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Systematics, biostratigraphy and paleoenvironmental investigation of early Ypresian *Alveolina* assemblages in the northern part of Isparta Angle (Keçiborlu, Isparta, SW Turkey)

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ABSTRACT

Thanetian-early Ypresian (middle Ilerdian) limestones from the northern part of Isparta Angle (Keçiborlu, Isparta, SW Turkey) contain rich benthic foraminiferal assemblage. Ilerdian beds of the Büyükkırtepe formation are characterized by high diversity of the following *Alveolina* species: *Alveolina (Glomalveolina) karsica, A. (G.)* aff. *karsica, A.(G.) lepidula, A.(G.)* cf. *subtilis, A. (Alveolina) aragonensis, A. (A.) cemali, A. (A.) corbarica, A. (A.)* cf. *coudurensis, A.(A.) decipiens, A.(A.) dedolia, A.(A.) ellipsoidalis, A.(A.) erki, A.(A.) guidonis, A.(A.)* cf. *ilerdensis, A.(A.) montanarii, A.(A.) moussoulensis, A.(A.) pasticillata, A.(A.) pisella, A.(A.) rotundata kazancii, A.(A.) trempina, A.(A.) varians,* and *A.(A.) vredenburgi*. In this study, 30 different Alveolina species including two new species and a new subspecies namely as *A. (A.) acari n.* sp., *A. (A.) ozbahcensis n.* sp., and *A.(A.) avsari fusunae n.* ssp. were identified for the first time. Besides, some probable new subspecies that were unnamed yet due to the insufficient number of individuals were also defined and proposed. Despite having close stratigraphic distributions with coeval assemblages described in different regions of Tethyan Province, *Alveolina* assemblages of the study area exhibit some stratigraphical range differences and present SBZ 3-SBZ 8 biozone intervals. The obtained data show that the study area was a lagoon to low energy shallow marine paleoenvironment with normal salinity in Thanetian – middle Ilerdian interval.

1. Introduction

Alveolinids are porcellaneous, planispirally coiled, involute larger benthic foraminifera, which frequently occur in the reef complexes and carbonates of restricted shelf environments throughout the Tethys (Hottinger, 1974). In the literature, it is seen that the highest species diversity of the alveolinid family, which range from Cretaceous to Recent, is in the genus *Alveolina* d'Orbigny. Numerous species of the genus *Alveolina* are index fossils representing of some of the shallow benthic foraminiferal biozones (Serra-Kiel et al., 1998) in Paleogene throughout Tethys. Since the shallow benthic zones (SBZ) introduced by Serra-Kiel et al. (1998), the updated taxonomic and biostratigraphic data for alveolinids, occurring in these zones, have been presented by many researchers along the Tethyan Belt (White, 1992; Sirel, 2003; Özgen-Erdem et al., 2007; Vecchio et al., 2007; Sirel and Acar, 2008; Scheibner and Speijer, 2009; Drobne et al., 2011; Sirel et al., 2013; Fornaciari et al., 2019; Hadi et al., 2019; 2020).

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The study area is located in the Isparta Angle (Figure 1). This angle in the SW Turkey is one of the most significant regions in Turkey in terms of tectonic development and has been the subject to the regional and structural geology studies (Blumenthal, 1947; Gutnic et al., 1979; Koçyiğit, 1983; Poisson et al., 1984; Waldron, 1984; Yalçınkaya et al., 1986; Karaman, 1990; 1994; 2000; Görmüş and Özkul, 1995; Akıncı et al., 2003; Nemec et al., 2017). A chronological review of these studies has been given by Robertson et al. (2003) in detail. Paleontological studies on the other hand are restricted by small number of thesis (e.g. Özkan, 1991; Köse-Yeşilot, 2000; Yüzgül, 2016) and articles (e.g. Sirel and Acar, 1982; Yıldız and Toker, 1991; Görmüş and Karaman, 1992; Görmüş and Nielsen, 2006; Sagular and Görmüş, 2006; Akkiraz et al., 2011; Bozkurt and Görmüş, 2019; Bozkurt et al., 2021). In the Isparta region where the study area is also located, there are no detailed studies on alveolinids especially regarding their biostratigraphy except for Sirel and Acar (1982), Bozkurt and Görmüş (2019) and Bozkurt et al. (2021).

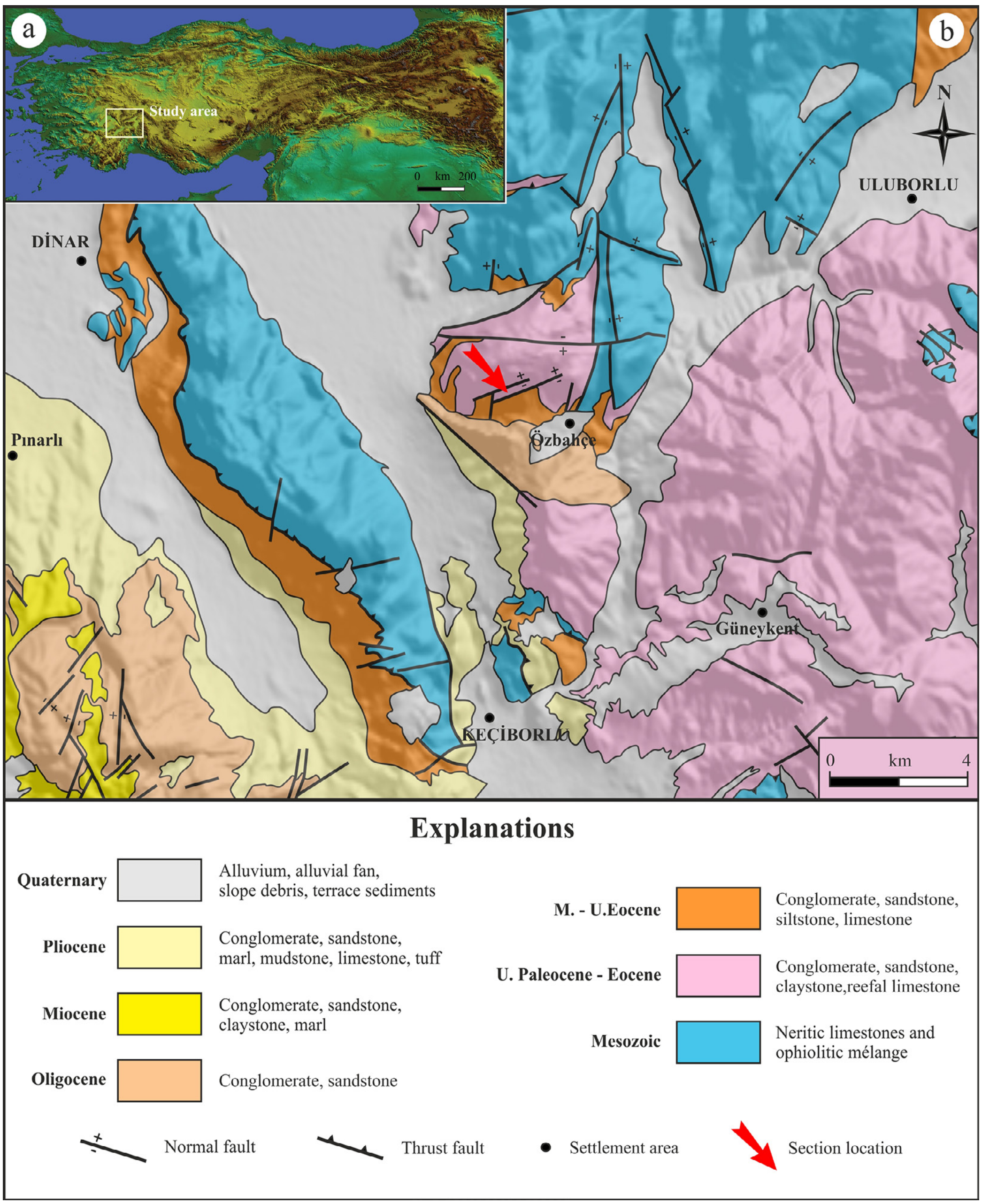

Figure 1- a) Location of study area on the 90 m resolution SRTM image of Turkey (Jarvis et al., 2008) and b) geological map (simplified from Balcı, 2011 and Şenel, 1997).

In this study, alveolinid taxomony and biostratigraphy of Thanetian-early Ypresian units outcropping in the north of the Özbahçe village (Keçiborlu, Isparta) on the 1/25.000 scale Afyon L24-c4 map sheet were studied. The determined assemblage was also compared with coeval assemblages described in different regions of the Tethyan Province. With the results obtained in this study, an abundant early Ypresian alveolinid assemblage was identified. New species and subspecies of the genus *Alveolina* were introduced from the assemblage of which systematic and biometric features were presented in detail. Considering the benthic foraminiferal assemblages of the study area and their characteristics, paleoenvironmental interpretations of the stratigraphic levels were discussed. In addition, the missing points in the paleogeographic development models of the region were tried to be enlightened with the obtained biostratigraphic data and the paleoenvironmental interpretations.

2. Material and Method

The studies were carried out in the Büyükkırtepe formation outcrops including rich alveolinids from the north of Özbahçe village, north of Keçiborlu (Isparta) (Figure 1). It was difficult and impossible to get free alveolinid tests due to the formation lithology. The formation is composed of hard limestones. So all the oriented thin sections were prepared from hard rocks. Detailed descriptions of the preparation of oriented thin sections from hard rocks were given by Acar (2019*a*), and the similar methods were followed in this study. The ways to be followed in the preparation of thin sections of *Alveolina* species are presented in figure 2. In the preparation of the oriented thin sections, first of all, the hard rock sample taken from the field was cut along the number 1 and 2 horizontal and vertical planes in order to see the general orientation of the alveolinids in the rock (Figure 2a). Later, slabs were cut from the rocks sample in parallel with the surfaces where the axial and subaxial alveolinid sections were commonly observed as shown in the figure 2b, and individuals on the slabs were separated by cutting (individual locations are shown in figure 2b with red dashed lines). The chips containing clear and apparent individuals were selected for grinding. In cases where the coiling axis of the individual and the chip surface are parallel to the each other, the grinding process was made along the chip surface (Figure 2c). In the case

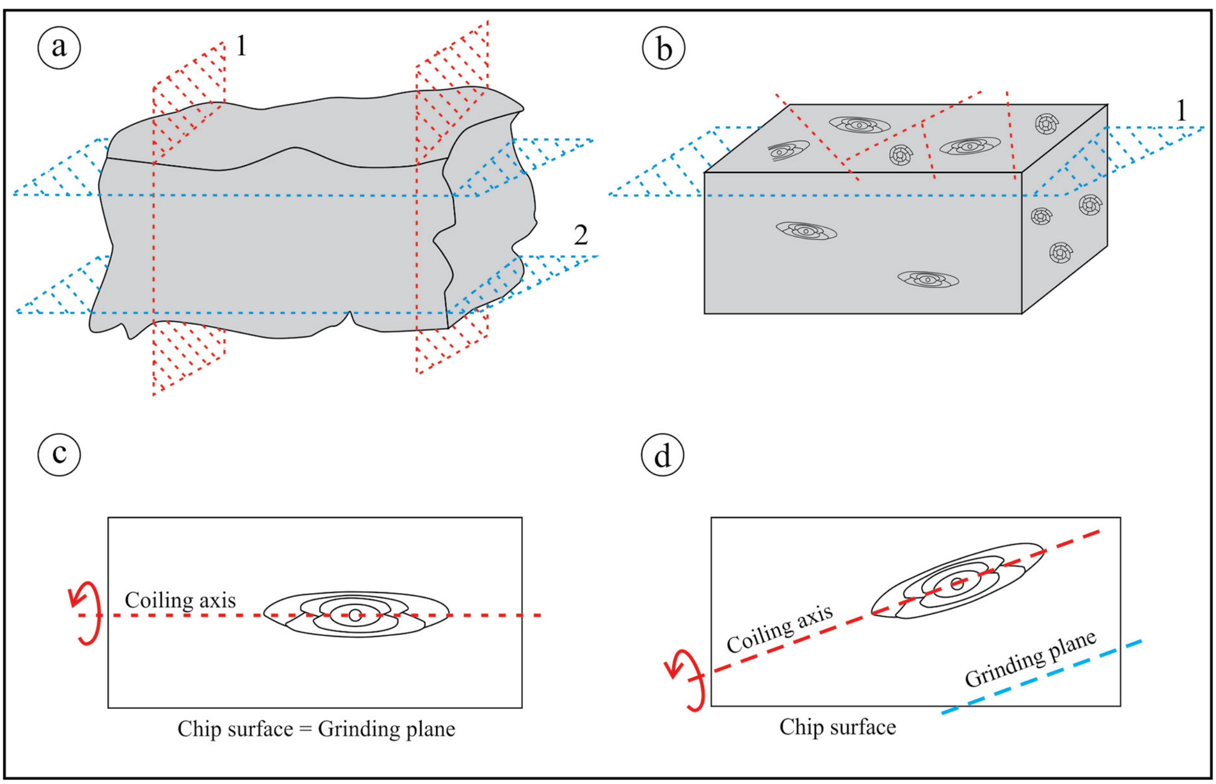

Figure 2- Schematic views showing the stages of oriented thin section preparation from the hard rock samples in the identification of *Alveolina* (see the text for process details, the figures are in hand sample size and not to scale).

of a certain angle being present between the coiling axis and chip surface, the grinding was performed by directing the chip to be parallel to the coiling axis (Figure 2d). The axial section plane obtained by completing the orientation was glued on the slide, the excess parts were grinded and thin section process was completed.

Total of 13 hard rock samples were taken from the Özbahçe measured stratigraphic section. Of these examples, a total of 232 thin sections, 201 of which were oriented, were prepared. Examinations of the foraminifers in thin sections were made under stereo microscope, and the microphotographs and biometric measurements were made in the laboratories of General Directorate of Mineral Research and Exploration (MTA) using the Leica MZ 16 A model research microscope in digital environment.

While preparing comparison graphics of biometric data for new species with other species, the values of the known species include only holotype and (if present) paratype data. The comparison graphics were prepared on the basis of number of whorls vs. index of elongation and the number of whorls vs. parameter C_n. The elongation index is the value, expressing a specific measure belonging to the test, obtained by dividing the axial diameter to the equatorial diameter in alveolinids (Hottinger, 1974; figure 3). White (1992) considered the greatest value of the axial thickening measured in the axial plane of alveolinid specimens as the Parameter C. From this point, the Parameter C_n was defined in this study in order to observe the changes of this parameter during all stages of ontogeny and make comparison among the species, instead of regarding only the greatest value of the axial thickening. Here, the "n" refers to the order of the whorls after proloculus (Figure 3).

Thin sections used in this study are deposited in the General Directorate of Mineral Research and Exploration (MTA).

3. Stratigraphy

Pre-Cenozoic rocks outcropping in the study area and its close vicinity located in northern part of the Isparta Angle in the Taurus Belt are; the Mesozoic carbonates of the Lycian Nappes and of Anamas-Akseki Autochthonous, and the ophiolitic melange of the Marmaris Ophiolitic Nappe (Figure 1). Paleogene sediments overlying these basement rocks are widespread between Keçiborlu and Uluborlu, and they contain formations developed in different environments (Gutnic et al., 1979; Karaman et al., 1988; Görmüş and Özkul, 1995; Karaman, 2000; Nemec et al., 2017). Upper Paleocene - Eocene sediments consist of calcarenites, neritic limestones and flyschodial rock groups. This rock asslemblage was called in different names in the literature, depending on their facies and lithological characteristics and on the basement rocks they cover, as Isparta Flysch (Gutnic et al., 1979), Koçtepe formation (Sarıiz, 1985), Kızılkırma formation (Karaman et al., 1988), Söbütepe formation (Yalçınkaya et al., 1986), Büyükkırtepe formation (Öztürk and Öztürk, 1989). The carbonate beds which are abundant in *Alveolina* in the study area and constitute the subject of this investigation, were

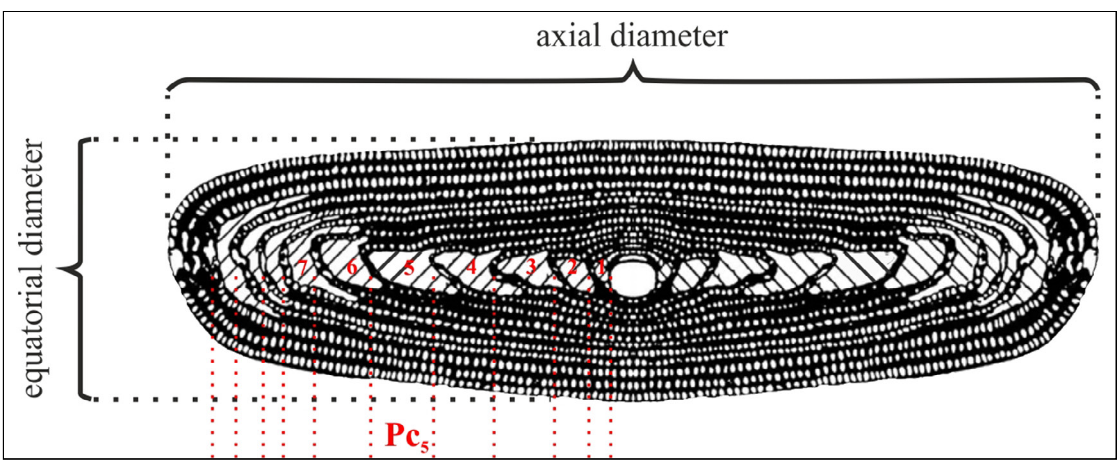

Figure 3- Illustration of axial and equatorial diameters used on determining the elongation index, and Parameter C_n (Pc_5 is the axial thickening for the 5th whorl, where n=5) (modified from White, 1992).

named as the Büyükkırtepe formation (Öztürk and Öztürk, 1989) (Figure 4).

Büyükkırtepe formation was named after the Büyükkırtepe Hill, which is located in north of the Karabedir village at 15 kilometers north of the study area, in the study carried out by Öztürk and Öztürk (1989) around Balçıkhisar-Karadilli (Afyonkarahisar) -Dereköy (Isparta). The formation crops out in northern parts of the study area located on the southern slopes of Tekke Hill and the heights named as Tekke Hill and Çağıllınıbaşı Hill in 1 / 25.000 scale L24-c4 sheet, including also the television transmitter (Figure 5). The formation, which begins with thick bedded and brecciated nummulitic limestones in the Büyükkır Hill (the type locality) at the bottom, continues with brecciated biosparites, passes into biomicrites in the upper levels and ends with clayey biomicrites (Öztürk and Öztürk, 1989). The unit, which is rarely observed as thin-bedded, consists of limestones with bedding thicknesses ranging generally from 20-30 cm to 1-2 m (Figure 4). Due to the fact that there is a large amount of lichen on the limestone surface in some parts of the outcrops and their effect on the rock texture, they exhibit a massive, very thick-bedded appearance. It is generally in white or gray colored on weathered surfaces and light beige to white color on fresh surfaces. Thin to medium calcarenite interlayers containing abundant *Nummulites* fossils are yellowish gray in color. Limestones are occasionally saccaroid-textured and marble-like. Fault and joint systems are much developed and there are joint systems that cut the stratification in different directions (Figure 4). Pelagic deposits of the Büyükkırtepe formation, which are mostly represented by the platform carbonates, have been examined by some researchers as member (Öztürk and Öztürk, 1989: Kaklıktepe member). The Büyükkırtepe formation, which presents limited spread, has a thickness of 50-175 m (Öztürk and Öztürk, 1989).

