ГЕОЛОШКИ АНАЛИ БАЛКАНСКОГА ПОЛУОСТРВА ANNALES GÉOLOGIQUES DE LA PÉNINSULE BALKANIQUE	69	39–47	БЕОГРАД, децембар 2008 BELGRADE, December 2008

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Late Triassic radiolarians from the Ovčar-Kablar Gorge (SW Serbia)

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Abstract. Detailed micropalaeontological research of Triassic siliceous rocks was carried out at a locality in the Ovčar–Kablar gorge, NE of Ovčar Banja. According to the determined radiolarian associations, the investigated chert and radiolarite are of Late Carnian–Early Norian age.

Key words: Late Triassic, radiolarians, Ovčar–Kablar Gorge, SW Serbia.

Апстракт. Детаљна микропалеонтолошка истраживања тријаских силицијских седимената извршена су на локалитету у Овчарско-кабларској клисури, СИ од Овчар Бање. На основу одређених радиоларијских асоцијација утврђено је да су рожнаци и радиоларити локалитета Овчар Бања горње карнијске до доње норичке старости.

Кључне речи: Горњи тријас, радиоларије, Овчарско-кабларска клисура, ЈЗ Србија.

Introduction

Siliceous sedimentary rocks, such as cherts and radiolarites, are widespread in southwestern Serbia. Noteworthy is that they originated in different geological settings and during different geological intervals (DIMITRIJEVIĆ 1997, KARAMATA 2006). They mostly occur in the internal parts of the Dinarides, in the vicinity of ophiolitic units and/or within ophiolitic mélange formations, less frequently in other geological environments. The maximum accumulation of radiolarian cherts occurred in the Middle to Late Triassic, as well as in the Middle to Late Jurassic, occasionally extending into the Cretaceous.

The territory of Serbia is rather interesting for studies of Mesozoic Radiolaria. Within the Serbian part of the internal Dinarides, Triassic and Jurassic radiolarians were described for the first time by Š. GORIČAN (personal communication 1988, 1990) as well as by OBRADOVIĆ & GORIČAN (1988) and OBRADOVIĆ *et al*. (1986, 1987/1988). Recent works reflect the increase of radiolarian studies in Serbia and their importance for stratigraphic, palaeogeographic, tectonic and palaeotectonic implications (GORIČAN *et al*. 1999, KARAMATA *et al*. 2004, DJERIĆ & VISHNEVSKAYA 2005, 2006; VISHNEVSKAYA & DJERIĆ 2006a, b; DJERIĆ *et al*. 2007a, b; GAWLICK *et al*. 2007a). Despite this considerable progress, knowledge of the Mesozoic Radiolaria from Serbia is still insufficient. Actually, there are only a few published data on Middle and Late Triassic radiolarians, as well as on Middle and Late Jurassic radiolarians. The main aim of this study was to obtain information on the late Triassic Radiolaria from SW Serbia.

Geological setting

The studied area is located in SW Serbia, about 2 km NE of Ovčar Banja (7434755, 4861714). This region belongs to the Vardar Zone Western Belt (Fig. 1), according to KARAMATA *et al*. (2000). On the territory of western Serbia, there are two belts of ophiolitic mélange overlain by large ultramafic massifs. The more external belt is known as the Dinaridic Ophiolites or

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Dinaridic Ophiolite Belt (PAMIĆ *et al*. 2002, KARAMATA 2006) or as the Central Dinaridic Ophiolite Belt (LUGOVIĆ *et al*. 1991). The more internal belt is referred to as the Vardar Zone Western Belt by KARAMATA (2006) The Western oceanic basin of the Vardar Ocean, existing from the Late Triassic, became a wide oceanic basin during the Jurassic–Early Cretaceous and then closed by the latest Cretaceous; its suture is the Vardar Zone Western Belt (VZWB).

