

A NEW DASYCLADALEAN ALGAE FROM THE LOWER EOCENE OF THE SEYITGAZI REGION, CENTRAL TURKEY: *BELZUNGIA BARATTOLOI* SP. NOV.

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Abstract This paper deals with the algal assemblage described from lower-middle Ilerdian sediments in the Kışlatepe section, Seyitgazi Region, Central Turkey. Eocene Dasycladalean flora from this region prevalingly contains species of the tribus Thyrsoporelleae, with genera *Belzungia*, *Anatolia* (type area) and *Thyrsoporella*. It is a unique area, a rich, diversified population of *Belzungia* occurs in a foraminifera limestone containing *Alveolina*, *Nummulites*, *Orbitolites*. *Belzungia barattoi* spec. nov. is introduced. The list of the genus *Belzungia* in the Kışlatepe section, as in the Sarıbayır and Kozyaka sections, includes *B. terquemi* Morellet, *B. silvestrii* (Pfender), *B. pfenderae* Radoičić & Özgen-Erdem, *B. barattoi* sp. nov. and some undetermined *Belzungia* specimens.

Keywords: Dasycladalean, *Belzungia*, new species, Eocene, Central Turkey

INTRODUCTION

Rich dasycladalean flora from the Eocene successions of the Seyitgazi region (Fig. 1) of central Turkey has been recently presented by Radoičić & Özgen-Erdem (2010). It is interesting that in the *Belzungia* population of this region are the most frequent specimens which was ascribed to little known *Belzungia bella* (Yu Jing) Radoičić (2006). The objective of the present study is to describe the new species *Belzungia barattoi* sp. nov. and to present *Belzungia* association from the Ilerdian shallow marine sequences of the Kışlatepe section in the investigated area. Dasycladalean assemblage is found along 122 meters (from 17th to 139th meters) in the Kışlatepe section and that especially rich association with diverse species is observed along 14 meters of the middle Ilerdian (between 94th and 109th meters). This interval is represented as the type level of *B. barattoi* sp. nov.

MATERIAL

In the column, prevailing species of genus *Belzungia* are presented, rare specimens of *Anatolia* and some other genera. The examined section is located at the southwest of Seyitgazi town (Fig. 1). The new species was studied in 34 rock samples from 225 m thick sequence. It is also found in the Kozyaka and Sarıbayır sections. Larger benthic foraminifera and dasycladalean algal content of this section were presented in Özgen-Erdem et al., (2007); Özgen-Erdem & Radoičić (2009) and Radoičić & Özgen-Erdem (2010). Thus, only Kışlatepe section being the type locality of new species is given in this study (Fig. 2).

At this locality the unit is composed of limestone, sandy limestone, clayey limestone and marl. Detailed studies were carried out on some 300 thin sections which had been taken from limestone and clayey limestone levels of sequence.

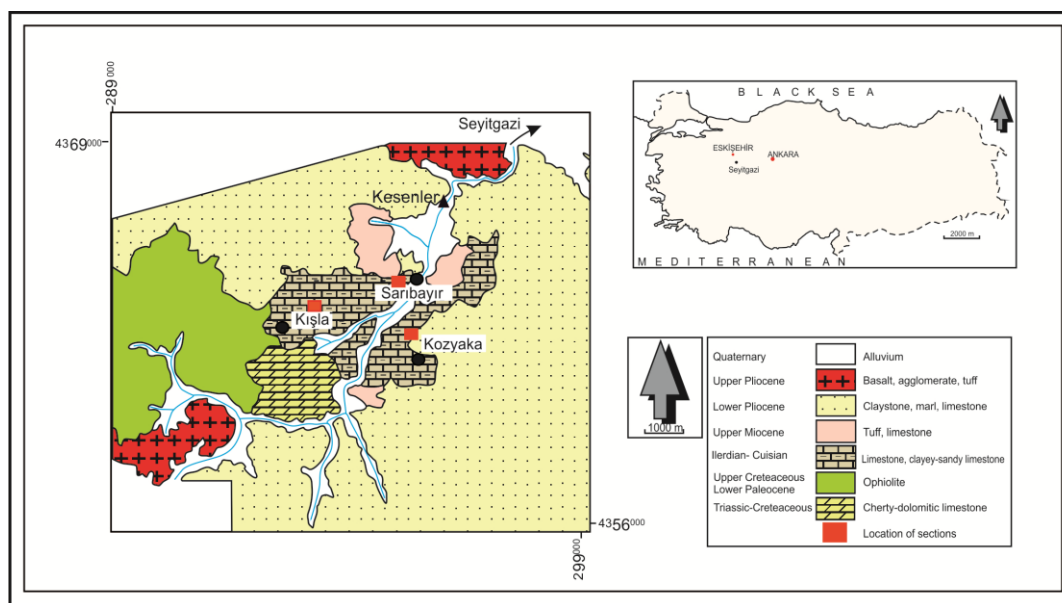


Fig. 1 Geological map of the studied area and location of stratigraphic sections (Geological map modified from Özcan et al., 1989).

