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Mesozoic Radiolaria of Bosnia and Serbia: New Data

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Abstract—Jurassic and Cretaceous radiolarian faunas were discovered in bedded chert of the Dinaric and Vardar tectonic zones of Bosnia and Herzegovina. Only Triassic radiolarians have previously been described in Bosnia and Herzegovina, while the finds of Bajocian, Bathonian–Callovian, Oxfordian–Kimmeridgian, Tithonian–Berriasian, and Campanian are new. Additional localities of Triassic and Jurassic radiolarians were investigated in Serbia. By correlation with radiolarians from the previous studies within Serbia, the Late Aalenian–Bajocian and Bathonian–Callovian Serbian radiolarian beds are newly dated. The first find of Cretaceous radiolarians in Serbia is reported. The oldest Mesozoic Radiolaria-bearing formations outcropping in the Western Belt of the Vardar Zone are dated Mid-Upper Triassic. The youngest radiolarians come from the Upper Cretaceous (Campanian) of the northern part of this belt of the Vardar Zone, where they co-occur with planktonic foraminifers. The distribution of 70 radiolarian samples within sections is shown. The taxonomic composition of 39 samples is analyzed. Radiolarian species extracted from 13 samples are described and figured. The list of 72 taxa and 3 plates of Jurassic radiolarians of Bosnia and Herzegovina, 3 plates of Triassic, 1 plate of Middle Jurassic, and 1 plate of Upper Cretaceous radiolarians of Serbia are presented.

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INTRODUCTION

The present paper is the first attempt at systematic description and biostratigraphic investigation of Jurassic to Cretaceous Radiolaria of Bosnia and Herzegovina and Triassic to Cretaceous Radiolaria of Serbia.

The main purposes of this report include the following:

(1) to show characteristic Jurassic to Cretaceous radiolarian assemblages discovered for the first time in Bosnia and Serbia;

(2) to provide descriptions of some common species of Mesozoic radiolarians of Bosnia and Serbia;

(3) to provide more biostratigraphic data on the Dinaridic and Vardar ophiolite belts of the northern Balkan Peninsula.

Radiolarians occur in radiolarites and, more frequently, in cherts (or *rožnaci*) in Bosnia and Serbia, well-known siliceous sedimentary rocks, which are widespread in the central part of the Balkan Peninsula. It is noteworthy that they were formed in different geological settings but mostly within distinct geological units and during several geological periods (Dimitrijević, 1997; Karamata, 2006). It should be stressed that the rožnaci include a wide series of lithological types from radiolarites via spongolites–radiolarites to spongolites and spiculites, which are siliceous, mostly chalcedony deposits (Karamata et al., 2004a), i.e., similar to the picture which was observed among siliceous formations of the Lesser Caucasus (Vishnevskaya, 1984). Moreover, these rocks were deposited at the foot of the continental slope on the abyssal plain, in oceanic trench, in continental rifts, and even in marine lagoons (Karamata et al., 2004a, 2005). They occur mostly in ophiolite belts, less often in other geologic environments and the time of their maximal accumulation was in the Middle and Upper Triassic as well as in the Jurassic and Cretaceous. However, radiolarians were also detected in certain siliceous limestones deposited in other geological settings (e.g., the Carpatho–Balkanids).

We present the first data on Jurassic and Cretaceous radiolarians of Bosnia (Figs. 1, 2, points 1.1–1.4, 2.1.1), additional data on Triassic and Jurassic radiolarians of western Serbia (Figs. 1, 2, points 1.5–1.9, 2.1.2, 2.1.3, 2.2.1), the first data on Cretaceous radiolarians of western Serbia (Figs. 1, 2, point 2.1.4), and new data on Jurassic and Early Cretaceous radiolarians of eastern Serbia (Figs. 1, 2, point 3.1).

PREVIOUS WORKS

Until the 1960s (Ćirić, 1958), the age of the Triassic and Jurassic cherts and radiolarites in western Serbia and Bosnia (Katzer, 1903) had been determined according to their geological position and certain Middle Tri-

Fig. 1. Simplified map of localities in Bosnia and Serbia; asterisks indicate the sections studied.

assic gastropod records in limestone. However, since the end of the 1980s, micropaleontological data: radiolarians from Middle and Upper Triassic to Upper Jurassic cherts and radiolarites and foraminifers from Upper Cretaceous cherty limestone have been recorded (e.g., written communication, Goričan, 1988; Karamata et al., 2005; etc.). However, they were confined to certain widely distributed occurrences and particular olistoliths and blocks.

Only one locality with one sample of Triassic (Middle Triassic, Upper Ladinian, Longobardian) radiolarians is known in Bosnia and Herzegovina (Tekin and Mostler, 2005a, 2005b), but it belongs to the external Dinarides named as the Dalmatian–Hercegovinian Zone known as the "High Karst Nappe" which is composed of Mesozoic carbonates (Dimitrijević, 1997) or considered as the Dalmatian–Hercegovinian composite terrane (Karamata et al., 2004a). It outcrops within cherty limestone from a floated block located at the Varoski Creek, 2 km west of Fojnica in the vicinity of Gacko near the Gacko–Mostar road (latitude 43°13'40" N; longitude 18°25′50″ E), in the southern part of Herzegovina. Radiolarians were obtained from a single limestone, Sample 88-272, which was collected by L. Krystyn (Austria) from a floating block. Because the sample was taken from a block, it is not clear whether it came from the limestone sequence below or above the tuffaceous claystone–chert intercalation of this succession (Tekin and Mostler, 2005a). In this sample, Kozur and Mostler (1996a, 1996b, 2006) and Tekin and Mostler (2005a, 2005b) described more than 160 radiolarian species, including 129 regarded as new.

We write here about the section of Fojnica, because it is the only section that represents the DHCT tectonic units with the richest radiolarian fauna, which suggests the assignment of this assemblage to the early Late Longobardian *Spongoserrula fluegeli* Subzone of the *Muelleritortis cohleata* Radiolarian Zone. Moreover, the age is confirmed by the presence of the conodont *Budurovignathus mungoensis* (Diebel) (Kozur and Mostler, 1996a, 1996b). Dimitrijević (2001) emphasizes that the Middle Triassic cherts are a pelagic episode within a carbonate platform succession. Regionally, this radiolarian-bearing sequences include pelagic sediments, such as cherty limestone, tuffaceous clay-

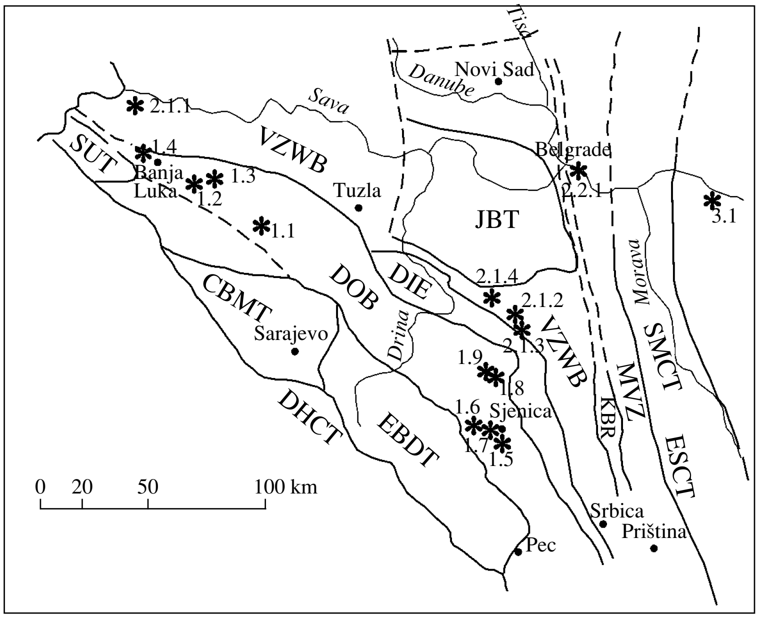


Fig. 2. Tectonic schematic map of the Balkan Peninsula (after Karamata et al., 1997, 2000) with the position of the localities studied. Designations: (*DHCT*) the Dalmatian–Hercegovinian composite terrane, from a Carboniferous geological unit with a post-Carboniferous cover; (*SUB*) Sana-Una-Banija-Kordun terrane, from the middle of a Cretaceous geological unit; (*CBMT*) Central Bosnian mountains terrane, from a Permian geological unit with flysches in the northeast; (*EBDT*) East Bosnian–Durmitor terrane, from an Upper Jurassic geological unit; (*DOB*) Dinaridic Ophiolite Belt; (*DIE*) Drina–Ivanjica terrane/element; (*VZWB*) Vardar Zone Western Belt; (*JBT*) Jadar block terrane, from the middle of a Cretaceous geological unit; (*KBR*) Kopaonik block and ridge; (*MVZ*) Main Vardar Zone; and (*SMCT*) Serbo–Macedonian composite terrane, from the middle of a Carboniferous geological unit; localities: (1.1) Jezeračka Reka, (1.2) Uslomac Mountain, (1.3) Jotanovići–Lipnje, (1.4) Ivanjska quarry, (1.5) Zaboj, (1.6) Krš Gradac, (1.7) Sjenica, (1.8) Visoka, (1.9) Mali Rzav River, (2.1.1) Crna Reka, (2.1.2) Ovčar Kablar gorge, (2.1.3) Čačak, (2.1.4) Struganik, (2.2.1) Grocka, and (3.1) Pesača.

stone, and radiolarites, and can be used for correlation and paleogeographic reconstructions.

The age of rožnaci of the Dinaridic Ophiolite Belt in Bosnia was determined as Triassic to Jurassic in accordance with the stratigraphic position between Triassic Carbonate Formation and Tithonian–Neocomian Flysch Formation and scarce finds of an Upper Triassic conodont within a limestone interlayer along with Middle?–Upper Jurassic radiolarians (Karamata et al., 2004a). Only the rožnaci within pillow lavas of the Vardar Ophiolite Belt in the northern part of Bosnia were dated as the Campanian to Maastrichtian based on foraminifers from a limestone interlayer (Karamata et al., 2005).

The first Triassic radiolarians in the Dinaridic and Vardar ophiolite belts in Serbia were recorded by Š. Goričan (Obradović et al., 1986; Obradović and Goričan, 1988). There are some references to several localities of Triassic radiolarians in Serbia, including two localities of Middle Triassic radiolarians, which are in the Ovčar Banja–Čačk section of the Western Belt of the Vardar Zone and one between Bistrica and Priboj in the Dinaridic Ophiolite Belt (Obradović and Goričan, 1988). The Ladinian radiolarians *Pseudostylosphaera japonica* (Nakaseko et Nishimura), *Oertlispongus inaequispinosus* Dumitrica, Kozur et Mostler, and *Triassistephanidium laticornis* Dumitrica were determined from an olistolith (Sample 32) of the "porphyrite–chert complex" of the Dinaridic Ophiolite Belt in a section located at the Bistrica–Priboj road (Obradović and Goričan, 1988, p. 55, text-fig. 4.3, photographs 1–3). The latest Illyrian–Longobardian radiolarians were reported from the olistolith (Sample 17) in a section located on the road near Ovčar Banja (on the road Ovčar Banja–Užička Požega); and some (*Falcispongus* sp., *Baumgartneria* sp., *Oertlispongus inaequispinosus* Dumitrica, Kozur et Mostler, *Pseudostylosphaera* sp., *Triassocampe scalaris* Dumitrica, and *Eptingium manfredi* Dumitrica) were figured (Obradović et al., 1986, pl. 1, photographs 1–10; Obradović et al., 1987–1988, pl. 1, photographs 1–10; Obradović and Goričan, 1988, text-fig. 4.2, photographs 7–11). A radiolarian association with *Triassocampe* sp., twisted spine, *Capnuchosphaera* sp., and *Vinassaspongus transitus* Kozur et Mostler from the "Diabase–Chert Formation" section (Sample 232/11) located at the Čačak–Ovčar Banja road, near the first dam was dated as Ladinian–Norian

(Obradović and Goričan, 1988, p. 55, text-fig. 4.3, photographs 4–8). Late Triassic radiolarians are well known in the Vardar Zone of Serbia. The radiolarian assemblage from the "Diabase-Chert Formation" section (Sample 14) located at the Čačak to Ovčar Banja road, including *Latium longulum* Blome, *Capnodoce anapetes* De Wever, *Capnodoce* sp., *Capnuchosphaera triassica* De Wever, *Kahlerosphaera ?* sp. (Obradović and Goričan, 1988, p. 55, text-fig. 4.3, photographs 9–13), and assemblages with *Latum* sp., *Capnodoce anapetes* De Wever, *Capnuchosphaera* sp. near the occurrences of pillow lavas at the Čačak–Ovčar Banja road were dated Late Carnian–Middle Norian (Obradović et al., 1986, pl. 1, figs. 11–15). Carnian (dentifications) radiolarians (*Excursion* Guide …, 2006) were also reported from the Vardar Zone in the red chert associated with basalt of an olistolith at the road to Valjevo, 3 km from Koana (Bukovi locality, unpublished data provided by L. Dosztaly). In the Dinaridic Ophiolite Belt, Late Triassic (Carnian–Norian) radiolarians are more abundant, coming from Sjenica (Goričan et al., 1999), Krš Gradac, and vicinity of Gostilje (unpublished data by Dosztaly). Goričan was the first to recognize Late Triassic radiolarians in the Dinaridic Ophiolite Belt. The latest Carnian–late Middle Norian radiolarian association comes from the chert olistolith near Sjenica, where *Capnodoce anapetes* De Wever, *Capnodoce* sp., *Capnuchosphaera crassa* Yeh, *C. theloides* De Wever, *Japonocampe nova* (Yao), *Kahlerosphaera* sp., *Nabolella* sp., *Nakasekoellus pessagnoi* (Nakaseko et Nishimura), *Xiphoteca* sp., *Whalenella* sp. were identified and figured (Goričan et al., 1999). L. Dosztaly (Hungary) determined Upper Triassic (Carnian–Norian) radiolarians (without species list) in a radiolarite fragment of the Olistostrome 8 km west of Sjenica near the Krš Gradac locality (*Excursion Guide* …, 2006). The Carnian radiolarian assemblage was also recorded in a radiolarite block associated with basalts on the bank of the Katushnica River near Gostilje (personal communications of L. Dosztaly).

Jurassic radiolarian-bearing siliceous sediments were also described in the Dinaridic and Vardar ophiolite belts as blocks widely varying in size from the olistostrome melange, i.e., from deposits of the subduction trench (Karamata, 2006). Within the Dinaridic Ophiolite Belt, both Jurassic and Triassic Serbian radiolarians were described for the first time by Goričan (written communication, 1988, 1990; Obradović and Goričan, 1988; Obradović et al., 1986, 1988).

At present, scientific literature provides information on several localities of Jurassic radiolarians in Serbia, including Middle Jurassic localities between Bistrica and Nova Varoš, in Mileševka, at Zlatar, Krš Gradac, Lokvice (Goričan, written communication, 1988; Obradović et al., 1988; Đerić, written communication, 2002); Late Jurassic radiolarians are more abundant in the following areas of Serbia: Krš Gradac, Bistrica, Sjenica, Pavlovića Brod, and Trijebinska Reka (unpublished data by Goričan and Đerić). Late Bajocian to Oxfordian (most likely Bathonian to Callovian) radiolarians from red cherts (Sample Zl 3) of melange at the Lokvice quarry on the southern flank of Zlatar Mountain of the Dinaridic Ophiolite Belt were reported by Š. Goričan (*Excursion Guide* …, 2006). Late Bathonian to Early Tithonian radiolarians were recorded by many authors (Š. Goričan, Slovenia; L. Dosztaly, Hungary; N. Đerić, Serbia) in different stratigraphic intervals of the chert olistolith named Krš Gradac (*Excursion Guide* …, 2006). The Callovian–Early Kimmeridgian association, with illustrations of the species *Triactoma jonesi* Pessagno, *T. blakei* (Pessagno), *Eucyrtidiellum unumaensis* (Yao), *Parvicingula dhimenaensis* Baumgartner, *Unuma* sp., *Hsuum maxwelli* Pessagno, *Spongocapsula* sp., *Sethocapsa* cf. *trachyostraca* Foreman, *Stichocapsa* cf. *convexa* Yao was determined by Š. Goričan (Obradović et al., 1986, 1987–1988; Obradović and Goričan, 1988) from the "Diabase–Chert Formation" section (Sample 37) located at the Nova Varoš–Bistrica road (also in the Dinaridic Ophiolite Belt). Moreover, Kimmeridgian–Tithonian (at a depth of 1400 m) and Oxfordian–Hauterivian (at 1378 m) radiolarians were recorded by Goričan (written communication, 1984) in the course of age determination of hydrogeological borehole No. 6267 (G-1, Vrtine Grocka), drilled 20 km southeast of Belgrade.

Thus, during these investigations, Triassic and Jurassic radiolarians from Bosnia and Serbia were determined or recorded within siliceous deposits; however, systematic descriptions of this radiolarian microfauna has not been performed.

METHODS

In the last few years, intense work devoted to the age determination of these radiolarian-bearing rocks was performed (Karamata et al., 2004a, 2004b; Djerić and Vishnevskaya, 2005, 2006; Vishnevskaya and Djerić, 2005, 2006b). To date, we have recognized some new radiolarian assemblages in Bosnia and Serbia. Well-preserved radiolarians were extracted from 70 samples of chert and siliceous limestone beds interstratified in a sequence of basalt–chert in different units of the Dinaridic and Vardar zones. The distribution of 70 radiolarian samples within sections is established.

The chert samples were treated with hydrofluoric (1–3%) acid. The siliceous limestone samples were treated with acetic (10%) and hydrofluoric (1–5%) acids. The residues of acid treatment, which have provided a well-preserved fauna were studied for taxonomic and biostratigraphic purposes. We summarize available data and add our new results. The taxonomic composition of 39 samples is analyzed. In the present study, we describe and illustrate radiolarian species extracted from 13 samples. The taxonomic list includes 72 taxa and 3 plates of Jurassic radiolarians of Bosnia and Herzegovina, 3 plates of Triassic, 1 plate of Middle Jurassic and 1 plate of Upper Cretaceous radiolarians of Serbia. Occurrence charts of 39 samples examined are shown in 9 tables.

An ISI-160 SEM microscope housed in the Geological Institute of the Russian Academy of Sciences, Moscow (GIN) was used for precise identification and illustration of the radiolarians.

GEOLOGICAL SETTING

The Balkan Peninsula is composed of two geotectonic units of cardinal importance: the Dinaridic Ophiolite Belt, a complex mosaic with the continental crust, and the Vardar Zone, representing a trace of a large oceanic realm (Dimitrijević, 1997). The Dinaridic Ophiolite Belt extends from western Serbia westward to northwestern Bosnia and southward to Albania (Fig. 2), western and central Greece, and further east (Karamata et al., 2004a).

The name of the Vardar Zone is derived from the Vardar River running through it from Skopje to its mouth (Kossmat, 1924). It represents a scar of the Vardar Ocean, i.e., the western part of the Neotethys in Mesozoic Alpine paleogeography. In this geotectonic unit, the Vardar Zone Western Belt, the Kopaonik Block and Ridge unit, and the Main Vardar Zone (Fig. 2) are recognized (Karamata et al., 1997).

The analysis of radiolarians mostly follows the geologic units established by Karamata et al. (1997) (Fig. 2): the Dalmatian–Hercegovinian Composite Terrane (*DHCT*), Sana-Una Terrane (*SUT*), Central Bosnian Mountains Terrane (*CBMT*), East Bosnian–Durmitor Terrane (*EBDT*), Dinaridic Ophiolite Belt (*DOE*), Vardar Zone Western Belt (VZWB), Jadar Block Tectonic Zone (*JBT*), flanks of the Kopaonik Block and Ridge (*KBR*), and the Main Belt of the Vardar Zone (*MVZ*), Serbo-Macedonian Composite Terrane (*SMCT*); in addition, some radiolarian-bearing siliceous sediments from the units of the Carpatho–Balkanids of eastern Serbia are involved. Later on, they will be classified according to the occurrences from the west or north to the east and south and, finally, considering their age.

Vishnevskaya et al. (2009) described in detail the lithostratigraphic sections considered in this study. Here we pay attention to radiolarian-bearing units of the sections investigated in Bosnia and Serbia.

DESCRIPTIONS OF STRATIGRAPHIC SECTIONS WITH RADIOLARIAN-BASED BIOSTRATIGRAPHY

1. Dinaric Ophiolite Belt

The first reports on Jurassic radiolarians of Bosnia were obtained as a result of joint Russian–Serbian research in 2000 in the Maslovare-Teslić profile (Karamata et al., 2004a). New data on radiolarians from siliceous chert in western Serbia and central Bosnia were obtained during field work in 2003 to 2006 and partly presented at the 32nd Session of the International Geological Congress in Florence (Karamata et al., 2004b) and INTERRAD 11 in Wellington (Vishnevskaya and Djerić, 2006a).

The best outcrops of Jurassic radiolarites are situated along the western margin of the Dinaridic Ophiolite Belt, with the best exposures at Uzlomac Mountain., eastern and northern Maslovare, about 35 km southeast of Banja Luka in Bosnia. The richest localities of Middle–Late Jurassic radiolarians have been discovered at the Jezeračka Reka, Maslovare (Pls. 1, 2) and Late Jurassic to Early Cretaceous in the Jotanovići sections.

1.1. Jezeračka Reka Section

In the region under study, a classical sequence of rožnaci was described in the Jezeračka Reka section east of Jezera (Figs. 1–4). The *lower member* of the sequence (165 m) is mostly composed of massive red-to-violet, sometimes gray chert (Fig. 4). Beds of chert are very often recognized as radiolarites and sampled for radiolarian analysis (Samples 1-16, 1-15, 1-14, 1- 14a, 1-13, 1-12). The biostratigraphy of radiolarian assemblages in all sections is based mainly on the Unitary Associations or Unitary Association Zones (UAZ) of Baumgartner et al. (1995), which were calculated to obtain radiolarian ages and zonation for the Middle–Late Jurassic and Early Cretaceous.

Samples 1-15 and 1-16 were taken at the bottom of the section, at 30 and 5 m from the bottom level (Fig. 4). The samples have yield a scarce radiolarian fauna; however, the presence of *Striatojaponocapsa plicarum plicarum* (Yao) ranging from Late Bajocian to Middle Bathonian (UAZ 4 to UAZ 5) and *Eucyrtidiellum unumaensis pustulatum* Baumgartner, with the last appearance data in Late Bathonian–Early Callovian (UAZ 7 and UAZ 8), indicates Bajocian–Bathonian age.

Samples 1-13 and 1-13a come from the *middle* part of the lower member (75 m above the bottom) and contain assemblages indicative of the terminal Bajocian–basal Callovian (Table 1). The radiolarian assemblage is characterized by well-preserved and abundant index species. The age is determined based on the first appearance of *Tetradicryma pseudoplena* Baumgartner in the latest Bajocian–Early Bathonian and the last

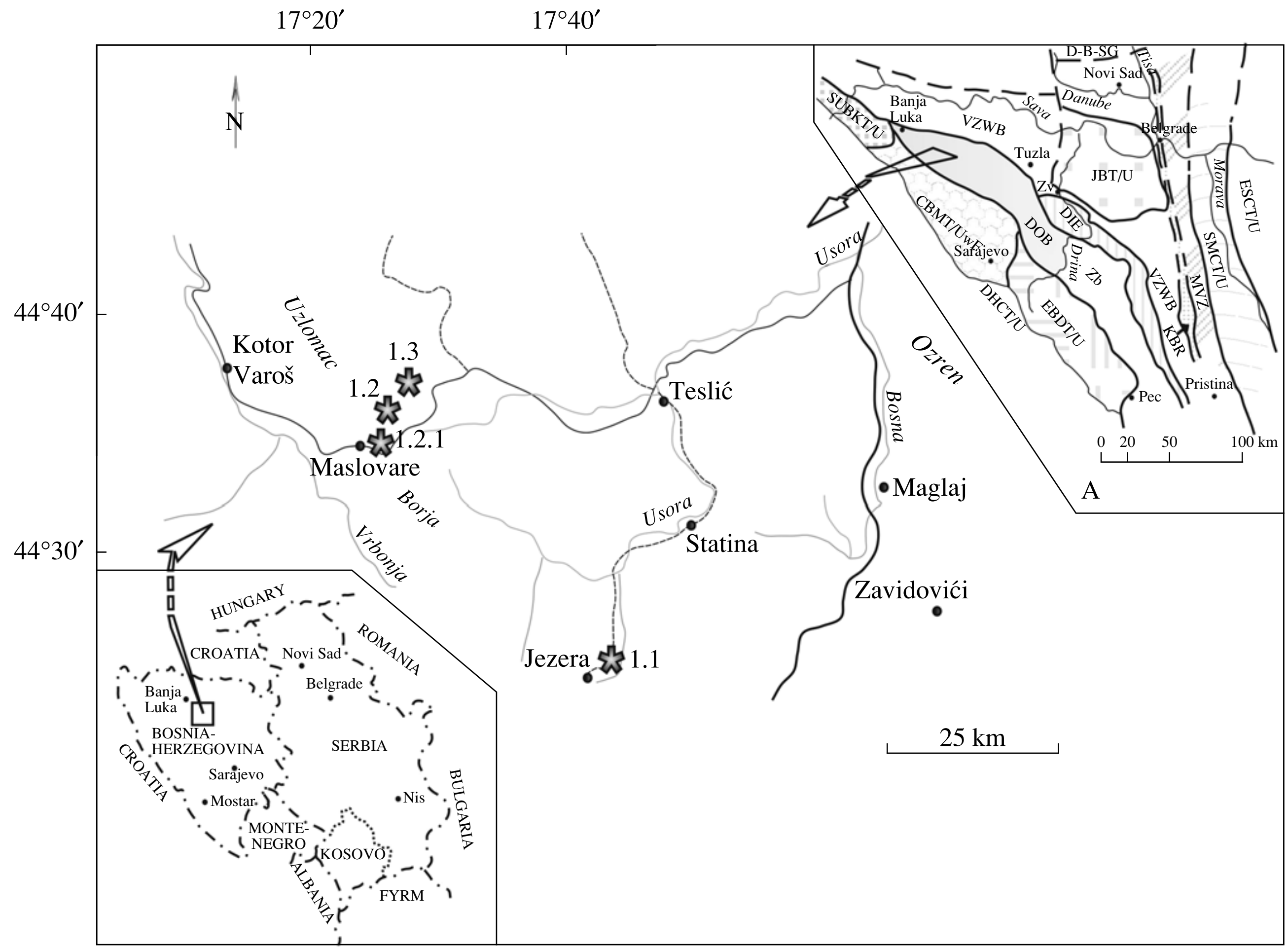


Fig. 3. Location of sections in more detail; localities: (1.1) Jezeračka Reka, (1.2) Uzlomac Mountain, (1.2.1) Maslovare, and (1.3) Jotanovići–Lipnje.

occurrence of *Parahsuum officerence* Pessagno in the Early Callovian (Baumgartner et al., 1995).

