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Systematic and biostratigraphic evaluation of the Late Cretaceous benthic foraminiferal assemblages of southeastern Batman

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Research Article

Keywords:
Benthic Foraminifera, Systematic Paleontology, Garzan formation, Maastrichtian.

ABSTRACT

The study area is located in 15 km west of Gercüş town (southeast of Batman) at the northern margin of the Arabian Plate. This region is the only place where Garzan formation, one of the important petroleum reservoir of the Southeastern Anatolia, outcrops and detailed scientific studies have been carried out. The unit, mainly of beige - yellowish, thin - thick bedded, benthic foraminifera and algae bearing limestones, has a rich fossil content and high diversity. This diversity in the benthic foraminifera is noteworthy. These assemblages contains *Vandenbroekia munieri* Marie, *Coskinolina* sp., *Cyclogyra* sp. with porcellaneous test; *Biconcava bentori* Hamaoui, *Nezzazata simplex* Omara, *Nezzazatinella picardi* (Henson), *Trochospira avnimelechi* Hamaoui, *Antalyna korayi* Farinacci and Köylüoğlu, *Moncharmontia apenninica* (De Castro), *Moncharmontia compressa* (De Castro), *Fleuryana adriatica* (De Castro), *Pseudocyclammina sphaeroidea* Gendrot, *Broeckinella arabica* Henson, *Cuneolina pavonia* d'Orbigny, *Cuneolina ketini* Inan, *Dicyclina schlumbergeri* Munier - Chalmas, *Pseudolituonella reicheli* Marie, *Dictyoconella complanata* Henson, *Minouxia lobata* Gendrot, *Minouxia gümbelitrioides* Marie, *Arenobulimina* sp. with microgranular and agglutinated tests and *Fissoelphidium operculiferum* Smout, *Orbitoides medius* (d'Archiac), *Orbitoides megaloformis* Papp and Küpper, *Omphalocyclus anatoliensis* Özcan, *Sirtina orbitoidiformis* Brönnimann and Wirtz, *Goupillaudina* sp. with hyaline test. In this study, the age of Garzan formation has been determined as Maastrichtian based on benthic foraminifera.

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1. Introduction

Southeastern Anatolia is the region where almost 99% of Turkey's petroleum production is produced. Batman region is the place where the most of this production is carried out. The study area is located in the southeast of Batman, about 15 km west of the town of Gercüş. Detailed paleontological researches could not be carried out due to the security issues in the region that has been lasting for years. The present studies are limited with the information obtained mostly from drillings done by of Turkish Petroleum Corporation (TPAO). The main geological structure of the Southeastern Anatolia Region is linked to the relative relations of the Arabian and Anatolian continents over time. The units formed in the North during the subduction of the oceanic crust between Eurasian and Arabian continents towards the Eurasian continent, thrusted over the Arabian Plate in early Miocene (Yılmaz, 1993; Robertson, 2000). In the vicinity of Batman, where the study area is located, the main structural elements formed during the Cenozoic nappe emplacement caused the Cretaceous aged reservoirs to be folded and fractured as well, due

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to the fact that the Cretaceous allochthons remain in the north. For this reason, Cenozoic structures, which can be defined very well, are important in terms of hydrocarbon exploration (Siyako et al., 2013). Most of the subsequent studies are unpublished and in the form of reports, which aimed at revealing the stratigraphy and the tectonic structure of the basin in order to determine the hydrocarbon possibilities of the region. Paleontological studies are also very limited. The aim of this study is to reveal the micropaleontological data of the Garzan formation from which some of the petroleum in Batman region are obtained. For this purpose; this purpose; detailed investigations were carried out on the benthic foraminifera determined in the formation, and systematic studies of larger benthic foraminifera based on the biometrical analysis were yada have been performed. The detailed age data obtained, provided a better understanding of the biostratigraphic features of the formation (Figure 1).

2. Material and Method

Measured section, isolated specimens and washing samples were taken from the outcrops which is the only locality of the Garzan formation in the area studied. Most of the isolated specimens are orbitoid forms. Equatorial sections have importance particularly in the determination of these forms (*Orbitoides*, *Omphalacyclus*). For this reason, before preparing thin sections, external views of the individuals were noted and their thickness was measured. Samples were soaked in diluted HCl (17%) in order to see their external view more clearly. The way followed in thin section preparation is as follows; in the preparation of equatorial sections, the specimen is abraded on the glass plate via grinding powders. This process is continued until the first chamber appears. When the first chamber appears, grinded surface of the specimen is adhered on the grinded slide, with Canada balsam by using a heater. In order to set the thin section to proper thickness for the examination under a microscope, grinding process repeated with grinding powders. The axial sections of the mentioned forms are prepared in following similar ways. Weathered sandy - clayey soft rock samples taken from the field were prepared and the soil samples were washed and dried well first. Then, the samples were kept in 17% diluted hydrogen peroxide solution for 24 hours. After the waiting period, they were filtered and dried in a drying - oven or in a hot environment. Finally, foraminifers were extracted under binocular microscope by using 0.125 - 0.250 mesh sieves. Hard rocks are first cut a few mm thick in the Petrocat machine. The surface to be adhered on the slide is smoothed on a glass plate with grinding powders. Similarly, the surface of the slide to be adhered is abraded by iron powders. The sample is adhered on to the glass with Canada balsam, that no air - bubble void should be remained. After cooling down for a while, the samples are thinned. In order to set the sample on the slide to proper thickness for the examination under a microscope, fine grinding powders are used. Thus, the required thickness is ensured. In addition, the Knitter Method was used to extract calcareous fossil forms from hard limestone samples. For this, approximately 100 grams of sample was ground coarsely and put into a deep bottle. 65% acetic acid and 100 ml of chloroform were added, enough to cover 0.5 cm more on it, the bottle was shaken and closed in a way that it would not take air. After waiting 15 hours, the samples were washed and dried. The above - mentioned oriented thin section preparation methods were carried out on the obtained individuals.

The samples taken from Garzan formation constitute 130 m of the section which is approximately 155 m along the section line. 20 samples were taken from the Garzan formation and most of these samples are hard limestone. In addition, isolated samples of orbitoids were obtained from unconsolidated levels. systematic descriptions and classification of foraminifera is in accordance with the studies of Loeblich and Tappan (1987).

3. Regional Geology and Stratigraphy

Distinct geological units ranging form Precambrian to recent are exposed in the Southeastern Anatolia Region. Due to the presence of representative outcrops in the Southeastern Anatolia, many geologists (predominantly the geologists from oil companies) have concentrated on in Amanos Mountains, in Adıyaman - Pendeği - Tut regions, in Karababa and Korudağ in the Hazro region, around Mardin - Derik, in the Harbol Hermis basins and in Hakkari (Yılmaz and Duran, 1997).

The main geological structure of the Southeastern Anatolia Region was controlled by the relative movements of the Arabian and Anatolian continents over time. Uplift and subsidence on the Arabian continent due to these movements controlled the

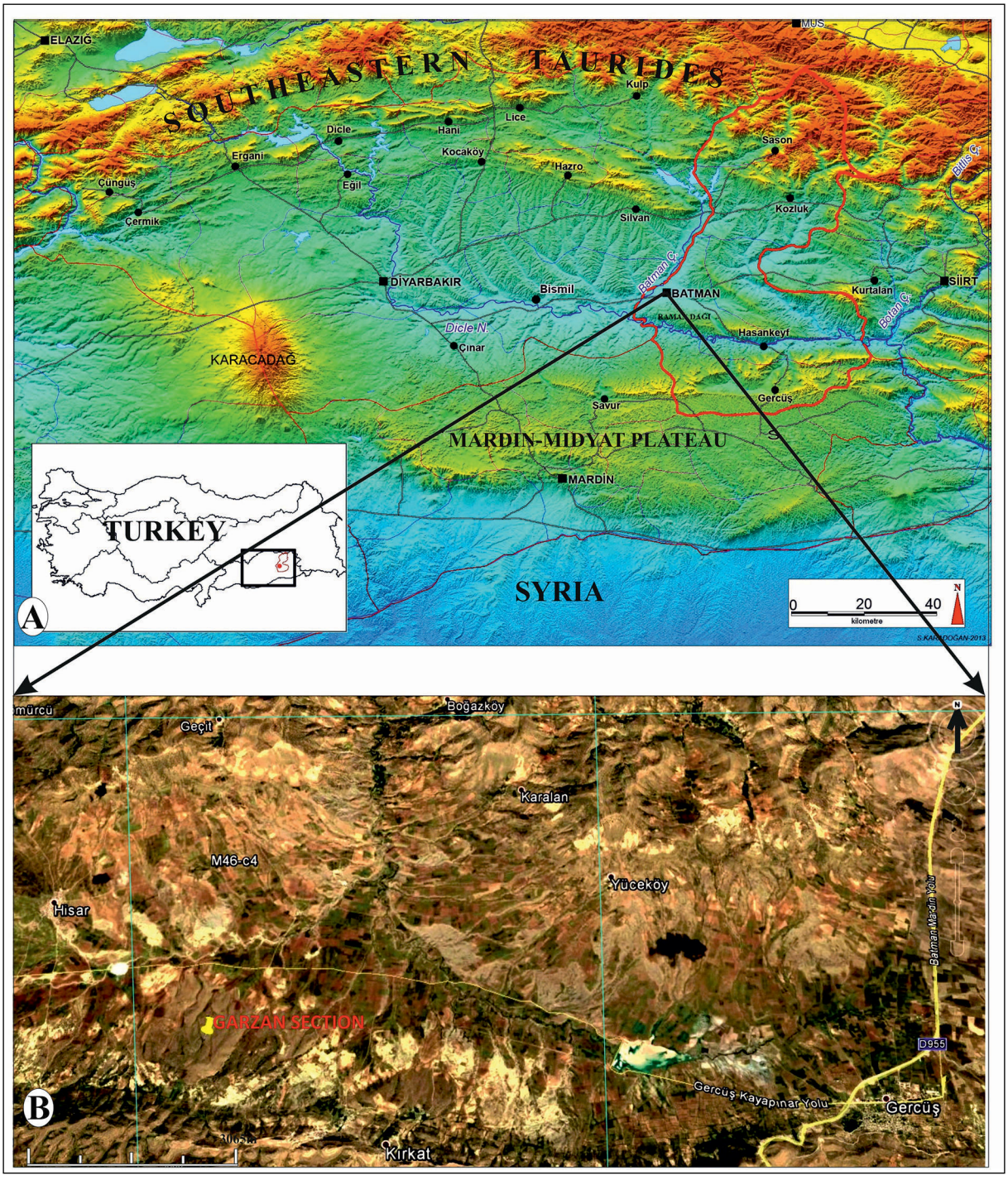

Figure 1- Location of the study area A) Geographical location of the province Batman -modified after Sinanoğlu et al., 2017; B) Google Earth view of the study area).