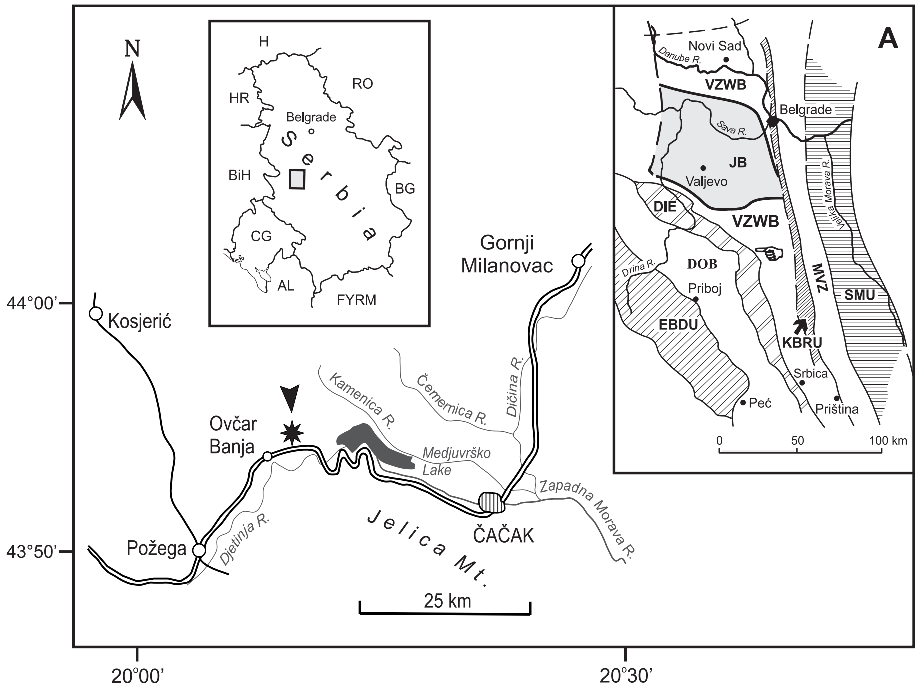

Fig. 1. Location of the Ovčar Banja section, SW Serbia. **A,** Tectonic units and terranes of part of the Balkan Peninsula in the *sense* of KARAMATA *et al*. (2000) and KARAMATA (2006): **EBDU,** East Bosnian–Durmitor Unit; **DOB,** Dinaridic Ophiolite Belt; **DIE,** Drina–Ivanjica Element; **VZWB,** Vardar Zone Western Belt; **JB,** Jadar Block; **KBRU,** Kopaonik Block and Ridge Unit; **MVZ,** Main Vardar Zone; **SMU,** Serbian–Macedonian Unit.

According to KARAMATA (2006), within the Western Basin of the Vardar Ocean, representing the precursor of the Vardar Zone Western Belt (VZWB), deep-water cherts and shales were deposited over basalts of the ophiolitic association from the Late Triassic to the Kimmeridgian. Large masses of trench deposits, represented by olistostrome mélange and gravity slides from the oceanic crust and the continental margin, accumulated within this basin from the Mid-Jurassic time.

According to SCHMID *et al*. (2008), there is a single Jurassic ophiolite sheet in the Dinarides, namely the Western Vardar Ophiolitic Unit that was obducted onto the passive margin of Adria during the latest Jurassic times. The ophiolitic mélange, which occurs below the metamorphic sole flooring the obducted ophiolites, typically contains a mixture of (1) rock types derived from the lower plate, mechanically scraped off and accreted to the upper plate, and (2) gravitationally emplaced olistoliths derived from the upper plate. The blocks derived from the lower plate consist, amongst other lithologies, of Triassic ultramafics and mafics (MORB-type ophiolitic blocks up to several km in diameter) that were derived from the Meliata-Maliac-Vardar Ocean, the age of which was inferred from preserved stratigraphic contacts with Triassic radiolarites (SCHMID *et al*. 2008). Amongst the blocks derived from the lower plate, Triassic strata derived from the adjacent Adria passive margin predominate over ophiolites. These Triassic strata, consisting of platform carbonates, slope to basinal facies, such as Hallstatt limestone, cherty limestone, thin-bedded radiolarite – pelagic limestone successions or radiolarites, of Late Anisian to Norian age (e.g. CHIARI *et al*. 1996, DIMITRIJEVIĆ *et al*. 2003, GORIČAN *et al*. 1999, 2005; BORTOLOTTI *et al*. 2005, GAWLICK *et al*. 2007b).