Sample 1-12 was taken in the *upper* part of the lower member (20 m below the top) and contains an uppermost Callovian–Oxfordian assemblage with *Pantanellium meraceibaence* Pessagno et MacLeod, *Archaeospongoprunum imlayi* Pessagno, *Triactoma blakei* Pessagno, *Tritrabs ewingi* Pessagno, *Cinguloturris carpatica* Dumitrica, *Podobursa helvetica* (Rüst), *P. triacantha* (Fischli), *Dibolachras chandrika* Kocher, *Eucyrtidiellum nodosum* Wakita (Pl. 1), and others (Table 1). The age is determined by the last occurrence of *Podobursa helvetica* (Rüst) in Oxfordian–Early Kimmeridgian, the first appearance of *P. spinosa* Ozvoldova in UAZ 8 (Middle Callovian–Early Oxfordian), and the presence of *Pantanellium meraceibaence* Pessagno et MacLeod, which is restricted to Callovian–Oxfordian (Baumgartner et al., 1995; Hull, 1997; De Wever et al., 2001).

The middle member of the sequence (82.5 m) is composed mostly of red clayey chert (3–5 cm) alternating with chert (8–12 cm) in the bottom part (2.5 m from the bottom, Sample 1-1) and light gray chert (2–5 cm) alternating with red cherty limestone (42.5 m from the bottom, Sample 1-6, see Table 1) in the middle part. The upper part of the middle member of this sequence contains light gray limestone with lenses of red-to-black chert or siliceous limestone with *Calpionelles* (*Calpionella* Lorenz; Samples 1–7) and recrystalized Tithonian radiolarians. The Oxfordian–Kimmeridgian radiolarian assemblage of Jezeračka Reka (Fig. 4, Samples from 1-1 to 1-4) is represented by the following species: *Homoeoparonaella argolidensis* Baumgartner, *Archaeodictyomitra apiarium* (Rüst), *Cinguloturris carpatica* Dumitrica, *Eucyrtidium ptyctum* (Riedel et Sanfilippo), *Transhsuum brevicostatum* Ozvoldova, *Hsuum* cf. *maxwelli* Pessagno, *Podobursa spinosa* Ozvoldova, *Dibolachras chandrika* Kocher, *Spongocapsula palmerae* Pessagno, and others (Table 1), while the Kimmeridgian–Tithonian assemblage of Jezeračka Reka (Sample 1-6) includes *Acanthocircus minispineus* Yang, *Tritrabs* cf. *ewingi* Pessagno, *Triactoma jonesi* Pessagno, *Eucyrtidiellum ptyctum*

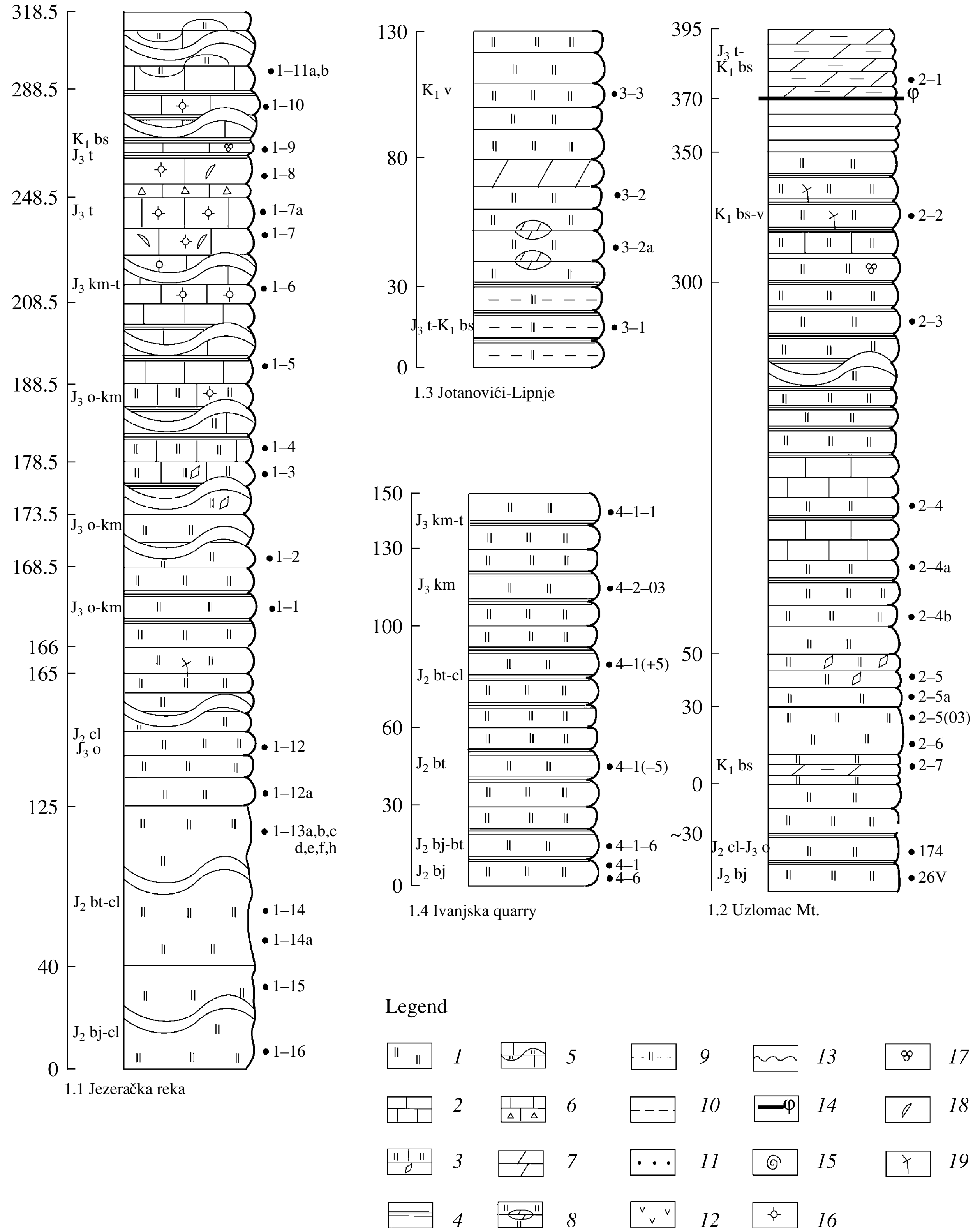
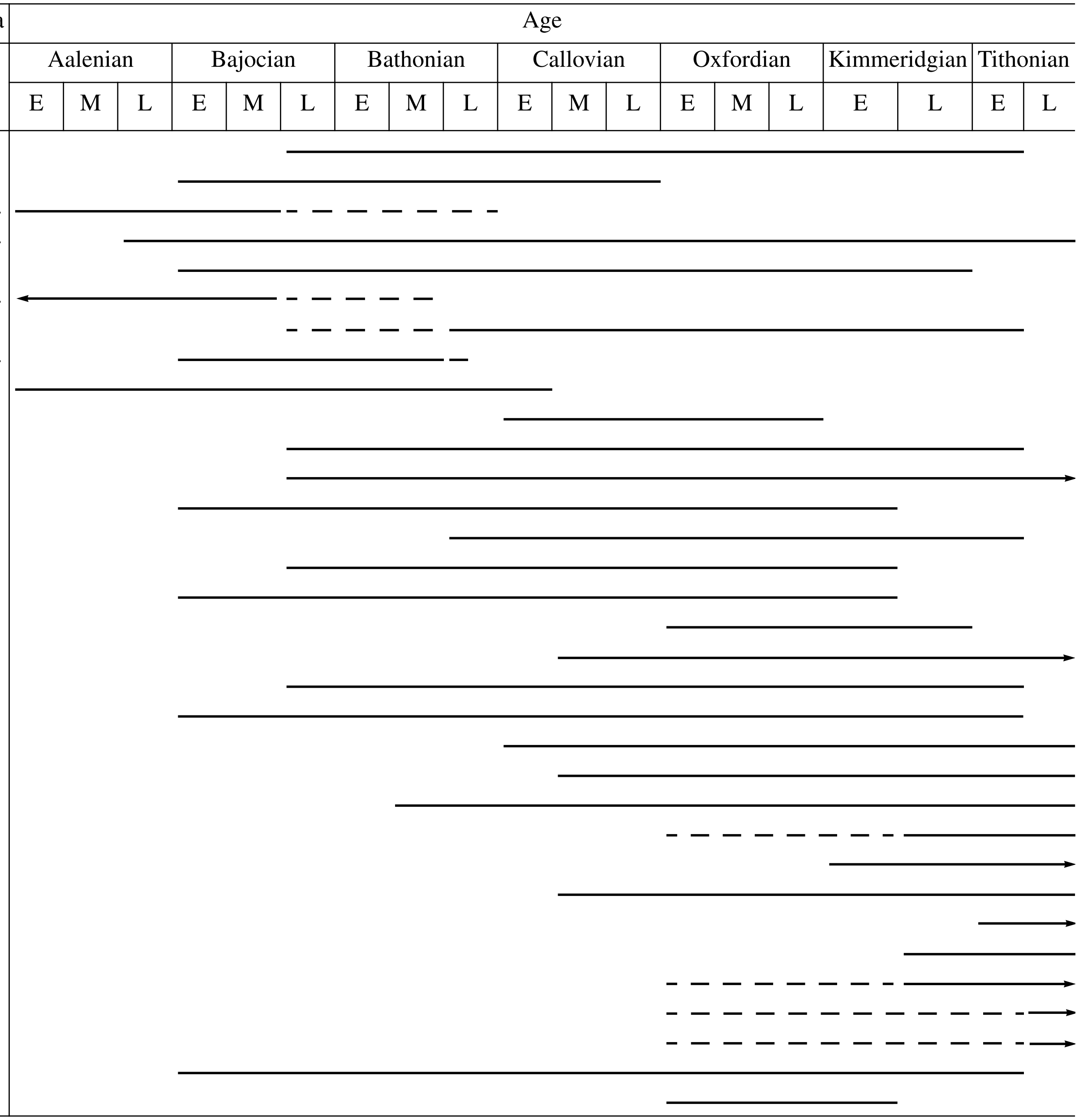


Fig. 4. Sample position and lithological logs of the sections examined: (1.1) Jezeračka sequence, (1.2) Uslomac Mountain, (1.3) Jotanovići–Lipnje, and (1.4) Ivanjska quarry (Bosnia). Designations: (*1*) chert (rožnaci), (*2*) limestone, (*3*) dolomitic limestone chert, (*4*) silicified chert, (*5*) lens of chert in limestone, (*6*) clastic and organic–detrital limestone, (*7*) marlstone, (*8*) lens of marlstone in chert, (*9*) clayey chert, (*10*) claystone, (*11*) sandstone, (*12*) basalt and pillow basalt, (*13*) disconformity, (*14*) tectonic contact, (*15*) ammonite, (*16*) radiolarians, (*17*) foraminifers, (*18*) calpionellids, (*19*) sponge spicule, and (*20*) tectonostratigraphic relationship.

Table 1. Ranges of some significant radiolarian species of the Jezeračka section

Species \ Samples	Jezeračka reka 1-6	1-1	1-12	1-13
Tetradycrima pseudoplena				●
Staurosphaera antiqua				●
Emiluvia splendida				cf.
Triactoma jonesi	●	cf.		cf.
Archaeospongoprunum ex gr. *imlayi*			●	●
Canoptum dixoni				cf.
Cinguloturris carpatica				●
Hsuum mirabundum				cf.
Parahsuum officerence				●
Pantanellium meraceibance			●	
Triactoma blakei			●	
Tritrabs ewingi			●	
Podobursa helvetica	cf.	●	●	
Dibolochras chandrica		●	●	
Stichocapsa robusta			●	
Eucyrtidiellum nodosum			●	
Transhsuum okamurai			cf.	
Archaeodictyomitra apiarium		●		
Eucyrtidiellum ptyctum	●	●	●	
Transhsuum brevicostatum		●		
Hsuum maxwelli		cf.		
Podobursa spinosa		●	●	
Spongocapsula palmerae		●		
Acanthocircus minispineus	●	●		
Podocapsa sp. aff. *P. amphitreptera*	●	●		
Podobursa sp. aff. *P. spinosa*	●	●	●	
Sethocapsa cetia	●	●		
Paculinapora marsupiala	●			
Alievium helenae	●			
Obesacapsula ruscoensis	●			
Obesacapsula ruscoensis umbriensis	●			
Tethysetta dhimenaensis s.l.	●	●		
Homoeoparonaella argolidensis		●		



(Riedel et Sanfilippo), *Podocapsa* aff. *amphitreptera* Foreman, *Podobursa* aff. *spinosa* Ozvoldova, *Sethocapsa cetia* Foreman, *Paculinapora marsupialia* Dumitrica et Zugel, and others (Table 1). The Oxfordian–Kimmeridgian age is determined based on the first appearance of *Archaeodictyomitra apiara* (Rüst), *Podobursa spinosa* Ozvoldova in the middle Callovian–Early Oxfordian and the last occurrence of *Homoeoparonaella argolidensis* Baumgartner in the Late Kimmeridgian; the Kimmeridgian–Tithonian is based on the first appearance of *Paculinapora marsupialia* Dumitrica et Zugel in the Kimmeridgian and the last occurrence of *Eucyrtidiellum ptyctum* (Riedel et Sanfilippo) in the Tithonian (De Wever et al., 2001).

The Tithonian radiolarian assemblage (Fig. 4, Sample 1-7a) includes *Alievium helenae* Schaaf, *Triactoma* cf. *jonesi* Pessagno, *Eucyrtidiellum ptyctum* (Riedel et Sanfilippo), *Podocapsa* aff. *amphitreptera* Foreman, *Transhsuum brevicostatum* Ozvoldova, *Obesacapsula ruscoensis* Baumgartner, *Spongocapsula palmerae* Pessagno, and *Tethysetta dhimenaensis dhimenaensis* (Baumgartner). This age is supported by the first appearance of *Obesacapsula ruscoensis umbriensis* Jud and the last occurrence of *Eucyrtidiellum ptyctum* (Riedel et Sanfilippo), and *Tethysetta dhimenaensis dhimenaensis* (Baumgartner) in the Tithonian (De Wever et al., 2001).

The *upper member* of the sequence (70 m) consists mostly of red clayey limestone, which has yielded *Calpionelles* (Tithonian to Berriasian *Calpionella alpina, C. elliptica*, Sample 1-8), with lenses of red and green chert containing abundant recrystalized radiolarians. Sometimes siliceous limestone beds contain benthic foraminifers (*Lenticulina*) and sponge spicules.

1.2. Uzlomac Mountain Section

Certain features of this section were described by Karamata et al. (2004a).

The cherts of Uzlomac Mountain, which are synchronous to the upper member of the Jezeračka Reka section, were also sampled (Samples 2-1 to 2-6) along the southwestern–northeastern profile from Maslovare to Jotanovići (Figs. 1–4).

The upper portion of the Uzlomac Mountain section (Sample 2-1) should probably be assigned to the Tithonian–Berriasian based on the co-occurrence of *Podocapsa amphitreptera* Foreman (Kimmeridgian–Berriasian), *Spongocapsula palmerae* Pessagno (Late Bathonian–Early Berriasian), and *Obesacapsula breggiensis* Jud (Late Tithonian–Early Valanginian) (De Wever et al., 2001).

The coeval interval of the Maslovare section (5 km to the north) is composed of red clay and alternation of limestone and chert with light green spiculite chert in the upper part (Samples 2-2 and 2-3) and the middle part (Sample 2-4). The alternation of limestone and chert (Samples 2-2 and 2-3) contains a few planktonic foraminifers and the radiolarians *Acanthocircus minispineus* Yang (Tithonian), *Sethocapsa cetia* Foreman (Kimmeridgian–Berriasian), *Sethocapsa testata* Jud (Berriasian), *Podocapsa amphitreptera* Foreman (Kimmeridgian–Berriasian), *Pseudodictyomitra depressa* Baumgartner (Berriasian–Hauterivian), and *Crolanium* cf. *pythiae* Schaaf (Valanginian–Hauterivian–Barremian), indicating the Berriasian–Valanginian age of the upper part; in the lower part, the presence of *Hsuum raricostatum* Jud (Tithonian–Lower Valanginian) and *Angulobracchia portmanni* Baumgartner (Berriasian–Hauterivian) is indicative of the Berriasian Age of these strata (Table 2).

1.2.1. Maslovare Section

The lowest member of Maslovare Mountain outcrops along the Kotor–Varos–Maslovare road and is dated Middle–Upper Jurassic (Samples 26V, 174; Table 3, Pl. 2). The age from the bottom upwards ranges from the Bajocian (the last occurrence of the index taxon *Bagotum* in Sample 26V according to the Russian Far East Zonation, in which *Bagotum* ranges to the Bajocian) to the Middle Callovian–Oxfordian (co-occurrence of *Stichocapsa robusta* Matsuoka, *Sethocapsa funatoensis* Aita, and *Gongylothorax favosus* Dumitrica) (De Wever et al., 2001; Vishnevskaya, 2001).

1.3. Jotanovići–Lipnje Section

The continual sequences have been investigated in the Jotanovići–Lipnje west-east striking (mostly longitudinal) section (Figs. 1–4). The lower part of the section consists of color radiolarian chert and shale. Blue, reddish, and green radiolarian cherts are intercalated with multidecimetric levels of red shales, with varying degrees of silica. One sample 3-1 was taken at 3 m from the bottom. The radiolarian assemblage found in this sample is documented in Table 2. The sample is assigned to the Late Tithonian–Berriasian based on co-occurrence of *Eucyrtidiellum pyramis* (Aita) (the last occurrence is in the Late Tithonian–Early Berriasian) and *Obesacapsula ruscoensis umbriensis* Jud (the first appearance is in the Late Berriasian) (De Wever et al., 2001). Two succeeding samples (Fig. 4, Samples 3-2 and 3-2a) within a 30–80-m interval indicate the same Late Tithonian–Berriasian age, probably up to the Valanginian, due to the presence of *Suna hybum* (Foreman). The upper part is represented by alternation of green and violet cherts (Sample 3-3), with the radiolarians *Pantanellium squinaboli* (Tan Sin Hok) (Berriasian–Albian), *Angulobracchia portmanni* Baumgartner (Berriasian–Hauterivian), *Homoparonaella peteri* Jud (Hauterivian–Barremian), *Suna hybum* (Foreman) (Valanginian–Barremian), *Bernoullius spelae* Jud (Berriasian–Barremian), *Hsuum* cf. *raricostatum* Jud (Tithonian–Lower Valanginian), *Sethocapsa testata* Jud (Berriasian), *Sethocapsa cetia* Foreman (Kimmeridgian–Berriasian), *Sethocapsa orca* Foreman (Val-

Table 2. Ranges of some significant radiolarian species of Uzlomac Mountain., Jotanovići–Lipnje

Samples / Species	Uzlomac Mt.					Jotanovići–Lipnje		Age								
								Late Jurassic			Early Cretaceous					
	2-2	2-3	2-4	2-5	2-6	3-1	3-3	Oxfordian	Kimmeridgian	Tithonian	Berriasian	Valanginian	Hauterivian	Barremian	Aptian	Albian
Acanthocircus minispineus	●									—	- -	- -				
Sethocapsa cetia	●						●		—	—	—	- -				
Sethocapsa testata	●			●			●				—	- -				
Podocapsa amphitreptera	●	●							—	—	—	- -				
Pseudodictyomitra depressa	●	●					●				—	—	—			
Crolanium pythiae	cf.										- -	—	—	—		
Pantanellium squinaboli							●				—	—	—	—	—	—
Angulobracchia portanni			●		●		●				—	—	—			
Homoparonaella peteri							●					- -	—	—		
Suna hubum							●					—	—	—		
Bernoullius spelae							●				—	—	—	—		
Hsuum raricostatum				●	●		cf.			—	—	- -				
Sethocapsa orca							●					—	—	—		
Obesacapsula verbana							●				—	—	—	—		
Obesacapsula breggiensis							cf.			—	—	—				
Xitus channelli							●					—	—	—		
Xitus horridus				●			●					- -	—	—		
Xitus spicularius							●				—	—	—	—	—	
Tethysetta boessi							●		—	—	—	—	—	—		
Tethysetta cosmoconica							●				—	—				
Tethysetta usotanensis							●				—	—	—	—	—	
Pseudodictyomitra carpatica					●						—	—	—			
Eucyrtidiellum pyramis						●					—	—				
Mirifusus chenodes							●							—		
Acaeniotyle umbilicata				●				—	—	—	—	—	—	—	—	—
Archaeospongoprunum patricki				●						—	—	—	—	—	—	
Mirifusus dianae s.l.			●					←	—	—	—	—	—			
Spongocapsula banale			●								—	—				
Obesacapsula ruscoensis umbriensis			●		●	●					—					
Obesacapsula ruscoensis ruscoensis					●	●					—	—				
Hsuum arabicum					●						—	—				
Paculinapora marsupialia					●					—						
Pseudoeucyrtis acus					●						—	—	—			
Spongocapsula palmerae						●		←	—	—						
Tethysetta dhimenaensis s.l.						●		←	—	—						

Table 3. Ranges of some significant radiolarian species of Maslovare

Species \ Samples	Maslovare		Age																
			Aalenian			Bajocian			Bathonian			Callovian			Oxfordian			Kimmeridgian		Tithonian	
	26V	174	E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	L	E	L
Archaeospongoprunum ex gr. *imlayi*		●				—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Cinguloturris carpatica		●									—	—	—	—	—	—	—	—	—	—	
Transhsuum brevicostatum gr.		●				—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Stichocapsa robusta		●						—	—	—	—	—									
Sethocapsa funatoensis		●											—	—	—	—					
Gongylothorax favosus		cf.											—	—	—	—	—	—			
Eucyrtidiellum ptyctum		cf.						—	—	—	—	—	—	—	—	—	—	—	—	—	
Eucyrtidiellum unumaense pustulatum		●						—	—	—	—	—	—	—	—	—					
Eucyrtidiellum nodosum	●	●				—	—	—	—	—	—	—	—	—	—	—	—	—			
Eucyrtidiellum unumaense s.l.	●					—	—	—	—	—	—	—	—	—	—	—	—				
Hsuum maxwelli	●					—	—	—	—	—	—	—	—	—	—	—	—	—			
Bagotum sp.	●		—	—	—	—	—	—													
Triversus sp.	●					—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	

anginian–Barremian), *Obesacapsula verbana* (Parona) (Berriasian–Barremian), *Obesacapsula* cf. *breggiensis* Jud (Tithonian-Valanginian), *Xitus channelli* Jud (Valanginian–Barremian), *Xitus horridus* Jud (Hauterivian–Barremian), *Xitus spicularius* Aliev (Berriasian–Aptian), *Tethysetta boesii* (Parona) (Callovian–Hauterivian in the Pacific Province or Tithonian–Barremian in the Mediterranian Province), *T. cosmoconica* Foreman (Berriasian–Valanginian), *T. usotanensis* (Tumanda) (Berriasian–Aptian), *Pseudodictyomitra depressa* Baumgartner (Berriasian–Hauterivian), *Mirifusus chenodes* Renz (Barremian), and others, which indicate the Valanginian Age (Table 2), may be up to the Hauterivian. Thus, this faunal assemblage represents very diverse Early Cretaceous (mostly Neocomian) associations and is of particular importance, because we have not had any reference to Cretaceous radiolarians in this region until now.

1.4. Ivanjska Quarry Section

Well-preserved Middle Jurassic (Bajocian–Bathonian and Bathonian–Callovian) and Late Jurassic (Kimmeridgian–Early Tithonian) radiolarians have been discovered in the Ivanjska quarry section, northwest of Banja Luka (Figs. 1, 2, 4, 5). The rožnaci sequence (about 30 m) is very monotonous and represented by alternating red and violet cherts at the bottom (Samples 4-6, 4-1, 4-1-6), green and violet cherts in the middle part from Sample 4-1(-5) to Sample 4-2-03, and red and gray cherts in the upper part (Sample 4-1-1).

The whole succession of the Bajocian to Bathonian, may be also including the Callovian and Kimmeridgian to Tithonian, is recognized here.

Samples 4-6 and 4-1 (Fig. 5) are attributed to the Bajocian (Table 4) based on the presence of *Cyrtocapsa* cf. *mastoidea* Yao and *Eoxitus hungaricus* Kozur (De Wever et al., 2001). Some radiolarians from these samples of the Ivanjska quarry section are represented by the following species shown in Pl. 3: *Triactoma? mexicana* Pessagno et Yang, *Archaeospongoprunum imlayi* Pessagno, *Palinandromeda* cf. *praepodbieleusis* Baumgartner, *Cyrtocapsa* cf. *mastoidea* Yao, and *Praewilliriedellum* cf. *spinosum* Kozur.

Sample 4-1-6 has yielded the following index species: *Eoxitus hungaricus* Kozur (Aalenian–Bajocian), *Unuma echinatus* Ichikawa and Yao (Bajocian–Bathonian), *Hsuum baloghi* Grill and Kozur (Aalenian–Bajocian), *Canoptum latiannulatum* Grill and Kozur (Aalenian–Bajocian), *Cyrtocapsa mastoidea* Yao. The Bajocian Age is determined based on the species ranges (De Wever et al., 2001; Grill and Kozur, 1986).

Sample 4-1-(-5) includes the index taxa *Hsuum bipartitum* Grill and Kozur (Aalenian–Bajocian), *Hsuum fuchsi* Grill and Kozur (Aalenian–Bajocian), *Parahsuum* cf. *magnum* Takemura (Aalenian–Bajocian), and *Pseudodictyomitrella spinosa* Grill and Kozur (Aalenian–Bajocian) as well as *Ristola turpicula* Pessagno et Whalen (Bathonian). The Bajocian–Bathonian age (probably Late Bajocian–Early Bathonian) is determined based on the co-occurrence of *Hsuum fuchsi* and *Ristola turpicula* (Grill and Kozur, 1986; De Wever et al., 2001).