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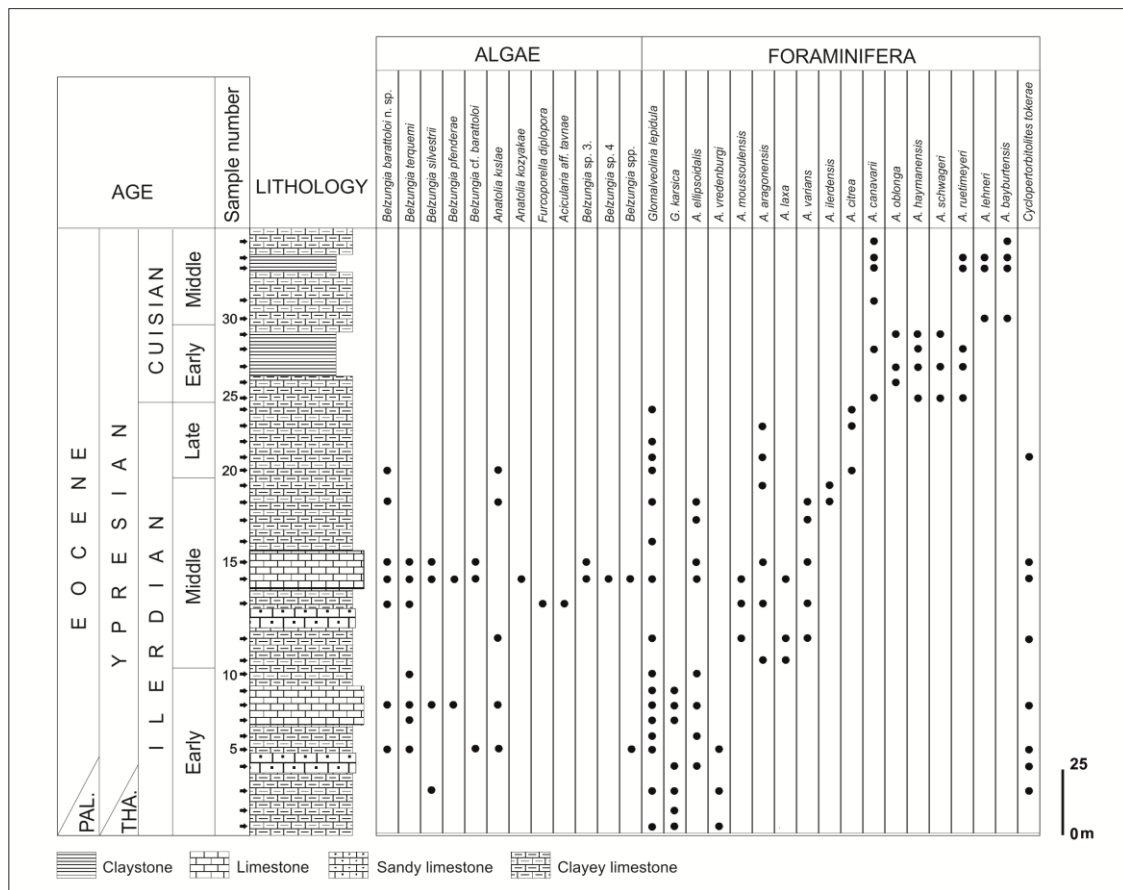


Fig. 2 Stratigraphic distribution of dasycladalean algae and benthic foraminifera in the Kışlatepe section.

SYSTEMATIC PALAEOLOGY

Family: Thyrso porellaceae Granier & Bucur, in Granier et al. 2013

Tribus: Thyrso porelleae (Pia, 1927) Elliott 1977

Genus: *Belzungia* Morellet, 1908

Belzungia bella (Yu Jing, 1976) Radoičić, 2006

1976 *Trinocladus bellus* - Yu Jing, Pl. 8, fig. 10 (holotype); Aff. Fig. 11; non fig. 9, 12; Eocene of Tibet (China).

Non 2010 *Belzungia bella* (Yu Jing, 1976) Radoičić, 2006 - Radoičić & Özgen-Erdem, Fig. 8a-i, Fig. 9a-k, Fig. 10e.

The combination proposed in Radoičić, 2006 concerned two out of four illustrated sections of *Trinocladus bellus* Yu Jing 1976: holotype (Pl. 8, fig. 10) and fig. 11 (now considered as *B. aff. B. bella*). Two other sections more probably are *Thyrso porella* sp. (fig. 12) and ?*Thyrso porella* sp. (fig. 9). According to Deloffre and Genot (1982), *Trinocladus bellus* is "Little known and poorly illustrated species of which better material has not been found since the original description and of which the validity is dubious".

Specimens from Seyitgazi region, clearly different from other *Belzungia* species (*terquemi*, *silvestrii*, *pfenderae*), were ascribed in Radoičić & Özgen-Erdem (2010) to known *Belzungia bella* (Ju Ying, 1976) Radoičić 2006.

Some new better preserved specimens, from the same Anatolian Eocene limestone sample, have provided new data on its taxonomy. The comparison of new specimens with those previously ascribed to *B. bella* justifies introduction of a new species *Belzungia barattoloi* sp. nov.

Belzungia barattoloi sp. nov.

Fig. 4a-f, Fig. 5a-f, Fig. 6e-i

2010 *Belzungia bella* Radoičić & Özgen-Erdem, Fig. 8, a-c (left), e, f-i non: d and h (= *Belzungia* sp.); Fig. 9, a-j, non: k (= *Belzungia* sp.); Fig. 10e; Lower Eocene of Western Anatolia (Turkey).

Derivation of name: The species is dedicated to Prof. Filippo Barattolo (Universita di Napoli "Federico II") for his contribution to the knowledge on paleontology.

Holotype: The specimen in the oblique section shown in the Fig. 4a, thin section NEK 14f.

Isotypes: Different sections of the specimens originated from the same sample NEK 14, illustrated in Fig. 4b-e; Fig. 5a, b; Fig. 6c, e, g, i.

