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RESEARCH ARTICLE

PALEONTOLOGY AND PALEO GEOGRAPHY OF THE TETHYAN PALEOGENE ROTALIID BENTHIC FORAMINIFERAL GENUS *UVIGERINA* AND SOME OTHER RELATED GENERA

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ABSTRACT

A continuation of this study of *Uvigerina* and its related genera has resulted in numerous studies which may be of general interest. Thirty-two Paleogene small Rotaliid benthic foraminiferal species of this genus and other related genera are common in eighteen localities in the Northern and Southern Tethys (USA, Mexico, Ecuador, Venezuela, Cuba, Caribbean, Chile, Argentina, France, Germany, Italy, Tunisia, Libya, Egypt, Nigeria, Jordan, United Arab Emirates (UAE), Pakistan). The taxonomy of the genus *Uvigerina* d'Orbigny with the other three related genera (i.e. *Rectuvigerina* Mathews, *Euvigerina* Thalmann and *Uvigerinella* Cushman) are presented and discussed.

KEYWORDS

Paleontology, stratigraphy, paleogeography, *Uvigerina*, Paleogene, Tethys.

1. INTRODUCTION

Industrial scientists create several new chemicals annually which in The paleontological occurrence the thirty-two members of the genus *Uvigerina* and other related genera have been recorded originally from eighteen localities in the Northern and Southern Tethys (Figure 1). The present study aims at throwing light: 1) to present together many data scattered

in the literature for these genera under a unifying theme, 2) to detect its paleontology, stratigraphy and paleogeographic distribution, 3) to present four new species: *Uvigerina ashrafi*, *Uvigerina awadhi*, *Uvigerina sameri* and *Uvigerinella jordania*, 4) to explain the taxonomic relationship of the genus *Uvigerina* d'Orbigny, with the other three related genera: *Rectuvigerina* Mathews, *Euvigerina* Thalmann and *Uvigerinella* Cushman (d'Orbigny, 1826; Mathews, 1945; Thalmann, 1952; Cushman, 1926).



Figure 1: The geographic distribution of the genus's members *Uvigerina* and other related genera in different countries in the world: North America (USA, Mexico), South America (Caribbean, Cuba, Ecuador, Venezuela, Chile, Argentina), Europe (France, Germany, Italy), Africa (Tunisia, Libya, Egypt, Nigeria), Asia (Jordan, UAE, Pakistan).

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2. MATERIAL OF STUDY

Rich and well-preserved thirty two Paleogene Rotaliid benthic foraminiferal species of the genus *Uvigerina* and some other related genera from eighteen countries in the Northern and Southern Tethys made it possible to elucidate them with modern taxonomical consideration. Following the Code of Zoological Nomenclature, a taxonomic revision of eight species of them are redescribed its morphological features, and also considered four species of them as a new.