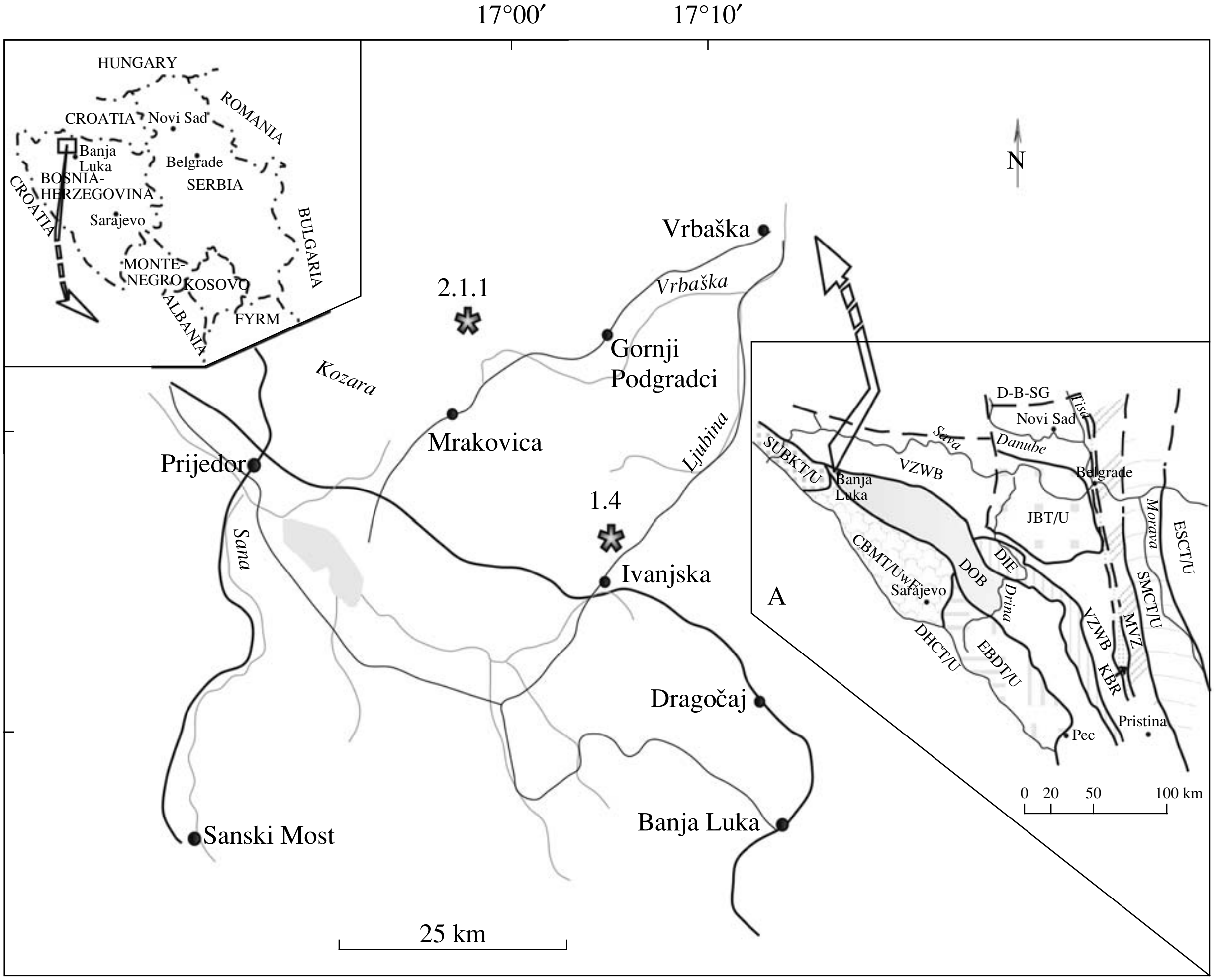


Fig. 5. Location of sections in more detail: (1.4) Ivanjska quarry and (2.1.1) Crna Reka.

The middle part of the Ivanjska quarry section has been sampled from top to bottom: a series of samples from 4-1-5 to 4-1-(+5). Sample 4-1-5 contains the index taxa *Cinguloturris carpatica* Dumitrica (Bajocian–Callovian–Kimmeridgian), *Ristola turpicula* Pessagno et Whalen (Bathonian), and *Tethysetta dhimenaensis* Baumgartner (Bathonian–Tithonian). The Bathonian Age is determined by the index taxon *Ristola turpicula.* The co-occurrence of *Archaeodictyomitra apiarium* (Rüst), *Stichocapsa robusta* Matsuoka, and *Podobursa helvetica* (Rüst) in Sample 4-1-(+5) indicates the Bathonian–Callovian age, while the co-occurrence of *Cinguloturris carpatica* Dumitrica and *Pseudodictyomitra carpatica* Lozyniak in Samples 4-2, 4-2-03 suggests the Kimmeridgian Age (De Wever et al., 2001).

Sample 4-1-1 from the uppermost part of the section, which contains the index species *Zhamoidellum ovum* Dumitrica (Oxfordian–Kimmeridgian), *Cinguloturris carpatica* Dumitrica (Bajocian–Callovian–Kimmeridgian), *Tethysetta dhimenaensis* Baumgartner (Bathonian–Tithonian), and *Thanarla pulchra* (Squinabol) (Late Tithonian–Aptian), was taken just external to the entrance to the quarry. The Kimmeridgian–Tithonian age is determined based on the ranges of index species (Table 4). All the above-mentioned associations from the Ivanska quarry are typical assemblages of open oceanic environments where all groups of cyrtoidal, prunoidal, discoidal, and sphaeroidal radiolarians are very diverse.

Thus, Jurassic along with Early Cretaceous radiolarians are widely represented in continental slope chert sequences in central and northern Bosnia. Moreover, all these Jurassic and Early Cretaceous localities belong to the Dinaride Ophiolite Belt.

Jurassic radiolarian-bearing siliceous rocks are widespread within the Dinaride Ophiolite Belt and continue into the territory of Serbia. They are best represented in western Serbia.

1.5. Zaboj Section

Late Aalenian–Bajocian radiolarians (Figs. 6, 7, Sample 68), recorded about 8 km south of Sjenica in

Table 4. Ranges of some significant radiolarian species of the Ivanjska quarry

Species / Samples	Ivanjska quarry							Age																		
	4-1-1	4-2	4-1-5	4-1-(–5)	4-1-6	4-1	4-6	Aalenian			Bajocian			Bathonian			Callovian			Oxfordian			Kim-meridgian		Titho-nian	
								E	M	L	E	M	L	E	M	L	E	M	L	E	M	L	E	L	E	L
Zhamoidellum ovum	●																	—	—	—	—	—	—	—	—	
Cinguloturris carpatica	●	●	●										- -	- -	- -	—	—	—	—	—	—	—	—	—	—	
Tethysetta dhimenaensis s.l.	●		●								—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Triactoma ? mexicana					●		●						—	—	—	—	—	—	—	—	—	—				
Paliandromeda praepodbielensis					●		cf.	—	—	—	—	—	—	—	—	—	—	—								
Cyrtocapsa mastoidea					●		cf.				—	—	—													
Praewilliriedellum spinosum					●		cf.				—	—	—	- -	- -	- -										
Eoxitus hungaricus					●	●							—	—	—	—	—	—	—	—						
Ristola turpicula			●	●									—	—	—	- -	- -	- -	- -							
Hsuum bipartitum				●				—	—	—	—	—	—	- -	- -	- -										
Hsuum fuschi				●				—	—	—	—	—	—	- -	- -	- -										
Parahsuum magnum				cf.						—	—	—	—	—	- -	- -										
Pseudodictyomitrella spinosa				●				—	—	—	—	—	—	- -	- -	- -										
Acanthocircus amissus					cf.																				—	—
Unuta echinatus					●			—	—	—	—	—	—	—	—	- -										
Hsuum baloghi					●			—	—	—	—	—	- -	- -	- -	- -										
Canoptum latiannulatum					●			—	—	—	—	—	—	- -	- -	- -										
Archaeospongoprunum ex gr. *imlayi*	●		●		●		●				—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Podobursa helvetica		●	●														—	—	—	—	—	—	—	—		
Tethysetta boesii		●															—	—	—	—	—	—	—	—	—	—
Thanarla pulchra	●																								—	—
Eucyrtidiellum ptyctum		●											—	—	—	—	—	—	—	—	—	—	—	—	—	
Hsuum rosebundense						●					—	—	—	—	—	—										

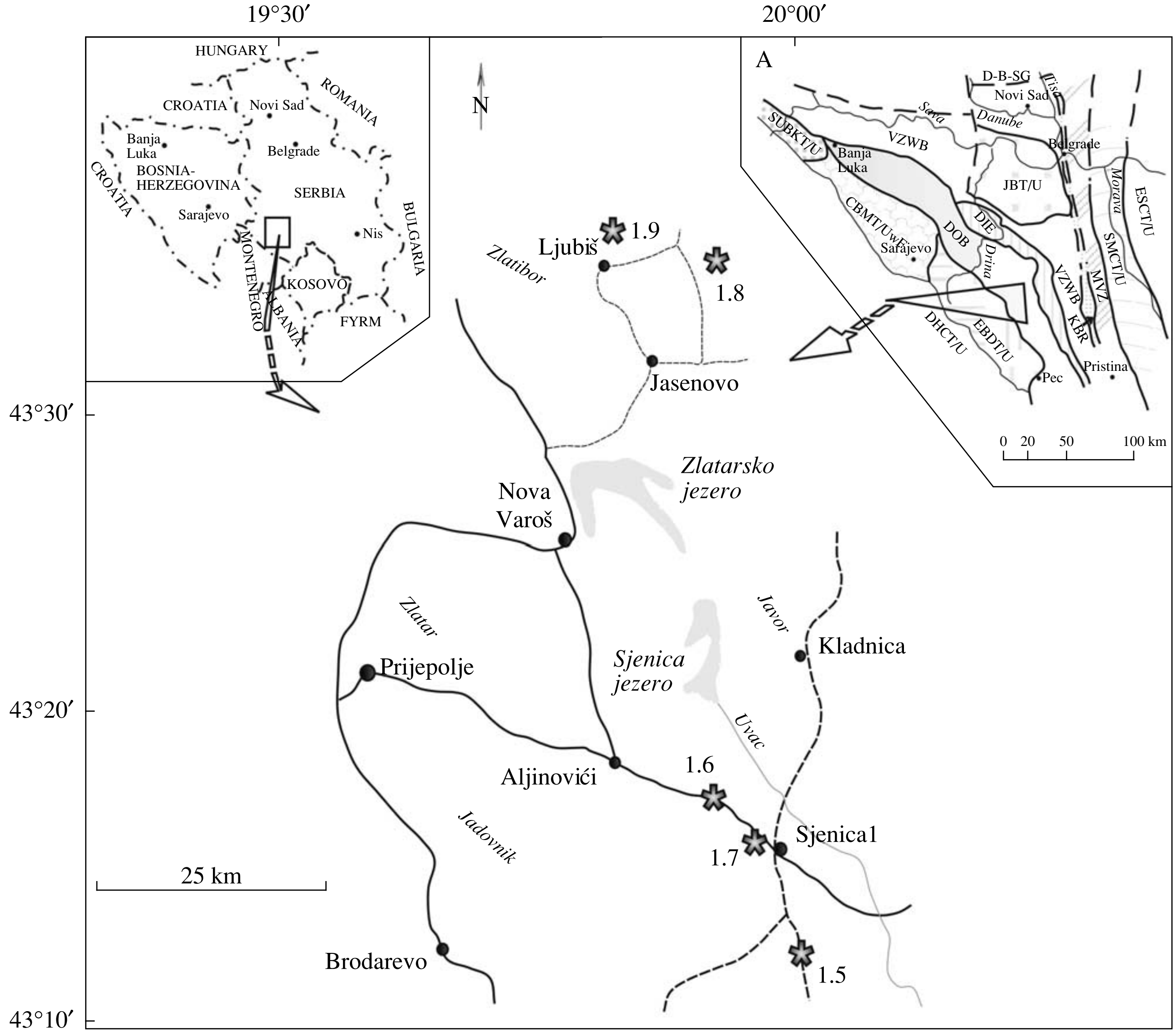
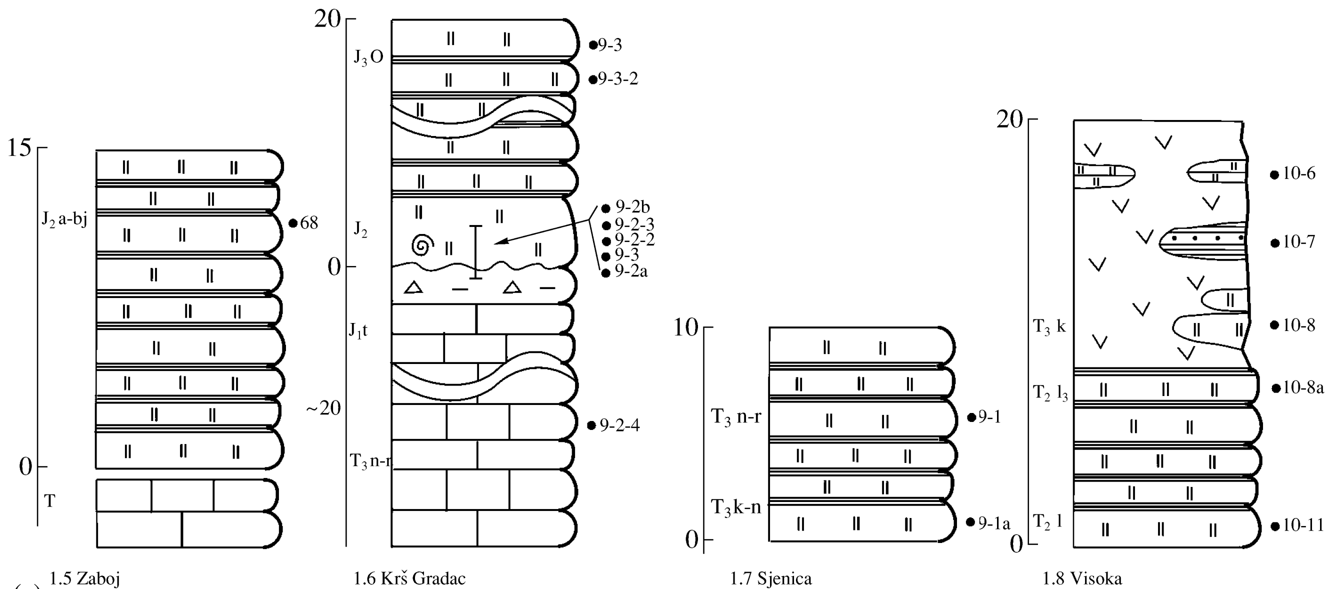


Fig. 6. Location of sections in more detail: (1.5) Zaboj, (1.6) Krš Gradac, (1.7) Sjenica, (1.8) Visoka, and (1.9) Mali Rzav River.

western Serbia (Figs. 1, 2), are of great importance. Firstly, this is one of the oldest records of Jurassic radiolarians. Secondly, radiolarians co-occur with abundant sponge spicule fragments and sponge carcasses. The radiolarian assemblage from Sample 68 was taken in the upper part of a 15-m-thick chert sequence and contains *Hexasaturnalis hexagonus* (Yao), *Triactoma wickiupensis* Pessagno et Yang, *Transhsuum* cf. *hisuikyoense* (Isozaki et Matsuda), *Mirifusus* cf. *proavus* Tonielli, *Parahsuum* cf. *officerense* Pessagno et Whalen, and *P.* cf. *nitidum* Pessagno et Whalen (Pl. 4). The presence of *Mirifusus* cf. *proavus* Tonielli suggests the Late Aalenian–Bajocian age (Table 5). Thirdly, the chert sequence lies above Triassic limestone and the lower part of chert shows the character of a marine lagoon (Dimitrijević, personal communication), while the upper part of the chert traces rim of the shelf-carbonate platform of the Dinaridic marginal sea or its continental slope due to mass co-occurrence (Plate 4) of dichotriaenes and pentactines (Pisera, 1997).

1.6. Krš Gradac Section

Previously, this section in 8 km to the west of Sjenica near Krš Gradac was considered as a large olistolith within a complicate Olistostrome (*Excursion Guide* …, 2006). The section or olistolith is in a creek below the main road, where a local road branches towards Rainovici. The section was investigated just near the bridge and under its. The section (Figs. 1, 3, 5) starts with massive Dachstein limestones, outcropping along (about 60 m) the Sjenica–Prijepolje road. The limestones are



(a)

(b)

Fig. 7. Some sections in the Dinaridic Zone of Serbia: (a) sample positions and lithological logs of the sections: (1.5) Zaboj, (1.6) Krš Gradac, (1.7) Sjenica, (1.8) Visoka, and (1.9) Mali Rzav River (see Fig. 15); for designations, see Fig. 4; (b) an ammonite from the Krš Gradac section.

Table 5. Ranges of some significant radiolarian species of the Dinaridic Belt

Species \ Samples	Zaboj 68	Krš Gradac 9-2b	Krš Gradac 9-3-2	Rzav 10-9
Hexasaturnalis hexagonus	●			
Triactoma wickiupensis	●			
Transhsuum hisuikyoense	cf.			
Mirifusus proavus	cf.			
Parahsuum officerense	cf.			
Parahsuum nitidum	cf.			
Pterotrabs sp. aff. *P. arcuballista*		●		
Pterotrabs marculus		●		
Cinguloturris carpatica		●	●	
Zhamoidellum ovum			●	
Archaeodictyomitra minoensis			●	
Williriedellum crystallinum			cf.	
Acaeniotyle umbilicata			cf.	
Transhsuum brevicostatum gr.			●	●
Eucyrtidiellum unumaensis s.l.			●	●
Eucyrtidiellum ptyctum				●
Eucyrtidiellum nodosum				●
Stichocapsa convexa				●
Hsuum maxwelli				cf.
Stichocapsa globosa				cf.
Striatojaponocapsa plicarum plicarum				●
Williriedellum carpathicum				●

Age

Species	Aalenian E	Aalenian M	Aalenian L	Bajocian E	Bajocian M	Bajocian L	Bathonian E	Bathonian M	Bathonian L	Callovian E	Callovian M	Callovian L	Oxfordian E	Oxfordian M	Oxfordian L	Kimmeridgian E	Kimmeridgian L	Tithonian E	Tithonian L
Hexasaturnalis hexagonus	—	—	—	—	—	—													
Triactoma wickiupensis	↓	—	—	—	—	—													
Transhsuum hisuikyoense			—	—	—	—	—	—	—	—									
Mirifusus proavus			—	—	—	—													
Parahsuum officerense	—	—	—	—	—	—	—	—	—	—									
Parahsuum nitidum				—	—	—													
Pterotrabs sp. aff. *P. arcuballista*										—	—	—	—	—	—				
Pterotrabs marculus										—	—	—	—	—	—				
Cinguloturris carpatica						—	—	—	—	—	—	—	—	—	—	—	—	—	
Zhamoidellum ovum											—	—	—	—	—	—	—	—	
Archaeodictyomitra minoensis														—	—	—	—	—	—
Williriedellum crystallinum									—	—	—	—	—	—	—	—	—	—	
Acaeniotyle umbilicata															—	—	—	—	↑
Transhsuum brevicostatum gr.				—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
Eucyrtidiellum unumaensis s.l.				—	—	—	—	—	—	—	—	—	—						
Eucyrtidiellum ptyctum						—	—	—	—	—	—	—	—	—	—	—	—	—	
Eucyrtidiellum nodosum				—	—	—	—	—	—	—	—	—	—	—	—				
Stichocapsa convexa							—	—	—	—									
Hsuum maxwelli				—	—	—	—	—	—	—	—	—	—	—	—	—			
Stichocapsa globosa				—	—	—	—	—	—	—	—	—							
Striatojaponocapsa plicarum plicarum						—	—												
Williriedellum carpathicum									—	—	—	—	—	—	—	—	—	—	

dated Norian and Rhaetian and contain brachiopod fragments and a few megalodont sectional traces. This outcrop (Fig. 7b) is discussed as the larger olistolith (*Excursion Guide* …, 2006). Just under the bridge (from the bottom upwards), the section is as follows:

about 5 m of fine-grained white limestone (on a fresh surface, it is gray), with Liassic microassociations;

5 to 8 m of pink limestone; in places close to intraformational breccia, with gastropods and reddish limestone with poorly preserved cephalopods;

0.5 to 1.0 m of Rosso Ammonitico, rich in cephalopods of the Early Toarcian age;

hard ground (*Excursion Guide* …, 2006).

Just above the hard ground, red and reddish limestone contains large ammonites (Fig. 7) and a few poorly preserved radiolarians (Samples 9-2, 9-2a) of the genus *Parahsuum*, which look like latest Early–Middle Jurassic forms. In *Excursion Guide* … (2006), this interval is considered to be 0.5 to 1.0 m of red radiolarian schists, which is overlain by 2.5 m of red, green, and dark radiolarite (dated by many authors based on radiolarians as Late Bathonian–Early Tithonian), with bed of graded calcrudite and fragments of Liassic and Upper Kimmeridgian–Portlandian limestones.

Further upwards, color limestones and cherty limestones (Fig. 7, Sample 9-2b) contain radiolarians (Table 5). This sample is dated Middle Jurassic (probably Callovian) due to the co-occurrence of *Pterotrabs marculus* Dumitrica, Baumgartner et Gorican (Bathonian–Callovian) and *P. arcuballista* Dumitrica, Baumgartner et Gorican (Callovian–Oxfordian).

The upper part of the sequence is represented by radiolarites (Samples 9-3-2 and 9-3). The age is determined as Oxfordian because of the co-occurrence of the index taxa *Archaeodictyomitra minoensis* (Mizutani) and *Eucyrtidiellum unumaensis* (Yao) (De Wever et al., 2001).

Moving to the east, new localities of Triassic radiolarians have been found in the Mali Rzav River Basin and to the west of Sjenica.

1.7. Sjenica Section

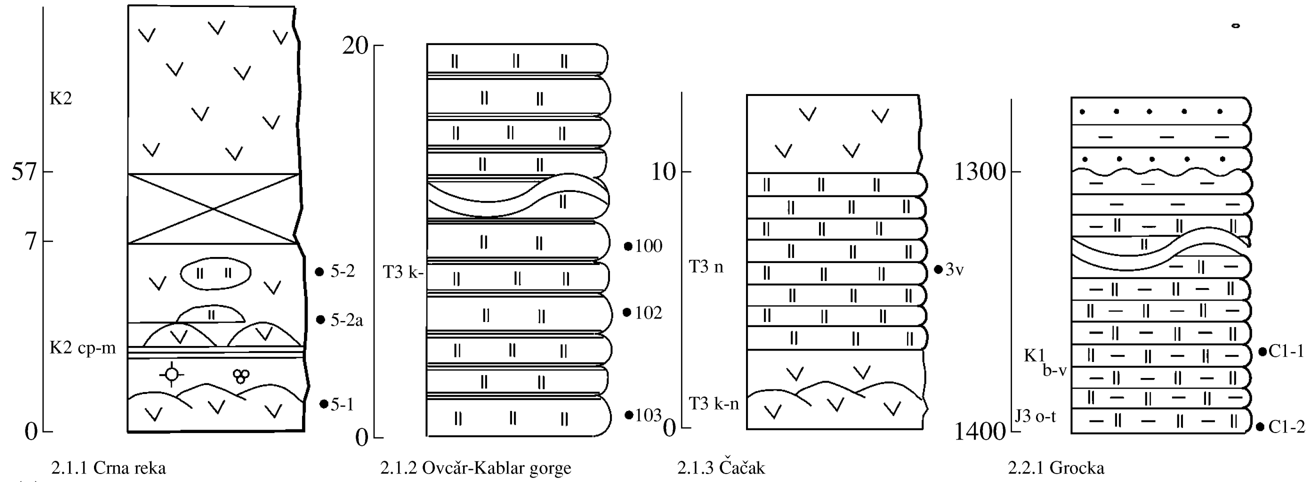
An outcrop is located 3 km west of Sjenica, at the Sjenica–Nova Varoš road, at small local branches off after about 30 m in the road-cut at the southern side. This section was described in detail for the first time by Goričan et al. (1999) as a block or olistolith in melange. We sampled an outcrop of bedded chert on the left bank of the river (just opposite the quarry, about 20 m from the bridge) (Figs. 1, 3, 6).

Along with *Capnodoce anapetes* De Wever, *Capnuchosphera triassica* De Wever, *C. crassa* Yeh, *Latium longulum* Blome, *Japonocampe nova* (Yao), *Nakasekoellus pessagnoi*, and *Whalenella* sp., which were dated by Goričan (Goričan et al., 1999) as the latest Carnian–late Middle Norian, we established a radiolarian assemblage from the bottom of this decameter-sized fragmental chert section in olistolith west of Sjenica (Sample 9-1a, 1 m from the bottom). The assemblage consists of *Capnodoce crystallina* Pessagno, *C. sarisa* De Wever, *Capnuchosphera tricornis* De Wever, *C. lenticulata* Pessagno, *Kahlerosphaera kemerensis* Tekin, and *Canoptum triassicum* Yao. The presence of *Capnodoce sarisa* De Wever (De Wever et al., 1979) and *Kahlerosphaera kemerensis* Tekin (Tekin, 1999) corroborates the latest Carnian–Norian age and supports the upper age limit as the Late Triassic (Norian).

In the upper part of fragmental section (Sample 9-1), the abundant radiolarians *Harsa* cf. *siscwaiensis* Carter, *Capnodoce sarisa* De Wever, *Sarla vetusta* Pessagno, *S.* aff. *viscainoensis* Pessagno, *Capnuchosphera tricornis* De Wever, *C. lenticulata* Pessagno, *C.* cf. *lea* De Wever, *Bistarcum ? cylindratum* Carter, *Kahlerosphaera kemerensis* Tekin, *Deflandrecyrtium curvatum* (Kozur et Mostler), *Proparvicingula moniliformis* Carter, *Canoptum triassicum* Yao, *Multimonilis pulcher* Yeh, *Whalenella regia* Blome, *W. ? speciosa* Blome, *Xiphotheca rugosa* Bragin, and others (Table 6, Pl. 6) are accompanied by the conodonts *Grodella* cf. *deliculata* (Mostler) (Rhaetian). The radiolarian assemblage from this sample can be attributed to the Norian–Early Rhaetian, with the co-occurrence of *Xiphotheca rugosa* Bragin and *Proparvicingula moniliformis* Carter. Similar Triassic radiolarian associations have previously been described from Albania (Kellici and De Wever, 1994, 1995; Chiari et al., 1996; Marcucci and Prela, 1996; Vishnevskaya, 2001, table 138).

1.8. Visoka Section

Middle Triassic radiolarians of the village of Visoka were recorded in the Mali Rzav River Basin (Figs. 1, 3, 6, Pl. 6). There are sporadic outcrops of reddish cherty limestone and cherts associated with basalt and volcano-clastics along the road between Radoshevo and the village of Visoka. Just near the village of Visoka, one sample (10-11) was taken in the lowest part of fragmental section. The presence of *Muelleritortis cochleata* (Nakaseko et Nishimura) and *Pseudostylosphaera coccostyla* (Rüst) indicates the Ladinian Age (Ramovs and Goričan, 1995; Tekin and Mostler, 2004). The second sample (10-8a) was collected in the upper part of the alternating red chert and reddish cherty limestone. The radiolarian assemblage includes *Muelleritortis cochleata* (Nakaseko et Nishimura), *M. granulosum* (Dumitrica, Kozur et Mostler), *Pentaspongodiscus mesotriassicus* Dumitrica, Kozur et Mostler, *Pseudostylosphaera goestlingensis* (Kozur et Mostler), *P. compacta* (Nakaseko et Nishimura), *P. multispinata* Tekin et Mostler, *Triassocampe deweveri* (Nakaseko et Nishimura), *T.* cf. *sulovensis* Kozur et Mock, *T.* cf. *coronata* Bragin, *Spinotriassocampe mesofassanica* Kozur et Mostler, *Eptingium manfredi* Dumitrica, *Oertlispon-*



(a)

(b)

Fig. 8. Some sections in the Vardar Zone: (a) sample positions and lithological log of sections (2.1.1) Crna Reka, (2.1.2) Ovčar-Kablar, (2.1.3) Čačak, and (2.2.1) Grocka; for designations, see Fig. 4; (b, c) alternation of red chert limestone and pillow basalt of the Crna Reka section.