Type locality and level: The Kışlatepe section is located 2 km west of Kışla, SW of Seyitgazi town (UTM coordinates: 4362650°, 292500°). The type bed K.14 is represented by foraminiferal limestones of middle Ilerdian age and contains *Glomalveolina lepidula* (Schwager), *Alveolina ellipsoidalis* Schwager, *A. moussoulensis* Hottinger, *A. laxa* Hottinger,

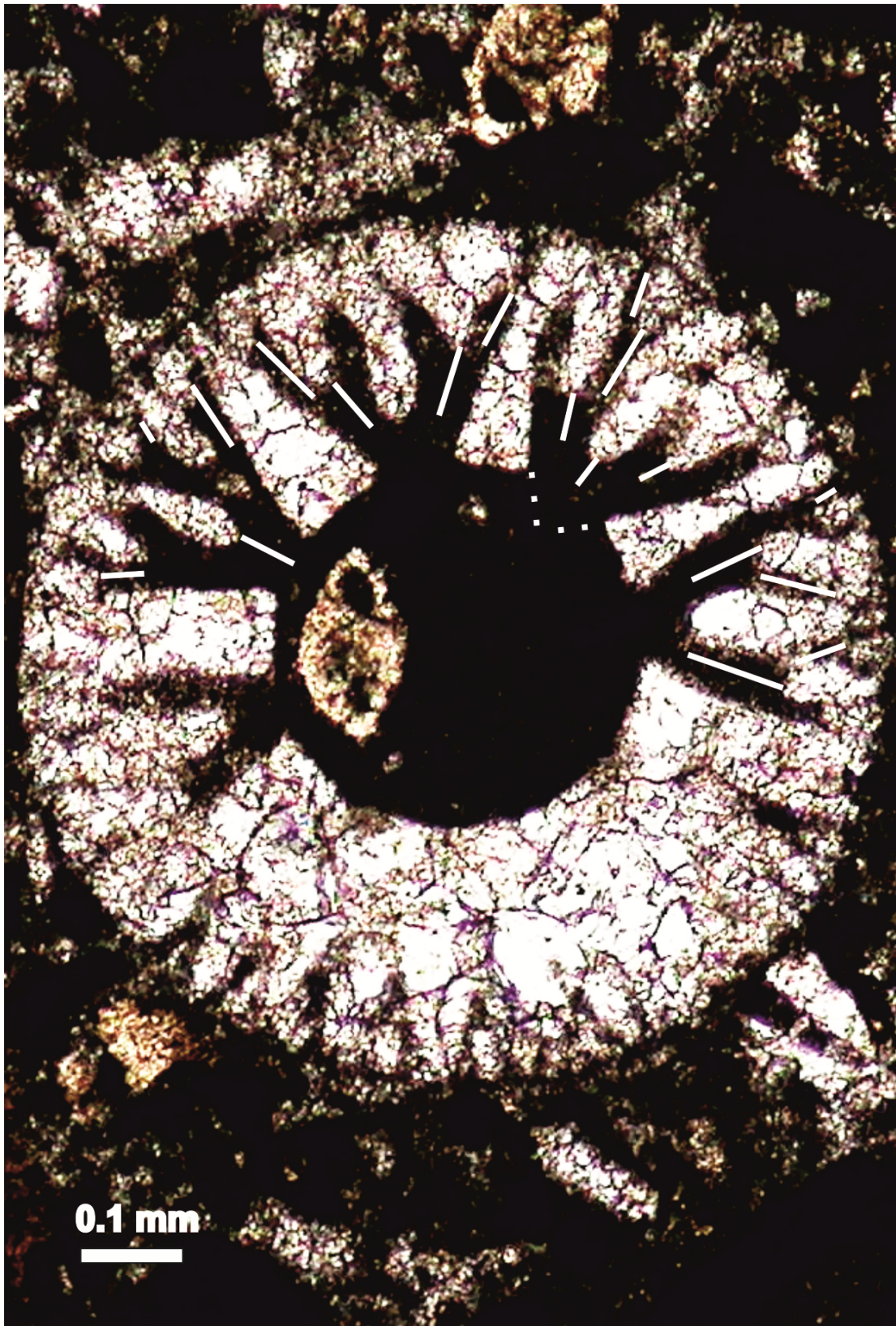


Fig. 3 *Belzungia barattoloi* sp. nov., enlarged slightly oblique transverse section of the whorl shown in the Fig. 4d. Assemblages of branches in this whorl are varying in form and dimension of their elements (white lines); even an assemblage of branches has more or less different length of the same order branches. Dotted line: the portion of the primary branch not enclosed by the skeleton, because this part corresponds to the mucilage layer around the main stem membrane. In the distal part of the skeleton (lower in the figure) 4th order branches are well visible growing in slightly different plane in relation to those in proximal part of the assemblage.

