Middle Triassic radiolarians from the Dolomites, Southern Alps, Italy

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ABSTRACT

In this paper, the taxonomy, biostratigraphy and stratigraphic range of Late Anisian (Illyrian) to Ladinian (Fassanian-Longobardian) radiolarians are examined from three continuous successions of the "Buchenstein Beds" (Livinallongo Formation) from the Seceda area, Dolomites in Northern Italy. The investigated sections contain well-preserved and diverse radiolarian assemblages, with 76 genera and 180 species, including one new genus and 18 new species. The richest and well-preserved radiolarian horizon belongs to the transition between the *Spongosilicarmiger transitus* and *Spongosilicarmiger italicus* Radiolarian Zones. This horizon is equivalent in age to the *Reitziites reitzi* Ammonoid Zone (*Reitzi* Subzone to *Avisianum* Subzone) and *Paragondolella? trammeri* Conodont Zone. This study provides new insights into the stratigraphic ranges of 180 species. The revisions to stratigraphic ranges indicate that the late Anisian (Illyrian) had a higher diversity of radiolarians than previously reported.

KEY WORDS

Middle Triassic, Radiolaria, Biostratigraphy, Paleobiogeography, Buchenstein Basin, Seceda

1. INTRODUCTION

The origin of this project goes back more than 25 years. In the mid-1990s, two possible candidate Anisian/Ladinian boundary sections were identified for the Global Boundary Stratotype Section and Point (GSSP) of the base of the Ladinian stage: the Bagolino section (Southern Alps), Italy and the Felsőörs section, Balaton Highland, Hungary. Eventually, the GSSP was defined in the Caffaro river bed close to the Bagolino village in the renowned "Buchenstein Beds" (Livinallongo Formation) at the base of the *Eoprotrachyceras curionii* ammonoid Zone and the first appearance of *Neogondolella praehungarica* conodont species (e.g. Brack et al., 2005). In the accepted global reference section, mainly marine invertebrate fossils provided the primary basis for positioning the GSSP. The Middle Triassic macro- and microfaunas of this section and generally from the Southern Alps have been increasingly well-documented over a century and many of these groups have provided essential data for constructing the Middle Triassic timescale. The particularly important fossil groups in this regard are ammonoids, bivalves, conodonts, foraminifers, palynomorphs and last but not least, radiolarians. Unfortunately, the Bagolino GSSP reference section contains no sufficiently preserved radiolarians, which hampers the direct correlations of ammonoids, conodonts and radiolarians. In contrast, the investigated sections around Seceda include rich radiolarian communities along with ammonites and *Daonella* (Brack & Rieber, 1993), conodonts (Muttoni et al., 2004), foraminifers (Maurer & Rettori, 2002) and palynomorphs (Hochuli et al., 2015). Consequently, this work illustrates that radiolarians might play an especially important role in the Middle Triassic biostratigraphy and presents a description and illustration of 180 species in 76 genera including 18 new radiolarian species and 1 new genus from the Seceda area in the Dolomites, Southern Alps. In addition, this report from the Seceda Mountains is the first in a series of publications dealing with the taxonomy, phylogeny and evolution history of Triassic radiolarians from the Western Tethyan area.

2. PALEOGEOGRAPHY AND GEOLOGICAL SETTING OF THE DOLOMITES

The Dolomites are one of the most spectacular mountain chains in the Southern Alps – External Dinarides domain (Fig. 1) which tectonically represent allochthonous units of the Adriatic Plate. The Adria-derived allochthon units comprise dominantly continental crust (Fig. 2) that remained loosely attached to Gondwana during and after Mesozoic rifting (e.g. Stampfli, 2005). The Adriatic plate (Apulian Plate) was pushed into the Eurasian continental lithosphere through the convergence between the Eurasian and African plates during Cretaceous–Cenozoic times (e.g. Battaglia et al., 2004). Conversely, the motion of Adria-derived allochthon units suggests that they are completely independent of both the African continent and the Eurasian plate's movement (e.g. Battaglia et al., 2004).
The Dolomites were located on a wide passive continental margin of the Neotethyan ocean (Fig. 2) from the Early Triassic (e.g. Brack et al., 1999). They are characterized by massive early Mesozoic carbonate buildups, affected by active transtensional tectonic activity, associated with differential subsidence and uplift and a significant volcanic event during the Middle Triassic (e.g. Brack & Rieber, 1993). In the early

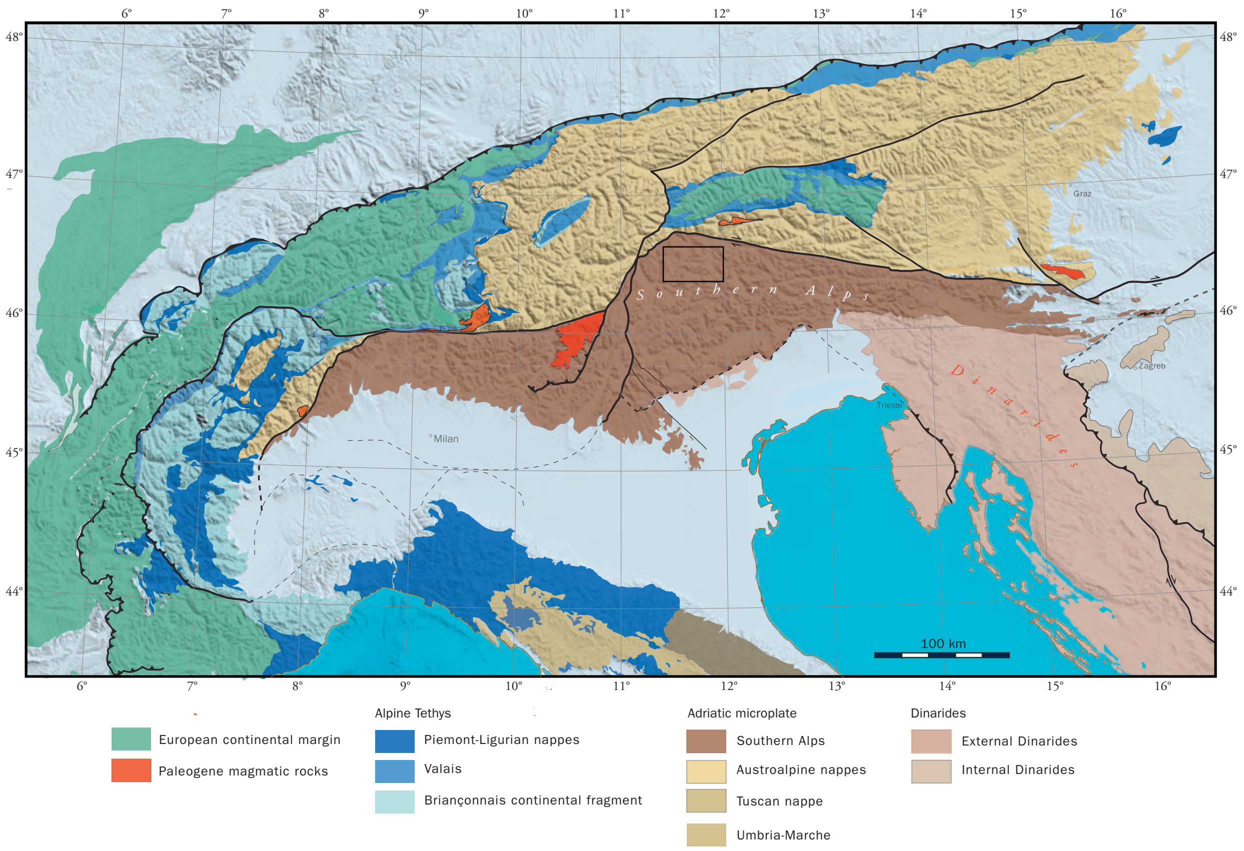


FIGURE 1. Generalised tectonic map of the Alps and Dinarides, showing the location of the Dolomites in the Southern Alps (simplified after Schmid et al., 2004; Bousquet et al., 2012).

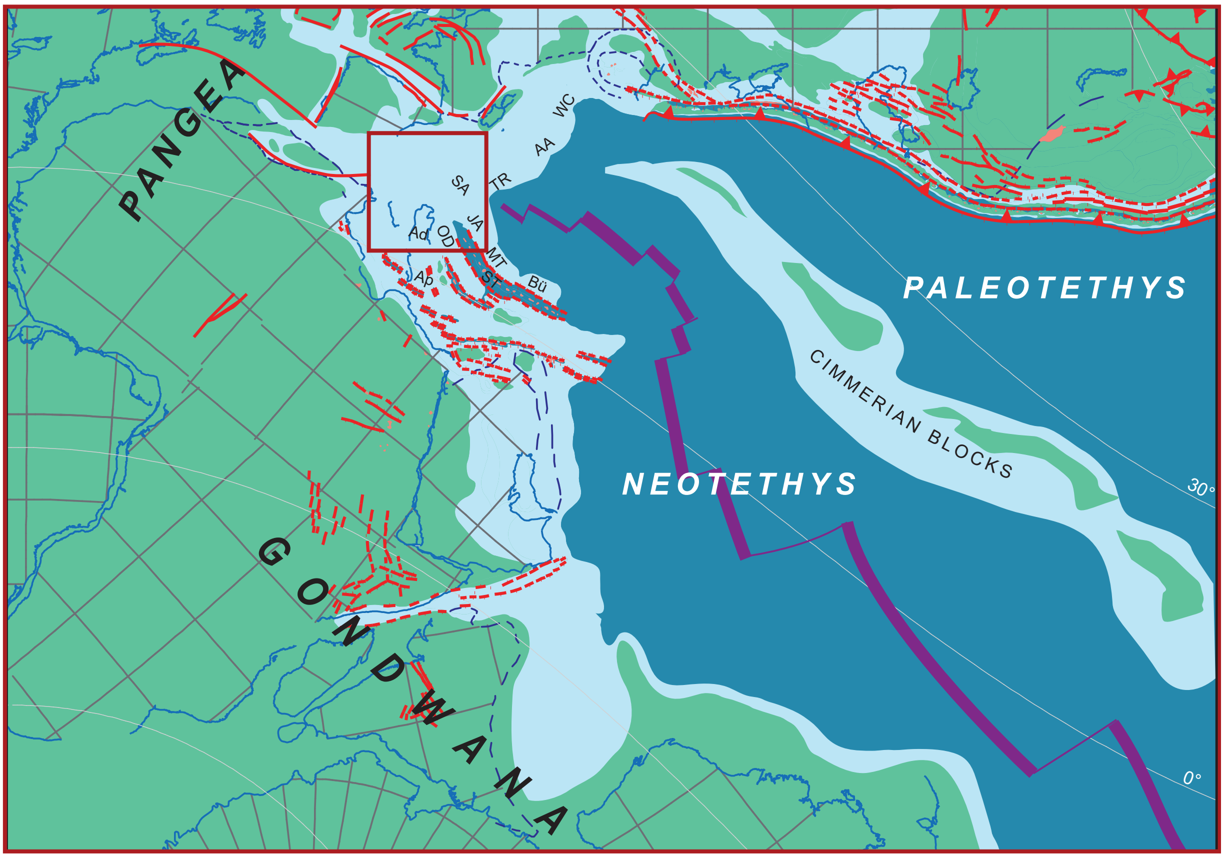


FIGURE 2. Palaeogeographic reconstruction for the Anisan showing the Southern Alpine (SA) location, including Seceda and the Dolomites (after Barrier et al., 2018). AA = Austroalpine units, Ad = Adria, Ap = Apulia, Bü = Bükk, JA = Julian Alps, MT = Mid-Transdanubian unit, OD = Outer Dinarides, ST = Slovenian Trough, TR = Transdanubian Central Range, WC = Western Carpathians.

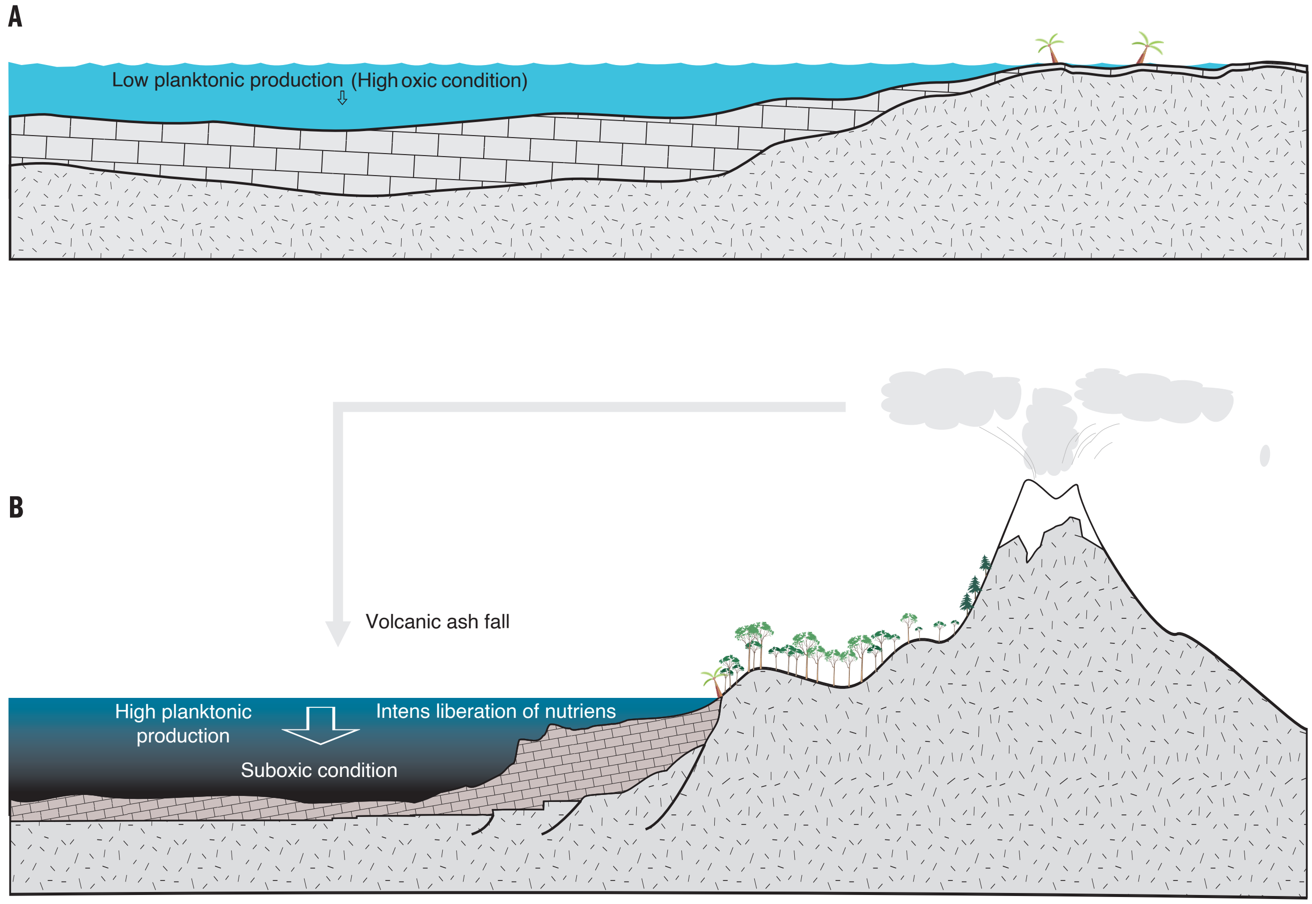


FIGURE 3. Conceptual depositional model for the Seceda area during the Late Anisian: A. Carbonate platform system built from the Late Anisian; B. In some areas the carbonate system was drowned by the increasing subsidence and a relatively deep basin formed during the latest Illyrian. Organic-rich sediments, reworked platform carbonates and siliceous pelagic carbonates accumulated in various thicknesses in the hemipelagic basin. Additionally, this formation contains a large amount of characteristic volcanoclastic materials (*pietra verde*) as well. Suboxic or low oxic conditions often existed in bottom waters.

Middle Triassic, shallow-water carbonate-producing environments developed with regionally different subsidence histories. During the late Anisian, the western part of the Dolomites was uplifted and subaerially eroded, locally exposing Permian sediments (e.g. Bosellini, 1968), while subsidence was still active throughout the eastern Dolomites (Bosellini et al., 2003). In the latest Anisian, the carbonate platform system was drowned through increasing subsidence and a relatively deep (up to 800 m) basin system formed between remaining and fast upbuilding carbonate platforms (e.g. Bosellini & Rossi, 1974, Gaetani et al., 1981). Organic-rich sediments, reworked platform carbonates and siliceous pelagic carbonates accumulated in various thicknesses in the hemipelagic basin (Livinallongo Formation = "Buchenstein Beds"). Additionally, this formation contains a large number of characteristic volcanoclastic layers ("pietra verde") as well (Brack & Rieber, 1993). Suboxic or low oxic conditions often characterized the bottom waters, while a rich biocommunity existed in the surface waters, as evidenced by rich ammonite, planktonic bivalve and radiolarian faunas (Fig. 3). During the Ladinian, mafic magmatism became widespread and dominant in the Dolomites (e.g., Doglioni, 1987). The deep interplatform basins were rapidly filled with massive erosional products (megabreccias, olistholits, etc.), and volcanic materials (pillow lavas, hyaloclastite).

2.1 THE BUCHENSTEIN BASINS

The Middle Triassic palaeogeography in the Dolomites was mainly characterized by shallow carbonate platforms bound by narrow but relatively deep basins (e.g. Bosellini, 1984; Brack & Rieber, 1993). In these basins, the classical "Buchenstein Beds" (Buchenstein/Livinallongo Fm. of the Buchenstein Group sensu Viel, 1979) formed. The name "Buchenstein" was introduced by Richthofen (1860) for a characteristic and up to 70 m thick succession consisting of siliceous carbonates, carbonate turbidites and fine to coarse-grained volcanoclastic layers (Viel, 1979; Brack & Rieber, 1993; Brack et al., 2000, etc.). The "Buchenstein Beds" were subdivided by Mojsisovics (1879) into three main lithological units. Based on a quite detailed revised description of Brack & Rieber (1993), the three units are the following: 1. The lower Plattenkalke, organic-rich, thin-bedded, dark grey siliceous limestone to dolomitic mudstone. This unit contains the best preserved and rich radiolarian material, and also contains large amounts of *Daonella* shells; 2. The Knollenkalke part of the "Buchenstein Beds" consists of bedded, wavy to nodular limestone with common cherty nodules. This part shows intense silicification, difficult the extraction of identifiable radiolarian material; 3. The Upper Bänderkalke unit is somewhat similar to the Lower Plattenkalke and again contains radiolarians and pelecypod shells (*Daonella* spp.). The "Buchenstein Beds" also comprise usually

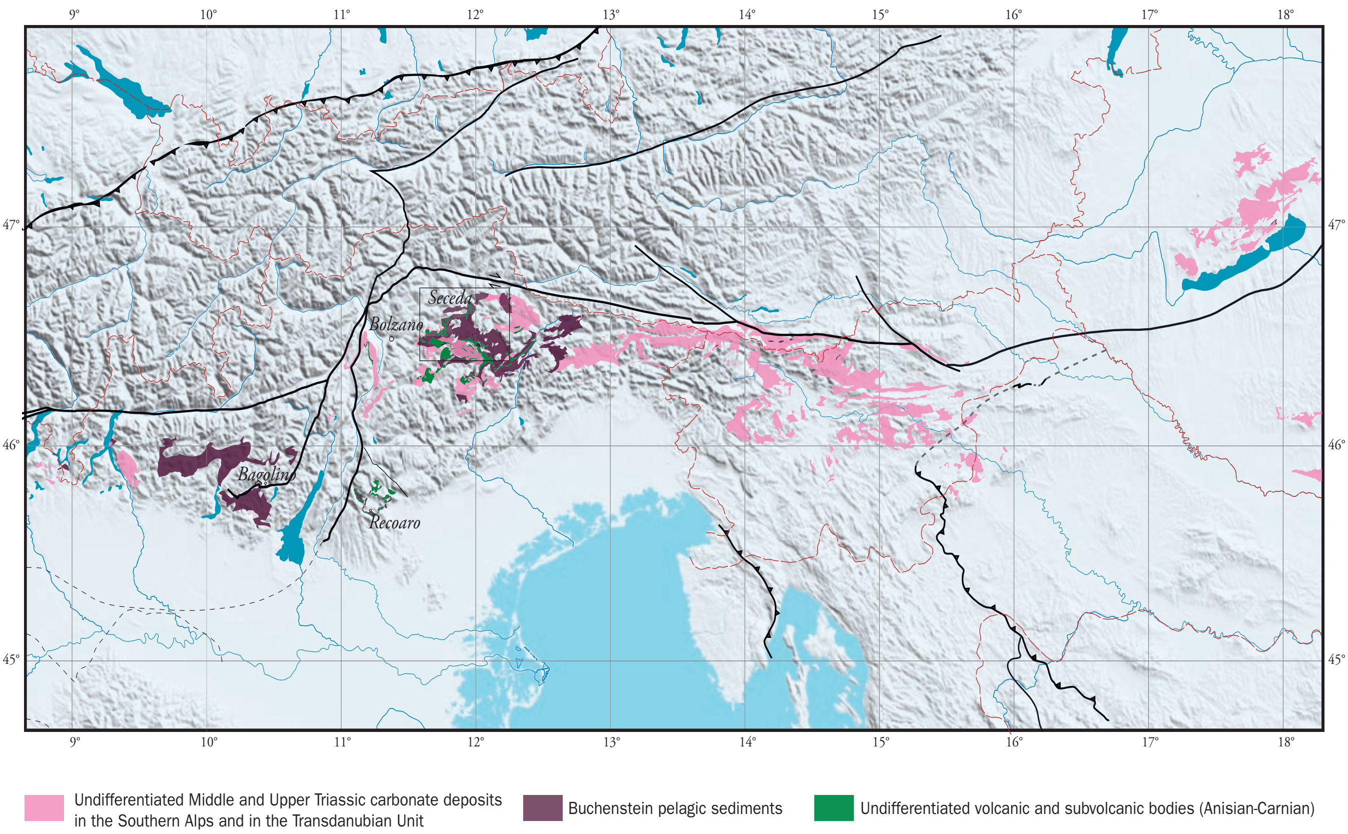


FIGURE 4. Generalised distribution of Triassic sediments and volcaniclastics from the Southern Alps to the Transdanubian Central Range, including the "Buchenstein Beds" which also appear in the Carnic Alps, in the Julian Alps, in the Southern Karavanke and further north-eastward as comparable lithologies in the Balaton Highland, Hungary. Modified after Bigi et al. (1990; Southern Alps and Northern Dinarides) and Fülöp (1984, Transdanubian Central Range).

greenish to reddish volcanoclastic material (*Pietra verde*) throughout the entire succession. Such intervals range from a few millimetres thin ash layers to massive, several meters thick volcanoclastic strata.

The characteristic Buchenstein-type successions or portions of it are widespread in the entire western Neotethyan domain (Fig. 4). However, such intervals are often referred to by different names. "*Nodosus* Formation" (Tornquist, 1898) is still used in the Vicentinian Alps (Recoaro and Tretto). "Reitzi-Schichten" (Salomon, 1908) and "Reitzi-Kalke" (Horn, 1913) are older names from the Southern Alps (Brack & Rieber, 1993). "*Tridentinus* limestone" was used for "Buchenstein Beds" in Balaton Highland (Böckh, 1872) and Budai (1992) revised the equivalent lithostratigraphic units as Buchenstein Group in this area. The Reifling Formation of the Northern Calcareous Alps comprises Buchenstein-type lithologies and similar intervals further occur in the Carnic Alps (Krainer & Lutz, 1995), in the Julian Alps (Gianolla et al., 1998; Celarc et al., 2013) and along the Southern Karavanke (Krainer & Mostler, 1992) (Fig. 4).

3. STUDIED SECTIONS

The late Anisian (Illyrian) radiolarian fauna presented in this paper was obtained from the Seceda drill core, from a closely tied Seceda outcrop and a bit further afield, from the Frötschbach section. All sections straddle the Anisian–Ladinian boundary interval (*R. reitzi* ammonoid zone to *E. curionii* zone). The Seceda core and section also reach younger Ladinian levels (*Frankites regoledanus* ammonoid zone) of presumably the lowermost Wengen Formation (Hochuli et al., 2015).

3.1 FRÖTSCHBACH SECTION

A detailed magnetostratigraphic and lithostratigraphic log from the Frötschbach section was published by Muttoni et al. (1996, 1997) and Brack & Muttoni (2000) (Fig. 5). The section exposes (Fig. 6) ca. 40 meters of the lower Plattenkalk and Knollenkalke part of the "Buchenstein Beds" and stratigraphically ranges from the *Reitzi* ammonoid zone to the "*Gredleri*" ammonoid zone (Brack & Muttoni, 2000). In 1996, Kozur & Mostler began with investigations of radiolarian fauna from four samples collected by Hans Rieber from the lowermost part of the Frötschbach section. More than 250 SEM pictures were taken but no results of the well-preserved radiolarians from this section were published. In 2010, Heinz Kozur managed to hand over to the first author (PO) the complete

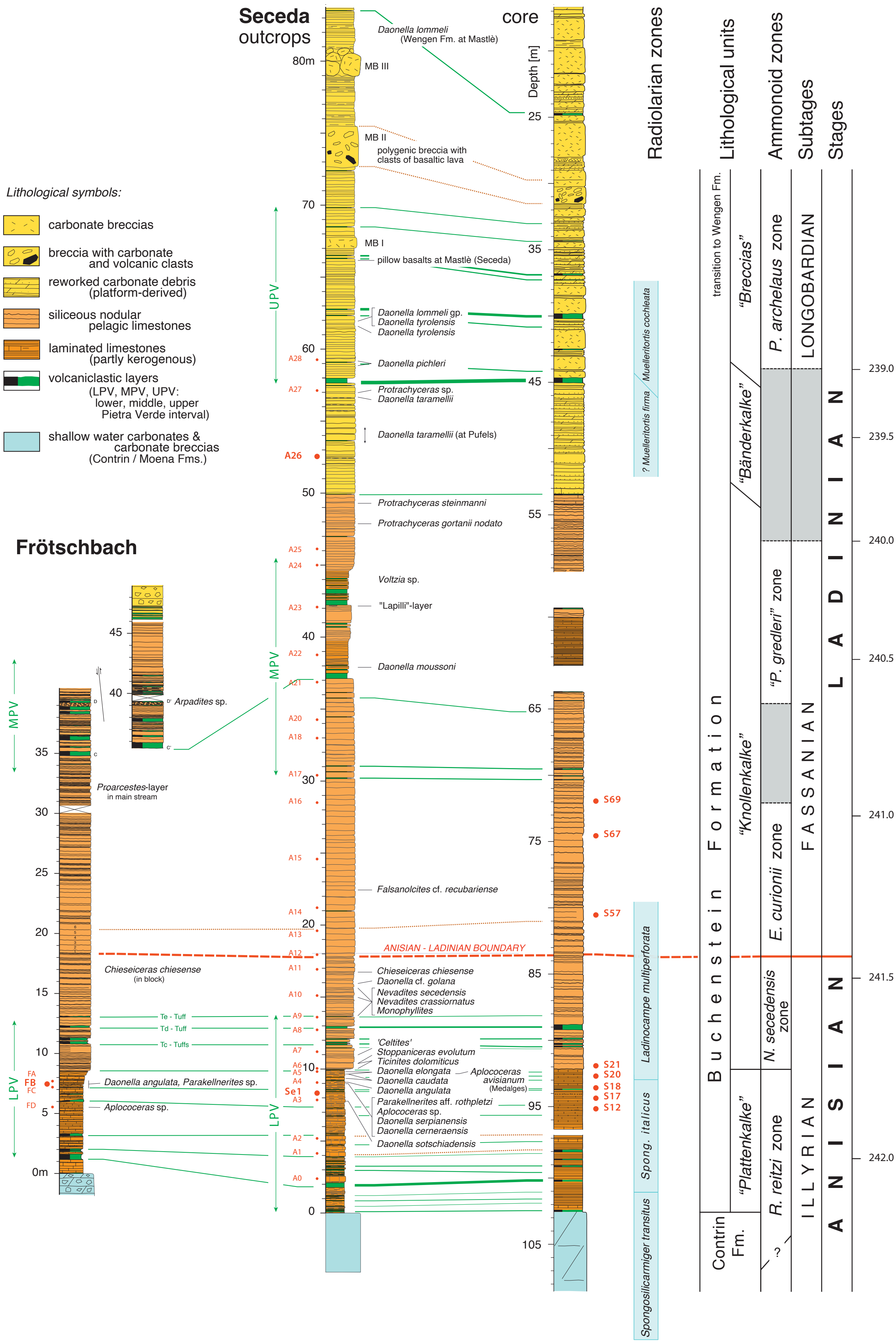


FIGURE 5 - Positions of radiolarian samples in the investigated sections at Frötschbach, Seceda and in the Seceda drill core (red dots). The productive samples as reported in this article are highlighted. Numeric ages and metric scale for Seceda are from Wotzlaw et al. (2018) and updated with respect to earlier representations (e.g. Brack & Rieber, 1993, Brack et al., 2000, 2005). The Frötschbach column is redrawn after Muttoni et al. (1997, 2004).

FIGURE 6. View of the first 25 metres of the Livinallongo Formation ("Buchenstein Beds") along the northeast bounding cliff of the Frötschbach creek (c. 1320m altitude in creek). The volcaniclastic markers Tc-Te are indicated. Beds of the interval shown here for Frötschbach can be traced on a layer basis to the corresponding interval at Seceda (Fig. 8).

residuum of the samples from Frötschbach along with the unpublished SEM pictures. Thereafter, PO rephotographed the residuum material and more than 800 SEM pictures were taken of the well-preserved radiolarians helping to fully assess this interesting and rich material.

3.2 SECEDA SECTION

The Seceda section represents one of the most complete successions of the "Buchenstein Beds" (Fig. 7) in the Dolomites and the first detailed log of this outcrop was published by Brack & Rieber in 1993 (Fig. 5). The section exposes 70 meters of the Buchenstein units from the lower Plattenkalke to the topmost breccias. Twentytwo samples (Se-1 and A1–A21) were taken by HR and PB from the base of the section (lower Plattenkalke to the middle part of the Knollenkalke unit) at the first cliffs immediately northwest of the Seceda cablecar station. Additional 8 samples from the upper part of the Seceda section were sampled in a steep gully on the northern slope of Seceda, approximately 500 m east of the peak. Sample Se-1 from the lower Plattenkalke, was taken in an interval rich in *Daonella* bivalve shells (*D. angulata, D. caudata, D. serpianensis, D. sotschiadensis*) (Fig. 5). This Seceda outcrop section has been correlated in detail with Buchenstein successions elsewhere in the Dolomites (Fig. 8; Brack & Muttoni, 2000; Muttoni et al., 2004).

FIGURE 7. The lower part of the Livinallongo Formation ("Buchenstein Beds") in the cliff south of the Seceda cable car arrival. The dark c.10 metres thick "Plattenkalke" follow with a sharp contact on top of the bright dolomitized shallow water carbonates of the Contrin Formation and are overlain by regularly bedded "Knollenkalke" (cherty nodular limestones). Volcaniclastic markers Tc-Te are indicated (see Fig. 5).

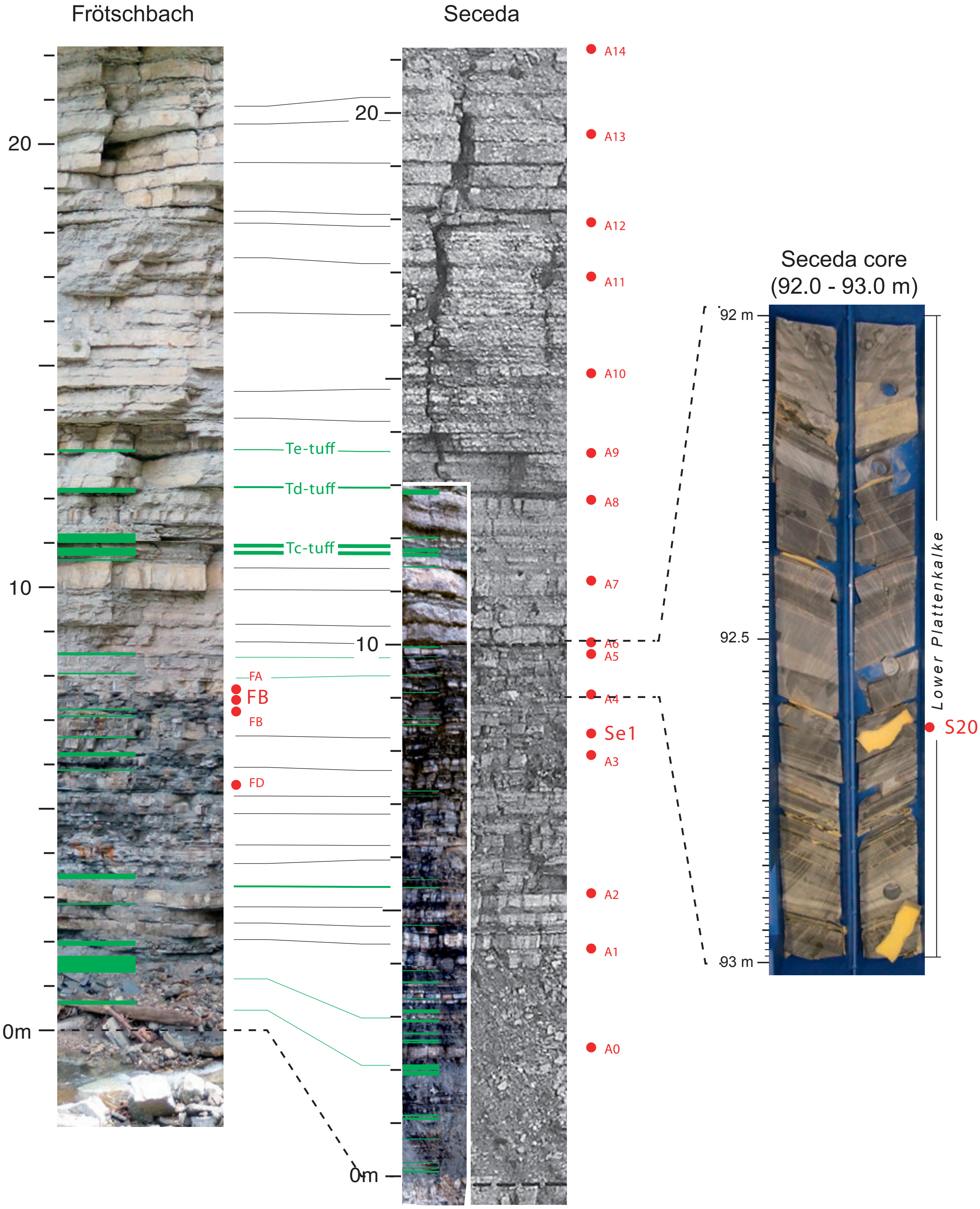


FIGURE 8. Bed-by-bed correlation of the "lower Plattenkalke" and lowermost part of "Knollenkalke" outcropping at Frötschbach, Seceda and Seceda core (see Fig. 5 for overview logs). Red dots mark the positions of the samples studied for radiolarians. Green bars indicate volcaniclastic layers.

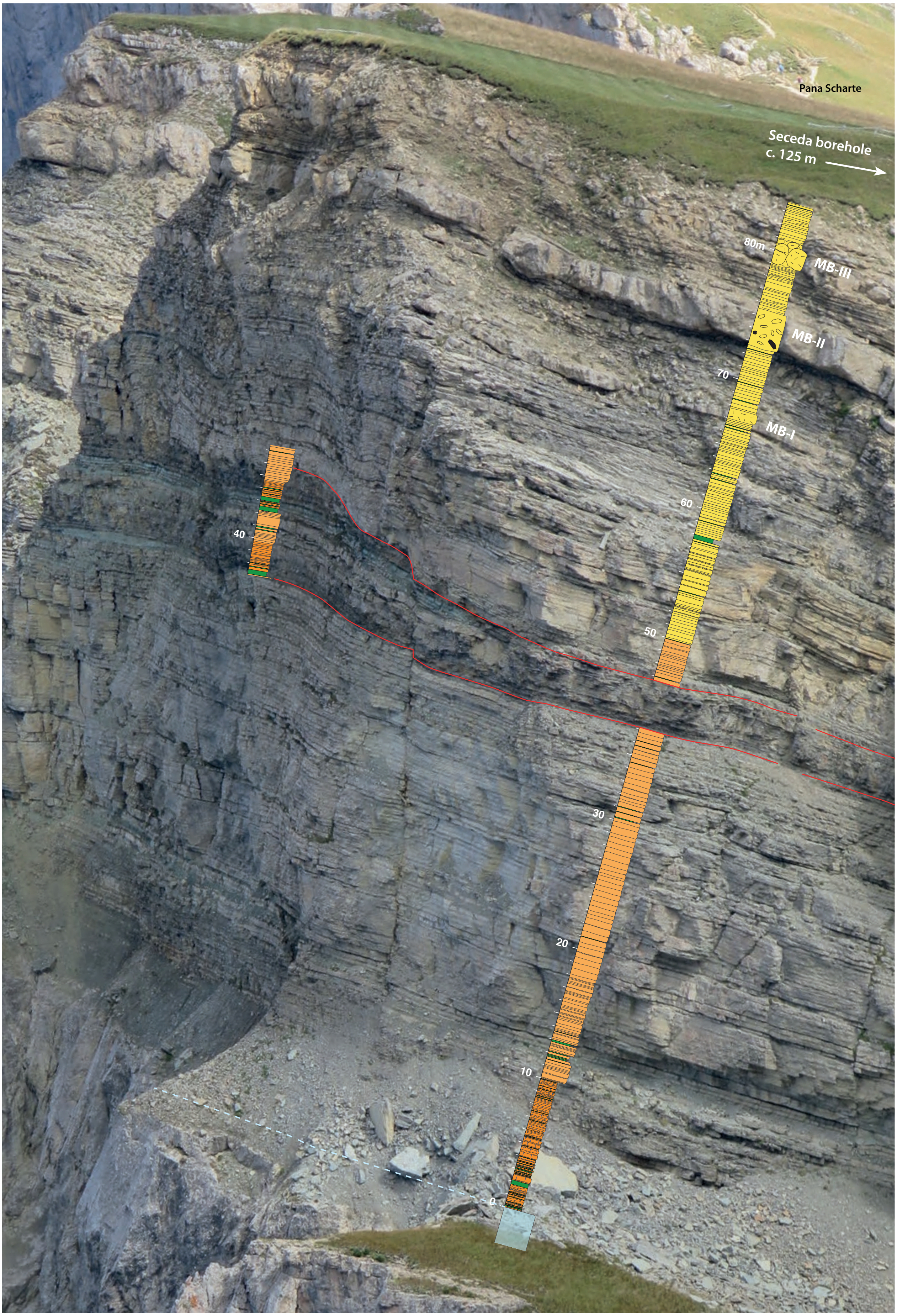


FIGURE 9. View of the steep cliff c. 350 m east of the Seceda peak, with the outcrop log of Fig. 5. The metrics of this log are as in Wotzlaw et al. (2018), i.e. revised with respect to older illustrations of the section in Brack & Rieber (1993), Brack et al. (2000, 2005) and Hochuli et al. (2015).

3.3 SECEDA CORE

In 1998 the Seceda borehole (Brack et al., 2000) was drilled for research purposes through a complete succession of Middle Triassic pelagic "Buchenstein Beds" (Fig. 9). The borehole penetrated 109 m of sediments, of which Buchenstein strata were recovered over 88 m of thickness (Fig. 5). The core has been extensively studied in the last two decades. Maurer & Schlager (2003) and Maurer et al. (2003, 2004) provided a sedimentological model and cyclostratigraphic analyses. Integrated biochronological studies include magnetostratigraphy and biostratigraphy (Muttoni et al., 2004), benthic foraminifera (Maurer & Rettori, 2002), conodonts (Muttoni et al., 2004) and palynolomorphs (Hochuli et al., 2015).
The Livinallongo Formation ("Buchenstein Beds") contains four different lithostratigraphic units in the core which were sampled for this study between 102.8 m and 36,95 m core depth levels (Fig. 5): a single sample comes from the top of the Contrin Formation, 20 samples from the "lower Plattenkalke" and 70 samples were taken from the "Knollenkalke" and "Bänderkalke". 7 samples are from the topmost "Breccias" part of the core. A total of 98 samples were taken from the entire borehole.

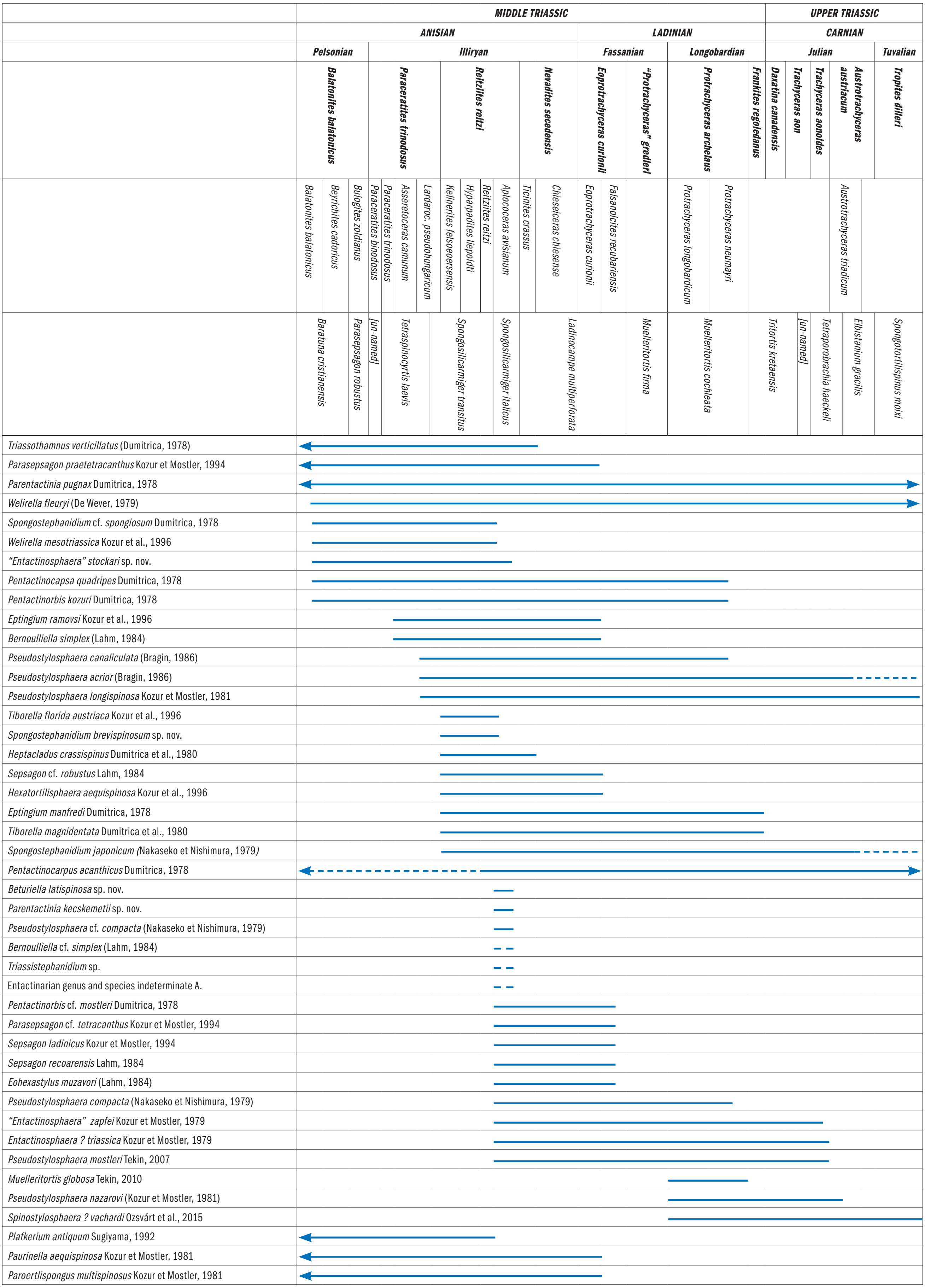
4. METHODS AND MATERIALS

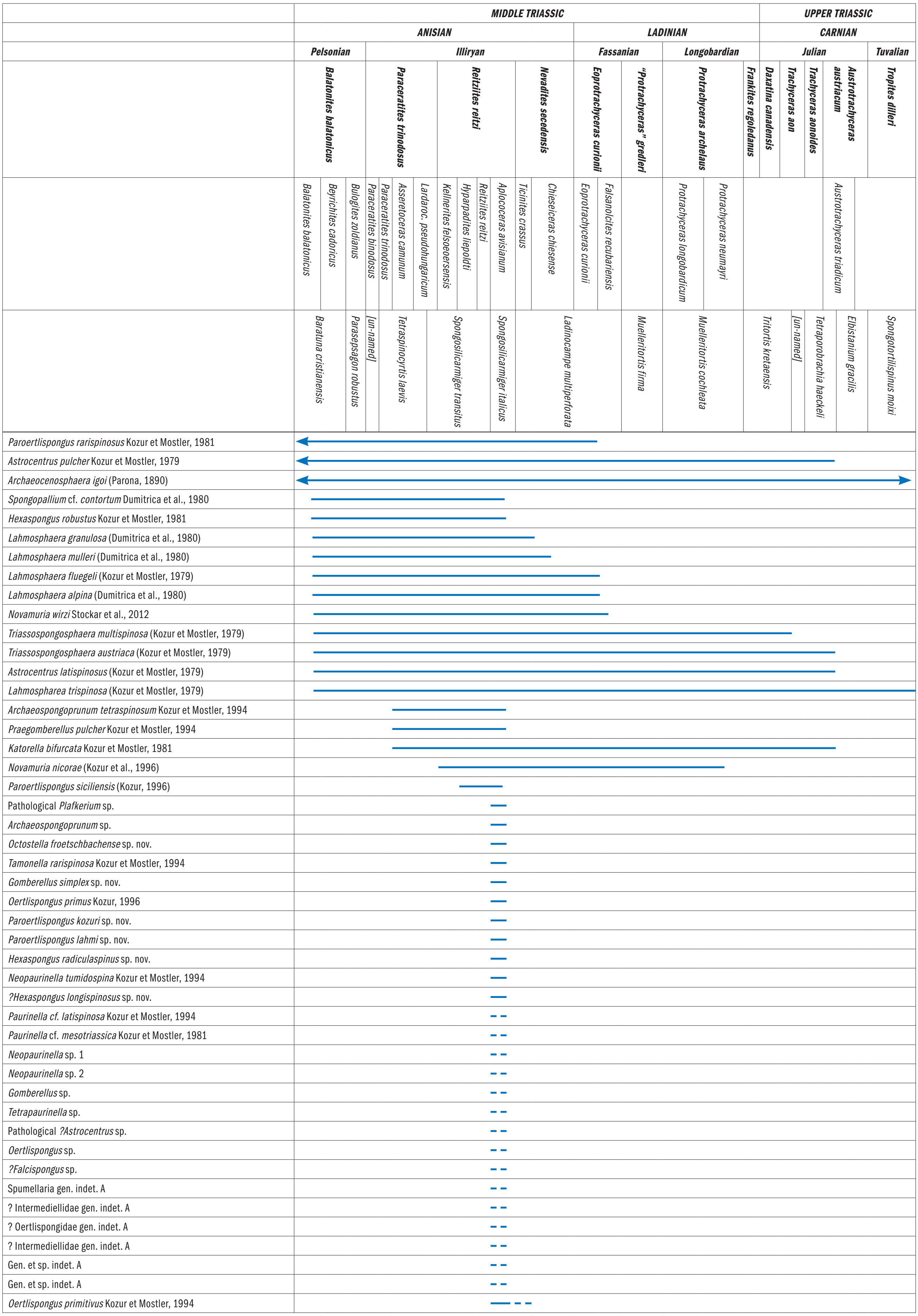
The lithologies of the Seceda core consist of silicified carbonates, cherty limestones and radiolarites. All samples with high silica content from the Seceda core were prepared with the standard dissolution method. Samples were dried and placed in approx. 3–5 % HF (nine parts distilled water and one part concentrated HF (herewith 48 %) following standard laboratory procedures in Pessagno & Newport (1972). Carbonate samples from the core were prepared with standard procedure, using hydrochloric acid (20 % HCl). All residues were washed through a 50 µm sieve and dried. The laboratory preparation of the samples was carried out at the Hungarian Natural History Museum, Budapest. The samples from the Frötschbach section were already prepared, as well as the samples from Seceda outcrops. The figured radiolarians presented herein were taken on Hitachi S-2600 N-type Scanning Electron Microscope at the Hungarian Natural History Museum, Budapest. Only in a few cases SEM photographs taken previously by H. Kozur at the Innsbruck University were used. The radiolarian specimens are deposited in the Hungarian Natural History Museum in Budapest, Hungary.