Büyükkırtepe formation can be correlated with Tekke member of the Yukarıtırtar formation defined by Koçyiğit (1980) in north of the Hoyran Lake and

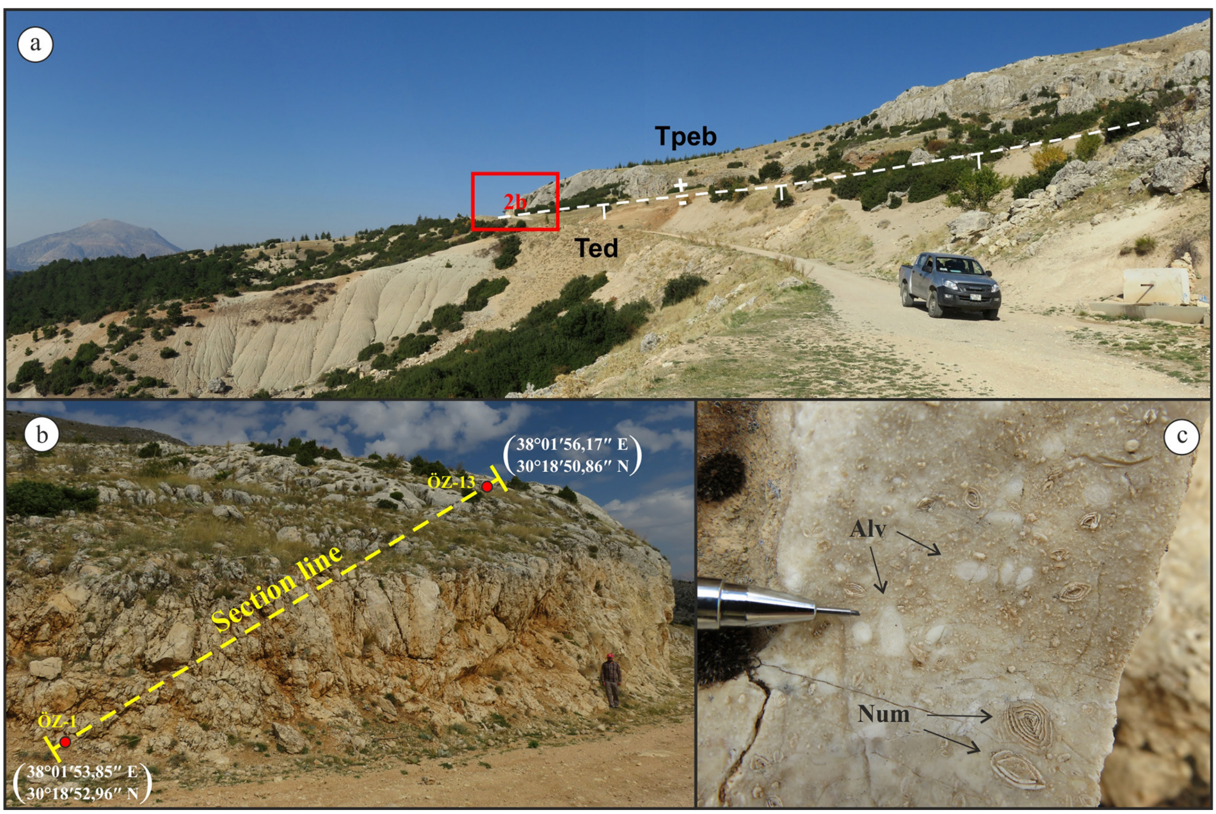

Figure 4- a) General view of the Büyükkırtepe formation (looking from SE to NW, Tpeb: Büyükkırtepe formation, Ted: middle-upper Eocene deposits). Outcrop of limestones in northwest of the Özbahçe village (Keçiborlu, Isparta), b) limestone outcrop from which the Özbahçe measured section was taken (looking from NW to SE) and c) their close up views (Alv: *Alveolina* sp., Num: *Nummulites* sp.).

neritic levels of the Kızılkırma formation defined by Karaman et al. (1988). Söbütepe formation, which was defined by Yalçınkaya et al. (1986) in a wide region including also the study area, is equivalent in age and lithology with the Büyükkırtepe formation. Büyükkırtepe formation can be assessed as the time-equivalent of basin interior deposits defined as the Koçtepe formation by Nemec et al. (2017) (W. Nemec, personal communication, 20th November 2019). The lithological and faunal characteristics of the unit indicate different environments ranging from lagoon to shelf environment.

Büyükkırtepe formation is laterally and vertically transitional with middle-upper Eocene flysch like sediments. These deposits of the Dereköy formation, which were defined by Koçyiğit (1980) from the Senirkent-Uluborlu region, have been revealed as being laterally and vertically transitional with upper Paleocene-Eocene deposits in the related literature (Koçyiğit, 1983; Öztürk and Öztürk, 1989; Görmüş and Özkul, 1995; Balcı, 2011). These deposits were named as the "Isparta Flysch" by Gutnic et al. (1979) and as the "Kayıköy formation" by Karaman (1994, 2000) in Isparta region. The siliciclastics of the Dereköy formation, which is stratigraphically located above, moved downward with dip slip normal faults in the study area (Figure 5). It is seen that the faults are almost vertical.

The Oligocene consists of shelf deposits with molasse character including terrestrial intervals (Şenel, 1997). The Miocene, represented by shallow shelf deposits (Şenel, 1997) and the Pliocene, represented by lacustrine (Şenel, 1997) and fluvial (Öztürk and Öztürk, 1989), constitute the Neogene sediments in the vicinity of the study area. The youngest sediments in the region are Quaternary alluvium, alluvial fan, slope debris and terrace sediments.

4. Özbahçe Measured Stratigraphic Section

Özbahçe measured section was taken from approximately 2 km northwest of the Özbahçe village in 1/25000 scale Afyon L24-c4 sheet in north of Keçiborlu (Isparta) (Figure 1). The section was

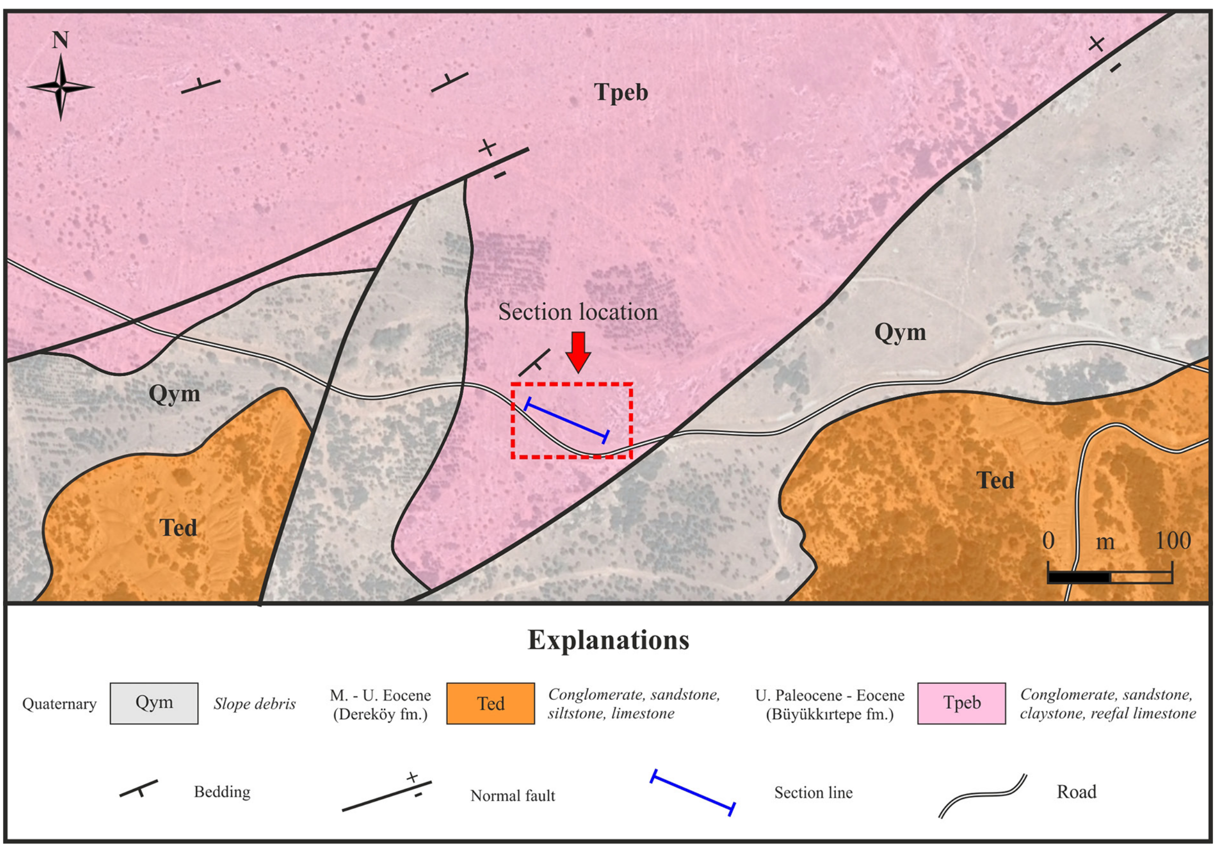

Figure 5- Geological map of the Özbahçe section and surroundings overlain on Google Earth image.

measured from 24.5 m thick part of the sequence between the coordinates of 38°01′53.85″ E - 30°18′52.96″ N and 38°01′56.17″ E - 30°18′50.86″ N, and the detailed studies were carried out on 13 limestone samples taken from the section.

It is observed that the Büyükkırtepe formation, which is frequently cut by normal faults, is also affected by reverse faults depending on tectonic development processes of the region. Likewise, the same stratigraphic levels were observed to be repeated within 24.5 m thickness in the section.

The foraminiferal assemblages of the sequence, which show a tectonostratigraphic structure in the study area, were evaluated by considering biostratigraphic principles. The distribution of foraminifers described throughout the section is given in figure 6. According to the evaluations made in this direction, the lower parts of the sequence (4.70 m) contain a foraminiferal assemblage of Thanetian age. Only one specimen of *Alveolina* (*Glomalveolina*) sp. was observed at this level, which is very poor in terms of *Alveolina* species. From these levels of the sequence, *Elazigina dienii, Idalina causae, I. sinjarica, Ranikothalia* sp., *Rotalia* sp., *Sistanites catali*, S. cf. *guvenci*, *S. iranicus, Sistanites* sp., *Socotraella*? sp. were also determined.

Lower Ilerdian levels, corresponding to a very low thickness (0.60 m) in the sequence, begin with the occurrence of *Alveolina* (*Alveolina*) *vredenburgi* and *A*. (*A.*) *varians*. Another species, *A. (G.) karsica*, which is another species representing early Ilerdian, appears for the first time at these levels. Besides, *A. (G.)* aff. *karsica*, *A. (G.)* cf. *subtilis, A. (A.) acari* n.sp., A. (A.) cf. *coudurensis, A. (A.) erki, A. (A.) moussoulensis, A. (A.) ozbahcensis* n.sp., *A. (A.) rugosa* ssp1 species were identified from these levels. This alveolinid assemblage is accompanied by such foraminifers as *Assilina* sp., *Discocyclina* sp., *Nummulites* sp., *Orbitolites* sp., *Ranikothalia* cf. *nuttalli*, *Ranikothalia* cf. *polatliensis*, *Rotalia* sp.

Middle Ilerdian, which represents the thickest part of the sequence (19,20 m), begins with the first appearance of *A. (A.) aragonensis, A. (A.) decipiens, A. (A.) dedolia, A. (A.) montanarii*. Apart from these, *A. (G.) karsica, A. (G.) lepidula, A. (A.) acari, A. (A.) avsari fusunaee* n.ssp., *A. (A.) baldaccii* ssp1, *A. (A.) cemali, A. (A.) corbarica, A. (A.)* cf. *coudurensis, A. (A.) ellipsoidalis, A. (A.) erki, A. (A.) guidonis, A. (A.)* cf. *ilerdenensis, A. (A.) montanarii* ssp1, *A. (A.) moussoulensis, A. (A.) muscatensis* ssp1, *A. (A.) ozbahcensis* n.sp., *A. (A.) pasticillata, A. (A.) pisella, A. (A.) rotundata kazancii, A. (A.) trempina, A. (A.) varians* were determined. This alveolinid assemblage is accompanied by foraminifers such as; *Assilina* sp., *Asterocyclina* sp., *Discocyclina* sp., *Elazigina* cf. *subsphaerica, Elazigina* sp., *Nummulites* sp., *Operculina* sp., *Opertorbitolites latimarginalis, Opertorbitolites* sp., *Orbitolites bellus, Orbitolites* cf. *complanatus, Orbitolites* cf. *megasphericus, Orbitolites* sp., *Ornatorotalia granum, Ranikothalia* cf. *nuttalli, Ranikothalia* sp., *Rotalia* sp., *Slovenites*? sp., *Sphaerogypsina* sp., gypsinid and stomatorbinid forms. *A. (A.) corbarica* and *A. (A.) trempina* species to appear as together in a sample taken from a section of 1,00 m corresponding to the top parts of the sequence, indicates that this level could probably be in the middle Ilerdian-upper Ilerdian transition.

5. Taxonomy of Alveolinids

In this section, the taxonomic criteria given by Hottinger (1960), Loeblich and Tappan (1987), Boudagher-Fadel (2008, 2018), Acar (2019*b*), Roskov et al. (2019) have been used. Taxa are presented in the alphabetical order. The ranges of species are given together with their corresponding shallow benthic zones (SBZ: Serra-Kiel et al., 1998). In this study, SBZ 3 and 4 zones, SBZ 5 and 6 zones, and SBZ 7 and 8 zones are presented by being merged due to coexistence of some index taxa representing these zones. The faunal assemblage accompanying each species is given in figure 6.

Phylum: Foraminifera D'ORBIGNY, 1826

Class: Tubothalamea PAWLOWSKI, HOLZMANN and TYSZKA, 2013

Order: Miliolida DELAGE AND HÉROUARD, 1896

Suborder: Miliolina DELAGE AND HÉROUARD, 1896

Superfamily: Alveolinoidea EHRENBERG, 1839

Family: Alveolinidae EHRENBERG, 1839

Genus: *Alveolina* D'ORBIGNY, 1826

Subgenus: (*Alveolina*) *Glomalveolina* HOTTINGER, 1960

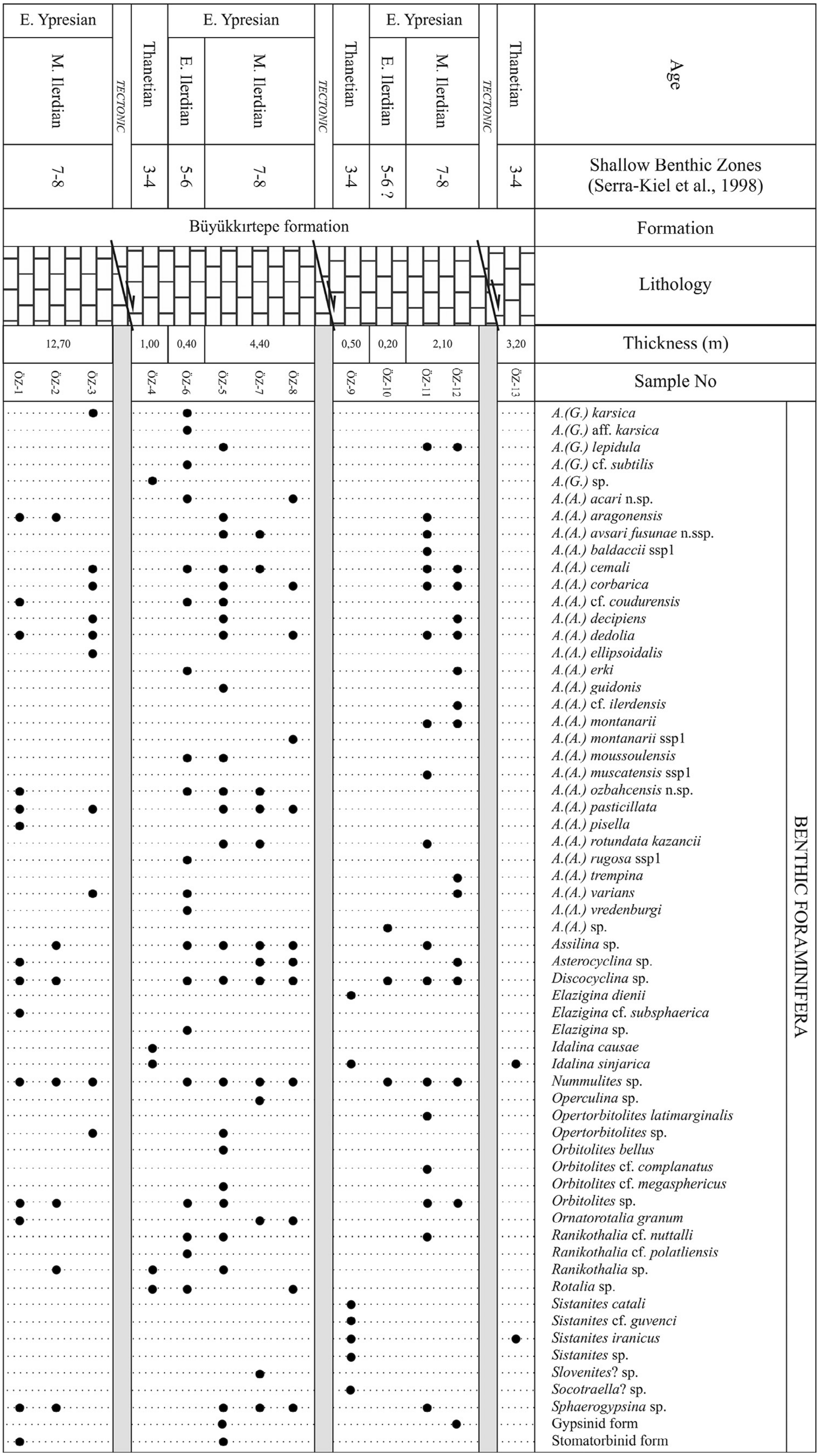

Figure 6- Foraminiferal distributions of the Özbahçe section.

Type species: *Alveolina dachelensis* SCHWAGER, 1883

***Alveolina (Glomalveolina) karsica* SİREL, 1998**

(Plate I, figure 4)

1998 *Alveolina (Glomalveolina) karsica* SİREL, pl.30, figs. 7-8; pl. 31, figs. 6, 7, 11.

