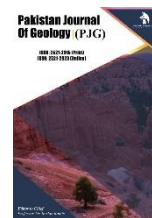


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RESEARCH ARTICLE

TURKISH TETHYAN EARLY PALEOGENE BENTHIC FORAMINIFERA

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ABSTRACT

The present study deals with the modern taxonomical consideration of the Paleocene -Eocene twenty smaller benthic foraminiferal species belonging to twenty genera, were identified and illustrated from central Black Sea Region of Turkey, which represent good example of the Northern Tethyan benthic foraminiferal assemblage. Eighteen of these species are believed here as new: *Trochamminoides turkiana*, *Spiroplectinella gurayi*, *Dorothia turkiana*, *Enantiodontalina turkiana*, *Neoflabellina turkiana*, *Lagena turkiana*, *Aragonia turkiana*, *Stilostomella turkiana*, *Globocassidulina turkiana*, *Ellipsoglandulina turkiana*, *Planulina turkiana*, *Cibicidoides turkiana*, *Cibicides turkiana*, *Nuttallides turkiana*, *Nonion turkiana*, *Oridorsalis turkiana*, *Osangularia turkiana* and *Anomalinoidea turkiana*. A comparative correlation between the recorded species from Turkey in Northern Tethys with other species in the other parts of the Southern Tethys indicates open marine connections, and wide paleogeographic distribution of the ancestral Tethys, which is connected with the ancestral Atlantic and Indian Oceans via Mediterranean Sea in the Early Paleogene. In general, the benthic foraminifera is predominantly considered to be related to open marine environment, photic zone, middle-upper neritic environment (100-200 m water depth), which shows an affinity with Midway-Type Fauna (MTF).

KEYWORDS

Benthic Foraminifera, Early Paleogene, Turkey, Middle East, Tethys

1. INTRODUCTION

According to the study, detailed taxonomical studies, a total of 18 genera and 87 planktonic foraminiferal species have been identified, and a total of 3 orders, 19 superfamilies, 30 families, 38 genera and 14 known species

of benthic foraminifera have also been recorded in the Erfelek 1 Section (Güray, 2014). The present study deals with the modern taxonomic consideration of Paleocene-Eocene twenty benthic foraminiferal species of three foraminiferal suborders: Textulariid (4 species), Lagenid (4 species) and Rotaliid (12 species) from Erfelek 1 section in central Black Sea region of Turkey (Figure 1, no. 5).



Figure 1: Location map of the study area on the Black Sea, Turkey: 1. Karaburun MSS, 2. Ayazlı MSS, 3. İstafan MSS, 4. Sinay-Karasu MSS, 5. Erfelek, Erfelek 1, Erfelek-A MSS, 6. Kaymakam Kayası and Kaymakam Kayası-A MSS (after Güray, 2014).

These recorded species from central Black Sea of Turkey are correlated with the synchronous benthic foraminiferal species from other Tethyan of

Southern localities, e.g.: USA, Cuba, Germany, Sweden (Northern Tethys), and Egypt, UAE, Chile (Southern Tethys).

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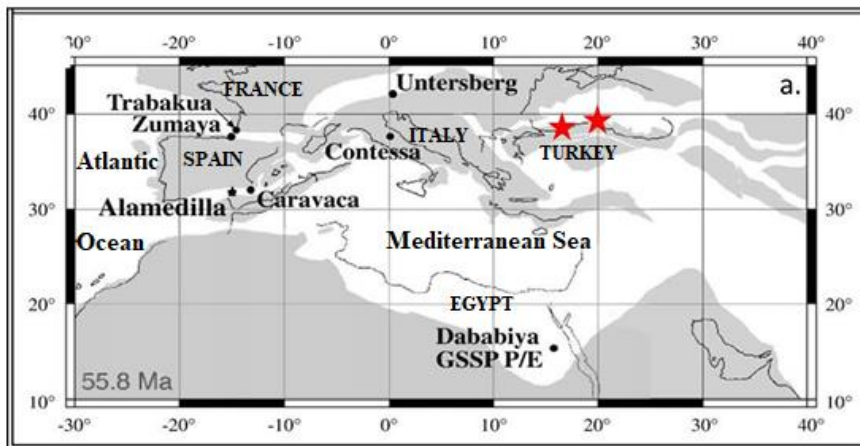


Figure 2: The Paleocene-Eocene paleogeographical map: Red stars: possible locations for the sections studied in Turkey; GSSP, Global Stratotype Section and Point P/E, Dababiya section of Egypt (after Güray, 2014).