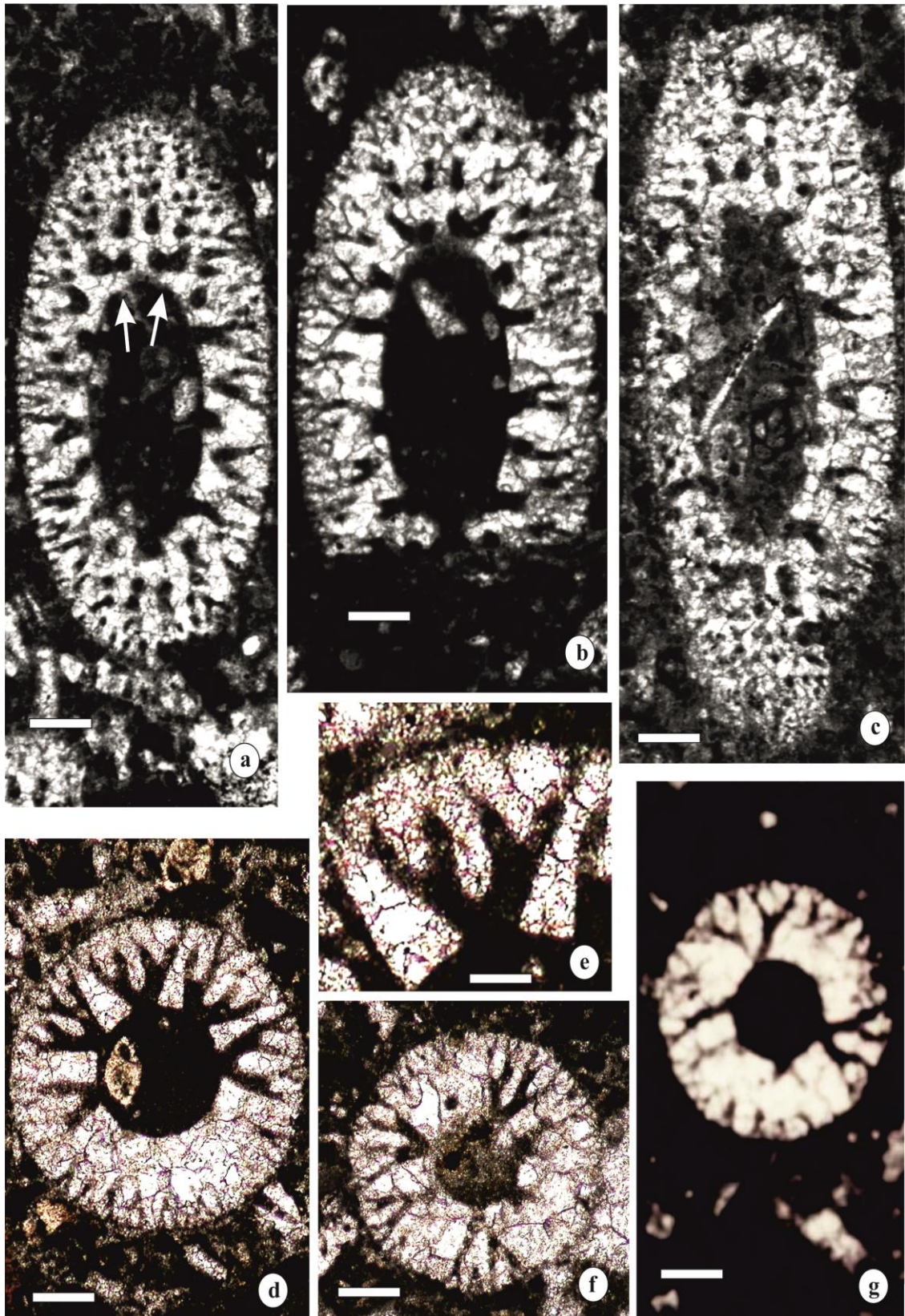


Fig. 4 a to f *Belzungia barattoloi* sp. nov. **a** Holotype, oblique section, notice the top part of primary branches with basal parts of secondaries (arrows), thin section NEK.14b. **b, c** Isotypes, oblique sections, thin section NEK.14f. **d to f.** Isotypes, slightly oblique transverse sections and transverse sections, e, detail of d, thin sections NEK.14g. **g** Transverse section, thin section NEK.13. Scale bars: 0.200 mm, except e: 0.100 mm.

