ZIBELINE INTERNATIONAL™ PUBLISHING

Earth Sciences Malaysia (ESMY)

DOI: http://doi.org/10.26480/esmy.01.2024.01.06

ISSN: 2521-5035 (Print)
ISSN: 2521-5043 (Online)
CODEN: ESMACU

CrossMark

RESEARCH ARTICLE

TAXONOMIC CONSIDERATION OF THE SOUTHERN TETHYAN ROTALIID BENTHIC FORAMINIFERAL MEMBERS OF THE GENUS *Cibicidoides*

Haidar Salim Anan*

Department of Stratigraphy and Paleontology, Former Vice President of Al Azhar University-Gaza, P. O. Box 1126, Palestine.
****Corresponding Author Email: profanan@gmail.com***

ARTICLE DETAILS

Article History:

Received 10 October 2023
Revised 13 November 2023
Accepted 17 December 2023
Available online 27 December 2023

ABSTRACT

Eighteen *Cibicidoides* Rotaliid benthic foraminiferal species were erected from three localities in the Southern Tethys Chile, Egypt and Pakistan. An American diagnostic west hemisphere species *C. vulgaris* is added to the assemblage, which was later is also recorded from another localities in the eastern hemisphere in the Southern Tethys: Egypt and Iran . One of the identified species is believed here to be new: *C. chilensis*. Environmental conditions of the identified species of the genus *Cibicidoides* represent middle-outer neritic environment (100-200 m) and show an affinity with Midway-Type Fauna "MTF".

KEYWORDS

Paleontology, Stratigraphy, *Cibicidoides*, benthic foraminifera, Tethys

1. INTRODUCTION

The author has examined eighteen species belonging to the Maastrichtian-Neogene Rotaliid benthic foraminiferal genus *Cibicidoides*, which were originally erected from the Southern Tethys (Egypt, Pakistan and Chile), which is distinguished by its biconvex lenticular trochospiral calcareous test, angular or keeled periphery, depressed or raised limbate sutures, interiomarginal and equatorial arch aperture at the base of the apertural face on the periphery which bordered by a small lip. Another American diagnostic species *C. vulgaris* is added to the assemblage, which was erected originally from USA (west hemisphere) and later had been recorded in some localities in the Southern Tethys (east hemisphere). The present study aims at throwing light on: 1) present together many data scattered in the literature for the different members of this genus *Cibicidoides* under a unifying theme, 2) detect its modern taxonomic consideration, stratigraphy and paleogeography of them, 3) present a new species: C. *chilensis*.

2. MATERIAL OF STUDY

Eighteen small Maastrichtian-Neogene benthic foraminiferal species of the Rotaliid genus *Cibicidoides* Thalmann were originally erected from three localities in the Southern Tethys (Egypt, Pakistan and Chile), and some of them are also recorded in the other localities in the Southern Tethys (e. g. Argentina, Tunisia, Libya, Palestine, UAE, Iran, India), and also Northern Tethys (e.g. Spain, France) (Figure 1). Following the Code of Zoological Nomenclature, a taxonomic revision of the assemblage, and one species of them is considered here as a new species.

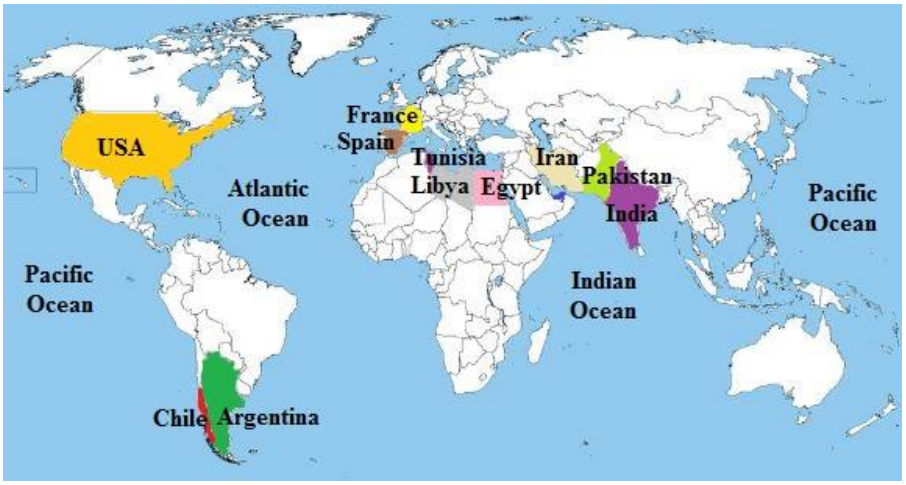


Figure 2: The paleogeographic distribution of the identified Maastrichtian-Neogene members of the genus *Cibicidoides* in the world: North and South America, west Europe, north Africa and south Asia.