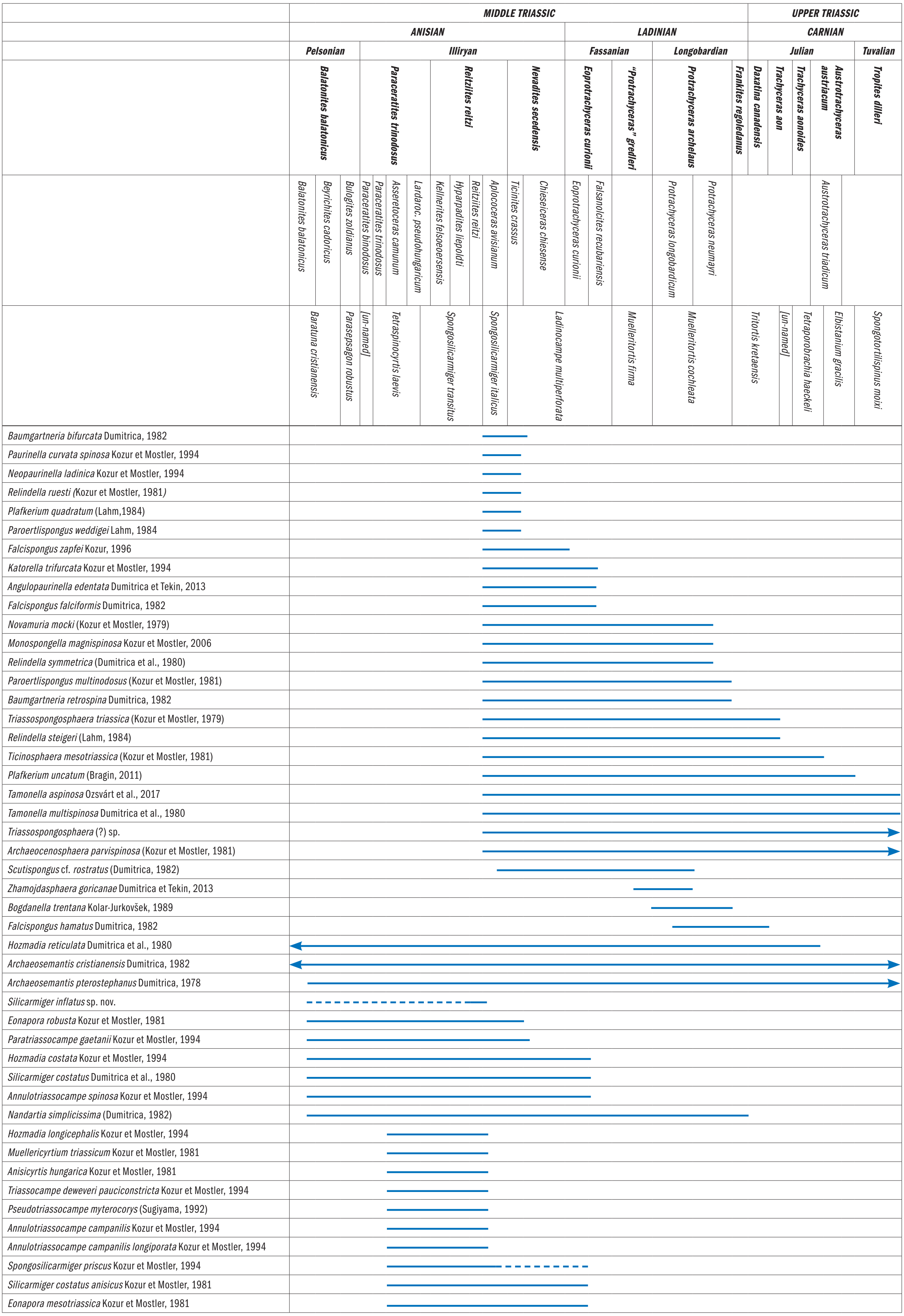
5. RADIOLARIAN FAUNA

The FB samples from the Frötschbach section contain well-preserved, siliceous and especially rich radiolarian fauna, whereas the radiolarian faunas from the Seceda borehole and the Seceda outcrop are rather poorly preserved. The radiolarians, in some cases, are so perfectly preserved that even their internal structure can be observed.
Radiolarian diversity is quite high in the Frötschbach section, wereas in the Seceda outcrop and borehole it seems to be significantly lower, even if the poor preservation in these sections could be a reason for the low diversity. This follows from the fact that the best-preserved and richest fauna horizon in the Frötschbach section also apparently contains much richer fauna in the other sections, so presumably, a significant blooming event might have occurred in this horizon. The spumellarians represent the highest ratio in the whole radiolarian fauna by 41 %, the nassellarians by 35 %, while the entactiarian by about 21 %. Therefore, the diversity of spumellarians and nassellarians significantly outnumber entactinarians by a ratio of about two to one (see Table 1). The distribution of radiolarian species in sampled localities in the Seceda area is shown in Table 2.
Spumellarian diversity is the highest among radiolarians and more than 70 percent of spumellarian species appear for the first time in the recently investigated sections (Table 1). Approximately half of these species have been described from another area of the Southern Alps, from somewhat younger horizons (e.g. Dumitrica, 1978a, 1978b; Dumitrica et al., 1980; Kozur & Mostler, 1994) and, therefore the ranges of these forms need to be extended. Spumellarians are most dominated by the radiolarians with spongy shell like the Intermediellidae group (*Paurinella, Neopaurinella, Angulopaurinella, Tetrapaurinella, Triassospongosphaera, Katorella* and *Astrocentrus*) and Oertlispongidae (*Paroertlispongus, Oertlispongus, Falcispongus* and *Baumgartneria*). Common groups, also with spongy shells are Gomberellidae (*Gomberellus, Praegomberellus, Tamonella* and *Monospongella*) and the quite conservative forms such as *Archaeocenosphaera* and *Novamuria* (Xiphostylidae). Additionally, important and abundant elements of radiolarian fauna are some uncertainly classified forms such as *Lahmosphaera* and *Ticinosphaera* (see Table 2).
Nearly a third of radiolarian fauna are nassellarians which are predominantly multicyrtid Ruesticyrtiidae (*Annulotriassocampe, Pararuesticyrtium, Pseudotriassocampe, Striatotriassocampe, Triassocampe* and *Yeharaia*) and Ultranaporidae (*Hinedorcus, Muellericyrtium*, *Silicarmiger* and *Spongosilicarmiger*). Also important are monocyrtids such as *Hozmadia, Eonapora, Neopylentonema, Poulpus* and *Triassobipedis*. Considering all radiolarian species, *Hozmadia reticulata* is one of the most frequent species in the Seceda area. The entactinarians are dominated by Hindeosphaerinae: *Bernoulliella, Eohexastylus, Parasepsagon, Sepsagon* and especially *Pseudostylosphaera.* Additionally, the dominating groups are the Eptingiidae family (*Eptingium, Spongostephanidium* and *Triassistephanidium*) and Pentactinocarpidae (*Pentactinocapsa, Pentactinorbis* and *Pentactinocarpus*). Although the entactinarians are the least abundant group in the total radiolarian fauna, *Pseudostylosphaera* represents one of the most diverse genera. A total of 8 different species are present in the fauna which means that these species may have had the most favourable environmental conditions within the Buchenstein-type basin. Another important entactinarian genus is "*Entactinosphaera*" because it was reported from the Devonian, originally. However, this huge time gap between the Middle Triassic and the Devonian makes the identification uncertain because relatively few "Lazarus taxa" are known among radiolarians.
Among nassellarians, special forms are the *Yeharaia bispinosa* sp. nov. and *Y. trispinosa* sp. nov. The genus *Yeharaia* is characterized by a massive single apical horn but in these two new species, the spine is bifurcated and trifurcated which is quite rare among nassellarians. Additional important and interesting paleontological elements of the radiolarians from the Seceda area are a large number of pathological forms such as *Plafkerium, ?Astrocentrus,* Spumellaria gen. indet. A, ?Intermediellidae gen. indet. A, which might represent an important transitional period in the evolutionary history of Middle Triassic radiolarians.

TABLE 1: Range chart for Middle Triassic radiolarians.




MIDDLE TRIASSIC
UPPER TRIASSIC
ANISIAN
LADINIAN
CARNIAN
Pelsonian
Illiryan
Fassanian
Longobardian
Julian
Tuvalian
Balatonites balatonicus
Paraceratites trinodosus
Reitziites reitzi
Nevadites secedensis
Eoprotrachyceras curionii
"Protrachyceras" gredleri
Protrachyceras archelaus
Frankites regoledanus
Daxatina canadensis
Trachyceras aon
Trachyceras aonoides
Austrotrachyceras austriacum
Tropites dilleri
Balatonites balatonicus
Beyrichites cadoricus
Bulogites zoldianus
Paraceratites binodosus
Paraceratites trinodosus
Asseretoceras camunum
Lardaroc. pseudohungaricum
Kellnerites felsoeoersensis
Hyparpadites liepoldti
Reitziites reitzi
Aplococeras avisianum
Ticinites crassus
Chieseiceras chiesense
Eoprotrachyceras curionii
Falsanolcites recubariensis
Protrachyceras longobardicum
Protrachyceras neumayri
Austrotrachyceras triadicum
Baratuna cristianensis
Parasepsagon robustus
[un-named]
Tetraspinocyrtis laevis
Spongosilicarmiger transitus
Spongosilicarmiger italicus
Ladinocampe multiperforata
Muelleritortis firma
Muelleritortis cochleata
Tritortis kretaensis
[un-named]
Tetraporobrachia haeckeli
Ebistanium gracilis
Spongotortilispinus moixi
Paroertlispongus rarispinosus Kozur et Mostler, 1981
Astrocentrus pulcher Kozur et Mostler, 1979
Archaeocenosphaera igoi (Parona, 1890)
Spongopallium cf. contortum Dumitrica et al., 1980
Hexaspongus robustus Kozur et Mostler, 1981
Lahmosphaera granulosa (Dumitrica et al., 1980)
Lahmosphaera mulleri (Dumitrica et al., 1980)
Lahmosphaera fluegeli (Kozur et Mostler, 1979)
Lahmosphaera alpina (Dumitrica et al., 1980)
Novamuria wirzi Stockar et al., 2012
Triassospongosphaera multispinosa (Kozur et Mostler, 1979)
Triassospongosphaera austriaca (Kozur et Mostler, 1979)
Astrocentrus latispinosus (Kozur et Mostler, 1979)
Lahmospharea trispinosa (Kozur et Mostler, 1979)
Archaeospongoprunum tetraspinosum Kozur et Mostler, 1994
Praegomberellus pulcher Kozur et Mostler, 1994
Katorella bifurcata Kozur et Mostler, 1981
Novamuria nicorae (Kozur et al., 1996)
Paroertlispongus siciliensis (Kozur, 1996)
Pathological Plafkerium sp.
Archaeospongoprunum sp.
Octostella froetschbachense sp. nov.
Tamonella rarispinosa Kozur et Mostler, 1994
Gomberellus simplex sp. nov.
Oertlispongus primus Kozur, 1996
Paroertlispongus kozuri sp. nov.
Paroertlispongus lahmi sp. nov.
Hexaspongus radiculaspinus sp. nov.
Neopaurinella tumidospina Kozur et Mostler, 1994
?Hexaspongus longispinosus sp. nov.
Paurinella cf. latispinosa Kozur et Mostler, 1994
Paurinella cf. mesotriassica Kozur et Mostler, 1981
Neopaurinella sp. 1
Neopaurinella sp. 2
Gomberellus sp.
Tetrapaurinella sp.
Pathological ?Astrocentrus sp.
Oertlispongus sp.
?Falcispongus sp.
Spumellaria gen. indet. A
? Intermediellidae gen. indet. A
? Oertlispongidae gen. indet. A
? Intermediellidae gen. indet. A
Gen. et sp. indet. A
Gen. et sp. indet. A
Oertlispongus primitivus Kozur et Mostler, 1994



MIDDLE TRIASSIC
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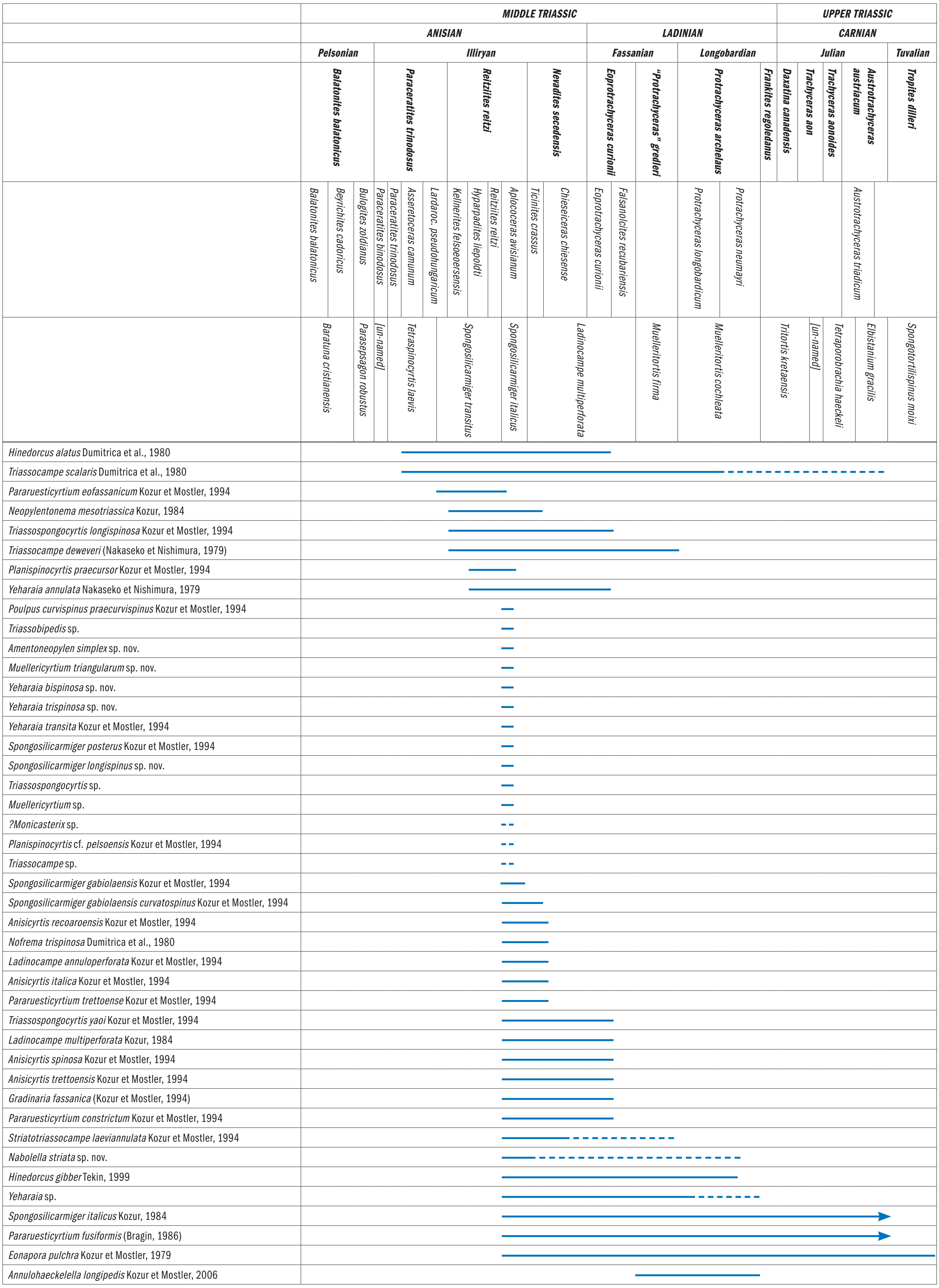
Reitzites reitzi
Nevadites secedensis
Eoprotrachyceras curionii
"Protrachyceras" gredleri
Protrachyceras archelaus
Frankites regoledanus
Daxatina canadensis
Trachyceras aon
Trachyceras aonoides
Austrotrachyceras austriacum
Tropites dilleri
Balatonites balatonicus
Beyrichites cadoricus
Bulogites zoldianus
Paraceratites binodosus
Paraceratites trinodosus
Asseretoceras camunum
Lardaroc. pseudohungaricum
Kellnerites felsoeoersensis
Hyparpadites liepoldti
Reitzites reitzi
Aplococeras avisianum
Ticinites crassus
Chieseiceras chiesense
Eoprotrachyceras curionii
Falsanolcites recubariensis
Protrachyceras longobardicum
Protrachyceras neumayri
Austrotrachyceras triadicum
Baratuna cristianensis
Parasepsagon robustus
[un-named]
Tetraspinocyrtis laevis
Spongosilicarmiger transitus
Spongosilicarmiger italicus
Ladinocampe multiperforata
Muelleritortis firma
Muelleritortis cochleata
Tritortis kretaensis
[un-named]
Tetraporobrachia haeckeli
Elbistanium gracilis
Spongotortilispinus moixi
Baumgartneria bifurcata Dumitrica, 1982
Paurinella curvata spinosa Kozur et Mostler, 1994
Neopaurinella ladinica Kozur et Mostler, 1994
Relindella ruesti (Kozur et Mostler, 1981)
Plafkerium quadratum (Lahm,1984)
Paroertlispongus weddigei Lahm, 1984
Falcispongus zapfei Kozur, 1996
Katorella trifurcata Kozur et Mostler, 1994
Angulopaurinella edentata Dumitrica et Tekin, 2013
Falcispongus falciformis Dumitrica, 1982
Novamuria mocki (Kozur et Mostler, 1979)
Monospongella magnispinosa Kozur et Mostler, 2006
Relindella symmetrica (Dumitrica et al., 1980)
Paroertlispongus multinodosus (Kozur et Mostler, 1981)
Baumgartneria retrospina Dumitrica, 1982
Triassospongosphaera triassica (Kozur et Mostler, 1979)
Relindella steigeri (Lahm, 1984)
Ticinosphaera mesotriassica (Kozur et Mostler, 1981)
Plafkerium uncatum (Bragin, 2011)
Tamonella aspinosa Ozsvárt et al., 2017
Tamonella multispinosa Dumitrica et al., 1980
Triassospongosphaera (?) sp.
Archaeocenosphaera parvispinosa (Kozur et Mostler, 1981)
Scutispongus cf. rostratus (Dumitrica, 1982)
Zhamojdasphaera goricanae Dumitrica et Tekin, 2013
Bogdanella trentana Kolar-Jurkovšek, 1989
Falcispongus hamatus Dumitrica, 1982
Hozmadia reticulata Dumitrica et al., 1980
Archaeosemantis cristianensis Dumitrica, 1982
Archaeosemantis pterostephanus Dumitrica, 1978
Silicarmiger inflatus sp. nov.
Eonapora robusta Kozur et Mostler, 1981
Paratriassocampe gaetanii Kozur et Mostler, 1994
Hozmadia costata Kozur et Mostler, 1994
Silicarmiger costatus Dumitrica et al., 1980
Annulotriassocampe spinosa Kozur et Mostler, 1994
Nandartia simplicissima (Dumitrica, 1982)
Hozmadia longicephalis Kozur et Mostler, 1994
Muellericyrtium triassicum Kozur et Mostler, 1981
Anisicyrtis hungarica Kozur et Mostler, 1981
Triassocampe deweveri pauciconstricta Kozur et Mostler, 1994
Pseudotriassocampe myterocorys (Sugiyama, 1992)
Annulotriassocampe campanilis Kozur et Mostler, 1994
Annulotriassocampe campanilis longiporata Kozur et Mostler, 1994
Spongosilicarmiger priscus Kozur et Mostler, 1994
Silicarmiger costatus anisicus Kozur et Mostler, 1981
Eonapora mesotriassica Kozur et Mostler, 1981


MIDDLE TRIASSIC
UPPER TRIASSIC
ANISIAN
LADINIAN
CARNIAN
Pelsonian
Illiryan
Fassanian
Longobardian
Julian
Tuvalian
Balatonites balatonicus
Paraceratites trinodosus
Reitziites reitzi
Nevadites secedensis
Eoprotrachyceras curionii
"Protrachyceras" gredleri
Protrachyceras archelaus
Frankites regoledanus
Daxatina canadensis
Trachyceras aon
Trachyceras aonoides
Austrotrachyceras austriacum
Tropites dilleri
Balatonites balatonicus
Beyrichites cadoricus
Bulogites zoldianus
Paraceratites binodosus
Paraceratites trinodosus
Asseretoceras camunum
Lardaroc. pseudohungaricum
Kellnerites felsoeoersensis
Hyparpadites liepoldti
Reitziites reitzi
Aplococeras avisianum
Ticinites crassus
Chieseiceras chiesense
Eoprotrachyceras curionii
Falsanolcites recubariensis
Protrachyceras longobardicum
Protrachyceras neumayri
Austrotrachyceras triadicum
Baratuna cristianensis
Parasepsagon robustus
[un-named]
Tetraspinocyrtis laevis
Spongosilicarmiger transitus
Spongosilicarmiger italicus
Ladinocampe multiperforata
Muelleritortis firma
Muelleritortis cochleata
Tritortis kretaensis
[un-named]
Tetraporobrachia haeckeli
Elbistanium gracilis
Spongotortilispinus moixi
Hinedorcus alatus Dumitrica et al., 1980
Triassocampe scalaris Dumitrica et al., 1980
Pararuesticyrtium eofassanicum Kozur et Mostler, 1994
Neopylentonema mesotriassica Kozur, 1984
Triassospongocyrtis longispinosa Kozur et Mostler, 1994
Triassocampe deweveri (Nakaseko et Nishimura, 1979)
Planispinocyrtis praecursor Kozur et Mostler, 1994
Yeharaia annulata Nakaseko et Nishimura, 1979
Poulpus curvispinus praecurvispinus Kozur et Mostler, 1994
Triassobipedis sp.
Amentoneopylen simplex sp. nov.
Muellericyrtium triangularum sp. nov.
Yeharaia bispinosa sp. nov.
Yeharaia trispinosa sp. nov.
Yeharaia transita Kozur et Mostler, 1994
Spongosilicarmiger posterus Kozur et Mostler, 1994
Spongosilicarmiger longispinus sp. nov.
Triassospongocyrtis sp.
Muellericyrtium sp.
?Monicasterix sp.
Planispinocyrtis cf. pelsoensis Kozur et Mostler, 1994
Triassocampe sp.
Spongosilicarmiger gabiolaensis Kozur et Mostler, 1994
Spongosilicarmiger gabiolaensis curvatospinus Kozur et Mostler, 1994
Anisicyrtis recoaroensis Kozur et Mostler, 1994
Nofrema trispinosa Dumitrica et al., 1980
Ladinocampe annuloperforata Kozur et Mostler, 1994
Anisicyrtis italica Kozur et Mostler, 1994
Pararuesticyrtium trettoense Kozur et Mostler, 1994
Triassospongocyrtis yaoi Kozur et Mostler, 1994
Ladinocampe multiperforata Kozur, 1984
Anisicyrtis spinosa Kozur et Mostler, 1994
Anisicyrtis trettoensis Kozur et Mostler, 1994
Gradinaria fassanica (Kozur et Mostler, 1994)
Pararuesticyrtium constrictum Kozur et Mostler, 1994
Striatotriassocampe laeviannulata Kozur et Mostler, 1994
Nabolella striata sp. nov.
Hinedorcus gibber Tekin, 1999
Yeharaia sp.
Spongosilicarmiger italicus Kozur, 1984
Pararuesticyrtium fusiformis (Bragin, 1986)
Eonapora pulchra Kozur et Mostler, 1979
Annulohaeckelella longipedis Kozur et Mostler, 2006

6. BIOSTRATIGRAPHY

Radiolarian biostratigraphic determination is based on KOZUR & MOSTER (1994), KOZUR et al. (1996), and KOZUR (2003). However, their biozonations are of limited use here, because the radiolarian fauna from the Seceda area cannot be properly positioned in the widely accepted schemes of KOZUR and co-authors (e.g. KOZUR & MOSTLER, 1994; KOZUR et al., 1996; KOZUR, 2003). Our radiolarian assemblage contains almost all index species from the *Tetraspinocyrtis laevis* Zone to *Ladinocampe multiperforata* Zone including all typical taxa from *Tiborella florida* Subzone to the *Ladinocampe annuloperforata* Subzone. The only exception is that only two specimens of *Oertlispongus inaequispinosus* DUMITRICA et al., 1980 were found in our fauna, although this is one of the most important index taxa of the *O. inaequispinosus* Subzone (upper part of *Spongosilicarmiger italicus* Zone of KOZUR & MOSTLER (1994).

The biostratigraphically most important group in the investigated sections are the primitive Oertlispongidae (*Paroertlispongus* spp., *Baumgartneria bifurcata* DUMITRICA, 1982), *Spongosilicarmiger italicus* KOZUR, 1984, *Spongosilicarmiger gabiolaensis* KOZUR et MOSTLER, 1994. However, the fauna contains *Yeharaia annulata* NAKASEKO et NISHIMURA, 1979, *Triassocampe deweveri* (NAKASEKO et NISHIMURA, 1979), *Triassocampe scalaris* DUMITRICA et al., 1980, *Falcispongus falciformis* DUMITRICA, 1982a, *Ladinocampe multiperforata* KOZUR, 1984, *Ladinocampe annuloperforata* KOZUR et MOSTLER, 1994, *Anisicyrtis* spp. (*Anisicyrtis spinosa* KOZUR et MOSTLER, 1994, *Anisicyrtis trettoensis* KOZUR et MOSTLER, 1994, *Anisicyrtis recoaroensis* KOZUR et MOSTLER, 1994) and these taxa are the most important representatives of all subzones from the *Yeharaia annulata* Subzone to the *Ladinocampe annuloperforata* Subzone. Although the classification is more or less valid, the radiolarian biozonation (KOZUR et MOSTLER, 1994 etc.) needs to be revised, because the definitions of the species used for biozones are rather outdated.

In fact, the Frötschbach section (sample FB and FB-R, see Fig. 5 and Table 2), Seceda outcrop (Se1, see Fig. 5) and Seceda borehole (sample S20, see Fig. 5) may belong to the transition between the *Oertlispongus primitivus* Subzone and *Oertlispongus inaequispinosus* Subzone. The co-occurrence of *Spongosilicarmiger italicus* KOZUR, 1984 with *Spongosilicarmiger gabiolaensis* KOZUR et MOSTLER, 1994 and with the frequent and characteristic primitive Oertlispongidae (*Paroertlispongus* spp., *Baumgartneria bifurcata* DUMITRICA, 1982) suggest the *Oertlispongus primitivus* Subzone, whereas the presence of two poorly preserved specimens of *Oertlispongus inaequispinosus* DUMITRICA et al., 1980 already presupposes the *Oertlispongus inaequispinosus* Subzone. A more precise age of this radiolarian rich horizon cannot be given.

The A26 sample from the Seceda outcrop (Fig. 5) may indicate a Longobardian age (Ladinian), although, it is difficult to say exactly which radiolarian zone it may belong to. The generally poor preservation and difficult-to-identify radiolarian species hampers a clear attribution of the A26 sample to the *Muelleritortis firma* or already to the *Muelleritortis cochleata* Zone. The ammonite zonation also does not give a clear indication for a Longobardian age (Fig. 5).

6.1 INDEPENDENT AGE DATING

All investigated sections contain stratigraphically important ammonoids, conodonts and palynofloras, as well as recent U-Pb single zircon ages.

6.1.1 Ammonoids

In the Seceda area the entire interval of the "Plattenkalke" series can be referred to the *Reitziites reitzi* ammonoid Zone (BRACK et al., 2005, WOTZLAW et al., 2018). The boundary between the *Reitzi* Zone and *Secedensis* Zone is close to the lithological boundary between the "Plattenkalke" and "Knollenkalke" series in all sections, whereas the boundary between the *Secedensis* Zone and the *Curionii* Zone (Anisian–Ladinian boundary) is at the ~83.5 m level in the Seceda core and around the 18 m level of the outcrop reference section (i.e. close to sample A12) and at ~18.3 m in the Frötschbach section (see in detail Fig. 5).

6.1.2 Conodonts

The Lower Plattenkalke of the Frötschbach section yielded *Paragondolella? trammeri*, *P. excelsa* and *Gladigondolella malayensis* conodont species (MUTTONI et al., 2004). *P. trammeri* usually appears in the Western Tethyan realm at the base of the Secedensis Zone (e.g., KRYSTYN, 1983) although at Seceda and Frötschbach this species occurs already in the uppermost Reitzi Zone (MUTTONI et al., 2004) together with the rich radiolarian fauna. *Neogondolella bakalovi* gr. at Frötschbach was indicated from a level close to the first appearance of the ammonoid genus *Ticinites* in the Seceda outcrop section (MUTTONI et al., 2004).

Samples from the Seceda core contain many *Gladigondolella* multielement apparatus at several levels, although these specimens are not quite useful in biostratigraphy. The Frötschbach samples of this study confirm the occurence of *Paragondolella? trammeri* in the uppermost Reitzi zone.

6.1.3 Palynological record

HOCHULI et al. (2015) reported palynological data from the Seceda core with the TrS-A Zone largely corresponding to the *Reitzi* Ammonoid Zone and TrS-C Zone to the *Curionii* Ammonoid Zone.

6.1.4 Radio-isotopic age data

The Middle Triassic acidic volcanic ash layers of the South-Alpine domain provide excellent radio-isotopic dating of pelagic sediments and these horizons are ideal markers for precise correlation between biostratigraphically dated sections throughout the Southern Alps. Earlier U/Pb single zircon age data from Southern and Eastern Alps Middle Triassic successions by MUNDIL et al. (1996, 2010), BRÜHWILER et al. (2007), BRACK et al. (2005), STOCKAR et al. (2012a) have been largely superseded by the recent up-to-date CA-ID-TIMS analyses in WOTZLAW et al. (2018) and STORCK et al (2019). The best estimate for the age of the Anisian–Ladinian boundary at Seceda is 241.461 ± 0.064/0.097/0.28 Ma, whereas the base of the Secedensis Zone is 241.77 ± 0.06 (Fig. 5).

7. MIDDLE TRIASSIC EXPLOSIVE DIVERSIFICATION OF THE RADIOLARIANS

Estimating radiolarian diversity during the entire Triassic period is a serious challenge, due to the extreme heterogeneity of published data. The information available from databases (e.g. PBDB, Neptune, etc.) are as yet inadequate. Therefore, a simple method is used here by extracting all plausible appea-

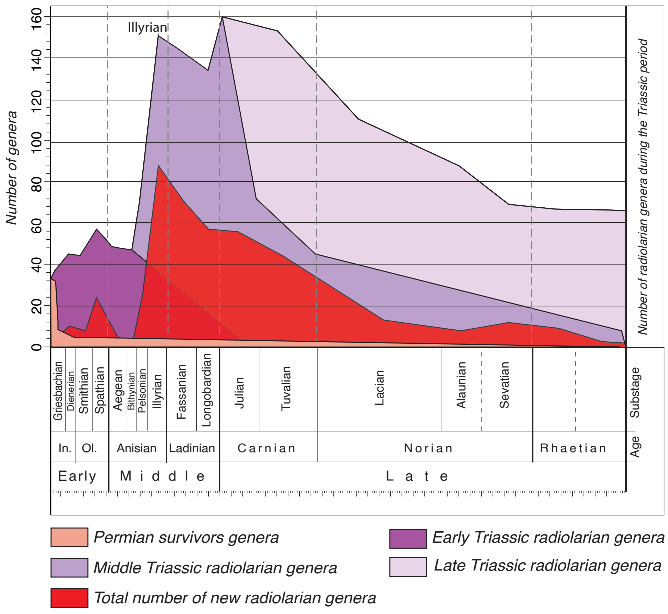


FIGURE 10. Genus diversity of radiolarians across the Triassic.

rance and disappearance datum (stratigraphically oldest and youngest occurrences in the paleontological record) of each radiolarian genera from all available publications and our unpublished data. Unfortunately, this method lacks sampling standardization (no information is available on the sample sizes), due to the highly confusing data reported in previous publications. Therefore the direct measurement of true diversity remains rather uncertain. Nevertheless, this new approach for estimating the diversity of radiolarian genera (Fig. 10) results in a new pattern for the diversity curve across the entire Triassic period. The highest peak of genera diversity occurred at the Ladinian–Carnian boundary, although the second highest peak (similar to the species diversity curve) falls in the late Anisian (Fig. 10). In addition, most of the new genera appearing during the Triassic are definitely related to the Illyrian (late Anisian) blooming event. In summary, the most striking feature of radiolarian diversity is a high number of new genera that appeared within a very short time span during the late Illyrian (late Anisian). This number is the highest for the entire Triassic. These unique evolutionary innovations and accelerated rates of evolutionary changes might have been caused by direct environmental influences on the radiolarian genome like a strong cosmic flux, although the roles of abiotic and biotic drivers of this particularly important diversification event remain unclear so far.

7.1 RADIOLARIAN BLOOMING EVENT IN THE MIDDLE TRIASSIC

After the End-Permian biospheric crisis which also affected radiolarians, the Early Triassic (Induan) to the Middle Triassic (upper Pelsonian) interval represents a time of recovery among radiolarian families. In this important faunal turnover episode, it is possible to appreciate little changes in the evolutionary process of radiolarians. Very few new species appear from the Early Triassic to the late Pelsonian (Middle Triassic) at lower and higher latitudes of the Northern Hemisphere, including Paleotethys and Neotethys that were characterized by extremely low diversity and poor preservation (e.g. Hori et al., 2003; Sashida 1983, 1991; Sugiyama 1992, 1997). In addition, some recent studies argue that "Permian" type radiolarians survived the Permian – Triassic Boundary (e.g. *Albaillella*, *Cauletella, Ishigaum, Hegleria* etc.) whereas several "Triassic" type forerunner forms like *Paurinella, Tetrapaurinella* or *Tamonella* genera (e.g., Aitchison et al., 2017) already appeared in the Changhsingian (Late Permian). Another interesting problem during the Early Triassic period was the so-called "radiolarite gap" referring to an interruption between the latest Changhsingian and the late Olenekian of the widespread deep-water radiolarite accumulation (e.g., Feng & Algeo 2014), which had formed in lower latitude oceanic basins from the Late Carboniferous onwards. However, a number of studies (e.g., Kamata et al., 2007) point to the fact that biogenic chert is found with no interruption through the PTB interval at higher latitudes in the Southern Hemisphere (Arrow Rocks, Northland, New Zealand). Relatively rich and diverse radiolarian faunas have been described e.g. from Induan and lower Olenekian (Smithian) sections in New Zealand by Hori et al. (2011), Kamata (2007), Takemura et al. (2007). Additionally, several high abundances but low diversity Spathian (upper Olenekian) to Bithynian (lower Anisian) radiolarian faunas are known from the Panthalassa ocean (Hori et al., 2003; Isogawa et al., 1998; Nagai & Mizutani, 1993; Sashida, 1983, 1991; Sashida et al., 1998; Sashida & Igo, 1992; Sugiyama, 1992;, 1997; Suzuki at al., 2002; Takahashi et al., 2017) including Paleotethyan and Neotethyan subbasins such as Lagonegro Basin, Southern Apennines, Italy (e.g., Amodeo et al., 1991; Passeri et al., 2005; Marcucci & Bertinelli, 2017) and Karakaya Complex, Northwestern Turkey (Kozur et al., 1996a). The first important episode in the Mesozoic evolutionary history of radiolarians is detected in the upper Pelsonian (Anisian, Middle Triassic). The oldest well-preserved and much more diverse than previous radiolarian communities is known from a single locality at Cristian village close to the Brasov in Romania (Dumitrica, 1982a, 1982b, 1991, 2004, etc.), whereas the first Illyrian well-preserved and diverse assemblage is known from the Felsőörs section in the Balaton Highland (Dosztály, 1991, 1993; Kozur & Mostler, 1994). The first major radiation of mono- and dicyrtid nassellarians genera (e.g. *Tripedocassis, Baratuna, Tripedurnula, Triassobipedis, Eonapora* and *Neopylentonema*) occurs in that period. The multicyrtids also experienced a large diversification from the Illyrian, and several new families such as the Tetraspinocyrtidae, Monicastericidae or Bulbocyrtiidae appeared for the first time (O'Dogherty et al., 2010). The Middle Anisian was also a period of high diversification in entactinarians. New families appeared at this time (e.g. Pentactinocarpidae, Heptacladidae or Hindeosphaerinae) and the spumellarians became quite frequent from the Middle Anisian, as well. The most important radiolarian event in the early late Anisian (*Reitziites reitzi* Ammonoid Subzone) is the diversification of the Oertlispongidae. This group underwent a significant acceleration in diversification during the Upper Illyrian and spread widely from the South Alpine domain to the Circum-pacific orogenic belt of the Panthalassa ocean (e.g. Sugiyama, 1997), therefore some of its genera like *Oertlispongus* are among the best index fossils of the Uppermost Anisian radiolarian biostratigraphy.

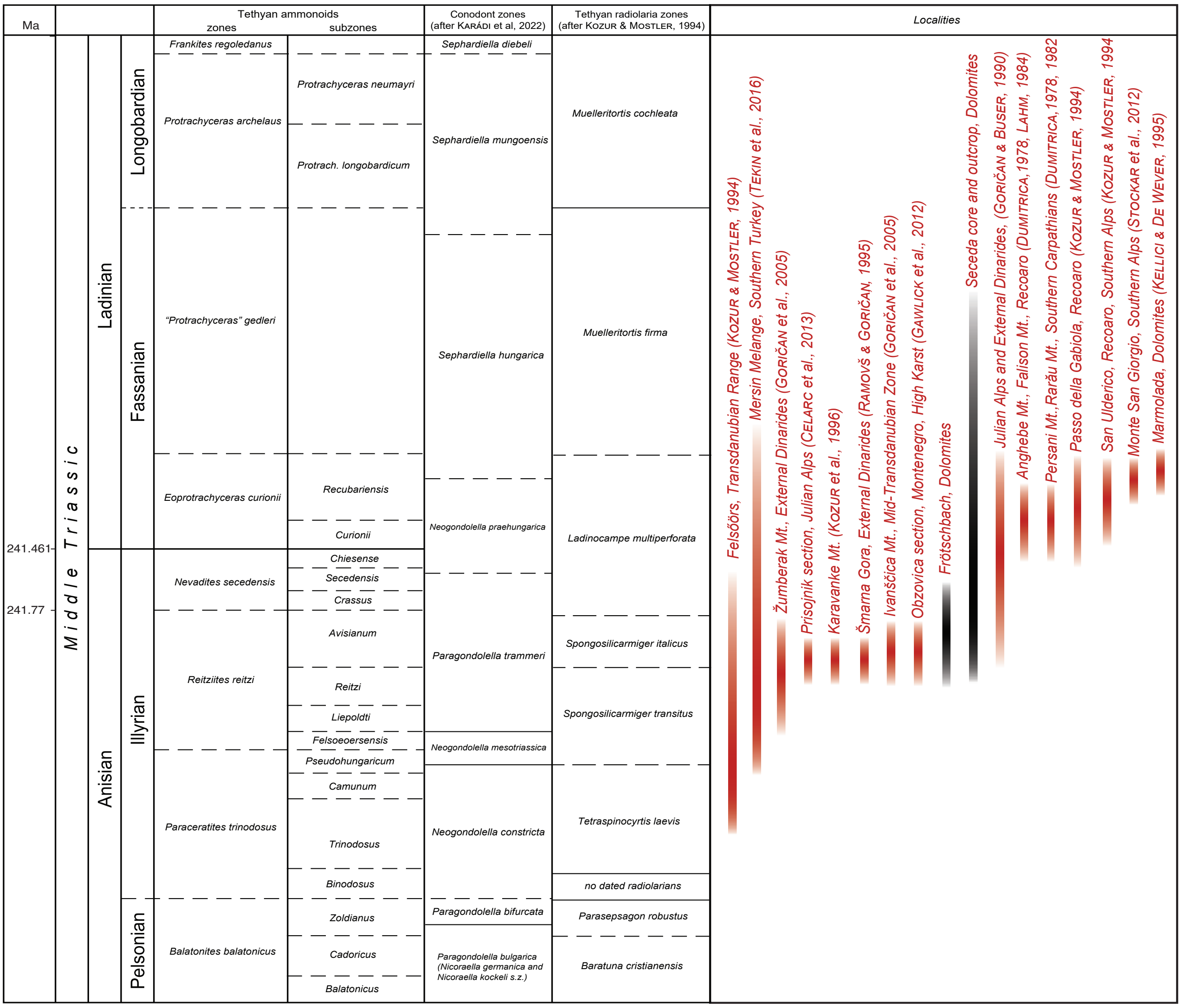


FIGURE 11. Age range of Western Tethyan radiolarian assemblages and localities from the Southern Alps, Dolomites, External Dinarides, Transdanubian Central Range, Eastern Carpathians and South-Taurides.

7.2 COMPARISON WITH OTHER AREAS OF THE WESTERN TETHYAN REALM

Most similar radiolarian faunas are known from varios localities with "Buchenstein Beds" across the Southern Alps including the Dolomites, the Vicentinian Alps, the Julian Alps, the Karavanke Mountains and further eastward the Transdanubian Central Range, Hungary (Fig. 11). Many other similar aged radiolarian assemblages have also been reported from the External Dinarides and South-Taurides belt suggesting a quick spreading of these radiolarian communities over long distances during the late Illyrian to early Fassanian. This rapid dispersal of radiolarians is thought to have been facilitated by the reorganization of ocean circulation systems and rising global sea level during the late Anisian (e.g. de Graciansky et al., 2011).

Radiolarians of the latest Anisian (Illyrian) to the earliest Ladinian (Fassanian) inteval were first discovered and described by Dumitrica (1978a, 1978b) from the Recoaro area, Vicentinian Alps, Italy. That rich material was extracted from isolated samples of the "Buchenstein Beds" (Nodosus Formation at Monte Anghebe, Monte Falison) provided by Manfred Epting. Although taxonomically one of the most unique radiolarian fauna from this period, due to the lack of independent fossil age data from the sampling sites, it is relatively difficult to integrate such data into comprehensive biostratigraphic studies. Epting et al. (1976) presumed a lowermost Ladinan age for the thin-bedded cherty "Buchenstein Beds" around Recoaro (Monte Anghebe, Monte Falison) because of the occurrence of *Protrachyceras curionii* Mojsisovics in a corresponding interval at Tretto (Bittner, 1883; Mietto et al., 2018). Unfortunately, the exact stratigraphic position of the investigated radiolarian samples (e.g., Dumitrica, 1978a, 1982a, 1982b) relative to the level with *Protrachyceras curionii* Mojsisovics and other ammonoids remains unclear. The "Buchenstein Beds" (Nodosus Formation) around Recoaro are dominated by volcaniclastic intervals, locally reach a thickness of > 60 m and could straddle several ammonoid zones, thus as yet not allowing an accurate calibration of the radiolaria data. Further investigations on the Recoaro-Tretto area (e.g. M. Anghebe, M. Falison, Val di Créme – Passo della Gabiola section, San Ulderico section, etc.) are reported in Dumitrica (1982a, 1982b, 1991, 2004, 2017a, 2017b), Dumitrica et al. (1980), Kozur & Mostler (1981, 1994), Lahm (1984), Dumitrica et al. (2013a, 2013b) and Dumitrica & Tekin (2014). According to their extensive taxonomic studies, all radiolarian assemblages from the Recoaro area contain characteristic taxa referable to *Spongosilicarmiger italicus* and *Ladinocampe multiperforata* Zones (Kozur & Mostler, 1994). However, with the exception of the San Ulderico section (Mietto & Petroni, 1979), there are no independent palaeontological data from any of the sampling sites that would allow a better biostratigraphic integration of these data.

The radiolarian collections from the Julian Alps and External Dinarides (Goričan & Buser, 1990) and several sections from the Eastern (Rarău Mt.) and Southern Carpathians (Persani Mt.) indicate similar ages according to Dumitrica (1982a, 1982b, 1991, 2004, 2017a, 2017b). All important taxa have been described in the above-mentioned publications, suggesting that the faunas from Recoaro are somewhat younger than the main fauna from Seceda and Frötschbach (Fig. 11).

Seceda radiolarian assemblages, compare closely with radiolarians from Recoaro. Although with some poorly preserved *O. inaequispinosus* specimens, these assemblages more likely belong to the lowermost part of *Spongosilicarmiger italicus* Zone (Fig. 11). Unfortunately, the definition of the *Oertlispongus primitivus* Subzone is rather unclear and *Oertlispongus primitivus* and *Oertlispongus inaequispinosus* do co-occur in MD 1 to MD 20 samples of the Passo della Gabiola section. This contrast with the earlier definition by Kozur & Mostler (1994) who designated Passo della Gabiola as the type section for the *Oertlispongus primitivus* Subzone.

Two similar somewhat younger sections have been reported from the Mid-Transdanubian Zone (Mt. Ivanščica) by Goričan et al. (2005) and from the High Karst of Montenegro (Obzovica section) by Gawlick et al. (2012). The faunas most similar in age to Seceda have been published from the External Dinarides (Žumberak Mt.) by Goričan et al. (2005) and from the Mersin Mélange, South-Taurides by Tekin et al. (2016). Three radiolarian collections of approximately the same age but slightly older are known from the Karavanke Mountains (Kozur et al., 1996), Julian Alps (Prisojnik section) by Celarc et al. (2013) and the External Dinarides (Šmarna Gora) by Ramovš & Goričan (1995). The radiolaria collections of these sections were proposed for the *Spongosilicarmiger transitus* Zone, however most frequent index species of this Zone range upward into the younger Zones (up to *Ladinocampe multiperforata* Zone). Additionally, the Balaton Highland, Transdanubian Central Range provide well-preserved radiolarian collections from various localities which have been so far published only in part (Dosztály, 1991, 1993; Kozur, 1988a, 1988b; Kozur & Mostler, 1981, 1994). The best-preserved radiolarian assemblages have been reported (Dosztály, 1991, 1993; Kozur & Mostler, 1994) from the renowned, continuous Felsőörs section which contains extensively studied ammonoid and conodont collections (e.g. Vörös et al., 1996, 2003). The richest and best-preserved radiolarian fauna belongs to the *Tetraspinocyrtis laevis* Zone, but several stratigraphically higher horizons also contain radiolarians, including younger levels from the *Felsoeoersensis* Subzone to the *Avisianum* Subzone (whole *Reitzi* Ammonoid Zone). However their preservation and richness are inferior to the richest layer around Seceda (Frötschbach).

In the Southern Alps two relatively diverse and well-preserved radiolarian collections have been reported from Lower Ladinian strata. The stratigraphically presumably older collection from Monte San Giorgio, Southern Alps, Switzerland provides a moderately to well-preserved radiolarian fauna from the lower part of the San Giorgio Dolomite in an interval possibly referable to the upper part of *Eoprotrachyceras curionii* Ammonoid Zone (Stockar et al., 2012b). The other well-preserved and rich radiolarian material was gained from samples collected by Cros (1977) on the SW-slope of Punta Zigola in the southern Marmolada Group (Kellici & De Wever, 1995). The interval with the investigated sample (BV85–70) can be traced laterally to a complete "Buchenstein" section at Costabella, a few km further west which in turn can be correlated in detail with Seceda. The position of this sample most likely corresponds to a level in the interval 29–40 m of the Seceda outcrop log and 60–71 m in the Seceda core (see Fig. 5). Consequently, this horizon corresponds to the interval transitional between the *Curionii* and *Gredleri* Ammonoid Zones. The corresponding radiolarian samples from the Seceda outcrop are between A16–22 and sample S69 in the Seceda core (Fig. 5).

The age ranges of the radiolarian assemblages yielded by the most important Middle Triassic localities from the Western Neothetys are summarised in Fig. 11.

8. CONCLUSIONS

Middle Triassic radiolarians (upper Illyrian to Longobardian) are reported from three continuous successions of the "Buchenstein Beds" (Livinallongo Formation) in the Seceda area, Dolomites in Northern Italy. The richest and well-preserved radiolarian horizon belongs to the middle part of the *Spongosilicarmiger italicus* Zone. This horizon is equivalent in age to the *Reitziites reitzi* Ammonoid Zone (Reitzi Subzone to Avisianum Subzone) and *Paragondolella trammeri* Conodont Zone. Spumellarian diversity is the highest among radiolarians; the most dominated groups are the Intermediellidae (*Paurinella*, *Neopaurinella*, *Tetrapaurinella*, *Triassospongosphaera*, *Katorella*, etc.) and Oertlispongidae (*Paroertlispongus*, *Oertlispongus*, *Falcispongus* and *Baumgartneria*). Nearly a third of the radiolarian fauna consists of nassellarians which are predominantly multicyrtid Ruesticyrtiidae (*Annulotriassocampe*, *Pararuesticyrtium*, *Pseudotriassocampe*, *Striatotriassocampe*, *Triassocampe* and *Yeharaia*) and Ultranaporidae (*Hinedorcus*, *Muellericyrtium*, *Silicarmiger* and *Spongosilicarmiger*). Considering all radiolarian species, *Hozmadia reticulata* is one of the most frequent species in the Seceda area. The entactinarians are dominated by the Hindeosphaerinae family and the Eptingiidae family. Although the entactinarians are the least abundant group in the total radiolarian fauna, *Pseudostylosphaera* represents one of the most diverse genera among radiolarians. A total of eight different species are present in the fauna which means that these species may have had the most favourable environmental conditions within the Buchenstein-type basin.

The radiolarian fauna from the Seceda area provides a special moment of a dynamic, accelerated evolving bloom of a complex and diverse fauna. This assemblage is comprised of many short-ranging forms that have been recorded from the upper part of the *Spongosilicarmiger italicus* Zone to the *Ladinocampe multiperforata* Zone from the Recoaro area. Unfortunately, neither the Seceda core nor the outcrop provide a sufficiently continuous radiolarian record suitable for a complete Middle Triassic radiolarian biostratigraphy with control by other fossil groups. Further detailed taxonomic and biostratigraphic radiolarian studies are needed to reconcile the results from different fossil groups towards an integrated biostratigraphic synthesis.

9. SYSTEMATIC PALEONTOLOGY

Systematic paleontology
Order Entactinaria Kozur et Mostler, 1982
Family Pentactinocarpidae Dumitrica, 1978a
Genus *Pentactinocarpus* Dumitrica, 1978a

Remarks: The genera *Praedruppatractylis* Kozur et Mostler, 1979 and *Oertlisphaera* Kozur et Mostler, 1979 are junior synonyms of this genus.

