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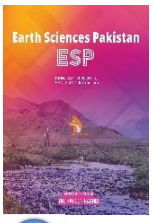

RESEARCH ARTICLE

NEW GEOGRAPHIC RECORD OF THE UAE PLANKTIC FORAMINIFERA *TURBOROTALIA SEMICUNIALENSIS* ANAN IN INDIA AND EGYPT

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ABSTRACT

The Late Eocene planktic foraminiferal species *Turborotalia semicunialensis* Anan with its raised keel in the first two chambers of the last whorl, was recorded recently from the planktic foraminiferal zonation *Globigerinatheca index* Zone (E16) of Jabal Hafit, United Arab Emirates (UAE). Another forms of this species, but under another names from the *Turborotalia cerroazulensis* group, were recorded from Cambay Basin, northwest of India (to the east of UAE), and from Wadi Hitan, Fayum area, Western Desert of Egypt (to the west of UAE). This documentation expanded the stratigraphic range of *T. semicunialensis* from E15 to P16 zonation throughout the Late Eocene. In general, the planktic foraminifera is predominantly considered to be related to open marine environment, photic zone, middle-upper neritic environment (100-200 m water depth).

KEYWORDS

Turborotalia, biostratigraphy, paleogeography, Eocene, UAE, India. Egypt.

1. INTRODUCTION

The *Turborotalia cerroazulensis* and *T. cocoaensis* were recorded from the Upper Eocene outcrops of the Cambay Basin, northwest India (Mukhopadhyay, 2005, Figure 1).

On the other hand, the Late Eocene strata (Priabonian, *Globigerinatheka semiinvoluta* Zone, E14) are exposed in Wadi Hitan or 'Valley of whales' is a world heritage site in the Western Desert of Egypt, some 140 kilometers southwest of Cairo and 60 kilometers west of Fayum (Figure 2).

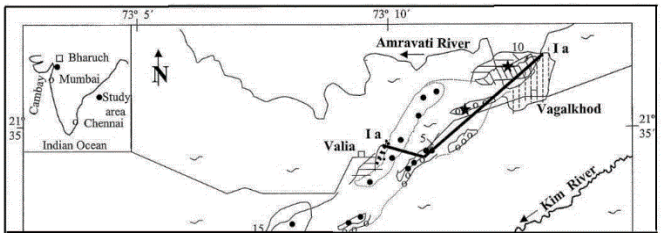

Figure 1: Location map of Cambay Basin, northwest of India (after Mukhopadhyay, 2005).

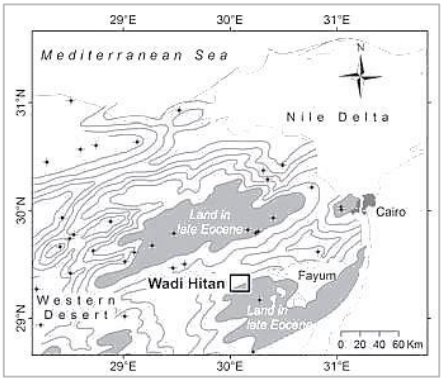

Figure 2: Location map of Wadi Hitan, 60 kilometers west of Fayum area, Western Desert of Egypt (after Strougo et al, 2013).

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2. STRATIGRAPHY

According to the modern biozonation the tripartite biozones are recognized in the current study, from base to top: *Globigerinatheka semiinvoluta* Zone (E14), *G. index* Zone (E15), and *Hantkenina alabamensis* Zone (E16) (after Berggren & Pearson, 2005; Wade et al., 2011; Molina, 2015) (Figure 3).

The stratigraphic log and stratigraphic range of the *T. semicunialensis* from the Cambay Basin, northwest India, including the stratigraphic position of the recorded species, *T. p*, 104b (Figures 4,5).

On the other hand, Strougo et al. (2013) presented a comprehensive stratigraphic study base on planktic foraminifera for the Late Eocene of Wadi Hitan section (Figure 6).

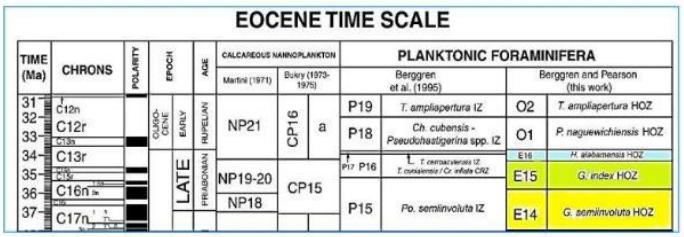

Figure 3: The Late Eocene planktic foraminiferal biozonation (after Berggren & Pearson, 2005).