2. MATERIAL AND METHODS

The modern taxonomical consideration of the recorded faunal assemblage is treated for Early Paleogene twenty smaller benthic foraminiferal species belonging to 20 genera were recorded from the central Black Sea of north Turkey (Northern Tethys).

3. SYSTEMATIC PALEONTOLOGY

The taxonomy is followed here for twenty benthic foraminiferal species belonging to 20 genera were recorded from the Early Paleogene stratigraphic succession of central Black Sea of Turkey (Loeblich and Tappan, 1988). These identified species are illustrated in Plate (1). The stratigraphic distribution of the different studied sections is shown in

Table 1).

Plate 1 (Scale bars 100 µm)

Figure. 1. *Bathysiphon paleocenicus* El-Dawy (2001), **2.** *Trochamminoides turkiana* Anan, n. sp., **3.** *Spiroplectinella gurayi* Anan, n. sp., **4.** *Dorothia turkiana* Anan, n. sp., **5.** *Enantiodontalina turkiana* Anan, n. sp., **6.** *Neoflabellina turkiana* Anan, n. sp., **7.** *Lagena turkiana* Anan, n. sp., **8.** *Reussoolina rustomi* Anan (2024), **9.** *Aragonia turkiana* Anan, n. sp., **10.** *Stilostomella turkiana* Anan, n. sp., **11.** *Globocassidulina turkiana* Anan, n. sp., **12.** *Ellipsoglandulina turkiana* Anan, n. sp., **13.** *Planulina turkiana* Anan, n. sp., **14a, b.** *Cibicoides turkiana* Anan, n. sp., **15a, b.** *Cibicides turkiana* Anan, n. sp., **16.** *Nuttallides turkiana* Anan, n. sp., **17.** *Nonion turkiana* Anan, n. sp., **18.** *Oridorsalis turkiana* Anan, n. sp., **19.** *Osangularia turkiana* Anan, n. sp., **20a, b.** *Anomalinoidea turkiana* Anan, n. sp.