2007 *Glomalveolina karsica* SİREL. ÖZGEN-ERDEM et al., p. 916, figs. 5b-c.

2008 *Glomalveolina karsica* (SİREL). SİREL and ACAR, pl.2, figs. 5-6, 8-9.

2008 *Glomalveolina karsica* SİREL. ÖZGEN-ERDEM, pl.I, fig. 8.

2019 *Alveolina (Glomalveolina) karsica* SİREL. BOZKURT and GÖRMÜŞ, pl.1, fig.5.

Material: 2 specimens representing the species were determined throughout the section (ÖZ-3, ÖZ-6).

Description: Test is small and subspherical. The axial and equatorial diameters are in the range of 0.54 - 0.67 mm and 0.44 - 0.61 mm, respectively. It has an elongation index of 1.10 - 1.23 and the proloculus is very small (0.02 mm). In two streptospiral cycles following the proloculus, there are undivided chambers in accordance with the characteristic feature of the subgenus *Glomalveolina*. In the following whorls, chambers are divided and consist of many spherical - subspherical chamberlets. Thickness of the basal layer and the chamber height increase gradually towards the outer whorls.

Range: A. (G.) karsica was found in the early - middle Ilerdian (SBZ 5-8) levels of the Özbahçe section. Sirel (1998) described this species in the Ilerdian of Kars region, and Özgen-Erdem et al. (2007) described it in the early Ilerdian of Eskişehir region. In addition, Özgen-Erdem (2008) described the same species in the middle Ilerdian of Kastamonu region.

***Alveolina (Glomalveolina)* aff. *karsica* SİREL, 1998**

(Plate I, figure 2)

1998 *Alveolina (Glomalveolina)* aff. *karsica* SİREL, pl.31, figs. 9, 10, 12.

2008 *Glomalveolina* aff. *karsica* (SİREL). SİREL and ACAR, pl.2, figs. 10-12.

Material: 1 specimen representing the species was identififed throughout the section (ÖZ-6).

Description: In the obtained specimen, test is small and nautiloid. The axial and equatorial diameters are 0.76 mm and 0.86 mm, respectively. It has an elongation index of 0.88. It has 3-4 streptospiral cycles following the very small proloculus. In the following whorls, the coarse chamberlets are observed. The heights of spherical to subspherical chamberlets rapidly increase towards outer whorls. They are elongated in the outer whorls. The chamberlet height in the 6th whorl following the streptospiral cycles, reaches approximately twice the size of the first divided chamber.

Remarks: The specimen presents similar biometric and morphological features with *A. (G.)* aff. *karsica* described by Sirel (1998) and Sirel and Acar (2008), and it is distinguished from *A. (G.) karsica* by its large size, nautiloid shape, and the size and shape of the chamberlets.

Range: *A. (G.)* aff. *karsica* was found in the early Ilerdian (SBZ 5-6) levels of the Özbahçe section. This species was found at the same stratigraphic levels in Kars region (Sirel, 1998; Sirel and Acar, 2008).

***Alveolina (Glomalveolina) lepidula* (SCHWAGER), 1883**

(Plate I, figure 5)

1883 *Alveolina ellipsoidalis* SCHWAGER var. *lepidula* SCHWAGER, p.98, pl.25, figs. 3a-g.

1960 *Alveolina (Glomalveolina) lepidula* (SCHWAGER). HOTTINGER, pl.1, fig. 27.

2007 *Glomalveolina lepidula* (SCHWAGER). ÖZGEN-ERDEM et al., p. 916, fig. 5a.

2008 *Glomalveolina lepidula* SCHWAGER. ÖZGEN-ERDEM, pl.I, fig. 7.

2009 *Glomalveolina pilula / lepidula* SCHWAGER. SCHEIBNER AND SPEIJER, p. 210, fig. 11f.

2019 *Alveolina (Glomalveolina) lepidula* (SCHWAGER). BOZKURT and GÖRMÜŞ, pl.1, fig. 4.

Material: 4 specimens representing the species were identififed throughout the section (ÖZ-5, ÖZ-11, ÖZ-12).

Description: Test is small and varies from spherical to oval. In oval forms, the poles are rounded. The axial and equatorial diameters are in the range of 1.00 - 1.32 mm and 0.75 - 1.24 mm, respectively. It has an elongation index of 1.06 - 1.33. The proloculus is very small (the largest diameter is 0.05mm). It has 3 streptospiral cycles following the proloculus. 4-5 whorls following those cycles constitu the adult stage. In this stage, cross-sections of the chamberlets are circular or tooth-shaped and their heights increase towards the outer whorls. Significant thickening in basal layer and loose coiling are observed in the last 2 or 3 whorls that constitute the senile stage. While the heights of the chamberlets increase further, their corss-sections change from circular to rectangular.

Range: *A. (G.) lepidula* was found in the middle Ilerdian (SBZ 7-8) levels of the Özbahçe section. The stratigraphic distribution of this species corresponds to the distribution given by Serra-Kiel et al. (1998). In addition, the presence of this species in the early - middle Cuisian (late Ypresian) in Niğde region was reported by Sirel and Acar (2008).

Alveolina (Glomalveolina) cf. _subtilis_ HOTTINGER, 1960

(Plate I, figure 3)

Material: 1 specimen representing the species was identifed throughout the section (ÖZ-6).

Description: Test is small, oval with pointed poles. Towards the ultimate whorls, this acuteness decreases. The axial and equatorial diameters are 1.06 mm and 0.68 mm, respectively. It has an elongation index of 1.56. Although the proloculus does not seem very clear in the only specimen obtained, it is probably very small. There are at least 2 or 3 streptospiral cycles after the proloculus. In the following 8 whorls, the heights of chamberlets progressively increase towards the outer whorls. Cross-section of chamberlets are circular throughout the ontogeny. Thickening of the basal layer in the axial direction is more than it is in the equatorial direction and increases gradually.

Remarks: The fact that this specimen, whose proloculus cannot be clearly observed, belongs to the microspheric generation, makes it much smaller in size than *A. (G.) subtilis* of which its holotype is megalospheric. This species, which is smaller in size than *A. (G.) subtilis* in the present case, is considered different because of its smaller size than *A. (G.) subtilis*, was first described by Hottinger (1960).

Range: *A. (G.)* cf. *subtilis* was found in the early Ilerdian (SBZ 5-6) levels of the Özbahçe section. The stratigraphic distribution of this species is similar to the distribution given by Hottinger (1960) for *A. (G.) subtilis*.

Alveolina (Glomalveolina) sp.

(Plate I, figure 1)

Material: 1 specimen representing the species was identifed throughout the section (ÖZ-4).

Description: Test is small, slightly nautiloid. For the single specimen obtained, the axial and equatorial diameters are 0.84 mm and 0.88 mm, respectively. The elongation index is 0.95. It is remarkable that the specimen whose juvenile stage cannot be seen clearly, has coarse chamberlets in 3-4 whorls of the adult stage. The basal layer is thick in the equatorial direction. The chamberlets are slightly depressed and subspherical.

Remarks: The biometric and morphological features observed in the single specimen obtained indicate that this species may belong to *A. (G.) primaeva* group (Hottinger, 1974). The foraminiferal assemblage that accompanies the specimen also supports this possibility.

Range: A. (G.) sp. was found in the Thanetian (SBZ 3-4) levels of the Özbahçe section.

Subgenus: *Alveolina* D'ORBIGNY, 1826

Type species: *Oryzaria boscii* DEFRANCE in BRONN, 1825

Alveolina (Alveolina) acari n.sp.

(Plate II, figures 1-5)

Derivation of name: This species is dedicated to Dr. Şükrü Acar (MTA) who has made important contributions to the subject of Cenozoic benthic foraminifers, particularly the alveolinids.

Material: 8 specimens representing the species were identifed throughout the section (ÖZ-6, ÖZ-8).

Holotype: Axial section of megalospheric specimen, illustrated by plate II, figure 1.

Type locality: Limestones outcropping approximately in 2 km NW of Özbahçe village, north of Keçiborlu (Isparta) (between the coordinates of 38°01′53,85″ E - 30°18′52,96″ N and 38°01′56,17″ E - 30°18′50,86″ N).

Type level: Büyükkırtepe formation, early - middle Ilerdian (SBZ 5-8). The section between 13,70 m and 18,50 m of the Özbahçe measured section.

Diagnosis: Small to medium megalospheric test is elongated and oval. The poles are rounded. In megalospheric specimens, the axial and equatorial diameters are in the range of 3.72 - 6.84 mm, and 1.58 - 3.64 mm, respectively. Total of 14 whorls of coiling is observed in a specimen with the axial diameter reaching 6,84 mm. The elongation index is between 1.76 and 2.35. The spherical proloculus is large and has a diameter of 0.24 to 0.38 mm. Following the proloculus, it has 2 or 3 tightly coiled whorls of juvenile stage. This is followed by 3 to 5 whorls, which suddenly thicken in the axial direction but not in the equatorial direction. No axial thickening is observed in the senile stage. In juvenile and adult stages, the chamberlets with circular cross-sections become rectangular and larger in the senile stage. In the first two stages, the chamberlet heights increase regularly. Thickness of the basal layer does not exceed half of the chamber height during ontogeny (except for one specimen). Microspheric specimens could not be obtained.

Differential diagnosis: This new species differs from the coeval *Alveolina* species by their size and type of coiling. The new species, showing similarities with *A. (A.) haymanaensis* in terms of Parameter C and morphology, is distinguished by its smaller size, higher elongation index and smaller proloculus (Figures 7a, d). It differs in that there is no thickening of basal layer in the equatorial direction and it is found in lower stratigraphic levels. It differs from *A. (A.) sakaryaensis* with its higher elongation index, smaller proloculus and that there is no thickening in the basal layer in the equatorial direction (Figure 7b). It is also different from the latter in terms of the course of Parameter C in juvenile and adult stages (Figure 7e). The new species, having similarities with *A. (A.) tumida* in terms of the course of elongation indices throughout the ontogeny (Figure 7c), is different with the fact that it reaches the same whorl number in a larger test and has a larger proloculus. The axial thickening in *A. (A.) tumida* increases gradually until senile age and never reaches the exaggerated dimensions and remains constant in the last whorls (Figure 7f). The new species differs from *A. (A.) tumida* with its axial thickening progressing differently at different stages of ontogeny (Figure 7f).

Range: The new *A. (A.) acari* was found in the early - middle Ilerdian (SBZ 5-8) levels of the Özbahçe section.

Alveolina (Alveolina) aragonensis HOTTINGER, 1960

(Plate I, figure 8)

1960 *Alveolina aragonensis* HOTTINGER, pl.6, figs. 5-8.

1978 *Fasciolites (Fasciolites) fornasinii* (CHECCHIA-RISPOLI). GAEMERS, pl.4, fig. 5.

2005 *Alveolina aragonensis* HOTTINGER. ÖZGEN-ERDEM et al., p. 413, fig. 10g.

2007 *Alveolina aragonensis* HOTTINGER. ÖZGEN-ERDEM et al., p. 917, fig. 6e.

2008 *Alveolina aragonensis* HOTTINGER. ÖZGEN-ERDEM, pl.II, fig. 2.

2008 *Alveolina aragonensis* HOTTINGER. SİREL and ACAR, pl.25, figs. 1-4.

2011 *Alveolina aragonensis* HOTTINGER. DROBNE et al., p.747, pl.1.

Material: 4 specimens representing the species were identififed throughout the section (ÖZ-1, ÖZ-2, ÖZ-5, ÖZ-11).

Description: Small sized megalospheric test ranges from subspherical to oval. It is slightly depressed at the poles. In megalospheric specimens, the axial and equatorial diameters are in the range of 2.32 - 4.58 mm and 1.50 - 2.83 mm, respectively. The elongation index ranges from 1.20 to 1.62 and the diameter of the proloculus is in the range of 0.34 - 0.46 mm. The first 2 or 3 whorls following the proloculus are slightly tightly coiled. The next 3-4 whorls are loosely coiled,

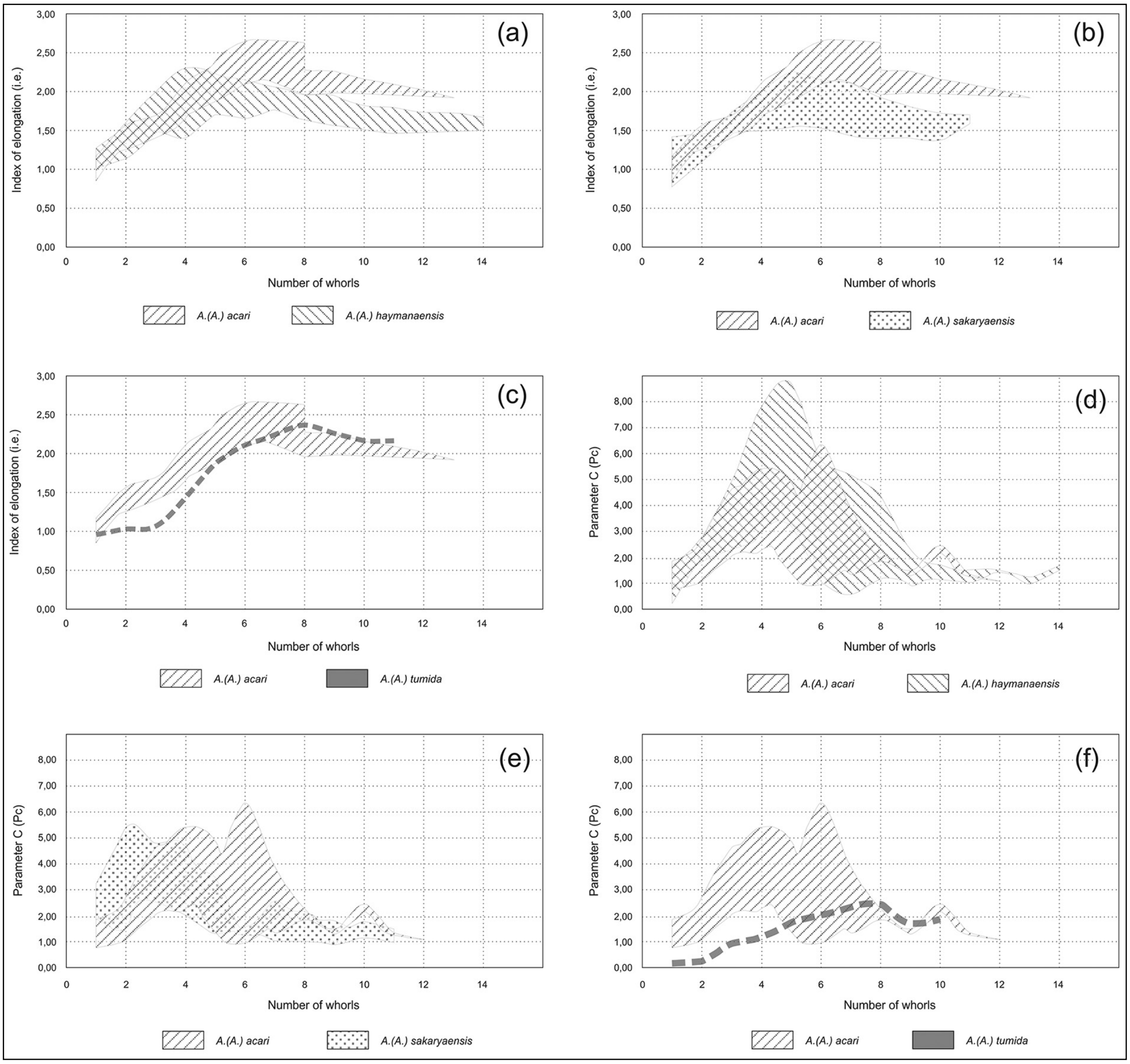

Figure 7- Number of whorls vs. elongation index comparison plots of *A. (A.) acari* n.sp. with a) *A. (A.) haymanaensis*, b) *A. (A.) sakaryaensis* and c) *A. (A.) tumida*; and the number of whorls vs Parameter C comparison plots of *A. (A.) acari* with d) *A. (A.) haymanaensis*, e) *A. (A.) sakaryaensis* f) *A. (A.) tumida*.

and the following 3-5 whorls become tightly coiled again. While the cross-sections of chamberlets change from circular to rectangular from inner to outer whorls, their heights also increase in the same direction. Microspheric specimens could not be obtained.

Range: A. (A.) aragonensis was found in the middle Ilerdian (SBZ 7-8) levels of the Özbahçe section corresponding to the distribution given by Hottinger (1960) and Serra-Kiel et al. (1998). On the other hand, Özgen-Erdem et al. (2007) reported that the distribution of this species in the Eskişehir region was from middle Ilerdian to late Ilerdian (SBZ 7-9).

Alveolina (Alveolina) avsari SİREL and ACAR *fusunae* n.ssp.

(Plate III, figures 6-7)

Derivation of name: This species is dedicated to valuable scientist Prof. Dr. Füsun Alkaya (Selçuk University) who contributed to the geology of Turkey with her studies on ammonites and the geologists she educated.

Material: 3 specimens representing the species were identified throughout the section (ÖZ-5, ÖZ-7, ÖZ-11).

Holotype: Axial section of megalospheric specimen illustrated by plate III, figure 6.

Type locality: Limestones outcropping appoximately at 2 km northwest of the Özbahçe village, north of Keçiborlu (Isparta) (between the coordinates of 38°01′53,85″ E - 30°18′52,96″ N and 38°01′56,17″ E - 30°18′50,86″ N).

Type level: Büyükkırtepe formation, middle Ilerdian (SBZ 7-8). The sections of the Özbahçe measured section between 14,10 m and 18,50 m and between 19,20 m and 21,30 m.

Diagnosis: Small to medium sized megalospheric test is subspherical. In megalospheric specimens, the axial and equatorial diameters were measured as 2.58 - 3.44 mm, 2.25 - 2.96 mm, respectively. The elongation index is between 1.15 - 1.24 and the proloculus has a large diameter between 0.22 - 0.52 mm. There is no distinct juvenile stage following the proloculus. During 2 whorls after the first 2 whorls, weak flosculinization develops. Thickening of basal layer in the axial direction is more than that it is in the equatorial direction. Depending on this, the test is slightly elongated. Flosculinization is not observed during the next 3-5 whorls. The chamberlets are slightly depressed at the beginning. The chamberlets with circular cross-sections in the flosculinized stage are elongated in the last whorls and have a rectangular shape. Microspheric specimens could not be obtained.

Differential diagnosis: The new subspecies differ from *A. (A.) avsari* with its coarser inner structure and larger proloculus. While 9 whorls are observed in the test of *A. (A.) avsari* that has an axial diameter of 2,65 mm, the new subspecies have only 6 whorls at the same axial diameter. *A. (A.) avsari* never shows axial thickening throughout ontogeny, yet the new subspecies typically has axial thickening in 2 whorls following the juvenile stage.

Range: A. (A.) avsari fusunae n.ssp. was found in the middle Ilerdian (SBZ 7-8) levels of the Özbahçe section.