Quick Response Code	Access this article online	
	Website: www.earthsciencesmalaysia.com	**DOI:** 10.26480/esmy.01.2024.01.06

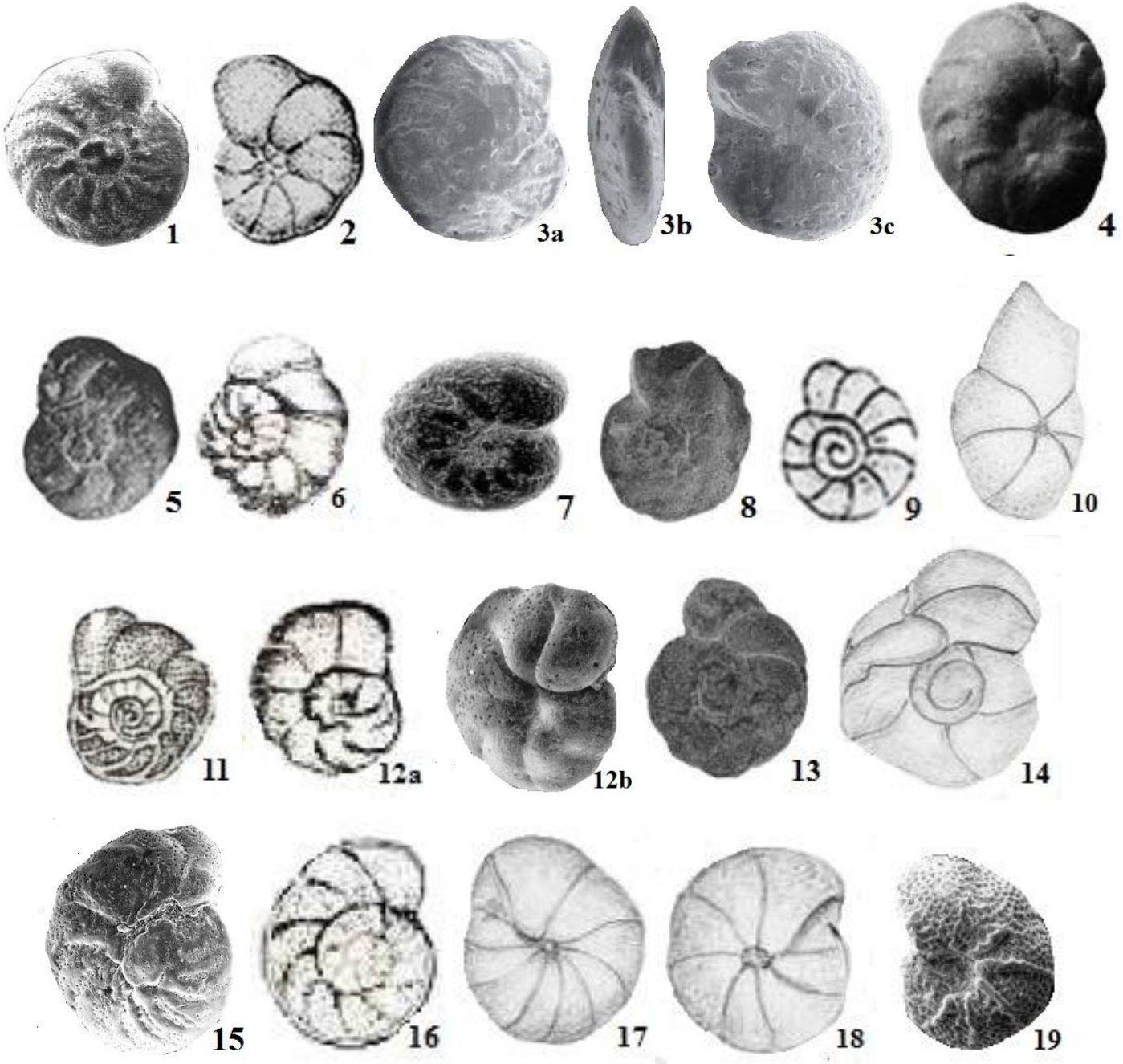
Cite The Article: Haidar Salim Anan (2024). Taxonomic Consideration of The Southern Tethyan Rotaliid Benthic Foraminiferal Members of The Genus *Cibicidoides*. *Earth Sciences Malaysia, 8(1): 01-06*.