(c)

Fig. 8. Contd.

gus inaquispinosus Dumitrica, Kozur et Mostler, *Pseudostylosphaera japonica* (Nakaseko et Nishimura), *Triassocampe scolaris* Dumitrica, and others. Some of them are shown in Plates 5 and 6. The age is determined as the Middle Triassic (Ladinian) based on the co-occurrence of the radiolarians *Triassocampe deweveri* and *Muelleritortis granulosum* (Tekin, 1999). The presence of *Pseudostylosphaera goestlingensis, P. multispinata*, and *Triassocampe* cf. *sulovensis* (Goričan and Buser, 1990; Kozur and Mostler, 1996a, 1996b; Tekin and Mostler, 2005a, 2005b) suggests the Late Ladinian age (Table 6).

Three samples (Fig. 7) were collected from chert lenses within basalts. The best radiolarian assemblage comes from Sample 10-8. The sample is assigned to the Late Ladinian–Carnian or Carnian due to the co-occurrence of *Spinotriassocampe carnica* (Kozur and Mostler, 1996a) and *Welirella fleurei* (Dumitrica et al., 1980) (Table 6). Samples 10-6 and 10-7 include radiolarians which are indicative of the Triassic.

1.9. Mali Rzav River

The outcrop under study is located 5 km north of the village of Lubish, at a small road in the Mali Rzav River Basin (Figs. 1, 2, 6). It is represented by isolated olistolith of alternating red and green cherts (30 m). A Middle Jurassic (Bathonian) radiolarian assemblage was obtained from an isolated outcrop (Sample 10-9) in this area (shown in Plate 2). The age is determined based on the co-occurrence of *Striatojaponocapsa plicarum plicarum* (Yao) ranging from the Late Bajocian to Middle Bathonian (O'Dogherty et al., 2006) and *Stichocapsa convexa* (Yao) with the last appearance data in the Late Bathonian–Early Callovian (De Wever et al., 2001) (Table 5).

2. Vardar Zone

Available data on radiolarians are restricted to the Western Belt of the Vardar Zone (*VZWB*) and the eastern flank of the Kopaonik Block and Ridge unit.

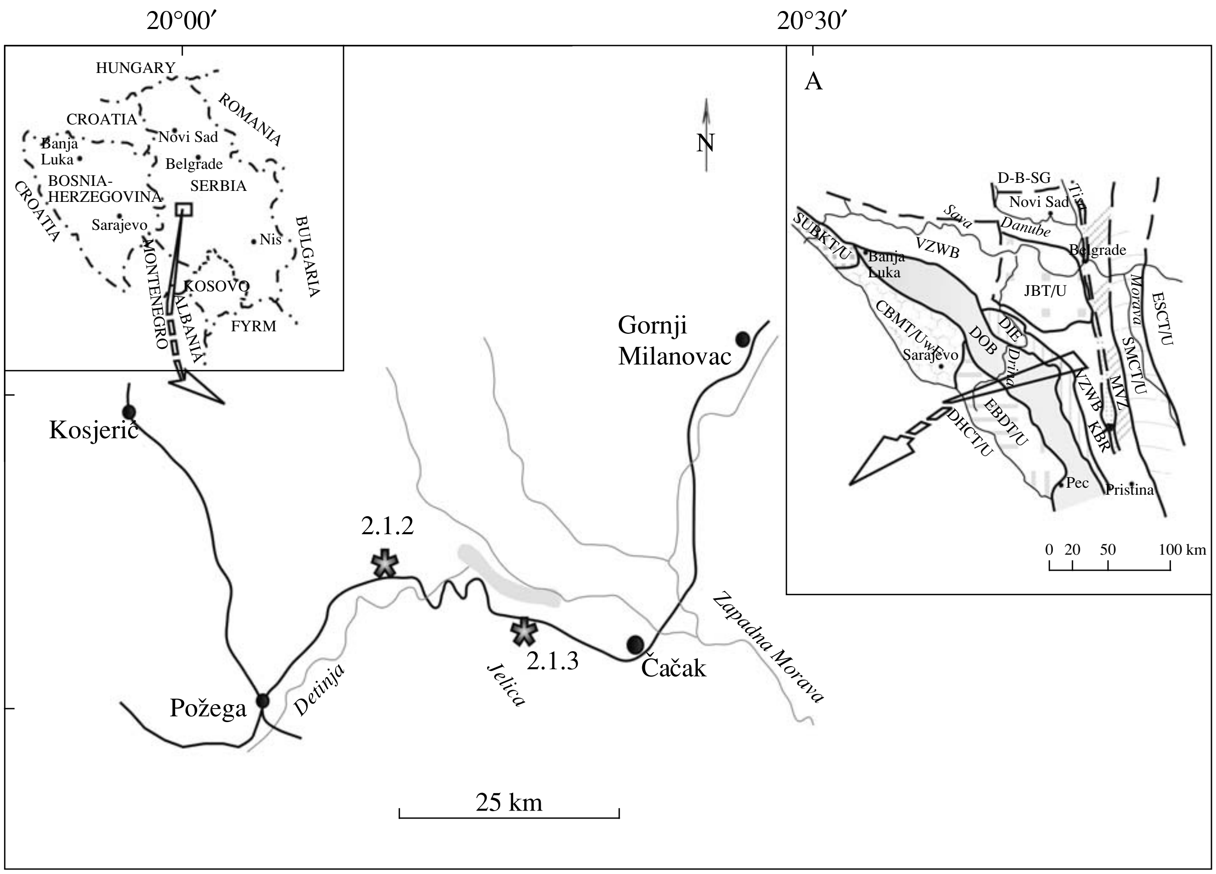


Fig. 9. Location of sections in more detail: (2.1.2) Ovčar-Kablar and (2.1.3) Čačak.

2.1. Vardar Zone Western Belt

In the Vardar Zone Western Belt, radiolarians are known from the Čačak area, Ovčar-Kablar gorge, Struganik in the east (western Serbia), and the Kozara area in the west (northern Bosnia).

2.1.1. Crna Reka

Basalt–chert sequences of the Crna Reka section, Kozara area (Figs. 1, 2, 5, 8), contains radiolarian cherts and siliceous limestone (Fig. 8A, b), with the abundant planktonic foraminifers *Globotruncana arca* (Cushman), *G. stuarti* (De Lapparent), and others, initially determined by Sladić-Trifunović in Karamata et al. (2005) as Campanian–Early Maastrichtian, and a few radiolarians. Based on the data on foraminifers (Grubić et al., 2006), these sediments were probably formed in the Campanian, most likely the Upper Campanian. Samples 5-1, 5-2, and 5-2a contain the radiolarians *Amphipyndax enesseffi* Foreman (zonal species of the Middle–Late Campanian) (Schaaf, 1985), *Crucella espartoensis* Pessagno (zonal species of the Early–Middle Campanian) (Pessagno, 1976), *A. stocki* (Campbell et Clark), and some other species (Table 7), which along with planktonic foraminifers indicate the Campanian Age (most probably Middle Campanian).

2.1.2. Ovčar–Kablar Gorge

The first radiolarian records in the cherts of the Ovčar-Kablar gorge (Figs. 1, 3, 9) were described by Obradović (1986) and Obradović et al. (1986, 1988). To date, we have obtained some additional data.

The radiolarian assemblage from sample 103 is attributed to the Late Carnian–Early Norian due to the co-occurrence of *Capnodoce crystallina* Pessagno and *Capnuchosphaera lenticulata* Pessagno (Tekin, 1999). The Late Carnian–Early Norian assemblage was determined in Sample 102 of this section. It includes *Capnodoce anapetes* De Wever, *Capnuchosphaera triassica* De Wever, *Capnuchosphaera* cf. *lea* De Wever, *Capnuchosphaera theloides* De Wever, *Japonocampe* cf. *nova* Yao, *Xiphotheca rugosa* Bragin, *Loffa ? mulleri* Pessagno. The Late Carnian–Early Norian age is determined based on the co-occurrence of *Capnuchosphaera triassica* and *Xiphotheca rugosa* (Table 6). The presence of *Capnuchosphaera tricornis* De Wever, *Sarla vetusla* Pessagno, and *Spongostylus carnicus* Kozur et Mostler suggests the Late Carnian–Early Norian age, most

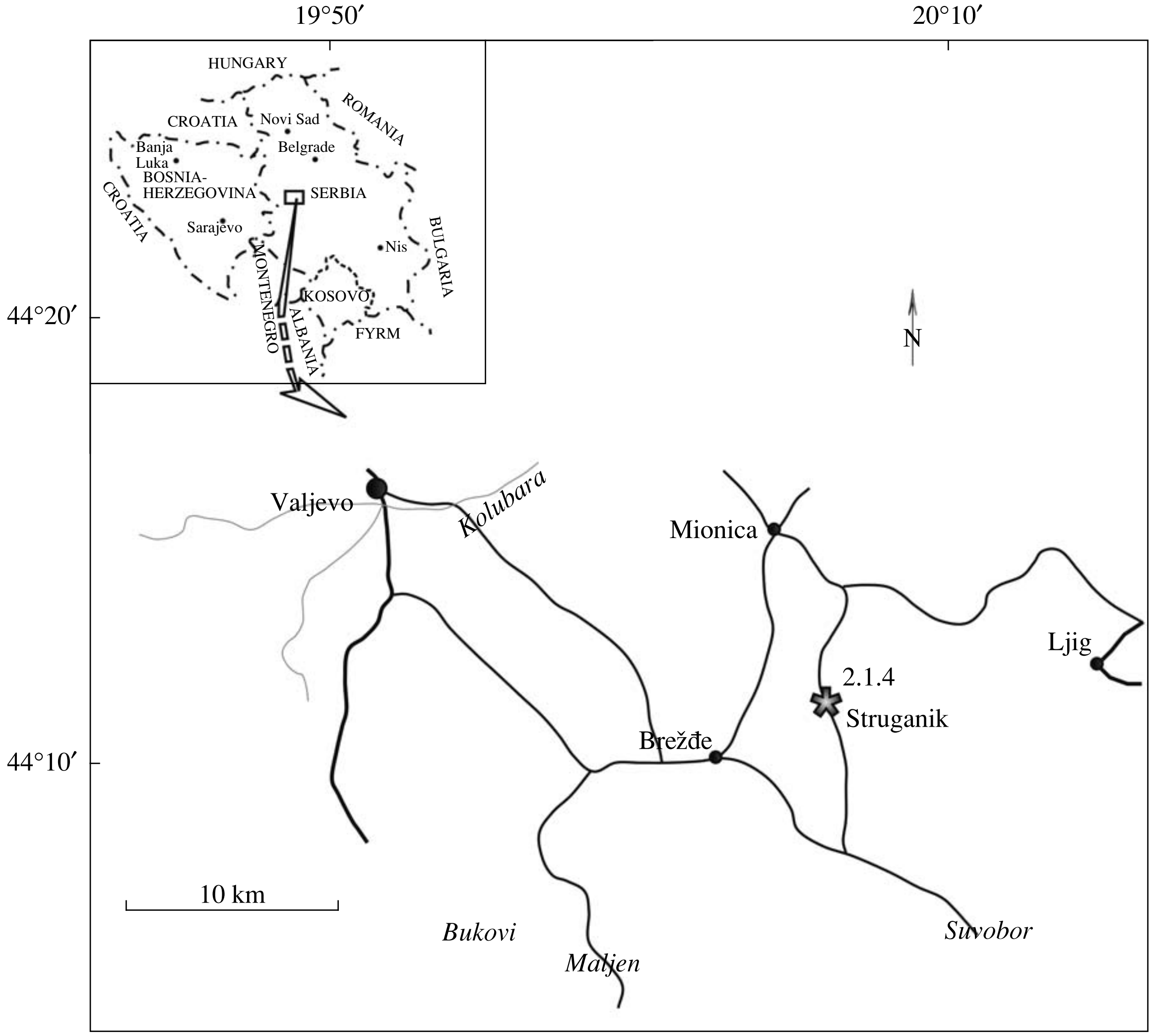


Fig. 10. Location of sections in more detail: (2.1.4) Struganik.

probably Early Norian due to the range of *Sarla vetusla* Pessagno (De Wever et al., 1979; Bragin and Krilov, 1999; Tekin, 1999). Some species, including *Spongostylus carnicus* Kozur et Mostler, *Multimonilis pulcher* Yeh, *Xiphotheca rugosa* Bragin, *Loffa ? mulleri* Pessagno, and others, are shown in Plate 7.

2.1.3. Čačak Section

In Serbia, the existence of Upper Triassic radiolarites along with MORB-type pillow lavas was confirmed in the Vardar Zone in locality 1 between Čačak and Ovčar Banja (Obradović and Goričan, 1988; Goričan et al., 1999). We sampled an outcrop of basalt-radiolarites near Čačak. Triassic (Norian) radiolarians from the Čačak locality (Figs. 1, 3, 9) (Sample 3v) are represented by the species *Pseudoheliodiscus primitivus* (Kozur et Mostler), *Scutispongus* cf. *tortilispinus* Kozur et Mostler, *Dicapnuchosphaera* aff. *sengori* Tekin, *Capnodoce sarisa* De Wever, *Icrioma tetrancistrum* De Wever, *Triassocampe* sp., and *Globolaxtorum* sp. Due to the presence of *Capnodoce sarisa*, the age is considered as Norian (De Wever et al., 1979; Kellici and De Wever, 1994; Tekin, 1999).

2.1.4. Struganik Section

The Struganik section is located in western Serbia, about 100 km southwest of Belgrade. The well-known carbonaceous Upper Cretaceous sediments of Struganik have yielded abundant inoceramids (Vasić et al., 2005); the sediments correspond primary to pyroclastic matter and occur as an interlayer. This sequence (Figs. 1, 3, 10) includes tuffaceous and cherty clay (Fig. 11) with radiolarians. This occurrence exhibits a succession of laminas built of crystalloclastic quartz, sanidine, plagioclase, and biotite and a distinct clay layer (Vasić et al., 2005), resembling that described by

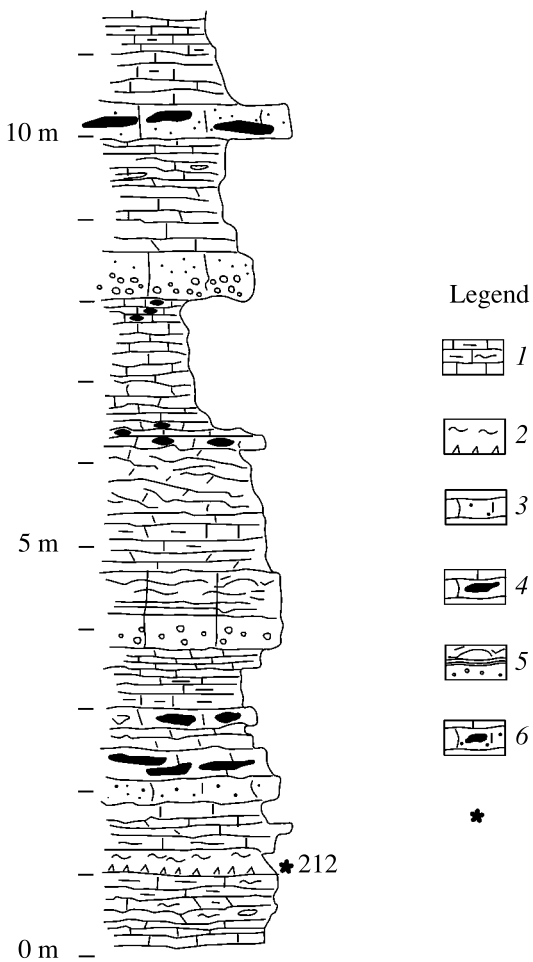


Fig. 11. Local lithological column of Struganik. Designations: (*1*) layered marly limestone and marlstone, (*2*) smectite clay, (*3*) gray allochemical limestone, (*4*) bedded marly limestone with chert concretions, (*5*) calcarudite, calcarenite, biointrasparite, (*6*) gray allochemical limestone with chert concretions, and (*7*) position of the radiolarian sample.

Vishnevskaya (1984). The radiolarian assemblage comes from this clay layer (Sample 212) and contains *Alievium superbum* (Squinabol), which is a zonal species of the Turonian of the Pacific Province and the Turonian–Coniacian of the Mediterranean Province, *Amphipyndax stocki* (Campbell et Clark), *Dictyomitra formosa* Squinabol, *D. koslovae* Foreman, *D. torquata* Foreman (characteristic species of the Coniacian and Campanian), and others (Table 7). Some index species are shown in Pl. 8. We consider the age of this radiolarian assemblage as the Coniacian based on the co-occurrence of *Alievium superbum* (Squinabol) and *Dictyomitra koslovae* Foreman (Vishnevskaya, 2001). This is the second find of Upper Cretaceous radiolarians in the Central Balkan Region after the Kozara locality of Bosnia, where basalt–chert sequences contain a Middle–Late Campanian radiolarian assemblage.

2.2. Main Vardar Zone

2.2.1. Belgrade Region (Grocka, Southern Banat)

Deposits in the Belgrade Region mostly belong to the Main Vardar Zone. The Middle–Upper Jurassic Diabase-Chert formations (or ophiolitic melange) are covered by Tithonian limestones interbedding with chert or organo-detrital limestone and synchronous or transgressive Tithonian–Valanginian flysch as the roof (Dimitrijević, 1997, p.106). Due to many faults, different viewpoints concerning the treatment of diverse have been stated. Based on the data provided by Marković et al. (Dimitrijević (1997, p.107), the oldest outcropping strata are Tithonian limestone with the aptichi beds (300 m) and chert overlain by the Valanginian–Hauterivian flysch and the Hauterivian–Barremian marlstone. The older Middle–Upper Jurassic deposits are only recorded in the cores of wells.

The borehole Grocka is situated 20 km southeast of Belgrade (Figs. 1, 2, 12). A revision of unpublished data of Goričan (written communication, 1984) and investigation of radiolarians extracted by Goričan confirm the presence of radiolarites within several geological intervals of this area. Goričan (written communication, 1984) discovered Kimmeridgian–Tithonian radiolarites at a depth of 1400 m and Oxfordian–Hauterivian radiolarites at a depth of 1378 m in the course of age determination of hydrogeological borehole No. 6267 (G-1, Vrtine Grocka), drilled 20 km southeast of Belgrade (Fig. 6). The radiolarian assemblage from the borehole Vrtine Grocka (G-1, No. 6267) is dated based on unpublished data of Goričan (1984) as the Upper Jurassic–Lower Cretaceous (probably up to Valanginian–Hauterivian). The section of the borehole from the top to the bottom is as follows (Fig. 8):

Depth of 1300 m. Dark red clay and sandstone.

Depth of 1375 m. Dark red pelitic radiolarian chert, with clay and limestone.

Depth of 1378 m. Dark red pelitic radiolarian chert (Sample Gl-1). The radiolarian assemblage includes many index species (Table 8), including *Archaeodictyomitra lacrimula* (Foreman), with the first appearance in the Berriasian, and *Syringocapsa vicetina* (Squinabol), with the last occurrence in the Valanginian (De Wever et al., 2001); this suggests the Berriasian–Valanginian age.

Depth of 1400 m. Radiolarites. The Late Oxfordian?–Kimmeridgian–Early Tithonian age of the radiolarian assemblage (Table 8) from the second sample (G1-2) is determined based on the first appearance of *Hsuum cuestaensis* Pessagno in the Middle–Late Oxfordian or *Podocapsa amphitreptera* Foreman in the Kimmeridgian and the last occurrence of *Cinguloturris carpatica* Dumitrica, *Eucyrtidium ptyctum* Riedel et Sanfilippo, *Transhsuum brevicostatum* (Ozvoldova) in the Early Tithonian (De Wever et al., 2001).

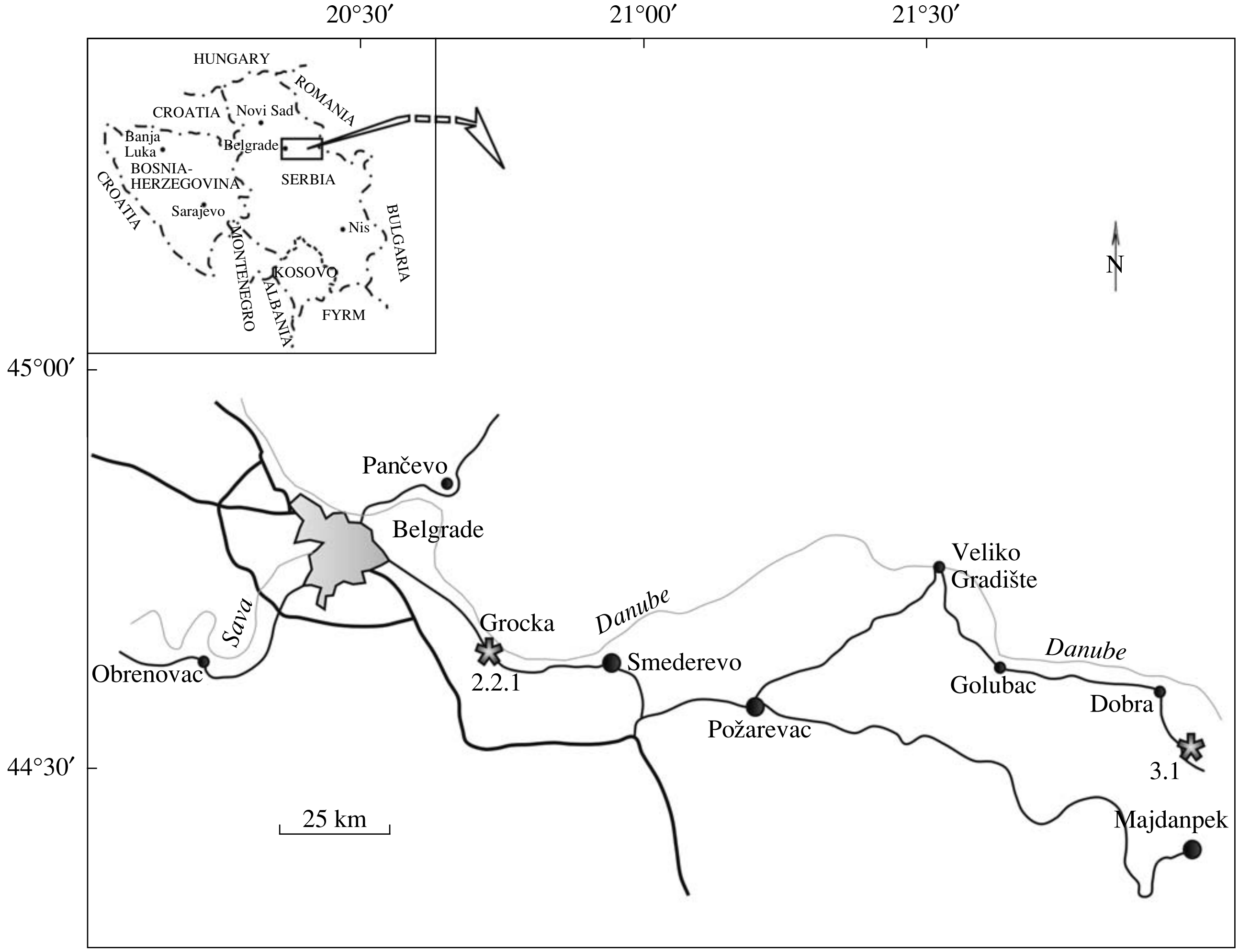


Fig. 12. Location of sections in more detail: (2.2.1) Grocka and (3.1) Pesača.

According to the point of view of Š Goričan (personal communication), the Jurassic succession of this borehole is in an overturned position.

The Neocomian sequences with radiolarians were recorded north of Belgrade (Figs. 5, 7, 9), in the South Banat Area, within the boreholes Banatsko Selo and Vladimirovac (Čanovič and Kemenci, 1975). They occur in the pelagic and deepwater facies in the borehole Banatsko Novo Selo-1 at a depth of 1112–1243 m and in the borehole Banatsko Novo Selo-2 at a depth between 1205 and 1283 m. Deposits of the borehole BNS-2 correspond to younger horizons of the Neocomian–Hauterivian; it is not inconceivable that they also include Barremian beds (Čanovič and Kemenci, 1975). The Vladimirovac-1 borehole includes Neocomian sediments at a depth of 1216–1355 m. This interval is represented by chert marls and aleurolites in laminated alternation, which have yielded a microfossil association, including radiolarians, ostracods, and tintinides (Čanovič and Kemenci, 1975).