sedimentation. The units in the study area start with the Kıradağ formation, which is not observed on the surface, and continues with the Garzan formation represented by shallow marine carbonates that are exposed in the core of the Gercüş Anticline. The oldest formation outcropping in the study area is the Garzan formation of Şırnak Group which consists of beige - yellowish colored algal limestones with abundant foraminiferal content. Due to ongoing deepening, Garzan carbonates are conformably covered by Lower Germav formation consisting of alternation of light grey colored, fossiliferous carbonated siltstone,

clayey limestone, marl. This formation, with a conformable contact, is followed by Paleocene aged Upper Germav formation which is characterized by dark grey marls, greenish grey sandstones and clays. The formation gains a regressive character towards the top, and passes to limestones and sandstones. With the regression, terrestrial Antak formation was deposited. Paleocene Antak formation consisting of fluvial - originated conglomerate, sandstone and mudstones, and the other units of this period were defined in the Şırnak Group. As the last stage, Hoya formation consisting of shallow marine limestones was deposited with the transgression that developed in the middle Eocene. Hoya formations which overlies the Şırnak Group with an angular unconformity was defined in the Midyat Group (Siyako et al., 2013; Figures 2 and 3).

3.1. Garzan Formation

The formation, consisting of shallow marine limestones, is defined as reservoir rocks in the Garzan oil field and was named after the Garzan (Yanarsu) River that flows in the south of the area (Kellog, 1960; 1961; Salem et al., 1986). It was first described by Kellog (1960) in the literature. Garzan formation, which was deposited in a widespread area in the region and has known to be operated for oil production in many fields, is accepted as the lateral equivalent of the Besni formation in the west and, in the east, Üçkiraz formation defined in Hakkari (Güven et al., 1991). The formation forms a high and flat hill in the study area, compared to the surrounding Germav shales (Figure 2). Bioclastic limestones deposited in shallow marine environments such as reefs, near reefs and lagoons constitute the main lithology of the unit. It is one of the levels where oil is produced and has very good reservoir characteristics in Western Raman, Garzan and Germik fields, which are some of the largest fields in the Batman Region (Figures 4 and 5).

There are also clayey limestone and marl levels in the formation. The formation consists of cream - grey - light grey - beige colored, hard to very hard, thin - bedded to massive, fractured rocks with abundant fossils and karstic cavities. Bedding in the formation is distinct and discontinuous. Asphaltite and heavy oil residues are seen in the upper levels.

4. Benthic Foraminiferal Systematics

In this study, systematic descriptions of the important benthic foraminifera determined in the Late Cretaceous Garzan formation outcropping around

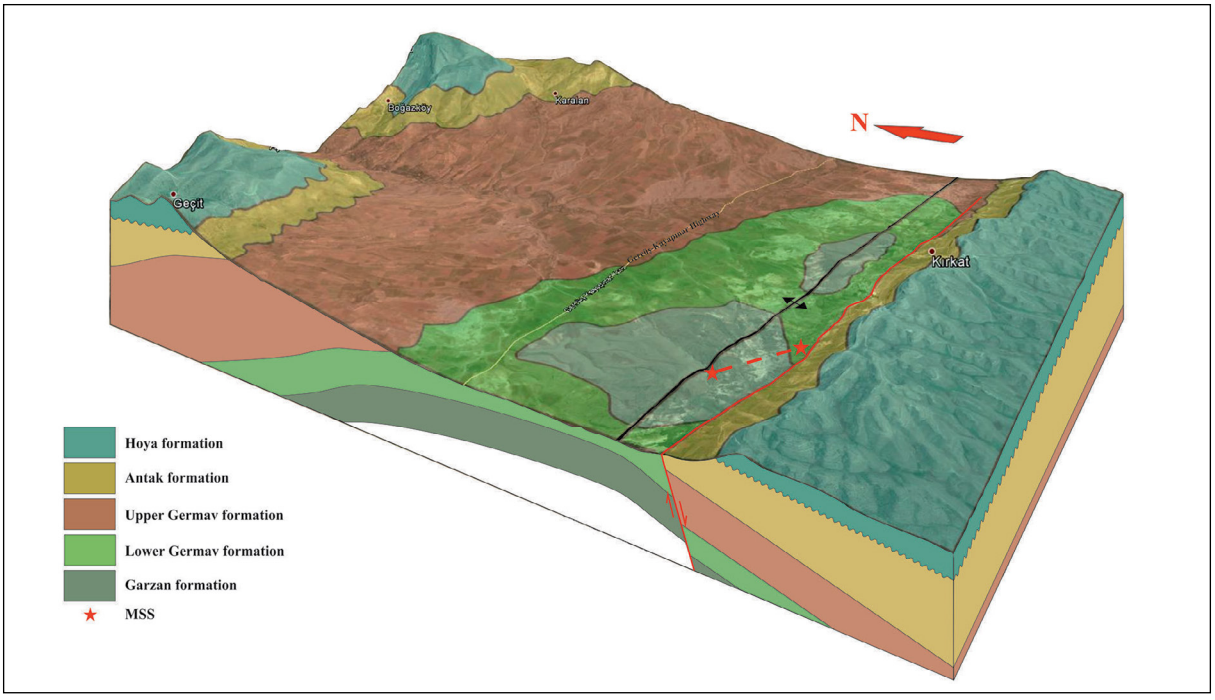

Figure 2- Garzan measured stratigraphic section line and 3D geological relief map of the study area (Section was measured between the coordinates N:4161 300 / E: 700 200 and N:4160 574 / E:700 308).

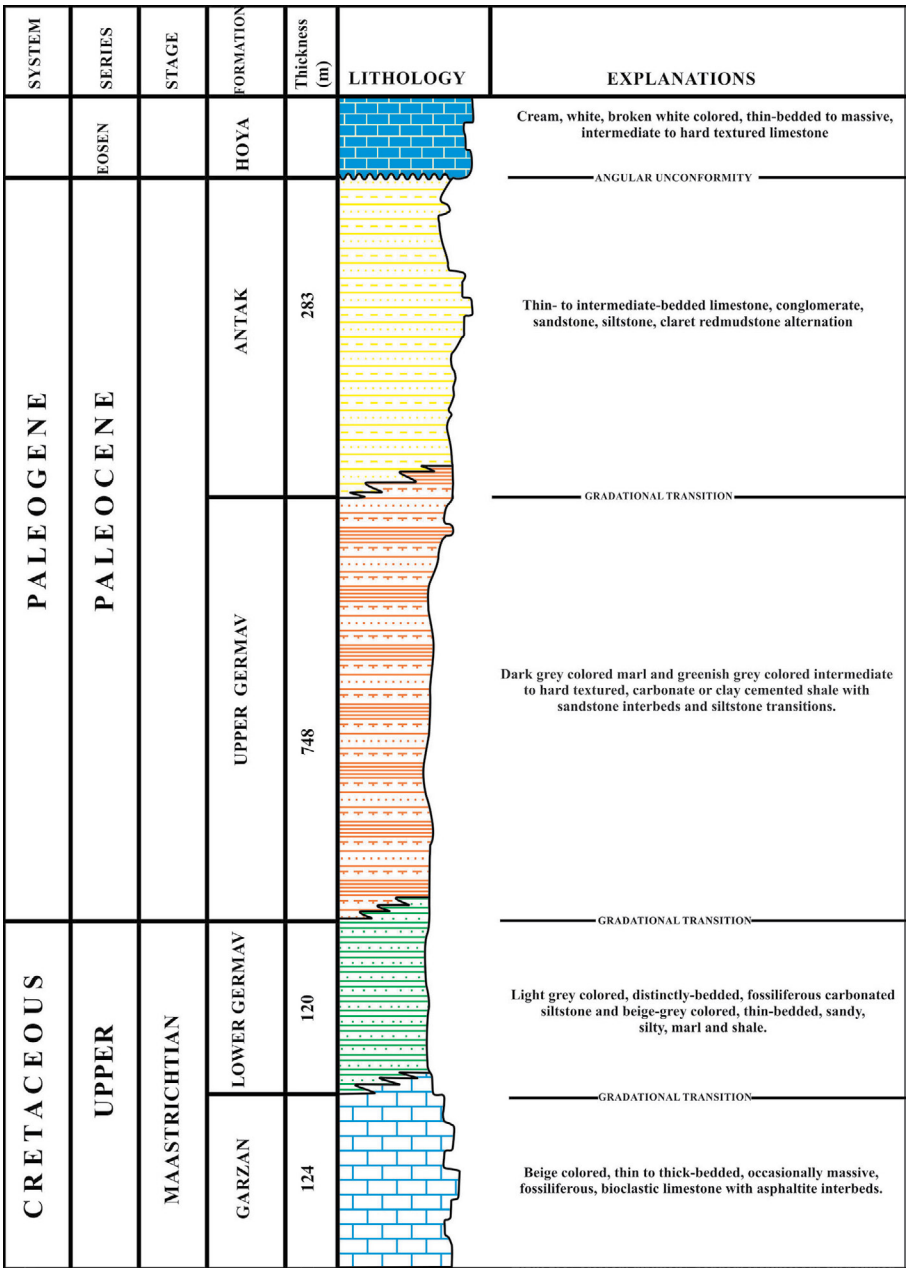

Figure 3- Generalized stratigraphic section of the study area (Modified after Siyako et al., 2013).

Gerçüş - Batman are given. Systematic descriptions are here presented based on fundamentally Loeblich and Tappan (1997). Figures of the determined foraminifers are presented in Plates 1-3.