Type species: *Pentactinocarpus fusiformis* Dumitrica, 1978a

Pentactinocarpus acanthicus Dumitrica, 1978a
Plate 1, Figures 1–2

1978a *Pentactinocarpus acanthicus* sp. nov. – Dumitrica, p. 44, pl. 3, fig. 3.
1980 *Pentactinocarpus acanthicus* Dumitrica – Dumitrica et al., p. 7, pl. 4, fig. 7.
1984 *Pentactinocarpus acanthicus* Dumitrica – Lahm, p. 22, pl. 2, figs 9–10.
1990 *Pentactinocarpus acanthicus* Dumitrica – Goričan & Buser, p. 149, pl. 7, fig. 12.
1994 *Pentactinocarpus acanthicus* Dumitrica – Kozur & Mostler, p. 46, pl. 2, figs 3, 5.
1999 *Pentactinocarpus acanthicus* Dumitrica – Tekin, p. 133, pl. 27, fig. 6.
2000 *Pentactinocarpus acanthicus* Dumitrica – Carter & Orchard, pl. 2, fig. 4.
2012b *Pentactinocarpus acanthicus* Dumitrica – Stockar et al., p. 388, pl. 1, figs 8–10.
? 2014 *Pentactinocarpus?* aff. *acanthicus* Dumitrica – Shigeta et al., p. 288, figs 204.4–204.7.
2015 *Pentactinocarpus acanthicus* Dumitrica – Ozsvárt et al., p. 345, figs 5.8–10

Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone) to Carnian–Norian boundary (*Primitius* conodont Zone), although *P.* aff. *acanthicus* has been reported from the upper Smithian (upper lower Olenekian) of Northeastern Vietnam (Shigeta et al., 2014); Cosmopolitan.

Genus *Pentactinocapsa* Dumitrica, 1978a
Type species: *Pentactinocapsa quadripes* Dumitrica, 1978a

Pentactinocapsa quadripes Dumitrica, 1978a
Plate 1, Figure 3

1978a *Pentactinocapsa quadripes* sp. nov. – Dumitrica, p. 45, pl. 1, figs 2–4.
1990 *Pentactinocapsa quadripes* Dumitrica – Goričan & Buser, p. 149, pl. 7, fig. 6.
1990 *Pentactinocapsa quadripes* Dumitrica – Kolar-Jurkovšek, p. 75, pl. 3, fig. 5
1994 *Pentactinocapsa quadripes* Dumitrica – Kozur & Mostler, p. 45, pl. 2, fig. 2.
1995 *Pentactinocapsa quadripes* Dumitrica – Kellici & De Wever, p. 153, pl. 3, fig. 19.
2005 *Pentactinocapsa quadripes* Dumitrica – Tekin & Mostler, p. 3, fig. 4.13.
2013 *Pentactinocapsa quadripes* Dumitrica – Celarc et al., figs 8.27–28.

Range and occurrence: Pelsonian (*Baratuna cristianensis* Zone) to upper Longobardian (*Muelleritortis cochleata* Zone); Southern Carpathians (Cristian), Southern Alps (Recoaro, Marmolada), Julian Alps, Dinarides (Fojnica).

Genus *Pentactinorbis* Dumitrica, 1978a
Type species: *Pentactinorbis kozuri* Dumitrica, 1978a

Pentactinorbis kozuri Dumitrica, 1978a
Plate 1, Figure 4

1978a *Pentactinorbis kozuri* sp. nov. – Dumitrica, p. 46, pl, figs 4–5.
1984 *Pentactinorbis kozuri* Dumitrica – Lahm, p. 26, pl. 3, fig. 2.
1990 *Pentactinorbis kozuri* Dumitrica – Goričan & Buser, p. 150, pl. 7, fig. 7.
1994 *Pentactinorbis kozuri* Dumitrica – Kozur & Mostler, p. 47, pl. 4, figs 1–2.
1995 *Pentactinorbis* aff. *kozuri* Dumitrica – Kellici & De Wever, p. 153, pl. 3, fig. 21.
? 2006 *Pentactinorbis kozuri* Dumitrica – Marquez et al., fig. 43.

Range and occurrence: Pelsonian (*Baratuna cristianensis* Zone) to upper Longobardian (*Ladinocampe multiperforata* Zone); Southern Carpathians (Cristian), Southern Alps (Recoaro, Marmolada), Julian Alps and Busuanga Island, Palawan, Philippines.

Pentactinorbis cf. *mostleri* Dumitrica, 1978a
Plate 1, Figure 5

cf. 1978 *Pentactinorbis mostleri* sp. nov. – Dumitrica, p. 47, pl. 4, figs 1–2.

Remarks: Poorly preserved specimen from the Frötschbach section, unfortunately quite difficult to identify this specimen, but it resembles *Pentactinorbis mostleri* Dumitrica.
Range and occurrence: upper Illyrian (*Spongosilicarmiger italicus* Zone to *Ladinocampe multiperforata* Zone); Southern Alps.

Family Eptingiidae Dumitrica, 1978b
Genus *Eptingium* Dumitrica, 1978b
Type species: *Eptingium manfredi* Dumitrica, 1978

Eptingium manfredi Dumitrica, 1978b
Plate 1, Figure 6

1978b *Eptingium manfredi* sp. nov. – Dumitrica, p. 33, pl. 3, figs 3–4; pl. 4, figs 1–2, 5–6.
2012b *Eptingium manfredi* Dumitrica – Stockar et al., p. 390, pl. 1, figs 18–21, pl. 2, figs 1–19. (cum syn).
2013 *Eptingium manfredi* Dumitrica – Celarc et al., figs 8.29–31.
2014 *Eptingium manfredi* Dumitrica – Kamata et al., pl. 2, figs 24–25.
2016 *Eptingium manfredi* Dumitrica – Tekin et al., pl., 2, figs 14–17.

Range and occurrence: Illyrian (*Spongosilicarmiger transitus* Zone) to Longobardian (*Tritortis kretaensis* Zone); Cosmopolitan.

Eptingium ramovsi Kozur et al., 1996
Plate 1, Figures 7–8

1978 *Eptingium manfredi* sp. nov. – Dumitrica, p. 33, pl. 4, fig. 7.
1979 *Tripocyclia japonica* sp. nov. – Nakaseko & Nishimura, p. 73, pl. 4, fig. 6.
1994 *Eptingium manfredi japonicum* (Nakaseko et Nishimura) – Kozur & Mostler, p. 42–43, pl. 1, fig. 4.
1995 *Eptingium* sp. A – Ramovš & Goričan, p. 185, pl. 5, figs 4–5.
1996 *Eptingium ramovsi* sp. nov. – Kozur et al., p. 206, pl. 4, fig. 13; pl. 10, fig. 8.
2012b *Eptingium* sp. cf. *ramovsi* Kozur et al. – Stockar et al., p. 392, pl. 3, figs 1–3.

Remarks: The first illustration of this species published by Dumitrica in 1978b (pl. 4, fig. 7: optical section of another specimen), shows a specimen with strongly twisted and distally pointed spines.
Range and occurrence: Illyrian (*Tetraspinocyrtis laevis* Zone) to Fassanian (*Ladinocampe vicentinensis* Subzone); Cosmopolitan.

Genus *Spongostephanidium* Dumitrica, 1978b
Type species: *Spongostephanidium spongiosum* Dumitrica, 1978b

Spongostephanidium brevispinosum Ozsvárt sp. nov.
Plate 1, Figures 11–12

1996 *Spongostephanidium longispinosum* (Sashida) – pars Kozur et al., p. 208, pl. 6, fig. 8.

Etymology: Brevis (Latin) = short, spinosum (Latin) = spiny.
Holotype: Plate 1, Figure 12; Hungarian Natural History Museum, Budapest: PAL 2022.130.1.
Studied material: Three specimens from the Frötschbach section.
Description: Test relatively small, slightly compressed, circular to triangular in outline with three massive spines. Meshwork of cortical shell composed of quite thick, triangular to polygonal pore-frames with large pores. Spines connected with wide, flat arches. Spines short, squat; two of them significantly shorter and equal in length than third one; spines smooth, pointed distally. Initial spicular system simple with slim bars; remained hidden.
Remarks: *S. brevispinosum* sp. nov. is distinguished by two significantly shorter spines from all other species of *Spongostephanidium*.
Dimensions: Length of test 90–100 µm, longest spine 110–130 µm, shorter spines 45–50 µm.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger transitus* Zone to *Spongosilicarmiger italicus* Zone); Southern Alps.

Spongostephanidium japonicum (Nakaseko et Nishimura, 1979)
Plate 1, Figures 9–10

1979 *Trilonche japonica* sp. nov. – Nakaseko & Nishimura p. 72, pl. 4, figs 8,10
1990 *Cryptostephanidium japonicum* (Nakaseko et Nishimura) – Yeh, p. 22, pl. 4, fig. 10; pl. 5, figs 1–2, 7; pl. 10, fig. 11; pl. 11, fig. 18.
1996 *Spongostephanidium japonicum* (Nakaseko et Nishimura) – Kozur et al., p. 207, pl. 6, figs 1–3. (cum syn.)

Remarks: *Spongostephanidium japonicum* (Nakaseko et Nishimura, 1979) differs from all other species of *Spongostephanidium* by the widening the middle part of the spines. Besides, our illustrated specimens have a relatively simple test, without spongy meshwork and rata her massive structure of shell which compose of thick, rod-like elements.
Range and occurrence: Illyrian (*Spongosilicarmiger transitus* Zone), although Yeh (1990) reported it from the early Late Carnian of the Busuanga Island, west Philippines; Cosmopolitan.

Spongostephanidium cf. *spongiosum* Dumitrica, 1978b
Plate 1, Figure 13

cf. 1978 *Spongostephanidium spongiosum* sp. nov. – Dumitrica, p. 32, pl. 2, figs 2–5.

Remarks: Due to the poor preservation, this specimen could tentatively assign to the *Spongostephanidium spongiosum* Dumitrica, because its spines are closer to the *S. spongiosum* than to the *S.≈japonicum* (Nakaseko et Nishimura, 1979).
Range and occurrence: Pelsonian from the Cristian section Romania to upper Illyrian (*Spongosilicarmiger italicus* Zone) in the Southern Alps.

Genus *Triassistephanidium* Dumitrica, 1978b
Type species: *Triassistephanidium laticornis* Dumitrica, 1978b

Triassistephanidium sp.
Plate 1, Figure 14

Remarks: The test is globular with mostly small-sized, circular to polygonal pore frames with three massive, three-bladed spines. All spines are approximately equal in length, proximally narrowed, later widening (approx. the widest part is at the 2/3 part), but distally pointed. Blades are strongly undulating, large-sized holes formed on the joining part of the test and spines. This specimen is most likely to be a new species because the characteristic massive, spines distinguish it from all other species of *Triassistephanidium*, but unfortunately, only one specimen was found in the Frötschbach section so far. *T. magniporatum* Kozur et Mostler has fairly similar spines, but those are slightly twisted, and the test is composed of significantly different pore frames, whereas *T. laticornis* Dumitrica wears significantly different spines.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps (Frötschbach section).

Family Multiarcusellidae Kozur et Mostler, 1979
Genus *Beturiella* Dumitrica et al., 1980
Type species: *Beturiella robusta* Dumitrica et al., 1980

Beturiella latispinosa Ozsvárt sp. nov.
Plate 1, Figure 15

Etymology: *Lata* (Latin, adj.) means wide, whereas *spinosa* means spines.
Holotype: Plate 1, Figure 15; Hungarian Natural History Museum, Budapest: PAL 2022.115.1.
Studied material: A single specimen from the Frötschbach section.
Description: Large, spherical shell with thick latticed layer composed of circular to polygonal pore frames. Five (or six),

large, triradiate spines, wide distally, broadest at middle part, pointed. Three robust, sharp ridges, furrows wide, shallow.
Dimensions: Diameter of test 100 µm, length os spines 80–85 µm.
Remarks: This species is distinguished from *B. robusta* DUMITRICA et al., by having significantly broader and different spines whereas *B. mengshengensis* FENG has slightly twisted spines which are hardly visible in illustrated pictures, but those specimens have significantly smaller pore frames.
Range and occurrences: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps (Frötschbach section).

Family Austrisaturnalidae KOZUR et MOSTLER, 1983
Genus *Tiborella* DUMITRICA et al., 1980
Type species: *Tiborella magnidentata* DUMITRICA et al., 1980

Tiborella florida austriaca KOZUR et al., 1996
Plate 2, Figure 1

1996 *Tiborella florida austriaca* sp. nov. – KOZUR et al., p. 219, pl. 4, figs 1, 5.
2013 *Tiborella florida austriaca* KOZUR et al. – CELARC et al., fig. 7.19.

Remarks: Our illustrated specimen has a relatively large, inflated test with huge pores, three stout spines and one significantly longer spine. The fourth, longer spine is slightly rotated compared to the other three: its wide ridges are in different planes.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger transitus* Zone to *Spongosilicarmiger italicus* Zone); Southern Alps, Julian Alps.

Tiborella magnidentata DUMITRICA et al., 1980
Plate 2, Figure 2

1980 *Tiborella magnidentata* sp. nov. – DUMITRICA et al., p. 18 pl. 1, figs 2, 6, pl. 11, figs 2–4, pl. 12, fig. 4.
1984 *Tiborella magnidentata* DUMITRICA et al. – LAHM, p. 108, pl. 19, fig. 7.
1990 *Tiborella magnidentata* DUMITRICA et al. – GORIČAN & BUSER, p. 159, pl. 1, fig. 4.
1990 *Tiborella magnidentata* DUMITRICA et al. – YEH, p. 20 pl. 4, fig. 17.
1995 *Tiborella magnidentata* DUMITRICA et al. – RAMOVŠ & GORIČAN, p. 192, pl. 4, fig. 6.

Range and occurrence: Upper Illyrian (*Spongosilicarmiger transitus* Zone to *Tritortis kretaensis* Zone); Southern Alp, Julian Alps; Busuanga Island, Philippines.

Family Centrocubidae HOLLANDE et ENJUMET, 1960
Genus *Welirella* DUMITRICA et al., 1980
Type species: *Welirella weveri* DUMITRICA et al., 1980

Welirella fleuryi (DE WEVER, 1979)
Plate 2, Figure 3

1979 *Conosphaera* (?) *fleuryi* sp. nov. – DE WEVER et al., p. 78, pl. 1, figs 5–7.
1996 *Welirella fleuryi* (DE WEVER) – KOZUR et al., p. 225, pl. 8, fig. 10
2013 *Welirella? fleuryi* (DE WEVER) – CELARC et al., fig. 7.13.

Range and occurrence: Pelsonian (*Baratuna cristianensis* Zone) to Lacian (lower Norian); Southern Carpathians, Southern Alps, Julian Alps, Sicily and Turkey (Antalya nappes).

Welirella mesotriassica KOZUR et al., 1996
Plate 2, Figure 4

1996 *Welirella mesotriassica* sp. nov. – KOZUR et al., p. 225, pl. 8, fig. 13.

Remarks: KOZUR et al. (1996) described *Welirella mesotriassica* as double-walled species, although this cannot be seen in that illustrated specimen (pl. 8, fig. 13) they noted that the inner pore frame possesses small to roundish pores, whereas the outer pore frames contain large irregular pores.
Range and occurrence: Pelsonian (*Baratuna cristianensis* Zone) to upper Illyrian (*Spongosilicarmiger italicus* Zone): Southern Carpathians, Southern Alps, Julian Alps.

Family Hindeosphaerinae KOZUR et MOSTLER, 1981
Genus *Pseudostylosphaera* KOZUR et MOSTLER, 1981
Type species: *Pseudostylosphaera gracilis* KOZUR et MOSTLER, 1981

Pseudostylosphaera acrior (BRAGIN, 1986)
Plate 2, Figures 5–7

1979 *Archaeospongoprunum compactum* sp. nov. – NAKASEKO & NISHIMURA, p. 68, pl. 1, figs 3, 7.
1982 *Archaeospongoprunum compactum* NAKASEKO et NISHIMURA – SATO et al., pl. 2, fig. 3.
1986 *Archaeospongoprunum* (?) *acrior* sp. nov. – BRAGIN, p. 69, pl. 2, fig. 5.
1988 "*Archaeospongoprunum*" *acrior* BRAGIN – BRAGIN et al., p. 25, pl. 2, fig. 4.
1989 *Pseudostylosphaera coccostyla* (RÜST) – MARTINI et al., pl. 1, fig. 17, pl. 2, figs 11–12, 16 pl. 3, fig. 10–11.
1990 *Pseudostylosphaera compacta* (NAKASEKO et NISHIMURA) – YEH, p. 15, pl. 3, figs 3–4, 20.
1991 *Pseudostylosphaera coccostyla* (RÜST) – DOSZTÁLY, pl. 4, fig. 3.
1991 "*Stylosphaera*" *acrior* BRAGIN – BRAGIN, p. 88, pl. 1, fig. 14.
1992 *Archaeospongoprunum compactum* NAKASEKO et NISHIMURA – FENG, pl. 2, fig. 5.
1993 *Pseudostylosphaera japonica* (NAKASEKO et NISHIMURA) – SASHIDA et al., p. 89, figs 7.9, 7.15.
1993 *Archaeospongoprunum compactum* NAKASEKO et NISHIMURA – FENG & LIU, pl. 1, figs 1–2.
1993 *Archaeospongoprunum japonicum* NAKASEKO et NISHIMURA – FENG & LIU, pl. 1, fig. 3.
1994 *Pseudostylosphaera coccostyla compacta* (NAKASEKO et NISHIMURA) – KOZUR & MOSTLER, p. 44, pl. 1, fig. 8.
1996 *Pseudostylosphaera coccostyla acrior* (BRAGIN) – KOZUR & MOSTLER, p. 211, pl. 6, figs. 12–14.
1997 *Pseudostylosphaera japonica* (NAKASEKO et NISHIMURA) – JASIN, pl. 3, fig. 3.
2000 *Pseudostylosphaera compacta* (NAKASEKO et NISHIMURA) – XIA & NING, p. 78, pl. 1, figs 1, 3, non 1, fig. 2!
2001 *Pseudostylosphaera compacta* (NAKASEKO et NISHIMURA) – FENG et al., p. 188, pl. 5, fig. 8–11.
2011 *Pseudostylosphaera acrior* (BRAGIN) – THASSANAPAK et al., p. 194, figs 6L, M, N.

2011 *Pseudostylosphaera compacta* (Nakaseko et Nishimura) – Thassanapak et al., p. 194, figs 6O, Q.
2011 *Pseudostylosphaera coccostyla acrior* (Bragin) – Ozsvárt et al., fig. 9.6.
2012b *Pseudostylosphaera acrior* (Bragin) – Stockar et al., p. 400, pl. 5, figs 2–5.

Range and occurrence: Illyrian (*Tetraspinocyrtis laevis* Zone) to Carnian (upper Julian or lower Tuvalian); Cosmopolitan.

Pseudostylosphaera canaliculata (Bragin, 1986)
Plate 2, Figures 8–9

1981 *Pseudostylosphaera coccosytla* (Rüst) – Kozur & Mostler, p. 31, pl. 46, fig. 5, non pl. 15, fig. 3!
1981 *Pseudostylosphaera* ? sp. – Kozur & Mostler, p. 33, pl. 47, fig. 5.
1984 *Pseudostylosphaera coccosytla* (Rüst) – Lahm, p. 33. pl. 4, figs 7–8.
1986 *Archaeospongoprunum* ? *canaliculatum* sp. nov. – Bragin, p. 69, pl. 2, fig. 6.
1986 *Pseudostylosphaera coccosytla* (Rüst) – Kozur & Réti, fig. 6E.
1990 *Pseudostylosphaera coccosytla* (Rüst) – Goričan & Buser, p. 153, pl. 5. f. 1.
1991 "*Stylosphaera*" *canaliculata* (Bragin) – Bragin, p. 2, figs 6–7.
1995 *Pseudostylosphaera coccosytla* (Rüst) – Ramovš & Goričan, p. 190, pl. 3, figs 3–4.
1995 *Pseudostylosphaera coccosytla* (Rüst) – Kellici & De Wever, p. 157, pl. 4, figs 11–12.
1996 *Pseudostylosphaera coccosytla* (Rüst) – Chiari et al., pl. 2, fig. 13.
1997 *Pseudostylosphaera coccosytla* (Rüst) – Jasin, pl. 3, fig. 1.
1999 *Pseudostylosphaera coccostyla coccosytla* (Rüst) – Sashida et al., p. 770, fig. 8.10.
1999 *Pseudostylosphaera coccostyla coccosytla* (Rüst) – Tekin, p. 128, pl. 25, fig. 8.
2001 *Pseudostylosphaera compacta* (Nakaseko et Nishimura) – Feng et al., p. 188, pl. 5, fig. 12.
2001 *Pseudostylosphaera coccostylus* (Rüst) –Feng et al., p. 190, pl. 5, figs 13–14.
2002 *Pseudostylosphaera coccosytla* (Rüst) – Wang et al., p. 219, pl. 1, fig. 23.
2009 *Pseudostylosphaera coccostyla* (Rüst) – Feng et al., p. 593, figs 5.3–4.
2012 *Pseudostylosphaera coccostyla coccosytla* (Rüst) – Ozsvárt & Kovács, pl. 1, fig. 1.
2012b *Pseudostylosphaera canaliculata* (Bragin) – Stockar et al., p. 398, pl. 5, fig. 1.

Range and occurrence: Illyrian (Upper part of *Tetraspinocyrtis laevis* Zone) to Longobardian (*Muelleritortis cochleata* Zone); Cosmopolitan.

Pseudostylosphaera compacta (Nakaseko et Nishimura, 1979)
Plate 2, Figures 10–11

1979 *Archaeospongoprunum compactum* sp. nov. – Nakaseko & Nishimura, p. 68, pl. 1, fig. 7,
1981 *Pseudostylosphaera coccostyla* (Rüst, 1892) – Kozur & Mostler, p. 31, pl. 15. fig. 3, non pl. 46, fig. 5.
1982 *Stylosphaera* (?) *compacta* (Nakaseko et Nishimura) – Kishida & Sugano, pl. 1, fig. 8.
1997 *Pseudostylosphaera compacta* (Nakaseko et Nishimura) – Jasin, pl. 3, fig. 2.
2001 *Pseudostylosphaera compacta* (Nakaseko et Nishimura) – Feng et al., p. 188, pl. 5, fig. 7.

Remarks: *Pseudostylosphaera compacta* (Nakaseko et Nishimura) differs from *P. acrior* (Bragin) by having significantly longer and slender spines.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone) to Longobardian (*Muelleritortis cochleata* Zone); Cosmopolitan.

Pseudostylosphaera cf. *compacta* (Nakaseko et Nishimura, 1979)
Plate 2, Figures 12–13

2012b *Pseudostylosphaera* sp. aff. *P. japonica* (Nakaseko et Nishimura) – Stockar et al., p. 397, pl. 4, figs 3–5.

Remarks: These specimens could be a transitional form between *Pseudostylosphaera japonica* (Nakaseko et Nishimura, 1979) and *P. compacta* (Nakaseko et Nishimura, 1979). *Pseudostylosphaera japonica* (Nakaseko et Nishimura, 1979) differs by having significantly shorter and wider polar spines (with characteristic widening at the midlength of spines) whereas *P. compacta* (Nakaseko et Nishimura, 1979) slightly differs by having straight (without narrowing and widening part of spines) spines.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone) to early Fassanian (*Ladinocampe multiperforata* Zone); Southern Alps.

Pseudostylosphaera longispinosa Kozur et Mostler, 1981
Plate 2, Figures 14

1981 *Pseudostylosphaera longispinosa* sp. nov. – Kozur & Mostler, p. 32, pl. 1, fig. 6.
1981 *Pseudostylosphaera longobardica* sp. nov. – Kozur & Mostler, p. 33, pl. 49, fig. 3.
1984 *Pseudostylosphaera longispinosa* Kozur et Mostler – Lahm, p. 34–35, pl. 4, figs 11–12.
1986 *Pseudostylosphaera longispinosa* Kozur et Mostler – Kozur & Réti, fig. 6D.
1990 *Pseudostylosphaera longispinosa* Kozur et Mostler – Goričan & Buser, p. 155, pl. 5, fig. 4.
1989 *Pseudostylosphaera longispinosa* Kozur et Mostler – Kolar-Jurkovšek, p. 76, pl. 5., figs 6 a, b.
1990 *Pseudostylosphaera longobardica* Kozur et Mostler – De Wever et al., pl. 1, fig. 5.
1990 *Pseudostylosphaera longispinosa* Kozur et Mostler – Yeh, p. 15, pl. 4, fig. 2.
1997 *Pseudostylosphaera compacta* (Nakaseko et Nishimura) – Jasin, pl. 3, fig. 2.
1997 *Pseudostylosphaera longispinosa* Kozur et Mostler – Sugiyama, p. 188, fig. 48.16.
1998 *Pseudostylosphaera longispinosa* Kozur et Mostler – Takahashi et al., pl. 1, fig. 4.
1999 *Pseudostylosphaera longispinosa* Kozur et Mostler – Tekin, p. 129, pl. 25, fig. 14.
2001 *Pseudostylosphaera longispinosa* Kozur et Mostler – Feng et al., p. 190, pl. 5, figs 22–24.
2006 *Pseudostylosphaera longispinosa* Kozur et Mostler – Marquez et al., pl. 2, fig. 13.

2007 *Pseudostylosphaera longispinosa* Kozur et Mostler – Tekin and Göncüoglu, pl. 2, fig. 25.
2008 *Pseudostylosphaera longobardica* Kozur et Mostler – Gawlick et al., fig. 10.10.
2010 *Pseudostylosphaera longispinosa* Kozur et Mostler – Tekin & Sönmez, fig. 7R.
2011 *Pseudostylosphaera longispinosa* Kozur et Mostler – Thassanapak et al., p. 195, fig. 6T.
2012 *Pseudostylosphaera longispinosa* Kozur et Mostler – Ozsvárt et al., fig. 9.7.
2012 *Pseudostylosphaera longobardica* Kozur et Mostler – Ozsvárt et al., fig. 9.8.
2012b *Pseudostylosphaera longispinosa* Kozur et Mostler – Stockar et al., p. 397, pl. 4., figs 16–24.
2015 *Pseudostylosphaera longispinosa* Kozur et Mostler – Ozsvárt et al., p. 349, fig. 6.6.

Range and occurrence: Upper Illyrian (*Tetraspinocyrtis laevis* Zone) to Tuvalian (*Spongotortilispinus moixi* Zone); Cosmopolitan.

Pseudostylosphaera mostleri Tekin, 2007
Plate 2, Figures 15–16

2007 *Pseudostylosphaera mostleri* n. sp – Tekin, p. 142, pl. 3, figs 1–5.

Remarks: Illustrated specimens from the Frötschbach section have somewhat more massive spines with slightly wider ridges and narrower grooves.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone) to upper Julian (*Tetraporobrachia haeckeli* Zone); Cosmopolitan.

Pseudostylosphaera nazarovi (Kozur et Mostler, 1981)
Plate 2, Figure 17

1979 *Stylosphaera* ? *nazarovi* sp. nov. – Kozur & Mostler, p. 55, pl. 1, fig. 5, pl. 14, figs 4, 6.
2007 *Pseudostylosphaera nazarovi* (Kozur et Mostler) – Tekin and Göncüoglu, pl. 2, figs 26–27.
2012 *Pseudostylosphaera nazarovi* (Kozur et Mostler) – Tekin et al., fig. 5b.

Range and occurrence: Lower Longobardian (*Muelleritortis cochleata* Zone) to Upper Julian (*Tetraporobrachia haeckeli* Subzone); Northern Calcareous Alps (Göstling), Southern Alps (Seceda section).

Genus *Spinostylosphaera* Ozsvárt et al., 2015
Type species: *Spinostylosphaera andrasi* Ozsvárt et al., 2015

Spinostylosphaera ? *vachardi* Ozsvárt et al., 2015
Plate 2, Figure 18

2011 *Dumitricasphaera simplex* Tekin – Bragin, p. 755, pl. 10, fig. 6.
2015 *Spinostylosphaera vachardi* sp. nov. – Ozsvárt et al., p. 349, figs 6.13–15.

Remarks: Although these specimens are poorly preserved in the material from the Seceda outcrop, they wear characteristic three-bladed polar spines with three pointed secondary spines. Du to poor preservation it is difficult to decide whether this specimen has a spongy or latticed frame.
Range and occurrence: Lower Longobardian (Ladinian) to lower Tuvalian (*Spongotortilispinus moixi* Zone); Southern Alps (Seceda outcrop), Sorgun Ophiolitic Mélange, Turkey.

Genus *Parasepsagon* Dumitrica et al., 1980
Type species: *Parasepsagon tetracanthus* Dumitrica et al., 1980

Parasepsagon praetetracanthus Kozur et Mostler, 1994
Plate 3, Figure 1

1984 *Staurosphaera? fluegeli* (Kozur et Mostler) – Lahm, p. 75, pl. 13, fig. 7
1990 *Plafkerium? cf. longidentatum* Kozur et Mostler – Goričan & Buser, p. 153, pl. 6, fig. 2.
1994 *Parasepsagon asymmetricus praetetracanthus* n. subsp. – Kozur & Mostler, p. 49, pl. 5, fig. 3.
1995 *Parasepsagon asymmetricus praetetracanthus* Kozur et Mostler – Ramovš & Goričan, p. 187, pl. 3, figs 1–2.
2012b *Parasepsagon praetetracanthus* Kozur et Mostler – Stockar et al., p. 401, pl. 5, figs 18, ?19–20.
2014 *Parasepsagon tetracanthus* Dumitrica et al. – Kamata et al., pl. 2, figs 13–14.

Range and occurrence: Aegean (*Hozmadia gifuensis* Zone) to Fassanian (*Ladinocampe multiperforata* Zone); Thailand, the Southern Alps.

Parasepsagon cf. *tetracanthus* Dumitrica et al., 1980
Plate 3, Figure 2

cf. 1980 *Parasepsagon tetracanthus* sp. nov. – Dumitrica et al., p. 13, pl. 1, fig. 8; pl. 2, fig. 7.

Remarks: This specimen fairly resembles the *P. tetracanthus* Dumitrica et al., but the preservation is rather poor therefore we can tentatively assign it to this genus.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone) to lower Fassanian (*Ladinocampe multiperforata* Zone); Southern Alps.

Genus S*epsagon* Dumitrica et al., 1980
Type species: *Triactoma longispinosum* Kozur et Mostler, 1979

Sepsagon ladinicus Kozur et Mostler, 1994
Plate 3, Figure 3

1980 *Sepsagon longispinosus* (Kozur et Mostler) – Dumitrica et al., p. 15, pl. 5, figs 1–2, 5–6; pl. 15, fig. 1.
1984 *Sepsagon longispinosus longispinosus* (Kozur et Mostler) – Lahm, p. 39, pl. 6, fig. 5, non 3–4.
1994 *Sepsagon ladinicus* sp. nov. – Kozur & Mostler, p. 48, pl. 4, figs 5–9.
2012b *Sepsagon ladinicus* Kozur et Mostler – Stockar et al., p. 402, pl. 6, figs 5–7.

Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone) to lower Fassanian (*Ladinocampe vicentinensis* Subzone); Southern Alps.

Sepsagon recoarensis LAHM, 1984
Plate 3, Figures 4a–b

1984 *Sepsagon longispinosus recoarensis* n. subsp. – LAHM, p. 40, pl. 6, fig. 8.
1984 *Sepsagon* cf. *longispinosus recoarensis* n. subsp. – LAHM, p. 40, pl. 6, fig. 9.
1995 *Sepsagon longispinosus* (KOZUR et MOSTLER) – KELLICI & DE WEVER, p. 158, pl. 5, fig. 8.
2012b *Sepsagon recoarensis* LAHM – STOCKAR et al., p. 402, pl. 6, figs 1–4.

Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone) to lower Fassanian (*Ladinocampe vicentinensis* Subzone); Southern Alps.

Sepsagon cf. *robustus* LAHM, 1984
Plate 3, Figure 5

1984 *Sepsagon* ? *robustus* sp. nov. – LAHM, p. 40, pl. 6, fig. 10.

Remarks: Poorly preserved specimens with one significantly longer spine than the other two. The shorter two spines are equal in length, whereas all of them increase distally, but from midlength decrease at the distal end. Ridges are extremely wide, whereas holes at the base of them are smaller than at the holotype. The inner structure has remained hidden.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger transitus* Zone) to Longobardian (*Muelleritortis cochleata* Zone); Southern Alps, Julian Alps, Northern Tibet.

Genus *Bernoulliella* STOCKAR et al, 2012
Type species: *Hexalonche simplex* LAHM, 1984

Bernoulliella simplex (LAHM, 1984)
Plate 3, Figures 6–8

1984 *Hexalonche simplex* sp. nov. – LAHM, p. 79, pl. 14, figs 2–3.
1996 *Hexalonche simplex* LAHM – KOZUR et al., p. 222, pl. 8, figs 1, 4.
2012b *Bernoulliella simplex* (LAHM) – STOCKAR et al., p. 407, text-fig. 11; pl. 7, figs 1–5.

Range and occurrence: Upper Illyrian (*Tetraspinocyrtis laevis* Zone) to lower Fassanian (*Ladinocampe multiperforata* Zone); Southern Alps, Julian Alps, Transdanubian Central Range (Felsőörs), Hungary.

Bernoulliella cf. *simplex* (LAHM, 1984)
Plate 3, Figures 9–10

Remarks: These specimens are fairly similar to the *Bernoulliella simplex*, the only difference is the significantly more massive spines (one or two), which possess secondary furrows at the proximal part of the spine(s). These furrows are relatively wide at the proximal part and narrowed distally, generally, they are rather short.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps (Frötschbach section).

Genus *Eohexastylus* STOCKAR et al., 2012
Type species: *Hexastylus muzavori* LAHM, 1984

Eohexastylus muzavori (LAHM, 1984)
Plate 3, Figures 11–12

1984 *Hexastylus muzavori* sp. nov. – LAHM, p. 78, pl. 14, fig. 1.
1995 *Phyletripes muzavori* (LAHM) – KELLICI & DE WEVER, p. 156, pl. 2, fig. 11.
2012b *Eohexastylus muzavori* (LAHM) – STOCKAR et al., p. 409, fig. 12; pl. 7, figs 7–9.

Remarks: The holotype of this species has slender test and longer terminal spines and more massive triradiate spines.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone) to lower Fassanian (*Ladinocampe multiperforata* Zone); Southern Alps.

Family Muelleritortiidae KOZUR, 1988
Genus *Muelleritortis* KOZUR, 1988
Remarks: The genera *Ditortis* KOZUR, 1988 and *Pentatortis* KOZUR, 1988 are junior synonyms of this genus.
Type species: *Emiluvia ? cochleata* NAKASEKO et NISHIMURA, 1979

Muelleritortis globosa TEKIN, 2010
Plate 4, Figure 1

2010 *Muelleritortis firma globosa* n. subsp. – TEKIN & SÖNMEZ, p. 211, figs 8H–K.

Remarks: TEKIN established a new subspecies *Muelleritortis firma globosa* although that species significantly differs from *M. firma* (GORIČAN) by having undivided ridges on spines, longer spines that widening in the middle part and tapering distally (except longest spine) which is straight and pointed distally without widening.
Range and occurrence: Longobardian (*Muelleritortis firma* Zone to *Muelleritortis cochleata* Zone); Southern Alps, Antalya nappes, Southern Turkey.

Family Palaeoscenidiidae RIEDEL, 1967
Genus *Parentactinia* DUMITRICA, 1978a
Type species: *Parentactinia pugnax* DUMITRICA, 1978a

Parentactinia pugnax DUMITRICA, 1978a
Plate 3, Figure 13

1978a *Parentactinia pugnax* sp. nov. – DUMITRICA, p. 50, pl. 4, figs 4?, 5, pl. V, figs 1–3.
1990 *Parentactinia pugnax* DUMITRICA – YEH, p. 13, pl. 4, fig. 19.
1990 *Parentactinia pugnax* DUMITRICA – GORIČAN & BUSER, p. 149, pl. 7, fig. 6.
1994 *Parentactinia pugnax* DUMITRICA – KOZUR & MOSTLER, p. 45, pl. 1, figs 11–12.
1995 *Parentactinia pugnax* DUMITRICA – RAMOVŠ & GORIČAN, p. 187, pl. 4, fig. 7.
2003 *Parentactinia* cf. *pugnax* DUMITRICA – HORI et al., fig. 5B.
2013 *Parentactinia pugnax* DUMITRICA – CELARC et al., figs 8.19–20.
? 2014 *Parentactinia* cf. *pugnax* DUMITRICA – SHIGETA et al., p. 286, fig. 203.5.
2015 *Parentactinia pugnax* DUMITRICA – OZSVÁRT et al., p. 345, fig. 5.7.

Range and occurrence: ?Olenekian from New Zealand and Vietnam; Middle Triassic from the Southern Alps (Recoaro);

Julian Alps; Transdanubian Central Range; Upper Triassic (lower Tuvalian) from the Sorgun Ophiolitic Mélange, Turkey.

Parentactinia kecskemetii OZSVÁRT sp. nov.
Plate 3, Figures 14–15

Etymology: This species is named in honour of TIBOR KECSKEMÉTI who has been turned 90 recently, he is a Hungarian palaeontologist, *Nummulites* expert and he held the deputy director position of the Hungarian Natural History Museum for a long time.
Holotype: Plate 3, Figures 14–15; Hungarian Natural History Museum, Budapest: PAL 2022.123.1.
Studied material: Two specimens from the Frötschbach section.
Description: This species has two, massive, straight or slightly curved and pointed distally apical spines which might wear short and pointed spinule. The median bar (MB) is extremely short; four similar to the apical spines but significantly longer basal spines which curved outward. Basal spines are connected to create an oviform test with irregular but rather triangular-shaped pores.
Dimensions: Length of the test 250 µm, diameter of the test 110 µm, length of apical spines 60–65 µm.
Remarks: *Parentactinia kecskemetii* sp. nov. is distinguished from *P. pugnax* DUMITRICA by having two apical spines instead of three or four of them.
Range and occurrence: Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps (Frötschbach section).

Family Thalassothamnidae HAECKER, 1906
Genus: *Triassothamnus* KOZUR et MOSTLER, 1981
Type species: *Palacantholithus? verticillatus* DUMITRICA, 1978a

Triassothamnus verticillatus (DUMITRICA, 1978a)
Plate 4, Figures 2–3

1978a *Palacantholithus? verticillatus* sp. nov. – DUMITRICA, p. 42, pl. 1, fig. 1; pl. 2, fig. 5.
1982 *Archaeothamnulus verticillatus* (DUMITRICA) – DUMITRICA, p. 418, pl. 5, figs 3–4; pl. 7, fig. 4.
1990 *Triassothamnus verticillatus* (DUMITRICA) – GORIČAN & BUSER, p. 160, pl. 7, fig. 3.
1996 *Triassothamnus verticillatus* (DUMITRICA) – KOZUR et al., p. 218, pl. 11, fig. 3.
2013 *Triassothamnus verticillatus* (DUMITRICA) – CELARC et al., fig. 8.24.
2014 *Triassothamnus verticillatus* (DUMITRICA) – SHIGETA et al., p. 288, figs 205.1–5.

Range and occurrence: Lower Olenekian to Illyrian (*Ladinocampe multiperforata* Zone); Bac Thuy Formation, northeastern Vietnam, Southern Alps (Recoaro) and Julian Alps.

Family Heptacladidae DUMITRICA et al., 1980
Genus *Heptacladus* DUMITRICA et al., 1980
Type species: *Heptacladus crassispinus* DUMITRICA et al., 1980

Heptacladus crassispinus DUMITRICA et al., 1980
Plate 4, Figures 4–6

1980 *Heptacladus crassispinus* sp. nov. – DUMITRICA et al., p. 3, pl. 5, fig. 3; pl. 13, figs 1–3, 5.
1984 *Heptacladus crassispinus* DUMITRICA et al. – LAHM, p. 29, pl. 3, fig. 10.
1994 *Heptacladus crassispinus* DUMITRICA et al. – KOZUR & MOSTLER, pl. 2, figs 8–9; pl. 3, figs 3, 8.
1996 *Heptacladus crassispinus* DUMITRICA et al. – KOZUR et al., p. 223, pl. 7, fig. 12.

Remarks: Outer layer of the shell is spherical, composed of large polygonal pore frames with rod-like, straight, long spines and numerous needle-like secondary spines. The initial spicule contains a short, stout median bar and similar but somewhat longer and thinner apical spines. Four basal spines contain the initial spicule, two of them continue in the rod-like, massive spines and the other two connect by an arch that is connected to the outer frame.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger transitus* Zone to *Ladinocampe multiperforatra* Zone); Southern Alps.

Family Entactiniidae RIEDEL, 1967
Genus *Entactinosphaera* FOREMAN, 1963
Type species: *Entactinosphaera esostrongyla* FOREMAN, 1963

"Entactinosphaera" stockari OZSVÁRT sp. nov.
Plate 4, Figures 7–10

2012b "*Entactinosphaera*"*? zapfei* KOZUR et MOSTLER, 1979 – STOCKAR et al., p. 428, pl. 12, fig. 2.

Etymology: This species is named for Dr RUDOLF STOCKAR for his outstanding contribution to paleoenvironmental investigations of the Middle Triassic Monte San Giorgio (Southern Alps, Switzerland).
Holotype: Plate 4, Figure 8; Hungarian Natural History Museum, Budapest: PAL 2022.116.1.
Studied material: Three specimens from the Frötschbach section.
Description: Test spherical (100–150 µm in diameter), cortical shell composed of latticed meshwork with large, circular pores, medullary shell absent. Simple initial spicular system made of slim, smooth median bar, apical spine, ventral spine, two primary lateral spines and two secondary lateral spines. Six massive, three-bladed, relatively short (100–200 µm in length) pointed distally spines with sharp ridges and deep grooves.
Remarks: *E. stockari* sp. nov. is quite similar to the *Bernouillella simplex* (LAHM, 1984) based on outer morphological characteristics, however, the initial spicular system is completely different because the medullary shell is absent. Besides, the outermost layer of the cortical shell possesses somewhat larger pores. "*E.*" *stockari* sp. nov. differs from "*Entactinosphaera*" *zapfei* KOZUR et MOSTLER by having significantly shorter and more robust spines and the cortical shell composed of latticed meshwork, whereas the cortical shell of "*Entactinosphaera*" *zapfei* KOZUR et MOSTLER (holotype: pl. 14, fig. 2 in KOZUR & MOSTLER, 1979) formed by irregular large pores.
Range and occurrence: Pelsonian (*Baratuan cristianensis* Zone) to lower Fassanian (*Ladinocampe multiperforata* Zone); Southern Carpathians and Southern Alps.

"Entactinosphaera" zapfei Kozur et Mostler, 1979
Plate 4, Figures 12–14

1979 *Entactinosphaera* ? *zapfei* sp. nov. – Kozur & Mostler, p. 71, pl. 8, fig. 3(?); pl. 14, fig. 2.
1984 *Entactinosphaera* ? *zapfei* Kozur et Mostler – Lahm p. 16, pl. 1, fig. 9.
non 2012b *"Entactinosphaera"* ? *zapfei* Kozur et Mostler – Stockar et al., p. 428, pl. 12, fig. 2.

Remarks: Illustrated specimens are the same as that illustrated by Kozur & Mostler (1979). However, the systematic position of this species is still questionable because of the huge gap in stratigraphic distribution (*Entactinosphaera* is a Devonian genus, originally) and the hidden internal structure of initial spicule.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone) to Julian (*Tetraporobrachia haeckeli* Zone); Southern Alps (Frötschbach section), Northern Calcareous Alps (Göstling).

"Entactinosphaera" ? *triassica* Kozur et Mostler, 1979
Plate 4, Figure 11

1979 *Entactinosphaera* ? *triassica* sp. nov. – Kozur & Mostler, p.70, pl. 6, fig. 2.
1984 *Entactinosphaera* ? *triassica* Kozur et Mostler – Lahm, p. 18, pl. 1, fig. 12.
2012 *Entactinosphaera* ? *triassica* Kozur et Mostler – Stockar, p. 428, pl. 12, fig. 1.

Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone) to Julian (*Tetraporobrachia haeckeli* Zone); Southern Alps (Frötschbach section), Northern Calcareous Alps (Göstling).

Entactinaria incertae sedis
Genus *Hexatortilisphaera* Kozur et al., 1996

Hexatortilisphaera aequispinosa Kozur et al., 1996
Plate 4, Figure 15

1996 *Hexatortilisphaera aequispinosa* sp. nov. – Kozur et al., p. 214, pl. 8, fig. 7.
2012b *Hexatortilisphaera aequispinosa* Kozur et al. – Stockar et al., p. 407, pl. 7, fig. 6.

Remarks: The two main, sinistrally twisted spines are significantly longer (approximately double in length) than four equatorial spines which are also slightly sinistrally twisted.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger transitus* Zone to *Ladinocampe vicentinensis* Subzone); Southern Alps, Julian Alps.

Entactinarian genus and species indeterminate A.
Plate 4, Figure 16

cf. 2000 *Actinomma* sp. – Sashida et al., p. 804, fig. 10.6.

Remarks: This species is tentatively assigned to Entactinaria, although the exact initial spicular system is hidden. Spherical test with massive polygonal to circular pore frames having tiny spines at vertices. 11–13 long, smooth and pointed spines with narrow, rounded longitudinal ridges and shallow longitudinal grooves at the proximal part of them. Sashida et al. (2000) published a fairly similar species as *Actinomma* sp., although it was assigned to the Spumellarian group.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps (Frötschbach section), Northern Thailand.

Order Spumellaria Ehrenberg, 1875
Family ?Pantanelliidae Pessagno, 1977

Family Xiphostylidae Haeckel, 1881
Genus *Archaeocenosphaera* Pessagno et Yang, 1989
Type species: *Archaeocenosphaera ruesti* Pessagno et Yang, 1989

Archaeocenosphaera igoi (Sashida, 2000)
Plate 5, Figures 1–2

1979 *Cenosphaera clathrata* Parona – Kozur & Mostler, p. 69, pl. 4, fig. 1.
1982 *"Cenosphaera"* sp. – Dumitrica & Mello, pl. 2, fig. 5.
1984 *Cenosphaera clathrata* Parona – Lahm, p. 15, pl. 1, figs 1–2.
1984 *Cenosphaera* sp. B – Lahm, p. 15, pl. 1, figs 5–6.
1994 *Cenosphaera* sp. – Kozur & Mostler, p. 248., pl. 2A, fig. 5
1996 *Cenosphaera clathrata* Parona – Chiari et al., pl. 1, fig. 19.
1996 *Cenosphaera parvispinosa* sp. nov. – Kozur et al., p. 222–223, pl. 9, fig. 12., non fig. 13.
1997 *Cenosphaera* sp. C – Yao, pl. 1, fig. 4.
1997 *Cenosphaera* ? sp. Zo – Yao, pl. 1, fig. 11.
2000 *Cenosphaera igoi* sp. nov. – Sashida et al., p. 804, figs 10.7–8.
2001 *Archaeocenosphaera* sp. – Hauser et al., pl. 3, fig. 10.
2007 *Cenosphaera igoi* Sashida – Saesaengseerung et al., fig. 8.52.
2008 *Cenosphaera igoi* Sashida – Saesaengseerung et al., p. 403, fig. 8.26.
2009 *Archaeocenosphaera clathrata* (Parona) – Feng et al., p. 585, fig. 3(1–4).
2011 *Archaeocenosphaera* sp. – Thassanapak et al., p. 188, figs 4C–D.
2012b *Archaeocenosphaera* sp. B sensu Lahm, 1984 – Stockar et al., p. 409, pl. 7, figs 10–11.
2014 *Archaeocenosphaera* sp. – Bragin, pl. 4, fig. 8.
2015 *Archaeocenosphaera clathrata* (Parona) – Ozsvárt et al., p. 344, fig. 5.1
2019 *Archaeocenosphaera* sp. – Bragin et al., pl. 1, figs 2.1–2.
2020 *Archaeocenosphaera* spp. – Slovenec et al., figs 10.19–23.

Remarks: Specimens previously assigned in the literature to *Cenosphaera clathrata* Parona, 1890. Kozur & Mostler (1979) figured the first SEM picture of this species, but it is a rather poorly preserved specimen, without any information regarding the locality and its exact age. However, that specimen has more or less circular to hexagonal pore frames, although it is really difficult to compare the illustrated Parona holotype because it is a rather schematic drawing (Parona, 1890, pl. 1, fig. 5). In fact, in Parona illustration has clearly fewer and symmetrically arranged hexagonal pore frames. Dumitrica et al. (1997) illustrated a specimen from Masirah Island, Oman that much more resembles the Parona holotype, but it is Berriasian in age. That specimen could be a true *Cenosphaera clathrata* Parona, 1890 (or *Archaeocenosphaera clathrata* (Parona, 1890) according to O'Dogherty et al. (2009) regarding erroneously used name for Mesozoic genera and it is a relatively good SEM illustration, much better than Parona drawings. The holotype of *C. clathrata* Parona, 1890 was recorded from the Upper

Jurassic and Lower Cretaceous, whereas Kozur & Mostler's specimens came out from the middle or late Triassic. Sashida et al. (2000) published a Middle Triassic (Anisian) species as *Cenosphaera igoi* Sashida which has a "single latticed shell with many circular pores. Pore frames are usually hexagonal and often bear small nodes, although this latter is hardly visible in figured specimens. In fact, the same or morphologically very similar specimens to Kozur & Mostler's specimen are commonly recorded from the Middle Triassic "Buchenstein Beds" (Livinallongo Formation) near Recoaro by Lahm (1984), from the Monte San Giorgio (Stockar et al., 2012b), from the Carnian Sorgun Ophiolitic Mélange, Southern Turkey by Ozsvárt et al. (2015), from Rubik complex in Albania by Chiari et al. (1996), additionally from Northern Thailand (Sashida et al., 2000) and Northern Tibet (Feng et al., 2009). As Stockar et al. (2012b) pointed out this huge gap between the Middle Triassic specimens and the Upper Tithonian or Lower Cretaceous Parona species makes the specify uncertain. Agreeing that long-ranged species are very rare among radiolarians, these illustrated specimens should be assigned to *Archaeocenosphaera igoi* (Sashida, 2000) rather than to *A. clathrata* Parona, 1890 as previously.
Range and occurrence: Lower Anisian (Sashida et al., 2000) to Carnian (Ozsvárt et al., 2015); Cosmopolitan.