2. Systematic Paleontology

The genus *Cibicidoides* Thalmann is characterized mainly by its smaller chambers of inner whorl than those of succeeding whorl, and have a very small boss in the center. It differs from the genus *Gavelinella* Brotzen by its biconvex, biumbonate test and angular periphery than rounded in the other, and it also differs from *Angulogavelinella* Hofker by its dorsally extended aperture than elevated interiomarginal arch. The taxonomy of the identified species of the genus *Cibicidoides* follows that of Loeblich &Tappan (1988), and the illustrated taxa have been shown in Plate 1.

Plate 1

Fig. **1.** *Cibicidoides abudurbensis* (Nakkady, 1950), **2.** *C. beadnelli* (LeRoy, 1953), **3a-c.** *C. chilensis* Anan, n. sp. (a. dorsal view, b. side view, c. ventral view), **4.** *C. decoratus* (LeRoy, 1953), **5.** *C. farafraensis* (LeRoy, 1953), **6.** *C. ghalebi* (Haque, 1956), **7.** *C. grandis* (LeRoy, 1953)**, 8.** *C. libycus* (LeRoy, 1953), **9.** *C. loeblichi* (Said & Kenawy, 1956), **10.** *C. megaloperforatus* (Said& Kenawy, 1956), **11**. *C. nammalensis* Haque, 1956, **12a,b**. *C. patalensis* (Haque, 1956) (a. after Haque, 1956; b. after Jannou, 2009), **13.** *C. pharaonis* (LeRoy, 1953), **14.** *C. praecursorius* (Schwager, 1883), **15.** *C. pseudoacutus* (Nakkady, 1950), **16.** *C. punjabensis* (Haque, 1960), **17.** *C. vulgaris* (Plummer, 1927) (all x 100).



Order Foraminiferida Eichwald, 1830

Suborder Rotaliina Eichwald, 1830

Superfamily Discorbinellacea Sigal, 1952

Family Parrelloididae Hofker, 1956

Genus *Cibicidoides* Thalmann, 1939

Type species *Truncatulina mundula* Brady, Parker& Jones, 1890

1) *Cibicidoides abudurbensis* (Nakkady, 1950) (=*Cibicides abudurbensis* Nakkady, **1950**, p. 691, pl. 90, figs. 35-38). Maastrichtian-Paleocene, Egypt (Nakkady, **1950**), Palestine (Almogi-Labin et al., 1990), UAE (Anan, 1993), Tunisia (Speijer, 1994), Spain (Alegret et al, 2003) and France (Sztrákos, 2005).

2) *Cibicidoides beadnelli* (LeRoy, 1953)(=*Cibicides beadnelli* LeRoy,1953, p. 23, pl. 10, figs. 6-8). Ypresian, Egypt (LeRoy, 1953) and Tunisia (Keller, 1988).

3) *Cibicidoides chilensis* Anan, n. sp.*(=Cibicidoides* sp. Finger, 2013, p.457, pl. 19, fig. 7).

Holotype: Illustrated specimen in Plate 1, Figure 3.

Etymology: After the State of Chile (Figure 2).

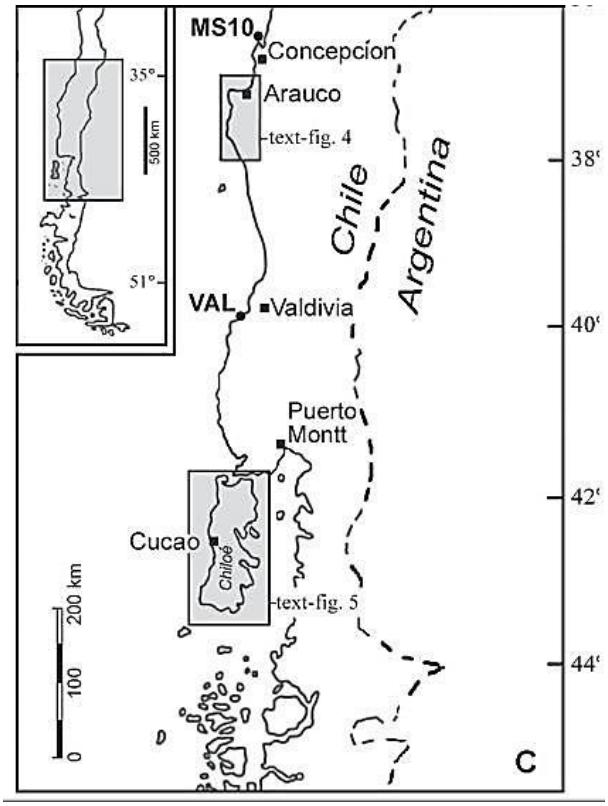


Figure 2: A. Location map of Chile, west South America, B. The study area in the central Chile, C. The location of the Lacui Formation, south Chile (Finger, 2013).