Order: Foraminiferidae Eichwald, 1830

Suborder: Textulariina Delage and Herouard,1896

Superfamily: Lituolacea de Blainville, 1827

Family: Mayncinidae Loeblich and Tappan, 1985

Genus: *Biconcava* Hamaoui, 1965

Biconcava bentori Hamaoui, 1965

(Plate I, Figures. 1,2)

1965 *Biconcava bentori* Hamaoui; p. 14, pl. 1, figs. 12a-b; pl. 5, fig. 14; pl. 14, fig. 7.

1966 *Biconcava bentori* Hamaoui; De Castro, p. 7, 27.

1968 *Biconcava bentori* Hamaoui; Sgrosso, p. 164, fig. 3.

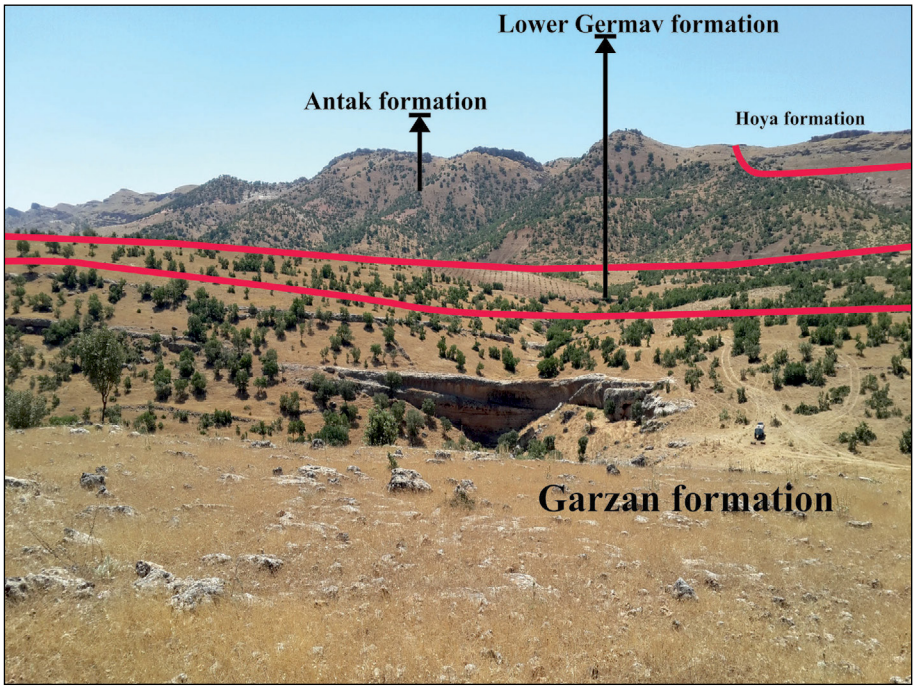

Figure 4- The stratigraphic position of the formations along the section line (M46-c4) (View to SE).

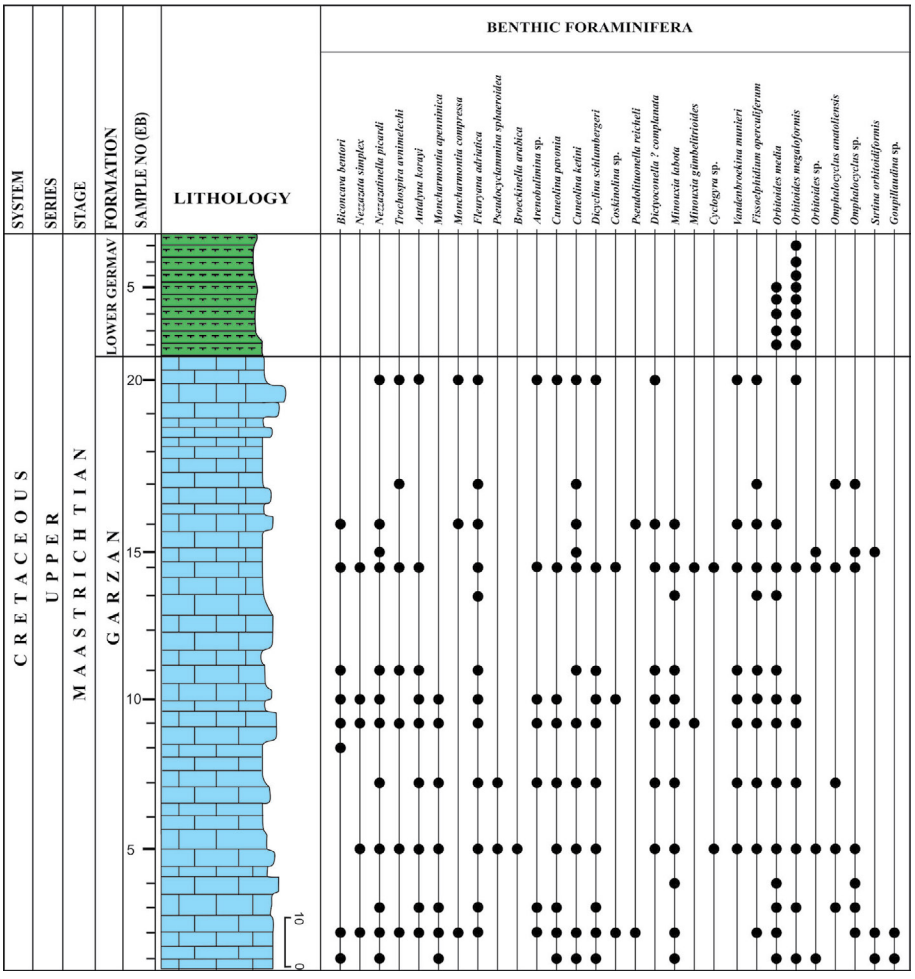

Figure 5- Benthic foraminiferal distribution of Garzan measured section.

1971 *Biconcava bentori* Hamaoui; Fleury, p. 185, pl. 3, figs. 15, 16.

Description: Test is lenticular, not rounded at the poles and has a partly angular appearance. Diameter and the thickness range between 0.30 - 0.55 mm and 0.09 - 0.15 mm, respectively. It is planispirally coiled and partly evolute. Proloculus is generally spherical and large in size. Its diameter is about 0.05 mm.

Stratigraphic and Geographical Distribution: *B. Bentori* was first described in the Cenomanian levels in the Hazera formation which is the type locality in Israel (Hamaoui, 1965; Luperto-Sinni, 1976). This species was found in Turkey (Bey Dağları) within the Late Cretaceous levels with *Chrysalidina gradata* d'Orbigny, *Trochospira avnimelechi* Hamaoui and Saint - Marc, *Nummoloculina regularis* (Philipson), *Dicyclina schlumbergeri* Munier - Chalmas, *Nezzazatinella picardi* (Henson), *Pseudolituonella reicheli* Marie, *Cuneolina pavonia* d'Orbigny, *Biplanata peneropliformis* Hamaoui and Saint - Marc (Sarı, 2006). It was reported from the late Cenomanian - early Turonian levels of the Eastern Desert/Egypt by İsmail et al. (2009) with *Daxia cenomana* Cuvillier and Szakal, *Flabellammina aegyptiaca* Said and Barakat, *F. alexanderi* Cushman, *Nezzazata gyra conica* (Smout), *N. simplex* Omara, *Dicyclina sampoi* Cherchi and Schroeder and *Nakkadyia awadi*. *B. bentori* was observed in the lower - middle levels of the Garzan section (Figure 5: 1 to16 meters).

Family: Nezzazatidae Hamaoui and Saint-Marc, 1970

Subfamily: Nezzazatinae Hamaoui and Saint-Marc, 1970

Genus: *Nezzazata* Omara, 1956

Nezzazata simplex Omara, 1956

(Plate I, Figures 3,4)

1956 *Nezzazata simplex* Omara, p. 889, pl. 102, figs. 7-13.

1965 *Nezzazata simplex* Omara; Omara and Strauch, p. 551, pl. 65, figs. 1-7.

2000 *Nezzazata simplex* Omara; İsmail, p. 250, figs. 7, 11, 12.

2009 *Nezzazata simplex* Omara; İsmail et al., pl. 4, fig. 1.

Description: Test is small and slightly conical. Diameter of the test varies between 0.175 - 0.50 mm. Proloculus is spherical shaped and tiny. Its diameter is about 0.01 mm. Coiling is in trochospiral manner. Size of the chambers slowly increase from the center towards the periphery. In the axial sections, marginal parts of the test show an angular appearance.

Stratigraphic and Geographical Distribution: This species was found in Cenomanian aged levels in its type locality in Egypt (Omara, 1956). İsmail (2000) reported this species from the Cenomanian - Turonian levels of Umm Khaysar Southern Galala, Eastern Desert (Egypt) with *Biconcava bentori, Nezzazata simplex, N. gyra conica, Dicyclina sampoi*. The same species, was later reported again in the Eastern Desert (Egypt) from the late Cenomanian - early Turonian aged levels with *Daxia cenomana, Flabellammina aegyptiaca, F. alexanderi, Nezzazata gyra conica, Biconcava bentori, Dicyclina sampoi* and *Nakkadyia awadi* (İsmail et al., 2009). *N. simplex* was observed at rare levels in the Garzan section in the study area (Figure 5: 2 to 4 meters).

Genus: *Nezzazatinella* Darmoian, 1976

Nezzazatinella picardi (Henson), 1948

(Plate I, Figure 5)

1947 *Valvulammina picardi* n. sp., Henson, p. 613, pl. 15, figs. 1, 3, pl. 18, figs. 3-6.

1981 *Nezzazatinella picardi* (Henson); Tronchetti, p. 49, pl. 11, figs. 1-10.

1985 *Nezzazatinella picardi* (Henson); Bilotte, pl. 15, figs. 3.

1992 *Nezzazatinella picardi* (Henson); Schlagintweit, pl. 1, figs. 9.

Description: Test is rounded or sharp at the poles, sutures are slightly curved and conical in shape. Diameter of the test ranges between 0.4 - 1.5 mm. Proloculus is spherical, and its diameter ranges between 0.07 - 0.25 mm. While the chambers are low in the early stage, they rapidly broaden in the adult stage. Coiling is in low trochospiral manner and asymmetrical (Table 1).

Stratigraphic and Geographical Distribution: Type locality of the species is the Middle East (Henson, 1948). Schlagintweit (1992) reported this species

Table 1- Biometrical data of *Nezzazatinella picardi*.