Archaeocenosphaera parvispinosa (Kozur et Mostler, 1981)
Plate 5, Figures 3–4

1981 *Heliosoma* ? *parvispinosa* sp. nov. – Kozur & Mostler, p. 66, pl. 1, fig. 2.
1994 *Archaeocenosphaera limbata* sp. nov. – Kito & De Wever, p. 125, pl. 1, figs 1–3.
1996 *Cenosphaera parvispinosa* sp. nov. – Kozur et al., p. 222, pl. 9, fig. 13.
2002 *Cenosphaera clathrata* Parona – Suzuki et al., 2002, p. 170, fig. 4C.
2015 *Archaeocenosphaera parvispinosa* (Kozur et al.) – Ozsvárt et al., p. 344, fig. 5.2.

Remarks: Kozur & Mostler (1981) figured a species as *Heliosoma* ? *parvispinosa* which also probably belongs to *A. parvispinosa*, because it has hexagonal pore frames with tiny spines, although its preservation is rather bad. Suzuki et al. (2002) illustrated a very similar specimen from Peru as *C. clathrata* Parona, although it bears spars, small needle-like spines. Kito & De Wever (1994) also figured (pl. 1, fig. 1) a Middle Jurassic specimen (*Archaeocenosphaera limbata*) from Sicily, Italy which quite resembles *A. parvispinosa* (Kozur et al., 1996), despite its spines are a bit thinner.
Range and occurrence: Upper Anisian and lower Ladinian: Southern Alps, Hungary (Kozur et al., 1996); Lower Jurassic of Peru (Suzuki et al., 2002), Middle Jurassic of Sicily, Italy (Kito & De Wever, 1994).

Genus *Novamuria* Özdikmen, 2009
Type species: *Amuria impensa* Whalen et Carter, 1998

Novamuria mocki (Kozur et Mostler, 1979)
Plate 5, Figure 5

1979 *Acanthosphaera* ? *mocki* sp. nov. – Kozur & Mostler, p. 49, pl. 7, fig. 1
non 1981 *Heliosoma* ? *mocki* (Kozur et Mostler) – Kozur & Mostler, p. 65, pl. 57, fig. 2.
non 1984 *Heliosoma* ? *mocki* (Kozur et Mostler) – Lahm, p. 64, pl. 11, fig. 6.
1984 *Welirella weveri* Dumitrica et al. – Lahm, p. 107, pl. 19, fig. 5.
1990 *Heliosoma* ? *mocki* (Kozur et Mostler – Kolar-Jurkovšek, p. 80, pl. 5, fig. 3.
2005 *Heliosoma* ? *mocki* (Kozur et Mostler) – Tekin & Mostler, p. 24, pl. 1, fig. 3.
2010 *Heliosoma* ? *mocki* (Kozur et Mostler) – Tekin & Sönmez, fig. 6A.

Remarks: Illustrated specimen from the Frötchbach section has 9–11 spines, whereas the holotype wears 14 massive tricarinate spines as Kozur & Mostler (1979) published, without any information about its inner structure, locality or age. Later, Kozur & Mostler (1981) re-published a quite different form as *Heliosoma* ? *mocki* (*Acanthosphaera* ? *mocki* was mentioned as a synonym of it). That form has a medullary shell, and quite different spines. Probably these specimens belong to two different genera. Additionally, the names *Acanthosphaera* and *Heliosoma* were used erroneously (O'Dogherthy et al., 2009) for Mesozoic, therefore neither *Acanthosphaera* nor *Heliosoma* are valid. We have assigned this form to the genus *Novamuria.*
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone to *Spongoserulla fluegeli* Subzone); Southern Alps (Frötschbach section), Antalya nappe, Turkey.

Novamuria nicorae (Kozur et al., 1996)
Plate 5, Figure 6

1996 *Acanthosphaera nicorae* sp. nov. – Kozur et al., p. 221, pl. 8, fig. 9.
cf. 2005 *Acanthosphaera nicorae* Kozur et al. – Tekin & Mostler, p. 24, pl. 1, fig. 1.

Range and occurrence: Upper Illyrian (*Spongosilicarmiger transitus* Zone to the *Spongoserulla fluegeli* Subzone); Southern Alps (Karavanke and Dolomites), Antalya nappe, Turkey.

Novamuria wirzi Stockar et al, 2012
Plate 5, Figures 7–9

2012b *Novamuria wirzi* sp. nov. – Stockar et al., p. 410, pl. 7, figs 12–17; pl. 8, figs 1–4.

Remarks: Carter (1993) published a quite similar species as *Archaeocenosphaera* sp. B from Sandilands Formation, Queen Charlotte Islands, Canada which, however, differs from *N. wirzi* Stockar et al., in having fewer (10–12) triradiate spines. *Acanthosphaera* (?) *lucida* published by Hull (1997) from the Tithonian of Stanley Mountain, California, is also fairly similar to the *N. wirzi* Stockar et al., however, some of them wear somewhat shorter and fewer spines.
Range and occurrence: Pelsonian (*Baratuna cristianensis* Zone) to upper Illyrian (*Ladinocampe vicentinensis* Subzones); Southern Carpathians and Southern Alps.

Family Intermediellidae Lahm, 1984
Genus *Katorella* Kozur et Mostler, 1981
Type species: *Katorella bifurcata* Kozur et Mostler, 1981

Katorella bifurcata Kozur et Mostler, 1981
Plate 5, Figures 10–12

1979 *Staurodoras dercourti* De Wever – Nakaseko & Nishimura, p. 71, pl. 3, fig. 7.
1981 *Katorella bifurcata* sp. nov. – Kozur & Mostler, p. 51, pl. 3, figs 4–5; pl. 60, figs 2a, b.
1984 *Katorella bifurcata* Kozur et Mostler – Lahm, p. 52, pl. 9, fig 2.
1989 gen. nov. indet. (= *Staurodauras dercourti* De Wever et al., 1979 in Nakaseko & Nishimura, 1979) – Martini et al., pl. 1, fig. 5.
1990 gen. sp. indet (= *Staurodauras dercourti* De Wever et coll., 1979 in Nakaseko & Nishimura, 1979) – De Wever et al., fig. 7.
1990 *Katorella bifurcata* Kozur et Mostler – Goričan & Buser, p. 147, pl. 1, fig. 11.
1994 *Katorella bifurcata* Kozur et Mostler – Kozur & Mostler, pl. 16, fig. 8.
1995 *Katorella bifurcata* Kozur et Mostler – Kellici & De Wever, p. 148, pl. 3, fig. 1.
1999 *Katorella bifurcata* Kozur et Mostler – Sashida et al., p. 772, fig. 8.17.
2006 *Katorella bifurcata* Kozur et Mostler – Marquez et al., pl. 5, fig. 41.
2007 *Katorella bifurcata* Kozur et Mostler – Saesaengseerung et al., fig. 8.38.
2009 *Katorella bifurcata* Kozur et Mostler – Feng et al., p. 591, figs 5.28–29.
2013 *Katorella bifurcata* Kozur et Mostler – Celarc et al., figs 7.7.

Remarks: Test spherical with very dense spongy meshwork and 1–12 pointed needle-like spines and 1–5 bifurcated spines projecting from the test with the inner continuation.
Range and occurrences: Illyrian (*Tetraspinocyrtis laevis* Zone) to Julian (*Tetraporobrachia haeckeli* Subzone); Western Neotethys: Austria, Italy, Slovenia, Hungary; Eastern Neotethys: West Timor (Indonesia), Northern Tibet (China); Pacific realm: Ogura Island (Japan).

Katorella trifurcata Kozur et Mostler, 1994
Plate 5, Figures 13–16

1984 *Katorella* sp. – Lahm, p. 53, pl. 9, fig. 3
1994 *Katorella trifurcata* sp. nov. – Kozur & Mostler, p. 75, pl. 16, figs 10, 12.
2009 *Katorella trifurcata* Kozur et Mostler – Feng et al., p. 591, figs 5.25–27.
2012 *Katorella bifurcata* Kozur et Mostler – Gawlick et al., pl. 1, fig. 24.

Remarks: The specimens from the Frötschbach section differ from the type material of *K. trifurcata* in having trifurcated and quadrifurcated main spines and they wear 1–3 bifurcated spines, too.
Range and occurrences: Upper Illyrian (*Oertlispongus primitivus* to *Ladinocampe vicentinensis* Subzone); Western Neotethys: Southern Alps (Italy), Montenegro, Balaton Highland (Hungary); Eastern Neotethys: Northern Tibet.

Genus *Triassospongosphaera* Kozur et Mostler, 1979
Type species: *Spongechinus triassicus* Kozur et Mostler, 1979

Triassospongosphaera austriaca (Kozur et Mostler, 1979)
Plate 6, Figure 1

1979 *Acanthosphaera austriaca* sp. nov. – Kozur & Mostler, p. 49, pl. 7, fig. 3.
1984 *Acanthosphaera austriaca* Kozur et Mostler – Lahm, p. 61, pl. 10, fig. 10.

Remarks: *Triassospongosphaera austriaca* (Kozur et Mostler, 1979) differs from other species of the genus *Triassospongosphaera* by having a significantly thicker, multi-layered spongy framework. Outer surface is very rugged and bears large polygonal pores and tiny vertices at connection points. The inner layers are denser with smaller circular pores. Spines are also longer and they are projecting from the surface with a special structure. Three large pores formed at the proximal part of them.
Range and occurrence: Pelsonian (*Baratuna cristianensis* Zone) to lower Carnian (*Tetraporobrachia haeckeli* Zone); Guttenstein Limestone in the Southern Carpathians (Cristian), "Buchenstein Beds" near Recoaro (Lahm, 1984), Göstling, Austria (Kozur & Mostler, 1979).

Triassospongosphaera multispinosa (Kozur et Mostler, 1979)
Plate 6, Figures 2–3

1979 *Acanthosphaera? multispinosa* sp. nov. – Kozur & Mostler, p. 50, pl. 20, fig. 3.
1981 *Triassospongosphaera multispinosa* (Kozur et Mostler) – Kozur & Mostler, p. 67, pl. 58, fig. 3.
1984 *Triassospongosphaera multispinosa* (Kozur et Mostler) – Lahm, p. 66, pl. 11, fig. 10.
1990 *Triassospongosphaera multispinosa* (Kozur et Mostler) – Kolar-Jurkovšek, pl. 8, fig. 2.
1996 *Triassospongosphaera multispinosa* (Kozur et Mostler) – Kozur et al., p. 222, pl. 8, figs 8, 12.
1999 *Triassospongosphaera multispinosa* (Kozur et Mostler) – Sashida et al., p. 772, figs 8.14–15.
2007 *Triassospongosphaera multispinosa* (Kozur et Mostler) – Saesaengseerung et al., fig. 8.42, 46.
2009 *Triassospongosphaera multispinosa* (Kozur et Mostler) – Feng et al., p. 591, figs 5.20–22.
2010 *Triassospongosphaera multispinosa* (Kozur et Mostler) – Tekin & Sönmez, fig. 6B.
2011 *Triassospongosphaera multispinosa* (Kozur et Mostler) – Thassanapak et al., p. 188, figs 4G–H.
2011 *Triassospongosphaera multispinosa* (Kozur et Mostler) – Ozsvárt et al., fig. 9.18.
2012b *Triassospongosphaera multispinosa* (Kozur et Mostler) – Stockar et al., p. 412, pl. 8, figs 10–11.

Remarks: *Triassospongosphaera multispinosa* (Kozur et Mostler, 1979) has a very dense and compact test compared to *T. triassica* (Kozur et Mostler, 1979) which has a relatively large, sponge-like medullary shell. The specimens from Frötschbach bear 16–20 needle-like 100–150 µm long spines.

Range and occurrence: Pelsonian (*Baratuna cristianensis* Zone) to Julian (*Tritortis kretaensis* Zone); Guttenstein Limestone in the Southern Carpathians (Cristian), "Buchenstein Beds" from the Southern Alps, Tibet (Feng et al., 2009), West Timor, Indonesia (Sashida et al., 1999), Tahtalidag Nappe, Antalya nappes, SW Turkey (Tekin & Sönmez, 2010), San Calogero section (Sosio Valley), Sicily, Italy.

Triassospongosphaera triassica (Kozur et Mostler, 1979)
Plate 6, Figures 4–6

1979 *Spongechinus triassicus* sp. nov. – Kozur & Mostler, p. 52, pl. 13, figs 6–7.
1981 *Triassospongosphaera triassica* (Kozur et Mostler) – Kozur & Mostler, p. 67, pl. 58, fig. 4, pl. 59, fig. 4.
1984 *Triassospongosphaera triassica* (Kozur et Mostler) – Lahm, p. 66, pl. 11, fig. 9.
2005 *Triassospongosphaera triassica* (Kozur et Mostler) – Feng et al., p. 242, pl. 1, figs 1–2.
2011 *Triassospongosphaera multispinosa* (Kozur et Mostler) – Bragin, p. 745, pl. 6, figs 5–6.
2012b *Triassospongosphaera triassica* (Kozur et Mostler) – Stockar et al., p. 412, pl. 8, figs 7–9.
2014 *Triassospongosphaera multispinosa* (Kozur et Mostler) – Bragin, pl. 3, fig. 6.

Remarks: *Triassospongosphaera triassica* (Kozur et Mostler, 1979) has a double-layered, spongy cortical shell and a spongy, spheroidal medullary shell. Two or even more (3–4) stronger and longer main spines which continue inward and reach the medullary shell. The shorter and thinner secondary spines are projecting outwards from the surface of the test.
Range and occurrence: Illyrian (*Spongosilicarmiger italicus* Zone) to Julian (*Tritortis kretaensis* Zone); Western Neotethys (Southern Alps, Italy); Eastern Neotethys (Feng et al, 2005); boreal Neotethyan realm (Kotel'nyi Island, Siberia) by Bragin (2011, 2014).

Triassospongosphaera (?) sp.
Plate 6, Figure 7

Remarks: This specimen has been tentatively assigned to *Triassospongosphaera*, although Hull (1997) published a rather similar species as *Lampasa blomei* from the Upper Jurassic of Stanley Mountain, California. This huge gap between the Middle Triassic and the Upper Jurassic makes this attribution rather uncertain.

Genus *Paurinella* Kozur et Mostler, 1981
Type species: *Paurinella curvata* Kozur et Mostler, 1981

Paurinella aequispinosa Kozur et Mostler, 1981
Plate 6, Figures 8–9

1981 *Paurinella aequispinosa* sp. nov. – Kozur & Mostler, p. 50, pl. 42, fig. 1; pl. 43, fig. 1.
1994 *Paurinella aequispinosa* Kozur et Mostler – Kozur & Mostler, p. 72, pl. 15, figs 9, 11.
1995 *Paurinella aequispinosa* Kozur et Mostler – Kellici & De Wever, p. 152, pl. 3, fig. 15.
1998 *Paurinella aequispinosa* Kozur et Mostler – Cordey, p. 78, pl. 10, fig. 7.
2001 *Paurinella aequispinosa* Kozur et Mostler – Feng et al., p. 196, pl. 7, figs 1–4.
2006 *Paurinella aequispinosa* Kozur et Mostler – Feng et al., p. 29, pl. 3, fig. 13–14.
2007 *Paurinella aequispinosa* Kozur et Mostler – Feng et al., pl. 1, figs 28–29.
2009 *Paurinella aequispinosa* Kozur et Mostler – Feng et al., p. 589, figs 5.13.
2011 *Paurinella aequispinosa* Kozur et Mostler – Thassanapak et al., p. 190, figs 5E–J.
2013b *Paurinella aequispinosa* Kozur et Mostler – Dumitrica et al., 2013b, p. 355, figs 1A, 3B.

Remarks: Both illustrated specimens have very dense spongy test and relatively long spines, which slightly widen at the central part of its.
Range and occurrence: The first appearance in the paleontological record is reported from the upper Changhsingian (Permian) of South China, Lower Anisian from Northern Tibet to upper Anisian of Northern Thailand which belonged to the Eastern Neotethyan area at that time. This species is also reported from the Fassanian (lower Ladinian) of Western Neotethys (Southern Alps, Balaton Highland) and Eastern Pacific realm (British Cordillera, Canada).

Paurinella curvata spinosa Kozur et Mostler, 1994
Plate 6, Figures 10–11

1994 *Paurinella curvata spinosa* n. subsp. – Kozur & Mostler, p. 71, pl. 15, figs 1, 8.

Remarks: Three to four relatively short, needle-like secondary spines are visible on one side of the test, and probably a similar amount of by-spines are present on the opposite side.
Range and occurrence: Upper Illyrian (*Oertlispongus primitivus–Ladinocampe annuloperforata* subzones); Southern Alps.

Paurinella cf. *latispinosa* Kozur et Mostler, 1994
Plate 6, Figure 12

1994 *Paurinella latispinosa* sp. nov. – Kozur & Mostler, p. 73, pl. 15, fig. 4.

Remarks: Two spines missing in both illustrated specimens, although relatively large spines that widen at the central part distinguish them from other species of the genus *Paurinella.*
Range and occurrence: Frötschbach section near Seceda (*Spongosilicarmiger italicus* Zone (*Spongosilicarmiger italicus* Zone)).

Paurinella cf. *mesotriassica* Kozur et Mostler, 1981
Plate 6, Figure 13

1981 *Paurinella mesotriassica* sp. nov. – Kozur & Mostler, p. 50, pl. 44, fig. 1.

Remarks: The figured broken specimen has an equal number of tiny by-spines of test as *Paurinella mesotriassica* Kozur et Mostler, 1981.
Range and occurrence: Frötschbach section near Seceda (*Spongosilicarmiger italicus* Zone).

Genus *Neopaurinella* Kozur et Mostler, 1981
Type Species: *Neopaurinella sevatica* Kozur et Mostler, 1981

Remarks: O'Dogherty et al. (2009) consider the genus *Neopaurinella* as a junior synonym of the genus *Paurinella*, although it is significantly different by having two main spines, a presence of distinctly slender and different structured spine, and finally the presence of pylome, therefore in this paper the name *Neopaurinella* is considered as a valid name.

Neopaurinella ladinica Kozur et Mostler, 1994
Plate 6, Figure 14

1994 *Neopaurinella ladinica* sp. nov. – Kozur & Mostler, p. 75, pl. 15, figs 5–6; pl. 16, fig. 6
2013b *Neopaurinella ladinica* Kozur et Mostler – Dumitrica et al., p. 357, figs 4J–K.

Remarks: The test is slightly asymmetrical, both tumid main spines are shorter (160–180 μm) than the holotype's ones (200–220 μm). Unfortunately, the third slender needle-like main spine is broken, but it is definitely more slender than the other two.
Range and occurrence: Upper Illyrian (*Oertlispongus primitivus* to *Ladinocampe annuloperforata* Subzone); Southern Alps.

Neopaurinella tumidospina Kozur et Mostler, 1994
Plate 6, Figures 15–17

1994 *Neopaurinella tumidospina* sp. nov. – Kozur & Mostler, p. 76, pl. 16, fig. 7.

Remarks: By-spines are tiny, significantly shorter and smaller than holotype's ones and they are distributed evenly on the test.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps.

Neopaurinella sp. 1
Plate 7, Figure 1

Remarks: The test is asymmetrical, rather ellipsoidal with densely spongy pore frames it is probably made of two or three outer layers, but the inner structure is unknown. The test wears two different thicknesses main spines which are slightly curved in a different way and pointed distally; additionally, two straight, needle-like, significantly thinner and smooth by-spines.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Frötschbach section, Southern Alps.

Neopaurinella sp. 2
Plate 7, Figures 2–3

Remarks: The shell is spherical to triangular in outline and it is composed of 2–3 layers of very densely spongy pore frames. The test has three main, smooth spines which are circular in axial section, and regularly arranged, the angle between them is 120°. two of them are definitely longer, thicker and they terminate at a longer point. The third spine is somewhat shorter and broadest at the distal part and terminates at a shorter point. Both illustrated specimens wear a relatively large hole between the bigger and smaller main spines (this is called pylom by Kozur & Mostler in many other species of the genus *Neopaurinella*), without any surrounding by-spines, therefore these seem a simple broken of the test and not pylom.

Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Frötschbach section in the Southern Alps.

Genus *Angulopaurinella* Kozur et Mostler, 2006
Type species: *Angulopaurinella crassa* Kozur et Mostler, 2006

Angulopaurinella edentata Dumitrica et Tekin, 2013
Plate 7, Figures 4–5

2012b *Angulopaurinella edentata* Dumitrica et al. – Stockar et al., p. 412, pl. 8, fig. 6.
2013 *Angulopaurinella edentata* sp. nov. – Dumitrica & Tekin, p. 359, figs 1h, 3d, 4p–r.

Remarks: The test is spherical with densely multi-layered spongy pore frames with a tritrabid type of microsphere and it wears three massive, three-bladed spines. Blades are generally simple but sometimes wear a quite shallow furrow, in this case, they are somewhat wider.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone) to lower Fassanian (*Ladinocampe vicentinensis* Subzone); Southern Alps.

Genus *Tetrapaurinella* Kozur et Mostler, 1994
Type species: *Tetrapaurinella discoidalis* Kozur et Mostler, 1994

Tetrapaurinella sp.
Plate 7, Figure 6

Remarks: Poorly preserved specimen with four smooth, long spines and relatively dense spongy test, although its external layers are missing.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps.

Genus *Zhamojdasphaera* Kozur et Mostler, 1979
Type species: *Zhamojdasphaera latispinosa* Kozur et Mostler, 1979

Zhamojdasphaera goricanae Dumitrica et Tekin, 2013
Plate 6, Figure 7

1990 *Zhamojdasphaera* sp. – Goričan & Buser, p. 161, pl. 2, fig. 9.
2013 *Zhamojdasphaera goricanae* sp. nov. – Dumitrica & Tekin in Dumitrica et al., p. 360, figs 5E–F.

Remarks: Poorly preserved specimen with triangular test and three slightly dextrally twisted, foliaceous spines.
Range and occurrence: Lower to middle Longobardian (upper part of *Muelleritortis firma* to *Muelleritortis cochleata* Zone); Frötschbach section, Southern Alps, Vršič section, Julian Alps (Slovenia), Rarau Mountains, Eastern Carpathians, Romania.

Genus *Astrocentrus* Kozur et Mostler, 1979
Type species: *Astrocentrus pulcher* Kozur et Mostler, 1979

Remarks: The genus *Astrocentrus* and related genera like *Triassospongosphaera, Spongechinus, Acanthosphaera, Heliosoma, Carinaheliosoma, Conosphaera* etc. are the most confused groups among the Triassic radiolarians. The first problem is the names of these genera as O'Dogherty et al. (2009) pointed out, because Haeckel and Ehrenberg's names were used erroneously for the Mesozoic. Additionally, most of the species have been reclassified by several authors confusing the systematic part. For example, *Spongechinus? latispinosus* was described by Kozur & Mostler (1979), but later this species was reclassified as *Triassospongosphaera? latispinosa* by Kozur & Mostler in 1981 and it appears lastly as *Atrocentrus? latispinosus* by Stockar et al. (2012b).

Astrocentrus latispinosus (Kozur et Mostler, 1979)
Plate 7, Figures 8–10

1979 *Spongechinus ? latispinosus* sp. nov. – Kozur & Mostler, p. 52, pl. 5, fig. 4.
1981 *Triassospongosphaera ? latispinosa* (Kozur et Mostler) – Kozur & Mostler, p. 67, pl. 3, fig. 6.
1984 *Astrocentrus ? latispinosus* (Kozur et Mostler) – Lahm, p. 21, pl. 2, fig. 7.
1995 *Astrocentrus* aff. *latispinosus* (Kozur et Mostler) – Kellici & De Wever, p. 142, pl. 1, fig. 3.
2012b *Astrocentrus ? latispinosus* (Kozur et Mostler) – Stockar et al., p. 413, pl. 8, figs 14–16.

Remarks: The cortical shell is composed of a rough, spongy double-layered framework. The outer framework is composed of irregular polygons to the circular lattice with relatively large pores, whereas the inner layer is composed of a significantly smaller, circular but also irregular-shaped lattice. The medullary shell is composed of a double-layered, coarse, spongy framework, which is connected to the cortical shell by needle-like beams in the continuation of massive triradiate spines. The microsphere seems a more or less regular pentagonal dodecahedron which connects to the medullary shell through vertices by needle-like beams.
Range and occurrence: This species has been reported from Cristian section (Dumitrica pers. comm.) as the earliest occurrence, additionally, this species has also been found in the lower part of *Ladinocampe multiperforata* Zone (*Ladinocampe annuloperforata* Subzone) from Recoaro (Lahm, 1984), Marmolada (Kellici & De Wever, 1995), in the upper part of *Ladinocampe multiperforata* Zone (Monte San Giorgio; Stockar et al., 2012b) and in the Carnian, as well (Großreifling and Göstling; Kozur & Mostler, 1979; Lahm, 1984)).

Astrocentrus pulcher Kozur et Mostler, 1979
Plate 7, Figures 12–14

1979 *Astrocentrus pulcher* sp. nov. – Kozur & Mostler, p. 72, pl. 1, figs 2–3, pl. 2, figs 1, 3.
1979 *Astrocentrus* cf. *pulcher* – Kozur & Mostler, pl. 20, fig. 1.
1995 *Astrocentrus pulcher* Kozur et Mostler – Kellici & De Wever, p. 144, pl. 1, fig. 4.
2012 *Astrocentrus latispinosus* Kozur et Mostler – Ozsvárt et al., fig. 9.16.
2012b *Astrocentrus pulcher* Kozur et Mostler – Stockar et al., p. 413, pl. 8, figs. 12–13.
2013 *Astrocentrus pulcher* Kozur et Mostler – Celarc et al., fig. 7.15.
2016 *Astrocentrus pulcher* Kozur et Mostler – Bragin et al., pl. 2, figs 5–6.

Remarks: Some of the specimens from the Frötschbach section are very well preserved and provided a partly preserved initial skeleton. *A. pulcher* Kozur et Mostler, 1979 is distinguished by possessing triradiate beams between cortical and medullary shells in contrast with *A. latispinosus* (Kozur & Mostler, 1979) where the medullary shell is connected to the cortical shell by needle-like, smooth beams. The exact shape of the microsphere is uncertain, but it seems a dodecahedron.
Range and occurrence: The first appearance in the paleontological record is reported from the Pacific realm from Central Japan (Sugiyama, 1992) from Middle Anisian (Bithynian or Pelsonian, *Paragondolella bulgarica* Conodont Zone). However, this species is also reported from several Middle Triassic Pamirian localities (Bragin et al., 2016), in a transitional position between the Western Neotethys (Alpine-Mediterranean region) and the Eastern Neotethys (Southern China and Thailand), and it became very common in the Western Neotethys from the Pelsonian (Cristian section) to Illyrian (e.g. Prisojnik section, Slovenia by Celarc et al., 2013, Avdella Mélange, Northern Pindos Mountains (Ozsvárt et al., 2012), Seceda core at 92.74 m, Frötschbach section, Recoaro (Lahm, 1984), Marmolada (Kellici & De Wever, 1995), in the Fassanian (early Ladinian) Monte San Giorgio (Stockar et al., 2012b) and in the Carnian, as well (Großreifling and Göstling; Kozur & Mostler, 1979).

Pathological ?*Astrocentrus* sp.
Plate 7, Figure 11

Description: This species probably belongs to the genus *Astrocentrus,* although the hidden inner structure makes this assignment rather difficult. The spherical shell is composed of a pentagonal to a polygonal relatively dense lattice. Test wear seven or more robust, three-bladed spines (50–100 µm) projecting outward from the surface and massive (more than 100) somewhat shorter, needle-like spines (circular in axial section) located between them. The pointed triradiate spines have relatively deep grooves and rounded ridges. This unusual phenomenon is rather rare among Triassic radiolarians that both main types of spines appear at the same species, additionally also quite rare to have such a dense bunch of spines. This phenomenon might have been caused by special contamination with a symbiont organism like a virus or could have been caused by strong environmental stress altered factors like temperature or geochemical changes.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Frötschbach section in the Southern Alps.

Family Relindellidae Kozur et Mostler in Dumitrica et al., 1980
Genus *Relindella* Kozur et Mostler in Dumitrica et al., 1980
Type species: *Relindella hexaspinosa* Dumitrica et al., 1980

Relindella ruesti (Kozur et Mostler, 1981)
Plate 8, Figure 1

1981 *Pentaspongodiscus ? ruesti* sp. nov. – Kozur & Mostler, p. 62, pl. 59, fig. 2–3.
1984 *Pentaspongodiscus ? ruesti* Kozur et Mostler – Lahm, p. 55, pl. 9, fig. 9.
1984 *Pentaspongodiscus mesotriassicus* Dumitrica et al. – Lahm, p. 56, pl. 9, fig. 11.
1990 *Pentaspongodiscus mesotriassicus* Dumitrica et al. – Goričan & Buser, p. 151, pl. 2, fig. 1.

2013 *Relindella ruesti* (Kozur et Mostler) – Dumitrica et al., p. 337, figs 8P, Q.

Remarks: *Relindella ruesti* (Kozur et Mostler, 1981) differs from *R. mesotriassicus* (Dumitrica et al., 1980) in having more twisted spines.
Range and occurrence: This species has been found so far in the Southern Alps (Frötschbach, Recoaro); Julian Alps and Dinaric Carbonate Platform (Bohinj, Vojsko and Zaklanec sections) from the *Spongosilicarmiger italicus* Zone to *Ladinocampe annuloperforata* Subzone.

Relindella steigeri (Lahm, 1984)
Plate 8, Figure 2

1984 *Pentaspongodiscus steigeri* sp. nov. – Lahm, p. 56, pl. 9, fig. 12.
1996 *Pentaspongodiscus steigeri* Lahm – Kozur et al., p. 231, pl. 4, fig. 15.
1999 *Pentaspongodiscus steigeri* Lahm – Tekin, p. 122, pl. 22, figs 8–9.
? 1994 *Pentaspongodiscus mesotriassicus* Dumitrica et al. – Kozur & Mostler, pl. 9, fig. 7.
2005 *Pentaspongodiscus steigeri* Lahm – Tekin & Mostler, p. 39, pl. 6, fig. 11.

Remarks: The specimen from the Frötschbach section has a relatively small test composed of irregularly shaped polygonal pore frames with relatively large pores on the outermost layer.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone to *Tritortis kretaensis* Subzone); Southern Alps (Frötschbach section, Recoaro); Fojnica, Bosnia and Herzegovina; Sugozu and Gazipasa sections, Antalya Nappes, Turkey.

Relindella symmetrica (Dumitrica et al., 1980)
Plate 8, Figure 3

1980 *Pentaspongodiscus symmetricus* sp. nov. – Dumitrica et al., p. 10, pl. 8, fig. 4.
1984 *Pentaspongodiscus symmetricus* Dumitrica et al. – Lahm, p. 57, pl. 10, fig. 2.
1984 *Pentaspongodiscus heptastylus* sp. nov. – Lahm, p. 58, pl. 10, fig. 3.
1990 *Pentaspongodiscus symmetricus* Dumitrica et al. – Goričan & Buser, p. 151, pl. 2, fig. 5.
1995 *Pentaspongodiscus symmetricus* Dumitrica et al. – Kellici & De Wever, p. 154, pl. 4, fig. 3.
2001 ?*Pentaspongodiscus* sp. cf. *P. symmetricus* Dumitrica et al. – Feng et al., p. 200, pl. 9, fig. 10.
2010 *Pentaspongodiscus symmetricus* Dumitrica et al. – Tekin & Sönmez, fig. 6M.
2011 *Pentaspongodiscus symmetricus* Dumitrica et al. – Thassanapak et al., p. 193, fig. 5S.
2013 *Relindella symmetrica* (Dumitrica et al.) – Dumitrica et al., p. 338, figs 8r, s.

Remarks: *Relindella symmetrica* (Dumitrica et al., 1980) bears straight, untwisted, pointed spines.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone to *Spongoserulla fluegeli* Subzone); Southern Alps (Frötschbach section, Recoaro, Marmolada), Julian Alps and Dinaric Carbonate Platform (Bohinj, Vojsko and Zaklanec sections), Tahtalidag Nappe of the Antalya Nappes, Turkey and further East in Northern Thailand.

Genus *Octostella* Tekin et Mostler, 2005
Type species: *Pentaspongodiscus? dihexacanthus* Carter, 1993

Octostella froetschbachensis Ozsvárt sp. nov.
Plate 8, Figure 4

? 1980 *Relindella hexaspinosa* sp. nov. – Dumitrica et al., p. 9, pl. 8, figs 1–3, 6.
? 1994 *Pentaspongodiscus mesotriassicus* Dumitrica et al. – Kozur & Mostler, pl. 9, fig. 7.

Etymology: This species is named after the Frötschbach section, Dolomites.
Holotype: Plate 8, Figure 4; Hungarian Natural History Museum, Budapest: PAL 2022.121.1.
Studied material: Two specimens from the Frötschbach section and Seceda outcrops.
Description: Test relatively small, discoidal, composed of irregularly shaped polygonal pore frames with relatively large pores. Eight, massive, slightly dextrally twisted, three-bladed spines. Deep, wide grooves and relatively high ridges (equal in width). Ridges rounded, distally thinning. Spines widen distally, terminating in sharp, long, needle-like points. Six equally spaced, radial spines; two same-shaped and sized polar spines.
Dimensions: Diameter of test 160–180 µm, length of spines 195–200 µm.
Remarks: *Octostella froetschbachense* sp. nov. is distinguished from *Octostella pulhra* Tekin et Mostler by different shaped and twisted spines. *Relindella hexaspinosa* Dumitrica et al., and *Pentaspongodiscus mesotriassicus* Dumitrica et al., illustrated by Kozur & Mostler (1994) are questionably listed in the synonym list, because quite difficult to decide whether the holotype of *R. hexaspinosa* Dumitrica et al., is only a broken *O. froetschbachense* sp. nov. or another species. The holotype of *R. hexaspinosa* seems incomplete, two spines are broken and a large circular part also might miss from the central part of the shell, although it was diagnosed as central depression, although Dumitrica et al. (2013) pointed out this "central depression" might cause by later dissolution process and it is not a generic character. Most likely there could be an additional spine like at *Octostella froetschbachense* sp. nov. which might break out from the test during the extracting method.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Frötschbach section in the Southern Alps.

Family Veghicycliidae Kozur et Mostler, 1972
Genus *Plafkerium* Pessagno, 1979
Type species: *Plafkerium abbotti* Pessagno, 1979

Plafkerium antiquum (Sugiyama, 1992)
Plate 8, Figure 5

1992 *Plafkerium ? antiquum* sp. nov. – Sugiyama, p. 1218, figs 18.4–6. (cum syn.)

Range and occurrence: From the Spathian (Upper Olenekian) of Central Japan to the of *Spongosilicarmiger italicus* Zone of the Frötschbach section, Italy.

Plafkerium quadratum (Lahm, 1984)
Plate 8, Figures 6–7

1984 *Tetraspongodiscus quadratus* sp. nov. – Lahm, p. 59, Pl. 10, fig. 6.
2013 *Plafkerium quadratum* Lahm – Dumitrica et al., p. 376, figs 8E, 9A–D, 10G–H.

Remarks: The test is composed of a rough, spongy framework with irregular pores, spines are straight or slightly clockwise twisted.
Range and occurrence: *P. quadratum* is known from the Illyrian of Recoaro (Lahm, 1984; Dumitrica et al., 2013) and Frötschbach section (*Spongosilicarmiger italicus* Zone to *Ladinocampe multiperforata* Zone).

Plafkerium uncatum (Bragin, 2011)
Plate 8, Figure 8

2011 *Tetraspongodiscus uncatus* sp. nov. – Bragin, p. 761, pl. 13, figs 1–5.

Remarks: The preservation of Middle and Upper Triassic boreal radiolarians from Kotel'nyi Island, Siberia is not perfect in the illustration of Bragin (2011). The assignation this specimen to the *Plafkerium uncatum* (Bragin, 2011) is based on the discoidal spongy test and the four slender, slightly counter-clockwise twisted spines.
Range and occurrence: Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps to Early Carnian of Kotel'nyi Island, Siberia so far.

Pathological *Plafkerium* sp.
Plate 8, Figures 9–10

Remarks: Two specimens from the Frötschbach section wear double spines instead of one. The test is tetragonal in outline and one of presents the double spines on the longer side of the test whereas the other wears the shorter part. Probably they are pathological forms.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Frötschbach section, Southern Alps.

Family Archaeospongoprunidae Pessagno, 1973 emend. Kozur et Mostler, 1981
Genus *Archaeospongoprunum* Pessagno, 1973
Type species: *Archaeospongoprunum tetraspinosum* Kozur & Mostler, 1994

Archaeospongoprunum tetraspinosum (Kozur et Mostler, 1994)
Plate 8, Figure 12

1994 *Archaeospongoprunum tetraspinosum* sp. nov. – Kozur & Mostler, p. 53, pl. 7, fig. 6.
Range and occurrence: Upper Illyrian (*Tetraspinocyrtis laevis* Zone to *Spongosilicarmiger italicus* Zone); Felsőörs, Hungary and Frötschbach, Southern Alps, Italy.

Archaeospongoprunum sp.
Plate 8, Figure 13

Remarks: The test is pear-shaped in outline and composed of a dense spongy framework with polygonal to circular pores. Four, long triradiate spines are disposed in a tetrahedral position; unfortunately, the inner structure remained hidden.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Frötschbach section, Southern Alps.

Family Spongopallidae Kozur et al., 1996
Genus *Spongopallium* Dumitrica et al., 1980

Spongopallium cf. *contortum* Dumitrica et al., 1980
Plate 8, Figure 11

cf. 1980 *Spongopallium contortum* sp. nov. – Dumitrica et al., p. 16, pl. 2, fig. 5; pl. 11, fig. 1.

Remarks: This specimen resambles to *S. contortum* Kozur et al., 1980, although its outer spongy shell is completely missed from the test.
Range and occurrence: Pelsonian from Cristian section, Romania to upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps (Recoaro and Frötschbach).

Family Gomberellidae Kozur et Mostler, 1981
Genus *Tamonella* Dumitrica et al., 1980
Type species: *Tamonella multispinosa* Dumitrica et al., 1980

Tamonella aspinosa Ozsvárt et al., 2017
Plate 8, Figure 14

2017 *Tamonella aspinosa* sp. nov. – Ozsvárt et al., p. 61, figs 6.10–11.

Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus Zone*) of Southern Alps (Frötschbach section) to *Spongotortilispinus moixi* Zone (early Tuvalian) of the Sorgun Ophiolitic Mélange, Turkey.

Tamonella multispinosa Dumitrica et al., 1980
Plate 8, Figure 15

1980 *Tamonella multispinosa* sp. nov. – Dumitrica et al., p. 7, pl. 10, fig. 8.
1984 *Tamonella multispinosa* Dumitrica et al. – Lahm, p. 43, pl. 7, fig. 3.
2017 *Tamonella multispinosa* Dumitrica et al. – Ozsvárt et al., p. 61, fig. 6.9.

Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone to *Spongotortilispinus moixi* Zone, early Tuvalian); Southern Alps (Frötschbach section, Recoaro); Sorgun Ophiolitic Mélange, Turkey.

Tamonella rarispinosa Kozur et Mostler, 1994
Plate 8, Figure 16

1994 *Tamonella rarispinosa* sp. nov. – Kozur & Mostler, p. 54, pl. 7, fig. 9.

Remarks: *T. rarispinosa* Kozur et Mostler, 1994 could be a transition species between *T. aspinosa* Ozsvárt et al., 2017 and *T. multispinosa* Dumitrica et al., 1980.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps (Frötschbach section, Passo della Gabiola).

Genus *Monospongella* Kozur et Mostler, 2006
Type species: *Monospongella tortilis* Kozur et Mostler, 2006

Monospongella magnispinosa (Kozur et Mostler, 2006)
Plate 9, Figure 1

1984 *Monostylus* sp. nov. – Lahm, p. 67, pl. 11, fig. 11.
2006 *Monospongella magnispinosa* sp. nov. – Kozur & Mostler, p. 29, pl. 4, fig. 12.

Remarks: The illustrated specimen possesses two or three spongy layers, although the inner structure has remained hidden.
Range and occurrence: Illyrian to Longobardian (*Spongosilicarmiger italicus* Zone to *Spongoserulla fluegeli* Subzone); Southern Alps (Frötschbach, Recoaro), Dinarides, Bosnia-Hercegovina (Fojnica).

Genus *Praegomberellus* Kozur et Mostler, 1994
Type species: *Praegomberellus pulcher* Kozur et Mostler, 1994

Praegomberellus pulcher (Kozur et Mostler, 1994)
Plate 9, Figures 2–3

1994 *Praegomberellus pulcher* sp. nov. – Kozur & Mostler, p. 58, pl. 9, figs 6, 8.

Remarks: This perfectly preserved form has a subglobular dense, spongy test with eight irregularly arranged spines which differ in length. Four of them are significantly shorter and slender whereas the other four are tricarinate and more robust which terminates in long, needle-like spinal shafts.
Range and occurrence: Upper Illyrian (*Tetraspinocyrtis laevis* Zone to *Spongosilicarmiger italicus* Zone); Felsőörs, Hungary; Frötschbach, Southern Alps, Italy.

Genus *Gomberellus* Dumitrica et al., 1980
Type species: *Gomberellus hircicornus* Dumitrica et al., 1980

Gomberellus simplex Ozsvárt sp. nov.
Plate 9, Figure 4

Etymology: Simplex (Latin) = simple.
Holotype: Plate 9, Figure 4; Hungarian Natural History Museum, Budapest: PAL 2022.117.1.
Studied material: Single specimen from the Frötschbach section.
Description: Relatively small globular test (110 µm), composed of dense spongy framework with circular pore frames. Two robust, wide, triradiate, untwisted spines (length 100 µm width 35 µm) width deep and wide grooves and ridges. Three significantly slender, triradiate spines (length 80 µm, width 20 µm) present at opposite pole.
Remarks: Kozur & Mostler (1994) distinguished the genus *Praegomberellus* by three, untwisted, significantly longer, and more massive spines from the genus *Gomberellus* (two longer and different spines), even so, we assigned this species to the genus *Gomberellus* because of its characteristic morphology. *G. simplex* sp. nov. differs from all other *Gomberellus* by having untwisted triradiate significantly slender spines.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps (Frötschbach section).

Gomberellus sp.
Plate 9, Figure 5

Remarks: The test is spherical and composed of a spongy framework with relatively large circular pores. The two stout spines are not connected on the surface of the test like other species of *Gomberellus* and they are three-bladed and untwisted. Significantly slender spines are present on the opposite side, but they are also three-radiate and untwisted.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps (Frötschbach section).

Family Oertlispongidae Kozur et Mostler in Dumitrica et al., 1980
Genus *Paroertlispongus* Kozur et Mostler, 1981
Type species: *Paroertlispongus multispinosus* Kozur et Mostler, 1981

Paroertlispongus kozuri Ozsvárt sp. nov.
Plate 9, Figures 6–8

Etymology: In honour of the late Heinz Walter Kozur (1942–2013) who was one of the most prolific authors among radiolarian specialists.
Holotype: Plate 9, Figure 6; Hungarian Natural History Museum, Budapest: PAL 2022.124.1.
Studied material: Four specimens from the Frötschbach section.
Description: Test globular to oval, composed of spongy framework with polygonal to circular pore frames. Test size: 150–180 µm. Characteristic main polar spine and two additional shorter, thinner main spines which differ clearly from by-spines and located in one plane. Main polar spine smooth, columnar but pointed distally from three-fifths part of it, approximately 250–300 µm long, straight or slightly curved, round in cross-section. Two additional main spines smooth, straight or slightly curved, pointed distally; significantly shorter and thinner than main polar spine but significantly longer and thicker than by-spines. 25–30 radial, short, needle-like present.
Remarks: This species is distinguished by possessing two additional shorter, slender main spines beside the characteristic straight polar spines.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Frötschbach section in the Southern Alps.

Paroertlispongus lahmi Ozsvárt sp. nov.
Plate 9, Figures 9–10

Etymology: In honour of Bernhard Lahm, for his outstanding contributions to Middle and Upper Triassic radiolarian taxonomy.
Holotype: Plate 9, Figure 10; Hungarian Natural History Museum, Budapest: PAL 2022.125.1.
Studied material: Three specimens from the Frötschbach section.
Description: Test globular to subglobular, composed of rough, spongy framework with circular pores (diameter of test 140–160 µm). Massive main polar spine, smooth and circular in cross-section, approximately 250–300 µm length. Its width until sharp angular bent is constant but decreases gradually to the distal end. Characteristic sharp angular bent visible in the distal fifth of this polar spine. Second main polar spine is opposite site of the test which is significantly thinner, shorter but it

is also smooth and pointed distally but straight. Sparsely scattered small needle-like by-spines (8–12) are present on the surface of the whole test.

Remarks: *Paroertlispongus lahmi* sp. nov. differs from all other species of the genus *Pseudoertlispongus* by its characteristic sharp angular bent in the distal fifth of the polar spine.

Range and occurrence: Frötschbach section in the Southern Alps (*Spongosilicarmiger italicus* Zone).

Paroertlispongus multinodosus (Kozur et Mostler, 1981)
Plate 9, Figure 11

1981 *Acaenispongus multinodosus* sp. nov. – Kozur & Mostler, p. 44, pl. 1, fig. 5.
1990 *Acaenispongus* cf. *multinodosus* Kozur et Mostler – Kolar-Jurkovšek, p. 78, pl. 8, fig. 6.

Remarks: Kozur & Mostler (1981) illustrated this species as a partly preserved form because the main polar spine is almost completely missed. The specimen from Seceda has been preserved in more detail, it seems well that the main polar spine bears three, small, ring-like ornamentations at the distal end of the spine.

Range and occurrence: Upper Illyrian (*Ladinocampe annuloperforata* Zone) to Longobardian (*Muelleritortis cochleata* Zone); Southern Alps ("Buchenstein Beds" from the Recoaro section, Seceda outcrops, Dolomites).

Paroertlispongus multispinosus Kozur et Mostler, 1981
Plate 9, Figures 12–13

1981 *Paroertlispongus multispinosus* sp. nov. – Kozur & Mostler, p. 48, pl. 44, fig. 2; pl. 45, fig. 1.
1984 *Paroertlispongus multispinosus* Kozur et Mostler – Lahm, p. 45, pl. 7, figs 5, 6.
1986 *Paroertlispongus multispinosus* Kozur et Mostler – Kozur & Réti, fig. 6G.
1992 *Palaeoeucyrtis elongata* sp. nov. – Feng, pl. 2, figs 13–14.
1993 *Paroertlispongus multispinosus* Kozur et Mostler – Dosztály, pl. 2, fig. 2.
1994 *Paroertlispongus multispinosus* Kozur et Mostler – Kozur & Mostler, p. 69, pl. 12, fig. 10; pl. 13, figs 4, 11.
1996 *Paroertlispongus multispinosus* Kozur et Mostler – Kozur, p. 291, pl. 1, fig. 1.
1996 *Paroertlispongus multispinosus* Kozur et Mostler – Kozur et al., p. 230, pl. 11, fig. 12.
2001 *Paroertlispongus multispinosus* Kozur et Mostler – Feng et al., p. 192, pl. 6, figs 12, 14–18.
2001 *Paroertlispongus multispinosus* Kozur et Mostler – Hauser et al., pl. 2, figs 2–3, 15–16.
2003 *Paroertlispongus multispinosus* Kozur et Mostler – Feng & Liang, p. 221, pl. 1, fig. 23.
2005 *Paroertlispongus multispinosus* Kozur et Mostler – Goričan et al., pl. 1, figs 5–9.
2005 *Paroertlispongus multispinosus* Kozur et Mostler – Feng et al., p. 249, pl. 4, figs 15–16.
2006 *Paroertlispongus multispinosus* Kozur et Mostler – Bortolotti et al., 2006, pl. 1, figs 10–11.
2007 *Paroertlispongus multispinosus* Kozur et Mostler – Feng et al., 2007, pl. 1, figs 23–25.
2009 *Paroertlispongus multispinosus* Kozur et Mostler – Feng et al., p. 587, figs 4.2–3.
2009 *Paroertlispongus multispinosus* Kozur et Mostler – Bortolotti et al., pl. 1, figs 7.
2011 *Paroertlispongus multispinosus* Kozur et Mostler – Thassanapak et al., p. 193, figs 5L–M.
2012 *Paroertlispongus multispinosus* Kozur et Mostler – Tekin et al., figs 5, 7a, b.
2012b *Paroertlispongus multispinosus* Kozur et Mostler – Stockar et al., p. 417, pl. 9, figs 8–13.
2012 *Paroertlispongus multispinosus* Kozur et Mostler – Chiari et al., pl. 1, fig. 6.
2016 *Paroertlispongus multispinosus* Kozur et Mostler – Gawlick et al., pl. 1, figs 14–16, 22.
2016 *Paroertlispongus multispinosus* Kozur et Mostler – Bragin et al., pl. 3, fig. 1.
2016 *Paroertlispongus multispinosus* Kozur et Mostler – Tekin et al., pl. 1, figs 22–24.