Type locality: Chiloé, Cucao, South Chile, Lacui Formation, CHO, CHE, CUC (Table 1).

Table 1: Stratigraphic level of *Cibicidoides chilensis* Anan, n. sp. (=*Cibicidoides* sp., Finger, 2013, pl.1-, figure. 7) in the Lacui Formation, Chile (VR = very rare, 1-5 specimens).

SECTOR	North												Central								South				
AREA	Las Cruces	Navidad											Conc	Arauco						Vald	Chiloé				
GEOLOGIC UNIT	El Peral beds	Navidad Fm.											Ranquil Fm.							SDom	Lacui Fm.				
LOCALITY	NLP	LPER	MOS	RAP	PPP	PPT	PPN	LBZ	PTA	MAT	NAV5	MPUP	CPUP	MS10	FRA	FRM	RQT	RQK	RAN	MIB	LEB	VAL	CHO	PCB	PNH	CHE	CUC
																							VR			VR	VR

Stratigraphic level: Miocene.

Diagnosis: Test low trochospiral compressed, coarsely punctate, 9–10 chambers in last whorl, oblique and slightly curved limbate sutures connected to bluntly rounded peripheral carina.

Remarks: The new species differs from the other members of the genus by its coarsely punctate surface, curved limbate sutures, and bluntly rounded periphery.

4) ***Cibicidoides decoratus*** **(LeRoy, 1953)(=** *Cibicides decoratus* LeRoy, 1953, p. 23, pl. 6, figs. 15-17). Ypresian, Egypt (LeRoy, 1953) and Tunisia (Speijer, 1994).

5) ***Cibicidoides farafraensis*** **(LeRoy, 1953)** (=*Cibicides farafraensis* LeRoy,1953, p. 24, pl.10, figs. 1-3). Ypresian, Egypt (LeRoy, 1953) and Tunisia (Berggren and Aubert, 1975).

6) ***Cibicidoides ghalebi*** **(Haque, 1956)** (=*Cibicides multifaria* (Schwager) *limbata* Haque, 1956, p. 205, pl.16, fig.5; *Cibicides multifaria ghalebi* Haque -Thalmann,1959, p.130).Paleocene, Pakistan.

7) ***Cibicidoides grandis*** **(LeRoy, 1953)** (=*Anomalina grandis* LeRoy,1953, p. 18, pl. 9, figs. 6-8). Maastrichtian-Ypresian, Egypt.

8) ***Cibicidoides libycus*** **(LeRoy, 1953)** (=*Cibicides libycus* LeRoy, 1953, p. 24, pl. 5, figs. 1-3). Paleocene-Ypresian, Egypt (LeRoy, 1953), Libya and Tunisia (Berggren & Aubert, 1975), France (Sztrákos, 2005), Turkmenia and Soviet Union (Saperson & Janal,1980).

9) ***Cibicidoides loeblichi*** **(Said & Kenawy, 1956)** (=*Cibicides loeblichi* Said and Kenawy, 1956, p. 155, pl. 7, fig. 11). Maastrichtian-Paleocene, Egypt.

10) ***Cibicidoides megaloperforatus*** **(Said & Kenawy, 1956)** (=*Cibicides megaloperforatus* Said & Kenawy, 1956, p. 155, pl. 7, fig. 13). Paleocene, Egypt.

11) ***Cibicidoides nammalensis*** **(Haque, 1956**) (=*Cibicides mensilla* (Schwager) var. *nammalensis* Haque, 1956, p. 205, pl. 20, fig. 10). Paleocene-Ypresian, Pakistan (Haque, 1956) and France (Sztràkos, 2005).

12) ***Cibicidoides patalensis*** **Haque, 1956** (=*Cibicides lobatulus* (Walker and Jacob) var. *patalaensis* Haque, 1956, p. 209, pl.. 16, fig. 6; *Cibicides* sp. cf. *lobatulus* (Walker and Jacob) var. *patalaensis* Haque - Jannou, 2009, p. 111, fig. 12F). Paleocene-Ypresian, Pakistan (Haque, 1956), India (Symphonia & Senthil, 2019) and Argentina (Jannou, 2009).

13) ***Cibicidoides pharaonis*** **(LeRoy, 1953)** (=*Cibicides pharaonis* LeRoy,1953, p. 24, pl. 7, figs. 9-11). Paleocene-Ypresian, Egypt.

14) ***Cibicidoides praecursorius*** **(Schwager, 1883)** (=*Cibicides praecursorius* Schwager, 1883, p. 125, pl. 27, figs. 12, 13). Ypresian, Egypt (Schwager, 1883) and Tunisia (Karoui-Yaakoub, 2006).