Sample	Diameter (mm)	Proloculus (mm)	Height-width of the chambers in the first whorl	Height-width of the chambers in the last whorl
GA1A2	1.125	0.25	-	0.275-0.275
GA1A3	0.625 0.5	0.075 0.25	0.1-0.1 0.1-0.1	0.125-0.25 0.125-0.375
GA2A1	0.975	0.05	0.15-0.075	0.125-0.375
GA2A2	0.375	0.075	0.1-0.1	0.175-0.1
GA2a	0.8 0.5	0.125 0.1	- 0.1-0.075	0.375-0.25 0.25-0.175
GA3A2	0.7	0.1	0.125-0.075	0.25-0.125
GA5A3	1.425	0.1	0.15-0.2	0.2-0.75
GA5a	1.025	0.15	0.075-0.075	0.35-0.15
GA10a	0.825 0.775	0.075 0.175	0.125-0.125 0.125-0.075	0.5-0.125 0.375-0.15
GA14A3	1.075	-	0.1-0.05	0.5-0.125
GA14a	1	0.125	0.125-0.75	0.525-0.225
GA16A1	0.575	0.2	0.125-0.1	0.325-0.125
GA20A3***	1.3	0.1	0.05-0.05	0.15-0.65

from the Cenomanian levels of Tyrol Mountains - Austria. This species was found in the Upper Cretaceous levels of Bey Dağları with *Nezzazatinella picardi* (Henson), *Dicyclina schlumbergeri* Munier, *Pseudonummoloculina heimi* (Bonet), *Scandonea* sp. and *Spiroloculina* sp. (Sarı, 2006). In this study, it has been determined from lower - middle - upper levels of the Garzan section (Figure 5: 1 to 20 meters).

Genus: *Trochospira* Hamaoui, 1965

Trochospira avnimelechi Hamaoui, 1965

(Plate I, Figure 6)

1965 *Trochospira avnimelechi* Hamaoui, p. 21, pl. 4, fig. 3.

1970 *Trochospira avnimelechi* Hamaoui; Hamaoui and Saint-Marc, p. 294, pls. 12-17.

1997 *Trochospira avnimelechi* Hamaoui; Çoruh et al., p. 417-418, pl. 75, figs. 1, 2.

Description: Test is lenticular or unequally biconvex. It shows a distinct angular appearance at the poles. Wall is microgranular calcareous and imperforate. Diameter and the thickness of the test range between 0.5 - 1.75 mm and 0.3 - 0.85, respectively. Coiling is in trochospiral manner, however, in the last whorl coiling may not be observed (Table 2).

Table 2- Biometrical data of *Trochospira avnimelechi*.

Sample	Diameter (mm)	Thickness (mm)	Height-width of the ultimate chamber
GA1d	1.125	0.5	0.25-0.125
GA3A1	1.55	0.85	0.8-0.25
GA5A1	1.55	0.6	0.6-0.2
GA5A3	1.625	0.7	0.625-0.55
GA5c	1.175	0.5	0.375-0.4
GA7b	0.5	0.275	0.25-0.275
GA10A2	0.5	0.35	0.125-0.35
GA10a	0.75	0.475	0.425-0.275
GA11b	0.775	0.35	0.25-0.125
GA11c	0.8	0.325	0.25-0.125
GA14A1	1.125	0.625	0.5-0.275
GA14A3	0.825	0.375	-
GA17d	0.9	0.425	0.35-0.2
GA20A2	1.75	0.625	0.625-0.375

Stratigraphic and Geographical Distribution: This species which was described (Hamoui, 1965) in the Cenomanian levels of its type locality in Israel, was determined also in the Cenomanian levels of Grecia Occidentale (Greece) region (Fleury, 1971). This species was found in the Upper Cretaceous levels of the Bey Dağları with *Biconcava bentori* Hamaoui, *Chrysalidina gradata* d'Orbigny, *Nummoloculina regularis* (Philipson) (Sarı, 2006). In this study, it has been determined in the lower - middle - upper levels of the Garzan section (Figure 5: 2 to 20 meters).

Subfamily: Coxitinae Hamaoui and Saint-Marc, 1970

Genus: *Antalyna* Farinacci and Köylüoğlu, 1985

Antalyna korayi Farinacci and Köylüoğlu, 1985

(Plate I, Figure 7)

1985 *Antalyna korayi* Farinacci and Köylüoğlu, p. 103-108, pls. 1-2, figs. 1-6.

2010 *Antalyna korayi* Farinacci and Köylüoğlu; Afghah, p. 74. 75, figs. 5, 3, 24.

2012 *Antalyna korayi* Farinacci and Köylüoğlu; Afghah and Farhoudi, p. 338, pl. 3, fig. 4.

Description: Test is convex in the dorsal side, and concave in the ventral side. Its basal view is ovoid. Wall is calcareous, microgranular, imperforate, subepidermal mesh is developed. Septal wall is simple mesh. Diameter and the height of the test range between 0.7 - 1.6 mm and 0.6 - 1.5 mm, respectively. Coiling is in milioline manner in in the early stage, and later on it becomes trochospiral. In the last whorl, height rapidly increases and no coiling is observed (Table 3).

Stratigraphic and Geographical Distribution: This species was described in the Late Maastrichtian from its type locality in Antalya with *Rhapydionina liburnica (*Stache), *Laffiteina mengaudi* (Astre), *Dictyoconella complanata* Henson (Farinacci and Köylüoğlu, 1985). This species was found in the Upper Cretaceous of Iran, accompanied by *Omphalocyclus macroporus, Lepidorbitoides minor, L. socialis, Loftusia minor, Orbitoides triangularis, O. apiculata, Siderolites calcitrapoides* (Afghah, 2010; Afghah and Farhoudi, 2012). It was observed at almost all levels in the Garzan section (Figure 5: 1 to 20 meters).

Table 3- Biometrical data of *Antalyna korayi*.

Sample	Diameter (mm)	Height (mm)
GA3c	0.75	0.625
GA10A2	1.625	1.5
GA14A3	0.8	1.025
GA14a	1.25 1.5 0.95	0.95 0.75 0.7
GA14b	1.25	0.625
GA14A2	1	0.625
GA14A3	1.425	0.75
GA20c	1.125	0.625

Superfamily: Biokovinacea Gusic, 1977

Family: Charentiidae Leoblich and Tappan, 1985

Genus: *Moncharmontia* De Castro, 1967

Moncharmontia apenninica (De Castro), 1967

(Plate I, Figure 8)

1966 *Neoendothyra apenninica* De Castro, p. 317-347, pl. 5.

1967 *Moncharmontia apenninica* (De Castro); De Castro, pl. 2.

1986 *Moncharmontia apenninica* (De Castro); Bilotte, pl. 369.

1994 *Moncharmontia apenninica* (De Castro); Chiocchini et al., pl. 22, figs. 16-18.

2001 *Moncharmontia apenninica* (De Castro); Tesovic et al., pl. 2, figs. G-I.

Description: Test is quite small, slightly inflated, lenticular or ovoid in shape. It is coiled in planispiral - evolute manner. Diameter and the thickness of the test vary between 0.20 - 0.50 mm and 0.2 - 0.3 mm, respectively. It has an elongation index of 1.5. Chambers are subspherical in the axial section, and their sizes increase towards the outer whorls (Table 4).

Stratigraphic and Geographical Distribution: It was described in Senonian in its type locality, Italy (De Castro, 1967). This species was found in the Pusica formation and the Upper Cretaceous carbonates of Brač Island (Croatia's Dalmatian Coast), accompanied by *Cuneolina pavonia, Discyclina schlumbergeri, Moncharmontia compressa, Orbitoides tissoti, O. media* (Tesovic et al., 2001). It generally occurs in the lower levels of Garzan section (Figure 5: 2 m).

Table 4- Biometrical data and features of the species *Moncharmontia apenninica* and *Moncharmontia compressa*.

Features	*Moncharmontia apenninica*	*Moncharmontia compressa*
Test shape in the axial parts	Umbilical area is smooth	Umbilical area is intermediate
Equatorial diameter (D)	0.20-0.50 mm	0.30-0.50 mm
Thickness (d)	0.20-0.30 mm	0.15-0.20 mm
Proloculus diameter	0.09-0.1 mm	0.05-0.08 mm

Moncharmontia compressa (De Castro), 1966

(Plate I, Figure 9)

1966 *Neoendothyra apenninica compressa* De Castro, p. 20-24, pl. 3, figs. 4-8.

1994 *Moncharmontia compressa* (De Castro); Chiocchini et al., pl. 23, figs. 2, 3, 10.

2001 *Moncharmontia compressa* (De Castro); Tesovic et al., pl. 2, figs. M-N.

Description: Test is quite small and flattened lenticular in umbilical area. Its wall structure is identical to that in *M. apenninica*. Diameter and the thickness range between 0.30 - 0.50 mm and 0.15 - 0.2 mm, respectively. It is coiled in planispiral - evolute manner. Chambers are heart - shaped in the axial section, and their sizes increase towards the outer whorls.

Stratigraphic and Geographical Distribution: It was described in Senonian in its type locality, Italy (De Castro, 1966). This species was reported from the Pusica formation in Brač Island (Croatia). It occurs in Upper Cretaceous carbonates with *Cuneolina pavonia, Discyclina schlumbergeri, Moncharmontia apenninica, Orbitoides tissoti, O. media* (Tesovic et al., 2001). It was generally observed in the lower and upper levels of the Garzan section (Figure 5: 1 and 16 to 20 meters).

Fleuryana adriatica (De Castro), 1972

(Plate I, Figures 10-11)

1972 *Moncharmontia apenninica compressa* De Castro-Bignot, pl. 16, figs. 6, 7, 8.

1988 *Moncharmontia apenninica* (De Castro); Drobne et al., pl. 24, figs. 6, 7.

1989 *Moncharmontia apenninica* (De Castro); Drobne et al., pl. 3, figs. 10, 11, 12.

1994 *Fleuryana adriatica* (De Castro); De Castro et al., p. 129-149, pl. 1, figs. 1-15; pl. 2, figs. 1-14; pl. 3, figs. 1-16; pl. 4, figs. 1-8.