Remarks: This species is distinguished by its gradually widening main polar spine which becomes needle-like after its three-quarter length.

Range and occurrence: The first appearance in the paleontological record is known from the Early Anisian of the Eastern Neotethys: Southwestern Yunnan, China (Feng et al., 2001), Tajikistan (Bragin et al., 2016) and Northern Thailand (Thassanapak et al., 2011). This species becomes more frequent in the Western Neotethys from the Pelsonian (Cristian section, Romania) and Illyrian (*Spongosilicarmiger transitus* Zone): Mersin Mélange (Tekin et al., 2016); early Fassanian (*Ladinocampe vicentinensis* Subzone): Southern Alps, Dinarides, Hellenides and Sicily.

Paroertlispongus rarispinosus Kozur et Mostler, 1981
Plate 9, Figure 14

1981 *Paroertlispongus rarispinosus* sp. nov. – Kozur & Mostler, p. 48, pl. 1, fig. 3.
1993 *Paroertlispongus* aff. *rarispinosus* Kozur et Mostler – Dosztály, pl. 1, fig. 5.
1994 *Paroertlispongus rarispinosus* Kozur et Mostler – Kozur & Mostler, p. 69, pl. 12, fig. 7.
1995 *Paroertlispongus rarispinosus* Kozur et Mostler – Ramovš & Goričan, p. 187, pl. 1, fig. 9.
1996 *Paroertlispongus rarispinosus* Kozur et Mostler – Kozur, pl. 1, fig. 2.
2001 *Paroertlispongus rarispinosus* Kozur et Mostler – Feng et al., p. 192, pl. 7, fig. 7.
2009 *Paroertlispongus rarispinosus* Kozur et Mostler – Feng et al., p. 587, fig. 4.1.
2011 *Paroertlispongus rarispinosus* Kozur et Mostler – Thassanapak et al., p. 193, fig. 5N.
2011 *Paroertlispongus multispinosus* Kozur et Mostler – Ozsvárt et al., fig. 9.5.
2012b *Paroertlispongus rarispinosus* Kozur et Mostler – Stockar et al., p. 417, pl. 9, figs 14–15.

Remarks: The specimens from Frötschbach sections are possessing significantly more by-spines on the whole surface of the test, nonetheless they are assigned to *Paroertlispongus rarispinosus* which was distinguished from *P. multispinosus* by less by-spine (Kozur & Mostler, 1981). *Paroertlispongus multispinosus* possesses a quite different main polar spine which is gradually widened until three-quarters of its length, in con-

trast, the main polar spine of *P. rarispinosus* is columnar and pointed distally.
Range and occurrence: Early Anisian of the Eastern Neotethys: Southwestern Yunnan, China (Feng et al., 2001) to early Fassanian (*Ladinocampe vicentinensis* Subzone): Southern Alps.

Paroertlispongus siciliensis (Kozur, 1996)
Plate 10, Figure 1

1996 *Pseudoertlispongus mostleri siciliensis* n. subsp. – Kozur, p. 293, pl. 1, fig. 7.
2003 *Pseudoertlispongus mostleri* Kozur – Feng & Liang, p. 223, Pl. 2, figs 7–8.
2009 *Pseudoertlispongus mostleri siciliensis* Kozur – Feng et al., p. 587, figs 4.8–11.
2016 *Pseudoertlispongus mostleri siciliensis* Kozur – Tekin et al., pl. 1, figs 34–36.

Remarks: *Paroertlispongus siciliensis* (Kozur, 1996) is distinguished from *Paroertlispongus weddigei* (Lahm, 1984) by the stronger inward bent of the main spine which is significantly longer, also.
Range and occurrence: Upper Illyrian (*Y. annulata* Subzone of the *S. transitus* Zone to *Oertlispongus primitivus* Subzone of the *Spongosilicarmiger italicus* Zone); Western Neotethys: Sicily; Southern Alps; Mersin Mélange, Turkey; Eastern Neotethys: West Sichuan, China and Bayan Har Basin Northern Tibet.

Paroertlispongus weddigei (Lahm, 1984)
Plate 10, Figure 2

1984 *Pseudoertlispongus weddigei* sp. nov. – Lahm, p. 46, pl. 7, fig. 10.
1994 *Paroertlispongus weddigei* (Lahm) – Kozur & Mostler, p. 69, pl. 12, figs 12–14.
1996 *Pseudoertlispongus mostleri* sp. nov. – Kozur, p. 292, pl. 1, fig. 6.
2009 *Pseudoertlispongus weddigei* Lahm – Feng et al., p. 587, figs 4.4–5.
2012 *Paroertlispongus* cf. *weddigei* (Lahm) – Ozsvárt et al., fig. 9.4.

Remarks: The holotype of *Paroertlispongus weddigei* (Lahm) has a straight polar spine which possesses a bent at distal part, the angle of bent is approximately 45°, whereas at this species the angle of bent is 60–65°.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone to *Ladinocampe annuloperforata* Subzone); Cosmopolitan.

Genus *Oertlispongus* Dumitrica et al., 1980
Type species: *Oertlispongus inaequispinosus* Dumitrica et al., 1980

Oertlispongus inaequispinosus Dumitrica et al., 1980
Plate 10, Figure 3

1980 *Oertlispongus inaequispinosus* sp. nov. – Dumitrica et al., p. 5, pl. 10, fig. 7.
1982 *Oertlispongus inaequispinosus* Dumitrica et al. – Dumitrica & Mello, pl. 2, figs 1–2.
1982 *Oertlispongus inaequispinosus* Dumitrica et al. – Dumitrica, p. 64, pl. 1, Figs 2, 4, 6, 7, 9.
1983 *Oertlispongus annulatus* sp. nov. – Kozur & Mostler, p. 33, pl. 1, fig. 6.
1983 *Oertlispongus longirecurvatus* sp. nov. – Kozur & Mostler, p. 33, pl. 1, fig. 5.
1984 *Oertlispongus inaequispinosus* Dumitrica et al. – Lahm, p. 48, pl. 8, fig. 2.
1985 *Oertlispongus inaequispinosus* Dumitrica et al. – Kozur & Réti, fig. 5F.
1988 *Oertlispongus inaequispinosus* Dumitrica et al. – Obradovič & Goričan, Fig. 4.2.9.
1989 *Oertlispongus inaequispinosus* Kozur et Mostler (erroneous) – Martini et al., pl. 3, fig. 14.
1990 *Oertlispongus inaequispinosus* Dumitrica et al. – Goričan & Buser, p. 148, pl. 3, figs 10–11.
1990 *Oertlispongus inaequispinosus* Dumitrica et al. – De Wever et al., pl. 1, fig. 16.
1990 *Oertlispongus inaequispinosus* Dumitrica et al. – Kolar-Jurkovšek, pl. 7, fig. 8.
1990 *Oertlispongus inaequispinosus* Dumitrica et al. – Yeh, p. 16, pl. 4, fig. 1.
1992 *Oertlispongus inaequispinosus* Dumitrica et al. – Dosztály & Józsa, pl. 1, fig. 5.
1993 *Oertlispongus inaequispinosus* Dumitrica et al. – Dosztály, pl. 2, figs 7–8.
1994 *Oertlispongus inaequispinosus inaequispinosus* Dumitrica et al. – Kozur & Mostler, p. 59, pl. 10, figs 1, 4, 7, 13; pl. 47, fig. 6.
1995 *Oertlispongus inaequispinosus inaequispinosus* Dumitrica et al. – Kellici & De Wever, p. 150, pl. 3, fig. 9.
1995 *Oertlispongus inaequispinosus* Dumitrica et al. – Halamić & Goričan, pl. 1, fig. 1.
1996 *Oertlispongus inaequispinosus inaequispinosus* Dumitrica et al. – Kozur & Mostler, p. 108, pl. 14, figs 10–11.
1996 *Oertlispongus inaequispinosus* Dumitrica et al. – Chiari et al., pl. 2, fig. 7.
1997 Spine A2 – Sugiyama, p. 138, fig. 35.3.
1999 *Oertlispongus inaequispinosus inaequispinosus* Dumitrica et al. – Sashida et al., p. 772, figs 10.28–29.
1999 *Oertlispongus inaequispinosus* Dumitrica et al. – Dumitrica, p. 35, pl. 1, figs 1, 3.
2001 *Oertlispongus inaequispinosus* Dumitrica et al. – Hauser et al., pl. 2, fig. 18.
2002 *Oertlispongus inaequispinosus* Dumitrica et al. – Kamata et al., p. 502, fig. 7Q.
2003 *Oertlispongus inaequispinosus* Dumitrica et al. – Feng & Liang, p. 223, pl. 2, figs 5–6.
2004 *Oertlispongus inaequispinosus* Dumitrica et al. – Feng et al., fig. 3d.
2005 *Oertlispongus inaequispinosus* Dumitrica et al. – Jasin et al., pl. 2, figs 14–15.
2005 *Oertlispongus inaequispinosus* Dumitrica et al. – Goričan et al., pl. 1, figs 21–26.
2009 *Oertlispongus inaequispinosus* Dumitrica et al. – Feng et al., p. 589, figs 4.18–22.
2009 *Oertlispongus inaequispinosus* Dumitrica et al. – Jasin & Harun, pl. 9, figs 8–9.
2012 *Oertlispongus inaequispinosus* Dumitrica et al. – Ozsvárt & Kovács, pl. 2, fig. 18.
2012b *Oertlispongus inaequispinosus* Dumitrica et al. – Stockar et al., p. 417, pl. 9, figs. 16–21.
2012 *Oertlispongus inaequispinosus* Dumitrica et al. – Chiari et al., pl. 1, fig. 4.
2012 *Oertlispongus inaequispinosus* Dumitrica et al. – Gawlick et al., 2016a, pl. 1, fig. 26.

2016 *Oertlispongus inaequispinosus* Dumitrica et al. – Tekin et al., pl. 1, figs 15–18, pl. 4, fig. 7.

Remarks: Only two poorly preserved *Oertlispongus inaequispinosus* Dumitrica et al., specimens have been found in the investigated sections. Compared to the holotype of Dumitrica et al. (1980) and the rather morphologically diverse specimens of Dumitrica (1982) and Kozur & Mostler (1994), our illustrated specimen has a slightly curved, relatively short polar spine. This presumably implies that the specimens from the Frötschbach section be early representatives of *O. inaequispinosus.*
Range and occurrence: *Spongosilicarmiger italicus* Zone to *Muelleritortis firma* Zone: Cosmopolitan, although it has been also reported from the Upper Triassic of Busuanga Island, Philippines (Yeh, 1990) together with typical Carnian forms, probably due to reworking.

Oertlispongus primus Kozur, 1996
Plate 10, Figures 4–5

1996 *Oertlispongus primus* sp. nov. – Kozur, p. 290, pl. 1, fig. 9.
2005 *Oertlispongus primus* Kozur – Goričan et al., pl. 1, figs 13–15.
2016 *Oertlispongus primus* Kozur – Tekin et al., pl. 1, figs 19–20.

Remarks: This species was described from the base of the main spine, but we have also found this species with a complete test in the Frötschbach section, Southern Alps (Italy). Test globular, spongy and wears several tiny by-spines on the lower part.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Sosio Valley, Sicily (Kozur, 1996), Mersin Mélange (Tekin et al., 2016), Ivanščica Mt., Croatia, Frötschbach section in Southern Alps and from Felsőörs section (bed 105), Hungary.

Oertlispongus sp.
Plate 10, Figure 6

Remarks: Slightly curved polar spines of the genus *Oertlispongus,* similar to the specimen published by Kozur & Mostler (1994; pl. 10, fig. 8) from the Recoaro (Vicentinian Alps) area (Passo della Gabiola, MD22 layer) from the lowermost part of *Ladinocampe multiperforata* Zone. This specimen probably belongs to the transition forms between *Paroertlispongus* (with straight polar spines) and *Oertlispongus* (with a strongly curved polar spine).
Range and occurrence: Frötschbach section (*Spongosilicarmiger italicus* Zone).

Genus *Baumgartneria* Dumitrica, 1982
Type species: *Baumgartneria retrospina* Dumitrica, 1982

Baumgartneria bifurcata Dumitrica, 1982
Plate 10, Figure 7

1982 *Baumgartneria bifurcata* sp. nov. – Dumitrica, p. 71, pl. 10, figs 3–4.
1994 *Baumgartneria bifurcata* Dumitrica – Goričan & Buser, p. 141, pl. 3, fig. 1.
1994 *Baumgartneria bifurcata* Dumitrica – Kozur & Mostler, p. 64, pl. 13, figs 3, 5–6, 10.
1997 *Baumgartneria bifurcata* Dumitrica – Sugiyama, p. 175, fig. 49.22.
1999 *Baumgartneria bifurcata* Dumitrica – Sashida et al., p. 772, figs 10.28–29.
2003 *Baumgartneria bifurcata* Dumitrica – Feng & Liang, p. 224, pl. 1, fig. 20.
2016 *Baumgartneria bifurcata* Dumitrica – Tekin et al., pl. 1, figs 3–4.

Remarks: *Baumgartneria bifurcata* is characterized by its bifurcate terminates on the stem (side-spines) of the polar spine however it differs from the holotype by the perpendicular planes of bifurcate ends. Sugiyama (1997) reported a similar specimen from Mino terrane, Central Japan.
Range and occurrence: This species ranges from *Spongosilicarmiger italicus* Zone to *Ladinocampe multiperforata* Zone from the Southern Alps: Recoaro (Passo della Gabiola), Frötschbach, Dolomites, Julian Alps: Bohinj, Zaklanec, Slovenia; Mersin Mélange, Southern Turkey; Eastern Tethys: West Sichuan, China and from the Pacific area: Mino terrane, Central Japan.

Baumgartneria retrospina Dumitrica, 1982
Plate 10, Figure 8

1982 *Baumgartneria retrospina* sp. nov. – Dumitrica, p. 70, pl. 9, figs 3–8, pl. 10, figs 1–2, pl. 12, fig. 3.
1992 *Baumgartneria retrospina* Dumitrica – Dosztály & Józsa, pl. 1, fig. 6.
1994 *Baumgartneria retrospina* Dumitrica – Kozur & Mostler, p. 63, pl. 2, figs 1, 4–6, 8–9..
2003 *Baumgartneria retrospina* Dumitrica – Feng & Liang, p. 224, pl. 1, figs 14–16, 19.
2005 *Baumgartneria retrospina* Dumitrica – Feng et al., p. 247, pl. 4, figs 6–7.
2005 *Baumgartneria retrospina* Dumitrica – Goričan et al., pl. 1, fig. 29.
2006 *Baumgartneria retrospina* Dumitrica – Zhu et al., fig. 3.24.
2016 *Baumgartneria retrospina* Dumitrica – Tekin et al., pl. 1, fig. 5.

Remarks: Poorly preserved specimen, the axial spine is slightly twisted, whereas the lateral branch is long and slender.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone) to Longobardian (*Meulleritortis cochleata* Zone); Southern Alps (Frötschbach section), West Sichuan, China.

Genus *Bogdanella* Kolar-Jurkovšek, 1989
Types: *Bogdanella trentana* Kolar-Jurkovšek, 1989

Bogdanella trentana Kolar-Jurkovšek, 1989
Plate 10, Figure 10

1989 *Bogdanella trentana* sp. nov. – Kolar-Jurkovšek, p. 162, fig. 3.
1990 *Bogdanella trentana* Kolar-Jurkovšek – Kolar-Jurkovšek, p. 79, pl. 7, fig. 7.
1996 *Bogdanella trentana* Kolar-Jurkovšek – Kozur & Mostler, p. 125, pl. 7, figs 7–9, 12–13.
2001 *Bogdanella* cf. *trentana* Kolar-Jurkovšek – Hauser et al., pl. 3, fig. 25.

Remarks: This poorly preserved specimen is distinguished easily by its long, corkscrew-like twisted polar spine which is circular in cross-section in the proximal part but gradually flattened towards the distal end.

Range and occurrence: Longobardian (*Muelleritortis cochleata* Zone); Southern Alps (Seceda outcrops, Dolomites, Julian Alps, Slovenia), Dinarides (Bosnia-Hercegovina) and Oman.

Genus *Falcispongus* DUMITRICA, 1982
Type species: *Falcispongus falciformis* DUMITRICA, 1982.

Falcispongus falciformis DUMITRICA, 1982
Plate 10, Figures 11–12

1982 *Falcispongus falciformis* sp. nov. – DUMITRICA, p. 66, pl. 1, fig. 5, pl. 2, figs 1, 3, 7; pl. 3, fig. 2–3, 5–6.
1984 *Falcispongus falciformis* DUMITRICA – DE WEVER, pl. 3, fig. 8.
1994 *Falcispongus falciformis* DUMITRICA – KOZUR & MOSTLER, p. 65, pl. 14, figs 2, 6, 12.
1994 *Falcispongus falciformis* DUMITRICA – MARCUCCI, pl. 1, fig. 5.
2001 *Falcispongus falciformis* DUMITRICA – HAUSER et al., pl. 2, fig. 17, pl. 3, fig. 4.
2005 *Falcispongus falciformis* DUMITRICA – GORIČAN et al., pl. 1, figs 18–20.
2009 *Falcispongus falciformis* DUMITRICA – FENG et al., p. 589, figs 4.13–16, 4.27–31.
2012b *Falcispongus falciformis* DUMITRICA – STOCKAR et al., p. 420, pl. 10, fig. 8.

Remarks: *Falcispongus falciformis* DUMITRICA, 1982 includes several morphotypes (DUMITRICA, 1982), but all bears various sized external wing. The holotype of *F. falciformis* has a relatively large, wide external wing in comparison with specimens from the Frötschbach section, which have a smaller and less broad external wing.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone to *Ladinocampe multiperforata* Zone); Southern Alps (Frötschbach, Recoaro, San Ulderico-Pallé, M. San Giorgio), Ivanščica and Kalnik Mt., Croatia, Albania, Oman and from Northern Tibet.

Falcispongus hamatus DUMITRICA, 1982
Plate 10, Figures 13–14

1982 *Falcispongus hamatus* sp. nov. – DUMITRICA, p. 66, pl. 3, figs 1, 4; pl. 4, fig. 1.
1990 *Falcispongus hamatus* DUMITRICA – GORIČAN & BUSER, p. 145, pl. 3, fig. 7.
1996 *Falcispongus hamatus* DUMITRICA – KOZUR & MOSTLER, p. 110, pl. 9, figs 1, 5; pl. 14, figs 2–3.
1996 *Falcispongus transitus* sp. nov. – KOZUR & MOSTLER, p. 111, only pl. 8, fig. 3; pl. 14, fig. 5.
2002 *?Falcispongus* cf. *hamatus* DUMITRICA – KAMATA et al., p. 503, fig. 7p.

Remarks: Poorly preserved specimen which remained together with relatively small spongy test. Comparing with the holotype of *Falcispongus hamatus* DUMITRICA the illustrated specimen herein has a significantly longer and recurved spine.
Range and occurrence: Longobardian (*Muelleritortis cochleata* Zone to *Tritortis kretaensis* Zone); Eastern Carpathians (Curmatura and Rarau Mts., Romania), Southern Alps (Seceda, Italy), Julian Alps (Vrišič section, Slovenia), Dinaric Carbonate Platform or High Karst (Fojnica, Bosnia-Herzegovina).

Falcispongus zapfei KOZUR, 1996
Plate 10, Figures 15–17

1996 *Falcispongus zapfei* sp. nov. – KOZUR, p. 290, pl. 1, fig. 10.
2005 *Falcispongus zapfei* KOZUR – GORIČAN et al., pl. 1, fig. 16.
2016 *Falcispongus zapfei* KOZUR – TEKIN et al., pl. 1, figs 12–13.

Remarks: Test globular, composed of a dense spongy framework. The polar spine is smooth, slightly widening and flatting in its upper part, perpendicularly bent with a straight or recurved distal part.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone to *Ladinocampe multiperforata* Zone); Southern Alps (Frötschbach), Ivanščica Mt., Croatia, Mersin Mélange, Turkey, Western Sicily, Italy.

?Falcispongus sp.
Plate 10, Figure 9

Remarks: Poorly preserved specimen, long slightly curved stem which gradually flattened towards the distal end. Long lateral branches curved downward.
Range and occurrence: Longobardian (*Muelleritortis firma* to *Muelleritortis cochleata* Zone) of Southern Alps (Frötschbach section).

Genus *Scutispongus* KOZUR et MOSTLER, 1996
Type species: *Scutispongus tortilispinus* KOZUR et MOSTLER, 1996

Scutispongus cf. *rostratus* (DUMITRICA, 1982)
Plate 10, Figure 18

cf. 1982 *Falciformis rostratus* sp. nov. – DUMITRICA, p. 66, pl. 3, figs 8–9; pl. 4, figs 2–3, 5–6, pl. 5, figs 2, 4.

Range and occurrence: Upper Illyrian (*Ladinocampe multiperforata* Zone to *Muelleritortis cochleata* Zone); Southern Alps (Seceda outcrop), Eastern Carpathians (Rarau Mountain).

Spumellaria incerte sedis
Genus *Hexaspongus* KOZUR et MOSTLER, 1981
Type species: *Hexaspongus robustus* KOZUR et MOSTLER, 1981

Hexaspongus robustus KOZUR et MOSTLER, 1981
Plate 11, Figures 1–2

1981 *Hexaspongus robustus* sp. nov. – KOZUR & MOSTLER, p. 78, pl. 56, fig. 2.

Remarks: Illustrated specimen differs from the holotype by possessing slightly longer and more pointed spines.
Range and occurrence: Pelsonian (Southern Carpathians) to upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps (Recoaro and Frötschbach).

Hexaspongus radiculaspinus OZSVÁRT sp. nov.
Plate 11, Figure 3

Etymology: Radicula (Latin) = small root; spina (Latin) = spine.
Holotype: Plate 11, Figure 3; Hungarian Natural History Museum, Budapest: PAL 2022.118.1.
Studied material: Single specimen from the Frötschbach section.

Description: Test globular, meshwork composed of mostly irregular spongy pore frames with six, primary spines perpendicularly arranged to each other. Spines approximately equal in length, slightly curved and twisted, triradiate width wide and deep grooves and relatively narrow ridges. Spines terminate in root-like branches (two or three). Spinules triradiate, pointed, with relatively small further spinules.
Dimensions: Diameter of test 120 μm, Length of spines 75–90 μm.
Remarks: *Hexaspongus radiculaspinus* sp. nov. differs from *H. robustus* Kozur et Mostler, 1981 by having strange, root-like spines.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps (Frötschbach section).

?Hexaspongus longispinosus Ozsvárt sp. nov.
Plate 11, Figures 4–5

Etymology: Referring to its long spines: longus (Latin) = long; spinosus (Latin) = spiny.
Holotype: Plate 11, Figure 4; Hungarian Natural History Museum, Budapest: PAL 2022.113.1.
Studied material: Two specimens from the Frötschbach section.
Description: Test globular, composed of two or three spongy frameworks with relatively large polygonal pores in outermost layer, whereas significantly smaller circular pores characterize the inner layers. Six (or five), straight or slightly curved, long, triradiate spines, perpendicular to each other. Spines equal in length and possess deep and relatively narrow, longitudinal grooves and rounded ridges. All ridges divided into longitudinal secondary grooves which extend until two-thirds part of the spines.
Dimensions: Diameter of test 150 μm, length of spines 170–190 μm.
Remarks: This form is questionably assigned to the genus *Hexaspongus* because none of the illustrated specimens seems the sixth spines, which may be broken or possess only five. In this latter case they should be assigned to a new genus. *?Hexaspongus longispinosus* sp. nov. is distinguished from other species of *Hexaspongus* by significantly longer, thinner spines which possess secondary grooves on ridges.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps (Frötschbach section).

Genus *Ticinosphaera* Stockar et al., 2012
Type species: *Helioentactinia mesotriassica* Kozur et Mostler, 1981

Ticinosphaera mesotriassica (Kozur et Mostler, 1981)
Plate 11, Figures 6–7

1981 *Helioentactinia mesotriassica* sp. nov. – Kozur & Mostler, p. 17, pl. 55, fig. 3.
1984 *Helioentactinia mesotriassica* Kozur et Mostler – Lahm, p. 19, pl. 2, fig. 4.
1984 *Helioentactinia oertlii* (Kozur et Mostler) – Lahm, p. 19, pl. 2, figs 2–3.
1984 *Helioentactinia oertlii* (Kozur et Mostler) – Kellici & De Wever, p. 148, pl. 2, fig. 10.
1996 *Helioentactinia oertlii* (Kozur et Mostler) – Kozur et al., p. 220, pl. 7. fig. 9.
2012b *Ticinosphaera mesotriassica* (Kozur et Mostler) – Stockar et al., p. 424, pl. 10, figs 21–25, pl. 11, figs 1–4.

Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone) to Julian (*Tetraporobrachia haeckeli* Zone); Southern Alps (Frötschbach section, Monte San Giorgio, Marmolada), Northern Calcareous Alps (Großreifling).

Genus *Lahmosphaera* Stockar et al, 2012
Type species: *Stauracontium?alpinum* Dumitrica et al., 1980

Lahmosphaera alpina (Dumitrica et al., 1980)
Plate 11, Figures 8–9

1980 *Stauracontium* ? *alpinum* sp. nov. – Dumitrica et al., p. 17, pl. 2, fig. 3; pl. 14, fig. 1.
1984 *Stauracontium alpinum* Dumitrica et al. – Lahm, p. 77, pl. 13, fig. 10.
2013 *Stauracontium* ? *alpinum* Dumitrica et al. – Celarc et al., fig. 7.24.
2012b *Lahmosphaera alpina* (Dumitrica et al.) – Stockar et al., p. 424, pl. 11, figs 5–8.
2016 *Lahmosphaera* sp. aff. *L. alpina* (Dumitrica et al.) – Bragin et al., p. 308, pl. 1, fig. 10.

Remarks: Some specimens from the Frötschbach section have slightly thinner and smaller tricarinate main spines, and the test has a bit smaller pore frames with rounded to polygonal pores.
Range and occurrence: Pelsonian (*Baratuna cristianensis* Zone) to upper Illyrian (*Ladinocampe multiperforata* Zone); Southern Alps (Frötschbach, Recoaro, San Ulderico-Pallé, M. San Giorgio), Julian Alps (Mt. Prisojnik, Slovenia)

Lahmosphaera fluegeli (Kozur et Mostler, 1979)
Plate 11, Figures 10–13

1979 *Staurosphaera* ? *fluegeli* sp. nov. – Kozur & Mostler, p. 58, pl. 13, fig. 2.
non 1984 *Staurosphaera* ? *fluegeli* Kozur et Mostler – Lahm, p. 75, pl. 13, fig. 7.
1989 *Stauracontium* sp. A – Yeh, pl. 3, fig. 11.
1995 *Staurosphaera* ? *fluegeli* Kozur et Mostler – Kellici & De Wever, pl. 4, fig. 10.
1996 *Staurolonche praegranulosa* – Kozur & Mostler, p. 228, pl. 10, fig. 11.
2003 *Staurosphaera* ? *fluegeli* Kozur et Mostler – Jin et al., pl. 4, fig. 17.

Remarks: Thanks to the imperfect illustration of *Staurosphaera* ? *fluegeli* Kozur et Mostler, 1979 it is quite difficult to decide whether that species wears a latticed or spongy framework. Authors described in diagnosis a "finely porous to spongy" framework which means they cannot also have decided. In our view, the illustrated specimen by Kozur & Mostler has no spongy test rather finely porous, therefore these specimens are assigned to the genus *Lahmosphaera* Stockar et al., 2012b. *Lahmosphaera fluegeli* has a relatively small-pored cortical shell and pentagonal dodecahedron microsphere with four, straight, pointed distally and three-bladed spines. Kozur et al. (1996) described *Staurolonche praegranulose* as a new species which clearly resembles *L. fluegeli.*
Range and occurrence: Pelsonian to Fassanian (*Baratuna cristianensis* Zone to *Ladinocampe multiperforata* Zone); Southern Alps, Frötschbach section; Oregon, North America; Changning-Menglian Belt, Western Yunnan, China.

Lahmosphaera granulosa (Dumitrica et al., 1980)
Plate 12, Figures 1–3

1980 *Staurocontium* ? *granulosum* sp. nov. – Dumitrica et al., p. 16, pl. 1, fig. 7; pl. 11, fig. 5.
1984 *Staurocontium granulosum* Dumitrica et al. – Lahm, p. 76, pl. 13, fig. 9.
non 1990 *Staurocontium* ? *granulosum* Dumitrica et al. – Goričan & Buser, p. 158, pl. 1, fig. 1.
1999 *Staurolonche granulosa* (Dumitrica et al.) – Sashida et al., p. 771, fig. 8.23.
2001 *Staurolonche granulosa* (Dumitrica et al.) – Feng et al., p. 198, pl. 8, fig. 3.

Remarks: Test composed of hexagonal to polygonal pore frames which yield small, pointed spines at pore frame vertices, although they can be fossilized in special cases, only. Four massive, slightly sinistrally twisted spines are presented.
Range and occurrence: Pelsonian (*Baratuna cristianensis* Zone) to upper Illyrian (*Ladinocampe multiperforata* Zone); Southern Alps (Recoaro, Frötschbach); Southwest Yunnan, China; Western Timor, Indonesia.

Lahmosphaera mulleri (Dumitrica et al., 1980)
Plate 12, Figure 4

1980 *Plafkerium* ? *mulleri* sp. nov. – Dumitrica et al., p. 14, pl. 1, fig. 3.
1995 *Plafkerium* ? *mulleri* Dumitrica et al. – Kellici & De Wever, p. 156, pl. 4, fig. 6.
2011 *Plafkerium* ? *mulleri* Dumitrica et al. – Ozsvárt et al., fig. 9.9.
2012b *Lahmosphaera mulleri* (Dumitrica et al.) – Stockar et al., p. 428. pl. 11, fig. 16
2016 *Lahmosphaera* sp. cf. *L. mulleri* (Dumitrica et al.) – Bragin et al., p. 308, pl. 3, fig. 13.

Remarks: The test is composed of relatively large, circular to polygonal pore frames. The illustrated specimen herein comparing to the holotype of *L. mulleri* (Dumitrica et al., 1980) has completely dextrally twisted massive spines, whereas the holotype has a short, straight part which is followed by a strongly twisted terminal portion.
Range and occurrence: Pelsonian (*Baratuna cristianensis* Zone) to Illyrian (*Ladinocampe multiperforata* Zone); Southern Alps (Recoaro, Frötschbach); Southeastern Pamirs.

Lahmospharea trispinosa (Kozur et Mostler, 1979)
Plate 12, Figures 5–6

1979 *Staurosphaera trispinosa* sp. nov. – Kozur & Mostler, p. 58, pl. 21, fig. 3.
1979 *Staurosphaera triloba* sp. nov. – Nakaseko & Nishimura, p. 72, pl. 5, figs 1–2.
1980 *Stauracontium* ? *trispinosum ladinicum* n. subsp. – Dumitrica et al., p. 17, pl. 1, fig. 5; pl. 2, fig. 4; pl. 3; figs 6–7; pl. 5; fig. 4; pl. 14, fig. 5.
1984 *Stauracontium* ? *trispinosum* (Kozur et Mostler) – Lahm, p. 76, pl. 13, fig. 8.
1986 *Staurosphaera triloba* Nakaseko et Nishimura – Bragin, pl. 2, fig. 1.
1989 *Stauracontium* ? *trispinosum ladinicum* Dumitrica et al. – Yeh, p. 68, pl. 3, fig. 7.
1990 *Stauracontium* ? *trispinosum ladinicum* Dumitrica et al. – Yeh, p. 20, pl. 6, fig. 17.
1990 *Stauracontium* ? *trispinosum* (Kozur et Mostler) – Grapes et al., fig. 8v.
1990 *Stauracontium* ? *trispinosum* (Kozur et Mostler) – Goričan & Buser, p. 158, pl. 1, fig. 2.
1991 *Staurolonche trispinosa* (Kozur et Mostler) – Bragin, pl. 1, fig. 6.
1995 *Stauracontium* ? *trispinosum* (Kozur et Mostler) – Chiari et al., pl. 3, fig. 8.
1995 *Stauracontium* ? *trispinosum* (Kozur et Mostler) – Kellici & De Wever, p. 162, pl. 5, fig. 19; pl. 6, figs 1–2.
1995 *Stauracontium* ? *trispinosum* (Kozur et Mostler) – Ramovš & Goričan, p. 196.
1996 *Staurolonche trispinosa trilobum* (Nakaseko et Nishimura) – Kozur et al., p. 228, pl. 10, fig. 16.
1999 *Staurolonche trispinosa* (Kozur et Mostler) – Sashida et al., p. 771, fig. 8.18.
2001 *Staurolonche trispinosa* (Kozur et Mostler) – Feng et al., p. 198, pl. 8, fig. 3.
2006 *Staurolonche trispinosa* (Kozur et Mostler) – Marquez et al., pl. 4, fig. 43; pl. 5, fig. 7; pl. 6, fig. 7.
2010 *Staurolonche trispinosa* (Kozur et Mostler) – Tekin & Sönmez, fig. 6F.
2011 *Stauracontium* ? *trispinosum* (Kozur et Mostler) – Ozsvárt et al., fig. 10.6.
2012b *Lahmospharea trispinosa* (Kozur et Mostler) – Stockar et al., p. 426, pl. 11, figs 9–15.
2016 *Lahmospharea trispinosa* (Kozur et Mostler) – Gawlick et al., pl. 1, fig. 5.

Remarks: Poorly preserved specimens, although based on their characteristic verticil of three lateral triangular spinules can be assigned to the *L. trispinosa* (Kozur & Mostler, 1979)
Range and occurrence: Pelsonian (*Baratuna cristianensis* Zone) to Carnian; Cosmopolitan.

Spumellaria gen. indet. A
Plate 12, Figures 7–8

Remarks: Globular test with four long, double spines (quite rare) in the same plane. Spines triradiate, equal in length and slightly twisted. The illustrated specimen resembles *Lahmosphara mulleri*, but the test is recrystallized and the double spines are quite strange and unusual.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps (Seceda core).

?Intermediellidae gen. indet. A
Plate 12, Figure 9

Remarks: This specimen has an irregularly shaped spongy shell with two slender, smooth spines. The lower part of the test might present a pylum. This species resembles the genus *Neopaurinella.*
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps.

?Oertlispongidae gen. indet. A
Plate 12, Figure 10

Remarks: Multi-layered globular test with single, quite short and pointed spine. Presumably, this species belongs to the family Oertlispongidae.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps.

? Intermediellidae gen. indet. A
Plate 12 Figure 11

Remarks: Globular, multi-layered, spongy test with 6 short, regularly arranged (perpendicular to each other) pointed spines which are equal in length and smooth.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps.

Gen. et sp. indet. A
Plate 12, Figure 12

Remarks: Single-layered shell, composed of thin, irregularly arranged and shaped pore frames; pores circular to polygonal. Six, extremely long, triradiate spines are arranged perpendicularly to each other. Slim blades, outer edges are rounded; shallow grooves.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps.

Gen. et sp. indet. B
Plate 12, Figures 13–14

Remarks: Double-layered, large globular shell; outer layer composed of irregularly arranged and shaped pore frames with large triangular to polygonal pores. Inner layer composed of dense, small circular pores. 10–14 extremely long triradiate spines, deep grooves, sharp blades. These specimens resemble the genus *Ticinosphaera* but they have a double-layered shell.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps.

Order Nassellaria Ehrenberg, 1875
Family Archaeosemantidae Kozur et Mostler, 1981
Genus *Archaeosemantis* Dumitrica, 1978a
Type species: *Archaeosemantis pterostephanus* Dumitrica, 1978a

Archaeosemantis cristianensis Dumitrica, 1982
Plate 13, Figure 1

1978a *Archaeosemantis pterostephanus* sp. nov. – Dumitrica, p. 52, pl. 5, figs 7–8
1982 *Archaeosemantis cristianensis* sp. nov. – Dumitrica, p. 423, pl. 1; fig. 11; pl. 3, fig. 11; pl. 4, figs 5, 7; pl. 6, fig. 2; pl. 7, figs 3, 12–13.
1999 *Archaeosemantis cristianensis* Dumitrica – Kamata, p. 663, fig. 8D, H. (cum syn.)
2012 *Archaeosemantis cristianensis* Dumitrica – Celarc et al., fig. 8.22

Range and occurrence: Lower Triassic (Spathian) to Ladinian (*Muelleritortis cochleata* Zone), although Sugiyama (1997) reported this species from the Spathian to Norian from Japan, without any illustration.

Archaeosemantis pterostephanus Dumitrica, 1978a
Plate 13, Figure 2

1978 *Archaeosemantis pterostephanus* sp. nov. – Dumitrica, p. 52, pl. 5, figs 9–12, non 7–8.
1982 *Archaeosemantis pterostephanus* Dumitrica – Dumitrica, p. 423, pl. 5, fig. 1; pl. 6, figs 1, 4–5; pl. 7, fig. 1.
2004 *Archaeosemantis pterostephanus* Dumitrica – Dumitrica, p. 219, pl. 8, fig. 6. (cum syn.)

Range and occurrence: Pelsonian (*Baratuna cristianensis* Zone) to uppermost Longobardian or lowermost Julian (*Tritortis kretaensis* Zone); Southern Alps (Frötschbach section, Recoaro), Oman (Hauser et al., 2001).

Genus *Nandartia* Dumitrica, 2004
Type species: *Tandarnia simplicissima* Dumitrica, 1982

Nandartia simplicissima (Dumitrica, 1982)
Plate 13, Figure 3

1982 *Tandarnia simplicissima* sp. nov. – Dumitrica, p. 414, pl 3, figs 3–4.
1995 *Tandarnia simplicissima* Dumitrica – Kellici & De Wever, p. 162, pl. 6, fig. 7.
2004 *Nandartia simplicissima* (Dumitrica) – Dumitrica, p. 222, pl. 5, fig. 1; pl. 9, fig. 3.

Range and occurrence: Pelsonian (*Baratuna cristianensis* Zone) to uppermost Longobardian (*Tritortis kretaensis* Zone); Southern Carpathians (Cristian), Southern Alps (Frötschbach section, Recoaro), Eastern Carpathians, Romania.

Family Poulpidae De Wever, 1981
Genus *Poulpus* De Wever, 1979
Type species: *Poulpus piabyx* De Wever, 1979

Poulpus curvispinus praecurvispinus Kozur et Mostler, 1994
Plate 13, Figures 4–5

1994 *Poulpus curvispinus praecurvispinus* n. subsp. – Kozur & Mostler, p. 116, pl. 32, fig. 3, 6, 7.

Remarks: Large, smooth cephalis without apical horn, with well-visible arches on the surface. Short median bar and massive spicular system with A, V, 2L, D, 2l. D and 2L are extended into slightly curved and tricarinate feet.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps (Frötschbach section, Passo della Gabiola).

Genus *Hozmadia* Dumitrica et al., 1980
Type species: *Hozmadia reticulata* Dumitrica et al., 1980

Hozmadia costata Kozur et Mostler, 1994
Plate 13, Figures 6–7

1994 *Hozmadia costata* sp. nov. – Kozur & Mostler, p. 114, pl. 31, figs 1, 2, 5–10.
1990 *Hozmadia reticulata* Dumitrica et al. – Goričan & Buser, p. 147, pl. 9, figs 9–10.
1995 *Hozmadia costata* Kozur et Mostler – Kellici & De Wever, p.148, pl. 4, figs 20–21.

1995 *Hozmadia reticulata* Dumitrica et al. – Kellici & De Wever, p. 148, pl. 2, figs 17–18 (non 15–16).
1995 *Hozmadia reticulata* Dumitrica et al. – Ramovš & Goričan, p. 186, pl. 7, figs 1–2 (non 3–4).
2003 *Hozmadia reticulata* Dumitrica et al. – Bortolotti et al., pl. 1, fig. 5 (not fig. 4).

Remarks: *Hozmadia costata* Kozur et Mostler unlikely forerunner of *H. reticulata* Dumitrica et al., as Kozur & Mostler (1994) pointed out because *H. costata* Kozur & Mostler appeared in the *Spongosilicarmiger italicus* Zone, whereas *H. reticulata* recorded from the Aegean (*Hozmadia gifuensis* Zone).
Range and occurrence: Pelsonian of the Cristian section, Romanis to upper Illyrian (*Ladinocampe multiperforata* Zone) in the Southern Alps.

Hozmadia reticulata Dumitrica et al., 1980
Plate 13, Figures 8–9

1980 *Hozmadia reticulata* sp. nov. – Dumitrica et al., p. 21, pl. 9, fig. 10.
1990 *Hozmadia reticulata* Dumitrica et al. – Goričan & Buser, p. 147, pl. 9, figs 8 (non 9–10).
1994 *Hozmadia reticulata* Dumitrica et al. – Kozur & Mostler, p. 111, pl. 21, fig. 4.
1995 *Hozmadia costata* Dumitrica et al. – Kellici & De Wever, p. 148, pl. 2, figs 15–16. (not 17–18)
1995 *Hozmadia reticulata* Dumitrica et al. – Ramovš & Goričan, p. 186, pl. 7, figs 3–4 (non 1–2).
2000 *Hozmadia reticulata* Dumitrica et al. – Xia & Zhang, p. 82, pl. 3, fig. 4.
2000 *Hozmadia* sp. A – Sashida et al., p. 807, fig. 9.12.
2007 *Hozmadia reticulata* Dumitrica et al. – Marquez et al., pl. 5, figs 11–12.
2012 *Hozmadia reticulata* Dumitrica et al. – Gawlick et al., pl. 1, fig. 31.
2012b *Hozmadia* sp. cf. *reticulata* Dumitrica et al. – Stockar et al., p. 429, pl. 12, fig. 6.
2013 *Hozmadia reticulata* Dumitrica et al. – Celarc et al., fig. 9.4.
2014 *Hozmadia reticulata* Dumitrica et al. – Kamata et al., pl. 2, fig. 27.

Remarks: This is one of the most frequent species in the Seceda area; perfectly preserved specimens wear characteristic ridges on the surface of the cephalis and rough texture between ridges. Although the apical horn of the holotype bears four blades, most of the specimens from the Seceda area have only three blades on the massive horn.
Range and occurrence: Lower Anisian (Aegean) *Hozmadia gifuensis* Zone to upper Anisian (Illyrian) *Ladinocampe multiperforata* Zone; Cosmopolitan.

Genus *Annulohaeckelella* Kozur & Mostler, 2006
Type species: *Annulohaeckelella longipedis* Kozur & Mostler, 2006

Hozmadia longicephalis Kozur et Mostler, 1994
Plate 13, Figure 10

1994 *Hozmadia longicephalis* sp. nov. – Kozur & Mostler, p. 115, pl. 29, figs 5–6.

Remarks: The test slightly widens around the middle part, but narrows distally; large, tricarinate apical horn with wide holes. This specimen has somewhat longer but straight feet which are tricarinate proximal but became rounded distally.
Range and occurrence: Upper Illyrian (*Tetraspinocyrtis laevis* Zone to *Spongosilicarmiger italicus* Zone); Felsőörs section, Hungary; Southern Alps (Frötschbach section).

Annulohaeckelella longipedis Kozur et Mostler, 2006
Plate 13, Figure 11

2006 *Annulohaeckelella longipedis* sp. nov. – Kozur & Mostler, p. 62, pl. 2, figs 4, 7.

Remarks: The illustrated specimen from the Seceda section possesses a somewhat longer and slender apical horn, whereas the holotype of this species has a stouter and wider three-bladed apical horn. Unfortunately, the preservation is incomplete therefore the ring on the thorax is missing.
Range and occurrence: Longobardian (*Muelleritortis firma* to *Muelleritortis cochleata* Zone); Southern Alps, Dinarides, Balaton Highland, Hungary (unpublished material).

Genus *Eonapora* Kozur et Mostler, 1979
Type species: *Eonapora pulchra* Kozur et Mostler, 1979

Eonapora mesotriassica Kozur et Mostler, 1981
Plate 13, Figures 12–13

1980 *Eonapora* sp. nov. – Dumitrica et al., p. 21, pl. 9, figs 3–4.
1981 *Eonapora mesotriassica* sp. nov. – Kozur & Mostler, p. 81, pl. 27, fig. 1.
1990 *Eonapora mesotriassica* Kozur et Mostler – Goričan & Buser, p. 143, pl. 10, fig. 1.
1994 *Sanfilippoella laevis* sp. nov. – Kozur & Mostler, p. 111, p. 29, figs 1–2.
1995 *Eonapora mesotriassica* Kozur et Mostler – Kellici & De Wever, p. 144, pl. 1, figs 16–17.

Remarks: Although the original description of this species does not mention velum, our specimens from Frötschbach wear thin and fragile velum with many pores.
Range and occurrence: Upper Illyrian (*Tetraspinocyrtis laevis* Zone) to lower Fassanian (*Ladinocampe multiperforata* Zone); Felsőörs section, Hungary, Southern Alps.

Eonapora pulchra Kozur & Mostler, 1979
Plate 13, Figure 14

1979 *Eonapora pulchra* sp. nov. – Kozur & Mostler, p. 90, pl. 19, fig. 11.
2016 *Eonapora pulchra* Kozur et Mostler – Ozsvárt et al., p. 150, pl. 3, fig. 8.

Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone to lower Tuvalian *Spongotortilispinus moixi* Zone); Southern Alps, Sorgun Ophiolitic Mélange, Turkey.

Eonapora robusta Kozur & Mostler, 1981
Plate 13, Figures 15–16

1981 *Eonapora robusta* sp. nov. – Kozur & Mostler, p. 82, pl. 29, fig. 1.
1990 *Eonapora* aff. *robusta* Kozur et Mostler – Goričan & Buser, p. 143, pl. 10, fig. 2.
1994 *Eonapora robusta* Kozur et Mostler – Kozur & Mostler, p. 113, pl. 30, figs 8, 11.
non 2011 *Eonapora robusta* Kozur et Mostler – Bragin, p. 767, pl. 14, fig. 8.

Range and occurrence: Pelsonian from the Cristian section, Romania to upper Illyrian (*Ladinocampe multiperforata* Zone); Felsőörs section, Hungary; Southern Alps, Julian Alps.

Genus *Triassobipedis* Kozur, 1984
Type species: *Triassobipedis balatonica* Kozur, 1984

Triassobipedis sp.
Plate 13, Figure 17

Remarks: This species is completely recrystallized, however, based on the two characteristic feet and the apical spine may assess the genus *Triassobipedis* Kozur, 1984. Probably this is a new species because the feet are tree-bladed, in contrast to *T. balatonica* Kozur, 1984. Goričan & Buser (1990) illustrated tree-bladed *T. balatonica* from the Julian Alps, Slovenia, whereas Sashida et al. (1999) also published a three-bladed *T. balatonica* from Western Timor, Indonesia.
Range and occurrence: *Spongosilicarmiger italicus* Zone (upper Illyrian); Southern Alps (Frötschbach section).

Genus *Neopylentonema* Kozur, 1984
Type species: *Neopylentonema mesotriassica* Kozur, 1984

Neopylentonema mesotriassica Kozur, 1984
Plate 13, Figures 18–19

1984 *Neopylentonema mesotriassica* sp. nov. – Kozur, p. 71, pl. 4, fig. 5; pl. 5, fig. 1; pl. 6, fig. 1.
1990 *Neopylentonema mesotriassica* Kozur – Goričan & Buser, p. 148, pl. 6, fig. 11.
1996 *Neopylentonema mesotriassica* Kozur – Kozur et al., p. 231, pl. 4, fig. 11.
2013 *Neopylentonema mesotriassica* Kozur – Celarc et al., fig. 9.1.

Remarks: This species is characterized by four-bladed spines which are prolongations of the spicular system and they terminate with small, pointed verticil spines except for the outer prolongation of V which does not wear verticil.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger transitus* Zone to *Ladinocampe multiperforata* Zone); the Southern Alps.

Genus *Amentoneopylen* n. gen.
Type species: *Amentoneopylen simplex* sp. nov.
Etymology: The name *Amentoneopylen* is formed by an arbitrary combination of letters, reminding to the name *Neopylentonema* Kozur, 1984 which shows a close phylogenetic relationship.
Description: Monocyrtid test with 7 massive spines. Globular, large-sized cephalis with distally located spicular system with Mb, A, V, 2L, D and 2l. Spicular system continues in massive spines on outer side of test. Spines are triradiate, except apical and ventral spines which are significantly smaller, an those are circular in cross-section. Neither of them bears apophysis like the species *Neopylentonema* Kozur, 1984.
Remarks: *Amentoneopylen* n. gen. differs from the genus *Neopylentonema* Kozur, 1984 by having triradiate spines without apophyses at the distal part.
Range and occurrence: *Spongosilicarmiger italicus* Zone (upper Illyrian); Southern Alps (Frötschbach section).

Amentoneopylen simplex Ozsvárt sp. nov.
Plate 14, Figures 1–3

Etymology: According to the simple structure of this species. Simplex (Latin, adj.) = simple.
Holotype: Plate 14, Figures 1–3; Hungarian Natural History Museum, Budapest: PAL 2022.114.1.
Studied material: Two specimens from the Frötschbach section.
Description: Test monocyrtid; globular, large-sized latticed cephalis. Spicular system is located at the distal part of cephalis, consists of smooth, needle-like rods and contains Mb, A, V, 2L, D and 2l, whereas arches: Al, Al, AL, AL, lL, lL, VA. Spicular system (A, V, 2L, D and 2l) continues in massive spines on outer side of test. D, LL, ll continue triradiate and significantly larger spines, whereas the prolongation of V and A are smaller, proximally tricarinate but distally became needle-like circular in cross-section, no verticil at distal part of spines.
Dimensions: Length of test 100 µm, width test 100 µm, apical spine 50 µm.
Range and occurrence: *Spongosilicarmiger italicus* Zone (upper Illyrian); Southern Alps (Frötschbach section).