15) ***Cibicidoides pseudoacutus*** **(Nakkady, 1950)** (=*Anomalina pseudoacuta* Nakkady, 1950, p. 691, pl. 90, figs. 29-32). Maastrichtian-

Ypresian, Egypt (Nakkady, 1950), Tunisia (Galeotti and Coccioni, 2002), France (Sztrákos, 2005).

16) *Cibicidoides punjabensis* (Haque, 1960)(=*Cibicides punjabensis* Haque,1960, p. 42, pl. 6, fig.1). Ypresian, Pakistan (Haque,1960) and India (Khanolkar & Saraswati, 2019).

17) *Cibicidoides schwageri* (Said & Kenawy, 1956)(=*Cibicides schwageri* Said & Kenawy, 1956, p. 155, pl. 7, fig. 10). Paleocene, Egypt (Said & Kenawy, 1956).

18) *Cibicidoides tappanae* (Said& Kenawy, 1956)(=*Cibicides tappanae* Said & Kenawy, 1956, p. 155, pl. 7, fig. 12). Maestrichtian, Egypt (Said & Kenawy, 1956).

19) *Cibicidoides vulgaris* (Plummer, 1927) (=*Truncatolina vulgaris* Plummer, 1927, p. 146, pl. 10, fig. 3). Paleocene-Ypresian, USA (Plummer, 1927), Argentina and Turkmenia (Berggren & Aubert, 1975), Egypt (Anan & Sharabi, 1988) and Iran (VahdatiRad et al., 2016).

3. Paleogeography

According to many authors (e.g. Rögl, 1999; Aubry et al., 2007; Abed, 2013; Anan, 2020), the Tethys had been connected from west Atlantic Ocean to east with the Indian Ocean via the Mediterranean Sea during the Maastrichtian-Neogene time. The identified species have wide stratigraphic distribution from many parts of the Southern and also Northern Tethys (Table 2).

Table 2: The paleogeographic distribution of the identified species of the genus *Cibicidoides* in the Tethys: U=USA, C=Chile, A=Argentina, F=France, S=Spain, T= Tunisia, L=Libya, E=Egypt, N=Palestine, A=UAE, R=Iran, P=Pakistan, I=India, K = Turkmenia, (Sp. no. = species number, ⊙=illustrated species, x = recorded species).

Sp. no.	Countries / Species of *Cibicidoides*	U	C	A	F	S	T	L	E	N	A	R	P	I	K
1	*abudurbensis*				x	x	x		⊙	x	x				
2	*beadnelli*					x	x	x	⊙						
3	*chilensis*		⊙												
4	*decoratus*						x		⊙						
5	*farafraensis*						x		⊙						
6	*ghalebi*												⊙		
7	*grandis*								⊙						
8	*libycus*				x		x	x	⊙						x
9	*loeblichi*								⊙						
10	*megaloperforatus*								⊙						
11	*nammalensis*				x								⊙		
12	*patalensis*			x									⊙	x	
13	*pharaonis*								⊙						
14	*praecursorius*						x		⊙						
15	*pseudoacutus*				x		x		⊙						
16	*punjabensis*												⊙	x	
17	*schwageri*								⊙						
18	*tappanae*								⊙						
19	*vulgaris*	⊙		x					x					x	x

The nineteen small benthic foraminiferal species belong to the diagnostic calcareous Rotaliid benthic foraminiferal genus *Cibicidoides* were identified from many localities in the Southern Tethys (Argentina, Chile, Tunisia, Egypt, UAE, Pakistan, India), and also Northern Tethys (USA, France, Spain). Some remarks of the paleogeographic distribution of the recorded species can be added:

1. Thirteen of the identified species were erected from the Southern Tethys, Egypt: 13/18 (about 72%), Pakistan 4/18 (about 22%), Chile 1/18 (about 0.05 %).

2. *C. abudurbensis* is recorded from six localities in the Southern and Northern Tethys (see Table 2).

3. *C. vulgaris* was erected from USA and recorded in Argentina (west hemisphere), and later on in three localities in the east hemisphere: Turkmenia, Egypt and Iran (Fig. 3).

4. *C. libycus* is recorded from four localities in the Tethys.

5. *C. patalensis* and *C. pseudoacutus* are recorded from three localities in the Tethys.

6. *C. beadnelli, C. decoratus, C. farafraensis, C. nammalensis, C. praecursorius, C. punjabensis* are recorded only from two localities in the Tethys.

7. *C. chilensis, C. ghalebi, C. grandis, C. loeblichi, C. megaloperforatus, C. pharaonis, C. schwageri, C. tappanae* are, so far, an endemic to their original erection.