Alveolina (Alveolina) baldaccii CHECCHIA and RISPOLI ssp1

(Plate I, figure 9)

Material: 1 specimen representing the species was identified throughout the section (ÖZ-11).

Diagnosis: Megalospheric test is small, subspherical to slightly oval. The axial and equatorial diameters of the single megalospheric specimen are 3.54 mm and 2.96 mm, respectively. The elongation index is 1.20. The diameter of the proloculus is 0.14 mm. The next 5 whorls after the flexostyle following the proloculus are tightly coiled. During these whorls that constitute the juvenile stage, the test is developed in oval shape. Following this, weak flosculinization is observed during 2-3 whorls. At this stage, the thickness of the basal layer reaches approximately 3 times of the height of the chamberlet. The next 8-9 whorls are loosely coiled and in this stage thickness of the basal layer and the chamberlet heights are almost. In juvenile stage, the spherical chamberlets are very small. While sizes of the chamberlets increase regularly in advanced stages of ontogeny, their cross-sections are rectangular in the senile stage.

Differential diagnosis: This potential new subspecies is distinguished from *A. (A.) baldaccii* with its weaker flosculinization, smaller chamberlets in the senile stage and accordingly, having more number of whorls in the same sized test.

Remarks: Acar (1995) described *A. (A.) dageri* as a new species, as he was probably not aware of existence of species *A. (A.) baldaccii*. Sirel and Acar (2008) acknowledged the same specimens as a subspecies of *A. (A.) blumenthali* considering their anatomical similarities. As *A. (A.) dageri* ACAR and *A. (A.) blumenthali dageri* SİREL and ACAR are anatomically and biometrically the same, they are junior synonyms of *A. (A.) baldaccii* and are invalid according to the rules of International Commision on Zoological Nomenclature (ICZN). Our specimen, which is most probably a new subspecies, is left to be named in future studies due to the insufficient number of individuals.

Range: *A. (A.) baldaccii* ssp1 was found in the middle Ilerdian (SBZ 7-8) levels of the Özbahçe section.

Alveolina (Alveolina) cemali SİREL and ACAR, 2008

(Plate I figures 6-7)

1978 *Fasciolites (Fasciolites) fornasinii* (CHECCHIA-RISPOLI). GAEMERS, pl.4, fig. 6.

1995 *Alveolina (Alveolina)* aff. *pisella* DROBNE, n.sp., ACAR, pl.22, fig. 6.

2008 *Alveolina cemali* SİREL and ACAR, pl.20, figs. 1-8.

Material: 8 specimens representing the species were identified throughout the section (ÖZ-3, ÖZ-5, ÖZ-6, ÖZ-7, ÖZ-11, ÖZ-12).

Description: Test is small and spherical to subspherical. In megalospheric specimens, the axial and equatorial diameters were measured as 1.62 - 3.32 mm and 1.28 - 2.90 mm, respectively. It has an elongation index of 1.04 - 1.41. The diameter of the proloculus is in the range of 0.16 - 0.32 mm. 2 or 3 whorls following the proloculus form a slightly tightly coiled juvenile stage. While the dimensions of spherical chamberlets increase regularly towards the outer whorls, their shapes change from spherical to rectangular. In microspheric specimens, the axial and equatorial diameters are between 4.40 - 4.74 mm and 4.02 - 4.06 mm, respectively. It has an elongation index of 1.09 - 1.17. All other features are similar to megalospheric specimens and reflect the characteristics of the species.

Range: A. (A.) cemali was found in the early - middle Ilerdian (SBZ 5-8) levels of the Özbahçe section. The stratigraphic distribution of this species is given as the upper part of the early Ilerdian and the lower parts of the middle Ilerdian (SBZ 6-7) by Sirel and Acar (2008).

Alveolina (Alveolina) corbarica HOTTINGER, 1960

(Plate IV, figures 4-5)

1960 *Alveolina corbarica* HOTTINGER, pl.2, figs. 20-24.

1995 *Alveolina (Alveolina) corbarica* HOTTINGER. ACAR, pl.18, figs. 1-4.

2005 *Alveolina corbarica* HOTTINGER. ÖZGEN-ERDEM et al., p. 413, fig. 10h.

2008 *Alveolina corbarica* HOTTINGER. ÖZGEN-ERDEM, pl.I, fig. 11.

2008 *Alveolina corbarica* HOTTINGER. SİREL and ACAR, pl.38, figs. 1-7.

Material: 5 specimens representing the species were identified throughout the section (ÖZ-3, ÖZ-5, ÖZ-8, ÖZ-11, ÖZ-12).

Description: Elongated, slightly fusiform shaped megalospheric test is small. In megalospheric specimens, the axial and equatorial diameters are in the range of 2.72 - 4.48 mm and 0.98 - 1.50 mm, respectively. It has an elongation index of 2.23 - 3.02 and the diameter of the proloculus is in the range of 0.36 - 0.38 mm. Its growth stages are indistinctly delimited. After the subspherical first whorl following the proloculus, a regular axial thickening develops. However, thickening in basal layer is not observed in the equatorial direction. The chamber connections at the poles may be truncated or slightly rounded. Chamberlets have circular cross-sections throughout ontogeny, and their sizes slightly increase from inner to outer whorls. Microspheric specimens could not be obtained.

Range: A. (A.) corbarica was found in the middle Ilerdian (SBZ 7-8) levels of the Özbahçe section. The range of species, which was given as the upper part of middle Ilerdian (SBZ 8) by Hottinger (1960) and Serra-Kiel et al. (1998), was found in the middle Ilerdian (SBZ 7-8) by Sirel and Acar (2008) in Ankara and Kayseri regions. This species was recorded in Tibet from SBZ 8 (BouDagher-Fadel et al, 2015).

Alveolina (Alveolina) cf. *coudurensis* HOTTINGER, 1960

(Plate IV, figure 7)

Material: 3 specimens representing the species were identified throughout the section (ÖZ-1, ÖZ-5, ÖZ-6).

Description: Megalospheric test is elongated, subcylindrical and small sized. In megalospheric specimens, the axial and equatorial diameters are in the range of 2.30 - 4.32 mm and 0.76 - 1.24 mm, respectively. It has an elongation index of 2.72 - 3.48. In descriptions made on the subaxial sections of the megalospheric specimens, the boundaries of the proloculus could not be seen clearly. It is observed that the species, which do not have any tightly coiled juvenile stage after the proloculus, rapidly thickens in axial and equatorial directions. The thickening in axial direction is twice that it is in the equatorial direction. The chamber connections at the poles are rounded or truncated. Spherical chamberlets are depressed in stages where thickening in basal layer is present, and their size increase slightly from inner to outer whorls. Microspheric specimens could not be obtained.

Remarks: This species, which is similar to *A. (A.) coudurensis* in terms of coiling type and general morphology defined by Hottinger (1960), offers much smaller equatorial diameters in the same number of whorls though it reaches the similar axial diameter. Therefore, it has a higher elongation index compared to *A. (A.) coudurensis*. In addition, *A. (A.) coudurensis* occurs in younger levels than this species does in terms of the stratigraphic distribution (Hottinger, 1960).

Range: A. (A.) cf. *coudurensis* was found in the early - middle Ilerdian (SBZ 5-8) levels of the Özbahçe section. The stratigraphic distribution of *A. (A.) coudurensis* was given as late Ilerdian - early Cuisian by Hottinger (1960).

***Alveolina (Alveolina) decipiens* SCHWAGER, 1883**

(Plate I, figure 10)

1883 *Alveolina decipiens* SCHWAGER, p.98, pl.26 (3), fig. 1.

1960 *Alveolina decipiens* SCHWAGER. HOTTINGER, pl.8, figs. 1-4, 6, 8.

1977 *Alveolina (Alveolina) decipiens* SCHWAGER. DROBNE, p.35, text-fig. 17; pl.5, fig. 20.

1995 *Alveolina (Alveolina) decipiens* SCHWAGER. ACAR, pl.16, fig. 3.

2007 *Alveolina decipiens* SCHWAGER. ÖZGEN-ERDEM et al., p. 916, fig. 5a.

Material: 3 specimens representing the species were identified throughout the section (ÖZ-3, ÖZ-5, ÖZ-12).

Description: Megalospheric test is subcylindrical and small sized. The largest axial and equatorial diameters measured in megalospheric specimens are 2.84 mm and 1.46 mm, respectively. The elongation index is 1.95 and the diameter of the spherical proloculus is 0,20 mm. The species, having indistinctively delimited growth stages, 1 or 2 chambers following the proloculus are relatively tightly coiled. In the following chambers, thickening in basal layer develops in both axial and equatorial directions. The axial thickening is more than it is in the equatorial direction. At the poles, the chamber connections can occasionally be seen as depressed. The cross-sections of chamberlets are circular and could occasionally be seen as slightly flattened in the flosculinized stage. Their dimensions gradually increase. Microspheric specimens could not be obtained.

Range: A. (A.) decipiens were found in the middle Ilerdian (SBZ 7-8) levels of the Özbahçe section corresponding to the distributions given by Hottinger (1960) and Serra-Kiel et al. (1998). *A. (A.) decipiens* was also idetified in the late Ilerdian of Eskişehir by Özgen-Erdem et al. (2007).

***Alveolina (Alveolina) dedolia* DROBNE, 1977**

(Plate IV, figure 11)

1977 *Alveolina (Alveolina) dedolia* DROBNE, pl.5, figs. 9-11.

2007 *Alveolina dedolia* DORBNE. ÖZGEN-ERDEM et al., p. 917, figs. 5c-d.

Material: 8 specimens representing the species were identified throughout the section (ÖZ-1, ÖZ-3, ÖZ-5, ÖZ-8, ÖZ-11, ÖZ-12).

Description: Megalospheric test is spherical to subspherical and small sized. In megalospheric specimens, the axial and equatorial diameters range from 2.14 to 3.18 mm and 1.84 to 2.70 mm, respectively. The elongation index is between 1.02 - 1.34 and the diameter of the spherical proloculus ranges between 0,16 - 0,20 mm. The test poles are mostly rounded and rarely truncated. 3-4 whorls after the proloculus is tightly coiled. In these whorls, forming the juvenile stage, the chamberlets are quite small in size and have circular section. In the following whorls, the thickening in the basal layer develops both in axial and equatorial direction. The basal layer thickness is very close in both axial and equatorial directions. The chamberlets in this stage are spherical and sometimes tooth-shaped (downward oval) at the begining; and rectangular in the last few whorls. Microspheric specimens could not be obtained.

Range: A. (A.) dedolia was found in the middle Ilerdian (SBZ 7-8) levels of the Özbahçe section. The stratigraphic distribution of this species was given as the lower part of the middle Ilerdian (*Alveolina moussoulensis* zone, SBZ 7) by Drobne (1977) and Serra-Kiel et al. (1998). On the other hand, Özgen-Erdem et al. (2007) described this species from the upper part of the early Ilerdian and lower part of middle Ilerdian (SBZ 6-7) in Eskişehir.

Alveolina (Alveolina) ellipsoidalis SCHWAGER, 1883

(Plate IV, figure 10)

1883 *Alveolina ellipsoidalis* SCHWAGER, pl.25 (2), figs. 1-2.

1960 *Alveolina ellipsoidalis* SCHWAGER. HOTTINGER, pl.2, figs. 1-8.

1995 *Alveolina (Alveolina) ellipsoidalis* SCHWAGER. ACAR, pl.5, figs. 1-4; pl.6, figs. 1-2; pl.7, fig. 1.

2007 *Alveolina ellipsoidalis* SCHWAGER. ÖZGEN-ERDEM et al., p. 916, figs. 5e-f.

2007 *Alveolina ellipsoidalis* SCHWAGER. VECCHIO et al., p.29, pl.1, figs. 1-2.

2008 *Alveolina ellipsoidalis* SCHWAGER. SİREL and ACAR, pl.32, figs. 1-6; pl.33, figs. 1-3.

Material: 5 specimens representing the species were identified throughout the section (ÖZ-3).

Description: Megalospheric test is oval and small sized. In megalospheric specimens, the axial and equatorial diameters range from 2.42 to 4.26 mm and 1.66 to 3.34 mm, respectively. The elongation index ranges from 1.25 to 1.49 and the diameter of the spherical proloculus is between 0.10 - 0.32 mm. 3-4 whorls following the proloculus are tightly coiled. The test rapidly becomes oval after the first 1 to 2 whorls of spherical shaped. The poles can be acute or rounded. Chamberlets have circular cross-sections throughout all growth stages, and their sizes regularly increase. In the whorls following the juvenile stage, a slight axial thickening is observed. The absence of thickening in the equatorial direction in similar whorls leads the test to elongate in the axial direction. Microspheric specimens could not be obtained.

Range: A. (A.) ellipsoidalis was found in the middle Ilerdian (SBZ 7-8) levels of the Özbahçe section. Although this species was defined as index species for the upper part of the early Ilerdian (SBZ 6) by Serra-Kiel et al. (1998); it has been reported from a wider range. This species has been found in the early-middle Ilerdian levels by Özgen-Erdem (2008) in Kastamonu and Özgen-Erdem et al. (2007) in Eskişehir region, in the early-late Ilerdian levels by Acar (1995) and Sirel and Acar (2008) in Ankara, and in the middle Ilerdian levels by Hadi et al. (2019) in the Elburz (Iran) region. *A.*(*A.*) *ellipsoidalis* appear at the top latest SBZ 6, Pb 5, in Tibet (BouDagher-Fadel et al, 2015).

Alveolina (Alveolina) erki ACAR, 1995

(Plate III, figure 8)

1995 *Alveolina (Alveolina) erki* ACAR, pl.3, figs. 10-13.

2008 *Alveolina erki* ACAR. SİREL and ACAR, pl.36, figs. 1-3.

2008 *Alveolina erki* ACAR. ÖZGEN-ERDEM, pl.1, fig. 9.

Material: 2 specimens representing the species were identified throughout the section (ÖZ-6, ÖZ-12).

Description: Megalospheric test is oval and small. In megalospheric specimens, the axial and equatorial diameters were measured as 1.58 - 1.80 mm and 0.84 - 1.08 mm, respectivley. The elongation index is between 1.67 and 1.88 and the diameter of the spherical proloculus is 0.30 mm. Following the proloculus, 1-2 whorls are tightly coiled. While a rapid axial thickening along the subsequent chambers are observed, no thickening is observed in the equatorial direction. The poles can be acute or rounded, and chamberlets are spherical and slightly increase in length towards the outer whorls. In some individuals, the sizes of chamberlets increase irregularly. Microspheric specimens could not be obtained.

Range: A. (A.) erki was found in the early-middle Ilerdian (SBZ 5-8) levels of the Özbahçe section. The stratigraphic distribution of this species was given as middle Ilerdian-early Cuisian by Acar (1995). In addition, this species was reported from the middle Ilerdian of Kastamonu region by Özgen-Erdem (2008), and from the earliest Ilerdian to late Ilerdian (SBZ 5 to 9) of Kayseri and Ankara regions by Sirel and Acar (2008).

Alveolina (Alveolina) guidonis DROBNE, 1977

(Plate V, figure 4)

1977 *Alveolina (Alveolina) guidonis* DROBNE, pl.15, figs. 6-12.

2011 *Alveolina guidonis* DROBNE, DROBNE et al., p.747, pl.1.

Material: 2 specimens representing the species were identified throughout the section (ÖZ-5).

Description: Megalospheric test is oval and small sized. Based on two oblique axial sections obtained, axial and equatorial diameters of the megalospheric specimens vary between 2.80 - 3.18 mm and 1.44 - 1.86 mm, respectively. The elongation index varies between 1.71 - 1.94. The diameter of the subspherical prolocus is 0.36 - 0.52 mm. The size of divided chambers following the proloculus and chamberlets in these chambers increase regularly. There is no distinct juvenile stage. After the proloculus, a regular axial thickening is observed and this increase is regular. The poles are rounded. The chamberlets are spherical in the early stages, and in the following stages, they become upright oval with an increase in their heights towards outer whorls. Microspheric specimens could not be obtained.

Range: A. (A.) guidonis was found in the middle Ilerdian (SBZ 7-8) levels of the Özbahçe section corresponding to the stratigraphic distribution given by Drobne (1977). However, Serra-Kiel et al. (1998) suggest the upper part of the middle Ilerdian and late Ilerdian levels (SBZ 8-9) as the stratigraphic interval for this species. Also, the specimens that Hadi et al. (2019) identified as *A.(A.)* gr. *guidonis* are quite similar to the holotype of *A. (A.) guidonis* in terms of biometry and morphology, and were found in the middle Ilerdian (SBZ 8).

***Alveolina (Alveolina)* cf. *ilerdensis* HOTTINGER, 1960**

(Plate IV, figure 9)

Material: 1 specimen representing the species was identified throughout the section (ÖZ-12).

Description: Megalospheric test is elongated, oval and small sized. According to the descriptions made based on the almost axial section of only megalospheric specimen obtained, the axial and equatorial diameters are 2.36 mm and 1.18 mm, respectively. The elongation index is 2.00 and the diameter of the subspherical proloculus is approximately 0.16 mm. There are two tightly coiled whorls following the proloculus. Due to the axial thickening following these chambers, the test becomes oval in shape. The poles are rounded. The whorls that axial thickening is observed, are loosely coiled in the equatorial direction. Chamberlets are spherical and very thin in all stages. Their dimensions slightly increase towards the outer whorls. Microspheric specimens could not be obtained.

Remarks: The obtained specimen presents morphological and biometric similarities with original species described by Hottinger (1960). The specimen, which may be a young form of *A. (A.) ilerdensis,* is described in this format as it was not well preserved.

Range: A. (A.) cf. *ilerdensis* was found in the middle Ilerdian (SBZ 7-8) levels of the Özbahçe section. The stratigraphic distribution of *A. (A.) ilerdensis* was given as the middle-late Ilerdian by Hottinger (1960) and Serra-Kiel et al. (1998).

***Alveolina (Alveolina) montanarii* DROBNE, 1977**

(Plate V, figures 3,5)

1977 *Alveolina (Alveolina) montanarii* DROBNE, p.29, text-figs. 12a-c; pl.4, figs. 19-24.

1995 *Alveolina (Alveolina) montanarii* DROBNE. ACAR, pl.14, figs. 4-7.

2008 *Alveolina montanarii* DROBNE. SİREL and ACAR, pl.5, figs. 1-3.

Material: 4 specimens representing the species were identified throughout the section (ÖZ-11, ÖZ-12).

Description: Megalospheric test is spherical to subspherical and small sized. In megalospheric specimens, the axial and equatorial diameters are 2.40 to 3.64 mm and 1.94 to 3.38 mm, respectively. The elongation index is between 1.08 to 1.31 and the diameter of spherical proloculus is between 0.12 to 0.16 mm. After the proloculus, 4 to 6 whorls are tightly coiled. During the following 1.5 to 2 whorls, flosculinization occurs. In this stage of *A. (A.) montanarii*, which exhibits heavy flosculinization, thickness of the basal layer reaches 6-7 times the height of the chamber. Although the basal layer thickness has significantly decreased after the flosculinized stage, it is still not tightly coiled. Generally, a slight increase in the dimensions of spherical chamberlets is observed towards the outer whorls. In the flosculinized stage, the chamberlets are slightly depressed. In advanced specimens that have many whorls belonging to the senile stage, the chamberlets are elongated and become rectangular in the last whorls. Microspheric specimens could not be obtained.