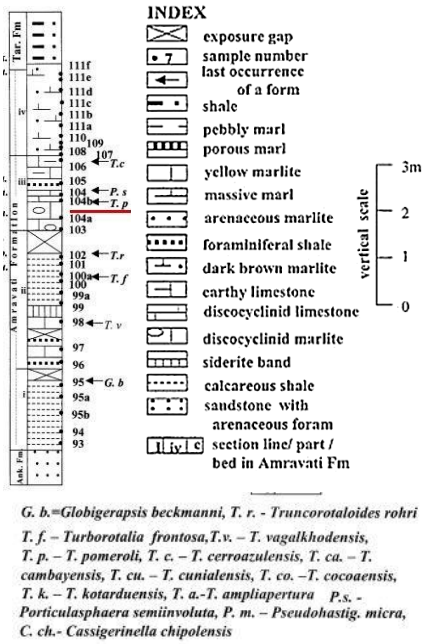

Figure 4: The stratigraphic studied section of Cambay Basin, northwest India (after Mukhopadhyay, 2005).

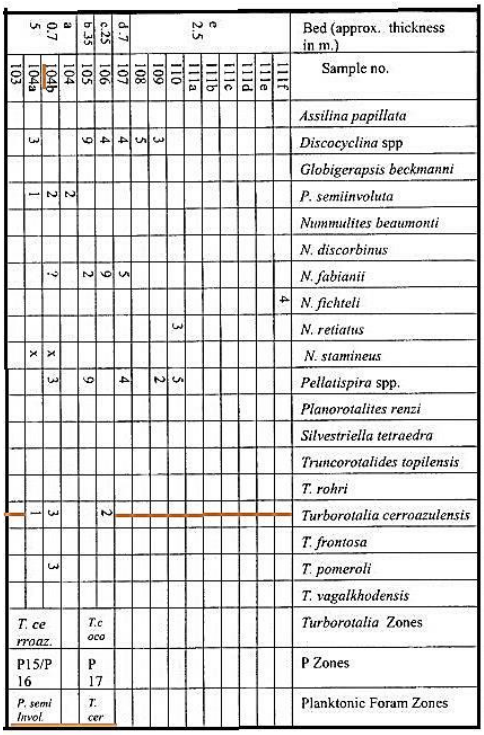

Figure 5: The stratigraphic range of the *T. cerroazulensis* (=*T. semicunialensis*) in the Late Eocene *G. semiinvoluta* Zone and *T. cerro.* Zone of Mukhopadhyay, 2005).

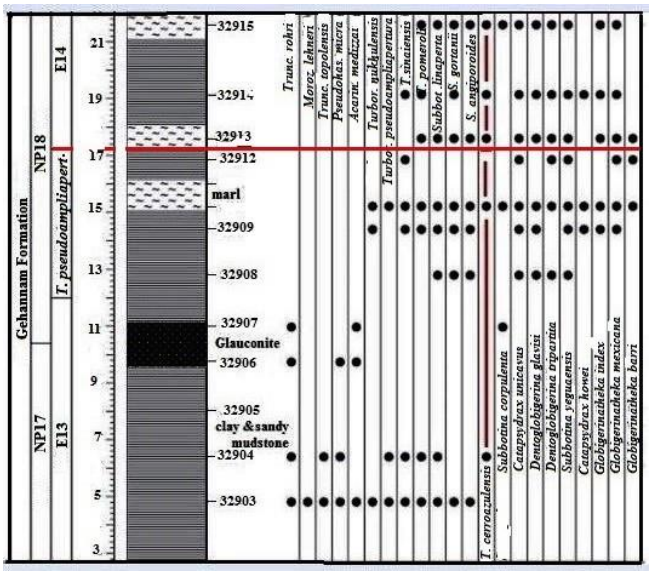

Figure 6: Stratigraphic column of Wadi Hitan section, S329 , showing the stratigraphic position of the planktonic foraminifera *T. cerroazulensis* from the sampled 32913 (E14).

3. Faunal Discussion

The *Turborotalia semicunialensis* Anan, represents a transitional specimen between *Turbrotalia cocoaensis* (Cushman) and *Turbrotalia cunialensis* (Toumarkine & Bolli). It differs from *T. cunialensis* in having weak raised keel in the first two chambers only than all chambers, and acute last chamber but without keel. It has the same stratigraphic level as *Globigerinatheka inflata* (Howe). In this study this species extends its stratigraphic level into the lower horizon to be existed in the early Late Eocene with the *Globigerinatheka semiinvoluta.*

4. Geographic Distribution

The planktic foraminiferal species *T. semicunialensis* was originally recorded from the Late Eocene of Jabal Hafit, UAE. In this study, this species were recorded in another two localities around UAE, but under another names from the *Turborotalia cerroazulensis* group, from Cambay Basin, northwest of India (to the east of UAE), and from Wadi Hitan, Fayum area, Western Desert of Egypt (to the west of UAE) (Figure 7), which indicates an open marine environment.