Family *Nabolellidae* Kozur et Mostler, 1979
Genus *Nabolella* Petrushevskaya, 1981
Type species: *Squinabolella longispinosa* Kozur et Mostler, 1979

Nabolella striata Ozsvárt sp. nov.
Plate 14, Figures 4–10

cf. 2005 *Deflandrecyrtium* sp. – Tekin & Mostler, p. 7, figs 5.8–10.

Etymology: *Striatus* (Latin, adj.) refers to thin, ridge-like projections on the surface.
Holotype: Plate 14, Figure 9; Hungarian Natural History Museum, Budapest: PAL 2022.120.1.
Studied material: 8 specimens from the Frötschbach section.
Description: Dicyrtid test cap-shaped in lateral view with large, globular cephalis without pores but with characteristic intersecting ridges which can be the appearance of arches on the surface of cephalis. Tiny, short spine present or completely missing. Initial spicule system consisting of short Mb, and A, V, ll, D and LL. Spines absent, however, a fairly small apical tip can be present, but the characteristic feet are completely missing. Cephalis slightly narrows distally and connected with smooth ring to the large conical thorax which presents huge circular to oval pores. Edge of thorax circular, rounded.
Dimensions: Diameter of globular cephalis = 140–160 µm; Height of test = 200–250 µm; Diameter of thorax = 250–300 µm.

Remarks: The absence of massive spines distinguishes *Nabolella striata* sp. nov. from all other species of *Nabolella.* Tekin & Mostler (2005) illustrated some fairly similar specimens as *Deflandrecyrtium* sp. from the Fojnica section, Bosnia and Herzegovina, but those specimens are illustrated from apical view therefore quite difficult to compare with our specimens. However, it seems clearly that those specimens have no spines.
Range and occurrence: *Spongosilicarmiger italicus* Zone (upper Illyrian): Southern Alps (Frötschbach section), but it might extend to the *Muelleritortis cochleata* Zone (upper Longobardian): Dinarides (Fojnica section, Bosnia and Herzegovina).

Family Ultranaporidae Pessagno, 1977
Genus *Hinedorcus* Dumitrica et al., 1980
Type species: *Hinedorcus alatus* Dumitrica et al., 1980

Hinedorcus alatus Dumitrica et al., 1980
Plate 14, Figures 11–14

1980 *Hinedorcus alatus* sp. nov. – Dumitrica et al., p. 24, pl. 15, fig. 4.
1990 *Hinedorcus alatus* Dumitrica et al. – Goričan & Buser, p. 146, pl. 10, fig. 5.
1995 *Hinedorcus alatus* Dumitrica et al. – Kellici & De Wever, p. 148, pl. 2, fig. 14.
2013 *Hinedorcus alatus* Dumitrica et al. – Celarc et al., fig. 9.18.

Remarks: Some specimens from the Frötschbach section wear 2–3 times bigger apical spines than the cephalis.
Range and occurrence: Upper Illyrian (*Tetraspinocyrtis laevis* Zone) to lower Fassanian (*Ladinocampe multiperforata* Zone); Balaton Highland (Felsőörs section); Southern Alps (Marmolada Mt.).

Hinedorcus gibber Tekin, 1999
Plate 14, Figures 15–19

1999 *Hinedorcus gibber* sp. nov. – Tekin, p. 146, pl. 32, figs 5–6.
2005 *Hinedorcus gibber* Tekin – Tekin & Mostler, p. 8, fig. 6.1.

Remarks: The holotype of this species (Tekin, 1999) has slightly curved feet and slightly twisted apical horn, whereas specimens from the Frötschbach section have somewhat slender test with more or less straight feet and thanks to the better preservation those specimens wear long, thin ridges on the surface of the cephalis. Thorax wears dense, irregularly shaped pores.
Range and occurrence: Upper Illyrian *Spongosilicarmiger italicus* Zone to upper Ladinian (*Muelleritortis cochleata* Subzone); Southern Alps (Frötschbach section), Dinarides (Fojnica section, Bosnia and Herzegovina), Antalya Nappes, Turkey.

Genus *Muellericyrtium* Kozur et Mostler, 1981
Type species: *Muellericyrtium triassicum* Kozur et Mostler, 1981

Muellericyrtium triassicum Kozur et Mostler, 1981
Plate 15, Figure 1

1981 *Muellericyrtium triassicum* sp. nov. – Kozur & Mostler, p. 111, pl. 8, fig. 2.
2013 *Muellericyrtium triassicum* Kozur et Mostler – Celarc et al., fig. 9.17.

Remarks: This quite rare form has been reported so far from two localities (Felsőörs section, Hungary and from Križevnik, Slovenia). Unfortunately, the illustrated holotype is incomplete, therefore the comparison is difficult. Our specimens from the Frötschbach section have similarly globular cephalis with short, pointed apical spine. A significantly shorter ventral spine is also present on the cephalis.
Range and occurrence: Upper Illyrian (*Tetraspinocyrtis laevis* Zone) to the *Spongosilicarmiger italicus* Zone (upper Illyrian); Balaton Highland (Felsőörs section), Southern Alps (Frötschbach section).

Muellericyrtium triangularum Ozsvárt sp. nov.
Plate 15, Figure 2

Etymology: *Triangularis* (Latin, adj.) = triangular, according to the triangular outline from the lateral view.
Holotype: Plate 15, Figure 2; Hungarian Natural History Museum, Budapest: PAL 2022.119.1.
Studied material: Single specimen from the Frötschbach section.
Description: Test tricyrtid, triangular shaped in lateral view with relatively small cephalis, bigger thorax and large abdomen. Globular cephalis with thin ridges on its surface with massive, triangular apical spine which wears longitudinal slots (5–6) on proximal part. Thorax is trapezoidal in lateral view and connected to the abdomen with sharp, elevated edge. Distally wears small circular pores. The widening thorax trapezoidal in lateral view, with dense, somewhat bigger circular or oval pores. Thorax terminates large, slightly wavy circular edge. Three tapering feet presented which are V-shaped in cross-section with sharp, straight ridges on outer surface.
Dimensisons: Diameter of cephalis 60 µm, length of test 260 µm, width of test 180 µm, length of apical spine 70 µm.
Remarks: *Muellericyrtium triangularum* sp. nov. is distinguished from the *M. triassicum* Kozur & Mostler by having different shapes of cephalis and thorax and by having significantly larger and longer apical spines which wear longitudinal slots on proximal part.
Range and occurrence: *Spongosilicarmiger italicus* Zone (Upper Illyrian); Southern Alps (Frötschbach section).

Muellericyrtium sp.
Plate 15, Figure 3

cf. 2001 *Hinedorcus* sp. – De Wever et al., fig. 159.5.

Description: This species has a large, spherical cephalis with a long, straight, rod-like apical horn. Outer surface of the cephalis run a large number of thin ridges in various direction. Cephalis narrows distally; thorax is present, however, it is a thin cylindrical segment, whereas abdomen widens and wears several, and circular tiny pores. Large, slightly curved feet wear sharp ridges and they are V-shaped in cross-section.
Remarks: This specimen is distinguished from *Muellericyrtium triassicum* by its large cephalis which is narrowing distally, by its longer and quite different shaped apical spine. De Wever et al. (2001) illustrated the same specimen as *Hinedorcus* sp., however, that specimen has a smooth apical spine and a characteristic ridge on the thorax, unknown to the species of *Hinedorcus.* Celarc et al. (2013) illustrated a fairly similar specimen from the Prisojnik section, Slovenia also as *Hinedorcus holdsworthi* Sugiyama, however, Sugiyama species wear rod-like feet,

whereas Celarc et al. (2013) specimen has V-shaped distally tapering feet.
Range and occurrence: Upper Illyrian *Spongosilicarmiger italicus* Zone; Southern Alps (Frötschbach section).

Genus *Silicarmiger* Dumitrica et al., 1980
Type species: *Silicarmiger costatus* Dumitrica et al., 1980

Silicarmiger costatus Dumitrica et al., 1980
Plate 15, Figures 4–6

1980 *Silicarmiger costatus* sp. nov. – Dumitrica et al., p. 23, pl. 7, fig. 2.
1990 *Silicarmiger costatus* Dumitrica et al. – Goričan & Buser, p. 156, pl. 10, fig. 8.
1994 *Silicarmiger costatus* Dumitrica et al. – Kozur & Mostler, p. 118, pl. 33, figs 6, 15, 16; pl. 34, fig. 8.
1995 *Silicarmiger costatus* Dumitrica et al. – Kellici & De Wever, p. 160, pl. 5, figs 11–14.

Remarks: Sometimes fairly difficult to distinguish the species of *Nofrema* Dumitrica et al. from the species of *Silicarmiger* Dumitrica et al., but the cephalis with apical horn is quite characteristic in both groups because the species of *Silicarmiger* wear irregularly arranged ridges on the surface of it, whereas the species of *Nofreama* has a spongy cover on the cephalis, Thorax, abdomen and postabdominal parts are fairly similar.
Range and occurrence: Pelsonian of the Cristian section, Romania to lower Fassanian (*Ladinocampe multiperforata* Zone); Balaton Highland (Felsőörs section), Southern Alps (Marmolada Mt.).

Silicarmiger costatus anisicus Kozur & Mostler, 1981
Plate 15, Figure 7

1981 *Silicarmiger costatus anisicus* n. subsp. – Kozur & Mostler, p. 104, pl. 10, fig. 1.
1994 *Silicarmiger costatus anisicus* Kozur et Mostler – Kozur & Mostler, p. 118, pl. 33, figs 1–5, 7–9, 13.
1995 *Silicarmiger costatus anisicus* Kozur et Mostler – Ramovš & Goričan, p. 190, pl. 6, fig. 7.
2013 *Silicarmiger costatus anisicus* Kozur et Mostler – Celarc et al., fig. 9.15.

Remarks: Although this species is somewhat poorly preserved, it can be assigned to *S. costatus anisicus*, even if has a bit longer apical horn than the Kozur & Mostler's holotype from the Felsőörs section.
Range and occurrence: Upper Illyrian (*Tetraspinocyrtis laevis* Zone to lower part of *Ladinocampe multiperforata* Zone); Balaton Highland (Felsőörs section), Southern Alps (San-Ulderico section), Julian Alps (Slovenia).

Silicarmiger inflatus Ozsvárt sp. nov.
Plate 15, Figures 8–9

2013 *Hinedorcus holdsworthi* Sugiyama – Celarc et al., fig. 9.16.

Etymology: *Inflatus* (Latin, adj.) = inflated refers to the large globular cephalis.
Holotype: Plate 15, Figure 9; Hungarian Natural History Museum, Budapest: PAL 2022.127.1.
Studied material: Two specimens from the Frötschbach section

Description: Large, inflated, globular cephalis covered by numerous thin, irregularly arranged ridges and many tiny pores. Long, straight or slightly curved, smooth apical horn which can be proximally divided by short blades. Short, slightly widened thorax with small circular pores. Abdomen somewhat bigger than cephalis and significantly longer than thorax, composed of loosely latticed frames with large pores; distally narrows. Abdomen wears 4–5, horizontal or irregularly located thin ribs, connected to the feet. Long feet, needle-like and connected some additional bars over abdomen.
Dimensions: Diameter of globular cephalis 120 μm, length of test 640 μm, width of test 200 μm, length of apical spine 200 μm.
Remarks: *Silicarmiger inflatus* sp. nov. differs from *S. costatus* Dumitrica et al. by inflated and significantly bigger cephalis and by a smooth and longer apical horn. Feet are smooth and needle-like against the bladed feet of *S. costatus.*
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps (Frötschbach section) but presumably this species already appeared in Pelsonian (Cristian, Romania).

Genus *Spongosilicarmiger* Kozur, 1984
Type secies: *Spongosilicarmiger italicus* Kozur, 1984

Spongosilicarmiger gabiolaensis Kozur et Mostler, 1994
Plate 16 Figure 1

1994 *Spongosilicarmiger gabiolaensis* sp. nov. – Kozur & Mostler, p. 121, pl. 35, figs 3, 6, 8–9, 11; pl. 36, figs ?1, 4–5, 7–8, 10; pl. 37, figs 2–4, 7–8.
2007 *Spongosilicarmiger gabiolaensis* Kozur & Mostler – Onoue & Sano, fig. 5. 21.

Range and occurrence: Upper Illyrian *Spongosilicarmiger italicus* Zone; Southern Alps (Mt. Spitz; Frötschbach section), Japan.

Spongosilicarmiger gabiolaensis curvatospinus
Kozur et Mostler, 1994
Plate 16, Figure 2

1990 *Spongosilicarmiger italicus* Kozur – Goričan & Buser, p. 158, pl. 10, fig. 7.
1994 *Spongosilicarmiger gabiolaensis curvatospinus* n. subsp. – Kozur & Mostler, p. 122, pl. 35, figs 3, 6, 9, 11; pl. 37, figs 2–4.

Range and occurrence: *Spongosilicarmiger italicus* Zone to the *Ladinocampe annuloperforata* Subzone (Upper Illyrian); Southern Alps (Frötschbach section), Julian Alps (Bohinj).

Spongosilicarmiger italicus Kozur, 1984
Plate 16, Figures 3–5.

1984 *Spongosilicarmiger italicus* sp. nov. – Kozur, p. 64, pl. 6, fig. 2; pl. 7, fig. 1.
1990 *Spongosilicarmiger italicus* Kozur – Yeh, p. 24, pl. 9, pl. 9, figs 1–3, 9–11; pl. 11, figs 21–22, 25.
2016 *Spongosilicarmiger italicus* Kozur – Tekin et al., pl. 4, figs 3–4.

Range and occurrence: This species is recorded from the upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps; Carnian in the Eastern Tethys (Busuanga Island) and in Panthalassa Ocean (Japan).

Spongosilicarmiger longispinus OZSVÁRT sp. nov.
Plate 16, Figures 9–10

Etymology: Referring to its long spines: longus (Latin) = long; spina, -us (Latin) = spine.
Holotype: Plate 16, Figure 6; Hungarian Natural History Museum, Budapest: PAL 2022.129.1.
Studied material: Two specimens from the Frötschbach section.
Description: Test slender, long (500–550 µm) and rocket-shaped from lateral view (width of test 200–220 µm). Cephalis small (30–40 µm), bell-shaped with tiny nodes. Especially long apical horn (150–170 µm), composed of tubular basal part and short, pointed distal tip. Basal part cylindrical and composed of latticed frame with large polygonal pores; distally narrows. Thorax is somewhat bigger than cephalis, cylindrical with small circular pores. Feet creep out at basal part of thorax and outward distally. Postcephalis segments composed of latticed frame with irregularly shaped pores and connected to the feet by downward rods.
Remarks: *Spongosilicarmiger longispinus* sp. nov. differs from all other species of *Spongosilicarmiger* by having an especially long apical horn, although *S. mostleri* SUGIYAMA bears long apical horn, although its basal tubular part is significantly shorter, whereas the top spine is more massive and longer.
Range and occurrence: Upper Illyrian *Spongosilicarmiger italicus* Zone; Southern Alps (Frötschbach section).

Spongosilicarmiger posterus KOZUR et MOSTLER, 1994
Plate 16, Figures 11–13.

1994 *Spongosilicarmiger posterus* KOZUR et MOSTLER, p. 123, pl. 35, figs 12–13; pl. 36, figs 2–3.
2009 *Spongosilicarmiger posterus* KOZUR et MOSTLER – FENG et al., p. 598, fig. 7(19).

Range and occurrence: *Spongosilicarmiger italicus* Zone (Upper Illyrian); Southern Alps, Eastern Tethys (Tibet).

Spongosilicarmiger priscus KOZUR et MOSTLER, 1994
Plate 16 Figures 14–15.

1979 *Stichopterium* (?) sp. B – NAKASEKO and NISHIMURA, p. 80, pl. 11, fig. 2.
1994 *Spongosilicarmiger priscus* sp. nov. – KOZUR & MOSTLER, p. 123, pl. 36, figs 9, 11.

Range and occurrence: *Tetraspinocyrtis laevis* Zone; Transdanubian Central Range (Felsőörs section) to Lower Ladinian (?); Panthalassa Ocean (Japan).

Genus *Nofrema* DUMITRICA et al., 1980
Type secies: *Nofrema trispinosa* DUMITRICA et al., 1980

Nofrema trispinosa DUMITRICA et al., 1980
Plate 15, Figures 10–19

1980 *Nofrema trispinosa* sp. nov. – DUMITRICA et al., p. 25, pl. 9, fig. 1; pl. 15, fig. 3.
1994 *Nofrema trispinosa* DUMITRICA et al. – KOZUR & MOSTLER, p. 120, pl. 34, figs 5–6, 10.

Remarks: Thanks to the good preservation of radiolarians from the Frötschbach section, our specimens somewhat differ from the holotype by having longer apical horn and feet and thorax continue in a very fragile segment composed of the latticed meshwork. Feet are divergent and connected to the thorax by thin bars.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone) to lower Fassanian (*Ladinocampe multiperforata* Zone); Southern Alps (Frötschbach section; Recoaro and Mt. Spitz).

Family Spongolophophaenidae KOZUR et MOSTLER, 1994
Genus *Triassospongocyrtis* KOZUR et MOSTLER, 1994
Type species: *Triassospongocyrtis longispinosa* KOZUR et MOSTLER, 1994

Triassospongocyrtis longispinosa KOZUR et MOSTLER, 1994
Plate 17, Figures 1–5

1994 *Triassospongocyrtis longispinosa* sp. nov. – KOZUR & MOSTLER, p. 127, pl. 39, figs 1–3, 6–7, 9.
1995 *Triassospongocyrtis longispinosa* KOZUR & MOSTLER – KELLICI & DE WEVER, p. 163, pl. 3, figs 7–9.
1995 *Triassospongocyrtis longispinosa* KOZUR & MOSTLER – RAMOVŠ & GORIČAN, p. 192, pl. 6, figs 8–10.

Range and occurrence: Upper Illyrian (*Spongosilicarmiger transitus* Zone) to lower Fassanian (*Ladinocampe multiperforata* Zone); Southern Alps.

Triassospongocyrtis yaoi KOZUR & MOSTLER, 1994
Plate 17, Figures 6–7

1994 *Triassospongocyrtis yaoi* sp. nov. – KOZUR & MOSTLER, p. 128, pl. 39, figs 5, 10.

Range and occurrence: *Spongosilicarmiger italicus* Zone (upper Illyrian) to lower Fassanian (*Ladinocampe multiperforata* Zone); Southern Alps (Frötschbach section), Balaton Highland (Köveskál section).

Triassospongocyrtis sp.
Plate 17, Figure 8

Remarks: This species differs from all other species of *Triassospongocyrtis* by having conical test, central position of apical spine and feet are directed downward close to the test. Inner layer of the test bears relatively large pores.
Range and occurrence: *Spongosilicarmiger italicus* Zone (upper Illyrian); Southern Alps (Frötschbach section).

Family Monicastericidae KOZUR et MOSTLER, 1994
Genus *Monicasterix* KOZUR et MOSTLER, 1994
Type species: *Monicasterix alpina* KOZUR et MOSTLER, 1994

?*Monicasterix* sp.
Plate 17, Figure 9

Remarks: Due to the poor preservation, this specimen could be tentatively assigned to the genus *Monicasterix.*
Range and occurrence: *Spongosilicarmiger italicus* Zone (upper Illyrian); Southern Alps (Frötschbach section).

Family Planispinocyrtidae KOZUR et MOSTLER, 1981
Genus *Planispinocyrtis* KOZUR et MOSTLER, 1981
Type species: *Planispinocyrtis baloghi* KOZUR et MOSTLER, 1981

Planispinocyrtis praecursor Kozur et Mostler, 1994
Plate 17, Figure 10

1994 *Planispinocyrtis praecursor* – Kozur & Mostler, p. 103, pl. 25, figs 7, ?13, 14.

Range and occurrence: Upper Illyrian (*Spongosilicarmiger transitus* Zone to *Spongosilicarmiger italicus* Zone); Hungarian Transdanubian Range (Felsőörs); Southern Alps (Frötschbach section).

Planispinocyrtis cf. *pelsoensis* Kozur & Mostler, 1994
Plate 17, Figure 11

cf. 1994 *Planispinocyrtis pelsoensis* – Kozur & Mostler, p. 100, pl. 25, fig. 12.

Remarks: This species is fairly similar to the *Planispinocyrtis pelsoensis* Kozur et Mostler, the base of tricarinate and downward directed spine which is probably a prolongation of V, although the illustrated specimen herein is somewhat shorter than the holotype.
Range and occurrence: *Spongosilicarmiger italicus* Zone (upper Illyrian); Southern Alps (Frötschbach section).

Genus *Ladinocampe* Kozur, 1984
Type species: *Ladinocampe multiperforata* Kozur, 1984

Ladinocampe annuloperforata Kozur et Mostler, 1994
Plate 17, Figures 12–15

1994 *Ladinocampe annuloperforata* sp. nov. – Kozur & Mostler, p. 92, pl. 22, fig. 2, 4–9; pl. 47, fig. 9.
2005 *Ladinocampe annuloperforata* Kozur & Mostler – Goričan et al., pl. 2, fig. 21.

Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone to *Ladinocampe multiperforata* Zone); Southern Alps (Frötschbach section), Ivanščica Mountains (Goričan et al., 2005).

Ladinocampe multiperforata Kozur, 1984
Plate 17, Figures 16–18

1984 *Ladinocampe multiperforata* sp. nov. – Kozur, p. 73, pl. 5, fig. 2.
1994 *Ladinocampe multiperforata* Kozur – Kozur & Mostler, p. 92, pl. 22, figs 3, 11–14; pl. 23, figs 1–2.

Remarks: This *Ladinocampe multiperforata* Kozur, 1984 is index species of the *Ladinocampe multiperforata* Zone (Kozur & Mostler, 1994), although the first appearance of this species is somewhat older (*Spongosilicarmiger italicus* Zone).
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone to *Ladinocampe multiperforata* Zone); Southern Alps.

Family Anisicyrtiidae Kozur et Mostler, 1981
Genus *Anisicyrtis* Kozur et Mostler, 1981
Type species: *Anisicyrtis hungarica* Kozur et Mostler, 1981

Anisicyrtis hungarica Kozur et Mostler, 1981
Plate 17, Figure 19

1981 *Anisicyrtis hungarica* sp. nov. – Kozur & Mostler, p. 105, pl. 13, fig. 2.
1994 *Anisicyrtis hungarica* Kozur et Mostler – Kozur & Mostler p. 78, pl. 17, figs 9–10; pl. 18, figs 1–4, 8.
2013 *Anisicyrtis hungarica* Kozur et Mostler – Celarc et al., fig. 9.23.

Remarks: Kozur & Mostler's holotype of this species is rather poorly preserved, although they published in 1994 a rich material from the same locality: Felsőörs, Balaton Highland, Hungary. Those specimens were fairly well preserved, therefore one of the most characteristic features is the small pointed spines on the cephalis and thorax in the extension of the spicular system and the first postabdominal segment which is significantly wider than others.
Range and occurrence: Upper Illyrian (*Tetraspinocyrtis laevis* Zone to *Spongosilicarmiger italicus* Zone); Balaton Highland (Frötschbach section), Southern Alps.

Anisicyrtis italica Kozur et Mostler, 1994
Plate 17, Figure 20

1994 *Anisicyrtis italica* sp. nov. – Kozur & Mostler, p. 80, pl. 19, figs 5, 7.
1994 *Anisicyrtis nodosa* sp. nov. – Kozur & Mostler, p. 81, pl. 19, figs ?3, 6, 8–9.
2012 *Anisicyrtis italica* Kozur & Mostler – Gawlick et al., pl. 19, figs 5, 7.

Remarks: *Anisicyrtis nodosa* Kozur et Mostler, 1994 and *A. italica* Kozur et Mostler, 1994 could be the same species, because there are no significant differences between these species, even though *A. italica* Kozur et Mostler, 1994 appeared in the *Spongosilicamiger italicus* Zone, whereas *A. nodosa* Kozur et Mostler, 1994 in the *Ladinocampe multiperforata* Zone, only. However, Kozur & Mostler (1994) pointed out clearly that *A. italica* Kozur et Mostler, 1994 is a forerunner species of *A. nodosa* Kozur et Mostler, 1994 but differences were not clearly highlighted.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone to *Ladinocampe multiperforata* Zone); Southern Alps, Dinarides (Montenegro).

Anisicyrtis recoaroensis Kozur et Mostler, 1994
Plate 17, Figure 21

1990 *Anisicyrtis* sp. A – Goričan & Buser, p. 140, pl. 12, fig. 10 (only).
1994 *Anisicyrtis recoaroensis* sp. nov. – Kozur & Mostler, p. 83, pl. 20, figs 3–5.

Remarks: First postabdominal segment is separated by a characteristic narrow ring from the abdomen and from the second postabdominal segment which is significantly longer than previous segments. Short spines on the thorax and abdomen are also characteristic features.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone to *Ladinocampe multiperforata* Zone); Southern Alps.

Anisicyrtis spinosa Kozur et Mostler, 1994
Plate 17, Figures 22–23

1994 *Anisicyrtis spinosa* sp. nov. – Kozur & Mostler, p. 84, pl. 19, figs 11–14.

Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone to *Ladinocampe multiperforata* Zone); Southern Alps.

Anisicyrtis trettoensis Kozur et Mostler, 1994
Plate 17, Figures 24–25

1994 *Anisicyrtis trettoensis* sp. nov. – Kozur & Mostler, p. 85, pl. 19, figs 10, 15; pl. 20, figs 1–2.

Remarks: Characteristic larger and inflated abdomen which is significantly wider than other segments.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone to *Ladinocampe multiperforata* Zone); Southern Alps.

Family Gradinariidae Dumitrica, 2017
Genus: *Gradinaria* Dumitrica, 2017
Type species: *Tetraspinocyrtis fassanica* (Kozur et Mostler, 1994)

Gradinaria fassanica (Kozur et Mostler, 1994)
Plate 18 Figure 1

1994 *Tetraspinocyrtis fassanica* sp. nov. – Kozur & Mostler, p. 131, pl. 40, fig. 7, 9, 11.
2017 *Gradinaria fassanica* (Kozur et Mostler) – Dumitrica, p. 21, fig. 1; pl. 7, figs 5–11.

Remarks: Poorly preserved species, however characteristic globular cephalis with hollow apical horn and three three-bladed spines which are arranged 120° from each other.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone to *Ladinocampe multiperforata* Zone); Southern Alps.

Family Ruesticyrtiidae Kozur et Mostler, 1979
Genus: *Pararuesticyrtium* Kozur et Mostler, 1981
Type species: *Pararuesticyrtium denisporatum* Kozur et Mostler, 1981

Pararuesticyrtium constrictum Kozur et Mostler, 1994
Plate 18, Figures 2–3

1994 *Pararuesticyrtium constrictum* sp. nov. – Kozur & Mostler, p. 108, pl. 28, figs 7–8.

Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone to *Ladinocampe multiperforata* Zone); Southern Alps.

Pararuesticyrtium eofassanicum Kozur et Mostler, 1994
Plate 18, Figures 4–5

1994 *Pararuesticyrtium eofassanicum* sp. nov. – Kozur & Mostler, p. 109, pl. 28, figs 5–6, 10, 12; pl. 43, fig. ?13.
2004 *Pararuesticyrtium eofassanicum* Kozur & Mostler – Hori, pl. 9, fig. 26.
2005 *Pararuesticyrtium* sp. – Goričan et al., pl. 2, fig. 17–18.

Range and occurrence: *Triassocampe deweveri* Zone (TR2C in Sugiyama, 1997) which is equivalent to *Spongosilicarmiger transitus* and *Spongosilicarmiger italicus* Zones of Western Tethyan radiolarian zonation; Cosmopolitan.

Pararuesticyrtium fusiformis (Bragin, 1986)
Plate 18, Figure 6

1986 *Triassocampe fusiformis* sp. nov. – Bragin, p. 74, pl. 3, fig. 3.
2001 *Pararuesticyrtium fusiformis* (Bragin) – Hauser et al., pl. 2, fig. 41.

Remarks: This form is widening until the middle part of the test, but distally narrows.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone) to Carnian (Bragin, 1896); Cosmopolitan.

Pararuesticyrtium trettoense Kozur et Mostler, 1994
Plate 18, Figure 7

1994 *Pararuesticyrtium trettoense* sp. nov. – Kozur & Mostler, p. 110, pl. 43, fig. 14.
2008 *Pararuesticyrtium* sp. cf. *P. trettoense* Kozur & Mostler – Saesaengseerung et al., p. 406, fig. 8.23.

Remarks: In the description of this species by Kozur & Mostler (1994), there is the following sentence: "The width of the postabdominal segments increases gradually until the fourth postabdominal segment." Specimens from the Frötschbach section provide two different morphotypes, one of them fits perfectly the original description, although the abdomen and postabdominal segments have the same sizes, whereas one of the other specimens shows a gradual increasing of the segments until only the second or third segments, subsequently became narrower.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone to *Ladinocampe multiperforata* Zone); Southern Alps, Northern Thailand (?).

Genus *Paratriassocampe* Kozur et Mostler, 1994
Type species: *Paratriassocampe gaetanii* Kozur et Mostler, 1994

Paratriassocampe gaetanii Kozur et Mostler, 1994
Plate 18, Figure 8

1994 *Paratriassocampe gaetanii* sp. nov. – Kozur & Mostler, p. 135, pl. 42, figs 7, 8, ?9, 10, 11.
2008 *Paratriassocampe* sp. cf. *P. gaetanii* Kozur & Mostler – Thassanapak, p. 132, pl. 2, fig. 10.

Range and occurrence: Pelsonian from the Cristian section, Romania to upper Illyrian (*Ladinocampe multiperforata* Zone) in the Southern Alps and Northern Thailand (?).

Genus *Striatotriassocampe* Kozur et Mostler, 1994
Type species: *Striatotriassocampe nodosoannulata* Kozur et Mostler, 1994

Striatotriassocampe laeviannulata Kozur et Mostler, 1994
Plate 18, Figure 9

1994 *Striatotriassocampe laeviannulata* sp. nov. – Kozur & Mostler, p. 139, pl. 43, figs 3, 7, 8.
2016 *Striatotriassocampe laeviannulata* Kozur & Mostler – Tekin et al., pl. 3, figs 23–25.

Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone to *Ladinocampe multiperforata* Zone); Southern Alps. Similar species has been published from the lower Longobardian of Oman (*Striatotriassocampe* cf. *laeviannulata* in Hauser et al., 2001).

Genus *Annulotriassocampe* Kozur et Mostler, 1994
Type species: *Annulotriassocampe baldii* Kozur et Mostler, 1994

Annulotriassocampe campanilis campanilis
Kozur et Mostler, 1994
Plate 18, Figures 10–11

1994 *Annulotriassocampe campanilis* sp. nov. – Kozur & Mostler, p. 132, pl. 41, figs 9–11.
1999 *Annulotriassocampe campanilis* Kozur et Mostler – Sashida et al., p. 781, figs 10.7–9, 10.14.
2001 *Annulotriassocampe campanilis* Kozur et Mostler – Feng et al., p. 178, pl. 1, figs 8–12.
2005 *Annulotriassocampe campanilis* Kozur et Mostler – Goričan et al., pl. 2, fig. 31.
2016 *Annulotriassocampe campanilis* Kozur et Mostler – Tekin et al., pl. 3, figs 20–21.

Range and occurrence: *Tetraspinocyrtis laevis* Zone to *Spongosilicarmiger italicus* Zone (*Spongosilicarmiger italicus* Zone): Western Neotethys (Transdanubian Central Range, Hungary; Mid-Transdanubian Zone, Ivanščica, Croatia; Mersin Mélnage, Turkey) to the Eastern sectors of Neotethys (West Timor, Indonesia); Paleotethys (Thailand).

Annulotriassocampe campanilis longiporata
Kozur et Mostler, 1994
Plate 18, Figure 12

1994 *Annulotriassocampe campanilis longiporata* – Kozur et Mostler, p. 132, pl. 41, figs 1–4, 7, 13, 15–18.
2020 *Annulotriassocampe campanilis* – Slovenec et al., fig. 10.6.

Range and occurrence: *Tetraspinocyrtis laevis* Zone to *Spongosilicarmiger italicus* Zone: Western Neotethys (Transdanubian Central Range, Hungary; Mid-Transdanubian Zone, Ivanščica, Croatia).

Annulotriassocampe spinosa Kozur et Mostler, 1994
Plate 18, Figure 13

1994 *Annulotriassocampe spinosa* sp. nov. – Kozur et Mostler, p. 133, pl. 41, figs. 5–6, 8, 12.

Remarks: Our specimens wear somewhat smaller apical and vertical horns compared to the Kozur & Mostler's holotype from the San Ulderico-Pallé road cut in Tretto.
Range and occurrence: Pelsonian in the Cristian section, Romania to upper Illyrian (*Ladinocampe multiperforata* Zone) in the Southern Alps.

Genus *Triassocampe* Dumitrica et al., 1980
Type species: *Triassocampe scalaris* Dumitrica et al., 1980

Triassocampe deweveri deweveri (Nakaseko et Nishimura, 1979)
Plate 18, Figure 14

1979 *Dictyomitrella deweveri* sp. nov. – Nakaseko & Nishimura, p. 77, pl. 10, figs 8–9.
1982 *Triassocampe* sp. A – Mizutani & Koike, p. 128, pl. 4, figs 3, 5.
1982 *Triassocampe* sp. B – Kishida & Sugano, p. 286, pl. 4, fig. 19.
1982 *Triassocampe* sp. H – Yao, p. 64, pl. 1, figs. 8–9.
1984 *Triassocampe deweveri* (Nakaseko et Nishimura) – Ishida, p. 26, pl. 1, figs 10–12.
1986 *Triassocampe deweveri* (Nakaseko et Nishimura) – Kozur & Réti, p. 288, fig. 5E.
1989 *Triassocampe deweveri* (Nakaseko et Nishimura) – Cheng, p. 148, pl. 6, figs 13–14; pl. 7, figs 10–11.
1989 *Triassocampe deweveri* (Nakaseko et Nishimura) – Martini et al., pl. 1, fig. 2.
1990 *Triassocampe deweveri* (Nakaseko et Nishimura) – Yeh, p. 28, pl. 7, figs.7, 18, 20; pl. 11, figs 2–3, 7–8, 13–14.
1993 *Triassocampe deweveri* (Nakaseko et Nishimura) – Feng & Liu, p. 547, pl. 3, figs 1–4.
1994 *Triassocampe deweveri* (Nakaseko et Nishimura) – Kozur & Mostler, p. 140, pl. 42, fig. 1; pl. 44, fig. 14; pl. 45, fig. 6.
1995 *Triassocampe deweveri* (Nakaseko et Nishimura) – Ramovš & Goričan, p. 192, Pl. 7, figs 13–14.
2001 *Triassocampe deweveri* (Nakaseko et Nishimura) – Feng et al., p. 182, pl. 3, figs 1–6.
2005 *Triassocampe deweveri* (Nakaseko et Nishimura) – Goričan et al., figs 25–28.
2006 *Triassocampe deweveri* (Nakaseko et Nishimura) – Marquez et al., pl. 2, fig. 21.
2007 *Triassocampe deweveri* (Nakaseko et Nishimura) – Saesaengseerung et al., fig. 8.7.
2007 *Triassocampe deweveri* (Nakaseko et Nishimura) – Onoue & Sano, fig. 5.9
2008 *Triassocampe deweveri* (Nakaseko et Nishimura) – Saesaengseerung et al., figs 8.1–3.
2008 *Triassocampe deweveri* (Nakaseko et Nishimura) – Thassanapak, p. 135, pl. 5, figs 11–14.
2008 *Triassocampe deweveri* (Nakaseko et Nishimura) – Kojima et al., figs 5.16–17.
2009 *Triassocampe deweveri* (Nakaseko et Nishimura) – Feng et al., p. 597, figs 7.1–4.
2010 *Triassocampe deweveri* (Nakaseko et Nishimura) – Tekin et al., figs 8U–V.
2010 *Triassocampe deweveri* (Nakaseko et Nishimura) – Sano et al., fig. 6.16.
2011 *Triassocampe deweveri* (Nakaseko et Nishimura) – Thassanapak, figs 8I, J, L.
2012 *Triassocampe deweveri* (Nakaseko et Nishimura) – Gawlick et al., pl. 1, fig. 21.
2013 *Triassocampe deweveri* (Nakaseko et Nishimura) – Nakae, p. 95, pl. 3, figs 12–13.
2013 *Triassocampe deweveri* (Nakaseko et Nishimura) – Celarc et al., fig. 9.27.
2014 *Triassocampe deweveri* (Nakaseko et Nishimura) – Kamata et al., pl. 3, fig. 34.

2016 *Triassocampe deweveri* (Nakaseko et Nishimura) – Tekin et al., pl. 3, figs 32–34.
2020 *Triassocampe deweveri* (Nakaseko et Nishimura) – Slovenec et al., fig. 10.4–5.

Range and occurrence: Upper Illyrian (*Spongosilicarmiger transitus* Zone to *Muelleritortis firma* Zone); Cosmopolitan, Yeh (1990) reported this species from the Busuanga Island, Philippines where it occurrences together with all *Capnuchosphaera* species, which are obviously appeared in the Carnian period. However, Yeh referred this species range also the Middle Triassic.

Triassocampe deweveri pauciconstricta Kozur & Mostler, 1994
Plate 18, Figure 15

1994 *Triassocampe deweveri pauciconstricta* n. subsp. – Kozur & Mostler, p. 141, pl. 44, fig. 14.

Remarks: The test is characteristically spindle-shaped and the first three or four postabdominal segments wear irregularly arranged and slightly elevated nodes. The following segments are wide and wear relatively large nodes arranged in a ring between two segments. Pores are arranged in regular rows.
Range and occurrence: *Tetraspinocyrtis laevis* Zone to the *Spongisilicarmiger italicus* Zone; Southern Alps, Transdanubian Central Range, Hungary.

Triassocampe scalaris Dumitrica et al., 1980
Plate 18, Figures 16–18

1980 *Triassocampe scalaris* sp. nov. – Dumitrica et al., p. 26, pl. 9, figs 5–6, 11; pl. 14, fig. 2.
1982 *Triassocampe scalaris* Dumitrica et al. – Mizutani and Koike, pl. 4, fig. 4.
1982 *Triassocampe deweveri* (Nakaseko et Nishimura) – Yao et al., p. 37, pl. 1, fig. 1.
1990 *Triassocampe scalaris* Dumitrica et al. – Goričan & Buser, p. 159, pl. 12, figs 2–3.
1990 *Triassocampe scalaris* Dumitrica et al. – Yeh, p. 29, pl. 7, figs 9, 19; pl. 11, fig. 6.
1994 *Triassocampe scalaris* Dumitrica et al. – Kozur & Mostler, p. 145, pl. 44, figs 1–6, 10–12; pl. 45, figs 1–2; pl. 47, figs 2–3.
1999 *Triassocampe scalaris* Dumitrica et al. – Tekin, p. 170, pl. 41, fig. 10.
2001 *Triassocampe scalaris* Dumitrica et al. – Feng et al., p. 182, pl. 3, fig. 14–16.
2001 *Triassocampe scalaris* Dumitrica et al. – Hauser et al., pl. 2, fig. 40.
2003 *Triassocampe scalaris* Dumitrica et al. – Feng et al., p. 225, pl. 2, fig. 9.
2005 *Triassocampe scalaris* Dumitrica et al. – Goričan et al., pl. 2, fig. 29.
2006 *Triassocampe scalaris* Dumitrica et al. – Marquez et al., pl. 5, fig. 27.
2007 *Triassocampe scalaris* Dumitrica et al. – Tekin and Göncüoglu, pl. 4, figs 7–8.
2008 *Triassocampe scalaris* Dumitrica et al. – Thassanapak, p. 136, pl. 6, figs 6–9.
2008 *Triassocampe* cf. *scalaris* Dumitrica et al. – Saesaengseerung et al., fig. 8.4.
2009 *Triassocampe scalaris* Dumitrica et al. – Feng et al., figs 7.5–7.
2011 *Triassocampe scalaris* Dumitrica et al. – Thassanapak et al., fig. 8M.
2012 *Triassocampe* cf. *scalaris* Dumitrica et al. – Gawlick et al., pl. 1, figs 7–8.
2012 *Triassocampe scalaris* Dumitrica et al. – Tekin et al., fig. 5x.
2016 *Triassocampe scalaris* Dumitrica et al. – Tekin et al., pl. 3, figs 35–37.
2020 *Triassocampe scalaris* Dumitrica et al. – Slovenec et al., figs 10.2–3.

Range and occurrence: Upper Illyrian (*Tetraspinocyrtis laevis* Zone) to Longobardian (*Muelleritortis cochleata* Zone): Western Neotethys (Southern Alps; Julian Alps; Transdanubian Central Range, Hungary; High Karst, Montenegro; Izmir-Ankara zone, Turkey); Upper Triassic (Carnian?): Eastern Neotethys (West Sichuan, China), although from several localities were reported from the from Tibet (Feng et al., 2009) and Busuanga Island, Philippines (Yeh, 1990).

Triassocampe sp.
Plate 18, Figure 19

Description: This species has globular, smooth and poreless cephalis. Thorax and abdomen hardly visible but very small pore ring run between these segments. Postabdominal segments are somewhat highly elevated and wear a proximal nodose ring and three rings of pores. From the fifth postabdominal segment, these proximal nodose rings became larger, significantly stronger and more characteristic. These segments display distally a significantly wider, smooth and poreless ring.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps (Frötschbach section).

Genus *Yeharaia* Nakaseko et Nishimura, 1979
Type species: *Yeharaia elegans* Nakaseko et Nishimura, 1979

Yeharaia annulata Nakaseko et Nishimura, 1979
Plate 18 Figures 20–21

1979 *Yeharaia annulata* sp. nov. – Nakaseko & Nishimura, p. 82, pl. 10, figs 1, 7; pl. 12, fig. 5.
1982 *Yeharaia annulata* Nakaseko et Nishimura – Kido, pl. 1, fig. 10.
1982 *Yeharaia annulata* Nakaseko et Nishimura – Kojima, pl. 2, fig. 5.
1982 *Triassocampe* ? *annulata* (Nakaseko et Nishimura) – Yao, pl. 1, fig. 11.
1982 *Triassocampe* ? *annulata* (Nakaseko et Nishimura) – Yao et al., pl. 1, fig. 8.
1990 *Yeharaia annulata* Nakaseko et Nishimura – Goričan & Buser, p. 161, pl. 12, fig. 6.
1994 *Yeharaia annulata* Nakaseko et Nishimura – Kozur & Mostler, p. 147, pl. 46, figs 6–11, 13; pl. 47, figs 4–5.
1995 *Yeharaia annulata* Nakaseko et Nishimura – Kellici & De Wever, p. 163, pl. 6, figs 16–18.
2004 *Spinotriassocampe annulata* (Nakaseko et Nishimura) – Hori, pl. 3, figs 55–56; pl. 6, figs 66–67; pl. 7, figs 47–48.; pl. 8, fig. 29.
2005 *Yeharaia annulata* Nakaseko et Nishimura – Goričan et al., pl. 2, fig. 23.
2008 *Yeharaia annulata* Nakaseko et Nishimura – Thassanapak, p. 139, pl. 6, fig. 10.

2011 *Yeharaia annulata* Nakaseko et Nishimura – Thassanapak, fig. 8V.
2016 *Yeharaia annulata* Nakaseko et Nishimura – Tekin, pl. 4, only fig. 2.

Range and occurrence: *Silicarmiger transitus* Zone to *Ladinocampe multiperforata* Zone; Cosmopolitan.

Yeharaia bispinosa Ozsvárt sp. nov.
Plate 18, Figures 22–24

Etymology: According to its bifurcated apical horn.
Holotype: Plate 18, Figure 22; Hungarian Natural History Museum, Budapest: PAL 2022.132.1.
Studied material: Two specimens from the Frötschbach section.
Description: Multicyrtid test with eight or more segments. Cephalis small, hemispherical, smooth and poreless. Apical horn bifurcated; each spine approximately 50–75 µm in length, straight and smooth. Thorax somewhat broader than cephalis, inflated, ring-shaped, poreless. Abdomen similar to thorax in shape but distinctly broader, smooth, poreless. Postabdominal segments differ in shape significantly; all of them trapezoidal with distinct proximal rings with characteristic pore rings. Deep strictures present between posabdominal segments, last segment contains relatively long, cylindrical skirt with sharp edge.
Dimensions: Length of test 275–380 µm, width of test 100–120 µm.
Remarks: *Yeharaia bispinosa* sp. nov. differs from all other species of *Yeharaia* by the bifurcated apical horn.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps (Frötschbach section).

Yeharaia trispinosa Ozsvárt sp. nov.
Plate 18, Figure 25

Etymology: According to its trifurcated apical horn.
Holotype: Plate 18, Figure 25; Hungarian Natural History Museum, Budapest: PAL 2022.133.1.
Studied material: Single specimen from the Frötschbach section.
Description: Multicyrtid test (length 160 µm, width 100 µm), conical in side view. Cephalis small, conical with trifurcated apical horn. Three spines equal in length; approximately 70–90 µm in length. Thorax and abdomen inflated, poreless; abdomen somewhat broader than thorax. Postabdominal segments trapezoidal, their size is growing gradually towards distal part. Characteristic proximal ring present on each segment with large circular pore ring and smooth, relatively wide, poreless stricture.
Remarks: *Yeharaia trispinosa* sp. nov. differs from the *Y. bispinosa* sp. nov. by the trifurcated apical horn and significantly larger pore ring.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone); Southern Alps (Frötschbach section).

Yeharaia transita Kozur & Mostler, 1994
Plate 18, Figure 26

1994 *Yeharaia transita* sp. nov. – Kozur & Mostler, p. 148, pl. 46, figs 1–4, 12

Range and occurrence: Upper Illyrian *Spongosilicarmiger italicus* Zone; Southern Alps (Frötschbach section).

Yeharaia sp.
Plate 18, Figures 27–28

cf. 1979 *Yeharaia elegans* sp. nov. – Nakaseko & Nishimura, p. 82, pl. 10, figs 2–5.
cf. 1991 *Yeharaia bulbosa* sp. nov. – Bragin, p. 104, pl. 4, fig. 13.

Remarks: This species is similar to *Y. elegans* Nakaseko et Nishimura, 1979, but this specimen has fewer pores on the cephalis, unfortunately, the apical horn is almost completely broken. *Y. bulbosa* Bragin, 1991 resembles this species, although the illustrated holotype is rather poor quality, but the base on the characteristic bigger cephalis makes it similar to the *Y. bulbosa.* However, it is also possible that this is a new species. The cephalic spicular system is very fragile with needle-like spines with Mb, A, slightly curved V, 2L, D and 2l. The apical horn is robust and tricarinate, although badly damaged. The thorax is somewhat smaller than the cephalis, but it composes the same spongy material. The abdomen has a strong, smooth, highly elevated collar and all postabdominal segments wear a similar collar and they are similar in shape. Postabdominal segments wear characteristic pore rings.
Range and occurrence: Upper Illyrian (*Spongosilicarmiger italicus* Zone) to ?Ladinian (Nakaseko & Nishimura, 1979; Bragin, 1991); Southern Alps (Frötschbach section), ?Southwest Japan and Pacific region.

Genus *Pseudotriassocampe* Kozur et Mostler, 1994
Type species: *Pseudotriassocampe hungarica* Kozur et Mostler, 1994

Pseudotriassocampe myterocorys (Sugiyama, 1992)
Plate 18, Figure 29

1992 *Triassocampe myterocorys* sp. nov. – Sugiyama, p. 1198, figs 11.1–3b.
1994 *Pseudotriassocampe angustiannulata* sp. nov. – Kozur & Mostler, p. 137, pl. 43, fig. 2.
2000 *Triassocampe myterocorys* Sugiyama – Sashida et al, p. 807, figs 9.2–5.
2001 *Triassocampe myterocorys* Sugiyama – Feng et al., p. 180, pl. 2, figs 16–17.
2011 *Triassocampe myterocorys* Sugiyama – Thassanapak et al., p. 198, fig. 8K.
2013 *Pseudotriassocampe myterocorys* (Sugiyama) – Celarc et al., fig. 9.25–26.

Remarks: Unfortunately, the holotype and paratypes of *T. myterocorys* (Sugiyama) are poorly preserved, but the characteristic apical horn is present in all types. *P. angustiannulata* Kozur et Mostler, 1994 is definitely the same; therefore, it is a junior synonym of Sugiyama's species.
Range and occurrence: *Tetraspinocyrtis laevis* Zone to *Spongosilicarmiger italicus* Zone; Cosmopolitan: Southern Alps, Transdanubian Central Range, Hungary, Southern China, Northern Thailand, Japan.

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PLATE 1

Figs 1–2. *Pentactinocarpus acanthicus* DUMITRICA, 1978a, 1–2: Sample FB-R.
Fig. 3. *Pentactinocapsa quadripes* DUMITRICA, 1978a, Sample FB.
Fig. 4. *Pentactinorbis kozuri* DUMITRICA, 1978a, Sample FB.
Fig. 5. *Pentactinorbis* cf. *mostleri* DUMITRICA, 1978a, Sample FB-R.
Fig. 6. *Eptingium manfredi* DUMITRICA, 1978b, Sample FB-R.
Figs 7–8. *Eptingium ramovsi* KOZUR et al., 1996, 7–8: Sample FB-R.
Figs 9–10. *Spongostephanidium japonicum* (NAKASEKO et NISHIMURA, 1979), 9: Sample FB, 10: Sample FB-R.
Figs 11–12. *Spongostephanidium brevispinosum* sp. nov., 11: Sample FB, 12: Holotype - PAL 2022.130.1, Sample FB-R.
Fig. 13. *Spongostephanidium* sp. cf. *spongiosum* DUMITRICA, 1978b, Sample FB-R.
Fig. 14. *Triassistephanidium* sp., Sample FB.
Fig. 15 *Beturiella latispinosa* sp. nov., Holotype - PAL 2022.115.1., Sample FB.