Range: A. (A.) montanarii was found in the middle Ilerdian (SBZ 7-8) levels of the Özbahçe section. The stratigraphic distribution of this species was determined as middle Ilerdian by Drobne (1977) and as middle-late Ilerdian (SBZ 7-9) by Serra-Kiel et al. (1998).

Alveolina (Alveolina) montanarii DROBNE ssp1

(Plate V, figure 2)

Material: 1 specimen representing the species was identified throughout the section (ÖZ-8).

Diagnosis: Test is small and subspherical. The axial and equatorial diameters of the only individual obtained are 1.78 mm and 1.50 mm, respectively. The elongation index is 1.19. The very small, spherical proloculus has a diameter of 0.04 mm. The first whorls of the specimen, whose embryonic stage cannot be clearly observed, seems to be arranged in milioline-way. Considering the dimensions of the proloculus and the appearance of the embryonic stage, our specimen may belong to the microspheric generation. Following the complex inner whorls, which probably arranged in milioline manner, 6 tightly coiled whorls containing divided chambers are observed. During the next two whorls after these, flosculinization occurs. In the flosculinized stage, thickness of the basal layer reaches 4-5 times the chamber height. There is no senile stage observed in the single specimen obtained. Size of the chamberlets with circular sections increase regularly. Chamberlets may occasionally appear as depressed in the flosculinized stage.

Differential diagnosis: The examined specimen reaches the same number of whorls in much smaller test as it has a chamber height lower than *A. (A.) montanarii*. Our specimen, which exhibit very close characteristics with *A. (A.) montanarii* in terms of morphological features and the development of growth stages, indicates that it might be a new subspecies due to occurring in the same stratigraphic levels with *A. (A.) montanarii*. It is left to be named in future studies due to the insufficient number of individuals.

Range: A. (A.) montanarii ssp1 was found in the middle Ilerdian (SBZ 7-8) levels of the Özbahçe section.

Alveolina (Alveolina) moussoulensis HOTTINGER, 1960

(Plate V, figure 1)

1960 *Alveolina moussoulensis* HOTTINGER, pl.2, fig. 10-16.

1964 *Alveolina moussoulensis* HOTTINGER. DEVOTO, pl.II, fig. 3.

1977 *Alveolina moussoulensis* HOTTINGER. DROBNE, pl.1, figs. 4-8.

2008 *Alveolina moussoulensis* HOTTINGER. SİREL and ACAR, pl.28, fig. 1.

2019 *Alveolina moussoulensis* HOTTINGER. HADI et al., p. 145, fig. 4.7.

Material: 5 specimens representing the species were identified throughout the section (ÖZ-5, ÖZ-6).

Description: Megalospheric test is elongated oval and medium sized. In megalospheric speciemens, the axial and equatorial diameters are 3.94 - 6.12 mm and 2.42 to 3.31 mm, respectivley. The elongation index ranges from 1.34 to 1.89 and the diameter of the spherical proluculus varies from 0.14 to 0.32 mm. The test poles are usually rounded, sometimes acute. After the proloculus 2-3 whorls are tightly coiled and are in spherical pattern. Throughout the following 7 to 8 whorls, the axial thickening and accordingly, the oval test shape develops. No thickening in the basal layer is observed in the equatorial direction. There is no axial thickening in the last 4 to 5 whorls. At this stage, the poles sometimes depressed. Chamberlets have circular cross-sections in the inner whorls. Their size increases gradually towards the outer whorls and they become rectangular in shape. Microspheric specimens could not be obtained.

Range: A. (A.) moussoulensis was found in the early - middle Ilerdian (SBZ 5-8) levels of the Özbahçe section. The stratigraphic distribution of this species was given as middle Ilerdian *(A. moussoulensis zone*) by Hottinger (1960). Serra-Kiel et al. (1998) defined this species as index species for SBZ 7 in the middle Ilerdian. In Tibet, *A.*(*A.*) *moussoulensis* is recorded from SBZ 7 to SBZ 9 (BouDagher-Fadel et al., 2015).

Alveolina (Alveolina) muscatensis WHITE ssp1

(Plate III, figure 5)

Material: 1 specimen representing the species was identified throughout the section (ÖZ-11).

Diagnosis: Small test is oval shaped. The axial and equatorial diameters of the single specimen obtained are 1.90 mm and 1.34 mm, respectively. The index of elongation is 1.42. The initial whorls of the specimen whose embryonic stage and the proloculus can not be clearly observed seem to be arranged in a milioline manner. In this regard, the specimen probably belongs to the microspheric generation. After the inner chambers (possibly not divided into chamberlets), tightly coiled 4-5 whorls that have divided chambers are observed. Throughout the 3 whorls following these whorls, there is a significant axial thickening, while a loose coiling is observed in equatorial direction. There is no senile stage in only specimen obtained. The sizes of the chamberlets, which are generally circular in cross-section, increase regularly towards the outer whorls. Chamberlets in the polar region of last few whorls are tooth-shaped (downward oval).

Differential diagnosis: The examined specimen differs from *A. (A.) muscatensis* by having a lower chamber height, thus reaching the same number of whorls in a smaller test. It offers similarities with *A. (A.) muscatensis* in terms of morphological features, elongation index and development of growth stages.

Remarks: Our specimen presents morphological and biometric similarities with *A. (A.) muscatensis* which is defined by White (1992) from the early Eocene of Oman. For this species, White (1992) stated that it would not be older than *A. dainellii* zone and refers to an age of Cuisian. The same species was defined by Özgen-Erdem et al. (2007) in Cuisian of the Eskişehir region and by Özcan et al. (2015) in the middle Ilerdian (SBZ 7-8) of Oman. Our specimen found in the middle Ilerdian of Özbahçe section probably points to a new subspecies considering the morphological similarities and biometric comparison with *A. (A.) muscatensis*. It is left to be named in future studies due to the insufficient number of individuals.

Range: A. (A.) muscatensis ssp1 was found in the middle Ilerdian (SBZ 7-8) levels of the Özbahçe section.

Alveolina (Alveolina) ozbahcensis n.sp.

(Plate III, figures 1-4)

Derivation of name: Özbahçe is a village located in the north of Keçiborlu (Isparta).

Material: 9 specimens representing the species were identified throughout the section (ÖZ-5, ÖZ-6, ÖZ-7).

Holotype: Axial section of megalospheric specimen, illustrated by plate III, figure 1.

Type locality: Limestones outcropping at nearly 2 km northwest of the Özbahçe village in north of Keçiborlu (Isparta) (between the coordinates of 38°01′53,85″ E - 30°18′52,96″ N and 38°01′56,17″ E - 30°18′50,86″ N).

Type level: Büyükkırtepe formation, early - middle Ilerdian (SBZ 5-8). The section between 13,70 m and 18,50 m of the Özbahçe measured section.

Diagnosis: Small to medium megalospheric test is elongated and oval. The poles are rounded. In megalospheric specimens, the axial and equatorial diameters are in the range of 2.62 - 5.68 mm and 1.58 - 3.22 mm, respectivley. An adult individual with a maximum axial diameter of 5.68 mm has 11 whorls. The elongation index is between 1.41 - 1.9 and the diameter of the spherical - subspherical proloculus varies between 0.22 - 0.48 mm. There are 2 or 3 spherical to subspherical whorls following the large proloculus of the species, which has no discernible juvenile stage. Subsequent whorls grow regularly in axial and equatorial directions. The basal layer gradually thickens in both directions. However, the thickening in the axial direction is larger than in the equatorial direction. Thickness of the basal layer reaches at maximum half of the chamber height in the equatorial direction, while reaching twice in axial direction. Chamberlets with circular cross-section become elongated in the last 1 or 2 whorls and have rectangular shape. Chamberlets are coarse throughout the ontogeny, and septa are very thin. Microspheric specimens could not be obtained.

Differential diagnosis: This new species shows similarities with *A. (A.) aragonensis* among coeval alveolinids and differs from the latter by its greater elongation index and indistinctly delimited juvenile stage. Unlike *A. (A.) aragonensis*, the growth steps in the new species are gradual (Figure 8a, d). The new species, showing similar ontogenic development with *A. (A.) guidonis*, differs from this species by its size and Parameter C (Figure 8e). It reaches 1.5 times the size of test in the same whorl number. While test size for 11 whorls is 3 mm in *A. (A.) guidonis*, this value in the new species is 4.7 mm. The elongation indices also differ between the two species (Figure 8b). While the index of elongation is 1.7 to 2.0 for *A. (A.) guidonis*; it varies between 1.4 and 1.9 for new species. The new species which show similaties with *A. (A.) moussoulensis* in terms of elongation index and shape, is distinguished from the latter with the trend of chamberlet size throughout ontogeny, absence of discernable juvenile-adult-senile stages and course of Parameter C (Figure 8c, f).

Remarks: Although it shows similarities with *A. (A.) guidonis* in terms of development of growth stages and morphology, *A. (A.) ozbahcensis* n.sp. is found in relatively older stratigraphic levels. In this context, it could be inferred that these two species may belong to the same phylogenetic lineage.

Range: A. (A.) ozbahcensis n.sp. was found in the early - middle Ilerdian (SBZ 5-8) levels of the Özbahçe section.

***Alveolina (Alveolina) pasticillata* SCHWAGER, 1881**

(Plate IV, figure 6)

1883 *Alveolina (Flosculina) pasticillata* SCHWAGER, pl.26 (3), figs. 2a,b.

1960 *Alveolina pasticillata* SCHWAGER. HOTTINGER, pl.4, figs. 26-33.

1977 *Alveolina (Alveolina) pasticillata* SCHWAGER. DROBNE, pl.4, figs. 1-7.

1992 *Alveolina (Alveolina) pasticillata* SCHWAGER. WHITE, p. 57, pl.2, fig. 11.

2008 *Alveolina pasticillata* SCHWAGER. SİREL and ACAR, pl.5, figs. 4-5.

2011 *Alveolina pasticillata* SCHWAGER. DROBNE et al., p.747, pl.1.

Material: 5 specimens representing the species were identified throughout the section (ÖZ-5, ÖZ-7, ÖZ-8).

Description: In megalospheric specimens, test is spherical to subspherical and small sized. The axial and equatorial diameters range from 1.92 to 3.68 mm and 1.62 to 3.40 mm, respectively. The elongation index is between 1.08 to 1.22 and the diameter of tiny proloculus is between 0.04 to 0.06 mm. Tightly coiled 4-5 whorls following the proloculus constitute juvenile stage and are in inflated lenticular-pattern. During the next 2 to 3 species, flosculinization occurs. In this stage, thickness of the basal layer increases towards the outer whorls and it reaches 8 times the chamberlet height in the thickest whorl. In the senile stage following the flosculinized stage, tightly coiled 4-5 whorls are observed. Chamberlets are spherical in the juvenile stage, while they are quite flattened in the flosculinized stage. In the senile stage, the chamberlet height increases and becomes slightly rectangular. Microspheric specimens could not be obtained.

Range: A. (A.) pasticillata was found in the middle Ilerdian (SBZ 7-8) levels of the Özbahçe section. Stratigraphic distribution of this species was given as early Ilerdian by Hottinger (1960). Serra-Kiel et al. (1998) defined SBZ 6 biozone by the biostratigraphic range of this species. Besides, Drobne et al. (2011) assigned the middle Ilerdian (SBZ 7-8) age for this species. Sirel and Acar (2008) also described this species from early?- middle Ilerdian of Bozcaada (Çanakkale). In Tibet, *A.*(*A.*) *pasticillata* is reported from top SBZ 6 to SBZ 7 (BouDagher-Fadel et al., 2015).

***Alveolina (Alveolina) pisella* DROBNE, 1977**

(Plate IV, figure 2)

1977 *Alveolina (Alveolina) pisella* DROBNE, p. 34, text-fig. 16; pl.5, figs. 17-19.

2007 *Alveolina pisella* DROBNE. ÖZGEN-ERDEM et al., p. 920, figs. 7a-c.

2011 *Alveolina pisella* DROBNE. DROBNE et al., p.747, pl.1.

Material: 1 specimen representing the species was identified throughout the section (ÖZ-1).

Description: Test is spherical and small sized. In the single megalospheric specimen obtained, the axial and equatorial diameters are 3.22 mm and 2.72 mm, respectively. The elongation index is 1.18 and the diameter of spherical proloculus was measured as 0.18 mm. The next 5 whorls following the proloculus form a tightly coiled juvenile stage. The subsquent 8 whorls are loosely coiled, but during these whorls thickness

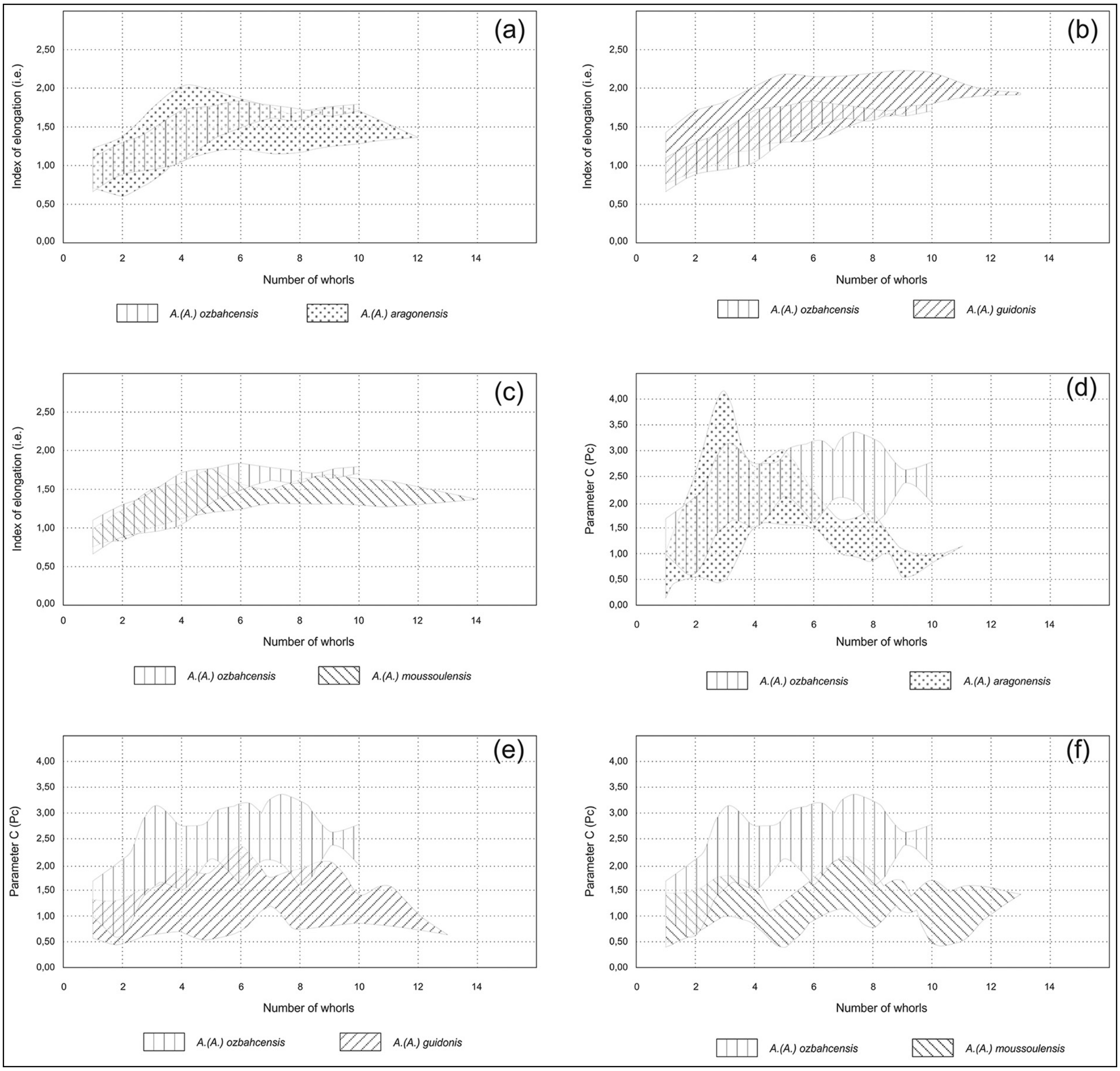

Figure 8- Number of whorls vs. elongation index comparison plots of *A. (A.) ozbahcensis* n.sp. with (a) *A. (A.) aragonensis*, (b) *A. (A.) guidonis*, (c) *A. (A.) moussoulensis*; the number of whorls vs Parameter C comparison plots of (d) *A. (A.) aragonensis*, (e) *A. (A.) guidonis*, (f) *A. (A.) moussoulensis*.

of the basal layer never reaches the chamber height. This species, which is characteristic with having delicate inner structure, chamberlets are small-sized and spherical throughout the juvenile stage. Sizes of the chamberlets slightly increase towards the outer whorls. In senile stage, they increase in size and become rectangular. A gradual increase in chamberlet size is also observed in this stage. Microspheric specimens could not be obtained.

Range: A. (A.) pisella was found in the middle Ilerdian (SBZ 7-8) levels of the Özbahçe section. The stratigraphic distribution of this species was given as middle-late Ilerdian (SBZ 8-9) by Drobne (1977) and Serra-Kiel et al. (1998). Also, Özgen-Erdem et al. (2007) described this species in the upper Ilerdian of the Eskişehir region (SBZ 9).

***Alveolina (Alveolina) rotundata* HOTTINGER *kazancii* SİREL and ACAR, 2008**

(Plate III, figure 10)

1995 *Alveolina (Alveolina) rotundata* HOTTINGER. ACAR, pl.22, figs. 2,3.

1995 *Alveolina (Alveolina) decipiens* SCHWAGER. ACAR, pl.16, fig. 4.

2008 *Alveolina rotundata kazancii* SİREL and ACAR, pl.34, figs. 1-3, 5, 7.

2016 *Alveolina rotundata kazancii* SİREL and ACAR. ÖZGEN-ERDEM et al., pl.1, figs. 8-10.

2019 *Alveolina (Alveolina) rotundata kazancii* SİREL and ACAR. BOZKURT and GÖRMÜŞ, pl.1, fig. 7.

Material: 3 specimens representing the species were identified throughout the section (ÖZ-5, ÖZ-7, ÖZ-11).