According to S. SCHMID (personal comm. 2007), this particular part of the mélange formation does not contain ophiolites but Triassic sediments, which probably derived from the adjacent passive margin. These Triassic sediments consist not only of radiolarites but also of cherty or micritic limestones of presumably Triassic age. These sediments were also sheared off during mélange formation, but they are tectonically underneath (and further W) of the ophiolitic blocks described above. These large (km-size) slices of Triassic sediments are analoguous to similar occurrences in Greece ("Maliac" nappes). The mélange formation underlies W-Vardar ophiolites, i.e. the Maljen ophiolite (S. SCHMID personal communication 2007).

The first findings of radiolarians in the chert from this locality were described in papers by OBRADOVIĆ (1986), OBRADOVIĆ *et al*. (1987/1988), OBRADOVIĆ & GORIČAN (1988). The studied siliceous sediments contain associations of radiolarians which points to Ladinian age (OBRADOVIĆ 1986, OBRADOVIĆ *et al*. 1987/1988, OBRADOVIĆ & GORIČAN 1988). These authors are of the opinion that sediments at this locality are olistoliths of the Porphyrite-Chert Formation.

Material and Methods

The described radiolarian assemblages originate from one single section at the Ovčar–Kablar Gorge (Fig. 1). Three samples were collected from the radiolarian cherts. The chert samples were only treated with dilute 5–7 % hydrofluoric acid, following the method of Pessagno & Newport (1972). In all samples, spumellarians were much more abundant than nassellarians. The residues of the acid treatment, which yielded well preserved faunas, were studied for biostratigraphic purposes. In order to establish the age of the radiolarian assemblages, the zonation schemes proposed by Tekin (1999) were used. An SEM microscope ISI-160 in GIN RAN (Moscow) was utilized for the precise identification and illustration of the radiolarians. These are illustrated in Plates 1 and 2. The micropalaeontology material is housed at the Faculty of Mining and Geology in Belgrade (registration numbers NDJ 100 to NDJ 103).

Section description and biostratigraphy

Characteristic layered chert with siliceous claystone and subordinate limestone occurs on a 70 m wide section along the road Čačak–Požega (Fig. 1), about 2 km NE of Ovčar Banja (7434755, 4861714).

The lowermost part of the section is composed of stratified, gently folded chert of dark red color (Fig. 2), which are from 10 to 50 cm thick, in alternation with thin-bedded green siliceous claystone, tuffite and light silicified and recrystallised limestone. The chert is intersected by fractures, which are mostly filled with calcite, rarely with secondary quartz. Microlamination due to a higher concentration of ferruginous material is locally visible in the chert. The approximate average thickness of the layers composed of siliceous claystone is 5 cm, while the limestone layers reach a thickness of about 10 cm. The whole sequence is about 20 m thick (Fig. 2).

Four samples were taken from the chert at the locality Ovčar Banja, three of which gave positive results.

Sample NDJ 103. Chert collected 20 cm from the bottom of the section (Fig. 2). The radiolarian association is relatively well preserved and is represented by the following species: *Canesium lentum* Blome, *Capnodoce crystallina* Pessagno, *Capnuchosphaera lenticulata* Pessagno, *Capnuchosphaera concava* De Wever, *Capnuchosphaera* sp. cf. *C. tricornis* De Wever, *Capnuchosphaera* sp. cf. *C. deweveri* Kozur & Mostler, *Sarla* sp. aff. *S. vizcainoensis* Pessagno, *Spongotortilispinus carnicus* (Kozur & Mostler), *Spongostylus tortilis* Kozur & Mostler, *Pachus multinodosus* Tekin, *Whalenella* ? *speciosa* Blome, *Japonocampe* sp. and *Triassocampe* sp.