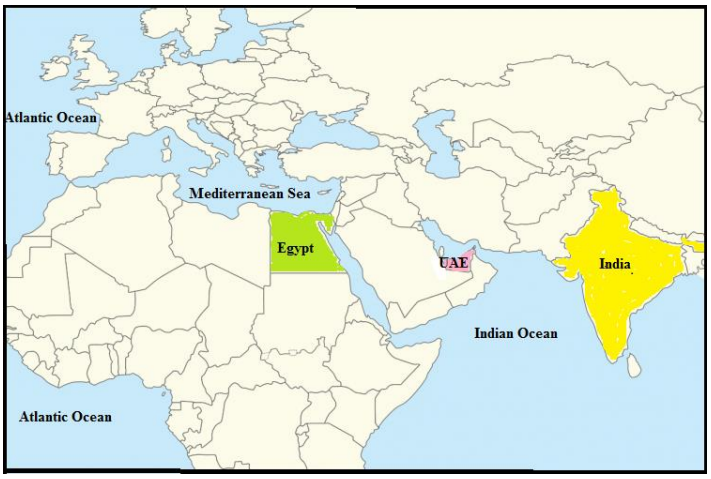

Figure 7: The geographic distribution of the Late Eocene *T. semicunialensis* Anan in the three localities (Egypt, UAE, India) in the Southern Tethys.

5. Taxonomy

The taxonomy followed in this study is that of (Pearson et al., 2006).

Order Foraminiferida Eichwald, 1830

Suborder Globigerinina Delage & Hérouard, 1896

Genus *Turborotalia* Cushman & Bermudez, 1949

Type species *Globorotalia centralis* Cushman & Bermudez, p. 26.

Turborotalia semicunialensis Anan, 2023, p. 36, pl. 1, fig. 9 [=the Upper Eocene transitional form between *T. cerroazulensis* (Cole) and *Turborotalia cocoaensis* (Cushman) of Mukhopadhyay, 2005, p. 26, pl. 2, fig. 5; =*Turborotalia cerroazulensis* (Cole) of Strougo et al., 2013, p. 128, fig. 12D].

Remarks: The recorded fourteen planktic foraminiferal species in the Late Eocene *Globigerinatheka semiinvoluta* Zone, E14 (of Strougo et al., 2013), identified one of these assemblage as *Turborotalia cerroazulensis* (Cole), sample 32913, but it belongs here to *Turborotalia semicunialensis* Anan due to its raised keel in the first two chambers of the last whorl than the moderate trochospiral test without keel in all chambers in the last whole of *T. cerroazulensis*.

6. Paleogeography

The paleogeographic map of many authors (e.g. Adams et al., 1983; Anan, 1994, 1995)

shows that the ancestral Tethyan Ocean in the Paleogene time is connected with the ancestral Indian, Atlantic, and Pacific Oceans. The late Eocene planktic foraminiferal assemblage, including *Cribrohantkenina inflata*, *Turborotalia semicunialensis*, *T. cunialensis* and *Hantkenina alabamensis* are restricted in the tropical-subtropical provinces (Lat. 45º N- 30º S). Rögl (1999) noted that by the end of the Eocene the Tethyan Ocean had already vanished (the new Indian Ocean was born), and the western end of the Tethys was reduced to the Mediterranean Sea (Figure 8). The deficiency of available

literatures, and/or the less homogeneity in the species concept between different authors, most probably provided the researchers of a complete information of the recorded species *Turborotalia semicunialensis* in other localities around the study area.

Plate 1: *Turborotalia semicunialensis* Anan (2023); **2**. *T. cerroazulensis* (Cole) of Mukhopadhyay (2005), from Cambay Basin, northwest India (=*T. semicunialensis* Anan, in this study); **3.** *Turborotalia cerroazulensis* (Cole) of Strougo et al (2013), from Wadi Hitan, Egypt (=*T. semicunialensis* Anan, in this study), **4.** *T. cerroazulensis* (Cole) of Anan (2023), from Jabal Hafit, UAE, **5.** *T. cunialensis* (Toumarkine & Bolli, 1970), from Jabal Hafit, UAE.

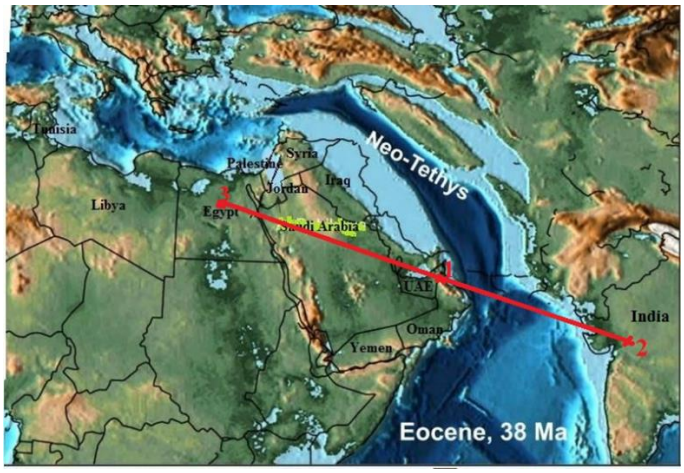

Figure 8: The Eocene paleogeographic map of the Neo-Tethys throughout the three locations: Egypt, UAE and India.

7. Paleoenvironment

The Late Eocene planktic foraminiferal assemblage from Egypt (in the west of the UAE) and India (in the eat) had been located in the tropical and warm temperature region based on many faunal environmental elements, i.e. tubular spines in the hantkeninids, keels in some Turborotaliids, and accessory apertures in the *Globigerinatheka* spp. (Frerichs, 1971; Coxall & Pearson, 2006, Wade & Pearson, 2008).

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