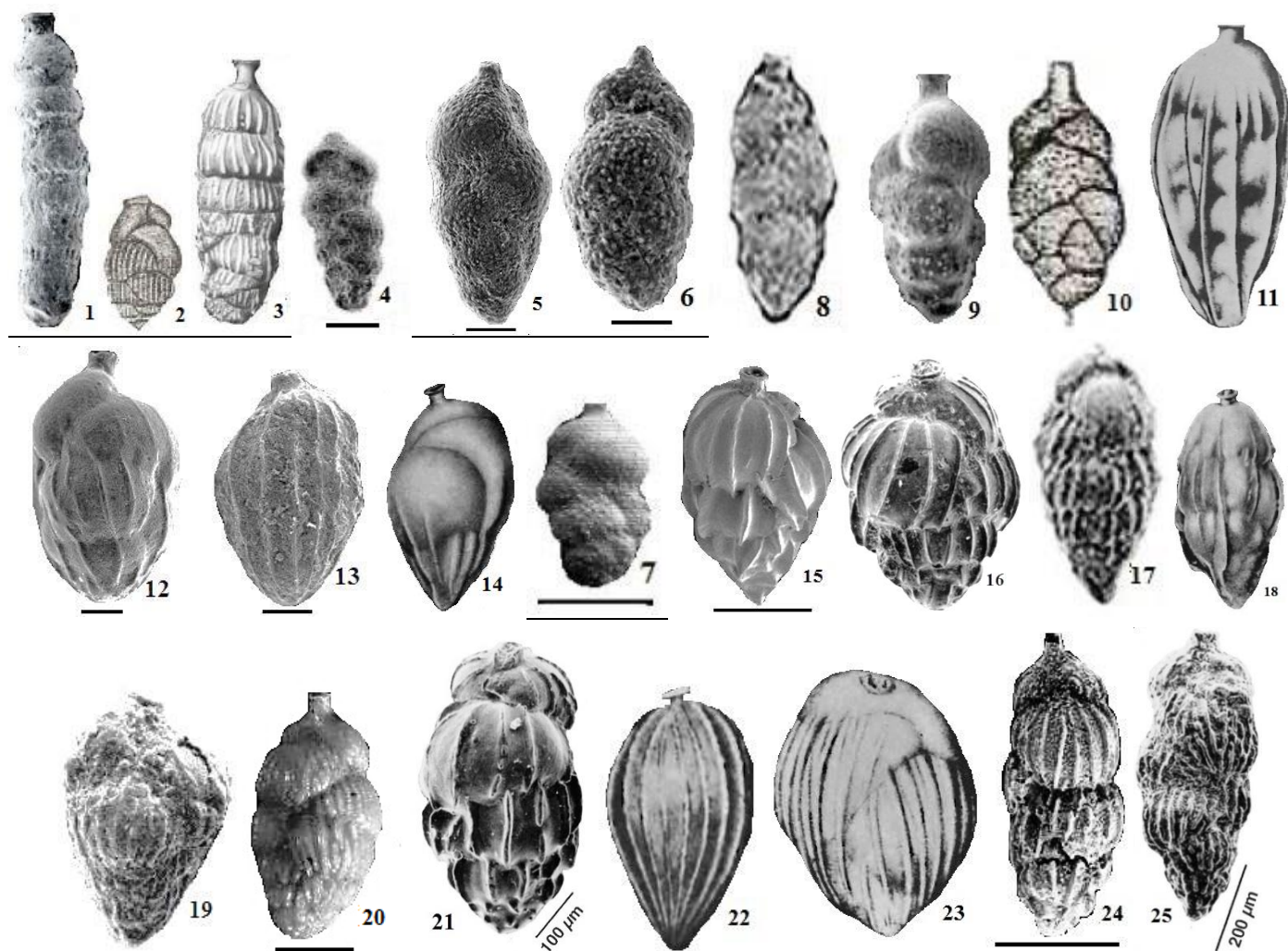
The classification Loeblich and Tappan is followed in this study (Loeblich and Tappan, 1988). The genus *Uvigerina* d'Orbigny [1] and other related genera have mainly elongated calcareous perforate test with triserial arrangement inflated chambers, sutures depressed and somewhat oblique, surface with longitudinal platy costae, striae, finely hispid or smooth, aperture terminal produced on a neck, and bordered with a phialine lip. The present study aims at throwing light on modern paleontological consideration of the Paleogene Uvigeriniid genera: *Uvigerina*, *Rectuvigerina*, *Euvigerina* and *Uvigerinella* (Table 1).

3. TAXONOMY

Table 1: The morphocharacters of four Rotaliid genera: *Uvigerina*, *Rectuvigerina*, *Euvigerina* and *Uvigerinella*.

Genus	Arrangement of chambers	Test shape	Ornamentation	Sutures	Aperture
<i>Uvigerina</i>	triserial	elongate	longitudinal platy costae or striae	distinctly depressed	tubular neck
<i>Rectuvigerina</i>	triserial	elongate	longitudinal costae	depressed	tubular neck
<i>Euvigerina</i>	triserial	elongate	numerous fine spines	depressed	tubular neck
<i>Uvigerinella</i>	Triserial tending to uniserial	elongate	smooth	slightly depressed	elongate slit

The Paleogene Rotaliid benthic foraminiferal species of the genus *Uvigerina* and other three related genera are identified and illustrated in Plate 1.