The radiolarian assemblage can be attributed to the early Norian due to the co-existence of *Capnodoce crystallina* Pessagno (latest Carnian/earliest Norian–early Norian, ? late middle Norian; Tekin 1999), *Capnuchosphaera lenticulata* Pessagno (early Norian–late middle Norian, ? late Norian; Tekin 1999), *Spongotortilispinus carnicus* (Kozur & Mostler) (middle Carnian–early Norian; Tekin 1999) and *Spongostylus tortilis* Kozur & Mostler (late Ladinian–early Norian; Tekin 1999).

Sample NDJ 102. Chert collected 1 m from the bottom of the section (Fig. 2). The abundant and versatile radiolarian association is represented by the following species: *Capnodoce* sp. cf. *C. anapetes* De Wever, *Capnodoce crystallina* Pessagno, *Capnuchosphaera concava* De Wever, *Capnuchosphaera* sp. cf. *C. lea* De Wever, *Capnuchosphaera theloides* De Wever, *Capnuchosphaera theloides minor* Bragin, *Capnuchosphaera triassica* De Wever, *Japonocampe nova* (Yao), *Japonocampe* sp. cf. *J. nova* (Yao), *Loffa* ? *mulleri* Pessagno, *Xiphothecella rugosa* (Bragin) and *Whalenella* sp.

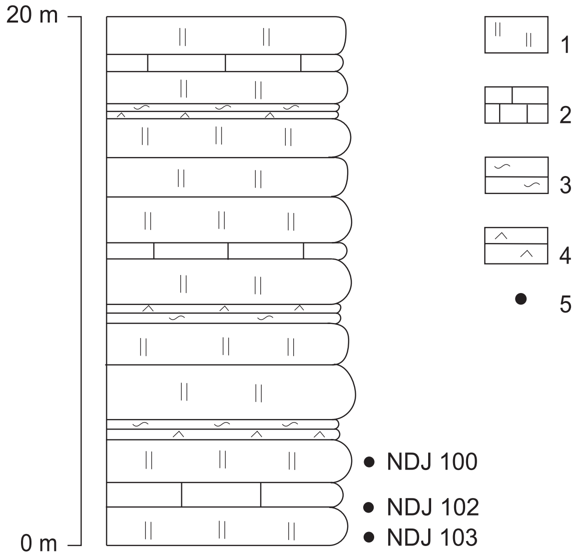

Fig. 2. Sample position and lithological log of the Ovčar Banja section. Legend: **1,** chert; **2,** limestone; **3,** silicified chert; **4,** tuff; **5,** radiolarian sample position.

The age is latest Carnian/earliest Norian–early Norian due to the co-occurrence of *Xiphothecella rugosa* (Bragin) (latest Carnian/earliest Norian–early Norian; Tekin 1999), *Capnodoce crystallina* Pessagno (latest Carnian/earliest Norian–early Norian, ?late middle Norian; Tekin 1999), *Capnuchosphaera triassica* De Wever (early Carnian–early Norian; Tekin 1999), *Capnuchosphaera concava* De Wever (early Carnian–early Norian; Tekin 1999).

Sample NDJ 100. Chert collected 2 m from the bottom of the section (sl. 2). The radiolarian association is relatively well-preserved and represented by the following species: *Capnuchosphaera theloides* De Wever, *Capnuchosphaera theloides minor* Bragin, *Capnuchosphera tricornis* De Wever, *Sarla vetusta* Pessagno, *Spongotortilispinus carnicus* (Kozur & Mostler), *Paronella* sp., *Capnuchosphaera* sp., *Japonocampe* ? sp., and *Whalenella* sp.

Based on the co-occurrence of *Capnuchosphera tricornis* De Wever (late Carnian–middle Norian; Tekin 1999), *Sarla vetusta* Pessagno (latest Carnian/earliest Norian–late middle Norian, ? late Norian; De Wever *et al*. 1979; BRAGIN & KRILOV 1999, TEKIN 1999) and *Spongotortilispinus carnicus* (KOZUR & MOSTLER) (Carnian–early Norian; TEKIN 1999; BRAGIN 2007), the age of the fauna is late Carnian–early Norian.