Description: Megalospheric test is elongated oval and small sized. The axial and equatorial diameters are between 2.35 and 3.44 mm and 1.19 and 1.91 mm, respectively. The elongation index ranges from 1.76 to 1.97 and the diameter of spherical proloculus was measured as 0.18 - 0.33 mm. The next 2-3 whorls following the proloculus are tightly coiled and in subspherical-pattern. During the following 4 whorls with loose coiling, test becomes elongated oval. In this stage, thickening in the axial direction is approximately 3 to 4 times of that in the equatorial direction. Both the basal layer thickness and chamberlet heights increase regularly from inner towards outer whorls. The chamberlets have circular cross-section in inner whorls, while in the loosely coiled outer whorls they are tooth-shaped (downward oval). Microspheric specimens could not be obtained.

Range: A. (A.) rotundata kazancii was found in the middle Ilerdian (SBZ 7-8) levels of the Özbahçe section. The stratigraphic distribution of this species is given as middle Ilerdian (SBZ 7-8) by Sirel and Acar (2008). Özgen-Erdem et al. (2016) also described this species in the middle Ilerdian of Kastamonu region.

Alveolina (Alveolina) rugosa HOTTINGER ssp1

(Plate III, figure 9)

Material: 1 specimen representing the species was identified throughout the section (ÖZ-6).

Diagnosis: Test is small, fusiform-subcylindrical shaped. The axial and equatorial diameters of the only megalospheric individual are 4.40 mm and 1.02 mm, respectively. The elongation index is 4.31. The proloculus is spherical and its diameter is 0.08 mm. Following the proloculus, 2-3 whorls are in lenticular pattern and tightly coiled. During these whorls, the chamberlets are very small. A remarkable axial thickening is observed during the next 5 whorls. In this stage, thickness of the basal layer in axial direction is about 10 times the thickness in the equatorial direction. Senile stage of the single specimen obtained contains only one whorl. At this stage, there is a distinct decrease in the axial thickening. Chamberlets have circular cross-sections throughout the ontogeny, and their size increases slightly towards the last whorl. While the poles of the test are sharp in the juvenile stage, they are subcylindrical in the last whorls.

Differential diagnosis: The examined specimen shows morphological similarities with *A. (A.) rugosa*. They are quite similar in terms of elongation indices and growth stages. This potential new subspecies differs from *A. (A.) rugosa* by having smaller dimensions and reaching the same number of whorls in a smaller test. In measurements taken from the paratype A form of *A. (A.) rugosa* (Hottinger, 1960: pl. 11, fig. 9), axial and equatorial diameters and proloculus diameter are 6.00 mm, 1.43 mm and 0.14 mm, respectively. However; the same values in this individual are 4.40 mm, 1.02 mm and 0.08 mm.

Remarks: Our specimen presents morphological similarities with *A. (A.) rugosa* defined by Hottinger (1960). For the age of *A. (A.) rugosa*, Cuisian was suggested by Hottinger (1960) and Serra-Kiel et al. (1998). Considering the morphological similarities and biometric comparison between our specimen obtained from Early Ilerdian and *A. (A.) rugosa*, it has been interpreted that this specimen could be a forerunner or subspecies of *A. (A.) rugosa*. Due to the insufficient number of individuals, it is left to be named in future studies.

Range: A. (A.) rugosa ssp1 was found in the early Ilerdian (SBZ 5-6) levels of the Özbahçe section.

Alveolina (Alveolina) trempina HOTTINGER, 1960

(Plate IV, figure 8)

1960 *Alveolina trempina* HOTTINGER, pl.2, figs. 17-19.

2008 *Alveolina trempina* HOTTINGER. SİREL and ACAR, pl.39, figs. 1, 3.

non *Alveolina trempina* HOTTINGER. SİREL and ACAR, 2008, pl.39, fig. 2.

Material: 4 specimens representing the species were identified throughout the section (ÖZ-12).

Description: Megalospheric test is elongated oval, fusiform and medium sized. In megalospheric specimens, the axial and equatorial diameters are between 4,24 - 7,32 mm and 1,56 - 2,74 mm, respectively. The elongation index ranges from 2.67 to 2.72 and the diameter of the spherical proloculus is between 0,24 - 0,34 mm. Following the proloculus, 1-2 whorls are tightly coiled and in spherical pattern. Throughout the next 5 whorls, rapidly developing axial thickening is observed and this thickening regularly increases. The last 3-5 whorls, constituting senile stage, are tightly coiled in axial and equatorial directions. Thickness of the basal layer is 7 to 8 times greater than that of the equatorial region. While the coarse chamberlets have circular cross-sections in inner whorls, they become upright oval in the senile stage. The sizes of the chamberlets increase slowly towards the last whorls. The poles, which are acute or slightly rounded in adult stage, are subcylindrical in the senile stage. Microspheric specimens could not be obtained.

Range: A. (A.) trempina species was found in the middle Ilerdian (SBZ 7-8) levels of the Özbahçe section. The stratigraphic distribution of this species was given as the late Ilerdian (SBZ 9) by Hottinger (1960) and Serra-Kiel et al. (1998). In addition, Özgen-Erdem et al. (2007, 2008) described this species from the upper Ilerdian (SBZ 9) of Eskişehir and Kastamonu regions. In Tibet, this species is reported from SBZ 9. In this study, coexistence of *A. (A.) trempina* and *A. (A.) corbarica* has been interpreted that these levels might be a transition from the middle to late Ilerdian.

Alveolina (Alveolina) varians HOTTINGER, 1960

(Plate IV, figure 3)

1960 *Alveolina varians* HOTTINGER, pl.8, figs. 9-12.

2007 *Alveolina varians* HOTTINGER. ÖZGEN-ERDEM et al., p.923, fig. 9f.

2008 *Alveolina varians* HOTTINGER. SİREL and ACAR, pl.24, figs. 7,8.

Material: 4 specimens representing the species were identified throughout the section (ÖZ-3, ÖZ-6, ÖZ-12).

Description: Small sized megalospheric test is oval. In megalospheric specimens, axial and equatorial diameters are between 2.58 to 3.42 mm and 1.98 to 2.42 mm, respectively. The elongation index ranges from 1.27 to 1.53. The diameter of the spherical proloculus is between 0,12 to 0,18 mm. There are tightly coiled 4-5 whorls following the proloculus. During the next 6-7 whorls, coiling is regular and loose. Thickness of basal layer is approximate in axial and equatorial regions. The cross-sections of the delicate chamberlets are circular and slightly elongated in the outer whorls. The sizes of the chamberlets are quite small in tightly coiled inner whorls, and gradually increases towards the outer whorls. Microspheric specimens could not be obtained.

Remarks: *A. (A.) varians* specimens obtained from Keçiborlu samples lack of the senile stage in which thickness of the basal layer is excessively increased as seen in *A. (A.) varians* defined by Hottinger (1960).

Range: A. (A.) varians was found in the early - middle Ilerdian (SBZ 5-8) levels of the Özbahçe section. This species, which was defined in the early Ilerdian (*A. cucumiformis* zone) by Hottinger (1960), was described as the index species for SBZ 5 in early Ilerdian by Serra-Kiel et al. (1998). In addition, *A. (A.) varians* was identified in the middle Ilerdian of Eskişehir region by Özgen-Erdem et al. (2007) and of Ankara (Polatlı) region by Sirel and Acar (2008).

Alveolina (Alveolina) vredenburgi DAVIES and PINFOLD, 1937

(Plate IV, figure 1)

1937 *Alveolina vredenburgi* DAVIES and PINFOLD, pl.5, fig. 25.

1960 *Alveolina cucumiformis* HOTTINGER, p.135, text-figs. 26, 29/1, 2, 71c, d, 72, 73.

1995 *Alveolina (Alveolina) cucumiformis* HOTTINGER. ACAR, pl.4, figs. 2-4.

2008 *Alveolina vredenburgi* DAVIES and PINFOLD. SİREL and ACAR, pl.31, figs. 1-3.

2009 *Alveolina vredenburgi* DAVIES and PINFOLD. SCHEIBNER AND SPEIJER, p. 209, fig. 10j.

Material: 1 specimen representing the species was identified throughout the section (ÖZ-6).

Description: Test is elongated oval and small sized. In the only megalospheric specimen obtained, axial and equatorial diameters are 4.06 mm and 1.64 mm, respectivley. The elongation index is 2.48 and diameter of the spherical proloculus was measured as 0.12 mm. The next 2-3 whorls following the proloculus are tightly coiled. In this stage, test is in subspherical pattern. In the following whorls, a distinct elongation occurs in the axial direction and accordingly, the test becomes elongated oval. In this stage, thickness of the basal layer in axial direction is 5 times of that in equatorial direction. These 6 to 7 whorls constitute the adult stage. In the following senile stage, axial thickening decreases again. Cross-sections of chamberlets are circular and become upright oval in the outer whorls. Microspheric specimens could not be obtained.

Range: A. (A.) vredenburgi was found in the early Ilerdian (SBZ 5-6) levels of the Özbahçe section. This species, which was defined in the early Ilerdian (*A. cucumiformis* zone) by Hottinger (1960), was given as the index species of SBZ 5 in early Ilerdian by Serra-Kiel et al. (1998). In Tibet, this species is reported from SBZ 5 to earliest SBZ 6 (BouDagher-Fadel et al., 2015).

6. Biostratigraphic Findings and Discussion

In this study, the biostratigraphic data based on the *Alveolina* species representing mainly the early Ypresian (Ilerdian) period were presented. In determining the biozones, the studies of Hottinger (1960; 1974), Drobne (1977), Serra-Kiel et al. (1998), Özgen-Erdem et al. (2007), Sirel and Acar (2008) were based on; and Serra-Kiel et al. (1998) was followed in biozone identifications. Stratigraphic distributions and assemblages were presented in the taxonomy chapter and compared with the abovementioned studies. While giving the ranges, the equivalents of shallow benthic zones defined by Serra-Kiel et al. (1998) were specified. However, the SBZ 3 and 4 zones, SBZ 5 and 6 zones, and SBZ 7 and 8 zones were merged due to coexistence of some index species representing these zones (Figure 9).

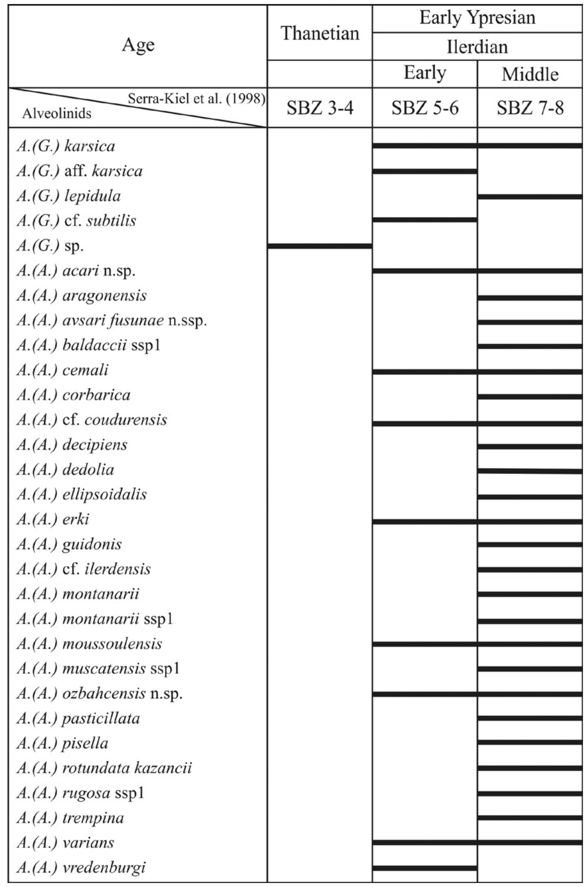

Figure 9- Stratigraphic distributions and biostratigraphic biozones of *Alveolina* species identified in the Özbahçe measured section.

6.1. SBZ3-SBZ4 (Thanetian)

In the study area that contains a fossil assemblage representing the Ilerdian period, age determination based on foraminiferal assemblages except *Alveolina*, shows that the bottom of the sequence is Thanetian (SBZ 3-4) aged. According to the definitions made by Serra-Kiel et al. (1998), considering the alveolinid groups, SBZ 3 and SBZ 4 biozones are defined by the biostratigraphic range of *Alveolina (Glomalveolina) primaeva* and *A. (G.) levis*, respectively. In these levels of the study area, only one specimen of *Alveolina (Glomalveolina)* sp., belonging to the genus *Alveolina*, was identified. This species, accompanied by *Elazigina dienii, Idalina causae, I. Sinjarica, Ranikothalia* sp., *Rotalia* sp., *Sistanites catali, Sistanites* cf, *guvenci, Sistanites* was thought to belong to the *A. (G.) primaeva* group (Hottinger, 1974) by considering its morphological and biometric properties. The accompanying assemblage also proves that the sequence begins with Thanetian. Thanetian levels were observed between the sections of 12,70 m to 13,70 m, 18,50 m to 19,00 m and 21,30 m to 24,50 m in the Özbahçe section.

6.2. SBZ5-SBZ6 (early Ilerdian)

The lower part of the early Ilerdian was defined as *Alveolina cucumiformis* zone by Hottinger (1960), and as SBZ 5 biozone by Serra-Kiel et al. (1998). When alveolinid groups are taken into consideration, the SBZ 5 biozone is defined by the biostratigraphic ranges of *Alveolina (Alveolina) vredenburgi, A. (A.) avellana avellana, A. (A.) aramaea aramaea* and *A. (A.) varians* (Serra-Kiel et al., 1998). In the study area, early Ilerdian was recognized by the first occurrences *Alveolina (Alveolina) vredenburgi* and *A. (A.) varians*, which are among the index taxa of this biozone. The upper part of the early Ilerdian was defined as the *Alveolina ellipsoidalis* zone by Hottinger (1960) and as SBZ 6 biozone by Serra-Kiel et al. (1998). This zone is defined by the biostratigraphic ranges of *Alveolina* species such as *A. (A.) ellipsoidalis, A. (A.) daniensis, A. (A.) pasticillata, A. (A.) solida* (Serra-Kiel et al., 1998). However, *A. (A.) ellipsoidalis* and *A. (A.) pasticillata* were not recognized in this interval in the study area. On the other hand, the current studies demonstrate that *A. (A.) ellipsoidalis* can be recognized in the whole the Ilerdian in different regions of Tethyan province (Özgen-Erdem et al., 2007; Özgen-Erdem, 2008, Sirel and Acar, 2008; Hadi et al., 2019; 2020). Similarly, the middle Ilerdian age is suggested for *A. (A.) pasticillata* (Sirel and Acar, 2008; Drobne et al., 2011). Indeed, these two species were not indicative for SBZ 5 biozone in the study area and observed at younger stratigraphic levels. The early Ilerdian fauna in the region consist of *Alveolina* species such as; *A. (G.) karsica, A. (G.)* aff. *karsica, A. (G.)* cf. *subtilis, A. (A.) acari* n.sp., *A. (A.) cemali, A. (A.)* cf. *coudurensis, A. (A.) erki, A. (A.) moussoulensis, A. (A.) ozbahcensis* n.sp., *A. (A.) rugosa* ssp1, and other larger bentic foraminifers such as; *Assilina* sp., *Discocyclina* sp., *Nummulites* sp., *Orbitolites* sp., *Ranikothalia* cf. *nuttalli, Ranikothalia* cf. *polatliensis, Rotalia* sp., The first occurrence of *A. (A.) moussoulensis* defined in the lower parts of the middle Ilerdian (SBZ 7) for the Tethyan province, was determined as early Ilerdian in this region. The lower Ilerdian levels were observed between 13.70 m to 14.10 m and 19.00 m to 19.20 m in the Özbahçe section.

6.3. SBZ7-SBZ8 (middle Ilerdian)

The lower part of the middle Ilerdian was defined as *Alveolina moussoulensis* zone by Hottinger (1960), and as SBZ 7 biozone by Serra-Kiel et al. (1998); and the upper part was defined as *Alveolina corbarica* zone by Hottinger (1960) and as SBZ 8 biozone by Serra-Kiel et al. (1998). SBZ 7 is defined by the biostratigraphic distributions *Alveolina (Alveolina) moussoulensis, A. (A.) subpyreanica, A. (A.) dedolia, A. (A.) laxa*. SBZ 8 on the other hand is defined by the biostratigraphic distributions of *A. (A.) corbarica, A. (A.) recondita, A. (A.) brassica* (Serra-Kiel et al., 1998). As the species belonging to these two biozones coexist as mentioned earlier, these biozones were merged in this study. The middle Ilerdian in the study area starts with the first occurrences of *A. (A.) aragonensis, A. (A.) decipiens, A. (A.) dedolia, A. (A.) montanarii*. Unlike the other regions of Tethyan province, *A. (A.) corbarica, A. (A.) guidonis, A. (A.) pisella*, representing the younger levels, and *A. (A.) ellipsoidalis, A. (A.) pasticillata and A. (A.) varians* representing the older levels accompany these species. In addition to these species, the middle Ilerdian fauna of the region contains *Alveolina* species such as; *A. (G.) karsica, A. (G.) lepidula, A. (A.) acari, A. (A.) avsari fusunae* n.ssp., *A. (A.) baldaccii* ssp1, *A. (A.) cemali, A. (A.)* cf. *coudurensis, A. (A.) erki, A. (A.)* cf. *ilerdensis, A. (A.) montanarii* ssp1, *A. (A.) moussoulensis, A. (A.) muscatensis* ssp1, *A. (A.) ozbahcensis* n.sp., *A. (A.) rotundata kazancii, A. (A.) trempina*, and other larger benthic foraminifers such as; *Assilina* sp., *Asterocyclina* sp., *Discocyclina, Elazigina* cf. *subsphaerica, Elazigina* sp., *Nummulites* sp., *Orbitolites bellus, Orbitolites* cf. *complanatus, Orbitolites* cf. *megasphericus*, *Orbitolites* sp., *Opertorbitolites latimarginalis, Opertorbitolites* sp., *Operculina* sp., *Ornatorotalia granum, Ranikothalia* cf. *nuttalli, Ranikothalia* sp., *Rotalia* sp., *Slovenites*? sp., *Sphaerogypsina* sp., gypsinid forms, and stomatorbinid forms. *A. (A.) trempina* defined as the index species of late Ilerdian (SBZ 9) by Hottinger (1960) and Serra-Kiel et al. (1998), was recognized in the middle Ilerdian in this region. The middle Ilerdian levels were observed between the levels of 0 m to 12.70 m, 14.10 m to 18.50 m, and 19.20 m to 21.30 m in the Özbahçe section.

7. Environmental Interpretation

The relationships between the test composition and the parameters of temperature, depth, salinity etc. of the living environments can be constructed based on the samples of recent foraminifers, thus the paleoecological interpretations could be made (Hallock and Glenn, 1982; Reiss and Hottinger, 1984; Dong et al., 2018). The relative proportions of foraminifers with hyaline, porcellaneous and agglutinated tests can be used as environmental indicators (Jorissen et al., 2007). Debenay (2012) found that the proportion of hyaline species increased with increasing depth and mud content in the sediment. In studies conducted to determine the responses of recent benthic foraminifers to changes in temperature and salinity, it was observed that with increasing temperature, the assemblage shifted from hyaline rotaliids to porcellaneous miliolids (Dong et al., 2018).