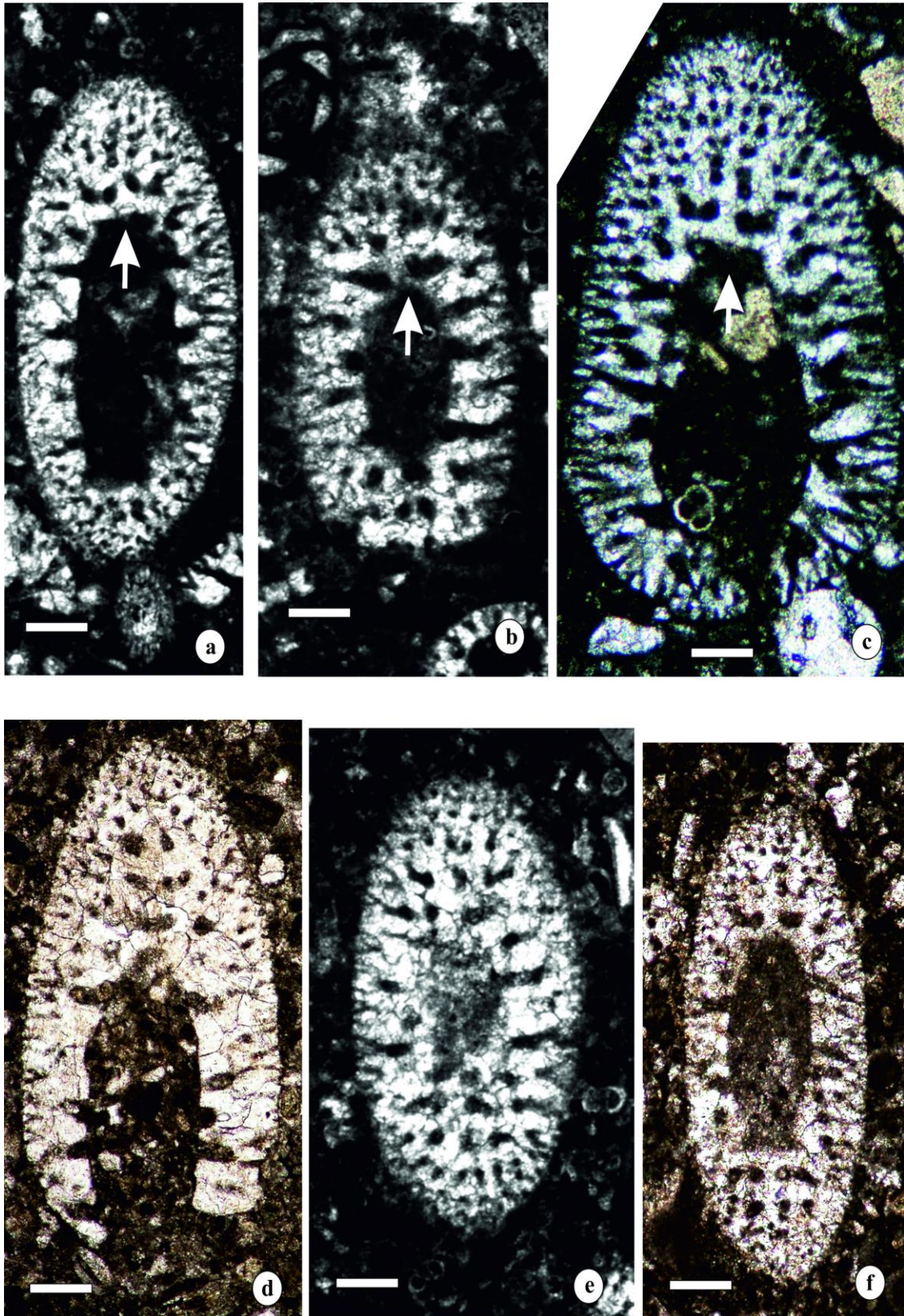


Fig. 5 a to f *Belzungia barattoloi* sp.nov. **a, b** Isotypes, oblique sections, arrows: slight twist of the whorls, thin sections NEK.14i and NEK.14g. **c** Oblique section, notice the basal part of article with ASB in down growing position and slight twist of the whorl (arrow), thin section NEK.15-3. **d to f**. Oblique sections, thin sections NEK.5g, NESAS.7d and NEK.15c. Scale bars: 0.200 mm.

Cycloperitorbitolites tokerae Özgen-Erdem and dasycladalean algae with *Belzungia terquemi*, *B. silvestrii*, *B. pfenderae*, *Anatolia kozyakae*, *Belzungia* sp.3, *Belzungia* sp.4, *Belzungia* spp.

Diagnosis: Cylindrical calcareous skeleton made up of articles with regularly spaced whorls perforated by a system of pores corresponding to assemblage of branches characteristic of the genus anatomy. First three orders of branches are larger, third and fourth orders are somewhat randomly oriented, while last two orders, fifth and sixth, are anarchically arranged (dichotomy in more or less different direction). Reproductive organs unknown. Thick calcareous skeleton of colorless spary calcite. Main stem is not encrusted.

Skeleton: The skeleton is usually more or less strongly recrystallized (blocky sparite). The inner skeleton surface is smooth or uneven. Calcareous sleeve enclosed assemblage of branches (ASB) to the thin cortex layer formed by the fine tiny sixth order branches, resting in rugged outer skeleton surface pierced with numerous minute pores (Fig. 4a-e). Primary branches usually are only in part enclosed by skeleton. Therefore, large pores at inner skeleton surface correspond to the nearly middle part of the length of primaries (Fig. 3, Fig. 4d). Primaries are massive, in the transverse section sub-triangular in form distally enlarged, in the vertical section are of the same thickness. In successive transverse sections from proximal to its distal part pores are circular, than oval and gradually oval enlarged to the distal end, below dichotomy (Fig. 4a arrows, d; Fig. 5c). The transverse section of the distal portion, depending of preservation (recrystallization), is more or less orthogonal in form (Fig. 5f, Fig. 6h). In the lower part of the oblique section on the Fig. 5c, through basal portion of the article, the assemblage of branches is in the downwards growing vertical position.

A rather insignificant deformation of the whorls has been noticed in some specimens, showing a slight twist of the whorl. When occasionally occurring in the whorl, it continues in all successive whorls of the same article, which is well visible in Fig. 5a-c (arrows).

Biometrical data: The longest observed skeleton is 2.20 mm; external diameter 0.343 - 1.00 mm; diameter of the axial cavity range from 0.12 to 0.42 mm; wall thickness is 0.290 mm; distance between whorls varies between 0.080 and 0.128 mm, and number of assemblages of branches per whorl 6-7 (8?). First two orders of branches cover about half of the skeleton thickness, three orders 80% or, in some cases, even 90%.

The length of branches of the same order varies, not only in one whorl but also in an assemblage (Fig. 3). Measurement made in partly recrystallized slightly oblique transverse section with one poorly and four better preserved ASB (Fig. 3, Fig. 4d) are: D - 0.89 mm, d (cavity) - 0.360 (? 0.37 or 0.38 mm), the calcified part of primaries 0.057 mm (in other sections up to 0.066 mm), secondaries vary from 0.034 - 0.098 mm, tertiaries 0.042 - 0.076 mm and branches of the fourth order 0.022 mm. In the same whorl, assemblages of branches are different. The difference consists in angle respectively in largeness in more or less large pores of proximal part (R1 and R2)

and in the dimensions of the same order branches (Fig. 3). Being different, assemblages have irregular extent on the skeleton surface corresponding to their largeness (Fig. 6e).