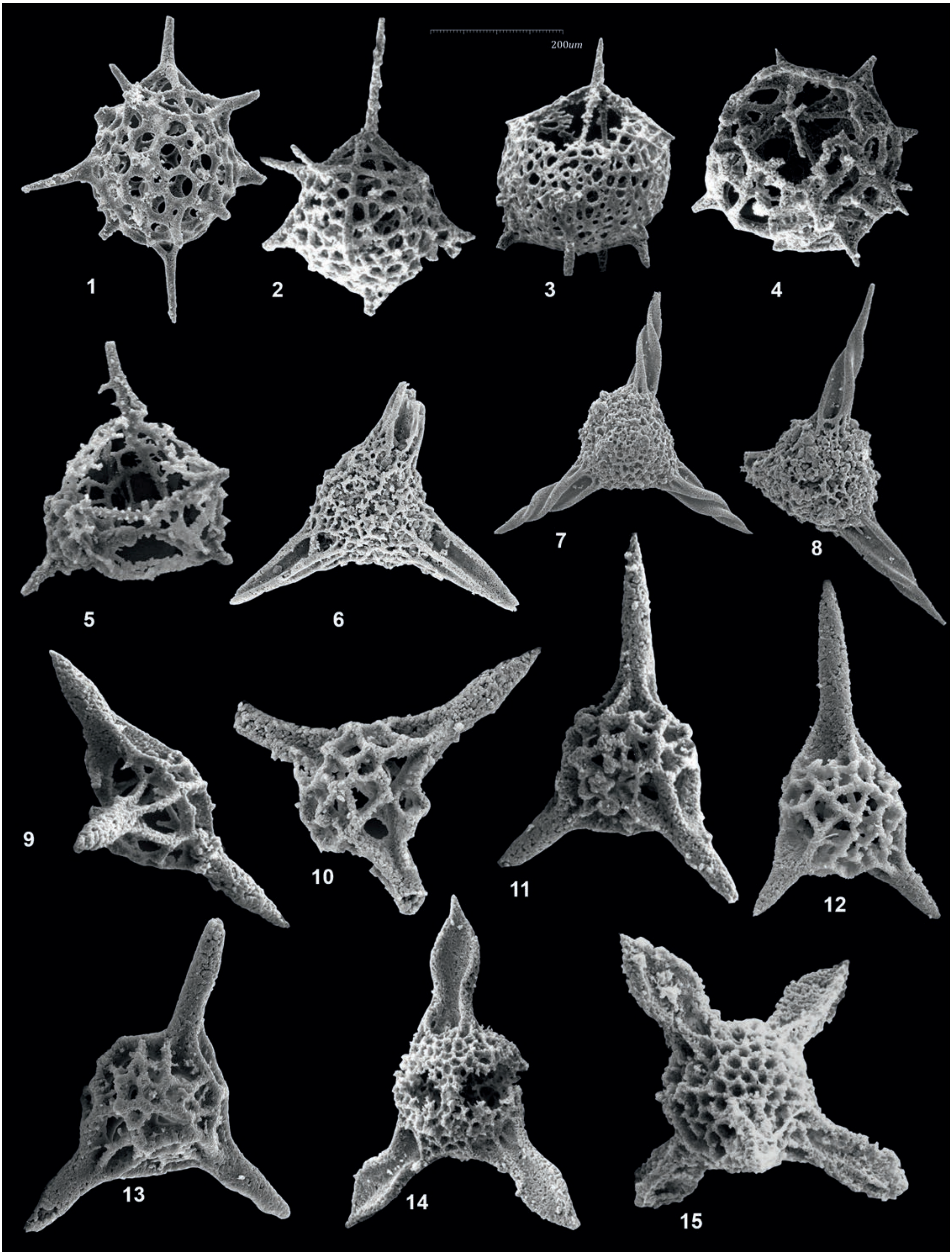
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PLATE 2

Fig. 1. *Tiborella florida austriaca* KOZUR et al., 1996, Sample FB.
Fig. 2. *Tiborella magnidentata* DUMITRICA et al., 1980, Sample FB-R.
Fig. 3. *Welirella fleuryi* (DE WEVER, 1979), Sample FB-R.
Fig. 4. *Welirella mesotriassica* KOZUR et al., 1996, Sample FB-R.
Figs 5–7. *Pseudostylosphaera acrior* (BRAGIN, 1986), 5: Sample FB-R. 6–7: Sample FB-R.
Figs 8–9. *Pseudostylosphaera canaliculata* (BRAGIN, 1986), 8: Sample Se1, 9: Sample FB-R.
Figs 10–11. *Pseudostylosphaera compacta* (NAKASEKO et NISHIMURA, 1979), 10–11: Sample FB-R.
Fig. 12–13. *Pseudostylosphaera* sp. cf. *compacta* (NAKASEKO et NISHIMURA, 1979), 12: Sample FB, 17: Sample FB-R.
Fig. 14. *Pseudostylosphaera longispinosa* KOZUR et MOSTLER, 1981, Sample FB-R.
Figs 15–16. *Pseudostylosphaera mostleri* TEKIN, 2007, 13–14: Sample FB-R.
Fig. 17. *Pseudostylosphaera nazarovi* (KOZUR et MOSTLER, 1981), Sample A26.
Fig. 18. *Spinostylosphaera* ? *vachardi* OZSVÁRT, MOIX et KOZUR, 2015, Sample A26.

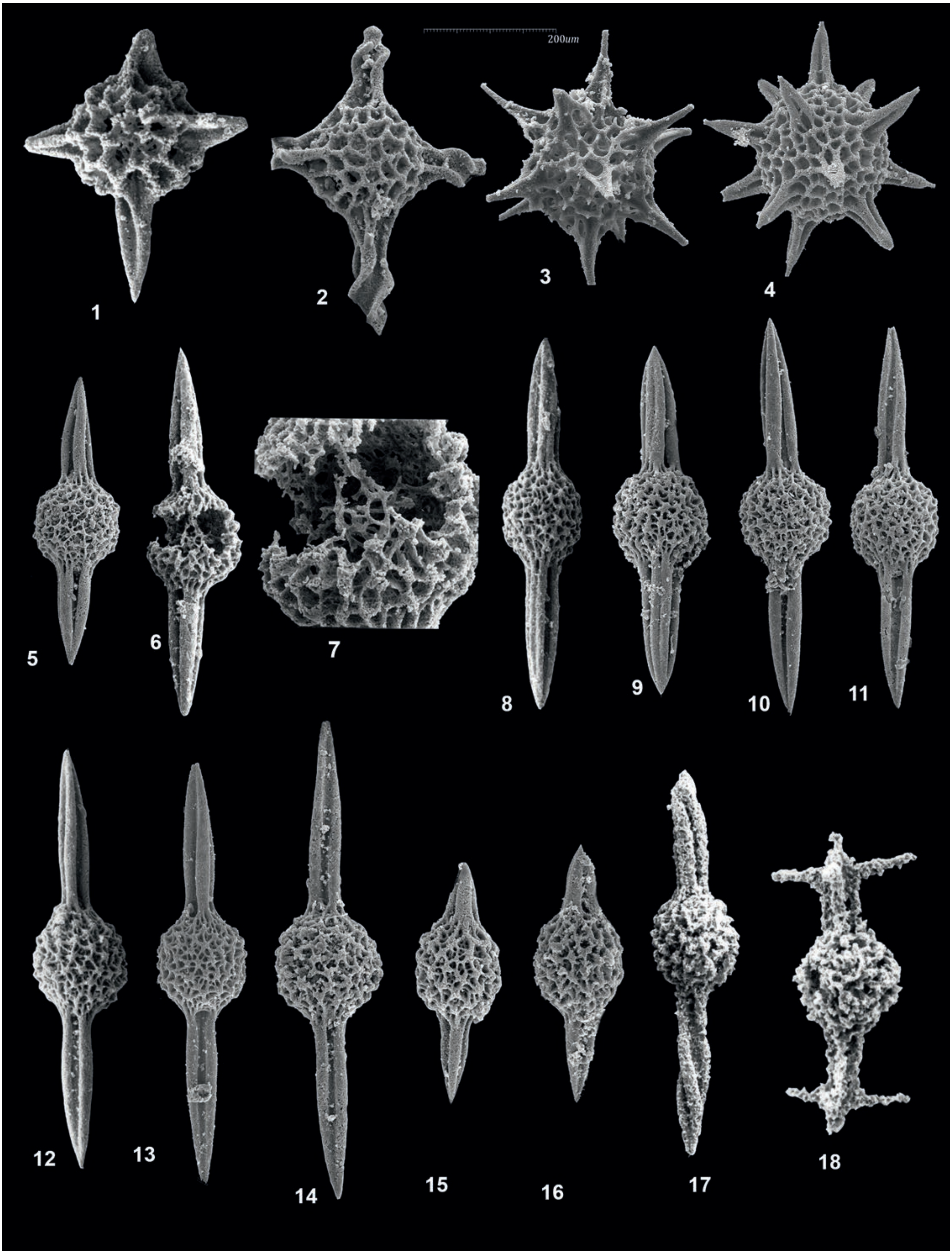
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PLATE 3

Fig. 1. *Parasepsagon praetetracanthus* KOZUR et MOSTLER, 1994, Sample FB-R.
Fig. 2. *Parasepsagon* sp. cf. *tetracanthus* DUMITRICA et al., 1980, Sample FB-R.
Fig. 3. *Sepsagon ladinicus* KOZUR et MOSTLER, 1994, Sample FB-R.
Figs 4a–b. *Sepsagon recoarensis* LAHM, 1984, Sample FB-R.
Fig. 5. *Sepsagon* sp. cf. *robustus* LAHM, 1984, Sample A26.
Figs 6–8. *Bernoulliella simplex* (LAHM, 1984), 6–8: Sample FB-R.
Figs 9–10. *Bernoulliella* sp. cf. *simplex* (LAHM, 1984), 9–10: Sample FB-R.
Figs 11–12. *Eohexastylus muzavori* (LAHM, 1984), 11–12: Sample FB.
Fig. 13. *Parentactinia pugnax* DUMITRICA, 1978a, Sample FB.
Figs 14–15. *Parentactinia kecskemetii* sp. nov., Holotype - PAL 2022.123.1., Sample FB-R.

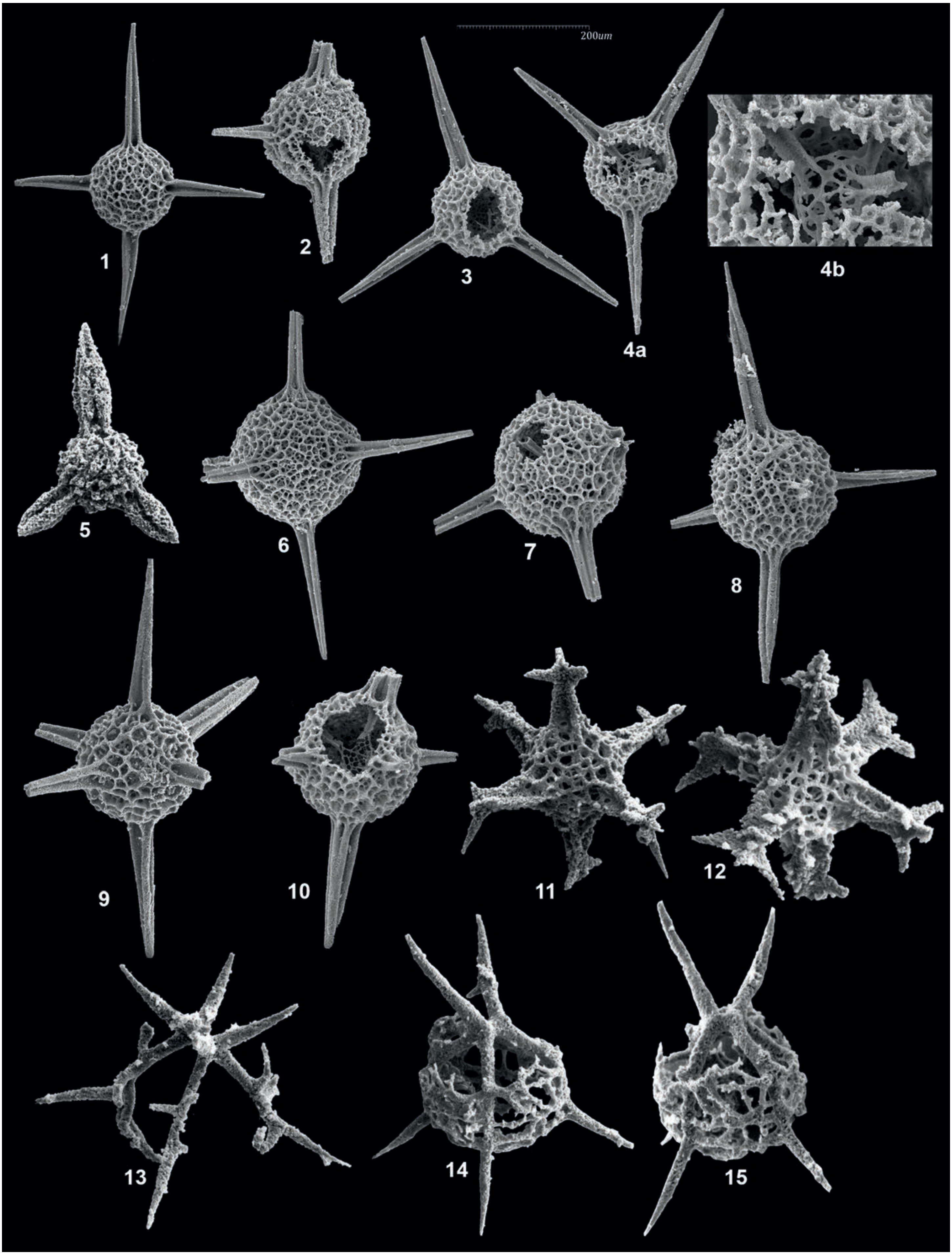
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PLATE 4

Fig. 1. *Muelleritortis globosa* TEKIN, 2010, Sample FB-R.
Figs 2–3. *Triassothamnus verticillatus* (DUMITRICA, 1978a), 2–3: Sample FB-R.
Figs 4–6. *Heptacladus crassispinus* DUMITRICA et al., 1980, 4, 6: Sample FB-R., 5: Sample FB.
Figs 7–10. *"Entactinosphaera" stockari* sp. nov. 8: Holotype - PAL 2022.116.1., Sample FB.
Fig. 11. *"Entactinosphaera"* ? *triassica* KOZUR et MOSTLER, 1979, Sample FB-R.
Figs 12–14. *"Entactinosphaera" zapfei* KOZUR et MOSTLER, 1979, 12–14: Sample FB.
Fig. 15. *Hexatortilisphaera aequispinosa* KOZUR et al., 1996, Sample FB.
Fig. 16. Entactinarian genus and species indeterminate A., Sample FB-R.

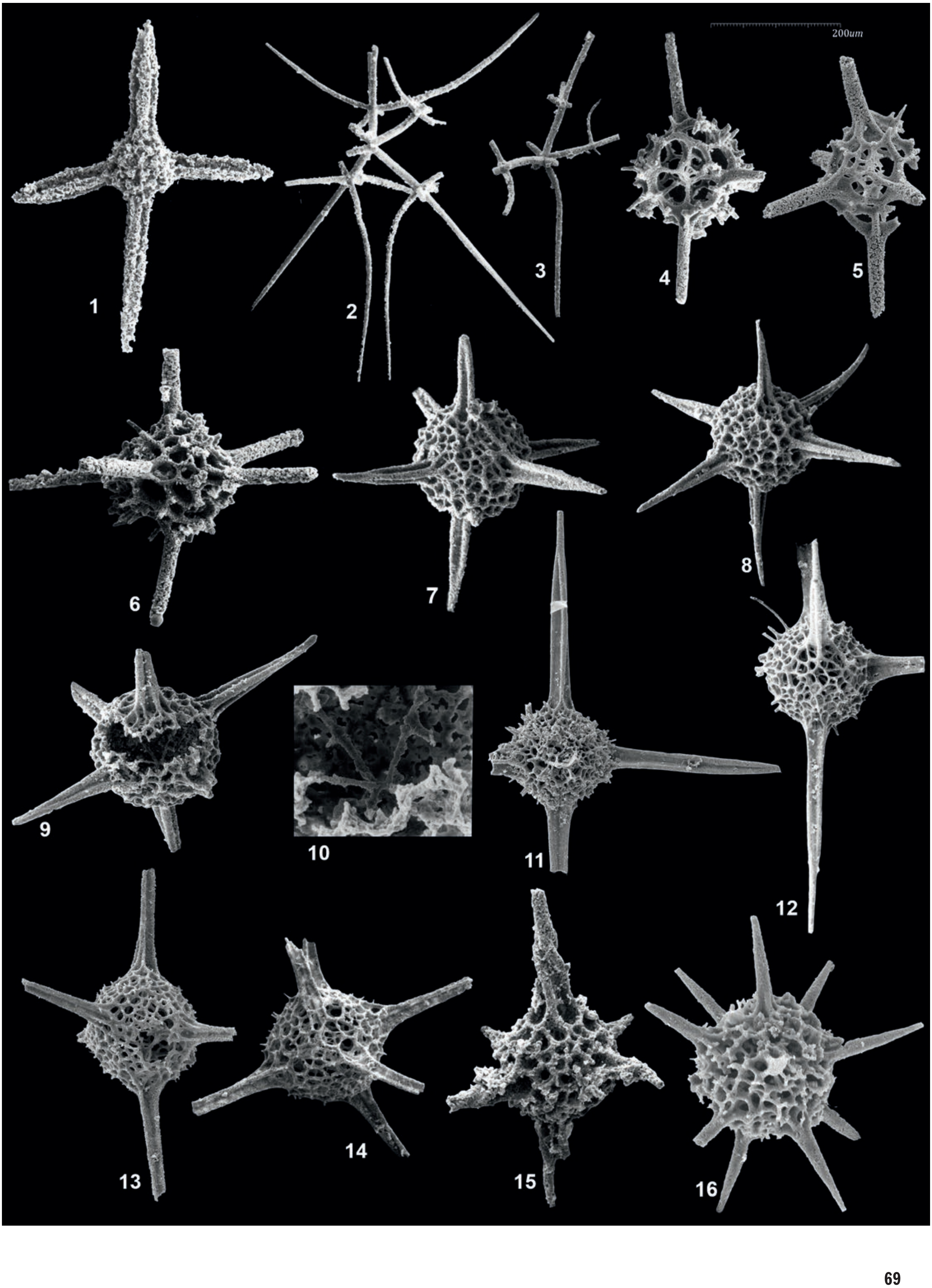
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PLATE 5

Figs 1–2. *Archaeocenosphaera igoi* (SASHIDA, 2000), Sample FB.
Figs 3–4. *Archaeocenosphaera parvispinosa* (KOZUR et al., 1996), 3–4: Sample FB-R.
Fig. 5. *Novamuria mocki* (KOZUR et MOSTLER, 1979), Sample FB-R.
Fig. 6. *Novamuria nicorae* (KOZUR et al., 1996), Sample FB-R.
Figs 7–9. *Novamuria wirzi* STOCKAR et al., 2012b, 7–9: Sample FB-R.
Figs 10–12. *Katorella bifurcata* KOZUR et MOSTLER, 1981, 10–12: Sample FB-R.
Figs 13–16. *Katorella trifurcata* KOZUR et MOSTLER, 1994, 13–15: Sample FB-R., 16: Sample FB.

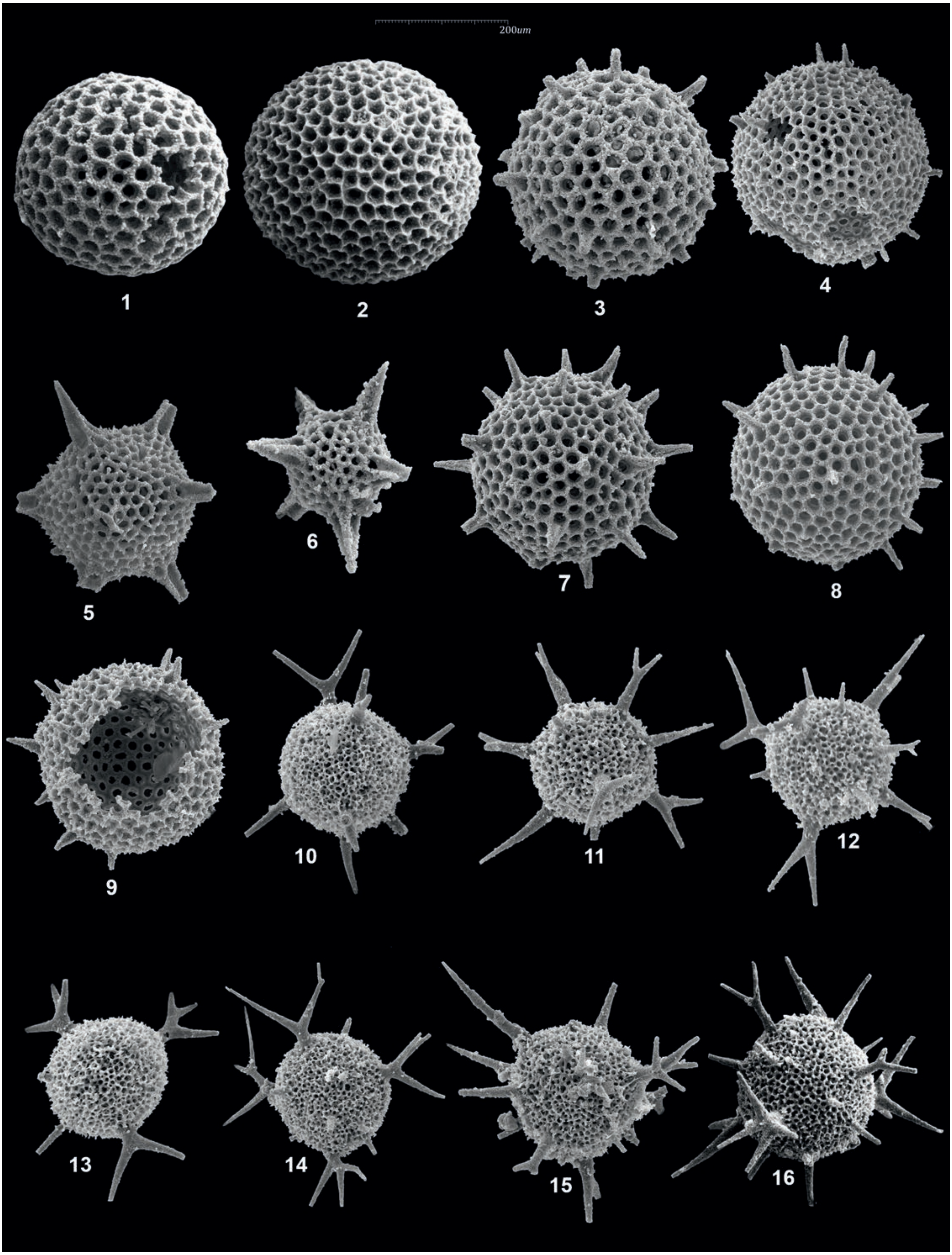
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PLATE 6

Fig. 1. *Triassospongosphaera austriaca* (KOZUR et MOSTLER, 1979), Sample FB-R.
Figs 2–3. *Triassospongosphaera multispinosa* (KOZUR et MOSTLER, 1979), 2–3: Sample FB-R.
Fig. 4–6. *Triassospongosphaera triassica* (KOZUR et MOSTLER, 1979), 4: Sample FB-R., 5–6: Sample FB.
Fig. 7. *Triassospongosphaera* (?) sp., Sample FB.
Figs 8–9. *Paurinella aequispinosa* KOZUR et MOSTLER, 1981, 8–9: Sample FB-R.
Fig. 10–11. *Paurinella curvata spinosa* KOZUR et MOSTLER, 1994, 10: Sample FB., 11: Sample FB-R.
Fig. 12. *Paurinella* sp. cf . *latispinosa* KOZUR et MOSTLER, 1994, Sample FB-R.
Fig. 13. *Paurinella* sp. cf. *mesotriassica* KOZUR et MOSTLER, 1981, Sample FB-R.
Fig. 14. *Neopaurinella ladinica* KOZUR et MOSTLER, 1994, Sample FB.
Figs 15–17. *Neopaurinella tumidospina* KOZUR et MOSTLER, 1994, Sample FB-R.

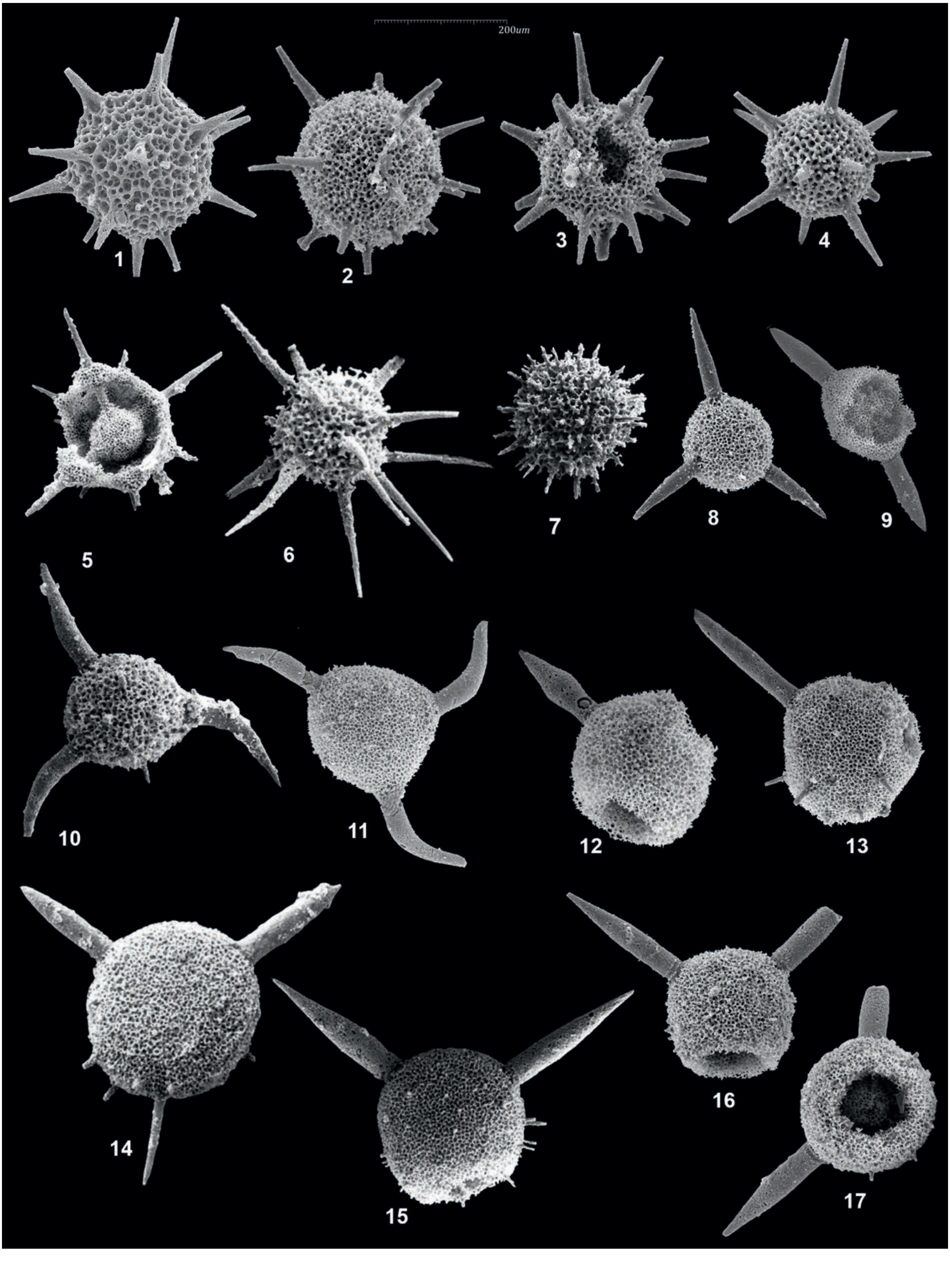
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PLATE 7

Fig. 1. *Neopaurinella* sp. 1, Sample FB-R.
Figs 2–3. *Neopaurinella* sp. 2, Sample FB-R.
Figs 4–5. *Angulopaurinella edentata* DUMITRICA et TEKIN, 2013, Sample FB-R.
Fig. 6. *Tetrapaurinella* sp., Sample FB-R.
Fig. 7. *Zhamojdasphaera goricanae* DUMITRICA et TEKIN, 2013, Sample A26.
Figs 8–10. *Astrocentrus latispinosus* (KOZUR et MOSTLER, 1979), 8–10: Sample FB-R.
Fig. 11. Pathological ?*Astrocentrus* sp., Sample FB.
Figs 12–14. *Astrocentrus pulcher* KOZUR et MOSTLER, 1979, 12–14: Sample FB-R.

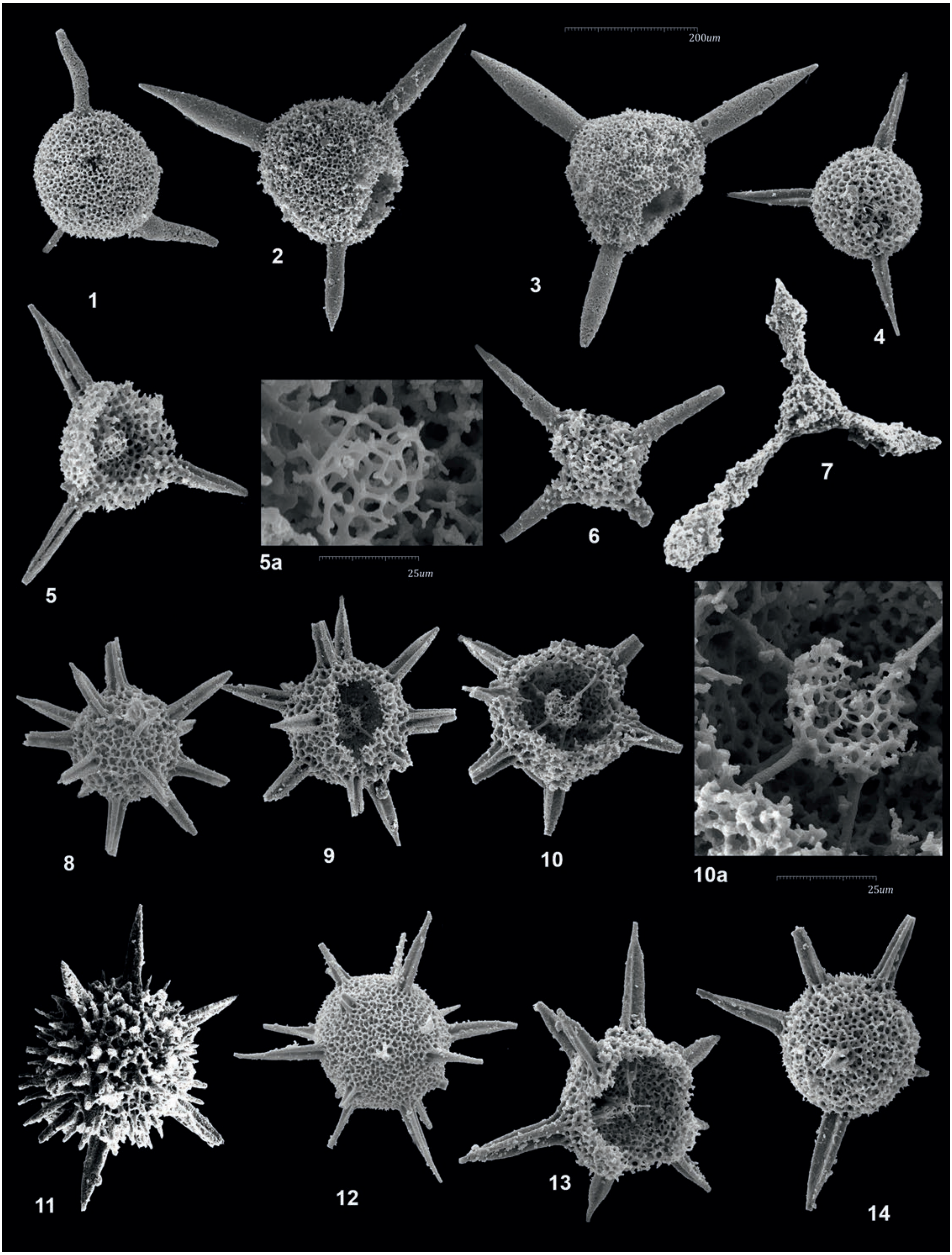
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PLATE 8

Fig. 1. *Relindella ruesti* (Kozur et Mostler, 1981), Sample FB-R.
Fig. 2. *Relindella steigeri* (Lahm, 1984), Sample FB-R.
Fig. 3. *Relindella symmetrica* (Dumitrica et al., 1980), Sample FB.
Fig. 4. *Octostella froetschbachense* sp. nov., Holotype - PAL 2022.121.1., Sample FB-R.
Fig. 5. *Plafkerium antiquum* Sugiyama, 1992, Sample FB.
Figs 6–7. *Plafkerium quadratum* (Lahm, 1984), 6: Sample FB., 7: Sample FB-R.
Fig. 8. *Plafkerium uncatum* (Bragin, 2011), Sample FB-R.
Fig. 9–10. Pathological *Plafkerium* sp., Sample FB.
Fig. 11. *Spongopallium* cf. *contortum* Dumitrica et al., 1980, Sample FB
Fig. 12. *Archaeospongoprunum tetraspinosum* Kozur et Mostler, 1994, Sample FB.
Fig. 13. *Archaeospongoprunum* sp., Sample FB.
Fig. 14. *Tamonella aspinosa* Ozsvárt et al., 2017, Sample FB-R.
Fig. 15. *Tamonella multispinosa* Dumitrica et al., 1980, Sample FB-R.
Fig. 16. *Tamonella rarispinosa* Kozur et Mostler, 1994, Sample FB-R.

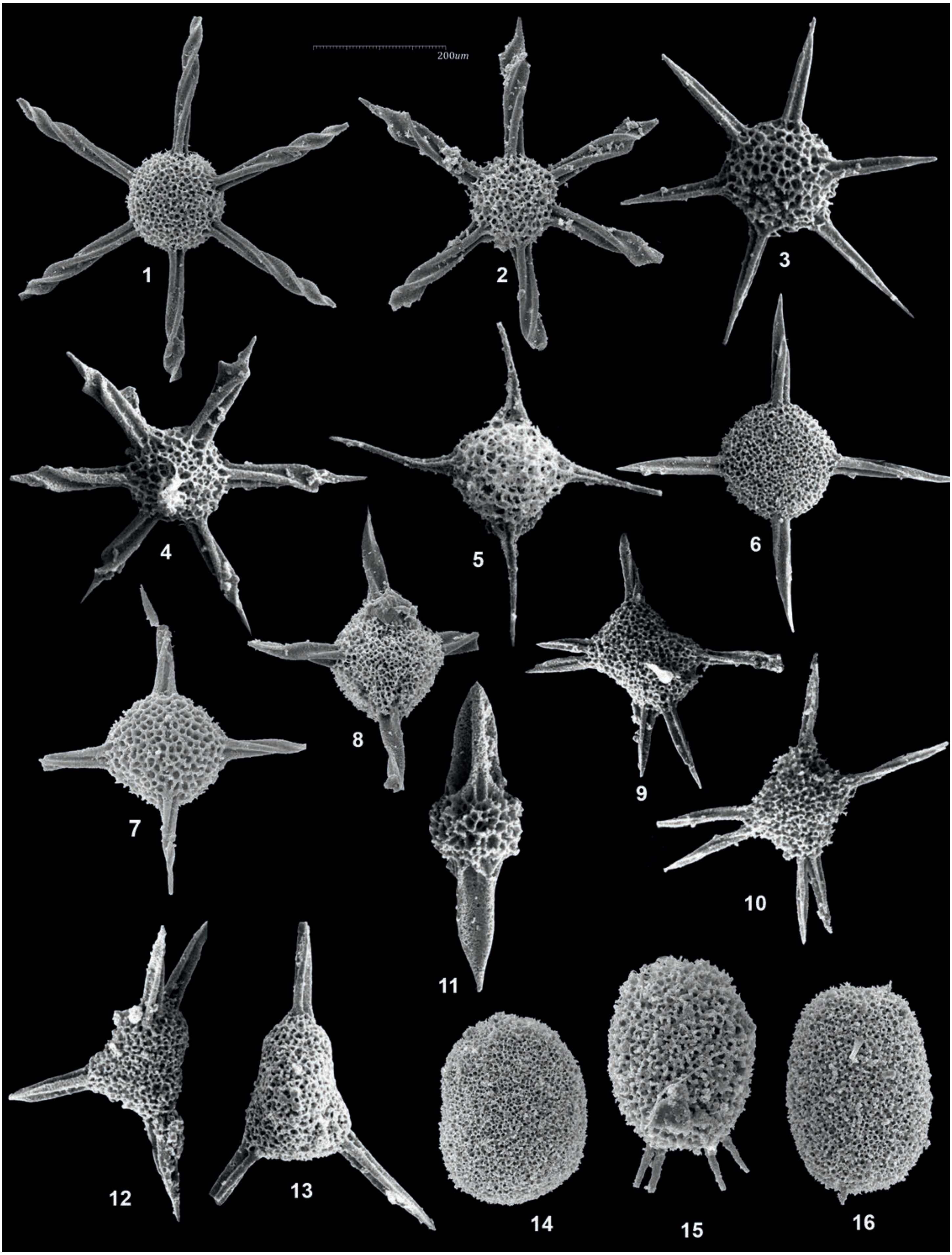
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PLATE 9

Fig. 1. *Monospongella magnispinosa* KOZUR et MOSTLER, 2006, Sample FB-R.
Fig. 2–3. *Praegomberellus pulcher* KOZUR et MOSTLER, 1994, Sample FB.
Fig. 4. *Gomberellus simplex* sp. nov., Holotype - PAL 2022.117.1., Sample FB-R.
Fig. 5. *Gomberellus* sp., Sample FB-R.
Figs 6–8. *Paroertlispongus kozuri* sp. nov., 6: Holotype - PAL 2022.124.1., Sample FB, 7–8: Sample FB-R.
Figs 9–10. *Paroertlispongus lahmi* sp. nov. 9: Holotype - PAL 2022.125.1., Sample FB., 10: Sample FB.
Fig. 11. *Paroertlispongus multinodosus* (KOZUR et MOSTLER, 1981), Sample A26.
Figs 12–13. *Paroertlispongus multispinosus* KOZUR et MOSTLER, 1981, 12: Sample FB-R., 13: Sample FB.
Fig. 14. *Paroertlispongus rarispinosus* KOZUR et MOSTLER, 1981, Sample FB-R.

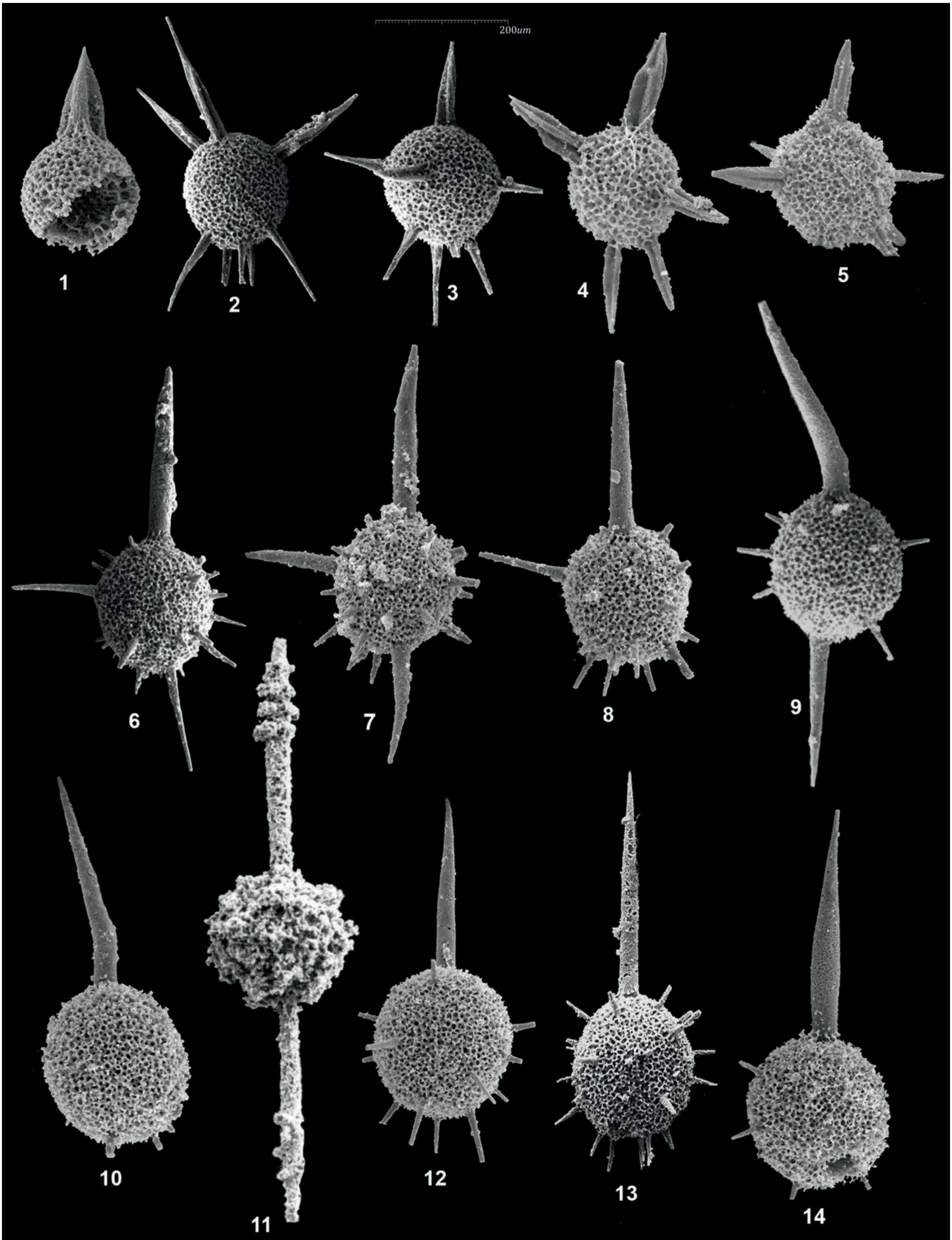
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PLATE 10

Fig. 1. *Paroertlispongus siciliensis* (KOZUR, 1996), Sample FB-R.
Fig. 2. *Paroertlispongus weddigei* (LAHM, 1984), Sample FB-R.
Fig. 3. *Oertlispongus inaequispinosus* DUMITRICA et al., 1980, Sample FB.
Figs 4–5. *Oertlispongus primus* KOZUR, 1996, Sample FB-R.
Fig. 6. *Oertlispongus* sp., Sample FB.
Fig. 7. *Baumgartneria bifurcata* DUMITRICA, 1982, Sample FB.
Fig. 8. *Baumgartneria retrospina* DUMITRICA, 1982, Sample FB.
Fig. 9. ?*Falcispongus* sp. Sample A26.
Fig. 10. *Bogdanella trentana* KOLAR-JURKOVŠEK, 1989, Sample A26.
Figs 11–12. *Falcispongus falciformis* DUMITRICA, 1982, Sample FB-R.
Figs 13–14. *Falcispongus hamatus* DUMITRICA, 1982, Sample A26.
Figs 15–17. *Falcispongus zapfei* KOZUR, 1996, Sample FB-R.
Fig. 18. *Scutispongus* sp. cf. *rostratus* (DUMITRICA, 1982), Sample A26.

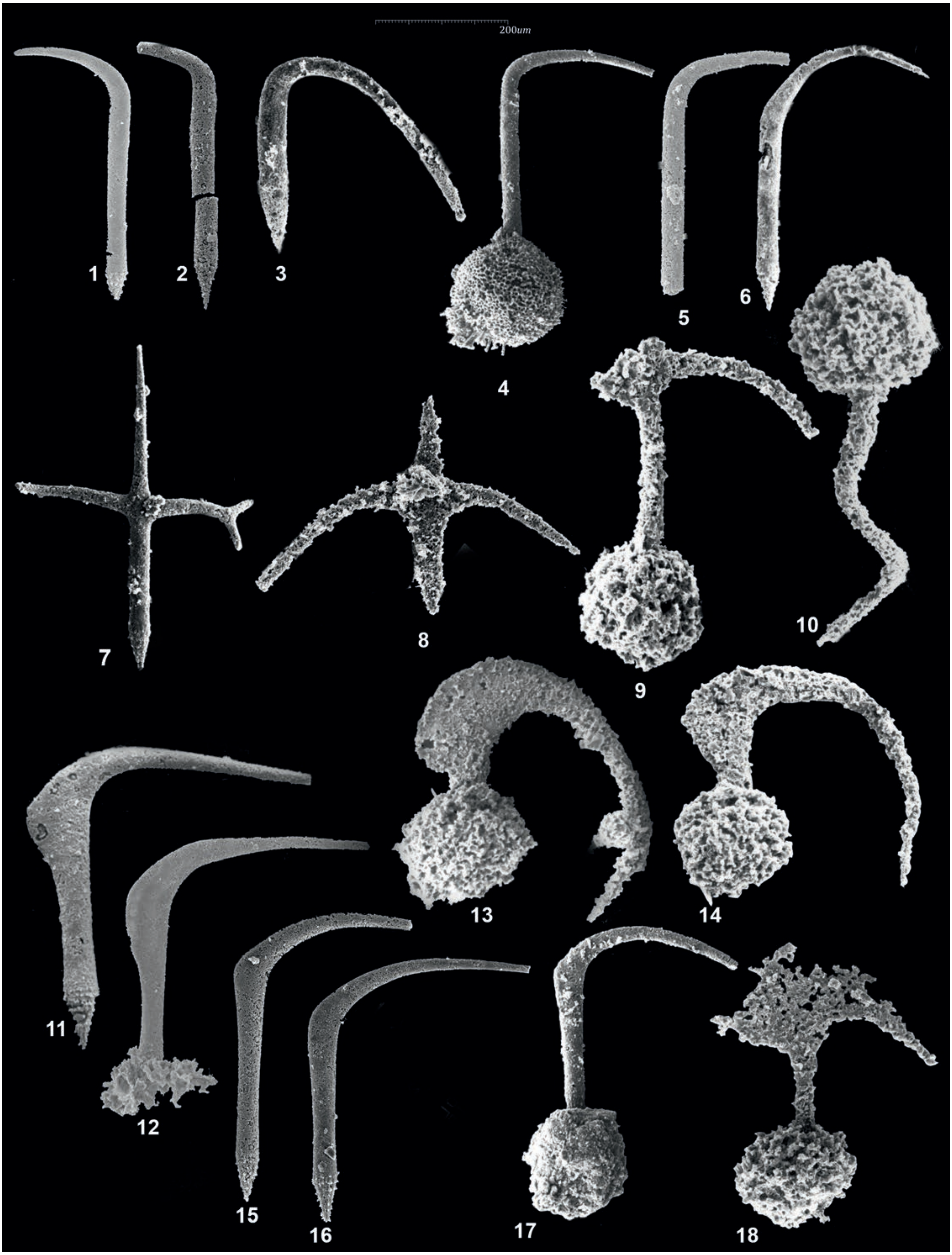
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PLATE 11

Figs 1–2. *Hexaspongus robustus* Kozur et Mostler, 1981, 1: Sample FB., 2: Sample FB-R.
Fig. 3. *Hexaspongus radiculaspinus* sp. nov., Holotype - PAL 2022.118.1., Sample FB.
Figs 4–5. ?*Hexaspongus longispinosus* sp. nov., 4: Holotype - PAL 2022.113.1., Sample FB-R., 5: Sample FB.
Figs 6–7. *Ticinosphaera mesotriassica* (Kozur et Mostler, 1981), Sample FB-R.
Figs 8–9. *Lahmosphaera alpina* (Dumitrica et al., 1980), 8: Sample FB., 9: Sample FB-R.
Figs 10–13. *Lahmosphaera fluegeli* (Kozur et Mostler, 1979), 10,12: Sample FB., 11,13: Sample FB-R.