Studies carried out on certain larger benthic foraminiferal groups, especially the alveolinids, nummulitids and amphisteginids, show that the test morphology changes depending on several parameters such as temperature, depth, light, hydrodynamic energy (Hottinger, 1960; 1997; Luterbacher, 1970; Hallock and Hansen, 1979; Hallock and Glenn, 1986; Murray, 1991; 2006; BouDagher-Fadel, 2008; 2018). It is known that the symbiont-bearing foraminifers with thin and flat tests can live at deeper environments than spherical, thick foraminifers (Hallock and Glenn, 1982).

In studies conducted particularly on alveolinids, the shape of test has been the primary parameter for paleoenvironmental interpretations. It has been determined that spherical alveolinides are mostly found in lagoon environments, however the elongated alveolinids are found in normal saline, restricted platform environments (Hottinger, 1960; Luterbacher, 1970). It was determined that alveolinids avoid generally the environments shallower than 5 m in the selection of habitat (Murray, 2006). Their recent relatives were reported to be abundant at depths between 25 and 35 m in the Maldives and the Gulf of Aqaba (Reiss and Hottinger, 1984). Hottinger (1977) stated that *Alveolina* species with higher elongation index live in relatively deeper environments. *Orbitolites* and *Opertorbitolites* from the soritid foraminifera also reflect the same environmental conditions as *Alveolina*. The coexistence of these genera shows low energy conditions in a shallow and protected marine environment (Hottinger, 1960; Luterbacher, 1970; Özgen-Erdem et al., 2016).

In the study area, the Thanetian period stands out with its low foraminiferal diversity. At these levels, foraminifer species with porcelain calcerous tests [*Idalina* spp., *Alveolina* (*Glomalveolina*) sp.] are dominantly seen, and they are accompanied by foraminifers with small amount of hyaline calcerous tests. Porcellaneous calcerous forms are typical forms of the low energy environments (Reiss and Hottinger, 1984) and indicate a high salinity (Murray, 2006).

The genus *Alveolina* is dominant in the early Ilerdian foraminiferal assemblage. It is accompanied by species belonging to the genera *Orbitolites* and *Opertorbitolites* and the hyaline calcaerous groups (*Nummulites, Assilina, Discocyclina* etc.). It was reported that species belonging to groups of *Alveolina ellipsoidalis, Alveolina decipiens* and *Alveolina subpyreanica*, which are also common in the *Alveolina* assemblage in the study area, are mostly distributed in restricted platform environments with normal salinity (Hottinger, 1960). The elongated alveolinids such as *A. (A.) vredenburgi* are also found in the assemblage, which consist mostly of spherical alveolinids.

The middle Ilerdian beds of the Özbahçe section contains abundant *Alveolina* species, which is accompanied by the species of *Orbitolites, Opertorbitolites* and by the increasing amount of hyaline calcerous species. Although it has a similar foraminiferal assemblage to the early Ilerdian, there is a quantitative increase in the hyaline calcerous group (Bozkurt et al., 2021). The *Alveolina* assemblage contains both spherical and elongated shaped species.

It has been inferred from the foraminiferal assemblages and their features (e.g. test morphology, composition etc.) that the sequence located in the north of Keçiborlu was deposited in a lagoon environment with high salinity during the Thanetian, then the environment turned into a low energy shallow marine environment with normal salinity in the early İlerdian. In addition to the similar foraminiferal assemblage in early Ilerdian, the increasing amount of the hyaline calcerous groups and generally discoidally shaped nummulitides indicates that the environment is relatively deepening.

8. Conclusions

In this study, alveolinid species were identified in detail from the measured section of the Büyükkırtepe formation, which crops out in northern corner of the Isparta Angle, north of Keçiborlu (Isparta).

It is seen that the foraminiferal assemblages include rich *Alveolina* species. Throughout the studied section, 30 different species/subspecies belonging to the genus *Alveolina* were recognized. Age of the lowest stratigraphic levels of the studied section that are poor in *Alveolina* was determined as Thanetian. In the lower Ilerdian beds, 9 known species and 2 new species of *Alveolina* were identified. 19 known species, 2 new species of *Alveolina* were described from the middle Ilerdian levels which has high diversity of *Alveolina* species. Considering other foraminiferal assemblages that accompany *Alveolina* species throughout the section, the age of cross section was determined as Thanetian - early Ypressian (middle Ilerdian).

A. (A.) acari n.sp., *A. (A.) ozbahcensis* n.sp. and *A. (A.) avsari fusunae* n.ssp. have been introduced for the first time. Possible new subspecies of *A. (A.) baldaccii*, *A. (A.) montanarii*, *A. (A.) muscatensis* and *A. (A.) rugosa* have been proposed, yet each has been named as ssp1 in the related *Alveolina* species.

Stratigraphic distributions of some species such as *A. (A.) corbarica*, *A. (A.) ellipsoidalis*, *A. (A.) guidonis*, *A. (A.) moussoulensis*, *A. (A.) trempina*, *A. (A.) pasticillata*, *A. (A.) pisella* and *A. (A.) varians* show some differences comparing to their distributions known in the Tethyan province (Hottinger, 1960; Drobne, 1977; Serra-Kiel, 1998; Sirel and Acar, 2008). It has been also stated by some previous researchers that the benthic foraminiferal fauna on the Anatolian platform shows some differences with fauna in Western Mediterranean regions (Spain, Italy, France) (Özgen-Erdem et al., 2007; Sirel and Acar, 2008; Hadi et al., 2020).

Due to the fact that some key *Alveolina* species representing the shallow benthic zones (Serra-Kiel et al., 1998) coexist in the study area, the biozones corresponding to Thanetian (SBZ 3-4), early Ilerdian (SBZ 5-6) and middle Ilerdian (SBZ 7-8) were merged in this study.

Based on foraminiferal assemblages and their characteristics, it is seen that while the region was a lagoon with high salinitiy during the Thanetian period, it turned into a low energy shallow marine with normal salinity environment in the early and middle Ilerdian periods and relatively deepened in time.

Pre-Lutetian carbonate shelf sediments, which are missing in the regional paleogeographic models related to the formation of the Isparta Angle (e.g. Nemec et al., 2017) but supporting these models, were identified in this study.

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PLATES

PLATE 1

1- *Alveolina (Glomalveolina)* sp., non-centered oblique section, (ÖZ-4-14).

2- *Alveolina (Glomalveolina)* aff. *karsica* SİREL, axial section, megalospheric? form, (ÖZ-6-12).

3- *Alveolina (Glomalveolina)* cf. *subtilis* HOTTINGER; axial section, (ÖZ-6-6).

4- *Alveolina (Glomalveolina) karsica* SİREL, axial section, megalospheric form, (ÖZ-3-2.1).

5- *Alveolina (Glomalveolina) lepidula* (SCHWAGER), axial section, megalospheric form, (ÖZ-5A-2.3).

6- *Alveolina (Alveolina) cemali* SİREL and ACAR, slightly oblique axial section, microspheric form, (ÖZ-5B-10-1).

7- *Alveolina (Alveolina) cemali* SİREL and ACAR, broken specimen, slightly oblique axial section, megalospheric form, (ÖZ-6-14-1).

8- *Alveolina (Alveolina) aragonensis* HOTTINGER, axial section, megalospheric form, (ÖZ-11-13).

9- *Alveolina (Alveolina) baldacci* CHECCHIA-RISPOLI ssp1., axial section, megalospheric form, (ÖZ-11-16).

10- *Alveolina (Alveolina) decipiens* SCHWAGER, axial section, megalospheric form, (ÖZ-5A-5-1).

PLATE 1

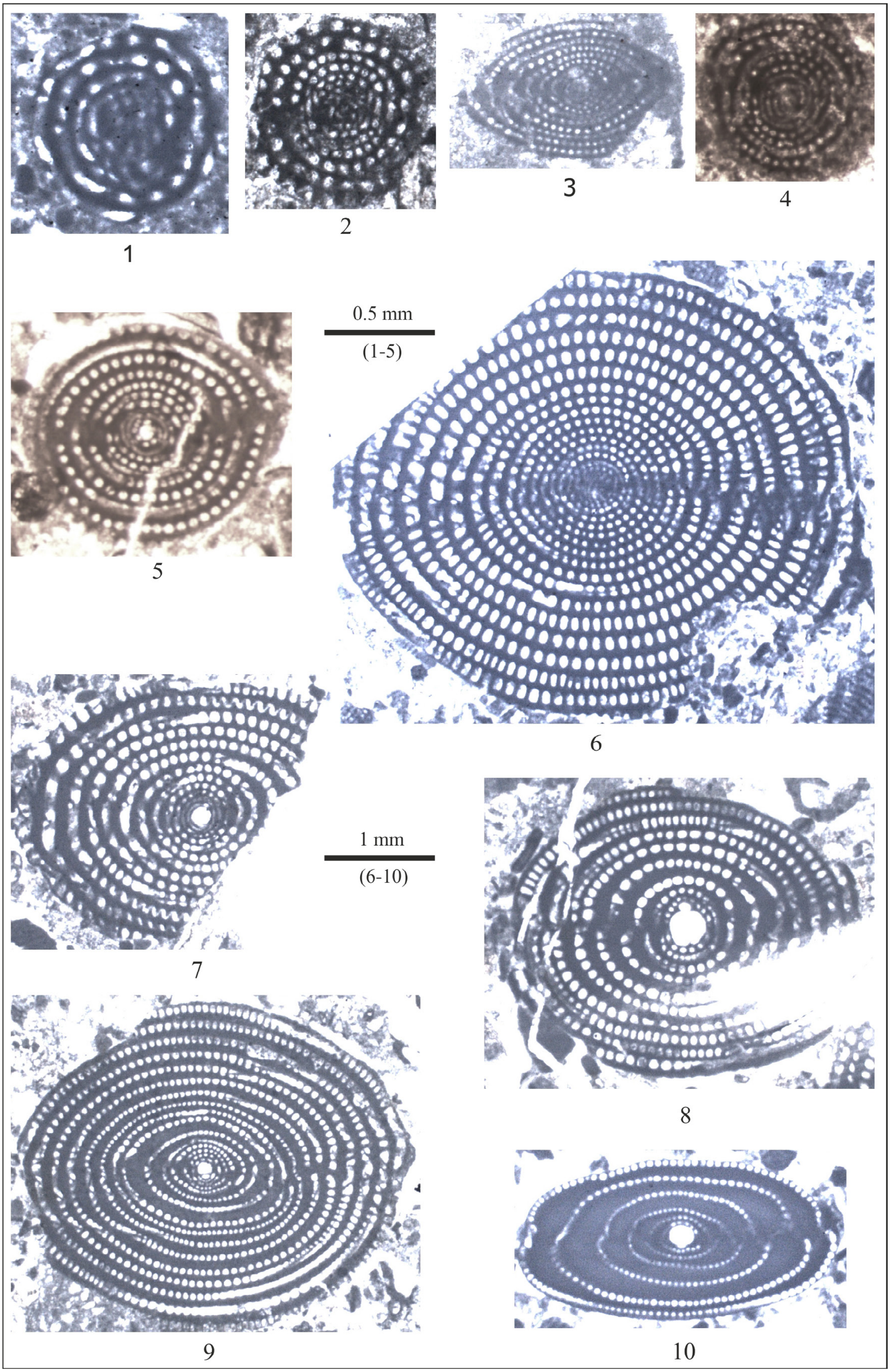

PLATE II

1- *Alveolina (Alveolina) acari* n.sp., holotype, broken axial section, megalospheric form, (ÖZ-6-10).

2- *Alveolina (Alveolina) acari* n.sp., axial section, megalospheric form, (ÖZ-6-21).

3- *Alveolina (Alveolina) acari* n.sp., slightly oblique axial section, megalospheric form, (ÖZ-6-19).

4- *Alveolina (Alveolina) acari* n.sp., axial section, megalospheric form, (ÖZ-8A-14).

5- *Alveolina (Alveolina) acari* n.sp., axial section, megalospheric form, (ÖZ-6-9).

PLATE 1I

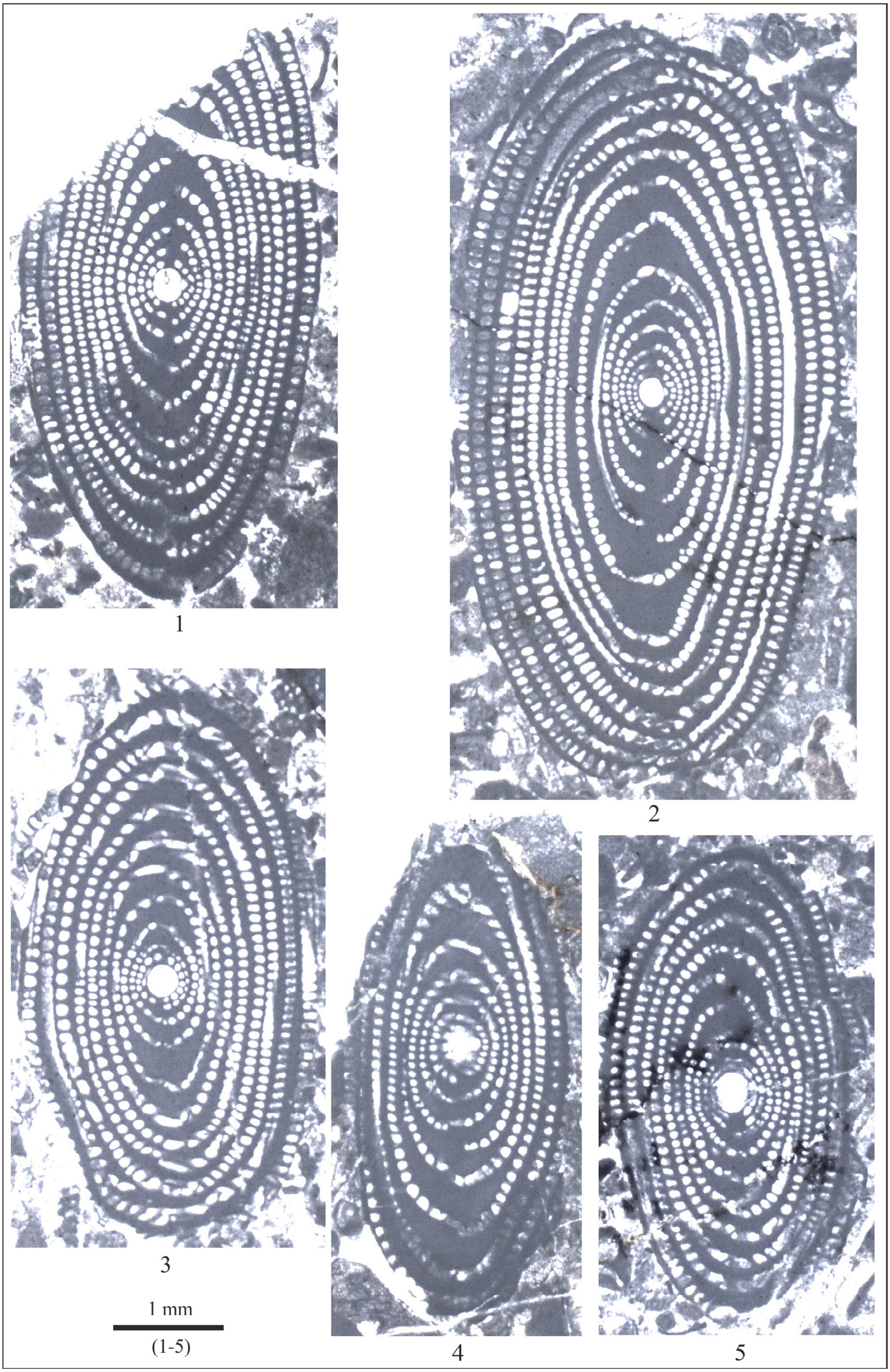

PLATE III

1- *Alveolina (Alveolina) ozbahcensis* n.sp., holotype, broken axial section, megalospheric form, (ÖZ-7-19).

2- *Alveolina (Alveolina) ozbahcensis* n.sp., slightly oblique axial section, megalospheric form, (ÖZ-5A-6).

3- *Alveolina (Alveolina) ozbahcensis* n.sp., slightly oblique axial section, megalospheric form, (ÖZ-6-15).

4- *Alveolina (Alveolina) ozbahcensis* n.sp., axial section, megalospheric form, (ÖZ-7-15).

5- *Alveolina (Alveolina) muscatensis* WHITE ssp1, axial section, microspheric? form, (ÖZ-7-19).

6- *Alveolina (Alveolina) avsari* SİREL and ACAR *fusunae* n.ssp., holotype, axial section, megalospheric form, (ÖZ-11-5-1).

7- *Alveolina (Alveolina) avsari* SİREL and ACAR *fusunae* n.ssp., broken axial section, megalospheric form, (ÖZ-7-17).

8- *Alveolina (Alveolina) erki* ACAR, slightly oblique axial section, megalospheric form, (ÖZ-11-4).

9- *Alveolina (Alveolina) rugosa* HOTTINGER ssp1, axial section, megalospheric form, (ÖZ-6-11).

10- *Alveolina (Alveolina) rotundata* HOTTINGER *kazancii* SİREL and ACAR, axial section, megalospheric form, (ÖZ-7-23).