Comparison

The majority of the species extracted from the samples taken from the section at the locality Ovčar Banja are widely known, primarily from the Triassic beds of the Mediterranean Region. Almost all of them occur in the Upper Triassic (Upper Carnian–Lower Norian) of southern Turkey (DE WEVER *et al*. 1979, TEKIN 1999) and southern Cyprus (BRAGIN 2007). The late Carnian to Early Norian radiolarians at the locality Ovčar Banja can be compared to the radiolarians in the volcano-sedimentary formation of the Rubik area in Albania (CHIARI *et al*. 1996, BORTOLOTTI *et al*. 2006), Greece and Sicily (DE WEVER *et al*. 1979), as well as to the Early Norian fauna of Slovakia (KOZUR & MOSTLER 1981). Some species, for example *Capnodoce anapetes*, *Capnodoce crystallina*, *Capnuchosphera theloides*, *Xiphothecella longa* and *Xiphothecella rugosa* were recorded in the Late Carnian of Transcaucasia (KNIPPER *et al*. 1997), the Upper Carnian–Lower Norian of Oman (OTSUOKA *et al*. 1992), the Upper Carnian–Lower Norian of the Far East of Russia (BRAGIN 1991) and Japan (SUGIYAMA 1997) and the Upper Carnian–Middle Norian of Mexico and Oregon (PESSAGNO *et al*. 1979, BLOME 1984).

Final remarks

The siliceous deposits from the Ovčar Banja locality consist of radiolarian cherts with clay, tuff and limestone interlayers. On the basis of the radiolarians, the analyzed cherts were deposited between the Late Carnian and the Early Norian. These sediments were also sheared off during the formation of mélange; they are, however, tectonically underneath the ophiolitic blocks described above. These large (km-size) slices of Triassic sediments are analoguous to similar occurrences in Greece ("Maliac" nappes). The late Carnian to Early Norian radiolarians at the locality Ovčar Banja can be compared to the radiolarians in the volcano-sedimentary formation of the Rubik area in Albania (CHIARI *et al*. 1996, BORTOLOTTI *et al*. 2006), Greece and Sicily (DE WEVER *et al*. 1979), as well as to the Early Norian fauna of Slovakia (KOZUR & MOSTLER 1981) and Cyprus (BRAGIN 2007).

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Резиме

Горњотријаске радиоларије из Овчарско-кабларске клисуре (ЈЗ Србија)

У оквиру западног појаса Вардарске Зоне истраживани су рожнаци у Овчарско-кабларској клисури (локалитет Овчар Бања). Локалитет се налази на путу Чачак–Пожега (сл. 1), око 2 km СИ од Овчар

Бање (7434755, 4861714). Карактеристични услојени рожнаци са силициозним глинцима и подређеним кречњацима откривени су на профилу широком око 70 m. Најнижи део профила састоји се од стратификованих, благо убраних рожнаца тамноцрвене боје, дебљине од 10 до 50 cm у смени са танкослојевитим зеленим силициозним глинцима, туфитима, туфовима и светлим силификованим и рекристаластим кречњацима. Рожнаци су испресецани жицама које су претежно испуњене калцитом, ређе секундарним кварцом. Слојеви силициозних глинаца су просечно дебљине око 5 cm, док слојеви кречњака достижу дебљину и од око 10 cm. Цео пакет је дебљине око 20 m. Према S. SCHMID (усмено саопштење) овај део формације меланжа не садржи офиолите него тријаске седименте који су вероватно били део пасивне маргине. Ове простране (km ред величина) пласе тријаских седимената су аналогне сличним појавама у Грчкој (“Maliac” навлаке). Из тријаских рожнаца локалитета Овчар Бања узорковане су три пробе које су дале позитивне резултате:

Проба НЂ 103, узоркована из најнижих делова профила, садржи релативно добро очувану заједницу радиоларија. Доње норичка старост одређена је на основу присуства врста *Capnodoce crystallina* PESSAGNO, *Capnuchosphaera lenticulata* PESSAGNO, *Spongotortilispinus carnicus* (KOZUR & MOSTLER) и *Spongostylus tortilis* KOZUR & MOSTLER.