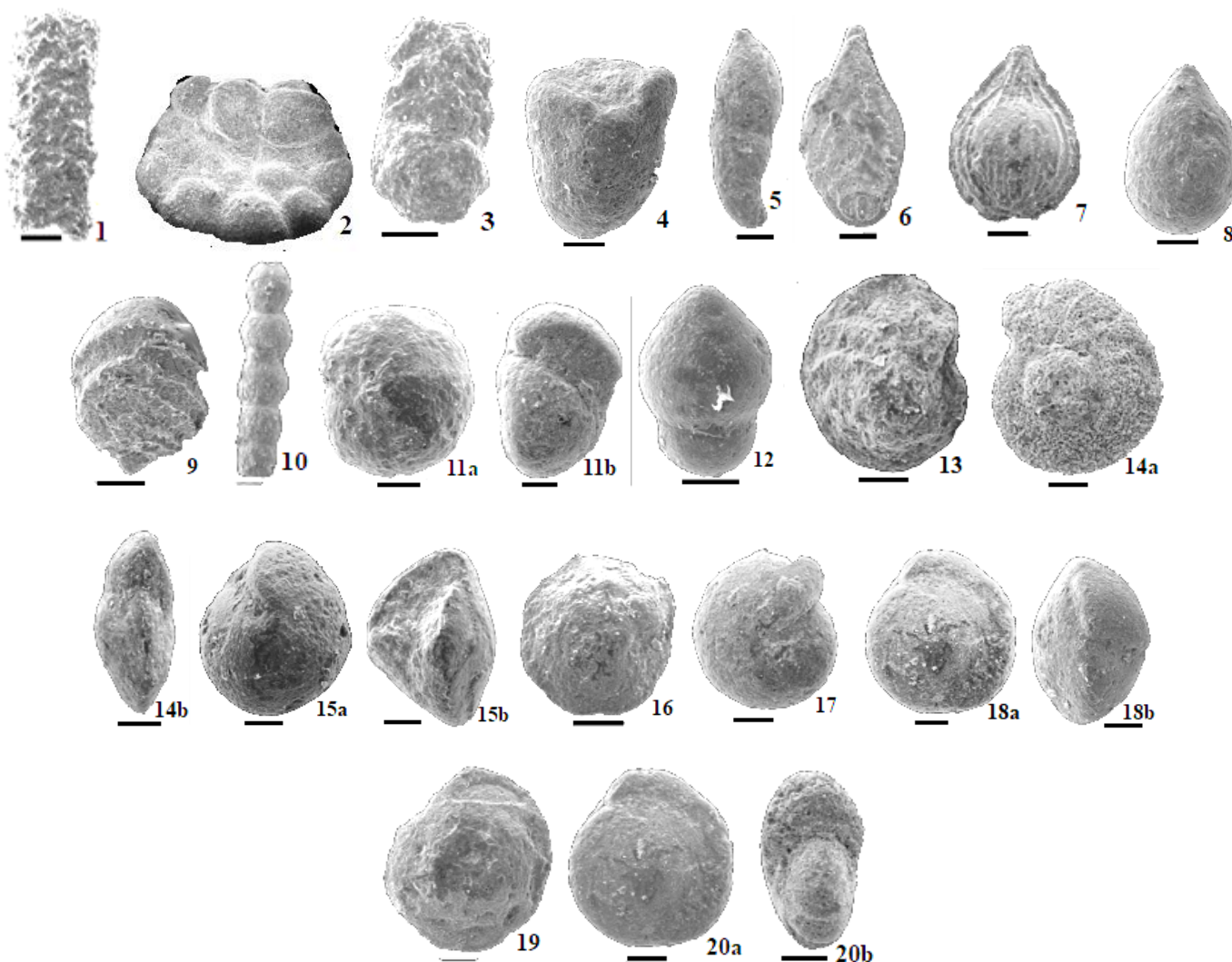


Table 1: Stratigraphical distribution of the studied sections, including Erfelek section 1 (after Güray, 2014).

AGE			MEASURED SECTIONS									
			AKÇAKOÇA, DÜZCE		SINOP							
			Karaburun	Ayazlı	Istafan	Sinay-Karasu	Erfelek	Erfelek 1	Erfelek-A	Kaymakam Kayası	Kaymakam Kayası-A	
OLIGOCENE												
EOCENE	Late Eocene	Priabonian										
		Bartonian										
	Middle Eocene	Lutetian										
		Ypresian										
	Early Eocene	Sparnacian/Ilerdian										
PALEOCENE	Late Paleocene	Thanetian										
		Selandian										
	Early Paleocene	Danian										
CRETACEOUS	Late Cretaceous	Maastrichtian										

Order Foraminiferida Eichwald, 1830

Stratigraphic range: Paleocene-Early Eocene.

Suborder Textulariina Delage and Hérouard, 1896

Diagnosis: The genus *Psammosiphonella* was treated as a junior synonym of the genus *Bathysiphon* by (Loeblich and Tappan, 1988). This Early Paleogene species has an elongate straight and cylindrical test and wall constructed of firmly cemented coarse sand grains with rough exterior.

1. ***Bathysiphon paleocenicus* El-Dawy, 2001** (= *Psammosiphonella* sp. - Güray, 2014, p. 207, pl. 11, Figure. 9). Egypt, UAE, Turkey.

Remarks: The Turkish form is much closed with the Egyptian *Bathysiphon paleocenicus* (El-Dawy, 2001).

Occurrence: Occurrence: Erfelek 1 MSS, sample no. 26, 31, 33, 35, 38, 39, 40, 41, 47, 48, 50, 51 (Table 2).

Table 2: Stratigraphic ranges of the illustrated species of Erfelek 1 section, Black Sea, Turkey (after Güray, 2014).