Description: Test is quite small and lenticular. It is planispirally - evolute coiled and has 2.5 - 3.5 whorls. Diameter of the test ranges between 0.30 - 0.60 mm. In first whorls, wall is involute, so leading to the chamber lumina to be triangular - shaped. Size of the chambers slightly increase towards the end, and they become higher and longer (Table 5).

Stratigraphic and Geographical Distribution: This species was found in the Upper Cretaceous levels in its type locality, Brač Island (Croatia) (De Castro et al., 1994). It was reported from the Maastrichtian of Austria (Sanders et al., 2004). Velic (2007) stated the presence of this species in the Maastrichtian of Southeastern Europe. It was observed in the lower - middle - upper levels of Garzan section (Figure 5: 2 to 20 meters).

Genus: Pseudocyclammina Yabe and Hanzawa, 1926

Superfamily: Ataxophragmiacea Schwager, 1877

Family: Cuneolinidae Saidova, 1981

Subfamily: Cuneolininae Saidova, 1981

Genus: *Cuneolina* d'Orbigny, 1839

Cuneolina pavonia d'Orbigny, 1839

(Plate I, Figures 15-16)

1839 *Cuneolina pavonia* d'Orbigny, p. 150, figs. 6B, C.

1993 *Cuneolina pavonia* d'Orbigny; Grotsch et al., figs. 5B-E.

2001 *Cuneolina pavonia* d'Orbigny; Tesovic et al., pl. 1, figs. B-C.

Description: Test is conical with a large basal diameter. Height of the biserial test ranges between 0.75 - 1.2 mm. In the basal sections, diameter and the thickness range between 0.825 - 1.375 and 0.04 - 0.003 mm, respectively. Large proloculus is ovoid, and its diameter is 0.026. Proloculus is followed by subepidermic zone with small chambers. Chambers are subdivided by vertical partitions. Chamberlets are rectangular - shaped (Table 6).

Table 5- Numbers of chambers of the species *M. apenninica* and *F. adriatica* in each whorl.

Species	1st whorl	2nd whorl	3rd whorl
M. apenninica	7-8	9-10.5	13 (rarely)
F. adriatica	10.5-11	13	14-16

Table 6- Biometrical data of *Cuneolina pavonia*.

Sample	Basal diameter (mm)	Height (mm)	Height-width of the chamberlets in first stage	Height-width of the chamberlets in last stage
GA1A3	1.375	1.2	0.025-0.025	0.05-0.05
GA1a	0.825	1	0.1-0.025	0.15-0.05
GA9A1	0.955	1.625	0.075-0.025	0.125-0.025
GA11c	0.875	0.775	0.075-0.05	0.125-0.075
GA14A3	0.755	0.85	0.05-0.025	0.125-0.05
GA16a	0.875	0.75	0.025-0.025	0.125-0.075
GA20A1	0.850 1.175	0.75 0.875	0.075-0.05 0.05-0.05	0.125-0.075 0.125-0.05

Stratigraphic and Geographical Distribution: This species was described from its type locality Cuba (d'Orbigny, 1839). Dilley (1973) reported this species from the Albian and Maastrichtian of Northern and Central America, Southern Europe, Northern and Western Africa, Middle East. It was determined in the Santonian of Spain (Hofker, 1967; Caus and Cornella, 1983; Caus, 1988; Gischler et al., 1994) and of Turkey (Sarı and Özer, 2002). It was also found in the Campanian of the Line Islands in the Pacific (Premoli Silva and Brusa, 1981) and in the Maastrichtian of Iraq (Al - Omari and Sadek, 1976). It was observed in the lower and middle parts of Garzan section (Figure 5: 2 to 20 meters).

Cuneolina ketini İnan, 1988

(Plate I, Figures 17-18)

1988 *Cuneolina ketini* İnan, pl. 1, figs. 1-8; pl. 2, figs. 1-8

2004 *Cuneolina ketini* İnan; Sanders et al., pl. 4, figs. 1, 2 and 7.

Description: Test is high conical with a small and narrow basal diameter. Height of the biserial test is 2.5 mm. In the basal sections, diameter and the thickness range between 0.4 - 1 and 0.2 - 0.5 mm, respectively. Proloculus is tiny and spherical. Proloculus is followed by a spiral stage. Rectangular chambers are subdivided by vertical partitions. Their heights and widths vary between 0.06 - 0.14 and 0.03 - 0.05, respectively Table 7).

Stratigraphic and Geographical Distribution: This species was found in the Upper Cretaceous levels in its type locality Sivas (Turkey) with *Orbitoides medius, O. apiculatus, Omphalocyclus macroporus, Pseudomphalocyclus blumenthali* and *Loftusia minor* (İnan, 1988). Sanders et al. (2004) stated its presence in Campanian levels of the Austrian Alps. Tewari et al. (2007) reported the presence of this species in Maastrichtian aged levels in the Northern Italy - Northwestern Adriatic Platform. It was observed in the lower - middle - upper levels of Garzan section (Figure 5: 1 to 20 meters).

Family: Dicyclinidae Loeblich and Tappan, 1964

Genus: *Dicyclina* Munier-Chalmas, 1887

Dicyclina schlumbergeri Munier-Chalmas, 1887

(Plate I, Figure 19)

1887 *Dicyclina schlumbergeri* Munier-Chalmas, p. 362, pl. 1; p.363, pl. 2.

1978 *Dicyclina schlumbergeri* Munier-Chalmas;

Table 7- Comparison of the genera *Dicyclina* and *Cuneolina*.

FEATURES	*Dicyclina*	*Cuneolina*
Test shape	Discoidal, slightly undulated and flattened	Compressed, flabelliform, conical.
Growth stage	Slightly inflated in the early stage	Trochospiral in the early stage, with about five chambers
Chambers and chamberlets	Chambers annular, added on the two sides of the test	Very broad and low biserally arranged
Internal part	Subdivided by numerous thin radial partitions	Subdivided into nearly rectangular chamberlets by radial partitions arising perpendicular to the outer wall
Aperture	Numerous pores at the periphery	At the internal margins, biserial

Luperto Sinni and Ricchetti, p. 47, figs. 1-7; p. 48, figs. 1-6.

1990 *Dicyclina schlumbergeri* Munier-Chalmas; Cherchi and Schroeder, p. 333, figs. 5-11.

2001 *Dicyclina schlumbergeri* Munier-Chalmas; Tesovic et al., pl. 1, figs. D-H.

Description: Test is discoidal, smooth or undulated on the surface. It more inflated in early stage comparing to the adult stage. Wall is agglutinated calcareous, and consists of imperforate epiderm and subepidermal mesh. Diameter and the thickness vary between 7.625 - 1.375 mm and 0.175 - 0.525 mm, respectively. Large proloculus is ovoid, and has a diameter of 1.1 mm. Alternating chambers on each side of the test developed as circle. Internal part is subdivided by numerous thin, radial partitions which are perpendicular to the wall and extending from chamber to chamber. Number of the secondary partitions located between the main partitions, varies between 3 to 5 (Table 8).

Stratigraphic and Geographical Distribution: This species was reported from the Upper Cretaceous levels in its type locality France (Munier - Chalmas, 1887). This species was found in the Pusica formation in Brač Island (Croatia's Dalmatian Coast) and in the Upper Cretaceous carbonates. It was accompanied by *Cuneolina pavonia, Moncharmontia apeninica, M. compressa, Orbitoides tissoti, O. media* (Tesovic et al., 2001). It was recorded in the Upper Cretaceous limestones of Murge/Altamura (Southern Italy) with the assemblage containing *Cuneolina pavonia, Moncharmontia apenninica, Minouxia conica, Pseudolituonella* sp. (Checconi et al., 2008). It was observed at almost all levels in the Garzan section (Figure 5: 1 to 20 meters).

Superfamily: Orbitolinacea Martin, 1980

Family: Orbitolinidae Martin, 1980

Subfamily: Dictyoconinae Moullade, 1965

Genus: Dictyoconella Henson, 1948

Dictyoconella ? *complanata* Henson, 1948

(Plate II, Figure 2)

1948 *Dictyoconella complanata* Henson, p. 25, pl. 6, figs. 2, 3, 16; pl. 10, figs. 14.

1985 *Dictyoconella complanata* Henson; Farinacci and Köylüoğlu, p. 106

2012 *Dictyoconella complanata* Henson; Afghah and Farhoudi, pl. 2, figs. 2.

Description: Test is quiet large, and bilaterally flattened peneropliform. A subepidermal mesh formed by intersecting primary and secondary horizontal extensions is observed interior. Early planispiral stage consists of numerous large, flattened and slightly arched chambers, while the adult stage consists of uncoiled, uniserially arranged chambers. Beams which connect with radial extensions, are present in the central zone (Table 9).

Table 8- Biometrical data of *Dicyclina schlumbergeri*.

Sample	Diameter (mm)	Thickness (mm)	Numbers of secondary partitions
GA5A1	1.87 4.62	0.175 0.275	3
GA5A2	1.375	0.325	-
GA5a	5.125 3.125	0.325 0.3	3-4, width of the proloculus: 0.875 3-4, height of the proloculus: 0.3
GA5d	6.625	0.375	-
GA7b	3.175	0.35	-
GA7c	5.375 2	0.5 0.3	- 4
GA7d	3.675	0.375	-
GA9A2	2.95	0.425	-
GA9A3	2.125 2	0.375 0.3	- -
GA9d	2.25	0.425	3
GA10A3	5.25 7.625	0.5 0.525	5 5

Table 9- Biometrical data of *Dictyoconella* ? *complanata*.