Проба НЂ 102, узоркована из средишњих делова профила садржи бројну и разноврсну асоцијацију радиоларија горње карнијске до доње норичке старости. Одредба старости извршена је на основу присуства карактеристичних врста: *Xiphothecella rugosa* (BRAGIN) и *Capnuchosphaera triassica* DE WEVER.

Проба НЂ 100 узоркована је из средишњих делова профила. Присуство врста *Capnuchosphera tricornis* DE WEVER, *Sarla vetusta* PESSAGNO и *Spongotortilispinus carnicus* (KOZUR & MOSTLER) указује на горње карнијску до доње норичку старост рожнаца ове пробе.

Горње карнијске до доње норичке радиоларијске асоцијације локалитета Овчар Бања могу се поредити са асоцијацијама радиоларија вулкано-седиментне формације Рубик подручја у Албанији (CHIARI *et al*. 1996; BORTOLOTTI *et al*. 2006), Грчке и Сицилије (DE WEVER *et al*. 1979), као и доње норичком фауном Словачке (KOZUR & MOSTLER 1981) и Кипра (BRAGIN 2007).

PLATE 1

Late Carnian to Early Norian radiolarians from the Ovčar-Kablar Gorge

Fig. 1. *Capnuchosphaera theloides* DE WEVER, Sample NDJ 102, × 200.
Fig. 2. *Spongotortilispinus* ? *carnicus* (KOZUR & MOSTLER), Sample NDJ 100, × 350.
Fig. 3. *Spongotortilispinus carnicus* (KOZUR & MOSTLER), Sample NDJ 103, × 300.
Fig. 4. *Loffa* ? *mulleri* PESSAGNO, Sample NDJ 102, × 200.
Fig. 5. *Capnuchosphaera* sp., Sample NDJ 100, × 200.
Fig. 6. *Capnuchosphaera triassica* DE WEVER, Sample NDJ 102, × 200.
Fig. 7. *Capnodoce* sp. cf. *C. anapetes* DE WEVER, Sample NDJ 102, × 200.
Fig. 8. *Capnodoce crystallina* PESSAGNO, SampleNDJ 103, × 200.
Fig. 9. *Pachus multinodosus* TEKIN, Sample NDJ 103, × 200.
Fig. 10. *Japonocampe* sp., Sample NDJ 103, × 200.
Fig. 11. *Japonocampe nova* (YAO), Sample NDJ 102, × 200.
Fig. 12. *Xiphothecella rugosa* (BRAGIN), Sample NDJ 102, × 100.
Fig. 13. *Japonocampe* ? sp., Sample NDJ 100, × 200.