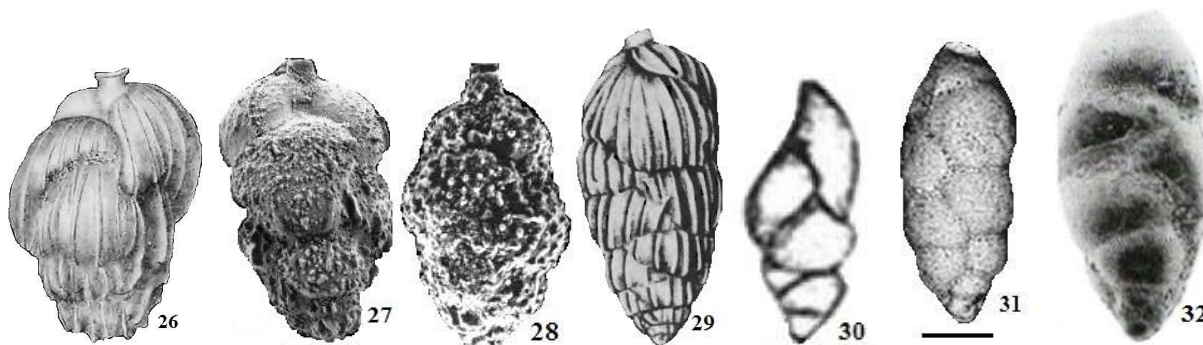


Plate 1: Figure 1: *Rectuvigerina argentinica* (Anan, 2023), 2. *Rectuvigerina lakiensis* (Haque, 1956), 3. *Rectuvigerina multicostata* (Cushman and Jarvis, 1929), 4. *Eouuigerina aegyptiaca* (Nakkady, 1950), 5. *Euuuigerina chirana* (Cushman and Stone, 1947), 6. *Euuuigerina farinosa* (Hantken, 1875), 7. *Euuuigerina helali* (Anan, 2024), 8. *Euuuigerina maqfiensis* (LeRoy, 1953), 9. *Euuuigerina minuta* (Cushman and Stone, 1949), 10. *Euuuigerina subproboscidea* (Haque, 1956), 11. *Uvigerina alazanensis* (Nuttall, 1932), 12. *Uvigerina ashrafi* Anan, n. sp., 13. *Uvigerina awadhi* Anan, n. sp., 14. *Uvigerina beccarii* (Fornancini, 1898), 15. *Uvigerina bifurcata* (d'Orbigny, 1839), 16. *Uvigerina cocoaensis* (Cushman, 1925), 17. *Uvigerina compressa* (Ansary, 1955), 18. *Uvigerina cubana* (Palmer and Bermudez, 1936), 19. *Uvigerina fadeli* (Bou Dagher, 1988), 20. *Uvigerina gallowayi* (Cushman, 1929), 21. *Uvigerina jacksonensis* (Cushman, 1925), 22. *Uvigerina mariannensis* (Cole and Ponton, 1930), 23. *Uvigerina mexicana* (Nuttall, 1932), 24. *Uvigerina peregrine* (Cushman, 1923), 25. *Uvigerina rippensis* (Cole, 1927), 26. *Uvigerina sameri* Anan, n. sp., 27. *Uvigerina senticosa* (Cushman, 1927), 28. *Uvigerina spinosa* (Boersma, 1984), 29. *Uvigerina vicksburgensis* (Cushman and Ellisor, 1931), 30. *Uvigerinella hofkeri* (Said and Kenawy, 1956), 31. *Uvigerinella jordanica* Anan, n. sp., 32. *Uvigerinella nakkadyi* (Anan, 1994) (Scale bar=100 µm 1).

Order Foraminiferida (Eichwald, 1830)

Suborder Rotaliina (Delage and Hérouard, 1896)

Superfamily Buliminacea (Jones, 1875)

Family Uvigerinidae (Haeckel, 1894)

Subfamily Uvigerininae (Haeckel, 1894)

Genus *Rectuvigerina* (Mathews, 1945)

Type species *Siphogenerina multicostata* (Cushman and Jarvis, 1929)

Rectuvigerina argentinica (Anan, 2023). Early Eocene, Argentina.

Rectuvigerina lakiensis (Haque, 1956). Paleocene-Early Eocene. Pakistan.

Rectuvigerina multicostata (Cushman and Jarvis, 1929). Eocene-Miocene, Trinidad.

Genus *Euuuigerina* (Thalman, 1953)

Type species *Uvigerina aculeata* (d'Orbigny, 1846)

Euuuigerina aegyptiaca (Nakkady 1950). Paleocene, Egypt.

Euuuigerina chirana (Cushman and Stone, 1947) (= *Uvigerina chirana*- (Galazzo et al. 2013)), p. 28, plate. 1, figure 24). Eocene, Italy.

Euuuigerina farinosa (Hantken, 1875) (= *Uvigerina farinosa*- (Galazzo et al. 2013)), p. 28, plate 1, figure 25). Eocene, Italy.

Euuuigerina helali (Anan, 2024). Ypresian, Egypt.

Euuuigerina maqfiensis (LeRoy, 1953) (= *Uvigerina maqfiensis*). Ypresian,

Egypt.