4. Paleoenvironment

Most recorded species in this study were erected from the Southern Tethys in Egypt and Pakistan, indicate open connection of the both sides of the Tethys and represent middle-outer neritic environment (100-200 m) and show an affinity with Midway-Type Fauna "MTF" of Berggren & Aubert (1975) which is characterized by the species of the genus *Cibicidoides*, and the flow of the Tethys Sea and its continuation as the North Equatorial Current transported various Tethyan, tropical, faunal elements to the Caribbean-Gulf Coast region (Figure 4).

Has a noted that the analysis of coiling direction preference in the benthic foraminifera *Cibicidoides pseudoacutus* (Nakkady) has been carried out across the K–T (Cretaceous–Tertiary boundary) from some Tunisian sections representing a palaeobathymetric transect from a middle–outer neritic to lower upper bathyal depositional setting, and this species developed a preference for sinisterly coiling in a short time period during the lowermost (Danian Galeotti and Coccioni, 2002). Adatte et al. (2002) figured a comparison between the Tethys (El Kef section, Tunisia) and the South Atlantic of the sea level, climate and major event around the K-T transition, which the bolide impact had a relatively incidental short-term effect on climate in the Tethys region (Figure 5), and they added that the high sea-levels generally correspond to increasing seasonality and drier conditions, whereas low sea-levels correspond to increasing humidity and possibly warmer conditions (Figure 6).

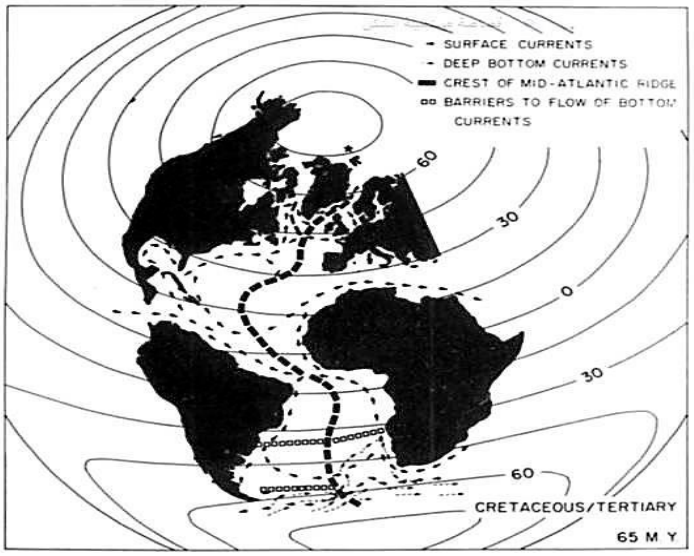


Figure 4: The paleocirculation patterns (65 M.Y. ago) of the Atlantic Ocean (Berggren and Aubert, 1975).

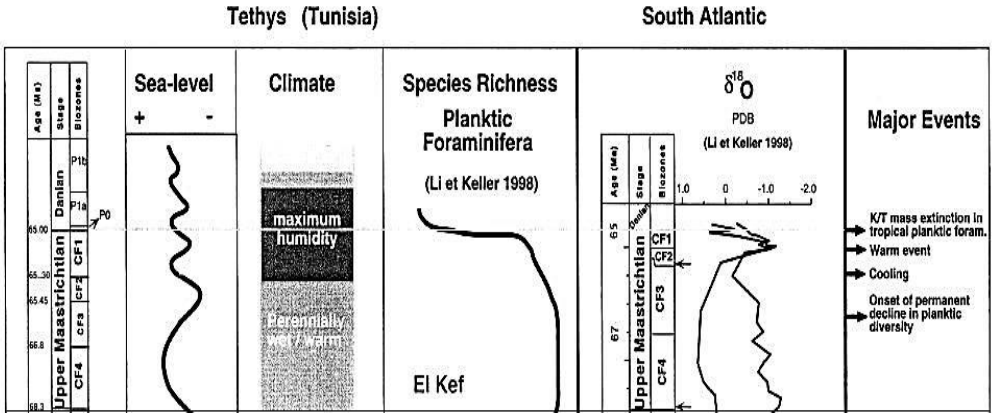


Figure 5: Fluctuation of the sea level, climate (alternating of the warm and cooling sea water), and major events of P/B ratio around the K/T boundary in the Tethys and South Atlantic (Adatte et al., 2002).