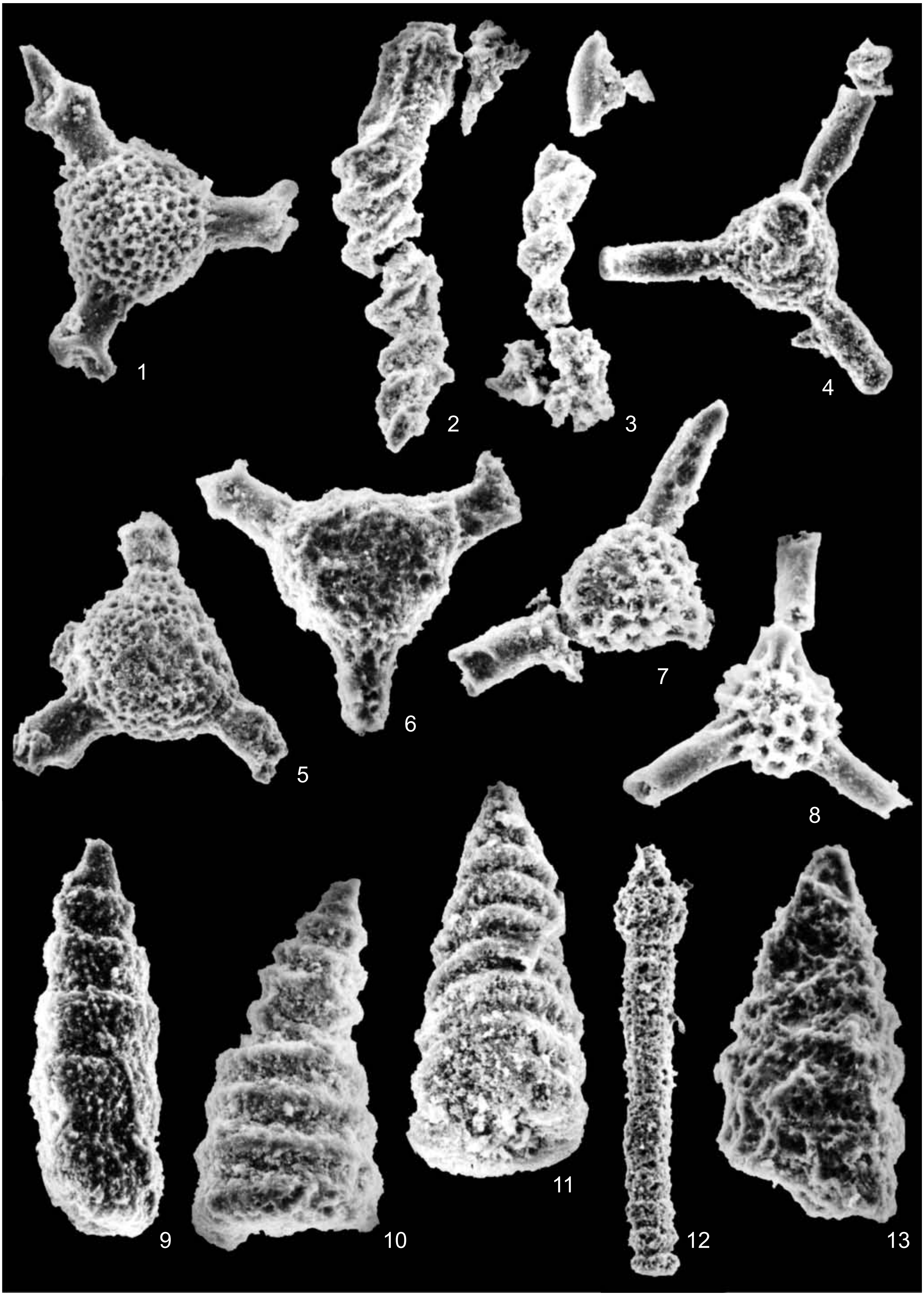
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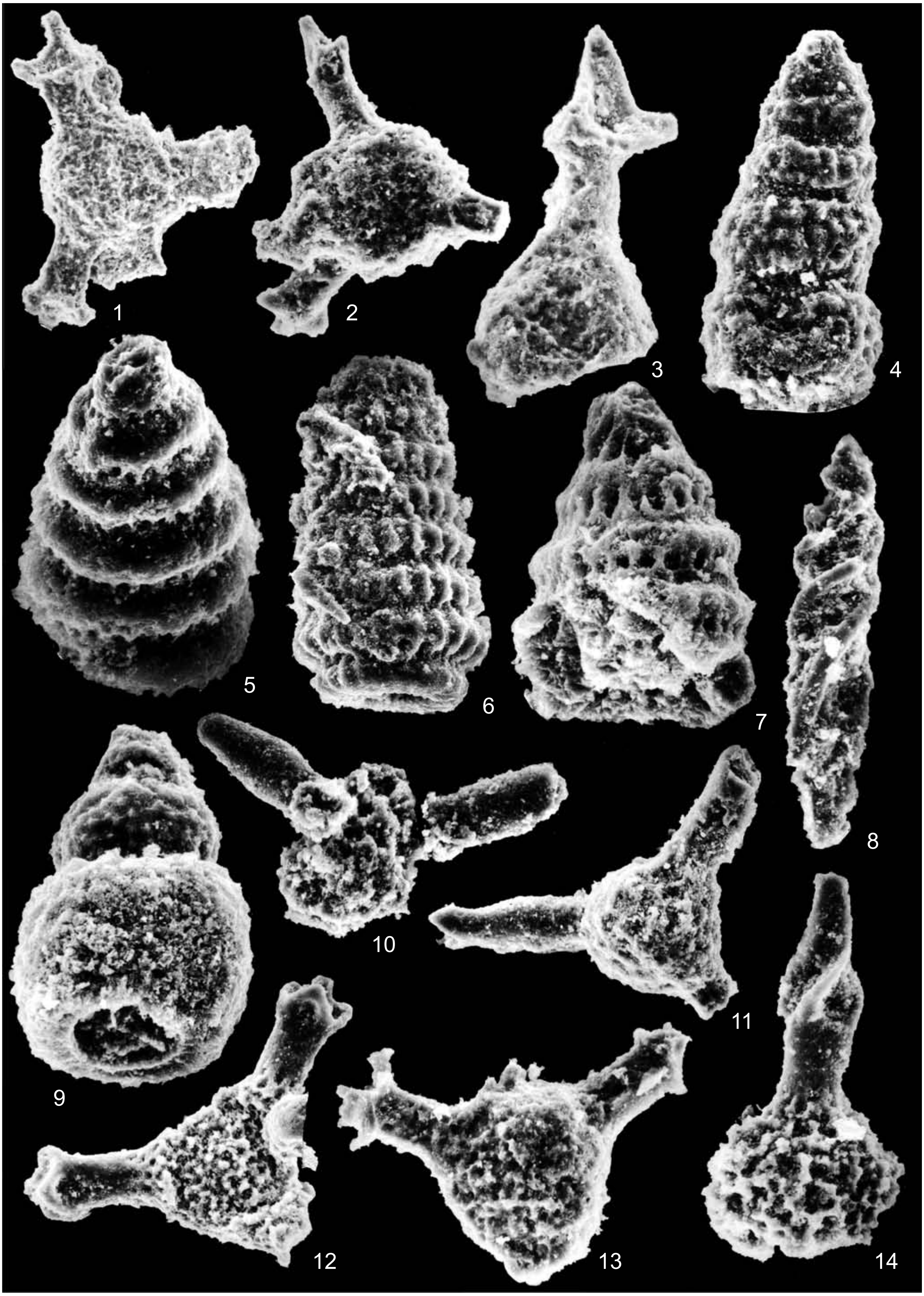
PLATE 2