Euuuigerina minuta (Cushman and Stone, 1949) (= *Uvigerina minuta*- (Jannou, 2009), p. 107, figure 8U, V). Eocene, USA, Argentina.

50) *Euuuigerina subproboscidea* (Haque, 1956) (= *Uvigerina subproboscidea*). Paleocene-Eocene, Pakistan, Egypt.

Genus *Uvigerina* (d'Orbigny, 1826)

Type species *Uvigerina pigmea* (d'Orbigny, 1826)

Uvigerina alazanensis (Nuttall, 1932). Oligocene, Mexico.

Uvigerina ashrafi Anan, n. sp. (= *Uvigerina* sp. C - (Galazzo et al, 2013), p. 28, plate. 1, figure 27). Eocene, Italy.

Holotype: Plate 1, Figure 12.

Etymology: after the Prof. Ashraf Baghdadi, Ain Shams University, Cairo, Egypt.

Stratigraphic level: Middle Eocene. Alano di Piave section, North Italy (Figure, 2A, B), COL10B-16.95 m.

Diagnosis: Test semi-globular calcareous, perforate, triserial arrangement, rounded in section, chambers inflated, sutures slightly depressed, longitudinal platy costae ornamented surface, long terminal aperture and produced on a neck bordered with a phialine lip.

Remarks: This species has semi-globular test with rounded in section, longitudinal platy costae ornamented surface, with long terminal aperture.

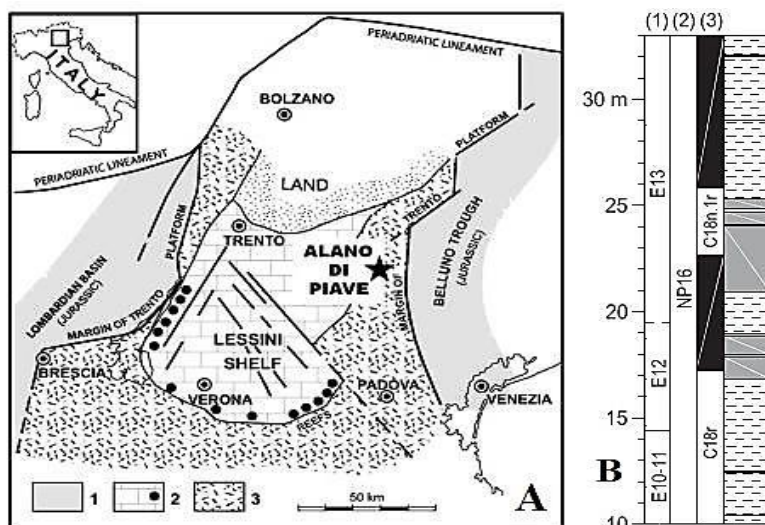


Figure 2: A. Location map of Alano di Piave section, North Italy, B. Stratigraphic log of the study section: (1) planktonic foraminiferal zones of (Berggren and Pearson, 2009), (2) calcareous nannofossil zones of (Martini 1971), (3) Polarity/Chron after (Agnini et al. 2011).

Uvigerina awadhi Anan, n. sp. (= *Uvigerina* sp. (Galazzo et al, 2013), p. 28, pl. 1, fig. 28). Eocene, Italy.

Holotype: Plate 1, Figure 13.

Etymology: after Prof. Samir Awadh, Ain Shams University, Cairo, Egypt.

Stratigraphic level: Middle Eocene. Alano di Piave section, North Italy (Figure, 2A, B), COL245B-19.30 m.

Diagnosis: Test calcareous, perforate, triserial elongate, rounded in section, sutures obscure, surface ornamented with longitudinal platy heavy costae along the test, aperture terminal, produced on a neck.

Remarks: This species is characterized by elongated heavy costae along the elongate test with nearly flush sutures.

Uvigerina beccarii (Fornasini, 1898). Oligocene, Ecuador.

Uvigerina bifurcata (d'Orbigny, 1839). Pleistocene to Recent, Atlantic, Pacific, Niger Delta Nigeria.

Uvigerina coccoensis (Cushman, 1925). Eocene, USA, Italy, Egypt, UAE.

Uvigerina compressa (Ansary, 1955), p. 96, plate 3, figure 15. Eocene, Egypt.

Uvigerina cubana (Palmer and Bermudez, 1936). Oligocene, Cuba.

Uvigerina fadeli (Bou Dagher, 1988). Eocene, Tunisia, Egypt.

Uvigerina gallowayi (Cushman, 1929). Eocene, USA, Ecuador, Venezuela, Chile, Libya.