LATE PALEOCENE <i>M. velascoensis</i> PRZ <i>M. angulata-A. nitida</i> VZ	AKVEREN EARLY EOCENE <i>M. velascoensis</i> PRZ												Formation Stage P Zone	SP	
	14	15	16	17	18	19	20	21	22	23	24	25			
	*	*	*	*	*	*	*	*	*	*	*	*	*	1	<i>Bathysiphon paleocenicus</i>
	*	*	*	*	*	*	*	*	*	*	*	*	*	2	<i>Trochamminoides turkiana</i> Anan n. sp.
	*	*	*	*	*	*	*	*	*	*	*	*	*	3	<i>Spiroplectinella gurayi</i> n. sp.
	*	*	*	*	*	*	*	*	*	*	*	*	*	4	<i>Dorothia turkiana</i> n. sp.
	*	*	*	*	*	*	*	*	*	*	*	*	*	5	<i>Enantiodentalina turkiana</i> n. sp.
	*	*	*	*	*	*	*	*	*	*	*	*	*	6	<i>Neoflabellina turkana</i> n. sp.
	*	*	*	*	*	*	*	*	*	*	*	*	*	7	<i>Lagena turkiana</i> Anan n. sp.
	*	*	*	*	*	*	*	*	*	*	*	*	*	8	<i>Reussolina rustomi</i> Anan, 2024
	*	*	*	*	*	*	*	*	*	*	*	*	*	9	<i>Aragonia turkiana</i> Anan n. sp.
	*	*	*	*	*	*	*	*	*	*	*	*	*	10	<i>Stilostomella turkiana</i> Anan n. sp.
	*	*	*	*	*	*	*	*	*	*	*	*	*	11	<i>Globocassidulina turkiana</i> Anan n. sp.
	*	*	*	*	*	*	*	*	*	*	*	*	*	12	<i>Ellipsoglandulina turkiana</i> Anan n. sp.
	*	*	*	*	*	*	*	*	*	*	*	*	*	13	<i>Planulina turkiana</i> Anan n. sp.
	*	*	*	*	*	*	*	*	*	*	*	*	*	14	<i>Cibicides turkiana</i> Anan n. sp.
	*	*	*	*	*	*	*	*	*	*	*	*	*	15	<i>Cibicides turkiana</i> Anan n. sp.
	*	*	*	*	*	*	*	*	*	*	*	*	*	16	<i>Nuttallides turkiana</i> Anan n. sp.
	*	*	*	*	*	*	*	*	*	*	*	*	*	17	<i>Nonion turkiana</i> Anan n. sp.
	*	*	*	*	*	*	*	*	*	*	*	*	*	18	<i>Oridorsalis turkiana</i> Anan n. sp.
	*	*	*	*	*	*	*	*	*	*	*	*	*	19	<i>Osangularia turkiana</i> Anan n. sp.
	*	*	*	*	*	*	*	*	*	*	*	*	*	20	<i>Anomalinoidea turkiana</i> Anan n. sp.

2. ***Trochamminoides turkiana* Anan, n. sp.** (= *Trochamminoides* sp. - Güray, 2014, p. 211, pl. 12, Figure. 19).

biserially arranged chambers increasing quietly in size and more regular periphery, sutures deeply depressed.

Occurrence: Erfelek 1 MSS, sample no. 9, 15, 19, 20, 23, 24, 25, 26, 28, 31, 33, 38, 39, 40, 50.

Remarks: This Early Paleogene species was most probably developed from the Maastrichtian *S. hamdani*, but differs by depressed than raised sutures, and more elongated parallel biserial stage than triangular shape.

Stratigraphic range: Paleocene-Early Eocene.

Diagnosis: This species has discoidal semi-rounded enrolled fine sands agglutinated multilocular test, deep proloculus in the center of the test, followed by irregularly coiled and undivided tubular chamber in early whorls, later divided into many chambers as a result of gradually growth and becoming planispiral and evolute.

4. ***Dorothia turkiana* Anan, n. sp.** (= *Dorothia* sp. - Güray, 2014, p. 211, pl. 12, Figure. 16). Turkey.

Occurrence: Erfelek 1 MSS, sample no. 9, 11, 20, 24, 25, 28, 29, 36, 38, 47, 50.

Stratigraphic range: Paleocene-Early Eocene.

Remarks: The Turkish species differs from the holotype *Trochamminoides proteus* (Karrer) by its less evolute test, rounded outline of the test, less number of the whorls and also chambers in the last whorl.

Diagnosis: This species has robust nearly parallel sides and it is circular in section test with a trochospiral early stage and biserially arranged chambers in the later stage, aperture is an interiomarginal slit.

3. ***Spiroplectinella gurayi* Anan, n. sp.** (= *Spiroplectamina* sp. - Güray, 2014, p. 210, pl. 12, Figure. 14). Turkey.

Remarks: This species differs from *Dorothia nacataensis* (White), by wider semiglobular initial early stage than conical shape of the latter.

Occurrence: Erfelek 1 MSS, sample no. 9, 28, 29, 32, 33, 35, 36, 39, 40, 43 55.

Stratigraphic range: Paleocene-Early Eocene.

Diagnosis: This species is characterized by its wall is coarsely agglutinated wall, large planispiral coiled early stage, followed by 4-5 pairs of elongate

5. ***Enantiodentalina turkiana* Anan, n. sp.** (= *Dentalina* sp. - Güray, 2014, p. 201, pl. 9, Figure. 9). Turkey.

Occurrence: Erfelek 1 MSS, sample no. 26, 39.

Stratigraphic range: Paleocene-Early Eocene.

Diagnosis: This species has elongate subcylindrical straight or slightly arcuate smooth test, early chambers biserial alternation clearly evident on the dorsal edge but less clear on the ventral edge, later uniserial, straight oblique sutures, and aperture terminal on the produced dorsal margin of the test.