Late Carnian to Early Norian radiolarians from the Ovčar-Kablar Gorge

Fig. 1. *Capnuchosphaera theloides minor* BRAGIN, Sample NDJ 100, × 200.
Fig. 2. *Capnuchosphaera concava* DE WEVER, Sample NDJ 102, × 200.
Fig. 3. *Capnuchosphaera* sp. cf. *C. tricornis* DE WEVER, Sample NDJ 103, × 200.
Fig. 4. *Triassocampe* sp., Sample NDJ 103, × 200.
Fig. 5. *Japonocampe* sp. cf. *J. nova* (YAO), Sample NDJ 102, × 200.
Fig. 6. *Whalenella* sp., Sample NDJ 102, ×200.
Fig. 7. *Whalenella* ? *speciosa* BLOME, Sample NDJ 103, ×200.
Fig. 8. *Spongostylus tortilis* KOZUR & MOSTLER, Sample NDJ 103, × 350.
Fig. 9. *Canesium lentum* BLOME, Sample NDJ 103, × 200.
Fig. 10. *Capnodoce crystallina* PESSAGNO, Sample NDJ 103, × 200.
Fig. 11. *Capnodoce crystallina* PESSAGNO, Sample NDJ 103, × 200.
Fig. 12. *Capnuchosphaera concava* DE WEVER, Sample NDJ 103, × 200.
Fig. 13. *Capnuchosphaera* sp. cf. *C. tricornis* DE WEVER, Sample NDJ 103, × 200.
Fig. 14. *Capnuchosphaera* sp. cf. *C. deweveri* KOZUR & MOSTLER, Sample NDJ 103, × 200.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