Uvigerina jacksonensis (Cushman, 1925). Eocene. USA, Libya, Egypt.

Uvigerina mariannensis (Cole and Ponton, 1930). Oligocene, USA.

Uvigerina mexicana (Nuttall, 1932). Oligocene, Mexico.

Uvigerina peregrina (Cushman, 1923). USA.

Uvigerina rippensis (Cole, 1927). USA, Caribbean, Libya, Egypt.

Uvigerina sameri Anan, n. sp. (= *Uvigerina* sp.- (Cushman and Edwards, 1937), p. 84, plate 14, figure 10). Germany.

Holotype: Plate 1, Figure 26.

Etymology: after my kinsman Dr. Samer Mohammad Omar.

Stratigraphic level: Middle Oligocene, Solingen, Germany (Figure. 3).

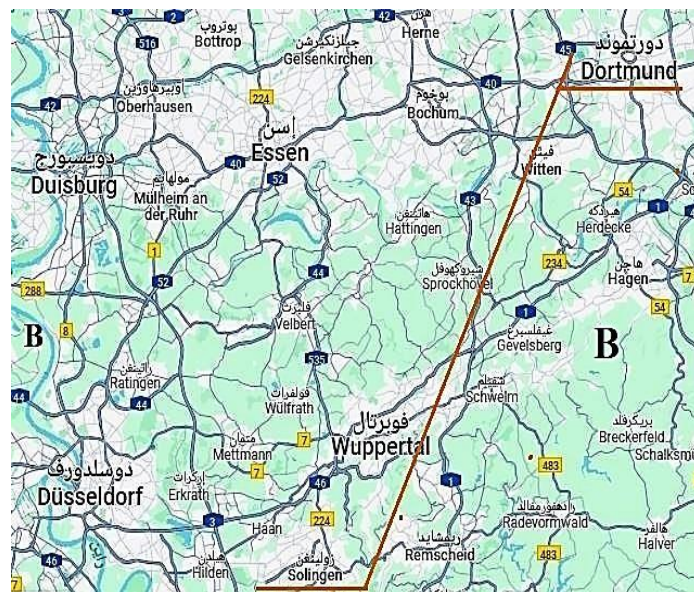


Figure 3: Location map of Solingen, south Dortmund, west Berlin, Germany.

Diagnosis: Test calcareous finely perforated, triserial arranged, broad about 1½ times as long as broad, chambers inflated, last-formed one tending to assume a terminal position, sutures distinct and depressed, surface ornamented by 10-12 high, plate-like, longitudinal costae, mostly independent of the chamber limits, aperture with a short neck and phialine lip.

Remarks: This species has nearly fusiform shape, about 1½ times as long as broad, ornamented by 10-12 high plate-like longitudinal costae and mostly independent of the chamber limits.

Uvigerina senticosa (Cushman, 1927). Miocene-Pleistocene, USA, Australia, Gulf of Mexico.

Uvigerina spinosa (Boersma, 1984). Eocene. USA, Gulf of Guinea.

Uvigerina vicksburgensis (Cushman and Ellisor, 1931). Oligocene, USA,

Mexico.

Uvigerinella (Cushman, 1926)

Type species *Uvigerina (Uvigerinella) californica* (Cushman, 1926).

Uvigerinella hofkeri (Said and Kenawy, 1956) (= *Eouvigerina hofkeri*). Danian, Egypt.

Uvigerinella jordanica Anan, n. sp. (= *Stainforthia cf. farafraensis*- (Alhejoj et al., 2020), p. 3, figure 2 E). Eocene, Jordan.

Holotype: Plate 1, Figure 31.

Etymology: after the Hashemite Kingdom of Jordan (Figure 4 A).

Stratigraphic level: Middle Eocene of Jabal Ghuzayma in the central Jordan (Figure 4 B).

