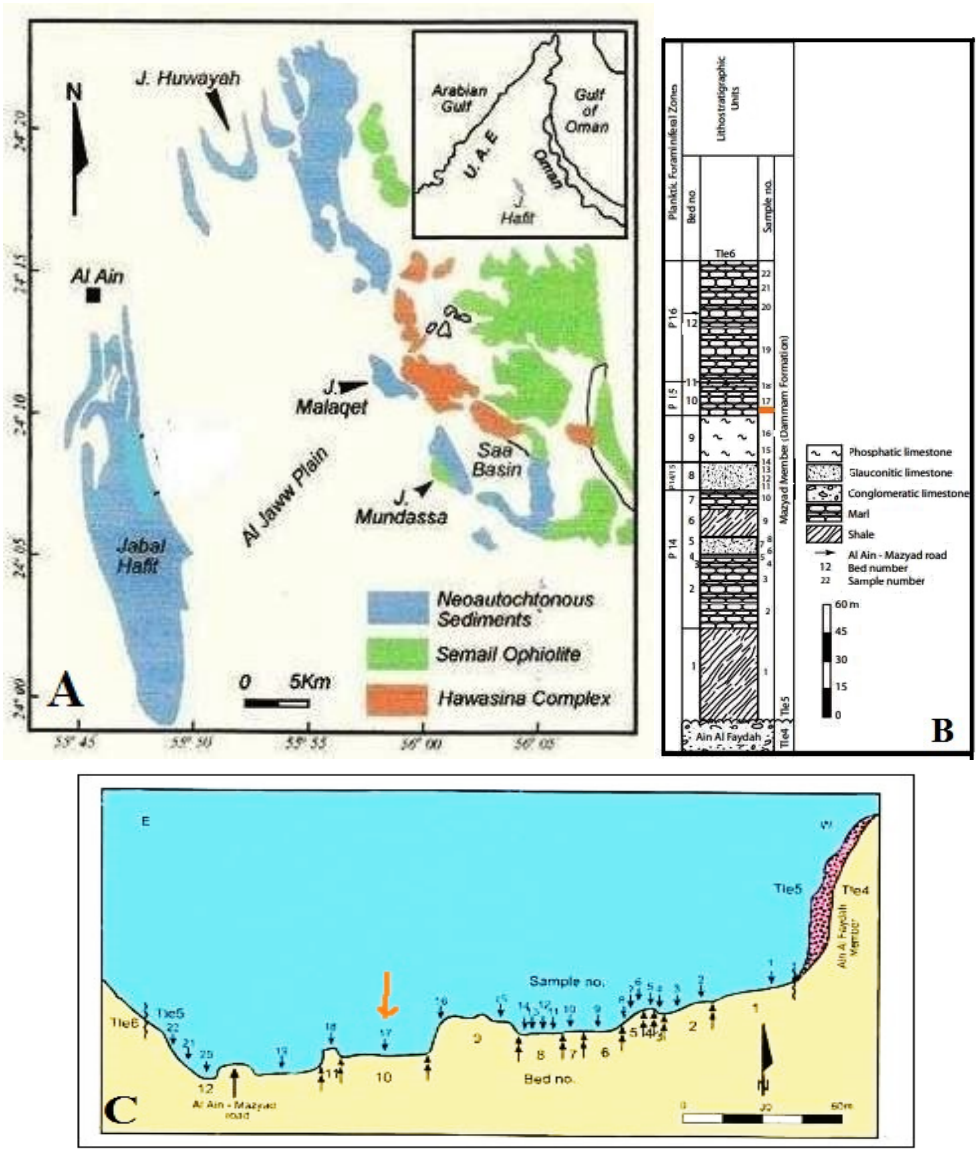

Figure 2: A) Location map of the UAE, Arabian Gulf, including **B)** the type of section eastern limb of Jabal Hafit, **C)** Schematic diagram of the study section (Tle5, between Tle4 and Tle6), the lower part of the Mazyad Member, Dammam Formation, eastern limb of J. Hafit, P15 (after Anan, 2005). The type of sample (no. 17) of the new gen. and n. sp. *Marginulinoides arabica* Anan.

4. PALEOGEOGRAPHY

The paleogeographic distribution of the identified new Eocene Lagenid benthic foraminiferal species *Marginulinoides* is expanded into six different parts of the in the Southern Tethys (UAE and Egypt) and Northern Tethys (Spain Austria, Hungaria and Romania). The Eocene fauna of Europe, Mediterranean and the Indo-Pacific exhibit pronounced similarities, which indicate that the connection between the three areas was mentioned by a marine seaway. This conclusion profs that the Tethys had been connected from west Atlantic Ocean to east with the Indian Ocean via the Mediterranean Sea during the Eocene time, which is in accordance with many authors, i. g.: (Morsi et al., 2008; Scotese, 2013) (Figure 3).

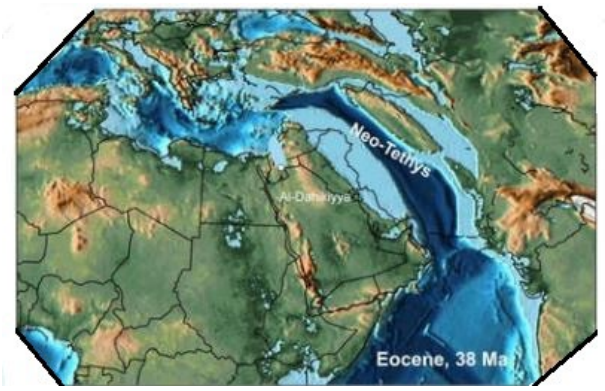

Figure 3: Paleogeographic maps of the Neo-Tethys during the Eocene period (modified after Scotese, 2013).

5. PALEOENVIRONMENT

The recorded new genus and species in this study were erected from both sides of the Northern and Southern Tethys, which indicate open connection of these both sides (Figure 4). The marine environment Lagenid benthic foraminiferal species supports the open marine environment, the Midway-Type Fauna "MTF' are dominated throughout the Tethys, although deeper water Velasco-Type "VT" assemblage species are consistently present, which suggested a neritic and deep-water foraminifera about 200-1000 m water depth in an open marine basin (Berggren, 1971; Anan, 1995; Aubry et al., 2007).

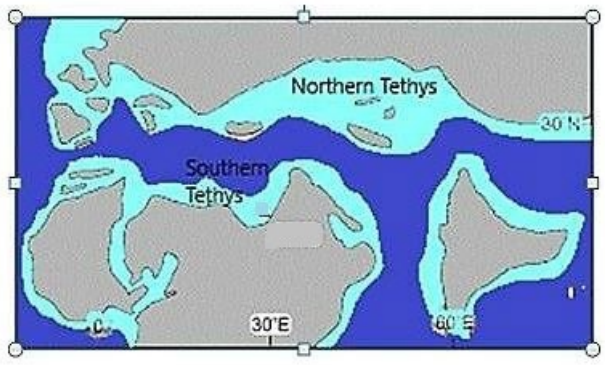

Figure 4: Paleogene Paleogeography distribution of the Northern Tethys and the Southern Tethys around the Mediterranean Sea

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