Relationships: The skeletons of *B. silvestrii* and *B. pfenderae* are very elongated and relatively narrow. *B. terquemi* shows smaller grade of anarchic structure; the structure seems even fairly regular especially in some tangential and axial or subaxial sections (pores of first, second and third order- Fig. 4a, b and d), it differs also by number ASB per whorl. Some transverse-oblique sections of *terquemi* and *barattoloi* can be very similar. They both have large first three orders of branches, those primaries in *barattoloi* are somewhat massive and of large angle.

Stratigraphic distribution: *Belzungia barattoloi* sp. nov. was described in the Ilerdian levels of Kışlatepe section. The species is also observed in the early-middle Ilerdian of Sarıbayır section and in the Ilerdian-early Cuisian of Kozyaka section.

Belzungia terquemi Morellet, 1908

Fig. 7a-d

Some *B. terquemi* sections from Kışlatepe section are larger than other specimens of recently presented association from this area: d - 0.350 mm, D max. 0.90 mm. Dimensional values on anarchic whorl's structure provided in the transverse section on Fig. 7c with 9 partly and/or poorly preserved ASB, are: D - 0.86 mm, d - 0.36 mm, encrusted part of primary branches reach 0.073 mm length, branches of secondary order varies from 0.56 to 0.108 mm, tertiaries from 0.046 to 0.080 mm, fourth order from 0.032 to 0.046 mm, and the branches of fifth order are about 0.02 mm.

Belzungia sp. 3

Fig. 7e-g

The group of three specimens in transverse and transverse slightly-oblique sections, leave impression of a low grade of anarchic structure. Some smaller difference between them and in the assemblages, are present such as in other species. Their relation to *B. terquemi* is not excluded.

Belzungia sp. 4 (sp. nov.?)

Fig. 8a, b, (c?)

Belzungia of fairly regular structure with especially thicker proximal part of assemblage of branches (primaries and secondaries). Certain difference in relation to presented *Belzungia* is noticeable; it could be new *Belzungia* taxon.

Some of the undetermined species are also illustrated in Fig. 8d-h. Although Kışlatepe limestone contains rich *Belzungia* association, the structural feature of numerous specimens has been more or less overlapped by recrystallization and/or deformation. Many of such specimens were unserviceable to study.

