

Latest Permian foraminifers from the Vlašić mountain area, northwestern Serbia

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ABSTRACT: Foraminifers from the Permian-Triassic boundary interval in the upper part of the “Bituminous Limestone” Formation of the Komirić section, northwestern Serbia are described and illustrated here for the first time. Four new species of foraminifers are described: *Hemigordius komiricensis* n. sp., *H. smiljkae* n. sp., *Multidiscus vlasicensis* n. sp., and *Eomarginulinella serbica* n. sp. The genus *Eomarginulinella* Sosnina 1969 is considered to be a valid genus and reinstated herein. The youngest Late Permian foraminifers are found together with conodonts of the Lower *Hindeodus praeparvus* Zone, the next to the last of the youngest conodont zones of the Upper Permian. The assemblage of the foraminifers from the upper part of the “Bituminous Limestone” in northwestern Serbia is most similar to coeval foraminiferal assemblages from the upper Changhsingian Belolabinskaya Group of the northwestern Caucasus and from the Nagyvisnyó Limestone Formation of the Bükk Mountains in northeastern Hungary. It is less similar to coeval foraminiferal assemblages of the Carnic Alps, Central Taurides of Turkey, Transcaucasia and China.

INTRODUCTION

Pantić (1969) published the first data about the presence of Middle and Late Permian foraminifers in northwestern Serbia during the preparation of the Basic Geological Map of SFRY (1:100000) for this part of Serbia. She described assemblages of foraminifers with illustrations of some species from different localities in the Jagodnja and Vlašić mountains, the Sokolska mountain area and the Pocerina region. These localities have strata that are related to unmetamorphosed younger Paleozoic strata of the Jadar development or Jadar Paleozoic (Simić 1938; Pešić et al. 1988), later named as the Jadar Block (Dimitrijević 1974) or the Jadar Block Terrane (Filipović and Knežević 1974; Filipović et al. 2003). Pantić identified 71 taxa of foraminifers and 14 taxa of algae that are characteristic for the Middle and Upper Permian. Based on these identifications and the analysis of the foraminiferal distribution in the other regions of the Tethyan Realm, Pantić (1969) concluded that the Serbian Late Permian foraminifers are most similar to the microfauna of similar age described by K. Miklukho-Maklay (1954) from the northwestern Caucasus.

Later, Pantić-Prodanović continued to study in detail the Late Permian and Early Triassic foraminifers and lithostratigraphy from each earlier described section, and also from some new localities. She illustrated assemblages of foraminifers from various

localities and sections in northwestern Serbia (Pantić-Prodanović 1989/90, 1994, 1996, 1997a, 1997b; Pantić-Prodanović and Radošević 1981).

In addition to establishing Late Permian age of the above mentioned foraminiferal assemblages from the studied sections, Pantić-Prodanović pointed out for the first time the presence of the oldest Early Triassic foraminifers in the sections of the Gučevo mountain area (Pantić-Prodanović and Radošević 1981, fig. 2). She noted the presence of *Earlandia tintiniformis* (Mišik), *Rectocornuspira kalthori* Brönnimann, Zaninetti and Bozorgnia, and *Cyclogyra? mahajeri* Brönnimann, Zaninetti and Bozorgnia. Earlier, Urošević and Sudćar (1980) studied the Triassic foraminifers and conodonts from strata also in the Gučevo mountain area. They identified the following species of foraminifers: *Rectocornuspira kalthori*, *Nodosinella collenoti* (Terquem), *N. siliqua* Trifonova, *Meandrospira pusilla* (Ho), *Glomospirella facilis* (Ho), *G. triphonensis* (Baud, Zaninetti and Brönnimann), *Ammodiscus incertus* (d’Orbigny), *Cyclogyra* cf. *C. mahajeri*, and *Glomospirella* sp., together with the conodonts: *Hadrodontina adunca* (Staesche), *H. biserialis* (Staesche), *Hindeodella nevadensis* Müller, *H. triassica* Müller, *Neospathodus homeri* (Bender), *Parachirognathus latus* (Staesche), *P. obliquus* (Staesche), *P. raridenticulatus* (Müller), *P. symmetricus* (Staesche) and *P. tricuspidatus* (Staesche).