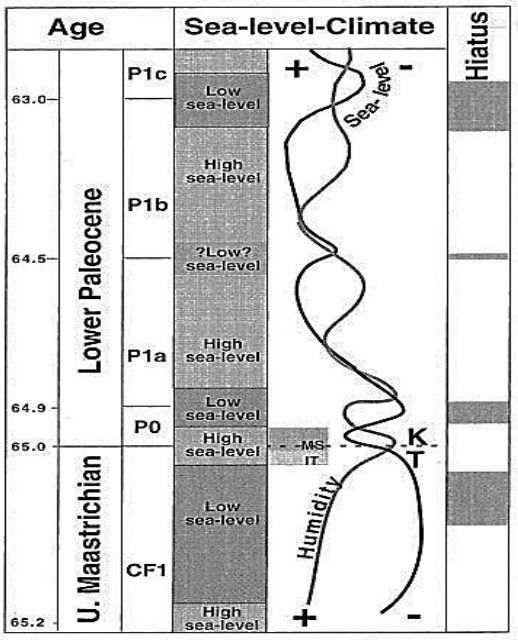


Figure 6: Relationships between the sea-level and climate in El Kef section (represents the Southern Tethys) explained increasing humidity and possibly warmer conditions during the low sea-level (Adatte et al., 2002).

5. Conclusions

The present study deals with the recording of eighteen identified species of the calcareous Rotaliid foraminifera genus *Cibicidoides* were originally erected from many localities in the Southern Tethys (Chile, Egypt, Pakistan). Another American diagnostic specie *C. vulgaris* includes to this assemblage due to its distinguished paleogeographic distribution in the west and also east hemispheres. Some of the identified species are also recorded far than its original erection in other localities in the South America (Argentina), West Europe (Spain, France) and Southern Tethys (Tunisia, Palestine, UAE, Iran and India). The Tethyan realm had been connected with the Atlantic Ocean from west to the Indo-Pacific Ocean to

the east, via Mediterranean Sea, which crossing the Middle East region during the Maastrichtian-Neogene time. Environmental conditions of the identified species represent middle-outer neritic environment (100-200m) and show an affinity with Midway-Type Fauna "MTF". The direction of coiling of *C. pseudoacutus* help to define the major faunal changing around K-T transition.

Acknowledgement

The author would like to express his sincere appreciation to the editor of ESP for kind cooperation. I am also indebted to my daughter Dr. Huda Anan for help in the development of the figures, table and plate.

References

Abed, A.M., 2013. The eastern Mediterranean phosphorite giants: An interplay between tectonics and upwelling. Geo Arabia, 18 (2), Pp. 67–94.

Adatte, T., Keller, G., Stinnesbeck, W., 2002. Late Cretaceous to early Paleocene climate and sea-level fluctuations: the Tunisian record. Palaeogeography, Palaeoclimatology, Palaeoecology, 178, Pp. 165-196.

Alegret, L., Molina, E., Thomas, E., 2003. Benthic foraminiferal turnover across the Cretaceous /Paleogene boundary at Agost (southeastern Spain): paleo-environmental inferences. Marine Micropaleontology, 48 (3-4), Pp. 251-279.

Alegret, L., Ortiz, S., 2006/2007. Global extinction event in benthic foraminifera across the Paleocene/ Eocene boundary at the Dababiya Stratotype section. Micropaleontology, 52 (5), Pp. 433-447.

Almogi-Labin, A., Flexer, A., Honigstein, A., Rosenfeld, A., Rosenthal, E., 1990. Biostratigraphy and tectonically controlled sedimentation of the Maastrichtian in Israel and adjacent countries. Revista Espaňola de Micropaleontologia, 5, Pp. 41-52.

Anan, H.S., 1993. Paleocene benthonic foraminifera of Jabal Malaqet, Al Ain region, United Arab Emirates. Al-Azhar Bulletin of Sci., Al Azhar University, Cairo, 4 (1), Pp. 293-320.

Anan, H.S., 2008. Maastrichtian-Paleogene LeRoy's benthic foraminiferal species from Egypt and Tethyan-Atlantic regions. Revue de Paléobiologie, 27 (2), Pp. 357-376.

Anan, H.S., 2019. Contribution to the paleontology, stratigraphy and paleoenvironment of ten diagnostic Egyptian benthic foraminifera. International Journal of Science and Research (IJSR), 8 (8), Pp. 171-177.

Anan, H.S., 2020. Southern Tethys benthic foraminifera in Northern Tethys. Earth Science Pakistan (ESP), 4 (2), Pp. 70-75.

Anan, H.S., Sharabi, S.A., 1988. Benthonic foraminifera from Upper Cretaceous-Lower Tertiary rocks of northwest Kharga Oasis, Egypt - Middle East Research Center, Ain Shams University, Earth Science Series, Cairo, 2, Pp. 191-218.