3. East Serbian Carpatho–Balkanides

3.1. Pesača Section

In the East Serbia Mesozoic sediments, with Jurassic and Lower Cretaceous radiolarians are well-known. The Upper Jurassic–Lower Cretaceous radiolarites or cherts with radiolarians are widespread in the Geticum Tectonic Zone. Oxfordian–Kimmeridgian chert and Tithonian limestone with chert (about 300 m) of the Kucevo section contain abundant radiolarians. Radiolarians were also identified in Kučaj limestone with chert sequences (Dimitrijević, 1997, p. 134), in Tupižnica and Tepoš sections (Dimitrijević, 1997, p. 139), and in Middle Jurassic–Lower Cretaceous cherty limestones and radiolarites of the Pesača–Greben Area (Vasić et al., 1999). The last are deepwater limestones, clayey limestones, cherts, and radiolarites (Vasić, 1994). For example, red nodular limestones with radiolarians of the Pesača–Greben Area (Figs. 1, 2, 12) occur at the Bathonian–Callovian stratigraphic level,

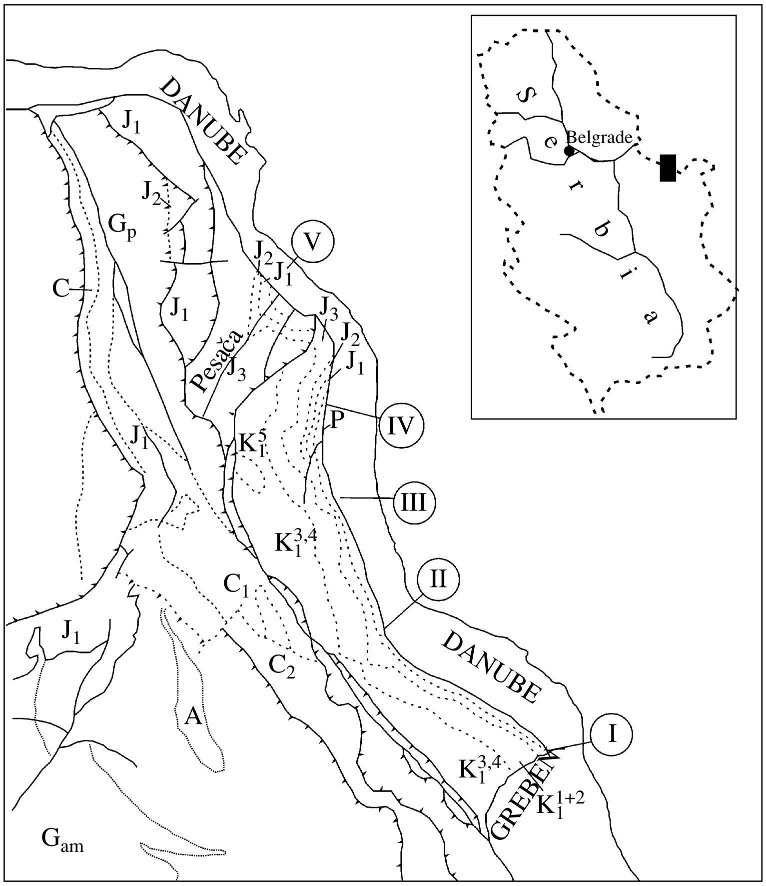


Fig. 13. Jurassic and Lower Cretaceous sediments of the Pesača section along the Pesača–Boljetin road: (I) Greben and (II–V) radiolarian-bearing outcrops: (II) Boljetin River, (III) Bivolja Stena, (IV) Coca Njalta, and (V) Pesača (after Vasić, 1994).

bedded cherts, and radiolarites of the Pesača River sequences and correspond to the Upper Oxfordian–Lower Kimmeridgian; upward in the section, they give place to Kimmeridgian–Oxfordian bedded limestone with gray chert containing radiolarians and, further upwards, there are Tithonian red nodular limestones with radiolarian cherts (Vasić, 1993; Vasić et al., 1999). Because of good preservation of the macrofauna in the Upper Jurassic–Lower Cretaceous strata of the Pesača River sequences, radiolarians have never been investigated with reference to paleontology. More than ten samples collected in the Jurassic and Lower Cretaceous of the Pesača section gave positive results. All samples were taken along the Pesača–Boljetin road (Figs. 13, 14) opposite Lepenski Vir Museum. For the precise position of the Pesača section in the geological map, with description of the section, see in Vasić et al. (1999). Three samples contain especially well-preserved radiolarians (Table 9). The lowest sample (4/05-2) is represented by red nodular chert and dated to the Oxfordian based on the co-occurrence of *Parvivacca blomei* Hull and *Emiluvia ordinaria* Ozvoldova (De Wever et al., 2001). The Oxfordian–Kimmeridgian radiolarian assemblage was determined in red chert (Sample 4/05). The Oxfordian–Kimmeridgian age was established based on the co-occurrence of *Transhsuum brevicostatum* (Ozvoldova) and *Mirifusus dianae minor* Baumgartner (De Wever et al., 2001).

Sample 4/03-1 is green chert obtained from thin-bedded pink micritic limestone with chert nodules (Figs. 12, 14b). This sample is assigned to the Late Tithonian because of the presence of *Parvivacca coronata* Hull and *P. curvata* (Steiger) (Hull, 1977; Steiger, 1992). Within the limestone, the association of *Lamellaptychus lamellosus* and *Punctaptychus punctatus* supports the Upper Tithonian age (Vasić et al., 1999).

Remnants of Jurassic radiolarites of the Vardar Ocean were found in other localities of the Carpatho–Balkanides (in the Trekljano Region of Bulgaria not far from the Serbian–Bulgarian boundary). They are represented by Aalenian–Tithonian radiolarites of the Rayantsi Formation (Zagorchev, 1986, 1998; Vishnevskaya, 2001). The nearest Jurassic and Lower Cretaceous radiolarians are well known in Montenegro and Slovenia (Goričan, 1994), Albania (Kellici and De

(a)

Fig. 14. Uppermost Jurassic to Lower Cretaceous sediments of Pesača along the Pesača–Boljetin road: (a) general view and (b) fragment of radiolarian siliceous limestone and clay alternation in the Pesača section.

Wever, 1994), Greece, Hungary, and Romania (Baumgartner et al., 1995).

The finds of Upper Cretaceous radiolarians are less frequent (Vishnevskaya, 2001).

Localities of Middle Triassic radiolarians are known close to Serbia in Montenegro, Bosnia, Herzegovina, Croatia, Slovenia, Albania, and Romania. Middle Triassic radiolarians (Late Ladinian) are found in limestones in southern Bosnia and Herzegovina (Varoš creak, 2 km west of Fojnica, as mentioned above) in association with the conodont *Budurovignathus mungoensis* (Diebel), displaying well-preserved diverse Nassellaria (Kozur and Mostler, 1996a, 1996b; Tekin and Mostler, 2005). The Ladinian assemblage from the area bordering Italy (Kolar-Jurkovšek, 1989) contains many spongy forms and abundant species similar to coeval assemblages from Croatia, from the localities south of Zagreb (Halamić and Goričan, 1995; Halamić et al., 1999; Goričan, 2005). Similar Triassic radiolarian associations were previously described from certain localities in Slovenia (Pavšic and Goričan, 1987; Goričan and Buser, 1990), Romania (Dumitrica, 1982), Albania (Kellici and De Wever, 1994; Chiari et al., 1996; Marcucci and Prela, 1996), and Turkey (Tekin, 1999).

CONCLUSIONS

The study of rich Triassic and Jurassic to Lower Cretaceous radiolarian associations in Serbia and Bosnia provided information necessary to do a precise age determination of some new sections of the Dinaridic Ophiolite Belt and the Vardar Tectonic Zone (Fig. 15). Additional radiolarian-based biostratigraphic data were obtained for the central part of the Balkan Peninsula (Tables 1–9).

Bajocian (Ivansky quarry), Bathonian–Callovian (Uzlomac Mountain, Maslovare), Oxfordian–Kimmeridgian (Jezerecka Reka), Tithonian–Berriasian to Valanginian (Jotanovići–Lipnje), and Campanian

(b)

Fig. 14. Contd.

(Crna Reka) radiolarian localities were discovered in the chert sequences of Bosnia. Additional localities of Triassic (Norian–Rhaetian in Sjenica and Ladinian–Carnian in the village of Visoka, Carnian–Norian in Ovčar–Kablar gorge, and Norian in Čačak) and Jurassic (Late Aalenian–Bajocian in Zaboj near Sjenica, Bathonian in the Mali Rzav River Basin, Callovian–Oxfordian in Krš Gradac) radiolarians were described in Serbia. The age of radiolarian assemblages from the Grocka borehole is determined more precisely as the Kimmeridgian–Early Tithonian and Berriasian-Valanginian, respectively. A new locality of Oxfordian–Tithonian Serbian radiolarian faunas, dated by macrofaunas, is proposed for progress study (sequences along the Pesača–Boljetin road opposite Lepenski Vir Museum). The first finding of Late Cretaceous (Coniacian) radiolarians in Serbia was documented. The distribution of 70 samples with radiolarians within sections is analyzed. The taxonomic composition of 39 samples is analyzed. Some characteristic and index species of Triassic and Jurassic to Cretaceous radiolarians discovered for the first time in Bosnia and Serbia were described and figured. The taxonomic list includes 72 taxa.

SYSTEMATIC PALEONTOLOGY

Class Actinopoda Calkins, 1909

Subclass Radiolaria Müller 1885

Genus *Alievium Pessagno,* 1972, emend. Foreman, 1973

Type species. *Theodiscus superbus* Squinabol, 1914.

Alievium cf. pregallowayi Pessagno

Plate 8, figs. 4

Remarks. This form differs from *Alievium pregallowayi* Pessagno, 1972 in having short primary spines.

Local range and occurrence. Coniacian of Struganik.

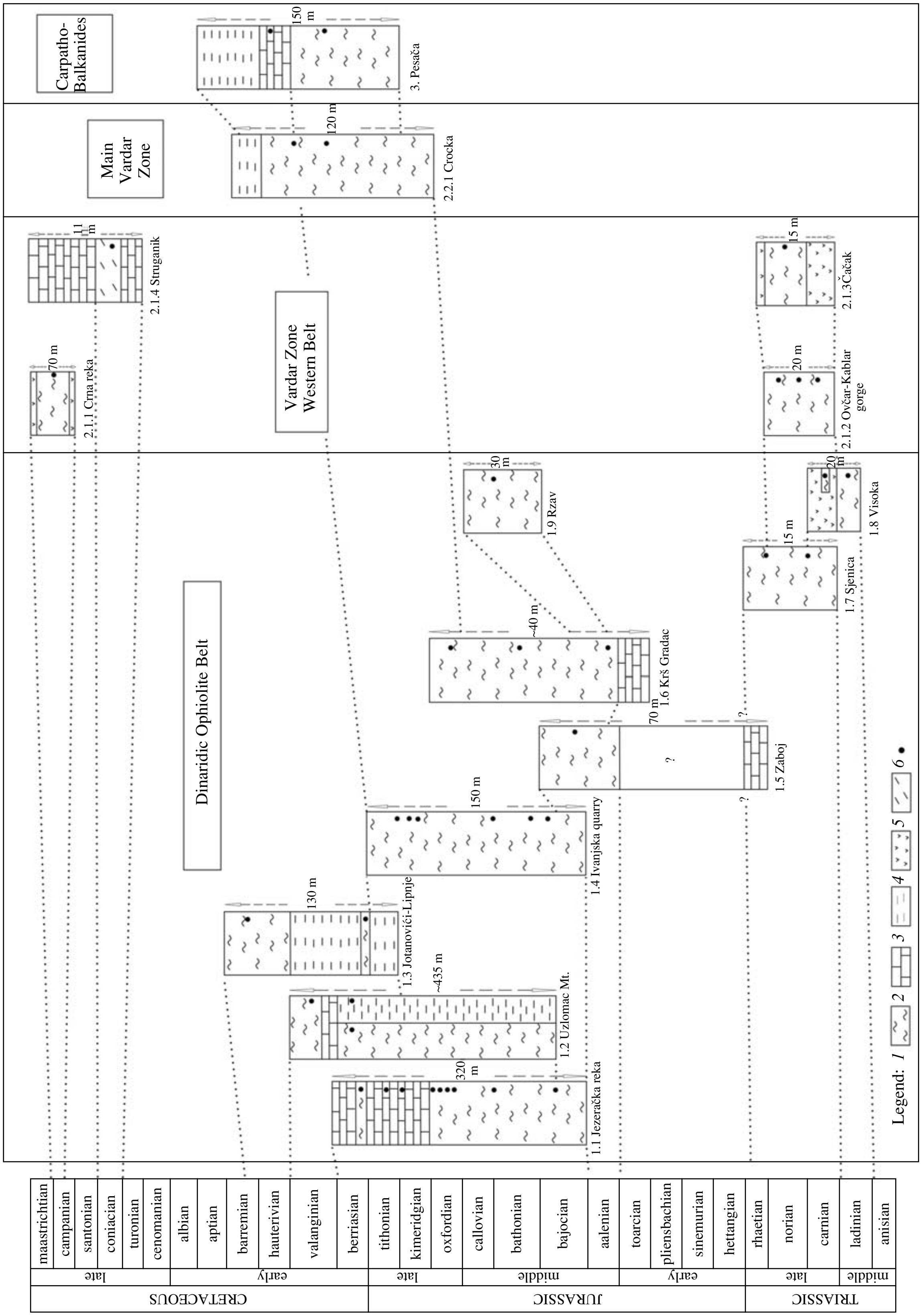


Fig. 15. Chronostratigraphic relationships of the sections studied grouped by tectonic units. Designations: (*1*) chert, (*2*) limestone, (*3*) clay, (*4*) basalt, (*5*) clay tuff, and (*6*) sample position.

Table 6. Ranges of some significant Triassic radiolarian species of the Dinaridic Belt

Species	Samples							
	Sjenica	Ovčar-Kablar gorge			Čačak	Visoka		
	9-1	100	102	103	3v	10-8	10-8a	10-11
Capnodoce anapetes	●		●					
Capnodoce sarisa	●				●			
Capnodoce crystallina				●				
Capnuchosphera triassica	●		●					
Capnuchosphera crassa	●							
Capnuchosphera tricornis	●			●				
Capnuchosphera lenticulata	●			●				
Capnuchosphera lea	cf.		cf.					
Capnuchosphera theloides		●				●		
Capnuchosphera theloides minor		●	●					
Capnuchosphera puncta						●		
Beturiella ? *robusta*	●							
Latium longulum	●							
Japonocampe nova	●		cf.					
Nakasekoellus pessagnoi	●							
Harsa siscwaiensis	cf.							
Sarla vetusta	●	●						
Sarla sp. aff. *S. viscainoensis*	●			●				
Bistarcum ? *cylindratum*	●							
Kahlerosphaera kemerensis	●							
Deflandrecyrtium curvatum	●							
Proparvicingula moniliformis	●							
Canoptum triassicum	●							
Canoptum poissoni				cf.				
Multimonilis pulcher	●							
Whalenella regia	●							
Whalenella ? *speciosa*	●			●				
Xiphotheca rugosa	●		●					
Karnospongella ? *bispinosa*		●						
Spogostylus karnicus		●		●				

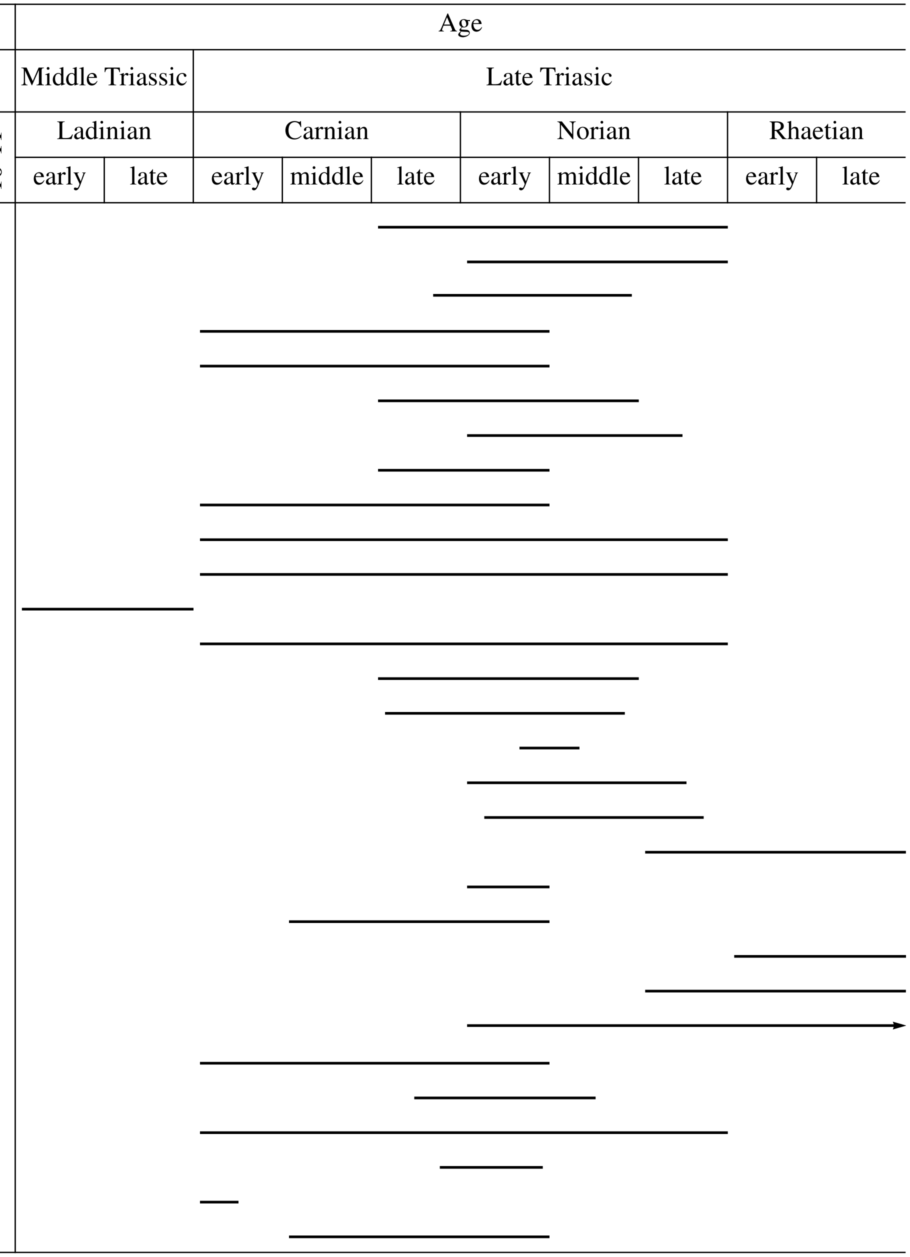


Table 6. (Contd.)

Species	Samples								Age									
	Sjenica	Ovčar-Kablar gorge			Čačak	Visoka			Middle Triassic		Late Triasic							
									Ladinian		Carnian			Norian			Rhaetian	
	9-1	100	102	103	3v	10-8	10-8a	10-11	early	late	early	middle	late	early	middle	late	early	late
Spongostylus tortilis				●						—	—	—	—	—				
Icrioma tetrancistrum					●									—	—			
Loffa ? *mulleri*			●											—	—			
Canesium lentum				●										—				
Pseudoheliodiscus primitivus					●						—	—	—					
Scutispongus tortilispinus					cf.				—	—								
Dicapnuchochosphaera aff. *sengori*					●									—				
Welirella fleurei						●					—	—	—	—	—	—		
Hindeosphaera bispinosa						●					—	—	—					
Ferresium triquetrum						●								—	—	—	—	—
Ferresium philippinense						cf.								—	—	—	—	—
Oertlispongus inaequispinosus							●		←—	—								
Pentaspongodiscus mesotriassicus							●		←—	—								
Pseudostylosphaera coccostyla						●	●	●	—	—								
Pseudostylosphaera nazarovi							●			—	—							
Pseudostylosphaera ? *hellenica*							●				—	—						
Pseudostylosphaera japonica							●		- -	- -								
Pseudostylosphaera goestlingensis							●	●		—	—	—						
Pseudostylosphaera compacta							●		- -	- -								
Pseudostylosphaera multispinata							cf.			—								
Zhamojdasphaera ? *latispinosa*							●			—	—	—						
Muelleritortis ? *cochleata*								●		—	—							
Muelleritortis granulosum							cf.		—	—								
Triassocampe sulovensis							cf.				—							
Triassocampe coronata						cf.	cf.		←—	—								
Triassocampe deweveri							●		←—	—								
Triassocampe scalaris							●		—	—								
Spinotrisaaocampe mesofassanica						●	●		←—	—								
Spinotrisaaocampe carnica						●					—	—	—					
Eptingium manfredi							●		—	—	—	—	—	—	—	—		

Table 7. Ranges of some significant Cretaceous radiolarian species of Crna Reka, Vardar Tectonic Zone

Samples / Species	Crna reka	Struganik	Age					
			Late Cretaceous					
	5-2	212	Cenomanian	Turonian	Coniacian	Santonian	Campanian	Maastrichtian
Amphipyndax enesseffi	●						—	- -
Amphipyndax stocki	●		—	—	—	—	—	→
Crucella espartoensis	●						—	
Dictyomitra andersoni	●						—	—
Dictyomitra multicostata	●		—	—	—	—	—	—
Stichomitra campi	●						—	—
Alievium superbum		aff.		—	—			
Alievium praegallowayi		cf.			—	—	—	
Dictyomitra formosa		●	← —	—	- -	- -		
Dictyomitra koslovae		●			—	—	—	
Dictyomitra torquata		●			—	—	—	
Pseudoaulophacus ex gr. *floresensis*		●			- -	—	—	
Pseudoaulophacus venadoensis		cf.			—	—		

Alievium aff. superbum (Squinabol)

Plate 8, fig. 3 and 5

Remarks. This form differs from *Alievium superbum* (Squinabol, 1914) in the absence of primary spines.

Local range and occurrence. Coniacian of Struganik.

Genus *Archaeospongoprunum* Pessagno, 1973

Type species. Archaeospongoprunum venadoensis Pessagno, 1973.

Local range and occurrence. Triassic(?)–Jurassic–Cretaceous; worldwide.

***Archaeospongoprunum elegans* Wu, 1993**

Plate 1, fig. 2

Archaeospongoprunum elegans: Wu, 1993, p. 118, pl. 1, figs. 5, 7, and 23.

Local range and occurrence. Uppermost Callovian–Oxfordian (Late Jurassic) of the Jezeračka Reka section.

***Archaeospongoprunum imlayi* Pessagno, 1977**

Plate 1, fig. 2; Plate 3, fig. 2

Archaeospongoprunum imlayi: Pessagno, 1977, p.73, pl. 3, figs. 1–4; Vishnevskaya, 2001, p. 150, pl. 108, fig.4.

Local range and occurrence. Uppermost Callovian–Oxfordian (Late Jurassic) of the Jezeračka Reka section. Bajocian–Bathonian of the Ivanjska quarry.

***Archaeospongoprunum* ex gr. *imlayi* Pessagno**

Plate 1, fig. 4

R e m a r k s . This form is distinguished by the relatively larger spherical shape of the test.

Local range and occurrence. Uppermost Bajocian–Bathonian of the Jezeračka Reka section.

Genus *Beturiella* Dumitrica, Kozur et Mostler, 1980

Type species. Beturiella robusta Dumitrica, Kozur et Mostler, 1980.

Local range and occurrence. Middle Triassic.

***Beturiella ? robusta* Dumitrica, Kozur et Mostler, 1980**

Plate 6, fig. 9

Beturiella robusta Dumitrica, Kozur et Mostler, 1980: Dumitrica et al., 1980, p. 11, pl. 3, fig. 5, pl. 12, figs. 1–3; Gorić an and Buser, 1990, p. 141, pl. 1, fig. 3; Vishnevskaya, 2001, pl. 138, figs. 36–38.

Local range and occurrence. The Carnian–Norian (Late Triassic), Sjenica section.

Table 8. Ranges of some significant radiolarian species of the Grocka borehole

Samples / Species	Grocka		Age								
			Late Jurassic			Early Cretaceous					
	1378 m	1400 m	Oxfordian	Kimmeridgian	Tithonian	Berriasian	Valanginian	Hauterivian	Barremian	Aptian	Albian
Foremanella diamphidia	●				—	—	—				
Pseudocrucella adriani	●		← —	—							
Pseudocrucella procera	cf.				—	—	—				
Emiluvia chica	●		← —	—	—	—	—	—			
Angulobracchia portmanni	●				—	—	—	—	—	—	
Archaeospongoprunum imlayi	●	●	← —	—							
Orbiculiforma lowreyensis	●				—						
Ristola cretacea	●				—	—	—				
Tethysetta boesii	●	●		—	—	—	—	—	—		
Pseudoeucyrtis micropora	●				—	—	—				
Archaeodictyomitra apiara	●		← —	—	—	—	—	—	—	—	
Archaeodictyomitra lacrimula	●					—	—	—	—	—	
Syringocapsa vicetina	●				—	—	—				
Thanarla gutta	cf.							—	—		
Tritrabs ewingi minima	●				—						
Angulobracchia mediopulvilla	●				—	—					
Tritrabs worzelli		●			—						
Obesacapsula morroensis		●	← —	—	—	—	—	—	—		
Podocapsa amphitreptera		●	—	—	—	—	—				
Hsuum maxwelli		●	← —	—	—						
Transhsuum brevicostatum		●	← —	—							
Mirifusus dianae s.l.		●	← —	—	—	—	—	—			
Spongocapsula palmerae		●	← —	—	—						
Stichocapsa convexa		●	← —	—					—		
Zhamoidellum ovum		●	—	—							
Hsuum cuestaensis		●	—	—							
Cinguloturris carpatica		●	← —	—							
Eucyrtidiellum ptyctum		●	← —	—							

Genus *Canoptum* Pessagno, 1979 in Pessagno et al., 1979

Type species. Canoptum poissoni Pessagno, 1979 in Pessagno et al., 1979.

Local range and occurrence. Middle Triassic–Middle Jurassic; worldwide.

***Canoptum* sp.**

Plate 3, fig. 10

R e m a r k s . This form is most similar to *Canoptum anulatum* Pessagno and Poisson, 1979 (p. 60, pl. 9,

Table 9. Ranges of some significant radiolarian species of the Pesača section

Species \ Samples	Pesača			Age								
				Late Jurassic			Early Cretaceous					
	4/05-2	4/05	4/03-1	Oxfordian	Kimmeridgian	Tithonian	Berriasian	Valanginian	Hauterivian	Barremian	Aptian	Albian
Archaeodictyomitra apiara	●			←—	—	—	—	—	—	—	—	
Pseudocrucella ehrenbergi	●			—								
Emiluvia ordinaria	●			—	—	—						
Emiluvia premyogii	●			←—	—							
Parvivacca blomei	●			—								
Archaeohagiastrium munitum	●			—	—	—						
Podobursa spinosa	●			←—	—	—						
Transhsuum brevicostatum gr.		●		←—	—	—						
Hsuum maxwelli		●		←—	—	—						
Mirfusus dianae s.l.		●		←—	—	—	—	—	—			
Mirfusus dianae minor		●		—	—	—	—	—	—			
Obesacapsula morroensis		●		←—	—	—	—	—	—	—		
Spongocapsula palmerae		●		←—	—	—						
Homoeoparonaella barbara			cf.			—						
Homoeoparonaella elegans			●			—						
Parvivacca coronata			●			—						
Parvivacca curvata			●			—						
Sethocapsa cetia			●		—	—	—	—	—			

figs. 6—9). Because of poor preservation of the specimen, circumferential ridges with costae are invisible.

Local range and occurrence. Bajocian–Bathonian of the Ivanjska quarry.

Genus *Capnodoce* De Wever, 1979

Type species. Capnodoce anapetes De Wever, 1979.

Local range and occurrence. Upper Triassic; worldwide.

→

Explanation of Plate 1

Uppermost Callovian–Oxfordian (Middle–Late Jurassic) radiolarians from northern Bosnia, Locality Jezeračka, Sample 1-12.

Fig. 1. *Pantanellium meraceibaense* Pessagno et MacLeod, ×530.

Fig. 2. *Archaeospongoprunum elegans* Wu, ×300.

Fig. 3. *Archaeospongoprunum imlayi* Pessagno, ×310.

Fig. 4. *Archaeospongoprunum* ex gr. *imlayi* Pessagno, ×340.

Fig. 5. *Triactoma blakei* (Pessagno), ×210.

Fig. 6. *Tritrabs ewingi* (Pessagno), ×220.

Fig. 7. *Hsuum ? maxwelli* Pessagno, ×470.