Sample	Basal diameter (mm)	Basal thickness (mm)
GA3a	1.1	0.375
GA5A1	1.05	0.3
GA5A3	1	0.725
GA7a	0.75	0.475
GA7c	1	0.325
GA9d	0.875	0.5
GA10A1	0.975 0.825	0.525 0.525
GA14A3	0.675	0.4
GA14a	1.375 1.125	0.825 0.6
GA14b	2 1.05	1 0.575
GA16A2	1	0.525
GA16A3	0.75	0.625
GA20A1	1.05 1.175 1.225	0.75 0.575 0.5
GA20A2	1.7	0.85
GA20a	1.625	0.6
GA20b	1.2 1.15	0.675 0.45
GA20c	1.125	0.525

Stratigraphic and Geographical Distribution: This species was described in the Upper Cretaceous aged levels from its type locality Qatar accompanying with *Omphalocyclus macropora* and *Loftusia* spp. (Henson, 1948). It was found in the Late Maastrichtian of Southwestern Turkey with *Rhapydionina liburnica, Laffiteina mengaudi, Antalyna korayi* (Farinacci and Köylüoğlu, 1985). In Zagros Mountains (Iran), it was reported from the Upper Cretaceous - Masstrichtian sediments of the Tarbur formation (Afghah and Farhoudi, 2012). It was observed at almost all levels in the Garzan section (Figure 5: 1 to 20 meters).

Vandenbroekia munieri Marie, 1958

(Plate II, Figures 4,5)

1958 *Vandenbroekia munieri* Marie, p. 135, pl. 1, figs. 1-8.

Description: Test is discoidal and slightly conical. Test diameter ranges approximately between 2.5 - 5.85 mm. Proloculus is spherical. In the megalospheric generations, it is followed by peneroplid type spiral chambers. Annular whorls are present after this stage. Chambers are peneropliform in the juvenile stage, while they are annular in the adult stage. Height of the chambers increase towards the outer whorls. Diameters of the test and proloculus varies between 2.5 - 6 mm and 0.425 - 0.475 mm, respectively. In the axial sections, proloculi are subspherical, and the ultimate chambers are elongated subspherical (Table 10).

Stratigraphic and Geographical Distribution: It was found in the Campanian levels of its type locality in France (Marie, 1958). It was observed at almost all levels in the Garzan section (Figure 5: 1 to 20 meters).

Superfamily: Orbitoidacea Schwager, 1876

Family: Orbitoididae Schwager, 1876

Table 10- Biometrical data of *Vandenbroekia munieri* (Pr= Proloculus).

Sample	Diameter (mm)	Thickness (Periphery-central) mm	Height-width of the chambers in the first and last whorls	Whorl numbers
GA5A1	4.75 5 4.875	0.225-0.1 0.175-0.1 0.15-0.125	0.075/0.1-0.15/0.15 - 0.075/0.1-0.125/0.1	19 12 17
GA5A2	3.25 4.5 5.125	0.15-0.1 0.15-0.05 0.1-0.05	- 0.05/0.05-0.125/0.125 -	- 17 11
GA5A3	5	0.1-0.05	-	13
GA5c	5.25	0.175-0.025	-	15
GA5d	5.375	0.2-0.05	-	12
GA7b	6	0.125-0.1	-	-
GA20A3	2.5; Pr=0.425 4.8; Pr=0.475	0.125-0.225 0.25-0.2	0.125/0.15-0.125-0.1 0.125/0.125-0.125/0.15	11 19
GA20a	5.85	0.2-0.2	0.125/0.125-0.125/0.15	14
GA20b	5.425	0.15-0.225	0.05/0.025-0.1/0.2	25

Subfamily: Orbitoidinae Schwager, 1876

Genus: *Orbitoides* d'Orbigny, 1848

Orbitoides media (d'Archiac), 1837

(Plate III, Figures 1,2)

1823 *Lycophris faujasi* Defrance, c. 24

1837 *Orbitoides media* (d' Archiac), pl. 3, figs. 1-6, pl. 5, figs. 3-4, pl. 35, figs. 2

1916 *Orbitoides media* (d'Archiac); Douville, pl. 12, figs. l a, b, c.

1935 *Orbitoides media* (d'Archiac); Florida, pl. 14, figs. l -2.

1958 *Orbitoides media* (d'Archiac); Neumann, pl. 3, figs. l -6; pl. 5, figs. 3-4.

1965 *Orbitoides media* (d'Archiac); Meriç, pl. 15. figs. 6-12; pl. 16, figs. l -4.

Description: Test is large, discoidal, generally biconvex and asymmetrical. Concavo - convex or planoconvex tests are rarely observed. Embryonic chambers of the megalospheric generation can be seen as three - or four - chambered depending on the level of the partitions in the horizontal sections. It has a subspherical protoconch and a reniform deuteroconch. There is a wall surrounding the embryon from the outside. Equatorial chambers surrounding the embryon are arcuate. Their heights and widths increase towards the edges. In the axial sections, lateral chambers enlarge towards the periphery. Beams are present at the margins. Many arcuate equatorial chambers and basic stolons, adjacent to each other, develop within successive cycles following the embryon. Equatorial layers are surrounded by many lateral chambers and pillars on both sides of the test. Limits in this species which were first accepted by Van Gorsel (1978) as 500<Li+li<600 and 4<E<5.5 followed in this study as well (Figure 6).

Stratigraphic and Geographical Distribution: The species was found in the Campanian levels of its type locality in France (d'Archiac, 1837). This species has also been observed in Spain, North Africa, Italy, Greece, Syria, Turkey and India. Baumfalk (1986) reported this species from the Upper Campanian sediments of France accompanying with *Orbitoides tissoti* and *Orbitoides medius megaloformis*. *Orbitoides medius* and *O. megaloformis* were recorded in the samples from Darende (probably in lower - middle Maastrichtian; Meriç and Görmüş, 1997) and Pazarcık regions (middle - upper Maastrichtian; Görmüş et al., 1994). In the Hekimhan region, the presence of *Orbitoides*

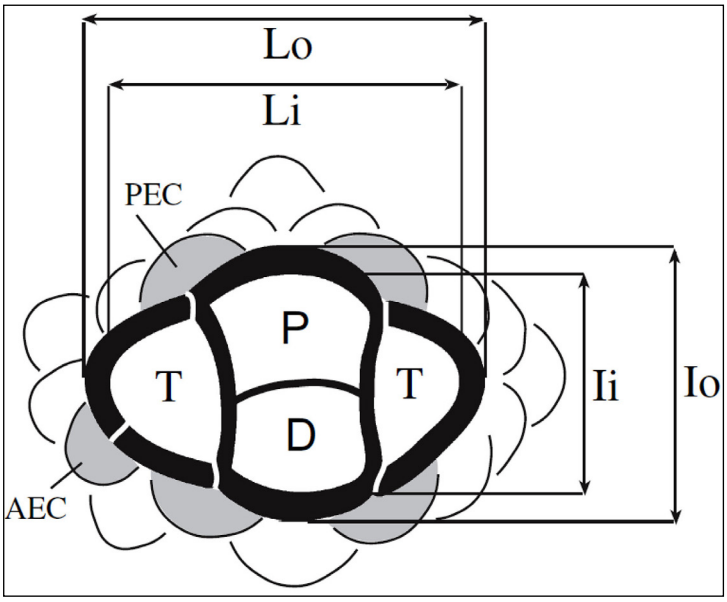

Figure 6- The first chamber and its parameters used in orbitoid identification criteria (AEC+PEC: Auxiliary chambers; Li: Largest diameter of embryon excluding the thickness of the wall; li: Diameter of embryon excluding the thickness of the wall and perpendicular to Li; Li+li: Size of embryon; after Özcan, 2007).

medius was mentioned in the mudstones (probably upper Campanian - lower Maastrichtian; Görmüş, 1992) associated with the reef framework. It was determined in the Pusica formation and in the Upper Cretaceous carbonates of the Brač Island (Croatia's Dalmatian Coast) accompanied by *Cuneolina pavonia, Discyclina schlumbergeri, Moncharmontia apeninica, M. compressa, Orbitoides tissoti, O. media* (Tesovic et al., 2001). In the Zagros Mountains (Iran), an assemblage which contains *Dicyclina schlumbergeri, Antalyna korayi, Dictyoconella complanata, Omphalocyclus macroporus, Orbitoides media, O. tissoti, Goupilloidina shirazensis, Minouxia* sp., *Trochospira* sp., *Nezzatinella* sp., *Nezzazata* sp. in the Upper Cretaceous - Maastrichtian sediments of the Tarbur formation was reported (Afghah and Farhoudi, 2012). Abyat et al. (2014) determined that species in the Upper Cretaceous levels of Southwestern Iran. In the Garzan section, it was found at the all levels of the Garzan formation, and in the lower levels of the Germav formation (Figure 5: 1 to 25 meters).

Orbitoides megaloformis Papp and Küpper, 1953

(Plate III, Figures 3,4)

1953 *Obitoides media megaloformis* n. ssp. Papp and Küpper, s. 74-75, pl. 1, figs. 9.

1956 *Obitoides media megaloformis* Papp and Küpper; Papp, p. 138, pl. 1, figs. 9.

1985 *Orbitoides megaloformis* Papp and Küpper; Drooger and Klerk, p. 115, pls. 3-4

1993 *Orbitoides megaloformis* Papp and Küpper; Neumman, p. 319-324, pl. 1, figs. 16-18; pl. 2, figs. 1-8, pl. 4, figs. 1, 3, 6

Description: Test is large, discoidal and generally biconvex. The megalospheric individuals with thin - walled embryon appear as having 3 or 4 partitions depending on the level of the parts in the horizontal sections and have a thick wall. Limits in this species which were first accepted by Van Gorsel (1978) as 600<Li+li<750 and 5.5<E<10 followed in this study as well (Figure 6). While the Equatorial chambers are constantly adjacent to the basic stolons in the peripheral parts of the test, they are curved in other horizontal parts. Thick - walled lateral chambers are developed on both sides of the equatorial chambers. There are many pillars between the lateral chambers (Table 11).

Table 11- Biometrical data of *Orbitoides* determined in the Garzan formation.

Sample	Li + li (µm)	E	Determination
Or-2	600	5	*O. media*
Or-3	620	8	*O. megaloformis*
Or-4	500	5	*O. media*
Or-5	550		*O. media*
Or-7	630		*O. media*
Or-9	690	8	*O. megaloformis*
Or-10	620	7	*O. megaloformis*
Or-13	670		*O. megaloformis*
Or-14	670		*O. megaloformis*
Or-15	660	7	*O. megaloformis*
Or-18	490	5	*O. media?*
Or-20	500	6	*O. media?*
Or-22	740	4	*O. media?*
Or-24	600	4	*O. media?*
Or-25	520		*O. media*
Or-27	720	4	*O. megaloformis?*
Or-28	590		*O. media*
Or-29	700		*O. media*
Or-30	580		*O. media*
GAY-1	670	7	*O. megaloformis*
GAY-2	700		*O. megaloformis*
GAY-4	630	4	*O. megaloformis*
GAY-5	700	7	*O. megaloformis*
GAY-8	500	5	*O. media*

Stratigraphic and Geographical Distribution: This species was found in the Upper Campanian levels of the Pemberger sandstones in its type locality in Austria (Papp and Küpper, 1953). Caus et al. (1996), reported this species accompanying with *O. medius* in the Pyrenees. In the Garzan section, it was found at the all levels of the Garzan formation, and in the lower levels of the Germav formation (Figure 5: 1 to 28 meters).