Aubry, M.-P., Ouda, Kh., Dupuis, C., Berggren, W.A., Van Couvering, J.A., 2007. The Global Standard Stratotype-section and Point (GSSP) for the base of the Eocene Series in the Dababiya section (Egypt). Episodes, 30 (4), Pp.271-286.

Berggren, W.A., Aubert, J., 1975. Paleocene benthonic foraminiferal biostratigraphy, paleobiogeography and paleoecology of Atlantic-Tethyan regions: Midway-type fauna. Palaeogeography, Palaeoclimatology, Palaeoecology, 18, Pp. 73-192.

Galeotti, S., Coccioni, R., 2002. Changes in coiling direction of Cibicidoides pseudoacutus (Nakkady) across the Cretaceous-Tertiary boundary of Tunisia: palaeoecological and biostratigraphic implications. Palaeogeography, Palaeoclimatology, Palaeoecology, 178, Pp. 197-210.

Haque, A.F.M.M., 1956. The foraminifera of the Ranikot and the Laki of the Nammal Gorge, Salt Range, Pakistan. Pakistan Geological Survey Memoir, Palaeontologica Pakistanica, 1, Pp. 1-229.

Haque, A.F.M.M., 1960. Some middle to late Eocene smaller foraminifera from the Sor Rang, Quetta District, West Pakistan. Pakistan Geological Survey Memoir, Palaeontologica Pakistanica, 2 (2), Pp. 9-57.

Karoui-Yaakoub, N., 2006. Effet du réchauffement climatique global sur le comportement des foraminifères benthiques de l'intervalle de passage Paléocène-Eocène de la coupe d'Ellès (Tunisie). Revue de Paléobiologie, Genève, 25 (2), Pp. 575-591.

Keller, G., 1988. Biotic turnover in benthic foraminifera across the Cretaceous/Tertiary boundary at al Kef, Tunisia. Palaeogeography, Palaeoclimatology, Palaeoecology, 66, Pp. 153-171.

Khanolkar, S., Saraswati, P.K., 2019. Eocene foraminiferal biofacies in Kutch Basin (India) in context of palaeoclimate and palaeoecology. Journal of Palaeogeography, 8 (21), Pp. 1-16.

LeRoy, L.W., 1953. Biostratigraphy of Maqfi section, Egypt. Geological Society of American Memoir, 54, Pp. 1-73.

Loeblich, A.R., Tappan, H., 1988. Foraminiferal genera and their classification. Van Nostrand Reinhold (VNR), New York, Part 1, Pp.1-970, part 2, Pp. 1-847.

Nakkady, S.E., 1950. A new foraminiferal fauna from the Esna Shale and Upper Cretaceous chalk of Egypt. Journal of Paleontology, 24 (6), Pp. 675-692.

Plummer, H.J., 1927. Foraminifera of the Midway Formation in Texas. Bulletin University of Texas, 2644, Pp. 3-206.

Rögl, F., 1999. Mediterranean and Paratethys. Facts and hypotheses of an Oligocene to Miocene paleogeography (short overview). Geologica Carpathica, 50 (4), Pp. 339-349.

Saperson, E., Janal, M., 1980. Biostratigraphy of the Anomalinidae and Cibicididae in Soviet Tethyan Paleogene. Micropaleontology, 26 (4), Pp. 392-413.

Schwager, C., 1883. Die Foraminiferen aus dem Eocaenable–gerungen der Libyschen wuste und Agyptens. Paleontographica, 30, Pp. 81-153.

Speijer, R.P., 1994. Extinction and recovery patterns in benthic foraminiferal paleocommunities across the Cretaceous/Paleogene and Paleocene/Eocene boundaries. Geologica Ultraiectina, Universiteit Utrecht, 124, Pp. 1-191.

Symphonia, T.K., Senthil, N.D., 2019. Taxonomic notes on Recent Foraminifera from the Continental Shelf-Slope Region of Southwestern Bay of Bengal, East Coast of India. Palaeontologia Electronica, 22.3.55A, Pp. 1-89.

Sztrákos, K., 2005. Les foraminifères du Paléocène et de l'Éocène basal du sillon nord-pyrénéen (Aquitaine, France) (French) [Paleocene and lowest Eocene foraminifera from the north Pyrenean trough (Aquitaine, France). Revue de Micropaléontologie, 48, Pp. 175-236.

Thalmann, H.E., 1959. Foraminiferal homonyms. Contributions from the Cushman Laboratory for Foraminiferal Research, 4, Pp. 127-129.

VahdatiRad, M., Vahidinia M., Sadeghi. A., 2016. Ypresian planktonic and benthic foraminifera from the Khangiran formation (northeast of Iran). Arab Journal of Geosciences, 9, 677, Pp. 1-13.