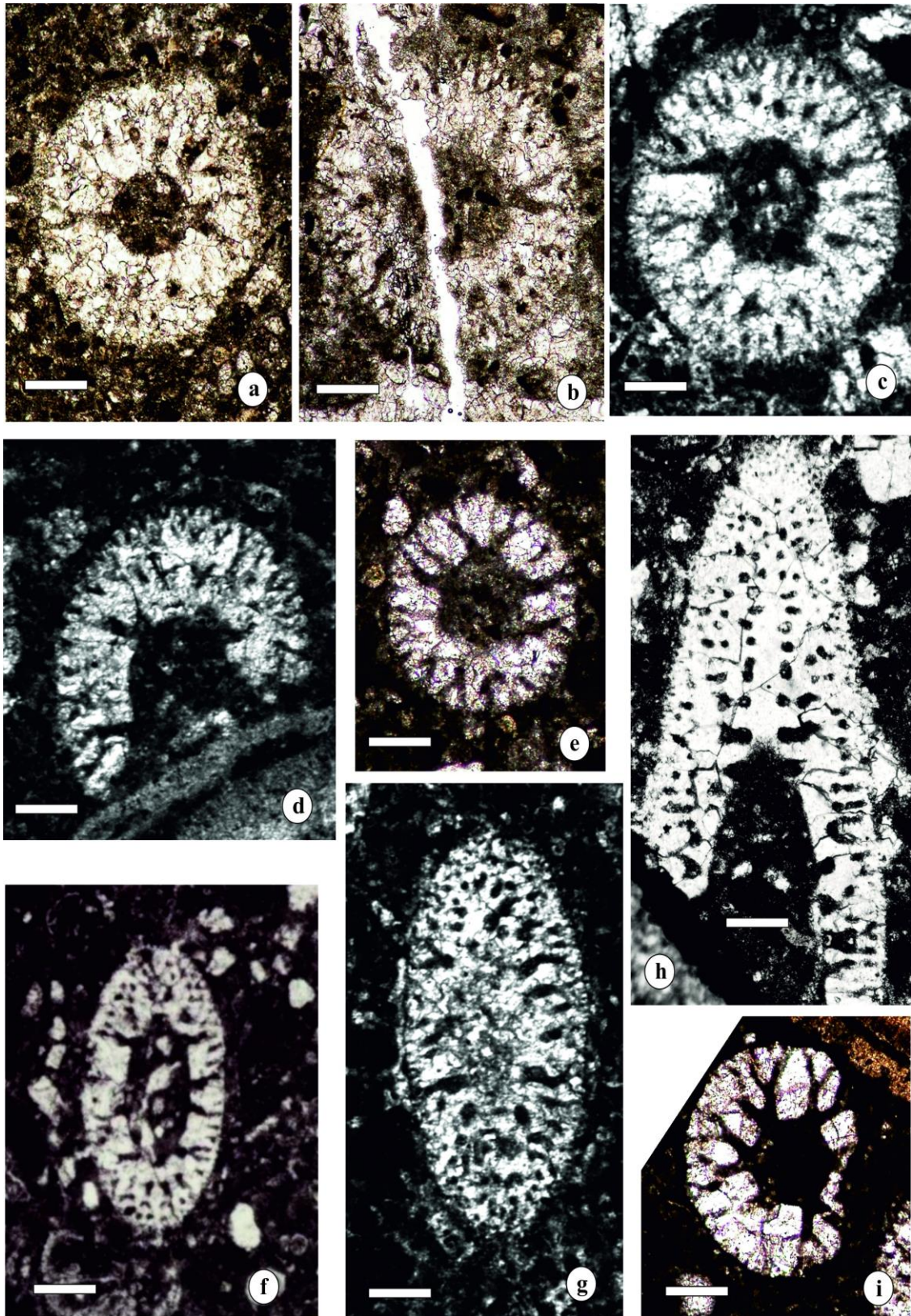


Fig. 6 a to d *Belzungia* cf. *barattoloi* sp. nov., transverse and transverse oblique sections, thin sections; NEK.5, NEK.5, NEK.14m and NEK.15b. **e** Isotype, transverse section, thin section NEK.14g; notice the largest angle of the ASB in the upper part of the figure: 95°. **f, g** Oblique sections, thin sections NEK.5a and NEK.14i, isotype. **h** Tangential - oblique section of large skeleton fragment, thin section NEK.8. **i** Isotype, transverse slightly oblique section with 6 ASB, thin section NEK.14h. Scale bars 0.200 mm.

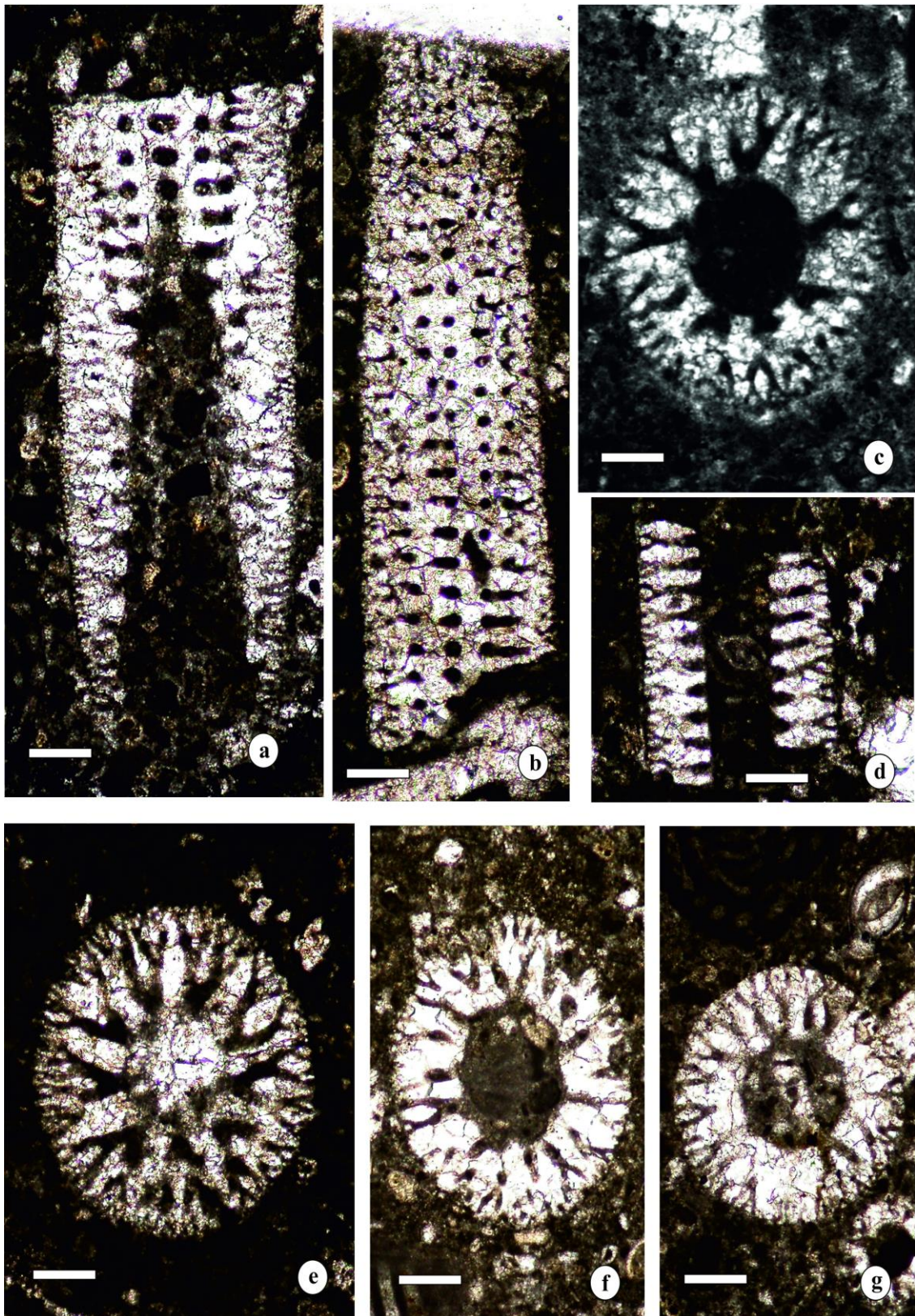


Fig. 7 a to d *Belzungia terquemi* (Michelin, 1846). a, b Oblique partly tangential and tangential sections, thin sections NEK.14g. c Slightly oblique section, thin section NEK.14g. d Subaxial section, thin section NEK.14h. e to g. *Belzungia* sp.3, slightly oblique and transverse sections, thin sections NEK.14f, NEK.14b and NEK.15b. Scale bars: 0.200 mm.