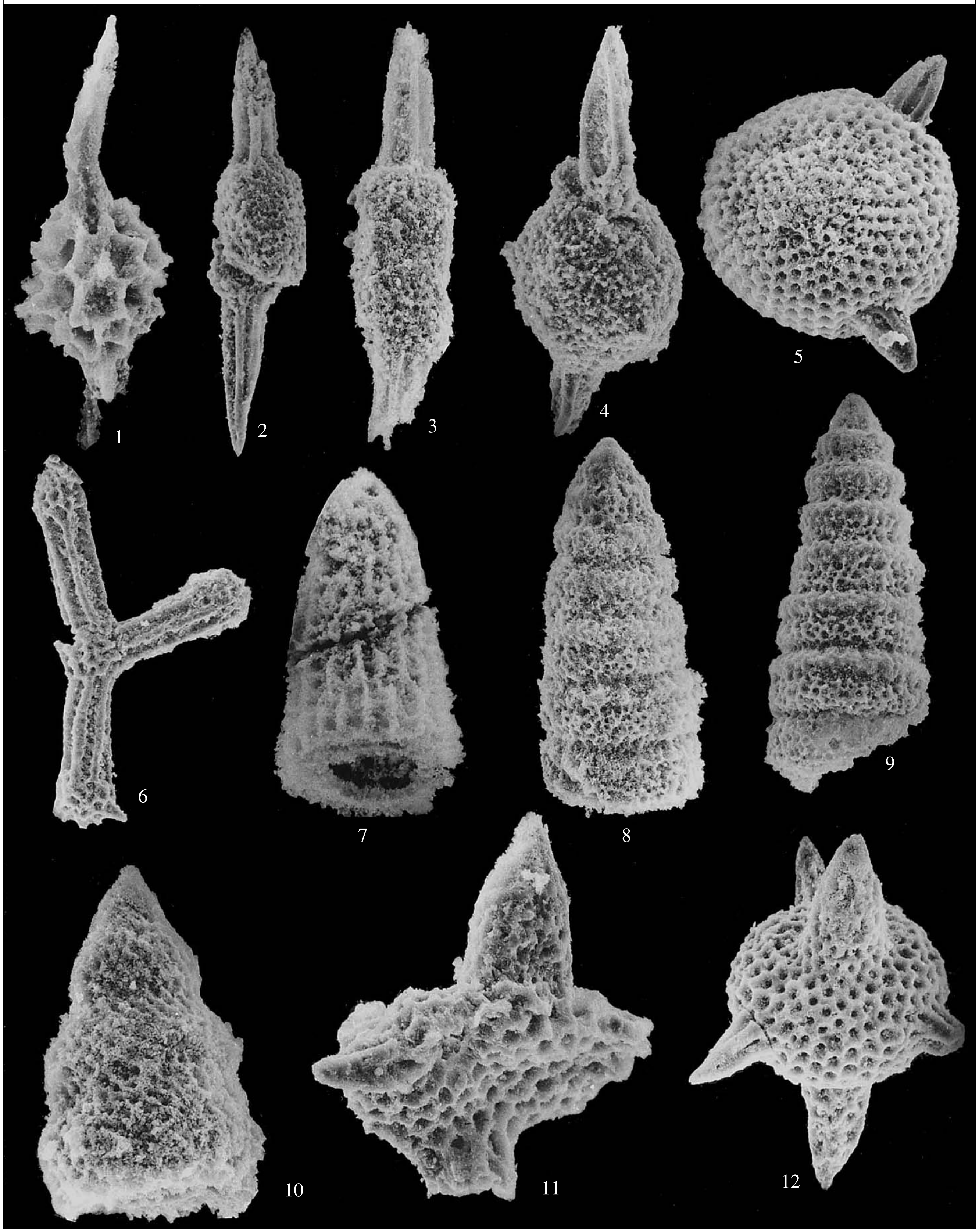
Figs. 8 and 9. *Cinguloturris carpatica* Dumitrica, ×300, 270.

Fig. 10. *Stichomitra? annibill* Kocher, ×550.

Fig. 11. *Podobursa helvetica* (Rüst), ×350.

Fig. 12. *Diboloachras chandrika* Kocher, ×280.

Plate 1



***Capnodoce* cf. *anapetes:* De Wever, 1979**

Plate 7, fig. 7

cf. *Capnodoce anapates*: De Wever in De Wever et al., 1979, p. 81, pl. 2, figs. 5–7.

R e m a r k s . This form differs from *Capnodoce anapetes* De Wever, 1879 by the shorter and wider prominent tubes.

Local range and occurrence. Late Carnian to Early Norian of the Ovčar-Kablar gorge.

***Capnodoce crystallina* Pessagno, 1979**

Plate 7, fig. 8

Capnodoce crystallina Pessagno in Pessagno et al., 1979, p. 176, pl. 1, figs. 1–3; Sato et al., 1986, text-figs. 16.11 and 16.12.

Capnodoce antiqua: Blome, 1984, p. 24, pl. 5. figs. 4, 12, 17; Bragin, 1986, pl. 2, fig. 1; Yoshida, 1986, pl. 10, figs. 4 and 5; Bragin, 1991, p. 83, pl. 6, fig. 10.

Capnodoce crystallina Pessagno Group: Sugiyama, 1997, p. 175, text-fig. 49 (17); Tekin, 1999, pp. 92, 93, pl. 11, figs. 2 and 3; Tekin and Yurtsever, 2003, p. 153, pl. 1, fig. 6.

Local range and occurrence. Late Carnian to Early Norian of the Ovčar-Kablar gorge.

Genus *Capnuchosphaera* De Wever, 1979

Type species. Capnuchosphaera triassica De Wever, 1979.

Local range and occurrence. Upper Triassic (Carnian to Norian); worldwide.

***Capnuchosphaera* sp.**

Plate 7, fig. 5

R e m a r k s . Tumidispinae two times shorter than the diameter of cortical shell. Since the specimen is poorly preserved and tumidispinae are dissolved, it is impossible to determine species.

Local range and occurrence. Late Carnian to Early Norian of the Ovčar-Kablar gorge.

***Capnuchosphaera theloides* De Wever, 1979**

Plate 7, fig. 1

Capnuchosphaera theloides De Wever: in De Wever et al., 1979, pp. 83, 84, pl. 3, figs. 10–13; Halamić and Goričan, 1995, pl. 2, fig. 13.

?Capnuchosphaera theloides minor Bragin: in Bragin and Krilov, 1999, p. 548, text-figs. 4d, 4e.

Local range and occurrence. Late Carnian to Early Norian of the Ovčar-Kablar gorge.

***Capnuchosphaera triassica* De Wever, 1979**

Plate 7, fig. 6

Capnuchosphaera triassica De Wever: in De Wever et al., 1979, p. 84, pl. 3, figs. 14–19; Halamić and Goričan, 1995, pl. 2, fig. 9.

Local range and occurrence. Late Carnian to Early Norian of the Ovčar-Kablar gorge.

Genus *Cinguloturris* Dumitrica, 1982 in Dumitrica and Mello, 1982

Type species. Cinguloturris carpatica Dumitrica, 1982 in Dumitrica and Mello, 1982.

Local range and occurrence. Uppermost Bajocian–Lowermost Tithonian; worldwide.

***Cinguloturris carpatica* Dumitrica, 1982**

Plate 1, figs. 8 and 9; Plate 2, fig. 4

Cinguloturris carpatica Dumitrica: in Dumitrica and Mello, 1982, p. 23, pl. 4, figs. 7–11; Yao, 1984, pl. 2, fig. 28; Matsuoka and Yao, 1985, pl. 2, fig. 13; Tanaka et al., 1985, pl. 1, fig. 12; Aita, 1985, text-figs. 7 and 12; Kishida and Hisada, 1986, pl. 2, fig. 12; Matsuoka, 1986a, pl. 2, fig. 16; Matsuoka and Yao, 1986, pl. 2, fig. 14; Aita, 1987, p. 64, pl. 10, fig. 12; Ozvoldova, 1988, pl. 6, fig. 8; Kawabata, 1988, pl. 2, fig. 10; Wakita, 1988, pl. 4, fig. ?16; pl. 5, fig. 8; Kata and Iwata, 1989, pl. 5, fig. 5; pl. 6, fig. 10; Yasuda,

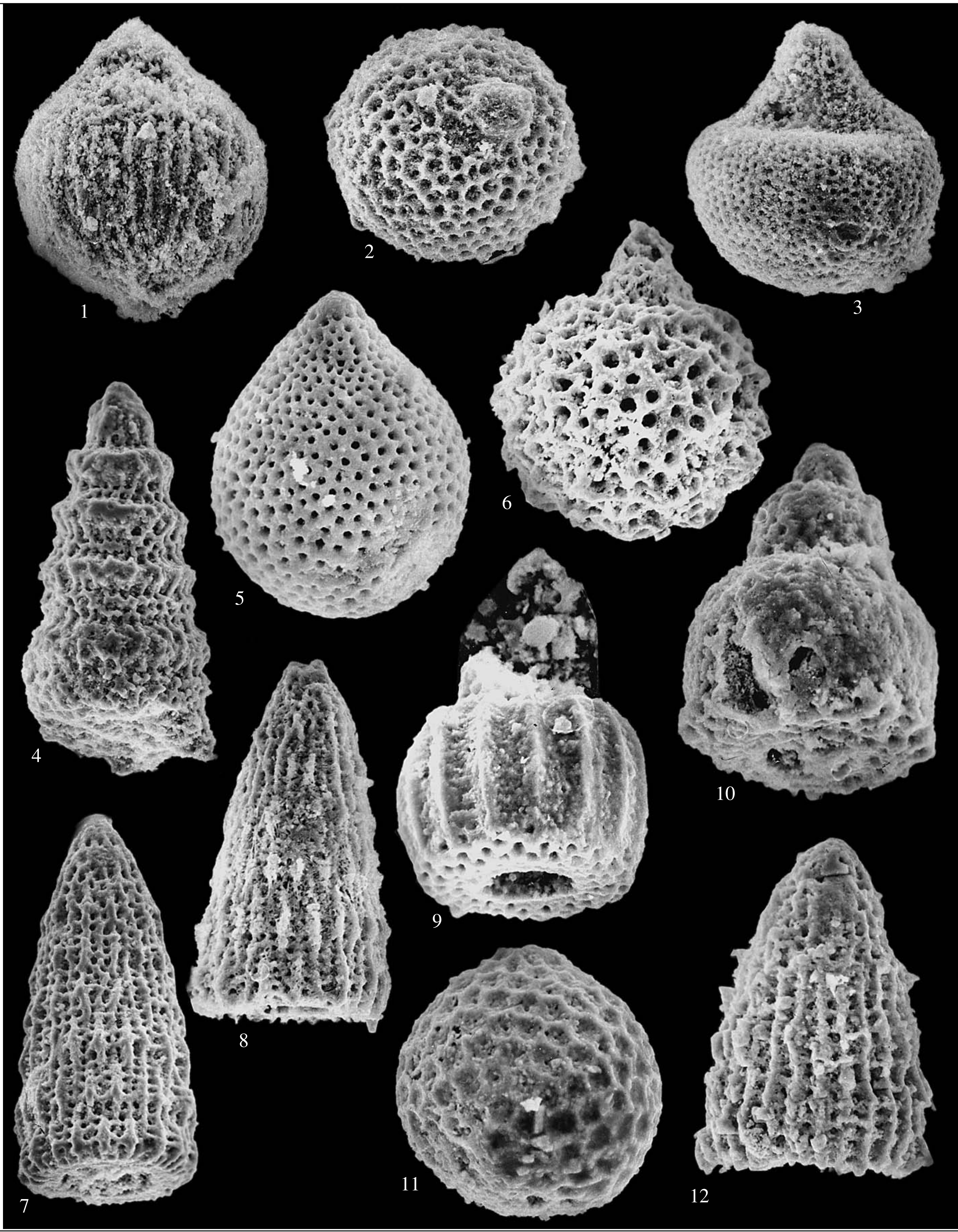
→

Explanation of Plate 2

Bathonian radiolarian assemblage of the Rzav River Basin (Sample 10-9, Figs. 1–3) and Callovian–Oxfordian radiolarian assemblage of the Maslovare Section (Sample 174, Figs. 4–12).

Fig. 1. *Striatojaponocapsa plicarum plicarum* (Yao), ×540.
Fig. 2. *Williriedellum ? carpaticum* Dumitrica, ×120.
Fig. 3. *Stichocapsa convexa* Yao, ×420.
Fig. 4. *Cinguloturris carpatica* Dumitrica, ×300.
Fig. 5. *Stichocapsa robusta* Matsuoka, ×250.
Fig. 6. *Sethocapsa funatoensis* Aita, ×300.
Fig. 7. *Hsuum maxwelli* Pessagno, ×250.
Fig. 8. *Hsuum* ex gr. *maxwelli* Pessagno, ×300.
Fig. 9. *Eucyrtidiellum ptyctum* Riedell and Sanfilippo, ×500.
Fig. 10. *Eucyrtidiellum unumaensis pustulatum* Baumgartner, ×400.
Fig. 11. *Gongylothorax favosus* Dumitrica, ×300.
Fig. 12. *Hsuum* ? sp., ×500.

Plate 2



1989, pl. 1, fig. 14; Widz, 1991, p. 244, pl. 1, fig. 11; Yao, 1991, pl. 4, fig. 11; Matsuoka, 1992, pl. 3, fig. 2, pl. 4, fig. 1; Vishnevskaya, 2001, pl. 106, fig. 1; pl. 108, fig. 7.

Local range and occurrence. Uppermost Bajocian–Kimmeridgian of the Jezeračka Reka section and Uzlomac Mountain.

Genus *Cyrtocapsa* Haeckel 1881

Type species. Cyrtocapsa ovalis Rüst 1885.

Local range and occurrence. Mesozoic–Cenozoic; worldwide.

Cyrtocapsa ? mastoidea Yao, 1979

Plate 3, fig. 5

Remarks. This form differs from *Cyrtocapsa mastoidea* Yao, 1979 in the broken last segment.

Local range and occurrence. Bajocian–Bathonian of the Ivanjska quarry.

Genus *Dibolachras* Foreman, 1973

Type species. Dibolachras tytthopora Foreman, 1973.

Local range and occurrence. Late Jurassic; worldwide.

Diboloachras chandrika Kocher, 1981

Plate 1, fig. 12

Dibolachras chandrica: Kocher, 1981, p. 61, pl.13, figs.1 and 2; Baumgartner et al., 1995, p. 180, pl. 3265, figs. 1 and 2 (with detailed synonymy); Vishnevskaya, 2001, pl. 48, figs. 5–7.

Local range and occurrence. Uppermost Callovian–Oxfordian (Late Jurassic) of the Jezeračka Reka section.

Genus *Dictyomitra* Zittel, 1876, emend. Pessagno, 1976

Type species. Dictyomitra multicostata Zittel, 1876.

Local range and occurrence. Cretaceous; worldwide.

Dictyomitra formosa Squinabol, 1904

Plate 8, figs. 10 and 11

Dictyomitra formosa: Squinabol, 1904, p. 232, pl. 10, fig. 4; Pessagno, 1976, p. 51, pl. 8, figs. 10–12; Taketani, 1982, p. 58, pl. 4, figs. 6a and 6b; pl. 11, fig. 13; Schaaf, 1985, text-fig. 12; Thurow, 1988, p. 400, pl. 1, figs. 23 and 25; O'Dogherty, 1994, p. 80, pl. 4, figs. 8–12; Vishnevskaya, 2001, p. 160, pl. 25, fig.10.

Dictyomitra torquata Foreman: Riedel and Sanfilippo, 1974, p. 778, pl. 5, figs. 1, 2, and 4.

Dictyomitra duodecimcostata (Squinabol): Foreman, 1975, p. 614, pl. 7, fig. 8; pl. 1G, fig. 5.

Local range and occurrence. Coniacian of Struganik.

Dictyomitra cf. *formosa* Squinabol

Plate 8, fig. 12

Remarks. Our specimen differs from *Dictyomitra formosa* Squinabol, 1904 in the smaller number of post-abdominal chambers. The test is costate throughout, with slighter constrictions.

Local range and occurrence. Coniacian of Struganik.

Dictyomitra koslovae Foreman, 1975

Plate 8, figs. 6–8

Dictyomitra koslovae Foreman, 1975: Foreman, 1975, p. 614, pl. 7, fig. 4; Taketani, 1982, p. 58, pl. 4, figs. 9 and 10; pl. 11, figs. 14 and 15; Sanfilippo and Riedel, 1985, p. 599, text-figs. 7.4a–7.4e; Schaaf, 1985, text-fig. 12; Thurow, 1988, p. 400, pl. 1, fig. 29; Vishnevskaya, 2001, p. 160, pl. 94, figs. 1 and 3, pl. 126, figs. 24–35.

Explanation of Plate 3

Bajocian–Bathonian radiolarians of the Ivanjska quarry: (Figs. 1–8) Sample 4-6 and (Figs. 9–12) Sample 4-1.

Fig. 1. *Triactoma? mexicana* Pessagno et Yang, ×110.

Fig. 2. *Archaeospongoprunum imlayi* Pessagno, ×155.

Fig. 3. *Tetraditryma* sp., ×170.

Fig. 4. *Palinandromeda* cf. *praepodbielensis* Baumgartner, ×150.

Fig. 5. *Cyrtocapsa ? mastoidea* Yao, ×200.

Fig. 6. *Stichocapsa* sp., ×290.

Fig. 7. *Hiscocapsa* sp., ×330.

Fig. 8. *Praewilliriedellum* cf. *spinosum* Kozur, ×270.

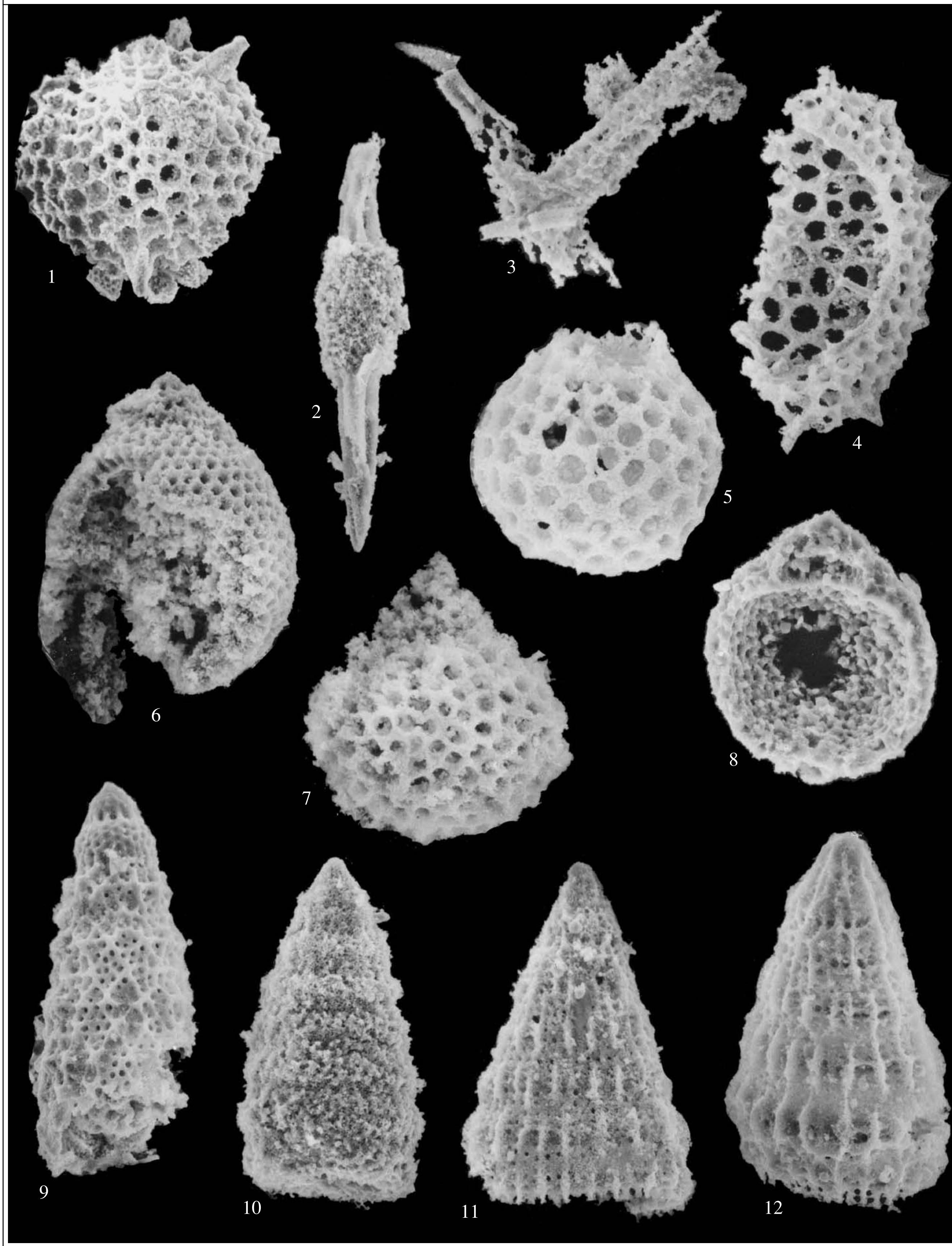
Fig. 9. *Eoxitus hungaricus* Kozur, ×220.

Fig. 10. *Canoptum* sp., ×180.

Fig. 11. *Hsuum* sp., ×205.

Fig. 12. *Hsuum* sp., ×255.

Plate 3



Local range and occurrence. Coniacian of Struganik.

Genus *Eoxitus* Kozur, 1985

Type species. Eoxitus hungaricus Kozur, 1985.

Local range and occurrence. Lower Bajocian to Bathonian, ? Callovian.

Eoxitus hungaricus Kozur, 1985

Plate 3, fig. 9

Parvicingula sp. C: Ishida, 1983, pl. 7, fig. 9.

Parvicingula sp.: Takashima and Koike, 1984, pl. 2, fig. 8.

Eoxitus hungaricus: Kozur, 1985, p. 216, text-figs. 1a, 1b, 1d, 1e; Sykora and Ožvoldova, 1996, pl. 2, fig. 12; Vishnevskaya, 2001, p. 161, pl. 60, fig. 6; pl. 98, figs. 7 and 8.

Local range and occurrence. Bajocian to Bathonian of the Ivanjska quarry.

Genus *Eucyrtidiellum* Baumgartner, 1984

Type species. Eucyrtidium (?) unumaensis Yao, 1979.

Local range and occurrence. Upper Triassic to Late Jurassic; worldwide.

Eucyrtidiellum ptyctum Riedell and Sanfilippo, 1974

Plate 2, fig. 9

Eucyrtidium ptyctum: Riedel and Sanfilippo, 1974, p. 778, pl. 5, fig. 7; pl. 12, fig. 14; Baumgartner et al., 1980, p. 53, pl. 3, fig. 13; Yao, 1984, pl. 2, fig. 30.

Eucyrtidium (?) ptyctum Riedell and Sanfilippo: Pessagno, 1977a, p. 94, pl. 12, fig. 7; Mizutani, 1981, p. 182, pl. 64, figs. 1a, 1b, and 2; Ishida, 1983, pl. 9, fig. 4; Takashima and Koike, 1984, pl. 2, fig. 5; Matsuoka and Yao, 1985, pl. 2, fig. 8; Dumitrica and Mello, 1982, pl. 3, fig. 10.

Eucyrtidiellum ptyctum (Riedell and Sanfilippo): Baumgartner, 1984, p. 764, pl. 4, figs. 1–3; Matsuoka, 1986a, pl. 2, fig. 10; Nagai, 1986, p. 14, pl. 2, fig. 7; Nagai, 1988, pl. 2, figs. 4a and 4b; Yao, 1991, pl. 4, fig. 15; Baumgartner et al., 1995, p. 214, pl. 3017, figs. 1–8 (with detailed synonymy).

Local range and occurrence. Late Bathonian to Callovian of Uzlomac Mountain.

Eucyrtidiellum unumaensis pustulatum Baumgartner, 1995

Plate 2, fig. 10

Eucyrtidium (?) unumaensis Yao: Kocher, 1981, p. 67, pl. 13, fig. 15; Suyari et al., 1983, pl. 7, fig. 1.

Eucyrtidiellum unumaense (Yao): Ishida, 1986, pl. 1, fig. 6; Nagai, 1986, pp. 13, 14, pl. 1, figs. 1a–1c, pl. 2, fig. 1; Nagai and Mizutani, 1990, p. 597, pl. 4, figs. 6 and 7; Goričan, 1994, pl. 9, figs. 5 and 6.

Eucyrtidiellum unumaensis pustulatum Baumgartner: Baumgartner et al., 1995, p. 220, pl. 3013, figs. 1–5 (with detailed synonymy).

Local range and occurrence. Late Bathonian to Callovian–Oxfordian of Uzlomac Mountain.

Genus *Gongylothorax* Foreman, 1968

Type species. Dicolocapsa verbeeki Tan, 1927.

Local range and occurrence. Jurassic–Cretaceous; worldwide.

Gongylothorax favosus Dumitrica, 1970

Plate 2, fig. 11

Gongylothorax favosus Dumitrica

Gongylothorax favosus: Dumitrica, 1970, p. 56, pl. 1, figs. 1a–1c, 2;

Baumgartner et al., 1995, p. 230, pl. 6131, figs. 1–7 (with detailed synonymy).

Local range and occurrence. Callovian–Oxfordian of Uzlomac Mountain.

Genus *Harsa Carter*, 1991

Type species. ***Harsa siscwaiensis Carter, 1991.***

Local range and occurrence. Upper Triassic; worldwide.

Harsa cf. *siscwaiensis* Carter

Plate 6, fig. 8

cf. *Harsa siscwaiensis*: Carter, 1991, pp. 199, 200, pl. 1, fig. 2.

→

Explanation of Plate 4

Late Aalenian–Bajocian radiolarian assemblage (Sample 68, chert sequences 8 km south of Sjenica).

Fig. 1. *Triactoma wickiupensis* Pessagno et Yang, ×120.

Fig. 2. *Hexasaturnalis hexagonus* (Yao), ×140.

Fig. 3. *Parahsuum* cf. *officerense* (Pessagno et Whalen), ×180.