Remarks: The Turkish form belongs here to the genus *Enantiodontalina* with its smooth surface with biserial to uniserial test arrangement, not only uniserial as *Dentalina* with longitudinal costae.

6. *Neoflabellina turkiana* Anan, n. sp. (= *Neoflabellina* sp. - Güray, 2014, p. 202, pl. 9, Figure. 15). Turkey.

Occurrence: Erfelek 1 MSS, sample no. 26, 33, 48.

Stratigraphic range: Paleocene-Early Eocene.

Diagnosis: This species has leaf-like test, small coiling planispiral early stage, followed by v-shaped uniserial chambers, straight slightly raised sutures, terminal on neck aperture.

Remarks: *N. turkiana* differs from *N. rugosa* (d'Orbigny) by smaller planispiral and number of uniserial chambers.

7. *Lagena turkiana* Anan, n. sp. (= *Fissurina* sp. - Güray, 2014, p. 201, pl. 8, Figure. 15). Turkey.

Occurrence: Erfelek 1 MSS, sample no. 23, 24, 25, 33, 39.

Stratigraphic range: Paleocene-Early Eocene.

Diagnosis: This species has compressed flask-like test, keel commonly with radiating tubules extends to the periphery, surface ornamented with longitudinal striae or fine ribs, and terminal aperture on thick neck.

Remarks: This Turkish form belongs here to the genus *Lagena* aligned punctuations ornamentation and double peripheral keels, not *Fissurina* with smooth surface, and ovate to terminal, aperture within a slightly depressed fissure at the test apex.

8. *Reusoolina rustomi* Anan, 2024 (= *Lagena* sp. - Güray, 2014, p. 201, pl. 9, Figure. 4). Chile, Turkey.

Occurrence: Erfelek 1 MSS, sample no. 26, 28, 32.

Stratigraphic range: Paleocene.

Diagnosis: This species has ovate smooth test but without an apiculate base protrusion, aperture rounded slightly produced with a distinct neck.

Remarks: The Turkish form has closed resemblance with the Miocene Chilean *Reusoolina rustomi* (Anan, 2024). It is also resemble the Maastrichtian-Miocene *R. apiculata* (Reuss), but lacks the apical protrusion. It seems that the two species have an evolutionary lineage: Maastrichtian-Miocene *R. apiculata* (with apical protrusion) → Miocene *R. rustomi* (without apical protrusion).

9. *Aragonia turkiana* Anan n. sp. (= *Aragonia* sp. - Güray, 2014, p. 200, pl. 8, Figure. 11). Turkey.

Occurrence: Erfelek 1 MSS, sample no. 17, 20, 23, 24, 25, 31, 38, 40, 43

Stratigraphic range: Paleocene-Early Eocene.

Diagnosis: This species has a rhomboidal outline test and compressed in section, tapering initial portion, biserial chambers arrangement increase rapidly in size, raised elevated thickened sutures, aperture basal.

Remarks: The Turkish form has less length/width (L/W) and more straight sutures than *A. aragonensis* which has equal L/W and zigzag sutural ridges.

10. *Stilostomella turkiana* Anan n. sp. (= *Nodosaria* sp. - Güray, 2014, p. 201, pl. 9, Figure. 10). Turkey.

Occurrence: Erfelek 1 MSS, sample no. 29, 31, 32, 33, 38, 39, 41, 50.

Stratigraphic range: Paleocene-Early Eocene.

Diagnosis: This species has subglobular uniserial and rectilinear chambers, surface finely pustulose, sutures distinct depressed, terminal aperture.

Remarks: This species differs from *S. impensia* (Cushman) by rectilinear

test nearly with parallel sides, than slightly arcuate test of the latter. The Early Paleogene *S. turkiana* may develop from Maastrichtian *S. impensia*.

11a,b. *Globocassidulina turkiana* Anan, n. sp. (= *Globocassidulina* sp. - Güray, 2014, p.199, pl. 8, Figure. 4). Turkey.

Occurrence: Erfelek 1 MSS, sample no. 39, 40.

Stratigraphic range: Early Eocene.

Diagnosis: This species has biserially enrolled globular smooth test, zigzag sutures due to chamber's orientation.

Remarks: The Turkish species is characterized by its zigzag sutures.

12. *Ellipsoglandulina turkiana* Anan, n. sp. (= *Ellipsoglandulina* sp. - Güray, 2014, p. 204, pl.10, Figure.7). Turkey.