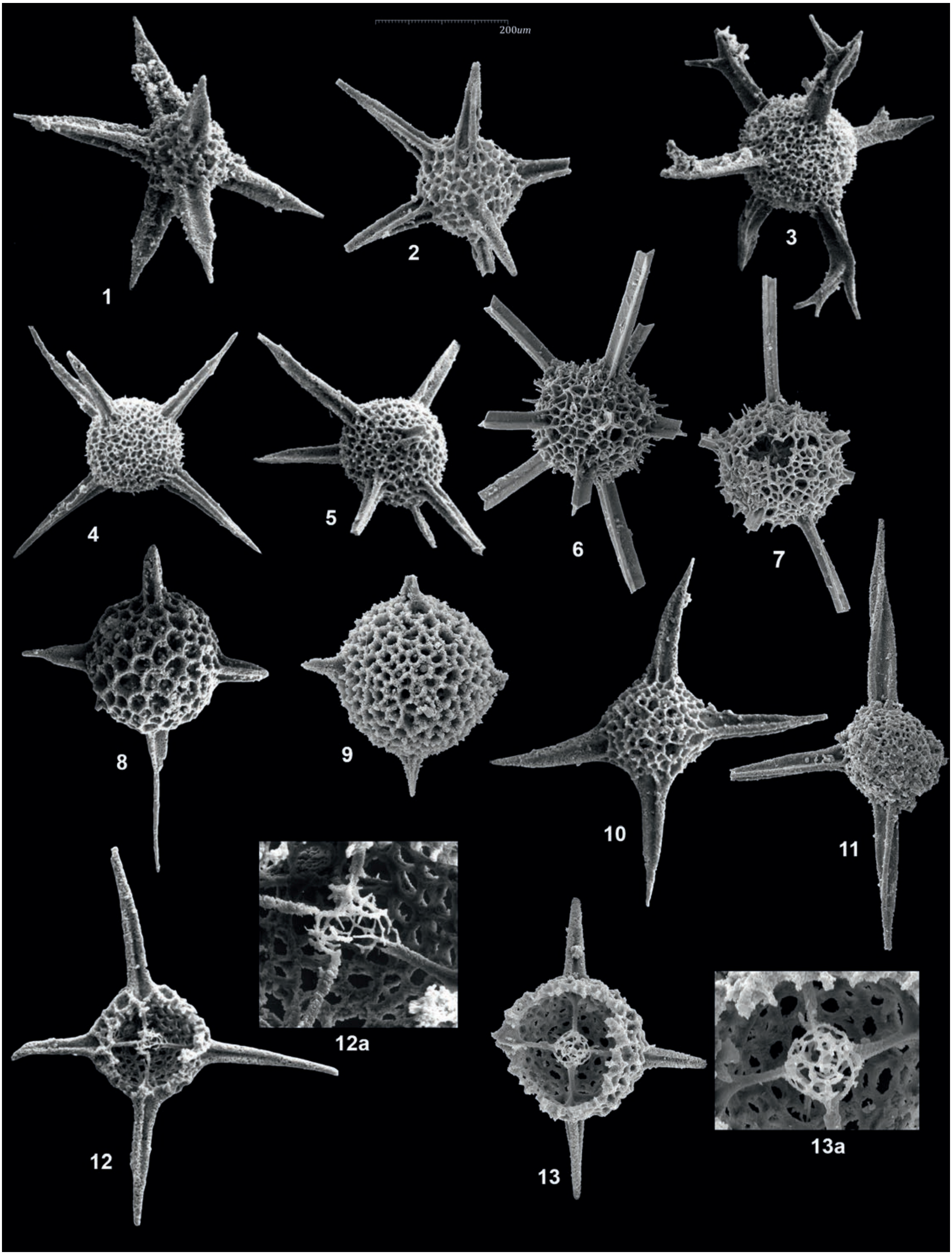
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PLATE 12

Figs 1–3. *Lahmosphaera granulosa* (Dumitrica et al., 1980), Sample FB.
Fig. 4. *Lahmosphaera mulleri* (Dumitrica et al., 1980), Sample FB-R.
Figs 5–6. *Lahmospharea trispinosa* (Kozur et Mostler, 1979), Sample FB-R.
Figs 7–8. Spumellaria gen. indet. A., Sample FB.
Fig. 9. ?Intermediellidae gen. indet. A., Sample FB-R.
Fig. 10. ?Oertlispongidae gen. indet. A., Sample FB-R.
Fig. 11. ?Intermediellidae gen. indet. B., Sample FB-R.
Fig. 12. Gen. et sp. indet. A., Sample FB-R.
Figs 13–14. Gen. et sp. indet. B., Sample FB-R.

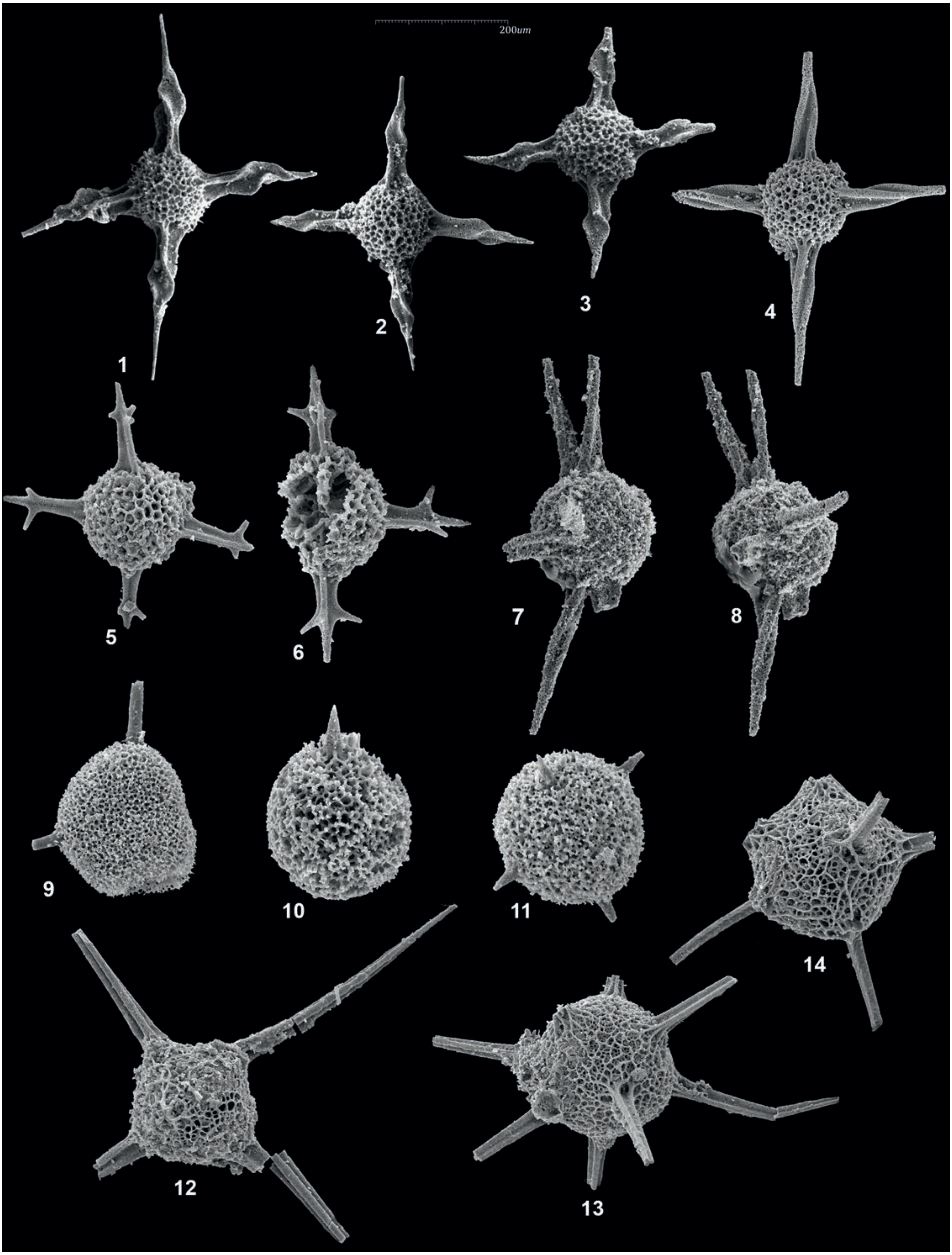
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PLATE 13

Fig. 1. *Archaeosemantis cristianensis* DUMITRICA, 1982, Sample FB.
Fig. 2. *Archaeosemantis pterostephanus* DUMITRICA, 1978a, Sample FB.
Fig. 3. *Nandartia simplicissima* (DUMITRICA, 1982), Sample FB.
Figs 4–5. *Poulpus curvispinus praecurvispinus* KOZUR et MOSTLER, 1994, Sample FB-R.
Figs 6–7. *Hozmadia costata* KOZUR et MOSTLER, 1994, Sample FB-R.
Figs 8–9. *Hozmadia reticulata* DUMITRICA et al., 1980, Sample FB-R.
Fig. 10. *Hozmadia longicephalis* KOZUR et MOSTLER, 1994, Sample FB.
Fig. 11. *Annulohaeckelella longipedis* KOZUR et MOSTLER, 2006, Sample FB.
Figs 12–13. *Eonapora mesotriassica* KOZUR et MOSTLER, 1981, Sample FB-R.
Fig. 14. *Eonapora pulchra* KOZUR et MOSTLER, 1979, Sample FB.
Fig. 15–16. *Eonapora robusta* KOZUR et MOSTLER, 1981, Sample FB-R.
Fig. 17. *Triassobipedis* sp., Sample FB-R.
Figs 18–19. *Neopylentonema mesotriassica* KOZUR, 1984, Sample FB-R.

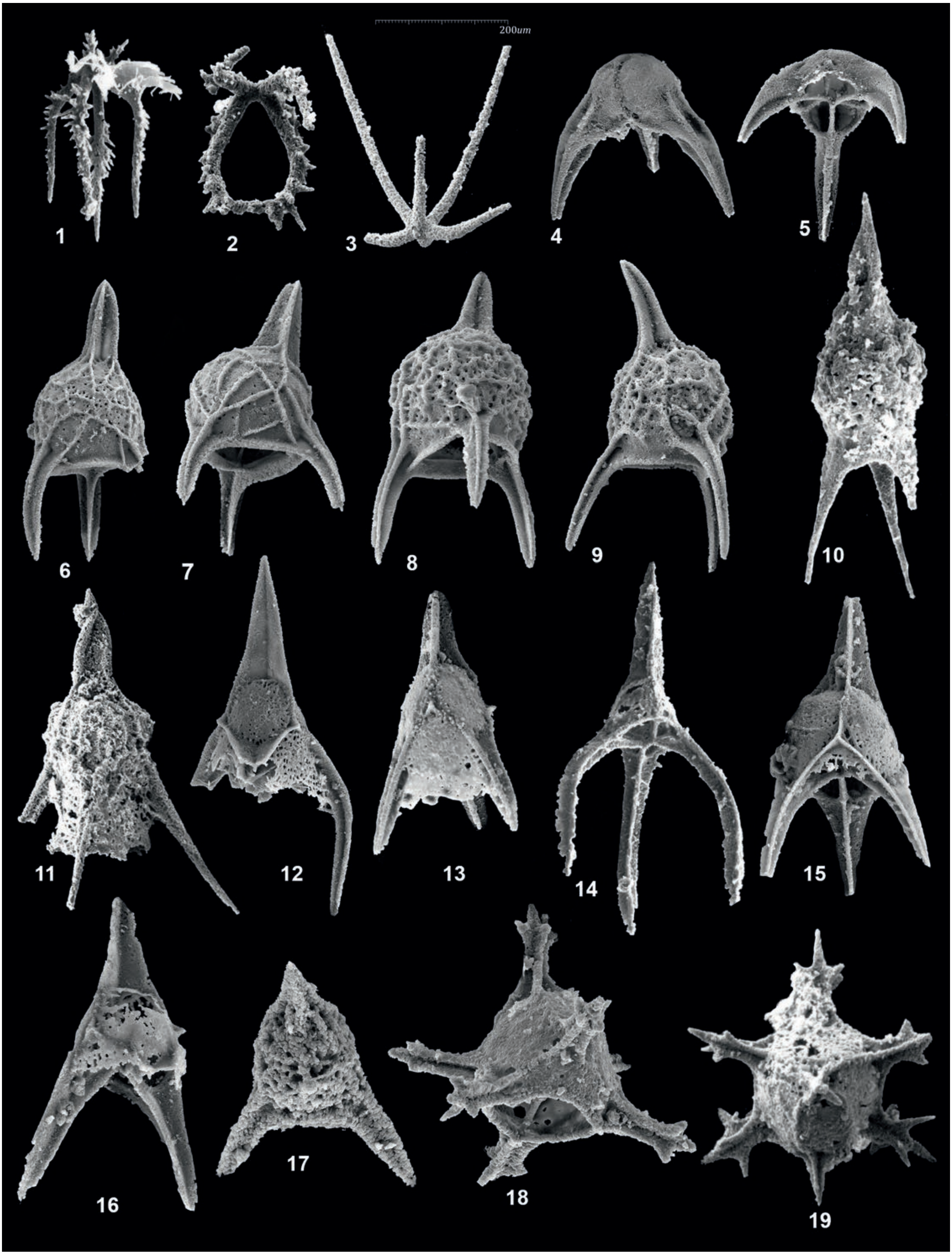
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PLATE 14

Figs 1–3. *Amentoneopylen simplex* sp. nov., Holotype - PAL 2022.114.1., Sample FB-R.
Figs 4–10. *Nabolella striata* sp. nov. 9: Holotype - PAL 2022.120.1., Sample FB-R., 4–8, 10: Sample FB-R.
Figs 11–14. *Hinedorcus alatus* DUMITRICA et al., 1980, Sample FB.
Figs 15–19. *Hinedorcus gibber* TEKIN, 1999, Sample FB-R

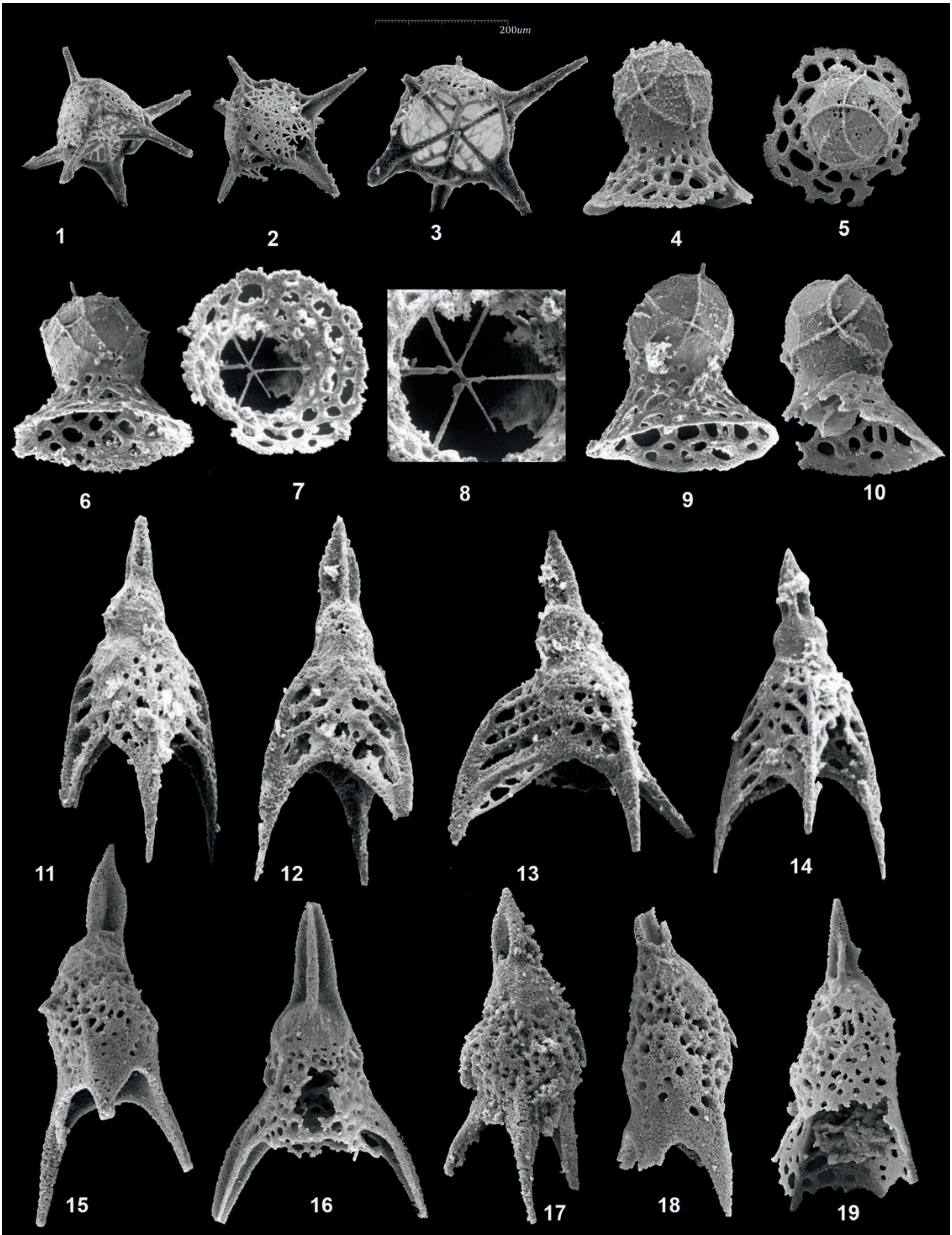
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PLATE 15

Fig. 1. *Muellericyrtium triassicum* Kozur et Mostler, 1981, Sample FB-R.
Fig. 2. *Muellericyrtium triangularum* sp. nov., Holotype - PAL 2022.119.1., Sample FB-R.
Fig. 3. *Muellericyrtium* sp., Sample FB.
Figs 4–6. *Silicarmiger costatus* Dumitrica et al., 1980, Sample FB-R.
Fig. 7. *Silicarmiger costatus anisicus* Kozur et Mostler, 1981, Sample FB.
Figs 8–9. *Silicarmiger inflatus* sp. nov., 8: Sample FB., 9: Holotype - PAL 2022.127.1., Sample FB.
Figs 10–19. *Nofrema trispinosa* Dumitrica et al., 1980, 10–13: Sample FB-R., 14: Sample FB., 15–19: Sample FB-R.

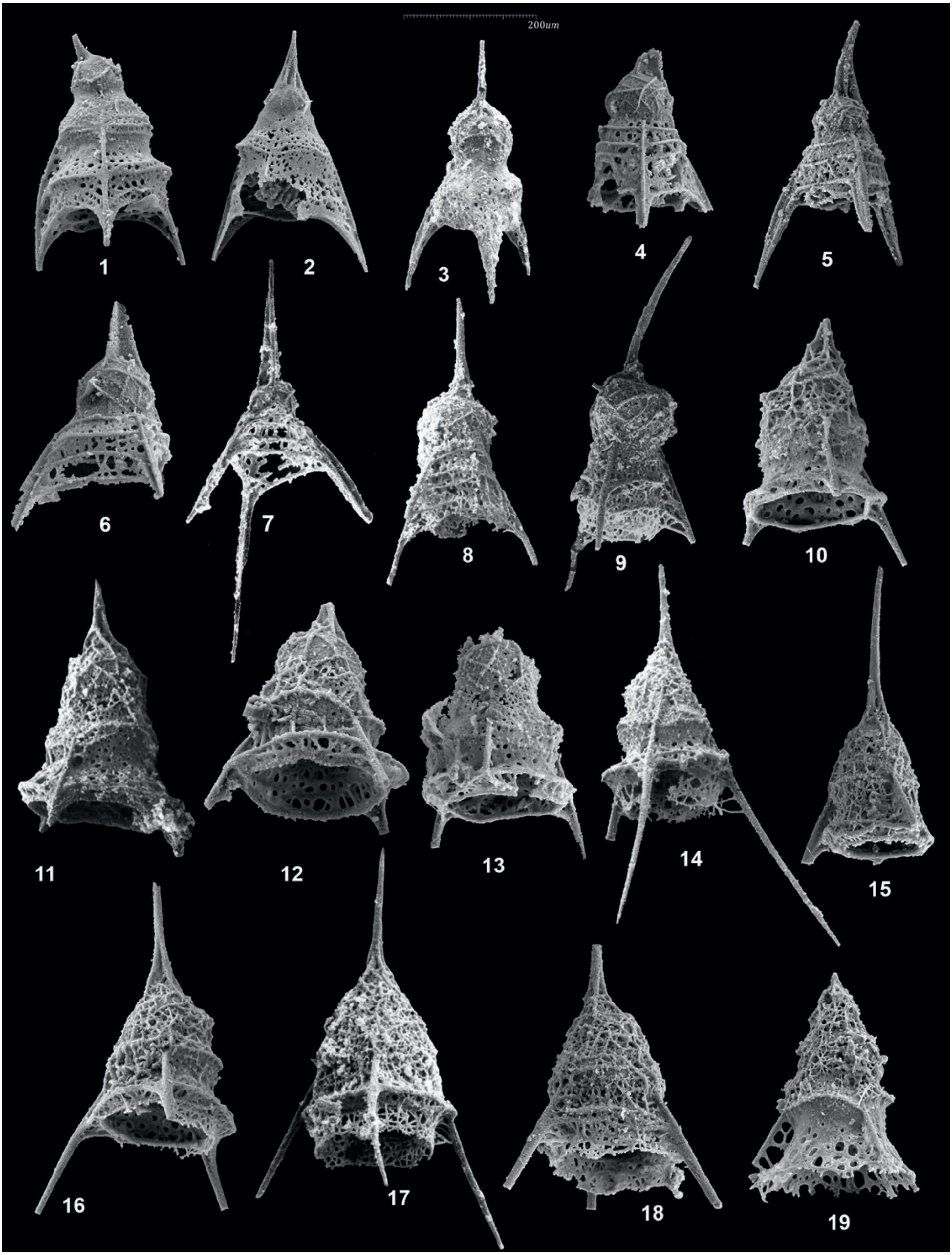
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PLATE 16

Fig. 1. *Spongosilicarmiger gabiolaensis* Kozur et Mostler, 1994, Sample FB.
Fig. 2. *Spongosilicarmiger gabiolaensis curvatospinus* Kozur et Mostler, 1994, Sample FB.
Fig. 3–8. *Spongosilicarmiger italicus* Kozur, 1984, 3: Sample FB., 4–5: Sample FB-R.
Figs 9–10. *Spongosilicarmiger longispinus* sp. nov., 9: Holotype - PAL 2022.129.1., Sample FB., 10: Sample FB-R.
Figs 11–13. *Spongosilicarmiger posterus* Kozur et Mostler, 1994, Sample FB-R.
Figs 14–15. *Spongosilicarmiger priscus* Kozur et Mostler, 1994, 14: Sample FB., 15: Sample FB-R.

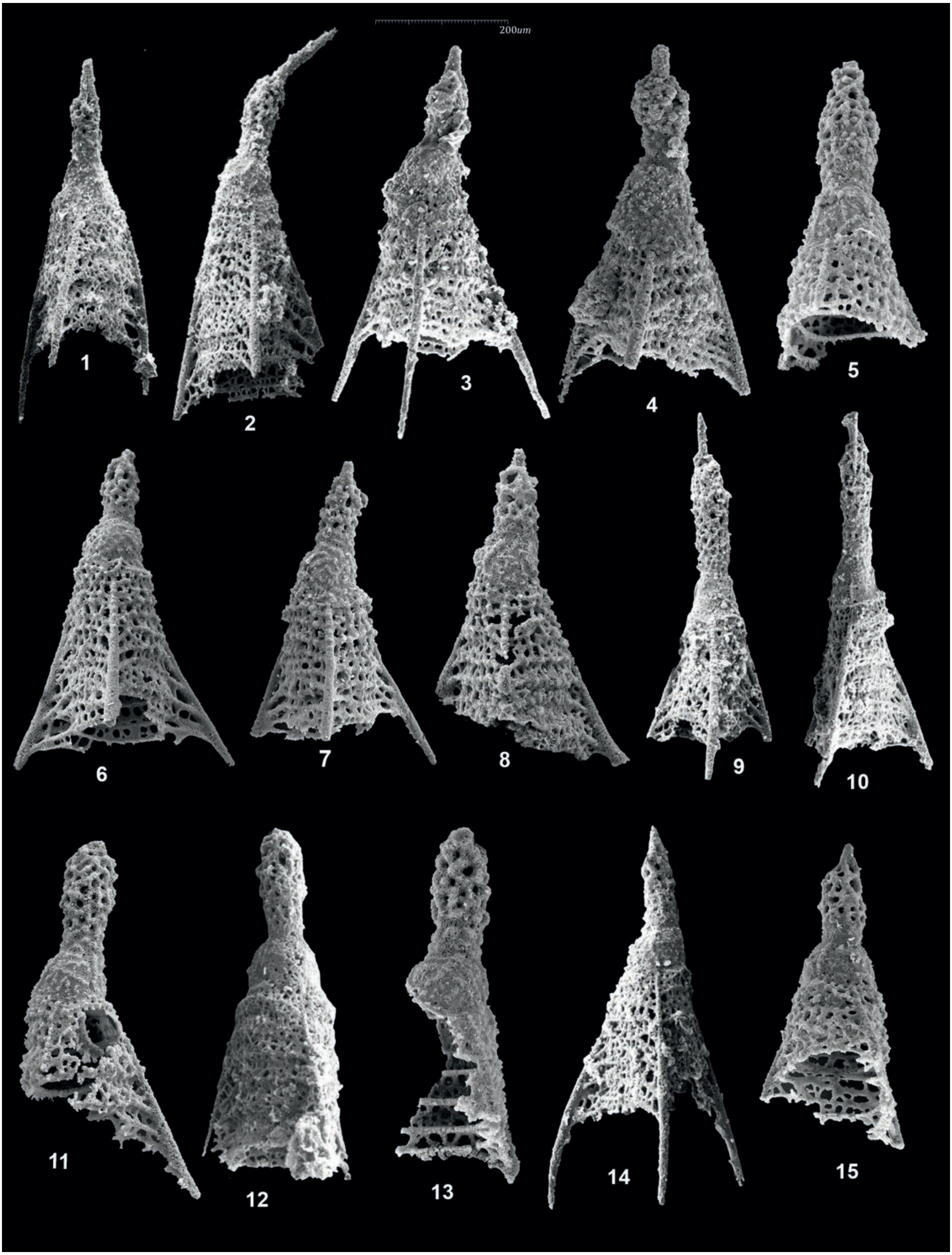
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PLATE 17

Figs 1–5. *Triassospongocyrtis longispinosa* KOZUR et MOSTLER, 1994, 1, 5: Sample FB., 2–4: Sample FB-R.
Figs 6–7. *Triassospongocyrtis yaoi* KOZUR et MOSTLER, 1994, Sample FB.
Fig. 8. *Triassospongocyrtis* sp., Sample FB.
Fig. 9. *?Monicasterix* sp., Sample FB.
Fig. 10. *Planispinocyrtis praecursor* KOZUR et MOSTLER, 1994, Sample FB-R.
Fig. 11. *Planispinocyrtis* sp. cf. *pelsoensis* KOZUR et MOSTLER, 1994, Sample FB-R.
Figs 12–15. *Ladinocampe annuloperforata* KOZUR et MOSTLER, 1994, Sample FB-R.
Figs 16–18. *Ladinocampe multiperforata* KOZUR, 1984, Sample FB-R.
Fig. 19. *Anisicyrtis hungarica* KOZUR et MOSTLER, 1981, Sample FB-R.
Fig. 20. *Anisicyrtis italica* KOZUR et MOSTLER, 1994, Sample FB-R.
Fig. 21. *Anisicyrtis recoaroensis* KOZUR et MOSTLER, 1994, Sample FB-R.
Figs 22–23. *Anisicyrtis spinosa* KOZUR et MOSTLER, 1994, Sample FB-R.
Figs 24–25. *Anisicyrtis trettoensis* KOZUR et MOSTLER, 1994, Sample FB-R.

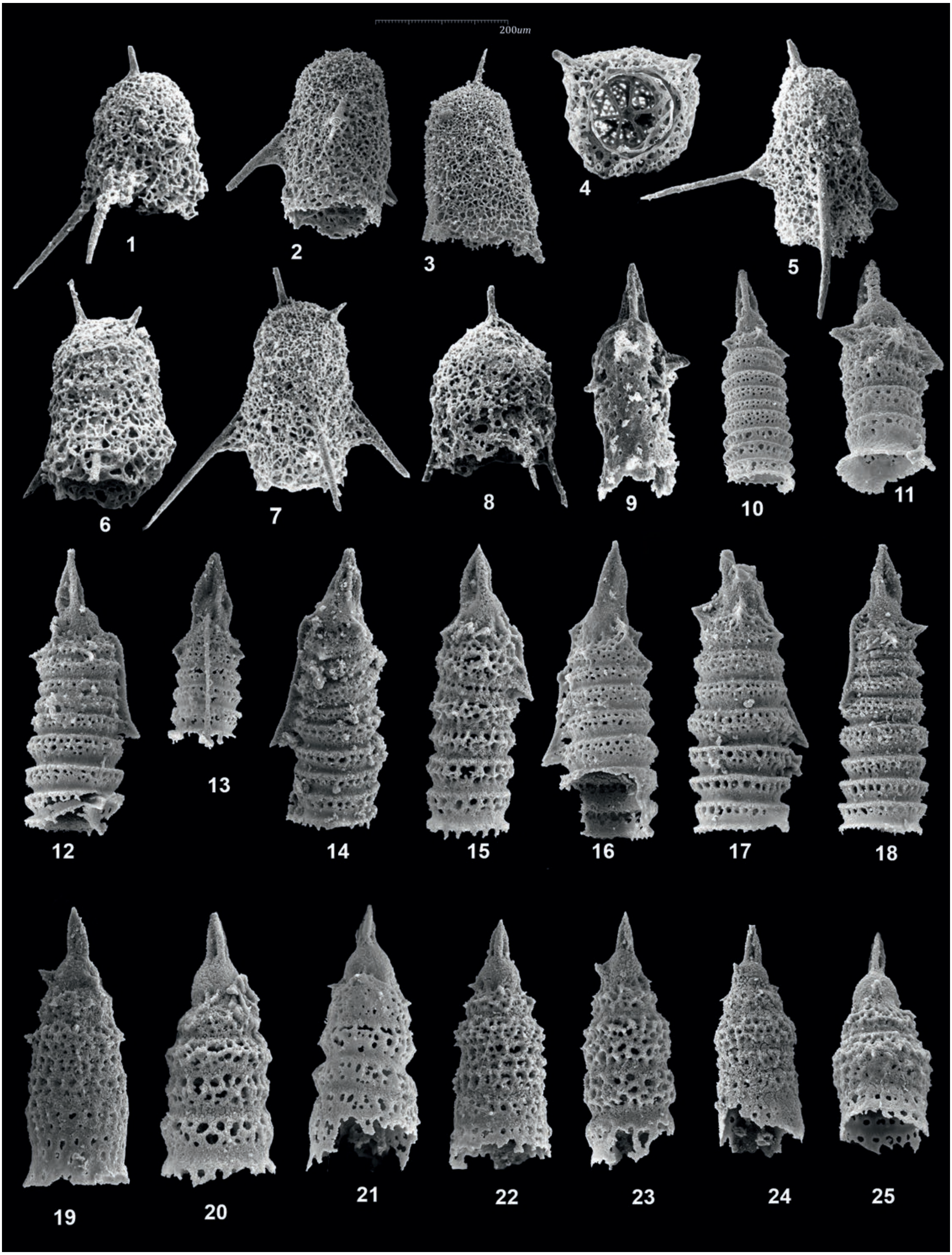
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PLATE 18

Fig. 1. *Gradinaria fassanica* (Kozur et Mostler, 1994), Sample FB-R.
Figs 2–3. *Pararuesticyrtium constrictum* Kozur et Mostler, 1994, 2: Sample FB., 3: Sample FB-R.
Figs 4–5. *Pararuesticyrtium eofassanicum* Kozur et Mostler, 1994, Sample FB-R.
Fig. 6. *Pararuesticyrtium fusiformis* (Bragin, 1986), Sample FB-R.
Fig. 7. *Pararuesticyrtium trettoense* Kozur et Mostler, 1994, Sample FB-R.
Fig. 8. *Paratriassocampe gaetanii* Kozur et Mostler, 1994, Sample FB.
Fig. 9. *Striatotriassocampe laeviannulata* Kozur et Mostler, 1994, Sample FB.
Figs 10–11. *Annulotriassocampe campanilis campanilis* Kozur et Mostler, 1994, Sample FB-R.
Fig. 12. *Annulotriassocampe campanilis longiporata* Kozur et Mostler, 1994, Sample FB.
Fig. 13. *Annulotriassocampe spinosa* Kozur et Mostler, 1994, Sample FB.
Fig. 14. *Triassocampe deweveri deweveri* (Nakaseko et Nishimura, 1979), Sample FB-R.
Fig. 15. *Triassocampe deweveri pauciconstricta* Kozur et Mostler, 1994, Sample FB-R.
Figs 16–18. *Triassocampe scalaris* Dumitrica et al., 1980, Sample FB-R.
Fig. 19. *Triassocampe* sp., Sample FB-R.
Figs 20–21. *Yeharaia annulata* Nakaseko et Nishimura, 1979, Sample FB-R.
Figs 22–24. *Yeharaia bispinosa* sp. nov., 22: Holotype - PAL 2022.132.1., Sample FB.
Fig. 25. *Yeharaia trispinosa* sp. nov., Holotype - PAL 2022.133.1., Sample FB-R.
Fig. 26. *Yeharaia transita* Kozur et Mostler, 1994, Sample FB-R.
Figs 27–28. *Yeharaia* sp., Sample FB.
Fig. 29. *Pseudotriassocampe myterocorys* (Sugiyama, 1992), Sample FB-R.

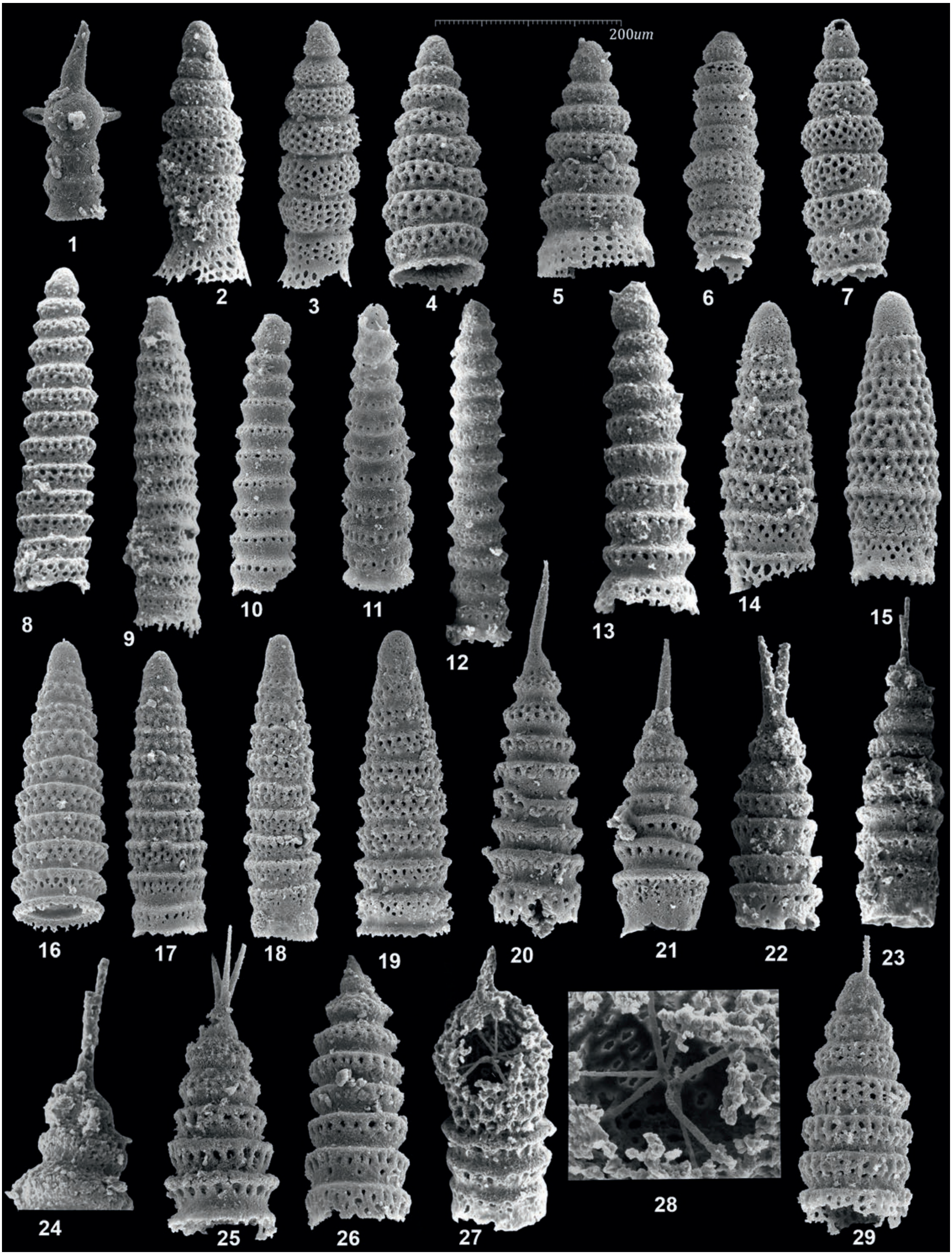
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TABLE 2: Distribution of radiolarians in sections at Frötschbach, Seceda outcrop and Seceda core.

		Se1	FB	FB-R	A26	Seceda-1 borehole							
						S12	S17	S18	S20	S21	S57	S67	S69
Entactinaria	*Bernoulliella* cf. *simplex* (Lahm, 1984)			+									
	Bernoulliella simplex (Lahm, 1984)			+			+		+				
	Beturiella latispinosa sp. nov.		+										
	Entactinarian genus and species indeterminate A.			+									
	Entactinosphaera ? triassica Kozur et Mostler, 1979		+										+
	"Entactinosphaera" zapfei Kozur et Mostler, 1979		+	+									
	„Entactinosphaera" stockari sp. nov.		+										
	Eohexastylus muzavori (Lahm, 1984)		+										+
	Eptingium manfredi Dumitrica, 1978			+					+				
	Eptingium ramovsi Kozur et al., 1996		+	+									
	Heptacladus crassispinus Dumitrica et al., 1980		+	+					+				
	Hexatortilisphaera aequispinosa Kozur et al., 1996		+										
	Muelleritortis globosa Tekin, 2010				+								
	Parasepsagon cf. *tetracanthus* Kozur et Mostler, 1994		+						+	+			
	Parasepsagon praetetracanthus Kozur et Mostler, 1994			+			+		+				
	Parentactinia kecskemetii sp. nov.		+										
	Parentactinia pugnax Dumitrica, 1978		+										
	Pentactinocapsa quadripes Dumitrica, 1978		+										
	Pentactinocarpus acanthicus Dumitrica, 1978		+	+		+		+	+				
	Pentactinorbis cf. *mostleri* Dumitrica, 1978			+									
	Pentactinorbis kozuri Dumitrica, 1978		+										
	Pseudostylosphaera acrior (Bragin, 1986)		+	+			+		+				
	Pseudostylosphaera canaliculata (Bragin, 1986)	+	+	+					+				
	Pseudostylosphaera compacta (Nakaseko et Nishimura, 1979)			+									
	Pseudostylosphaera cf. *compacta* (Nakaseko et Nishimura, 1979)		+	+									
	Pseudostylosphaera longispinosa Kozur et Mostler, 1981			+					+	+	+		
	Pseudostylosphaera mostleri Tekin, 2007			+									
	Pseudostylosphaera nazarovi (Kozur et Mostler, 1981)				+								
	Sepsagon ladinicus Kozur et Mostler, 1994			+									
	Sepsagon recoarensis Lahm, 1984		+	+									
	Sepsagon cf. *robustus* Lahm, 1984				+								
	Spinostylosphaera ? vachardi Ozsvárt et al., 2015				+								
	Spongostephanidium brevispinosum sp. nov.		+	+									
	Spongostephanidium cf. *spongiosum* Dumitrica, 1978				+								
	Spongostephanidium japonicum (Nakaseko et Nishimura, 1979)		+	+									
	Tiborella florida austriaca Kozur et al., 1996		+										
	Tiborella magnidentata Dumitrica et al., 1980		+	+									
	Triassistephanidium sp.		+										
	Triassothamnus verticillatus (Dumitrica, 1978)	+	+										
	Welirella fleuryi (De Wever, 1979)			+									
	Welirella mesotriassica Kozur et al., 1996			+									
Spumellaria	*Angulopaurinella edentata* Dumitrica et Tekin, 2013			+									
	Archaeocenosphaera igoi (Parona, 1890)		+						+				
	Archaeocenosphaera parvispinosa (Kozur et Mostler, 1981)			+									
	Archaeospongoprunum sp.		+										
	Archaeospongoprunum tetraspinosum Kozur et Mostler, 1994		+										
	Astrocentrus latispinosus (Kozur et Mostler, 1979)			+									
	Astrocentrus pulcher Kozur et Mostler, 1979			+			+	+	+	+			
	Baumgartneria bifurcata Dumitrica, 1982		+										
	Baumgartneria retrospina Dumitrica, 1982			+									+
	Bogdanella trentana Kolar-Jurkovšek, 1989				+								
	Falcispongus falciformis Dumitrica, 1982		+	+									
	Falcispongus hamatus Dumitrica, 1982				+								
	Falcispongus zapfei Kozur, 1996		+	+									
	?Falcispongus sp.				+							+	
	Gomberellus simplex sp. nov.			+									
	Gomberellus sp.			+									
	Hexaspongus radiculaspinus sp. nov.		+										
	Hexaspongus robustus Kozur et Mostler, 1981		+	+									
	?Hexaspongus longispinosus sp. nov.		+	+									

		Se1	FB	FB-R	A26	Seceda-1 borehole							
						S12	S17	S18	S20	S21	S57	S67	S69
Spumellaria	*Katorella bifurcata* Kozur et Mostler, 1981		+	+					+				
	Katorella trifurcata Kozur et Mostler, 1994		+	+									
	Lahmosphaera alpina (Dumitrica et al., 1980)		+	+									
	Lahmosphaera fluegeli (Kozur et Mostler, 1979)		+	+					+				
	Lahmosphaera granulosa (Dumitrica et al., 1980)		+										
	Lahmosphaera mulleri (Dumitrica et al., 1980)			+									
	Lahmosphaera trispinosa (Kozur et Mostler, 1979)			+									
	Monospongella magnispinosa Kozur et Mostler, 2006			+									
	Neopaurinella ladinica Kozur et Mostler, 1994		+										
	Neopaurinella sp. 1			+									
	Neopaurinella sp. 2			+									
	Neopaurinella tumidospina Kozur et Mostler, 1994		+	+									
	Novamuria mocki (Kozur et Mostler, 1979)			+									
	Novamuria nicorae (Kozur et al., 1996)			+									
	Novamuria wirzi Stockar et al., 2012			+									
	Octostella froetschbachense sp. nov.		+										
	Oertlispongus primitivus Kozur et Mostler, 1994		+										
	Oertlispongus primus Kozur, 1996		+	+									
	Oertlispongus sp.		+										
	Paroertlispongus kozuri sp. nov.		+	+									
	Paroertlispongus lahmi sp. nov.		+	+									
	Paroertlispongus multinodosus (Kozur et Mostler, 1981)		+					+					
	Paroertlispongus multispinosus Kozur et Mostler, 1981		+	+		+			+	+		+	+
	Paroertlispongus rarispinosus Kozur et Mostler, 1981			+			+						
	Paroertlispongus siciliensis (Kozur, 1996)			+									
	Paroertlispongus weddigei Lahm, 1984			+									
	Pathological *?Astrocentrus* sp.		+										
	Pathological *Plafkerium* sp.		+										
	Paurinella aequispinosa Kozur et Mostler, 1981			+									
	Paurinella cf. *latispinosa* Kozur et Mostler, 1994			+			+		+				
	Paurinella cf. *mesotriassica* Kozur et Mostler, 1981			+									
	Paurinella curvata spinosa Kozur et Mostler, 1994		+	+									
	Plafkerium antiquum Sugiyama, 1992		+										
	Plafkerium quadratum (Lahm,1984)		+	+									
	Plafkerium uncatum (Bragin, 2011)			+									
	Praegomberellus pulcher Kozur et Mostler, 1994		+										
	Relindella ruesti (Kozur et Mostler, 1981)			+			+						
	Relindella steigeri (Lahm, 1984)			+									
	Relindella symmetrica (Dumitrica et al., 1980)		+	+			+						
	Scutispongus cf. *rostratus* (Dumitrica, 1982)				+								
	Spongopallium cf. c*ontortum* Dumitrica et al., 1980		+										
	Tamonella aspinosa Ozsvárt et al., 2017			+									
	Tamonella multispinosa Dumitrica et al., 1980			+									
	Tamonella rarispinosa Kozur et Mostler, 1994			+									
	Tetrapaurinella sp.			+									
	Ticinosphaera mesotriassica (Kozur et Mostler, 1981)			+									
	Triassospongosphaera (?) sp.		+										
	Triassospongosphaera austriaca (Kozur et Mostler, 1979)			+									
	Triassospongosphaera multispinosa (Kozur et Mostler, 1979)			+			+		+				
	Triassospongosphaera triassica (Kozur et Mostler, 1979)		+	+									
	Zhamojdasphaera goricanae Dumitrica et Tekin, 2013				+								
	Spumellaria gen. indet. A					+							
	? Intermediellidae gen. indet. A			+									
	? Oertlispongidae gen. indet. A			+									+
	? Intermediellidae gen. indet. A			+									
	Gen. et sp. indet. A			+									
	Gen. et sp. indet. A			+									

		Se1	FB	FB-R	A26	Seceda-1 borehole							
						S12	S17	S18	S20	S21	S57	S67	S69
Nassellaria	*Amentoneopylen simplex* sp. nov.			+									
	Anisicyrtis hungarica Kozur et Mostler, 1981			+									
	Anisicyrtis italica Kozur et Mostler, 1994			+									
	Anisicyrtis recoaroensis Kozur et Mostler, 1994			+									
	Anisicyrtis spinosa Kozur et Mostler, 1994			+									
	Anisicyrtis trettoensis Kozur et Mostler, 1994			+									
	Annulohaeckelella longipedis Kozur et Mostler, 2006				+								
	Annulotriassocampe campanilis Kozur et Mostler, 1994			+									
	Annulotriassocampe campanilis longiporata Kozur et Mostler, 1994		+										
	Annulotriassocampe spinosa Kozur et Mostler, 1994		+	+									
	Archaeosemantis cristianensis Dumitrica, 1982		+										
	Archaeosemantis pterostephanus Dumitrica, 1978		+										
	Eonapora mesotriassica Kozur et Mostler, 1981		+	+									
	Eonapora pulchra Kozur et Mostler, 1979		+										
	Eonapora robusta Kozur et Mostler, 1981	+		+									
	Gradinaria fassanica (Kozur et Mostler, 1994)			+									
	Hinedorcus alatus Dumitrica et al., 1980	+	+	+									
	Hinedorcus gibber Tekin, 1999			+									
	Hozmadia costata Kozur et Mostler, 1994			+									
	Hozmadia longicephalis Kozur et Mostler, 1994		+										
	Hozmadia reticulata Dumitrica et al., 1980	+		+									
	Ladinocampe annuloperforata Kozur et Mostler, 1994		+	+									
	Ladinocampe multiperforata Kozur, 1984			+									
	Muellericyrtium sp.		+										
	Muellericyrtium triangularum sp. nov.			+									
	Muellericyrtium triassicum Kozur et Mostler, 1981		+	+									
	?Monicasterix sp.		+										
	Nabolella striata sp. nov.		+	+									
	Nandartia simplicissima (Dumitrica, 1982)		+										
	Neopylentonema mesotriassica Kozur, 1984		+	+									
	Nofrema trispinosa Dumitrica et al., 1980		+	+									
	Pararuesticyrtium constrictum Kozur et Mostler, 1994		+	+									
	Pararuesticyrtium eofassanicum Kozur et Mostler, 1994			+									
	Pararuesticyrtium fusiformis (Bragin, 1986)			+									
	Pararuesticyrtium trettoense Kozur et Mostler, 1994			+									
	Paratriassocampe gaetanii Kozur et Mostler, 1994		+	+									
	Planispinocyrtis cf. *pelsoensis* Kozur et Mostler, 1994			+									
	Planispinocyrtis praecursor Kozur et Mostler, 1994			+									
	Poulpus curvispinus praecurvispinus Kozur et Mostler, 1994			+									
	Pseudotriassocampe myterocorys (Sugiyama, 1992)			+									
	Silicarmiger costatus anisicus Kozur et Mostler, 1981		+										
	Silicarmiger costatus Dumitrica et al., 1980			+				+					
	Silicarmiger inflatus sp. nov.		+										
	Spongosilicarmiger gabiolaensis curvatospinus Kozur et Mostler, 1994		+										
	Spongosilicarmiger gabiolaensis Kozur et Mostler, 1994		+										
	Spongosilicarmiger italicus Kozur, 1984		+	+					+				
	Spongosilicarmiger longispinus sp. nov.		+										
	Spongosilicarmiger posterus Kozur et Mostler, 1994		+	+									
	Spongosilicarmiger priscus Kozur et Mostler, 1994		+	+									
	Striatotriassocampe laeviannulata Kozur et Mostler, 1994		+										
	Triassobipedis sp.			+									
	Triassocampe deweveri (Nakaseko et Nishimura, 1979)			+									
	Triassocampe deweveri pauciconstricta Kozur et Mostler, 1994			+									
	Triassocampe scalaris Dumitrica et al., 1980			+									
	Triassocampe sp.			+									
	Triassospongocyrtis longispinosa Kozur et Mostler, 1994		+	+					+				
	Triassospongocyrtis sp.		+										
	Triassospongocyrtis yaoi Kozur et Mostler, 1994		+										
	Yeharaia annulata Nakaseko et Nishimura, 1979			+					+				
	Yeharaia bispinosa sp. nov.		+										
	Yeharaia transita Kozur et Mostler, 1994			+									
	Yeharaia trispinosa sp. nov.			+									
	Yeharaia sp.		+										