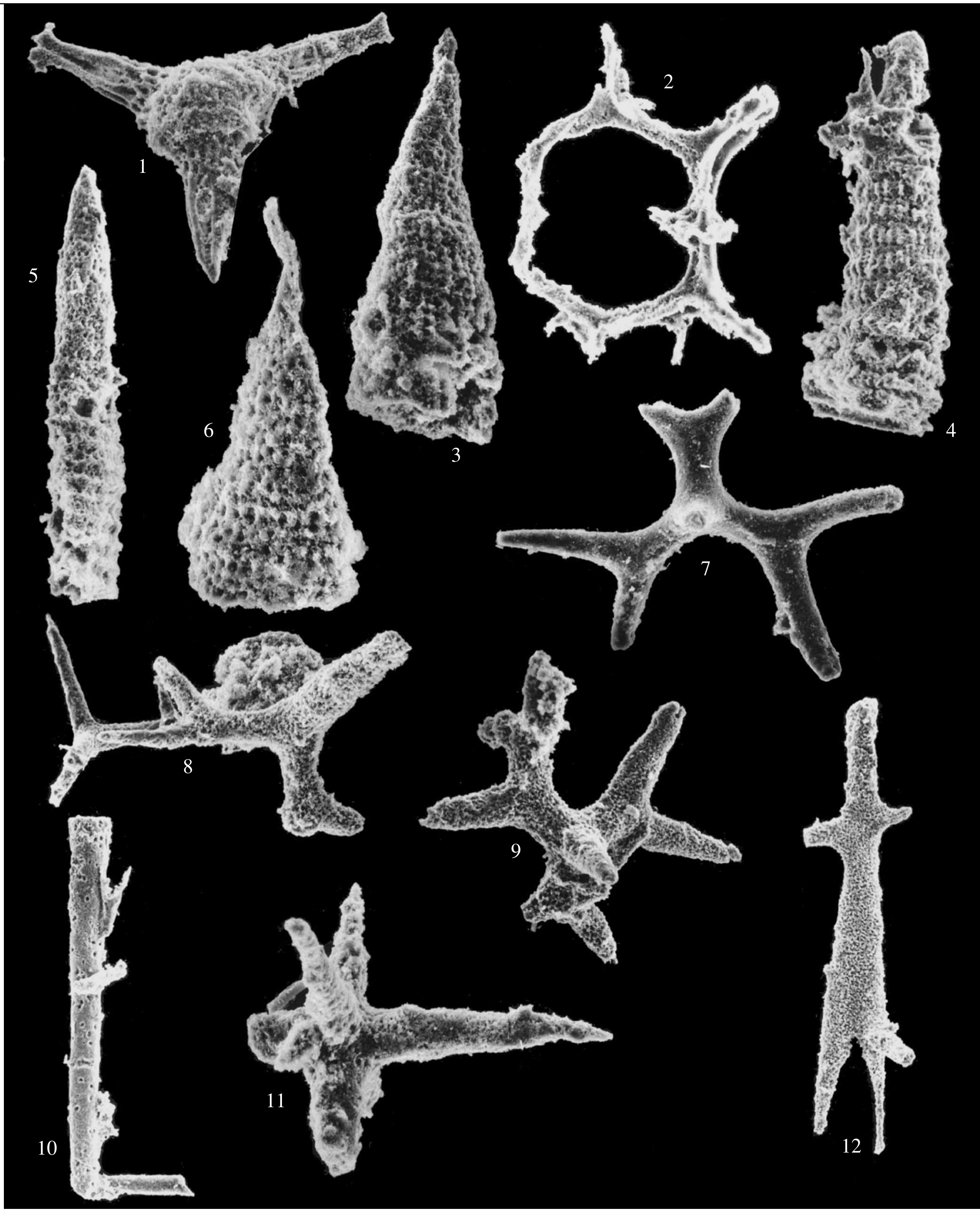
Fig. 4. *Transhsuum* cf. *hisuikyoense* (Isozaki et Matsuda), ×130.

Fig. 5. *Mirifusus* cf. *proavus* Tonielli, ×140.

Fig. 6. *Parahsuum* cf. *nitidum* (Pessagno et Whalen), ×100.

Figs. 7–12. Fragments of sponge spicules, ×70: (7, 10) *Prodichotriaenes*, with a very short conical shaft and slender straight clads; (11) Massive dermal pentactines.

Plate 4



Remarks. It differs from *Harsa siscwaiensis* Carter (1991, pp. 199, 200, pl. 1, fig. 1) in the more flattened test.

Local range and occurrence. Norian (Late Triassic); Sjenica.

Genus *Hexasaturnalis* Kozur et Mostler, 1983

Type species. Spongosaturnalis ? hexagonus Yao, 1972.

Local range and occurrence. Toarcian–Valanginian; worldwide.

Hexasaturnalis hexagonus (Yao), 1972

Plate 4, fig. 2

Spongosaturnalis ? hexagonus: Yao, 1972, p. 31, pl. 6, figs. 1–3.

Acanthocircus hexagonus (Yao): Fujii et al., 1993, pl. 1, fig. 3.

Hexasaturnalis hexagonus (Yao): Baumgartner et al., 1995, p. 252, pl. 3502, figs. 1–3 (with detailed synonymy).

Local range and occurrence. Aalenian to Early Bajocian; Zaboj.

Genus *Hiscocapsa* O'Dogherty, 1994

Type species. Cyrtocapsa grutterinki Tan, 1927.

Local range and occurrence. Berriasian to Middle Albian of the Northern Apennines (Italy) and Betic Cordillera (Spain).

Hiscocapsa sp.

Plate 3, fig. 7
31, figs. 7–13

Remarks. This form is poorly preserved. The visible features, the inflated subspherical terminal post-abdominal chamber, with large polygonal irregularly arranged pores are most similar to *Hiscocapsa asseni* (Tan) in O'Dogherty, 1994, pp. 200, 201, pl. 31, figs. 7–13.

Local range and occurrence. Bajocian to Bathonian of the Ivanjska quarry.

Genus *Hsuum* Pessagno, 1977 emend. Takemura, 1986

Type species. Hsuum cuestaense Pessagno, 1977.

Local range and occurrence. Lower Jurassic to Lower Cretaceous (Upper Valanginian); worldwide.

Hsuum maxwelli Pessagno, 1977

Plate 2, fig. 7

Hsuum maxwelli: Pessagno, 1977, p. 81, pl. 7, figs. 14–16; Kocher, 1981, p. 73, pl. 14, fig. 14.

Hsuum ex gr. *maxwelli* Pessagno: Vishnevskaya, 2001, pl. 41, fig. 12; pl. 107, fig. 6, pl. 108, figs. 5, 6, 8, and 9.

Local range and occurrence. Callovian to Oxfordian of the Uzlomac Mountain.

Hsuum ex gr. *maxwelli* Pessagno

Plate 2, fig. 8

Local range and occurrence. Callovian to Oxfordian of the Uzlomac Mountain.

Hsuum ? maxwelli Pessagno

Plate 1, fig. 7

Remarks. This shell is subconical multisegmental, with imperforate proximal part; eight longitudinal costae visible in lateral view; and large, irregularly arranged pores along the intercostal depressions.

Local range and occurrence. Uppermost Callovian to Oxfordian of the Jezerača section.

Hsuum sp.

Plate 3, fig. 11

Remarks. This form has a subconical test, with costae, which do not continue from one segment to another; two rows of pores along the intercostals depressions; smooth cephalis imperforate with short rounded apical horn. This form is very close to *Transhsuum* sp. in Sykora and Ozvoldova (1996, pl. 2, fig. 13).

Local range and occurrence. Bajocian to Bathonian of the Ivanjska quarry.

→

Explanation of Plate 5

Ladinian (Middle Triassic) radiolarians from Serbia, Visoka locality (Sample 10-8a).

Figs. 1 and 2. *Pentaspongodiscus ? mesotriassicus* Dumitrica, Kozur et Mostler, ×150, 260.

Fig. 3. *Pseudostylosphaera* cf. *multispinata* Tekin et Mostler, ×280.

Figs. 4 and 5. *Pseudostylosphaera nazarovi* (Kozur et Mostler), ×95 and ×85.

Fig. 6. *Pseudostylosphaera ? hellenica* De Wever, ×180.

Fig. 7. *Zhamojdasphaera ? latispinosa* Kozur et Mostler, ×330

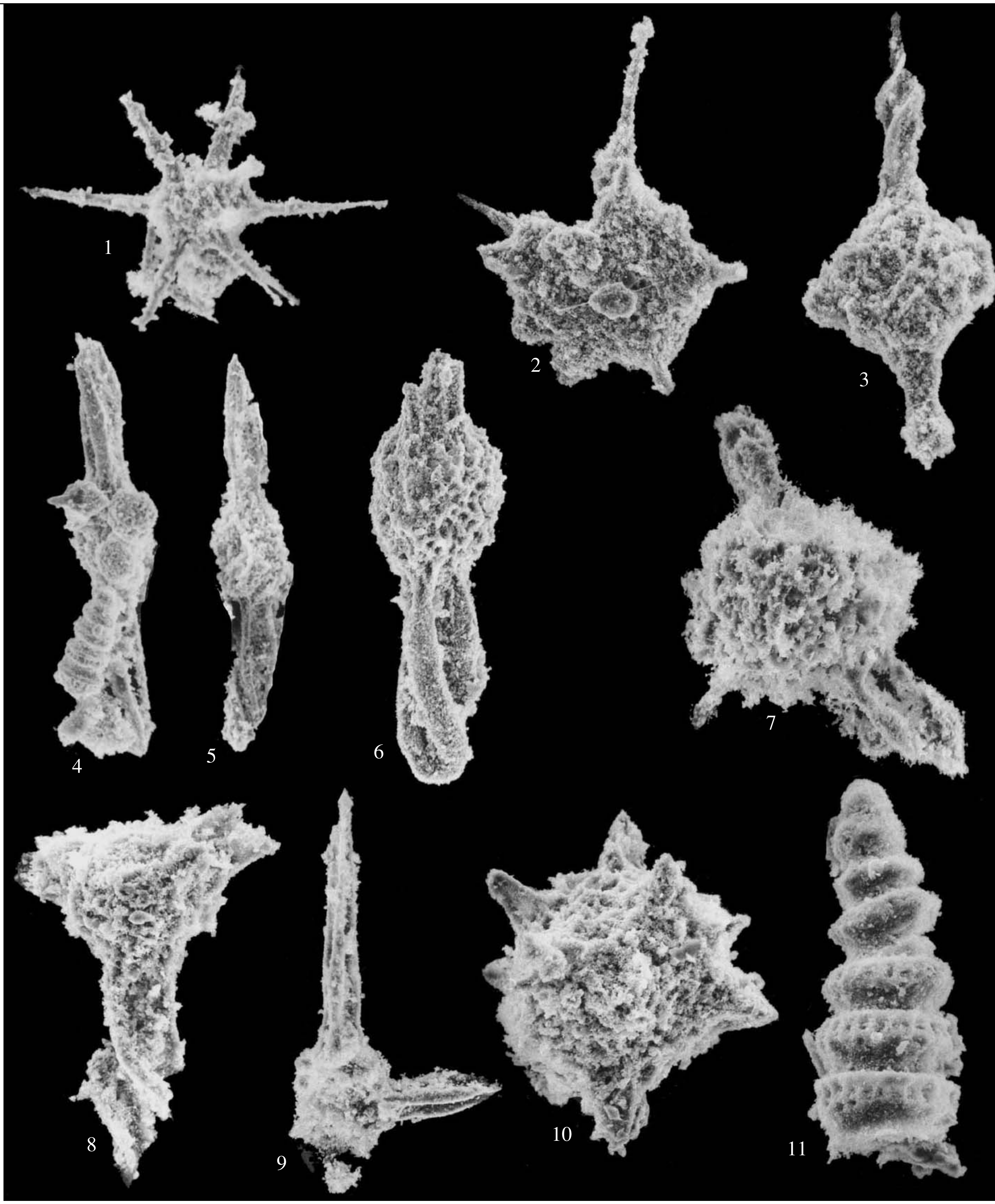
Fig. 8. Twisted spine, ×440.

Fig. 9. *Muelleritortis* cf. *granulosum* (Dumitrica, Kozur et Mostler), ×220.

Fig. 10. *Welirella ?* sp., ×350.

Fig. 11. *Triassocampe* cf. *sulovensis* Kozur et Mock, ×350.

Plate 5



***Hsuum* sp.**

Plate 3, fig. 12

Remarks. The shell is multisegmental, subconical. The cephalis is small, semispherical, nonporous without an apical horn. Nine to ten longitudinal costae are visible in lateral view. Pores arranged in transverse rows, scarce in the distal part of the shell.

Local range and occurrence. Bajocian to Bathonian of the Ivanjska quarry.

***Hsuum ?* sp.**

Plate 2, fig. 12

Remarks. The test is conical, without clear crossing of strips and cut strictures between segments. The test is covered with small circular pores located between strips.

Local range and occurrence. Late Bathonian to Oxfordian of Uzlomac Mountain.

Genus *Japanocampe* Kozur, 1984

Type species. Triassocampe nova Yao, 1982.

***Japanocampe nova* (Yao, 1982)**

Plate 7, fig. 11

Dictyomitrella sp. B: Yao, Matsuda and Isozaki, 1980, pl. 3, figs. 1-3.

Triassocampe nova Yao, 1982, p. 59, 60, pl. 2, figs. 1-4; Yao et al., 1982, pl. 1, fig. 14; Bragin, 1986, pl. 3, fig. 4; Yoshida, 1986, pl. 4, figs. 7 and 8; Bragin, 1991, p. 101, pl. 5, figs. 12 and 16; Danelian and Robertson, 2001, text-figs. 5e and 5f.

Japanocampe nova (Yao): Kozur, 1984, pl. 1, fig. 4; Sugiyama, 1997, p. 181, fig. 50 (1).

Japanocampe nova (Yao) Group: Tekin, 1999, p. 138, pl. 29, figs. 3–5; Tekin and Yurtsever, 2003, p. 157, pl. 2, fig. 7.

Local range and occurrence. Late Carnian to Early Norian of the Ovčar-Kablar gorge.

Genus *Kahlerosphaera* Kozur et Mostler, 1979

Type species. Kahlerosphaera parvispinosa Kozur et Mostler, 1979.

Local range and occurrence. Upper Triassic.

***Kahlerosphaera kemerensis* Tekin, 1999**

Plate 6, figs. 6 and 7

Kahlerosphaera ? sp.: Obradović and Goričan, 1988, pl. 4, fig. 13.

Kahlerosphaera kemerensis Tekin, 1999, p. 64, pl. 1, figs. 5–9.

Local range and occurrence. Norian (Upper Triassic); Sjenica.

Genus *Loffa* Pessagno, 1979

Type species. Loffa mulleri Pessagno, 1979.

Local range and occurrence. Upper Triassic.

***Loffa ? mulleri* Pessagno, 1979**

Plate 7, fig. 4

Remarks. Due to poor preservation, the fourth tumidispine is almost invisible and the typical pantanellid shape is not recorded.

Local range and occurrence. Late Carnian to Early Norian of the Ovčar-Kablar gorge.

Genus *Mirifusus* Pessagno, 1977, emend. Baumgartner, 1984

Type species. Mirifusus guadalupensis Pessagno, 1977.

Local range and occurrence. Middle Jurassic to Lower Cretaceous; worldwide.

***Mirifusus* cf. *proavus* Tonielli**

Plate 4, fig. 5

Remarks. Our specimen differs from *Mirifusus proavus* Tonielli, 1991 (Tonielli, 1991, p. 24, pl. 2, figs. 2–4, 8; Baumgartner et al., 1995, p. 322, pl. 3158, figs. 1–3) in the more elongated test. The resemblance

Explanation of Plate 6

Middle–Upper Triassic radiolarians of Serbia, Ladinian (Middle Triassic) radiolarians: (Figs. 1–5) from the Rzav River Basin, Sample 10-11, and Norian (Upper Triassic) radiolarians; (Figs. 6–11) from Sjenica cherts (Sample 9-1), where deposits contain conodonts *Grodella* cf. *deliculata* (Mostler) (Rhaetian).

Fig. 1. *Pseudostylosphaera coccostyla* (Rüst), ×260.

Fig. 2. *Pseudostylosphaera* sp., ×280.

Fig. 3. *Muelleritortis ? cochleata* (Nakaseko et Nishimura), ×410.

Fig. 4. *Pseudostylosphaera* sp., ×400.

Fig. 5. Spine of *Pseudostylosphaera* sp., ×460.

Figs. 6 and 7. *Kahlerosphaera kemerensis* Tekin, ×285.

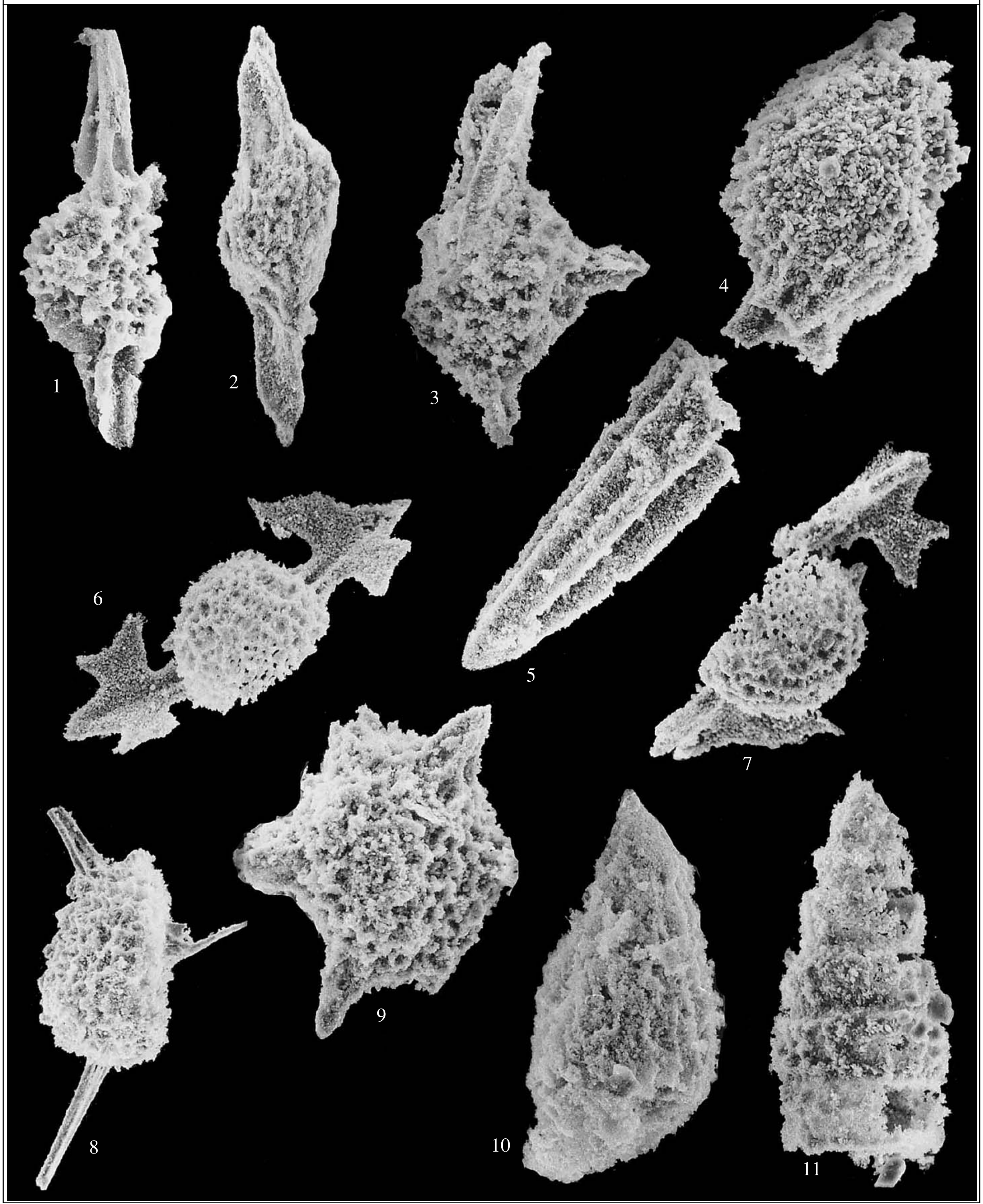
Fig. 8. *Harsa* cf. *siscwaiensis* Carter, ×530.

Fig. 9. *Beturiella ? robusta* Dumitrica, Kozur et Mostler, ×250.

Fig. 10. *Parahsuum ?* sp., ×650.

Fig. 11. *Whalenella regia* (Blome), ×450.

Plate 6



in outline of our specimen and *Ristola (?) praemirifusus* Baumgartner et Bartolini, 1995 (Baumgartner et al., 1995, pl. 2041, figs. 1–4) suggests that they are closely related.

Local range and occurrence. Aalenian to Early Bajocian; Zaboj.

Genus *Muelleritortis* Kozur, 1988

Type species. Emiluvia (?) cochleata Nakaseko et Nishimura, 1979.

Local range and occurrence. Rare in the Early Longobardian; common in the Middle and Late Longobardian, very rare in the basal Cordevolian. Tethys, Philippines, Japan, British Columbia.

Muelleritortis cf. granulosum (Dumitrica, Kozur et Mostler, 1980)

Plate 5, fig. 9

Remarks. It differs from *Muelleritortis* cf. *granulosum* (Dumitrica, Kozur et Mostler, 1980) in Dumitrica et al. (1980) in the more elongated and nontwisted spines.

Local range and occurrence. Ladinian of the Visoka section (Rzav River Basin).

Muelleritortis ? cochleata (Nakaseko et Nishimura, 1979)

Plate 6, fig. 3

Remarks. It is similar to *Muelleritortis cochleata* (Nakaseko et Nishimura) in Halamić and Goričan (1995, pl. 1, figs. 13, 14) and differs in the larger cortical shell and the large rounded polygonally framed pores. Because of poor preservation of the specimen, three main spines are invisible.

Local range and occurrence. Ladinian of the Visoka section (Rzav River Basin).

Genus *Multimonilis* Yeh, 1989

Type species. Multimonilis pulcher Yeh, 1989.

Local range and occurrence. Upper Triassic; worldwide.

Multimonilis ? pulcher Yeh, 1989

Plate 7, fig. 13

Multimonilis pulcher: Yeh, 1989, pp. 72, 73, pl. 9, figs. 9 and 19; Bragin and Krylov, 1999, text-fig. 14d.

Local range and occurrence. Late Carnian to Early Norian of the Ovčar-Kablar gorge.

Genus *Pachus* Blome, 1984, emend. Tekin, 1999

Type species. Pachus firmus Blome, 1984.

Local range and occurrence. Upper Triassic; worldwide.

Pachus multinodosus Tekin, 1999

Plate 7, fig. 9

Pachus multinodosus: Tekin, 1999, pp. 139, 140, pl. 29, figs. 9–12; Feng in Feng et al., 2005, pp. 251, 252, pl. 3, figs. 4–6.

?Nassellarian indet. A: Carter and Orchard, 2000, pl. 2, fig. 8.

Local range and occurrence. Late Carnian to Early Norian of the Ovčar-Kablar gorge.

Genus *Palinandromeda* Pessagno in Pessagno et al., 1993

Type species. Andromeda crassa Baumgartner, 1980.

Local range and occurrence. Aalenian–Oxfordian.

Palinandromeda cf. *praepodbieleusis* Baumgartner, 1984

Plate 3, fig. 4

Remarks. Because of poor preservation of the specimen, the cephalis, thorax, and abdomen are invisible. This form differs from *Andromeda podbielensis*

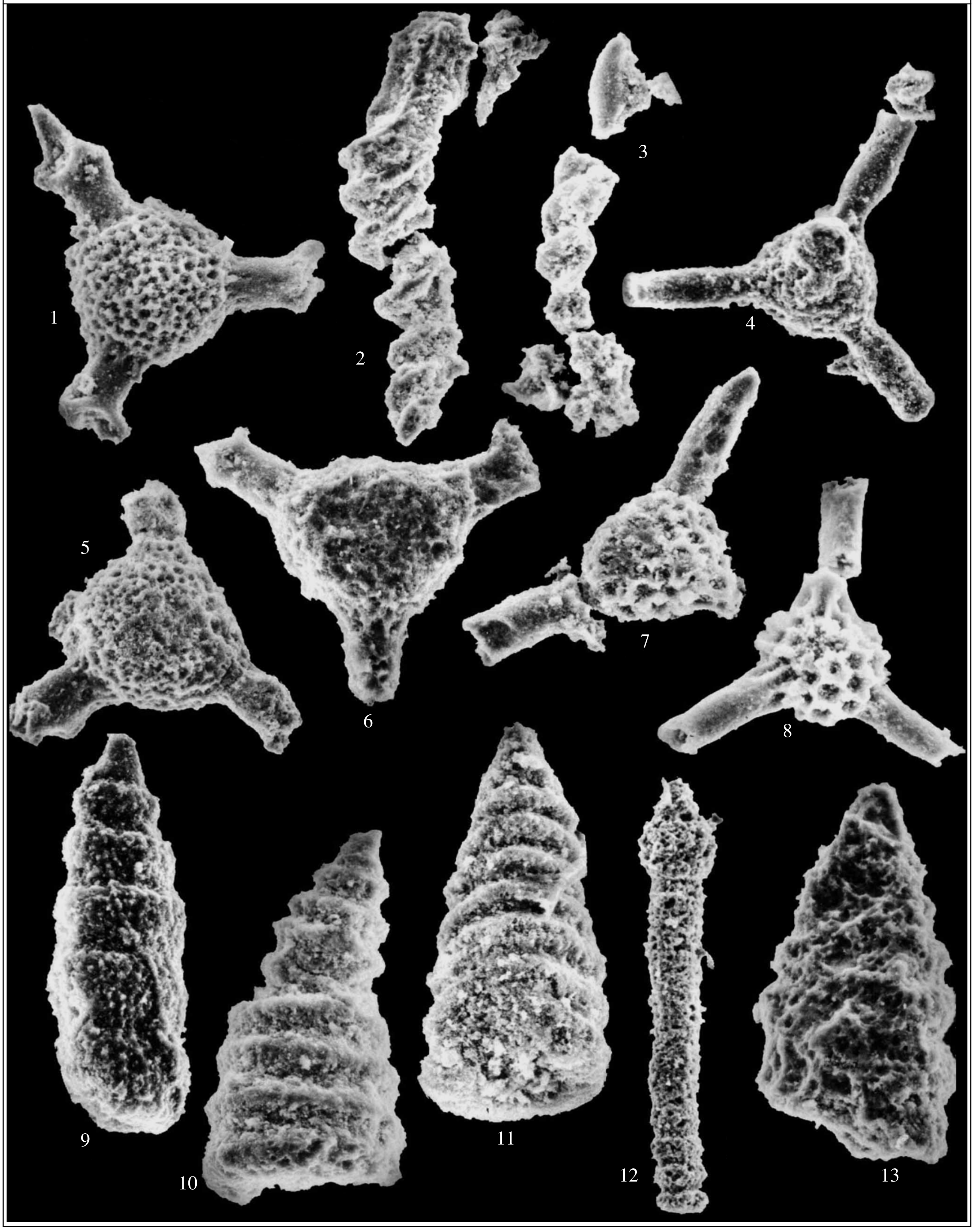
→

Explanation of Plate 7

Late Carnian to Early Norian radiolarians from the Ovčar-Kablar gorge (Figs. 1, 4, 6, 7, 11, 12, Sample 102; Figs. 2, 5, 13, Sample 100; Figs. 3, 8–10, Sample 103).