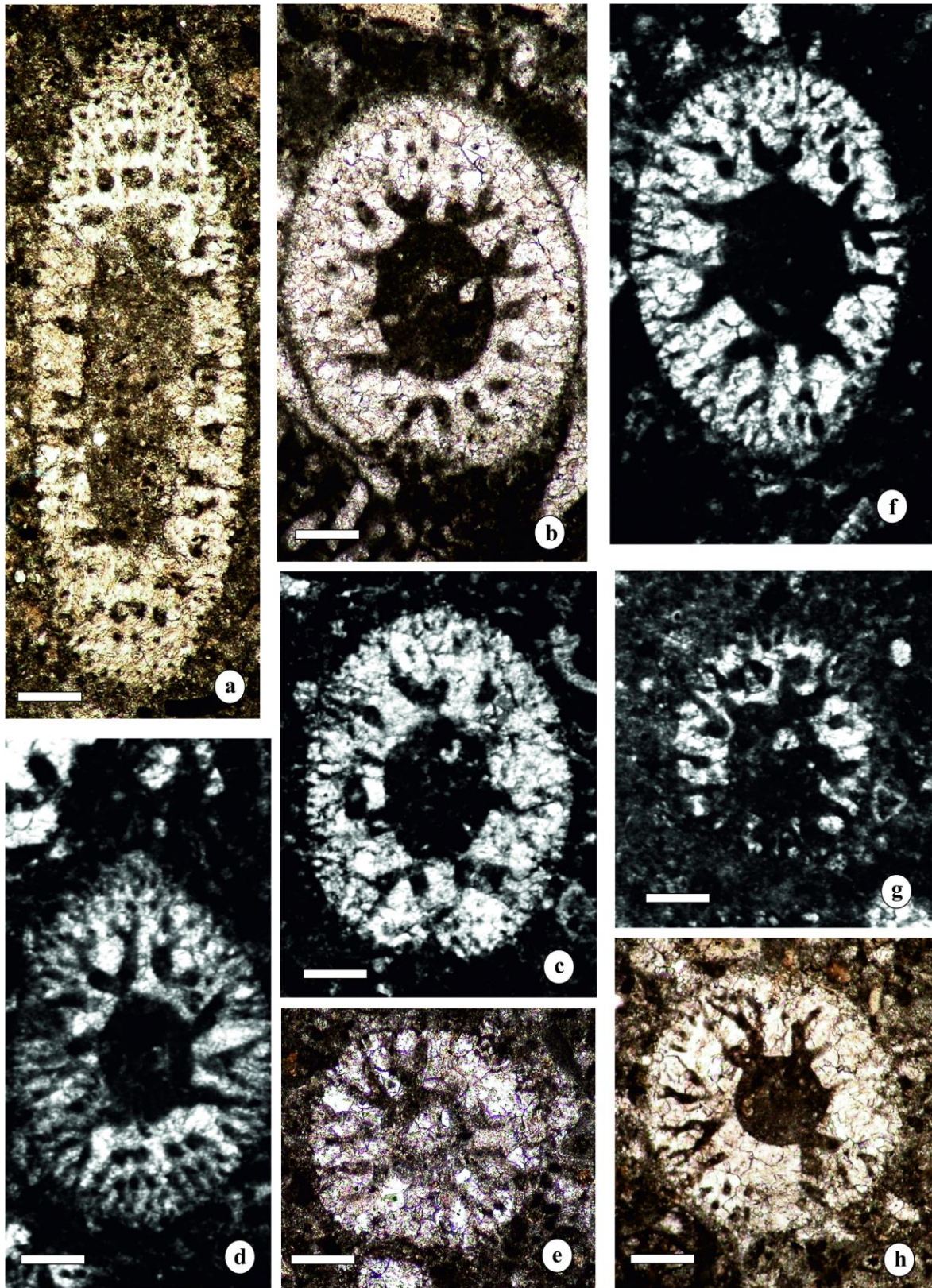


Fig. 8 a, b, (c?). *Belzungia* sp.4 (sp. nov.?), oblique - longitudinal and slightly oblique transverse sections, thin sections; NES.5a, NEK.14b and NEK.14i). **d** to **h**. *Belzungia* undetermined species, thin sections; NEK.14n, NEK.14g, NEK.14g, NEK.14f, NEK.5g. Scale bars: 0.200 mm.

Lower Eocene Dasycladales of Seyitgazi Region

The list of presented species includes:

Tribus Thyrsoporelleae (Pia 1927) Elliott 1997

Genus *Belzungia* Morellet 1908

Belzungia terquemi Morellet & Morellet, 1917

Belzungia silvestrii (Pfender in Pfender & Massieux, 1966) Radoičić & Özgen-Erdem, 2010

Belzungia pfenderae Radoičić & Özgen-Erdem, 2010

Belzungia barattoloi sp.nov.

Belzungia sp. 1

Belzungia sp. 2

Belzungia sp. 3

Belzungia sp. 4 (sp. nov.?)

Genus *Anatolia* Radoičić & Özgen-Erdem, 2010

Anatolia kislai Radoičić & Özgen-Erdem, 2010

Anatolia kozyakae Radoičić & Özgen-Erdem, 2010

Anatolia? sp.

Thyrsoporella sp.1

Other Dasycladales:

Furcoporella diplopora Pia (in Trauth), 1918

Furcoporella? sp.

Dissocladella aff. *gracilis* Radoičić, 1991

Uteria aff. *merienda* (Elliott 1955)

Uteria sp.

Acicularia aff. *tavnae* Radoičić, 1991

Clypeina? *tekini* Özgen-Erdem & Radoičić (in press)

Cymopolia sp.1

Cymopolia sp.2

Neomeris sp.

Salpingoporella? sp.

and some not presented undetermined / unknown species.

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