PLATE 1II

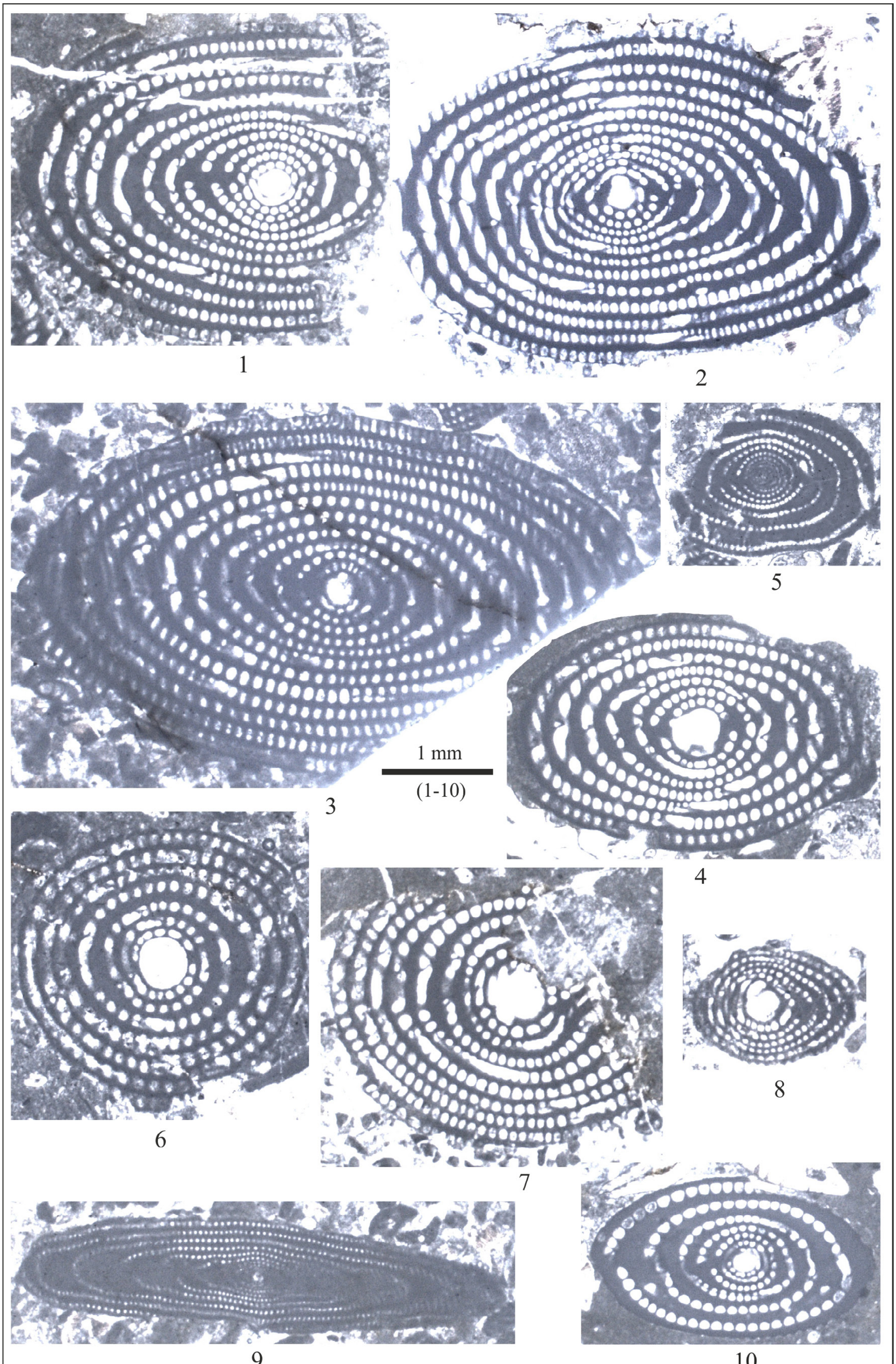

PLATE IV

1- *Alveolina (Alveolina) vredenburgi* DAVIES and PINFOLD, axial section, megalospheric form, (ÖZ-6-7-1).

2- *Alveolina (Alveolina) pisella* DROBNE, axial section, megalospheric form, (ÖZ-1-15-1).

3- *Alveolina (Alveolina) varians* HOTTINGER, axial section, megalospheric form, (ÖZ-3-7).

4- *Alveolina (Alveolina) corbarica* HOTTINGER, slightly oblique axial section, megalospheric form, (ÖZ-3-8).

5- *Alveolina (Alveolina) corbarica* HOTTINGER, axial section, megalospheric form, (ÖZ-11-6).

6- *Alveolina (Alveolina) pasticillata* (SCHWAGER), axial section, megalospheric form, (ÖZ-1-11).

7- *Alveolina (Alveolina)* cf. *coudurensis* HOTTINGER, subaxial section, megalospheric form, (ÖZ-5B-8).

8- *Alveolina (Alveolina) trempina* HOTTINGER, broken axial section, megalospheric form, (ÖZ-12-5).

9- *Alveolina (Alveolina)* cf. *ilerdensis* HOTTINGER, almost axial section, megalospheric form, (ÖZ-12-16).

10- *Alveolina (Alveolina) ellipsoidalis* SCHWAGER, axial section, megalospheric form, (ÖZ-3-5).

11- *Alveolina (Alveolina) dedolia* DROBNE, axial section, megalospheric form, (ÖZ-8A-4).

PLATE 1V

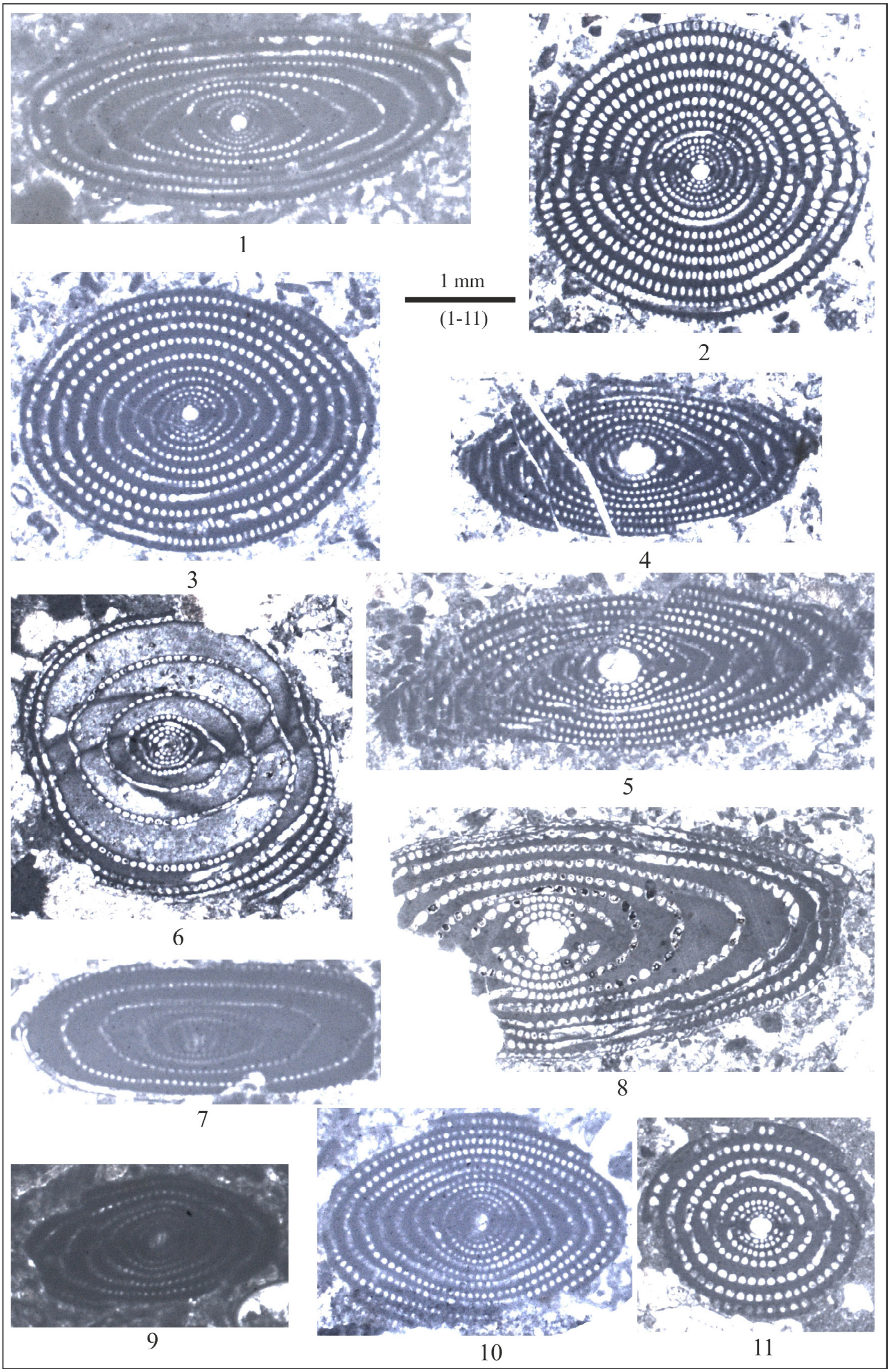

PLATE V

1- *Alveolina (Alveolina) moussoulensis* HOTTINGER, axial section, megalospheric form, (ÖZ-6-20).

2- *Alveolina (Alveolina) montanarii* DROBNE ssp1, axial section, microspheric? form, (ÖZ-8A-12).

3- *Alveolina (Alveolina) montanarii* DROBNE, axial section, megalospheric form, (ÖZ-12-3).

4- *Alveolina (Alveolina) guidonis* DROBNE, oblique axial section, megalospheric form, (ÖZ-5A-8).

5- *Alveolina (Alveolina) montanarii* DROBNE, slightly oblique axial section, megalospheric form, (ÖZ-11-20).

6- *Discocyclina* sp., axial section, megalospheric form, (ÖZ-11-9Dsc).

7- *Slovenites*? sp., vertical section, megalospheric form, (ÖZ-7-1-2).

8- *Ranikothalia* cf. *polatliensis* SİREL, axial section, microspheric? form, (ÖZ-6-2.6).

9- *Assilina* sp., axial section, microspheric form, (ÖZ-7-6Asl).

10- *Ranikothalia* cf. *nuttalli* (DAVIES), axial section, megalospheric form, (ÖZ-5A-4).

11- *Nummulites* sp., broken axial section, microspheric form, (ÖZ-5B-14Num).

PLATE V

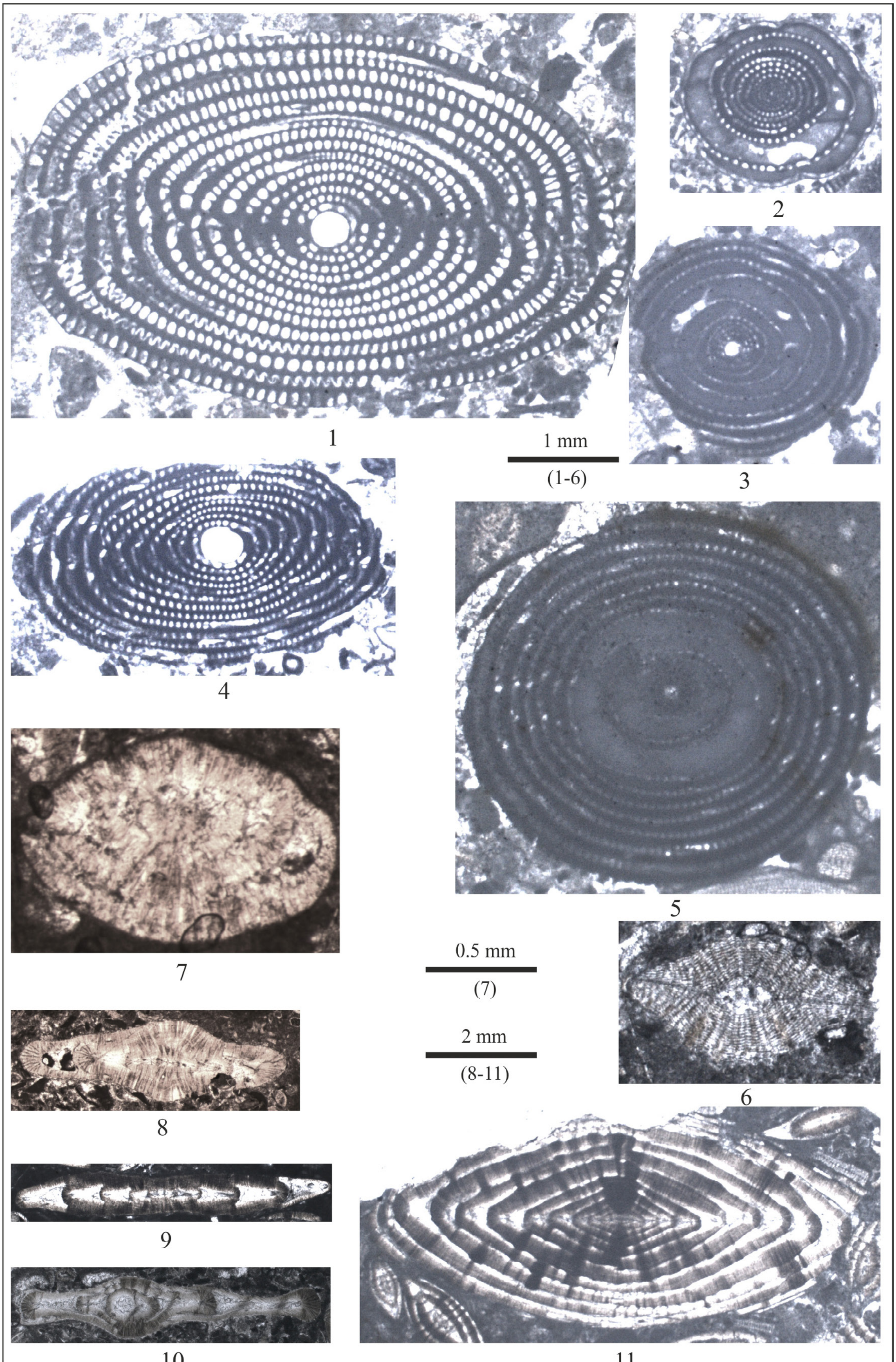

PLATE VI

1- *Orbitolites* cf. *complanatus* LAMARCK, non-centered oblique axial section, (ÖZ-11-11Orb).

2- *Orbitolites bellus* ZHANG, broken axial section, megalospheric form, (ÖZ-5B-1.3).

3- *Orbitolites* cf. *megasphericus* ZHANG, broken axial section, megalospheric form, (ÖZ-5A-1.2).

4- *Opertorbitolites latimarginalis* (LEHMANN), axial section, megalospheric form, (ÖZ-5B-1.3).

5- *Idalina causae* SİREL, section perpendicular to the apertural axis, megalospheric form, (ÖZ-4-8-2).

6- *Idalina sinjarica* GRIMSDALE, section parallel to the apertural axis, megalospheric form, (ÖZ-13-3).

7- *Idalina causae* SİREL, section perpendicular to the apertural axis, megalospheric form, (ÖZ-4-5).

8- *Idalina causae* SİREL, section perpendicular to the apertural axis, microspheric form, (ÖZ-4-7-1).

9- *Idalina causae* SİREL, section parallel to the apertural axis, microspheric form, (ÖZ-4-6).

10- *Operculina* sp., equatorial section, megalospheric form, (ÖZ-7-25Op).

11- *Ornatorotalia granum* BENEDETTI, DI CARLO and PIGNATTI, vertical section, (ÖZ-12-1.2).

PLATE VI

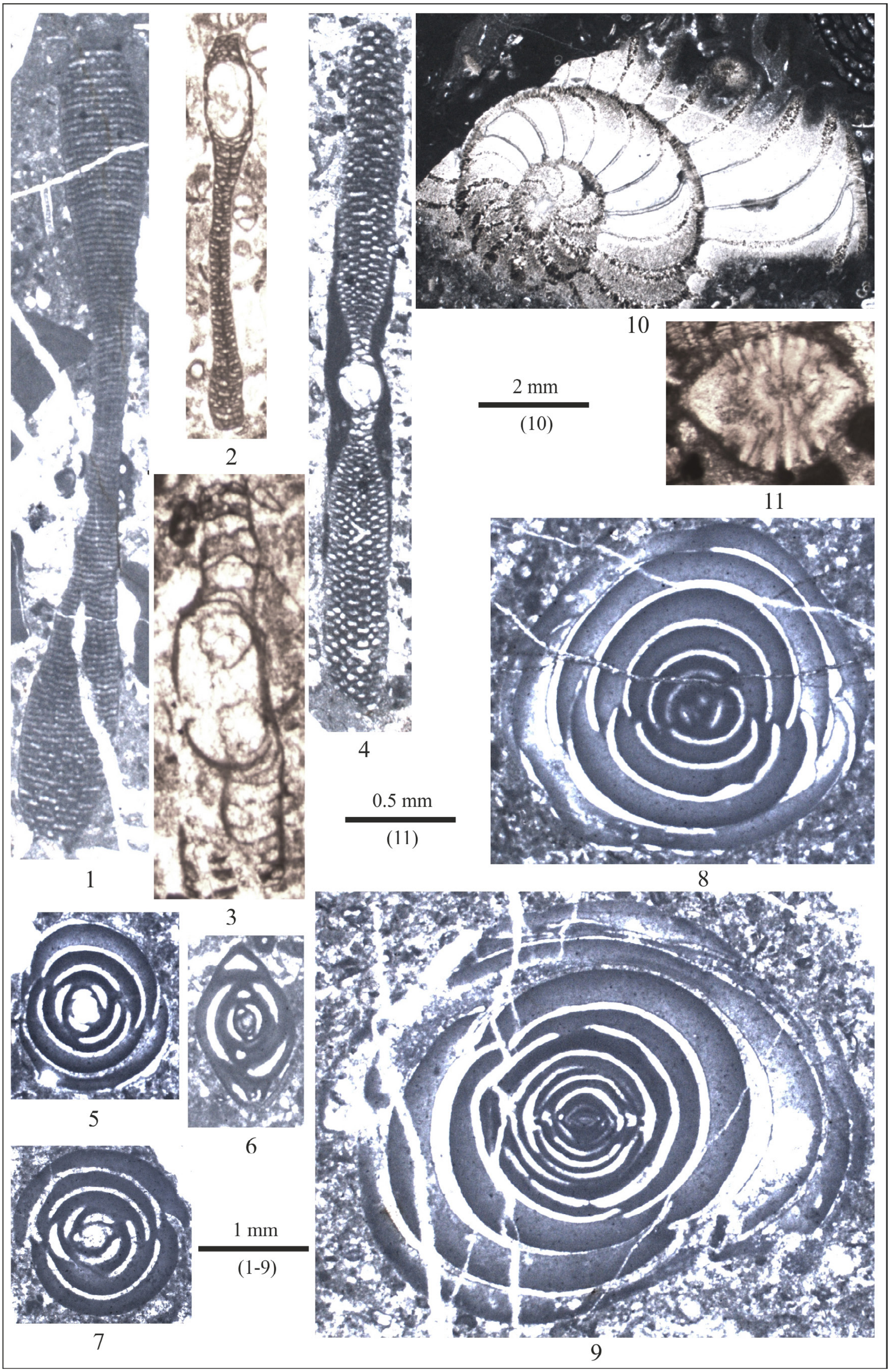

PLATE VII

1- *Socotraella*? sp., vertical sections (on the left and rigth), *Sistanites* sp. oblique section (in the middle), (ÖZ-9-1.4).

2- *Sphaerogypsina* sp., centered section, megalospheric form, (ÖZ-1-9).

3- *Sistanites catali* (ACAR), vertical section, megalospheric? form, (ÖZ-9-1-6).

4- *Socotraella*? sp., oblique basal section, (ÖZ-9-1-3).

5- *Sistanites iranicus* RAHAGHI, oblique section, megalospheric form, (ÖZ-9-2.1).

6- *Sistanites* cf. *guvenci* (ACAR), subvertical section, (ÖZ-9-3Sis).

7- Stomatorbinid form, vertical section, megalospheric form, (ÖZ-12-1.1).

8- *Elazigina* cf. *subsphaerica* (SİREL), vertical section, (ÖZ-1-5Rot).

9- *Rotalia* sp., vertical section, (ÖZ-4-2-1).

10- Gypsinid form, axial section, (ÖZ-12-1.1).

11- *Elazigina dieni* (HOTTINGER), vertical section, (ÖZ-9-4Rot).

12- *Elazigina* sp., vertical section, (ÖZ-5A-7).

13- *Asterocyclina* sp., axial section, (ÖZ-12-1.4).

PLATE VII