Subfamily: Omphalocyclinae Vaughan, 1928

Genus: Omphalocyclus Bronn, 1853

Omphalocyclus anatoliensis Özcan, 2007

(Plate III, Figures 5,6)

2007 *Omphalocyclus anatoliensis* sp. nov., Özcan, figs. 8, 9 A-G, I-P, 13 P, U

Description: Test is quite small (diameter<3 mm), flattened, depressed in the center, biconcave. It is seen as in form of bowtie in the axial sections due to its shape. Very small embryon of the species typically has three partitions. Depending on the size, levels of the partitions and asymmetrical conditions with respect to the equatorial layers, it may have double, triple and quadruplet partitions. Li+li values range between 164 µm and 575 µm (Figure 6). E value is between 3 - 4 on average. Equatorial chamberlets are generally narrow, and mostly curved in the early stage, then they broaden towards the outwards. Embryon, at first, is followed by orbitoid type (arcuate) chambers. Towards the periphery, the equatorial chambers increase in width and decrease in height. Therefore, the equatorial chambers take a rectangular shape towards the periphery of the test. It does not contain a real lateral chamber (Table 12).

Table 12- Biometrical data of *Omphalocyclus anatoliensis* determined in the Garzan formation.

Sample	Li + li (µm)	E	Determination
Om-3	390	-	*O. anatoliensis*
Om-5	270	-	*O. anatoliensis*
Om-7	430	4	*O. anatoliensis*
GA-14	420	3	*O. anatoliensis*
GA17A2	270	4	*O. anatoliensis*
GA17b	290	3	*O. anatoliensis*

Stratigraphic and Geographical Distribution: This species was found in the late Campanian levels of its type locality in Kahta - Adıyaman accompanied by *L. bisambergensis, O. media, O. megaloformis, S. calcitrapoides* and *Loftusia* spp. (Özcan, 2007). It was observed in the lower and upper levels of the Garzan section (Figure 5: 3 to 16 meters).

5. Discussion and Conclusions

The forms determined in the Garzan measured stratigraphic section, are common in the Upper Cretaceous shallow marine sediments of Tethyan Belt.

Fleuryana adriatica which was obtained at almost all levels of the Garzan section, was observed in Maastrichtian in Austria and Southeastern Europe (Sanders et al., 2004; Velic, 2007). Likewise, the *Cuneolina ketini* found in the Garzan section, was described in the Maastrichtian levels in Sivas, which is the type locality of the species (İnan, 1988).

Cuneolina pavonia was recorded by Dilley (1973) in the Albian and the Maastrichtian in Northern and Central America, Southern Europe, Northern and Western Africa and Middle East. It was determined in the Santonian in Spain (Hofker, 1967; Caus and Cornella, 1983; Caus, 1988; Gischler et al., 1994) and in Turkey (Sarı and Özer, 2002). This species was mentioned in the Coniacian - early Campanian by Checconi et al. (2008) in southern Italy, in the Cenomanian - early Turonian by Robertson et al. (2015) in Adıyaman, in the middle - late Cenomanian by Taslı et al. (2006) in the Bolkar Mountains, in the late Cenomanian - Maastrichtian by Tesovic et al. (2001) in Croatia, in the Campanian - Maastrichtian by Vaziri et al. (2005) and Vaziri (2011) in Iran.

Dicyclina schlumbergeri (Munier - Chalmas, 1887) reported in Upper Cretaceous levels in France, which is its type locality, was observed in the measured section at all levels. This species was found in the Coniacian - Campanian carbonate sediments in Croatia, accompanied by the species *Cuneolina pavonia, Moncharmontia apeninica, M. compressa, Orbitoides tissoti, O. media* (Tesovic et al., 2001). It was mentioned in the Coniacian - Campanian aged limestones of Murge/Altamura (Southern Italy) with the assemblage containing *Cuneolina pavonia, Moncharmontia apenninica, Minouxia conica, Pseudolituonella* sp. (Checconi et al., 2008). Taslı et al. (2006) reported *Moncharmontia compressa* and *Dicyclina schlumbergeri* in Coniacian - Santonian from the Bolkar Mountains. Schlüter et al. (2008) stated the presence of *M. apenninica* and *D. schlumbergeri* in Coniacian - Maastrichtian in the southern Italy. Boix et al. (2011) recorded *D. schlumbergeri* in Coniacian - Santonian in the Spanish Pyrenees. *C. pavonia, N. simplex, N. picardi, D. schlumbergeri* was determined in the Cenomanian - Coniacian levels of the Bey Dağları by Sarı et al. (2009). This species was reported in the Campanian - Maastrichtian levels of Iran by several researchers (Vaziri et al., 2005; Afghah, 2009; Vaziri, 2011; Afghah and Farhoudi, 2012; Abyat et al., 2014), accompanied by the assemblage of *A. korayi, O. medius, D. complanata, M. apenninica, N. picardi*. Sanders et al. (2004) determined this species in the Cenomanian - Maastrichtian of Austria.

Biconcava bentori was observed in the Cenomanian levels in the Bolkar Mountains (Taslı et al., 2006; Sarı et al., 2009), Southern Italy (Frija et al., 2015) and Egypt (İsmail et al., 2009).

The genus *Vandenbroekia* whose type locality is the Campanian aged levels in France, has not been observed in the previous studies. The presence of *Vandenbroekia*, which offers a limited spread, has been reported for the first time with this study both in Turkey and in the Maastrichtian.

Nezzazatinella picardi, which was observed in the lower - middle - upper levels of the Garzan section, was found in the Cenomanian - Turonian aged levels in Adıyaman by Robertson et al. (2015). This species was also reported in the middle - upper Cenomanian of the Bolkar Mountains by Taslı et al. (2006), in the Cenomanian - Coniacian of the Bey Dağları by Sarı et al. (2009), in the Campanian - Maastrichtian of Iran by Vaziri et al. (2005) and Vaziri (2011), in the Cenomanian - Santonian of Austria by Schlagintweit (1992).

Antalyna korayi was described in the late Maastrichtian in its type locality in Antalya, accompanied by *Rhapydionina liburnica* (Stache), *Laffiteina mengaudi* (Astre), *Dictyoconella complanata* Henson (Farinacci and Köylüoğlu, 1985). This species was found in the Campanian - Maastrichtian levels of Iran, with *Omphalocyclus macroporus, Lepidorbitoides minor, L. socialis, Loftusia minor, Orbitoides triangularis, O. apiculata, Siderolites calcitrapoides* (Afghah, 2010; Afghah and Farhoudi, 2012; Abyat et al., 2014).

Orbitoides media was first described in the Campanian levels of its type locality in France (d'Archiac, 1837). It was determined in the Pusica formation and the Upper Cretaceous carbonates in Croatia, accompanied by *Cuneolina pavonia, Discyclina schlumbergeri, Moncharmontia apeninica, M. compressa, Orbitoides tissoti* (Tesovic et al., 2001). This species was also reported from the Maastrichtian levels of Iran (Afghah and Farhoudi, 2012; Abyat et al., 2014).

Orbitoides megaloformis was found in the Pemberger Sandstone in Austria which the type locality of the species (Papp and Küpper, 1953). Caus et al., (1996) reported this species in the Campanian aged levels from the Pyrenees.

Omphalocyclus anatoliensis was found in the Upper Campanian levels of Kahta - Adıyaman, the type locality, accompanied by *L. bisambergensis, O. media, O. megaloformis, S. calcitrapoides* and *Loftusia* spp. (Özcan, 2007). In the Garzan section, it was observed that this species was not occurred with forms characterizing the late Campanian, but with forms in the Maastrichtian.

Garzan formation, which contains mainly beige - yellowish colored, thin - thick bedded shallow marine limestones, is remarkable with high diversity and abundance in terms of larger benthic foraminifera. Porcellaneous, microgranular and agglutinated genera and species such as *Vandenbroekia munieri* Marie, *Biconcava bentori* Hamaoui, *Nezzazatinella picardi* (Henson), *Trochospira avnimelechi* Hamaoui, *Antalyna korayi* Farinacci and Köylüoğlu, *Moncharmontia apenninica* (De Castro), *Moncharmontia compressa* (De Castro), *Fleuryana adriatica* (De Castro), *Cuneolina pavonia* d'Orbigny, *Cuneolina ketini* İnan, *Dicyclina schlumbergeri* Munier - Chalmas, *Dictyoconella complanata* Henson starts appearing from the lower levels of the unit, however, they become abundant or poor at different levels.

In this study, supported also by biometric data, in the light of all individuals identified and the paleontological data, it was determined that the age of the Garzan formation is Maastrichtian (Upper Cretaceous).