Fig. 1. *Capnuchosphaera theloides* De Wever, ×200.
Fig. 2. *Spongostylus ? carnicus* Kozur et Mostler, ×350.
Fig. 3. *Spongostylus carnicus* Kozur et Mostler, ×300.
Fig. 4. *Loffa ? mulleri* Pessagno, ×200.
Fig. 5. *Capnuchosphaera* sp., ×200.
Fig. 6. *Capnuchosphaera triassica* De Wever, ×200.
Fig. 7. *Capnodoce* cf. *anapetes* De Wever, ×200.
Fig. 8. *Capnodoce crystallina* Pessagno, ×200.
Fig. 9. *Pachus multinodosus* Tekin, ×200.
Fig. 10. *Triassocampe* sp., ×200.
Fig. 11. *Japonocampe nova* (Yao), ×200.
Fig. 12. *Xiphoteca rugosa* Bragin, ×100.
Fig. 13. *Multimonilis ? pulcher* Yeh, ×200.

Plate 7



(Ozvoldova, 1979) and *Palinandromeda praepodbieleusis* Baumgartner, 1984 (Baumgartner et al., 1995) in the concave basal surface.

Local range and occurrence. Bajocian to Bathonian of the Ivanjska quarry.

Genus *Pantanellium* Pessagno, 1977

Type species. Pantanellium riedeli Pessagno, 1977.

Local range and occurrence. Upper Triassic to Lower Cretaceous (Lower Albian); worldwide.

Pantanellium meraceibaence Pessagno et MacLeod, 1993

Plate 1, fig. 1

Pantanellium meraceibaence Pessagno et MacLeod: Yang, 1993, p. 15, pl. 2, figs. 6 and 22.

Local range and occurrence. Uppermost Callovian to Oxfordian of the Jezeračka section.

Genus *Parahsuum Yao*, 1982

Type species. Parahsuum simplum Yao, 1982.

Local range and occurrence. Upper Triassic? to Middle Jurassic of northeastern Asia, Japan.

Parahsuum cf. *nitidum* (Pessagno et Whalen)

Plate 4, fig. 6

Remarks. It differs from *Lupherium nitidum* Pessagno et Whalen, 1982 (Pessagno and Whalen, 1982, p. 135, pl. 8, figs. 7, 8, pl. 13, fig. 17) in the irregular structure of porous frames and the thick horn.

Local range and occurrence. Aalenian to Early Bajocian; Zaboj.

Parahsuum cf. *officerense* (Pessagno et Whalen)

Plate 4, fig. 3

Remarks. It differs from *Lupherium officerense* Pessagno et Whalen, 1982 (Pessagno and Whalen, 1982, p. 135, pl. 6, figs. 5, 13, and 18; pl. 12, fig. 5 from the Lower–Middle Bajocian) and *L. officerense* Pessagno et Whalen, 1982 in Baumgartner et al. (1995, p. 382, pl., 2011, figs. 1, 2) in the thicker horn and elongated test; however, it is very similar to *Lupherium officerense* Pessagno et Whalen, 1982 in Grill and Kozur (1986, pl. 1, figs. 4, 5) from the Aalenian–Middle Bajocian.

Local range and occurrence. Aalenian to Early Bajocian; Zaboj.

Parahsuum ? sp.

Plate 6, fig. 10

Remarks. Because of poor preservation, this specimen is difficult to identify. In general, the test has a rectangular apical horn and circumferential ridges in the distal part.

Local range and occurrence. Upper Norian to Rhaetian; Sjenica.

Genus *Pentaspongodiscus* Kozur et Mostler, 1979

Type species. Pentaspongodiscus tortilis Kozur et Mostler, 1979.

Local range and occurrence. Carnian; Austria.

Pentaspongodiscus ? mesotriassicus Dumitrica, Kozur et Mostler, 1980

Plate 5, figs. 1 and 2

Pentaspongodiscus mesotriassicus Dumitrica, Kozur et Mostler, 1980: Dumitrica et al., 1980, p. 10, pl. 8, fig. 7; Lahm, 1984, p. 56, pl. 9, fig. 11; Goričan and Buser, 1990, p. 151, pl. 2, figs. 1 and 2; Kellici and De Wever, 1995, p. 153, pl. 4, fig. 2; Kozur et al., 1996, p. 231, pl. 4, fig. 14; Tekin and Mostler, 2005b, p. 39, pl. 6, fig. 6.

Local range and occurrence. Ladinian of the Visoka section (Rzav River Basin).

Genus *Podobursa* Wisniowski 1889 emend. Foreman, 1973b

Type species. Podobursa dunikowskii Wisniowski 1889.

Local range and occurrence. Triassic to Cretaceous; worldwide.

Podobursa helvetica (Rüst, 1885)

Plate 1, fig. 11

Podobursa helvetica (Rüst): Baumgartner et al., 1980, p. 60, pl. 3, fig. 11; pl. 6, fig. 5; Baumgartner, 1984, p. 779, pl. 7, fig. 7; Ozvoldova, 1988, pl. 6, fig. 7; Conti and Marcucci, 1991, pl. 3, fig. 9.

Local range and occurrence. Uppermost Callovian–Oxfordian (Late Jurassic) of the Jezeračka Reka section.

Genus *Praewilliriedellum* Kozur, 1984

Type species. Praewilliriedellum cephalospinosum Kozur, 1984.

Local range and occurrence. Bajocian of Bükk Mountains and Rudábanya Mountains.

Praewilliriedellum cf. *spinosum* Kozur

Plate 3, fig. 8

Remarks. Because of poor preservation of the specimen, segments are hardly visible.

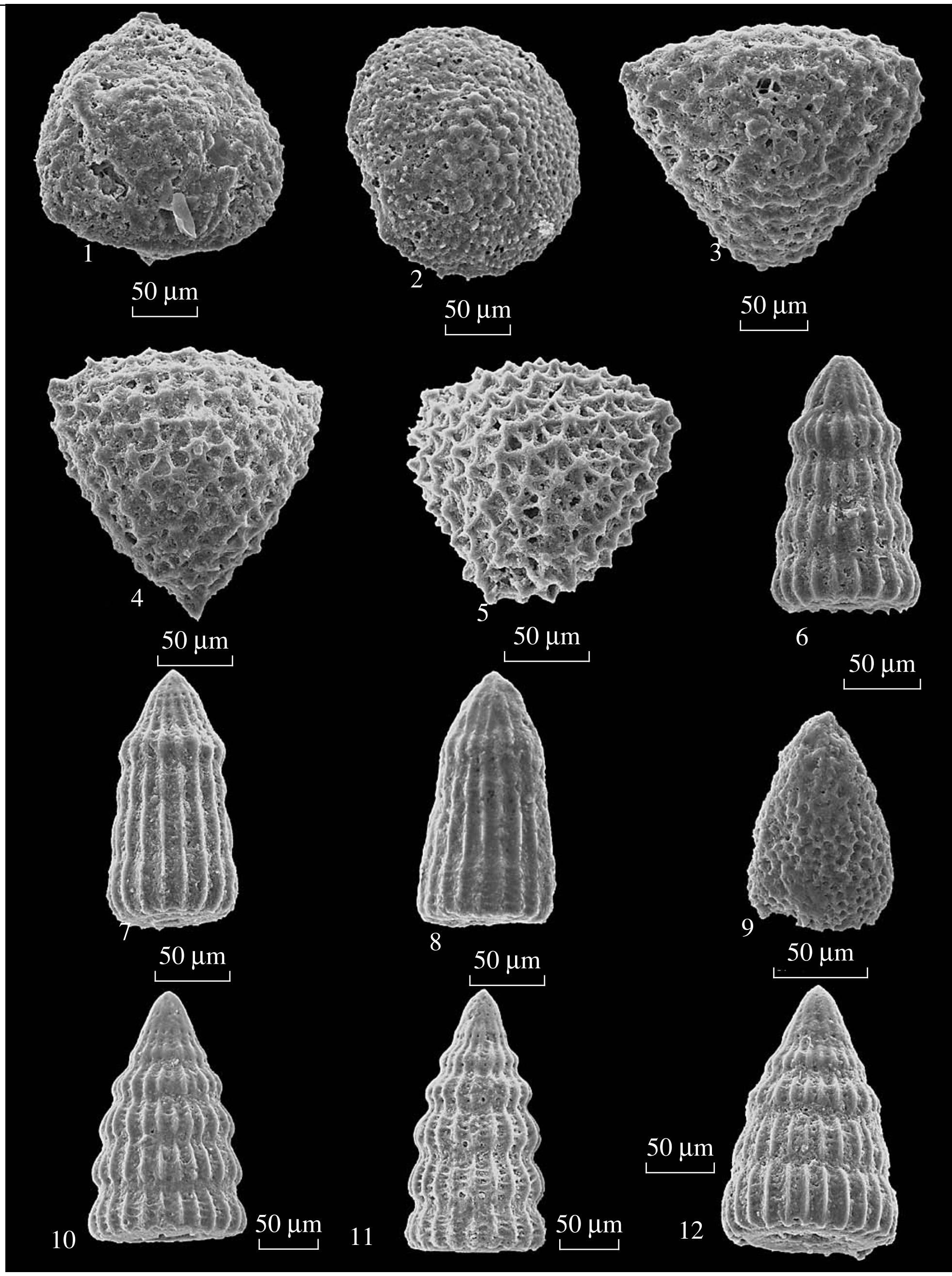
Local range and occurrence. Bajocian to Bathonian; Ivanjska quarry.

Genus *Pseudoaulophacus* Pessagno, 1963, emend. Pessagno, 1972

Type species. Pseudoaulophacus floresensis Pessagno, 1972.

Local range and occurrence. Late Cretaceous; worldwide.

Plate 8



Explanation of Plate 8

Coniacian radiolarian assemblage of the Struganik locality (Sample 212). Magnification is indicated in the plate.

Fig. 1. *Pseudoaulophacus* ex gr. *floresensis* Pessagno.

Fig. 2. *Pseudoaulophacus* cf. *venadoensis* Pessagno.

Fig. 3 and 5. *Alievium* aff. *superbum* (Squinabol).

Fig. 4. *Alievium* cf. *praegallowayi* Pessagno.

Figs. 6–8. *Dictyomitra koslovae* Foreman.

Fig. 9. *Stichomitra* sp.

Figs. 10 and 11. *Dictyomitra formosa* Squinabol.

Fig. 12. *Dictyomitra* cf. *formosa* Squinabol.

***Pseudoaulophacus* ex gr. *floresensis* Pessagno**

Plate 8, fig. 1

Remarks. The shell is subtriangular. Because of poor preservation of the specimen, spines and the number of pores between spines on the disc periphery are invisible.

Local range and occurrence. Coniacian of Struganik.

***Pseudoaulophacus* cf. *venadoensis* Pessagno**

Plate 8, fig. 2

Remarks. In the equatorial plane, the shell is circular as in *Pseudoaulophacus venadoensis* Pessagno, 1972 (Pessagno, 1976) rather than subtriangular. Because of poor preservation of the specimen, spines and the number of pores between spines are invisible.

Local range and occurrence. Coniacian of Struganik.

Genus *Pseudostylosphaera* Kozur et Mostler, 1981

Type species. *Pseudostylosphaera gracilis Kozur et Mostler, 1981.*

Local range and occurrence. Triassic; worldwide.

***Pseudostylosphaera coccostyla* (Rüst), 1892**

Plate 6, fig. 1

Spongotractus coccostylus Rüst: Rüst, 1892, p. 160, pl. 21, fig. 8.

Pseudostylosphaera coccostyla (Rüst): Kozur and Mostler, 1981, pp. 31, 32, pl. 15, fig. 3; pl. 46, fig. 5; Goričan and Buser, 1990, pp. 153, 154, pl. 5, fig. 1; Sashida et al., 1993, p. 90, text-fig. 7: 10, 12, and 14; text-fig. 8: 14; Kellici and De Wever, 1994, p. 156, pl. 4, figs. 11 and 12.

Local range and occurrence. Ladinian of the Visoka section (Rzav River Basin).

***Pseudostylosphaera nazarovi* (Kozur et Mostler), 1979**

Plate 5, figs. 4 and 5

Stylosphaera ? nazarovi: Kozur and Mostler, 1979, p. 55, pl. 1, fig. 5; pl. 14, figs. 4 and 6.

Pseudostylosphaera nazarovi (Kozur et Mostler): Kozur and Mostler, 1981, p. 31; Sugiyama, 1997, p. 186, text-fig. 48-17; Cordey, 1998, p. 74, pl. 16, fig. 6; Tekin, 1999, p. 130, pl. 25, fig. 15.

Local range and occurrence. Ladinian of the Visoka section (Rzav River Basin).

***Pseudostylosphaera ? hellenica* De Wever, 1982**

Plate 5, fig. 6

Remarks. It differs from *Pseudostylosphaera hellenica* De Wever, 1982 in the shorter and more massive polar spines.

Local range and occurrence. Ladinian of the Visoka section (Rzav River Basin).

***Pseudostylosphaera* cf. *multispinata* Tekin et Mostler**

Plate 5, fig. 3

cf. *Pseudostylosphaera multispinata* Tekin et Mostler: Tekin and Mostler, 2005a, pp. 2–3, text-figs. 4–6.

Remarks. It differs from *Pseudostylosphaera multispinata* Tekin et Mostler, 2005 in the absence of needle-like spines.

Local range and occurrence. Ladinian of the Visoka section (Rzav River Basin).

***Pseudostylosphaera* sp.**

Plate 6, figs. 2, 4, and 5

Remarks. The test is much larger and more robust than that of other representatives of *Pseudostylosphaera*. The form shown in Pl. 6, fig. 5 is very similar to *Pseudostylosphaera coccostyla* (Rüst, 1892) figured by Goričan and Buser (1990, pp. 153, 154, pl. 5, fig. 1), but differs in having four-bladed spines. This form probably has secondary grooves on the main ridge.

Local range and occurrence. Ladinian of the Visoka section (Rzav River Basin).

Genus *Sethocapsa* Haeckel 1881

Type species. Sethocapsa cometa (Pantanelli), 1880.

Local range and occurrence. Jurassic–Cretaceous.

***Sethocapsa funatoensis* Aita, 1987**

Plate 2, fig. 6

Sethocapsa funatoensis Aita, 1987, p. 73, pl. 2, figs. 6a and 7b; Baumgartner et al., 1995, p. 494, pl. 3070, figs. 1–5H.

Local range and occurrence. Callovian–Oxfordian of Uzlomac Mountain.

Genus *Spongostylus* Haeckel 1882

Type species. Spongostylus hastatus Haeckel 1882.

***Spongostylus carnicus* Kozur et Mostler, 1979**

Plate 7, fig. 3

Spongostylus carnicus: Kozur and Mostler, 1979, p. 58, pl. 9, figs. 5, 6, 8, and 9; Kozur and Mostler, 1981, pl. 38, fig. 3; Lahm, 1984, p. 69, pl. 12, fig. 4; Yeh, 1989, p. 67, pl. 13, fig. 8; Carter et al., 1989, pl. 1, fig. 5; Grapes et al., 1990, text-fig. 8.0; Halamić and Goričan, 1995, pl. 2, figs. 18 and 19; Bragin and Krylov, 1999, fig. 7f; Tekin, 1999, p. 67, pl. 2, figs. 5 and 6.

Spongostylus aequicurvistylus Lahm, 1984, pp. 69, 70, pl. 12, fig. 5.

Local range and occurrence. Late Carnian to Early Norian of the Ovčar-Kablar gorge.

***Spongostylus ? carnicus* Kozur et Mostler, 1981**

Plate 7, fig. 2

Remarks. Because of poor preservation, it is tentatively included in the species *Spongostylus carnicus* Kozur et Mostler.

Local range and occurrence. Late Carnian to Early Norian of the Ovčar-Kablar gorge.

Genus *Stichocapsa* Haeckel 1881

Type species. Stichocapsa jaspida Rüst, 1885.

Local range and occurrence. Jurassic–Cretaceous; worldwide.

***Stichocapsa convexa* Yao, 1979**

Plate 2, fig. 3

Stichocapsa convexa Yao, 1979, p. 35, pl. 5, figs. 14–16; pl. 6, figs. 1–7; Kocher, 1981, p. 95, pl. 16, figs. 21 and 22; Takemura, 1986, p. 55, pl. 7, figs. 9 and 10; Baumgartner et al., 1995, p. 518, pl. 3055, figs. 1–4.

Local range and occurrence. Late Bathonian to Callovian of the Rzav River Basin.

***Stichocapsa robusta* Matsuoka, 1984**

Plate 2, fig. 5

Stichocapsa robusta Matsuoka: Baumgartner et al., 1995, p. 524, pl. 3298, figs. 1–7 (with detailed synonymy).

Local range and occurrence. Callovian to Oxfordian of Uzlomac Mountain.

***Stichocapsa* sp.**

Plate 3, fig. 6

Remarks. This form is very poorly preserved. Visible features are most similar to *Stichocapsa robusta* Matsuoka, 1984.

Local range and occurrence. Bajocian to Bathonian of the Ivanjska quarry.

Genus *Stichomitra* Cayeux, 1897

Type species. Stichomitra costata Cayeux, 1897.

Local range and occurrence. Jurassic–Cretaceous; worldwide.

***Stichomitra ? annibill* Kocher, 1981**

Plate 1, fig. 10

Stichomitra annibill Kocher, 1981, p. 96, pl. 16, figs. 24–26.

Remarks. It differs from the holotype of *S. annibill* in the complicate xitoidal-like structure of the test.

Local range and occurrence. Uppermost Callovian to Oxfordian of the Jezeračka section.

***Stichomitra* sp.**

Plate 8, fig. 9

Remarks. It is very similar to *Stichomitra mediocris* (Tan) in O'Dogherty (1994, pl. 17, figs. 3–5), but differs in the smaller test, smoother proximal part of the wall, and subtriangular rather than hemispherical, knoblike cephalis.

Local range and occurrence. Coniacian of Struganik.

Genus *Striatojaponocapsa* Kozur, 1984

Type species. Tricolocapsa plicarum Yao, 1979.

Local range and occurrence. Bajocian of the Bükk Mountains and Japan.

***Striatojaponocapsa plicarum plicarum* (Yao, 1997)**

Plate 2, fig. 1

Striatojaponocapsa plicarum plicarum (Yao): Hull, 1997, p. 168, pl. 37, figs. 6–9.

Remarks. The specimen examined is similar to *Striatojaponocapsa synconexa* O'Dogherty, Goričan, and Dumitrica in O'Dogherty et al., 2005, pp. 447–450, pl. 10, figs. 9–17 (with detailed synonymy).

Local range and occurrence. Late Bathonian to Callovian of the Rzav River Basin.

Genus *Tetraditryma* Baumgartner, 1980

Type species. Tetraditryma pseudoplena Baumgartner, 1980.

Local range and occurrence. Middle Jurassic (Bajocian) to Lower Cretaceous (Berriasian); worldwide.

***Tetraditryma* sp.**

Plate 3, fig. 3

Remarks. Because the test in question is poorly preserved, the features of this form are difficult to identify.

Local range and occurrence. Bajocian to Bathonian of the Ivanjska quarry.

Genus *Transhsuum* Takemura, 1986

Type species. Transhsuum medium Takemura, 1986.

Local range and occurrence. Aalenian to Bajocian; worldwide.

***Transhsuum* cf. *hisuikyoense* (Isozaki et Matsuda)**

Plate 4, fig. 4

Remarks. Because of poor preservation of the specimen, postcephalic segments and the distal part are hardly visible. It differs from *Transhsuum hisuikyoense* (Isozaki et Matsuda, 1985) in the more elongated test.

Local range and occurrence. Aalenian to Early Bajocian of the Zaboj.

Genus *Triactoma* Rüst 1885

Type species. Triactoma tithonium Rüst 1885.

Local range and occurrence. Triassic to Lower Cretaceous; Tethyan and Boreal Realms.

***Triactoma blakei* (Pessagno, 1977)**

Plate 1, fig. 5

Tripocyclia blakei Pessagno, 1977, p. 80, pl. 6, figs. 15 and 16; Ishida, 1983, pl. 4, fig. 15.

Triactoma blakei (Pessagno): Kocher, 1981, p. 101, pl. 17, fig. 5; Ozvoldova, 1990, pl. 1, fig. 1; Baumgartner et al., 1995, p. 584, pl. 3095, text-figs. 1–4.

Triactoma cf. *blakei* (Pessagno): Dumitrica and Mello, 1982, pl. 3, fig. 4.

Remarks. The connection between the sphere and short spines is very similar to that of *Triactoma mexicana* Pessagno et Yang, 1989 (Pessagno et al., 1989).

Local range and occurrence. Uppermost Callovian to Oxfordian of the Jezeračka section.

***Triactoma wickiupensis* Pessagno et Yang, 1989**

Plate 4, fig. 1

Triactoma wickiupensis Pessagno and Yang in Pessagno et al., 1989, p. 222, pl. 7, figs. 5, 11, and 21; Goričan, 1994, pl. 2, fig. 9.

Remarks. One spine differs in having the spine tip similar to that of *Triactoma jakobsae* Carter (in Baumgartner et al., 1995, p. 588).

Local range and occurrence. Aalenian to Early Bajocian of Zaboj.

***Triactoma ? mexicana* Pessagno et Yang, 1989**

Plate 3, fig. 1

Remarks. Because of poor preservation of the specimen, two secondary spines are invisible.

Local range and occurrence. Bajocian to Bathonian of the Ivanjska quarry.

Genus *Triassocampe* Dumitrica, Kozur et Mostler, 1980

Type species. Triassocampe scalaris Dumitrica, Kozur et Mostler, 1980.

Local range and occurrence. Middle and Upper Triassic of the European Tethys.

***Triassocampe* cf. *sulovensis* Kozur et Mock**

Plate 5, fig. 11

Remarks. Our specimen differs from *Triassocampe sulovensis* Kozur et Mock, 1981 in Goričan and Buser (1990, pl. 12, figs. 4, 5) in the smaller number of segments. The last three segments have one or two rows of small circular pores.

Local range and occurrence. Ladinian of the Visoka section (Rzav River Basin).

***Triassocampe* sp.**

Plate 7, fig. 10

Remarks. Because of poor preservation of the specimen, the rows of pores around the circumferential ridges are invisible.

Local range and occurrence. Upper Carnian to Lower Norian of the Ovčar-Kablar gorge.

Genus *Tritrabs* Baumgartner, 1980

Type species. Paronaella (?) casmaliaensis Pessagno, 1977a.

Local range and occurrence. Jurassic; worldwide.

***Tritrabs ewingi* (Pessagno, 1977)**

Plate 1, fig. 6

Paronaella (?) ewingi: Pessagno, 1977a, p. 70, pl. 1, figs. 14 and 15.

Tritrabs ewingi (Pessagno): Baumgartner, 1980, p. 293, pl. 4, figs. 5, 7, 17, and 18; Ozvoldova and Sykora, 1984, p. 273, pl. 14, fig. 5; pl. 15, fig. 5; Tumanda, 1989, p. 35, pl. 2, fig. 5.

Tritrabs ewingi gr. (Pessagno): Jud, 1994, p. 116, pl. 23, figs. 12 and 13.

Tritrabs ewingi sensu lato (Pessagno): Baumgartner et al., 1995, p. 606, pl. 3113, figs. 1–8.

Local range and occurrence. Uppermost Callovian to Oxfordian of the Jezeračka section.

Genus *Welirella* Dumitrica in Dumitrica et al., 1980

Type species. Welirella weveri Dumitrica in Dumitrica et al., 1980.

Local range and occurrence. Lower Ladinian to Middle Norian of the Tethyan Realm.

***Welirella ?* sp.**

Plate 5, fig. 10

Remarks. Because of poor preservation, the features of this form are difficult to identify. It is tentatively included in the genus *Welirella* Dumitrica, Kozur et Mostler, 1980.

Local range and occurrence. Ladinian of the Visoka section (Rzav River Basin).

Genus *Whalenella* Kozur, 1984

Type species. Dictyomitra arecta Hinde, 1908.

Local range and occurrence. Triassic; worldwide.

***Whalenella regia* (Blome, 1984)**

Plate 6, fig. 11

Corum regium: Blome, 1984, p. 51, pl. 13, figs. 3, 8, and 15; Yoshida, 1986, pl. 5, fig. 4; Fujii et al., 1993, pl. 3, fig. 7; Aita and Sporli, 1994, pl. 7, fig. 5; Sugiyama, 1997, p. 176, fig. 49 (4); Tekin, 1999, p. 153, pl. 35, figs. 10 and 11.

Whalenella regia (Blome): Tekin and Yurtsever, 2003, p. 159, pl. 2, fig. 11.

Local range and occurrence. Ladinian of the Visoka section (Rzav River Basin).

Genus *Williriedellum* Dumitrica, 1970

Type species. Williriedellum crystallinum Dumitrica, 1970.

Local range and occurrence. Jurassic–Lower Cretaceous; worldwide.

Williriedellum ? carpaticum: **Dumitrica, 1970.**

Plate 2, fig. 2

Williriedellum carpaticum: Dumitrica, 1970, p. 70, pl. 9, figs. 56a, 56b, 57–59, pl. 10, fig. 61; Baumgartner et al., 1995, p. 626, pl. 4055, figs. 1–3H.

Remarks. The form in question is very similar to *Tricolocapsa* sp. S in Baumgartner et al. (1995, p. 602, pl. 4057, figs. 1–3) from the Late Bajocian to terminal Bajocian–Early Bathonian.

Local range and occurrence. Late Bathonian to Callovian of the Rzav River Basin.

Genus *Xiphotheca* De Wever in De Wever et al., 1979

Type species. Xiphotheca karpenissionensis De Wever in De Wever et al., 1979.

Local range and occurrence. Triassic; worldwide.

Xiphoteca rugosa **Bragin, 1991 emend. Tekin, 1999**

Plate 7, fig. 12

Xiphotheca karpenissionensis: De Wever in De Wever et al., 1979, only pl. 7, fig. 3.

Xiphoteca rugosa: Bragin, 1991, pp. 107, 108, pl. 5, figs. 11–13; Bragin and Krylov, 1999, text-figs. 13a–13c, 13i; Tekin, 1999, p. 175, pl. 42, figs. 15–18; pl. 43, figs. 1–5; Tekin et al., 2002, pp. 132, 133, text-figs. 5-12 and 5-13; Bertinelli et al., 2005a, text-figs. 4–8, 23.

Xiphotheca sp.: Halamić and Goričan, 1995, only pl. 1, fig. 24.

?Xiphotheca sp. cf. *X. rugosa* Bragin: Bertinelli et al., 2005a, text-figs. 4-21 and 4-22.

?Xiphotheca sp. cf. *X. rugosa* Bragin: Bertinelli et al., 2005b, text-figs. 15-2 and 15-3.

Local range and occurrence. Late Carnian to Early Norian of the Ovčar-Kablar gorge.

Genus *Zhamojdasphaera* Kozur et Mostler, 1979

Type species. Zhamojdasphaera latispinosa Kozur et Mostler, 1979.

Local range and occurrence. Cordevol of Göstling.

Zhamojdasphaera ? latispinosa **Kozur et Mostler, 1979**

Plate 5, fig. 7

Remarks. Our specimen differs from *Zhamojdasphaera latispinosa* Kozur et Mostler, 1979 in the shape of the wings and the spine length.

Local range and occurrence. Ladinian of the Visoka section (Rzav River Basin).

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