Occurrence: Erfelek 1 MSS, sample no. 22, 23, 24, 31, 38

Stratigraphic range: Paleocene-Early Eocene.

Diagnosis: This species has smooth flaring uniserial throughout semispherical test, circular in section and in apertural view, widest-size in the middle, pointed initial end, strongly overlapping two chambers increase rapidly in size length/width (l/w) about 1.5, last chamber comprising greater part (about ¾) of the test, sutures depressed, aperture terminal semilunate.

Remarks: The Eocene Turkish form most probably the ancestor of the Egyptian Early Eocene *E. arafati* Anan (2009) with three chambers than two, and about 1.37 of (l/w).

13. *Planulina turkiana* Anan, n. sp. (= *Planulina* sp. - Güray, 2014, p. 204, pl. 10, figs. 5, 6). Turkey.

Occurrence: Erfelek 1 MSS, sample no. 38, 39, 40, 50.

Stratigraphic range: Early Eocene.

Diagnosis: This species has very low trochospiral planoconvex evolute test, arched 10-12 chambers, raised thick curved sutures, equatorial an interiomarginal arch aperture.

Remarks: The Turkish species differs from the Egyptian Danian *P. mellahensis* Nakkady by more compressed test, tighter umbilicus, and more elongated arched aperture. *P. mellahensis* most probably the ancestor of *P. turkiana*.

14a, b. *Cibicidoides turkiana* Anan, n. sp. (= *Cibicidoides* sp. - Güray, 2014, p. 203, pl. 10, figs. 3, 4). Turkey.

Occurrence: Erfelek 1 MSS, sample no. 24, 26, 29, 32, 35, 36, 38.

Stratigraphic range: Paleocene-Early Eocene.

Diagnosis: This species has biconvex lenticular trochospiral test with 14-15 chambers increasing gradually in size as added, curved limbate slightly raised sutures, large distinct umbo, faint peripheral keel, low an interiomarginal basal equatorial arch aperture bordered by small lip.

Remarks: The Turkish species differs from the Egyptian Maastrichtian *C. nekhlianus* (Said and Kenawy, 1956) by more number of chambers, and larger umbo. *C. nekhlianus* most probably the ancestor of the *C. turkiana*.

15a, b. *Cibicides turkiana* Anan, n. sp. (= *Cibicides* sp. - Güray, 2014, p. 203, pl. 10, figs. 1, 2). Turkey.

Occurrence: Erfelek 1 MSS, sample no. 20, 24, 29, 33.

Stratigraphic range: Paleocene.

Diagnosis: This species has planoconvex trochospiral smooth test with 9-10 chambers increasing gradually in size as added, flush sutures, acute periphery, and a low interiomarginal equatorial opening aperture.

Remarks: The Turkish species differs from the Egyptian Danian *Cibicides schwageri* Said and Kenawy (1956) by tighter and wider opening umbilical area, acuter angular periphery. *Cibicides schwageri* most probably the ancestor of the *Cibicides turkiana*.

16. *Nuttallides turkiana* Anan, n. sp. (= *Nuttallides* sp. - Güray, 2014, p. 198, pl. 8, Figure. 1) Turkey.

Occurrence: Erfelek 1 MSS, sample no. 11, 15, 25, 26, 31, 32, 33, 35, 38, 39

Stratigraphic range: Paleocene-Early Eocene.

Diagnosis: This species has trochospiral lenticular biconvex test with a keel, crescentic chambers on spiral side and subtriangular chambers on umbilical side, interiomarginal aperture extends nearly to keel periphery.

Remarks: The Turkish Early Paleogene *Nuttallides turkiana* differs from Maastrichtian-Paleocene *N. truempyi* with nearly planoconvex test, carinate periphery, and more open umbilical area.

17. *Nonion turkiana* Anan, n. sp. (= *Nonion* sp. - Güray, 2014, p. 203, pl. 9, Figure. 18). Turkey.

Occurrence: Erfelek 1 MSS, sample no. 20, 26, 28, 32, 40.

Stratigraphic range: Paleocene-Early Eocene.

Diagnosis: This species has planispiral biumbilicate rounded test, non-lobulate periphery, nearly flush sutures, low interiomarginal and equatorial slit aperture at the base of arched apertural face, extending laterally nearly to umbilicus.

Remarks: The Turkish Early Paleogene *Nonion turkiana* differs from *Nonion havanense* Cushman and Bermúdez from the P/E Dababiya Stratotype section of Egypt (after Alegret and Ortiz, 2006/2007) by rounded periphery and nearly flush sutures, than lobulate periphery and slightly depressed sutures of the latter.