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PLATES

PLATE I

1. *Biconcava bentori* Hamaoui, equatorial section, X100 (GA11A1-k)

2. *Biconcava bentori* Hamaoui, axial section, X100 (GA14a-k)

3,4. *Nezzazata simplex* Omara, equatorial sections, X60 (GA9b-k, GA14b-d)

5. *Nezzazatinella picardi* (Henson), axial section, X60 (GA14a-d)

6. *Trochospira avnimelechi* Hamaoui, oblique section, X60 (GA14A2-d)

7. *Antalyna korayi* Farinacci ve Köylüoğlu, oblique section, X60 (GA14a-b)

8. *Moncharmontia apenninica* (De Castro), axial section, X100 (GA9A1-h)

9. *Moncharmontia compressa* (De Castro), axial section, X100 (GA9A2-c)

10. *Fleuryana adriatica* (De Castro), oblique section, X100 (GA9d-e)

11. *Fleuryana adriatica* (De Castro), equatorial section, X100 (GA9c-b)

12. *Pseudocyclammina sphaeroidea* Gendrot, axial section, X60 (GA5A1-6)

13. *Arenobulimina* sp., axial section, X60 (GA10a-k)

14. *Broeckinella arabica* Henson, axial section, X60 (GA5A2-f)

15. *Cuneolina pavonia* d'Orbigny, axial section, X60 (GA9c-a)

16. *Cuneolina pavonia* d'Orbigny, basal section, X60 (GA9A1-3)

17. *Cuneolina ketini* İnan, vertical section, X60 (GA11c-a)

18. *Cuneolina ketini* İnan, basal section, X60 (GA16d-1)

19. *Dicyclina schlumbergeri* Munier-Chalmas, axial sections, X30 (GA5a-10)

20. *Coskinolina* sp., oblique section, X60 (GA2a-ı)

21. *Minouxia gümbelitrioides* Marie, equatorial section, X60 (GA5A2-3)

PLATE-I

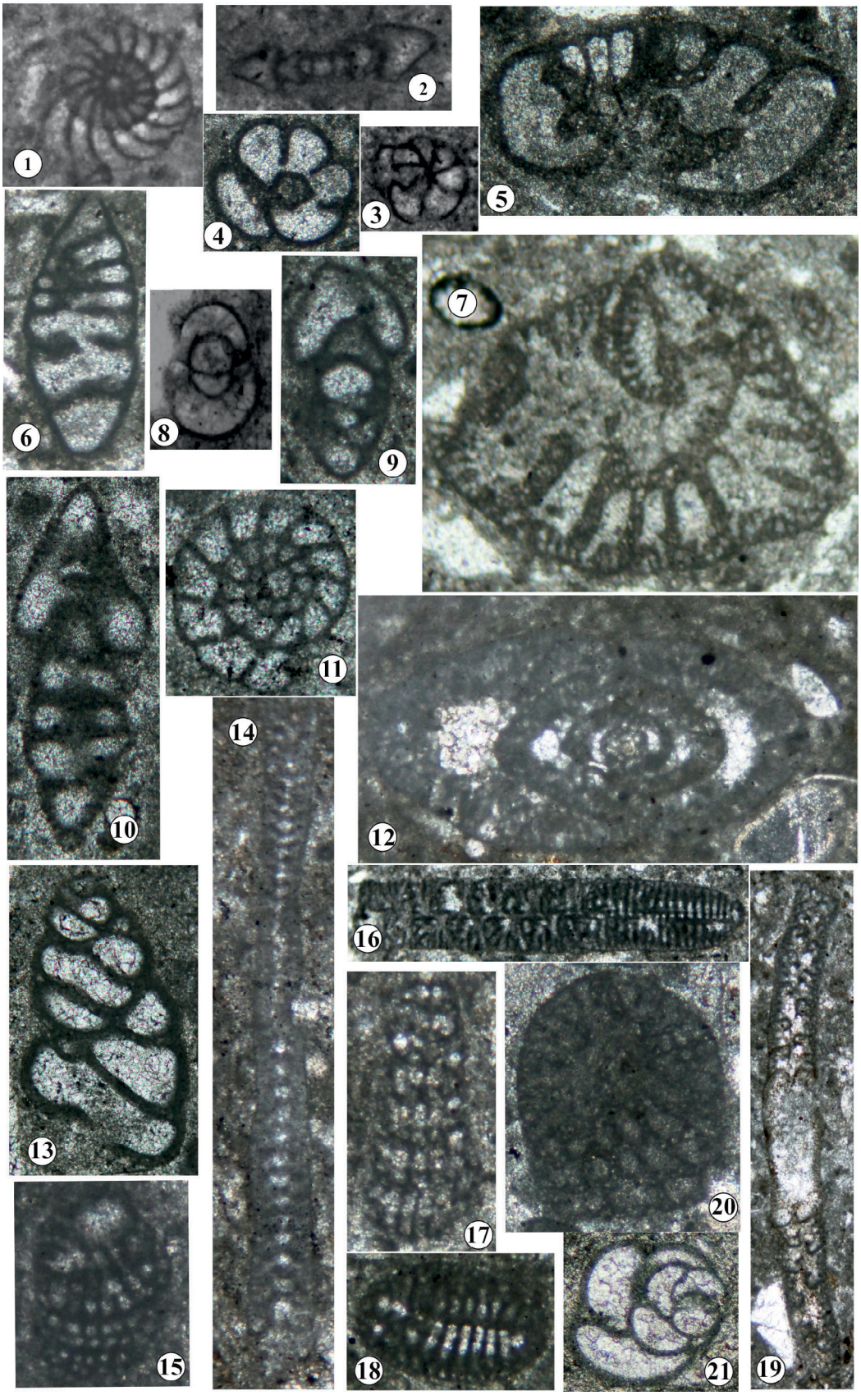

PLATE II

1. *Pseudolituonella reicheli* Marie, longitudinal section, X60 (GA2d-3)

2. *Dictyoconella* ? *complanata* Henson, basal section, X60 (GA14a-a)

3. *Minouxia lobata* Gendrot, equatorial section, X60 (GA9c-3)

4,5. *Vandenbroekia munieri* Marie, axial sections, X30 (GA20b-2, GA5A3-13)

6. *Cyclogyra* sp., axial section, X60 (GA5d-7)

7. *Fissoelphidium operculiferum* Smout, axial section, X60 (GA14a-f)

8. *Fissoelphidium operculiferum* Smout, equatorial section, X60 (GA5A2-1)

9. *Sırtina orbitoidiformis* Brönnimann ve Wirtz, axial section, X60 (GA2b-1)

10. *Goupillaudina* sp., axial section, X100 (GA1b-f)

11. *Goupillaudina* sp., equatorial section, X100 (GA2A1-c)

12. *Omphalocyclus* sp., axial section, X20 (GA5A3-1)

PLATE-II

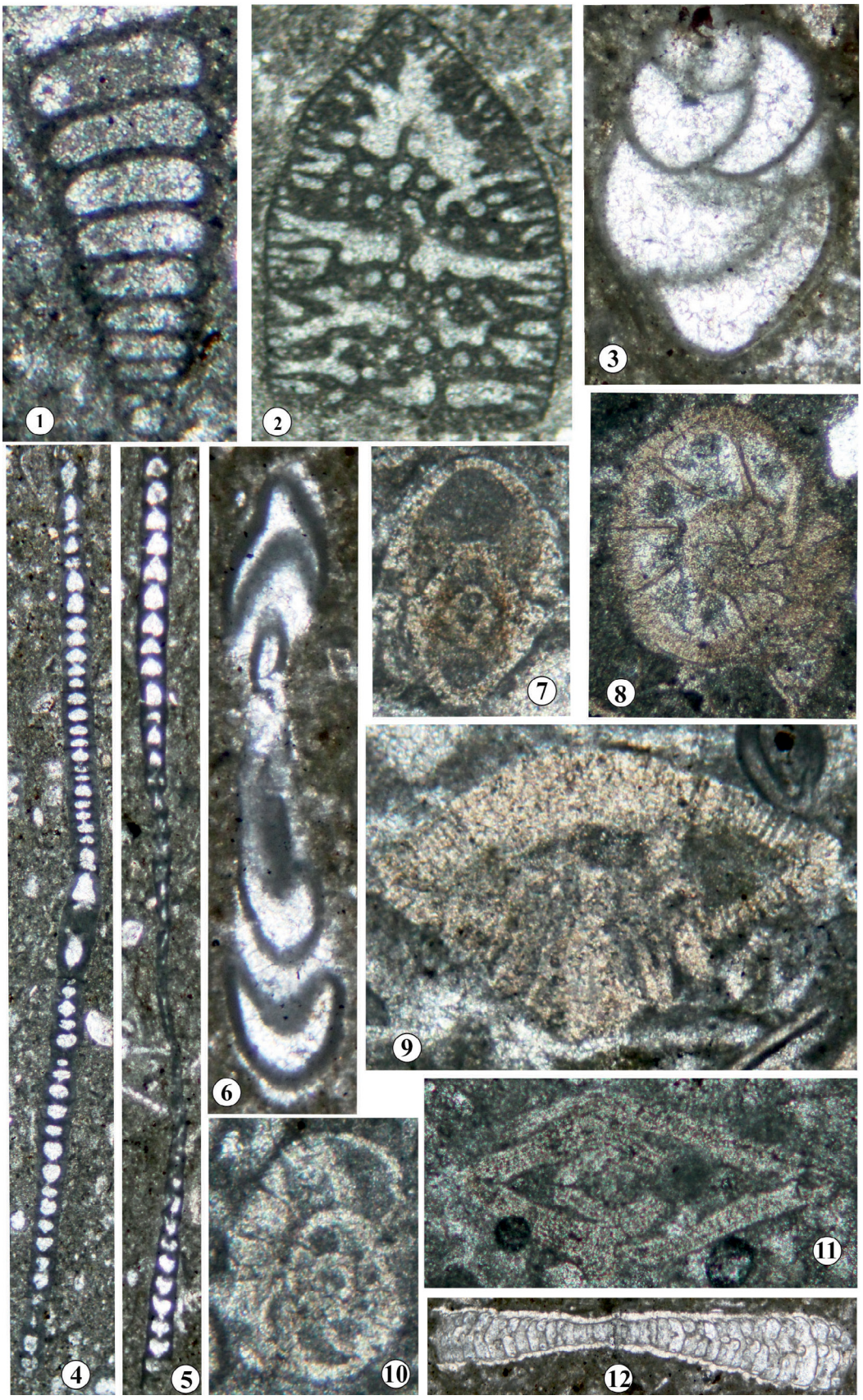

PLATE III

1,2. *Orbitoides media* (d'Archiac), equatorial sections, X20 (GA-Or-2)

3,4. *Orbitoides megaloformis* Papp ve Küpper, equatorial sections, X20 (GA-Or-9, GA-Or-15)

5,6. *Omphalocyclus anatoliensis* Özcan, equatorial sections, X20 (GA-Om-7, GA17b)

7. *Omphalocyclus* sp., axial section, X20 (GA5A3-11)

8,9. *Orbitoides* sp., axial sections, X20 (GA14b-b)

PLATE-III