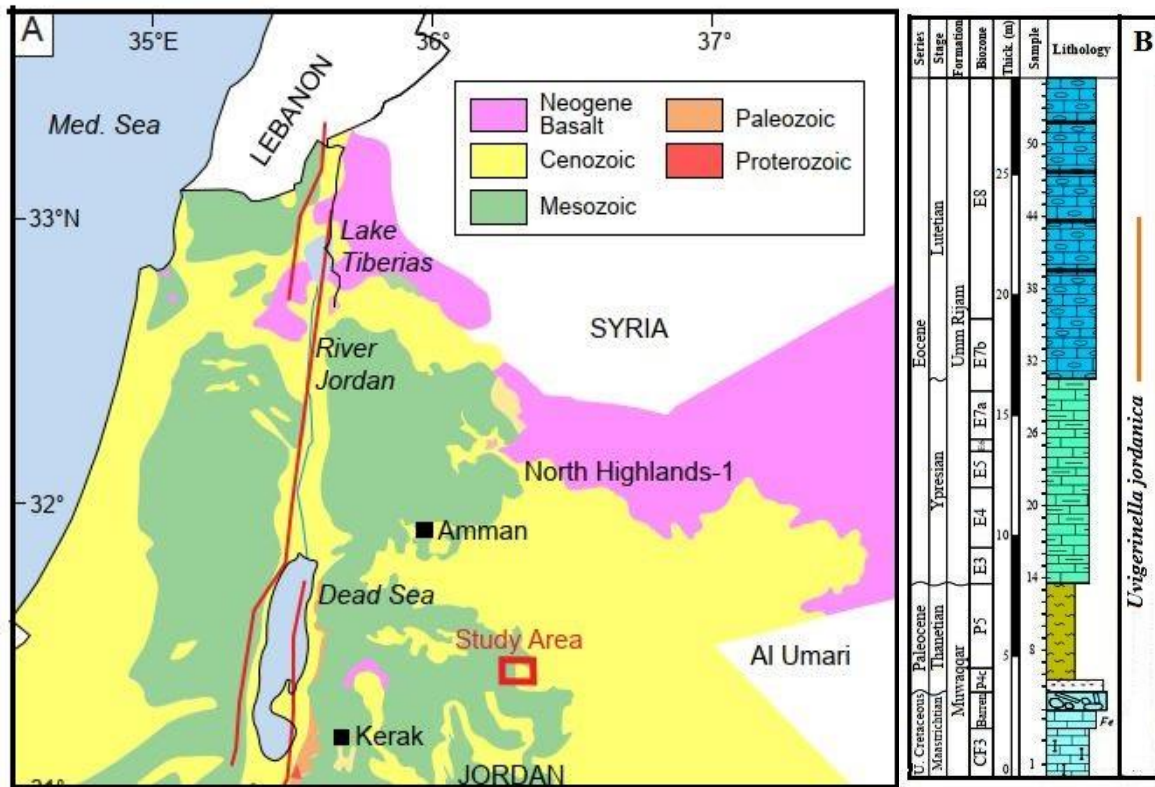


Figure 4: A. Location of the study area Jabal Ghuzayma, central Jordan, B. stratigraphic level of the new species *Uvigerinella jordanica* (= *Stainforthia cf. farafraensis* of Alhejoj et al, 2020).

Diagnosis: Test calcareous finely perforate, triserial and tending to become uniserial, elongate and circular in section, chambers increasing in height as added, sutures depressed, surface smooth, aperture an elongate slit extending from near the base of the final chamber.

Remarks: This species differs the main characters of the genus *Stainforthia* in having regular increasing in height as added chambers, with slightly depressed sutures, and without initial long spine *Uvigerinella nakkadyi* (Anan 1994), p. 224, figure 9. 5. Eocene, Egypt, UAE.

4. PALEOGEOGRAPHY

This study proved that the paleogeographic distribution of the four *Uvigerinid* genera (*Uvigerina*, *Rectuvigerina*, *Eouvigerina* and *Uvigerinella*) and its species are expanded into eighteen different parts of the Northern and Southern Tethys (USA, Mexico, Ecuador, Venezuela, Cuba, Caribbean, Chile, Argentina, France, Germany, Italy, Tunisia, Libya, Egypt, Nigeria, Jordan, United Arab Emirates, Pakistan).

5. PALEOENVIRONMENT

Due to the high abundance of pelagic *Uvigerinid* benthic foraminiferal assemblage indicate an open connection to the Tethys which supports the open flow direction of the Tethyan Circumglobal Current (TCC) in all directions (Figure. 5, after (Abed, 2020)). And most probably represents neritic-bathyal environment ~200-2000 m depth after many authors (Bignot, 2013)).



Figure 5: The Neo-Tethys ocean during the Paleogene time showing the open flow direction of the Tethyan Circumglobal Current (TCC) in all directions (after Abed, 2020).

6. CONCLUSION

The present study deals with the recording of thirty-two species of the Rotaliid Uvigeriniid genera (*Uvigerina*, *Rectuvigerina*, *Euuvigerina* and *Uvigerinella*) of eighteen localities in the Northern and Southern Tethys. Most of these species are distributed in one and more sites in the Tethys.

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