18a, b. *Oridorsalis turkiana* Anan, n. sp. (= *Oridorsalis* sp. - Güray, 2014, p. 200, pl. 8, figs. 8, 9). Turkey.

Occurrence: Erfelek 1 MSS, sample no. 15, 17, 20, 23, 24, 25, 26, 28, 33, 36, 38, 39, 40, 50.

Stratigraphic range: Paleocene-Early Eocene.

Diagnosis: This species has lenticular low biconvex trochospiral test, interiomarginal tight aperture extending from closed umbilicus to periphery.

Remarks: The Turkish Early Paleogene *Oridorsalis turkiana* differs from Maastrichtian-Paleocene *Oridorsalis umbonatus* (Reuss) by less convex spiral side, tighter aperture, and wider rounded periphery.

19. *Osangularia turkiana* Anan, n. sp. (= *Osangularia* sp. - Güray, 2014, p. 200, pl. 8, figs. 10). Turkey.

Occurrence: Erfelek 1 MSS, sample no. 20, 23, 24, 25, 32, 34, 35, 36, 38.

Stratigraphic range: Paleocene-Early Eocene.

Diagnosis: This species has biumbonate lenticular trochospiral test with carinate keeled periphery, 10-12 trapezoidal chambers separated by oblique raised sutures, areal aperture with an acute angle to the base of the chamber face.

Remarks: The Turkish Early Paleogene *Osangularia turkiana* differs from *Osangularia plummerae* Brotzen from the P/E Dababiya Stratotype section of Egypt by trapezoidal chambers with carinate periphery than triangular chambers with ragged transparent keel.

20a, b. *Anomalinoidea turkiana* Anan, n. sp. (= *Anomalinoidea* sp. - Güray, 2014, p. 199, pl. 8, figs. 6, 7).

Occurrence: Erfelek 1 MSS, sample no. 16, 23, 24, 26, 28, 31, 33, 35, 38, 40, 50.

Stratigraphic range: Paleocene-Early Eocene.

Diagnosis: This species has low trochospiral, biconvex test, inflated chambers on spiral side and separated with curved and depressed sutures, rounded periphery, low arch interiomarginal aperture extends on the spiral side.

Remarks: The Turkish Early Paleogene *Anomalinoidea turkiana* differs from the Egyptian Early Eocene *Anomalinoidea zitteli* (LeRoy) by biconvex test, rounded periphery, extended aperture on the spiral side, than nearly planoconvex test, acute periphery with imperforated keel, and limited extended aperture on both sides of the apertural face.

4. PALEO GEOGRAPHY

The ancestral Tethys is connected with the ancestral Atlantic and Indian Oceans via Mediterranean Sea by many authors: i.e., (Berggren, 1971; Haq and Aubry, 1978; Solakius et al., 1990; Haynes and Nwabufo-Ene, 1998; Abed, 2013; Anan, 2025). On the other hand, the Northern and Southern Tethys are also connected as explained between Turkey, in Northern Tethys, and Egypt in the Southern Tethys (Figure. 3).

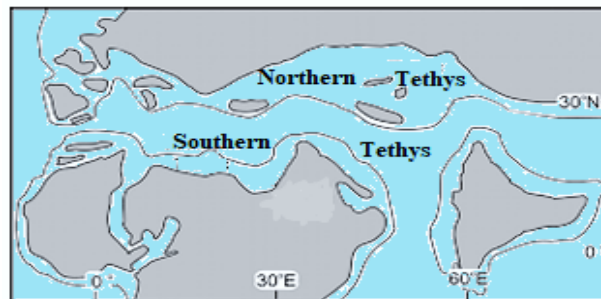


Figure 3: Early Paleogene paleogeography distribution of the Northern Tethys and the Southern Tethys.

The two assemblages of the two localities in the Northern and Southern Tethys include rich agglutinated and calcareous benthic foraminifera (that were introduced by the present author, and shown in Table 3), which

indicate that the benthic foraminifera is predominantly considered to be related to open marine middle-upper neritic environment (100-200 m water depth), which shows an affinity with Midway-Type Fauna (MTF).

Table 3: Comparative study of the Paleocene-Early Eocene benthic foraminiferal species of Anan between the Turkish assemblage (18 species) and Egyptian assemblage (12 species).

Sp. no.	Paleocene-Eocene Turkish (T) and Egyptian (E) benthic foraminifera of Anan	T	E	Sp. no.	Paleocene-Eocene Turkish (T) and Egyptian (E) benthic foraminifera of Anan	T	E
1	<i>Bathysiphon dababiyaensis</i>		x	16	<i>Bulimina dababiyaensis</i>		x
2	<i>Haplophragmoides dababiyaensis</i>		x	17	<i>Buliminelloides dababiyaensis</i>		x
3	<i>Trochamminoides turkiana</i>	x		18	<i>Uvigerinita dababiyaensis</i>		x
4	<i>Spiroplectinella gurayi</i>	x		19	<i>Ellipsoglandulina turkiana</i>	x	
5	<i>Gaudryina dababiyaensis</i>		x	20	<i>Stilostomella turkiana</i>	x	

Table 3 (cont): Comparative study of the Paleocene-Early Eocene benthic foraminiferal species of Anan between the Turkish assemblage (18 species) and Egyptian assemblage (12 species).

6	<i>Dorothia dababiyaensis</i>		x	21	<i>Planulina turkiana</i>	x	
7	<i>Dorothia turkiana</i>	x		22	<i>Cibicidoides turkiana</i>	x	
8	<i>Pseudogaudryina dababiyaensis</i>		x	23	<i>Cibicides turkiana</i>	x	
9	<i>Enantiodentalina turkiana</i>	x		24	<i>Nuttallides turkiana</i>	x	
10	<i>Lenticulina dababiyaensis</i>		x	25	<i>Nonion turkiana</i>	x	
11	<i>Neoflabellina turkiana</i>	x		26	<i>Nonionella dababiyaensis</i>		x
12	<i>Lagena turkiana</i>	x		27	<i>Oridorsalis turkiana</i>	x	
13	<i>Aragonia turkiana</i>	x		28	<i>Osangularia turkiana</i>	x	
14	<i>Globocassidulina turkiana</i>	x		29	<i>Anomalinoidea dababiyaensis</i>		x
15	<i>Stainforthia dababiyaensis</i>		x	30	<i>Anomalinoidea turkiana</i>	x	

5. PALEOENVIRONMENT

The paleoenvironment of the Northern and Southern Tethyan taxa mainly would have been a middle-outer shelf sea (MFT) of normal salinity, as is

suggested by the dominance of infaunal morphotypes and excellent preservation of the tests by many authors, e.g., (Berggren and Aubert, 1975; Alegret and Ortiz, 2006/2007; Aubry et al., 2007; Stassen et al., 2012; Anan, 2023) (Figure. 4).

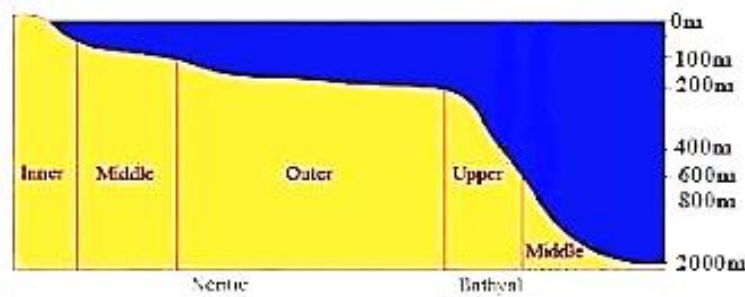


Figure 4: The water depth distribution of the middle-outer shelf neritic environment.

As noted that the benthic foraminiferal assemblage is dominant than the planktonic foraminifera during the Late Paleocene in the study area around the Black Sea region of Turkey, which may play around the Paleocene-Eocene thermal maximum (PETM) (Güray, 2014). In this area,

contrary to the low abundance and diversity of the planktonic foraminifera, numerous benthic foraminifera with both calcareous and agglutinated walls are recorded (Figure. 5).

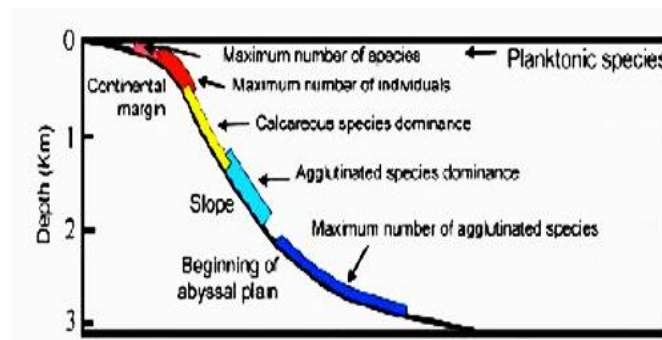


Figure 5: Depth distribution of planktic and benthic foraminiferal fauna.

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