Based on the presence of these species, Urošević and Sudar (1980) established an Early Triassic (“Campilian”) age for the encompassing deposits. In addition to studying foraminifers in thin sections, Urošević and Sudar for the first time extracted free specimens of foraminifers of most of the above mentioned species. Based on the age of the conodonts, they also demonstrated the presence of Upper Triassic (Carnian and Norian) deposits in northwestern Serbia.

Although conodonts demonstrated the presence of Triassic age deposits in northwestern Serbia, Late Permian conodonts were not found in underlying strata until recently. The Permian Standard Scale is based on the distribution of certain species of conodonts whose first appearance marks the lower boundaries of series and stages. The first appearance of the conodont species *Hindeodus parvus* (Kozur and Pjatakova) marks the lower boundary of the Lower Triassic worldwide (see discussion in Sudar et al. 2007; Ogg et al. 2008). In this connection some Permian-Triassic boundary sections were reinvestigated in northwestern Serbia, especially the Komirić section (Panića Cave section of Pantić-Prodanović) which, according to Pantić-Prodanović (1996), was assumed to be continuous. Sudar et al. (2007) restudied the Komirić section and found that the uppermost beds of the Upper Permian contain abundant foraminifers, algae, ostracods, holothurian sclerites, crinoids, echinoids, brachiopods, gastropods, ophiuroids and conodonts. They identified the following conodont species: *Ellisonia* sp., *Hindeodus praeparvus* Kozur, *H. typicalis* (Sweet), *H. cf. H. latidentatus* (Kozur, Mostler and Rahimi-Yazd) and *H. sp.* that indicate youngest Permian age strata (Lower *praeparvus* Zone). Sudar et al. (2007) also found a breccia at the top of the Permian sequence in the section and concluded that “the sequence across the P-T boundary is not continuous as it was traditionally believed for many places in NW Serbia” (Ibid., p. 146).

In this paper we primarily describe and illustrate the assemblage of foraminifers found in samples taken from the Komirić section in the Vlašić mountain area, northwestern Serbia. The foraminifers occur together with conodonts in the lower part of the section. One indeterminate specimen of *Nodosariida* is illustrated from the overlying Triassic strata. This study is part of ongoing targeted projects to define the Permian-Triassic boundary interval of the Dinarid region (Aljinović et al. 2006; Kolar-Jurkoveš and Jurkoveš 2007) and is linked with the worldwide IGCP project.

GEOLOGICAL SETTING

Geographically, the Jadar Block is located on the southern margin of the Pannonian Basin. It belongs to the central part of the Balkan Peninsula, i. e., mostly to northwestern Serbia, southern Srem and extends partly westward over the Drina River into eastern Bosnia (text-fig. 1A). The Jadar Block, as an exotic terrane in which Dinaridic features predominate, was placed into the Vardar Zone before the Late Cretaceous (Karamata et al. 2000; Karamata 2006). It is surrounded by the Vardar Zone Western Belt, except on the farthest southeastern part where it is in the direct contact with the Kopaonik Block and the Ridge Unit which is a part of the Vardar Zone as well (text-fig. 1A). The Jadar Block differs from the Vardar Zone Western Belt based on the lack of data on post-Liassic sediments as well as in the absence of ultramafites, ophiolitic mélange, and Cretaceous flysch development (Filipović et al. 2003).

In this area, deposition took place during the Variscan and Early Alpine evolution with obvious similarities with coeval

successions of the “Bükkium” and Sana–Una terranes, and even of the Carnic Alps (Protić et al. 2000; Filipović et al. 2003). The main characteristics of the Jadar Block during this time are: a) marine development of the Carboniferous and Permian with deposition of shallow water marine carbonates in the Late Permian and in the earliest Triassic; b) Middle Triassic rocks with dolomite of Anisian age; c) “porphyrites” and pyroclastics of Ladinian age; d) platform – reefal limestone of Middle and Late Triassic age and their gradual transition into Liassic limestone. Younger Jurassic formations are not known.

In the Jadar Block the Upper Permian is represented by the “Bituminous Limestone” Formation and the Lower Triassic by the Svileuva Formation (Filipović et al. 2003).

Location of the Komirić section

The Komirić section is located on the right side of the Valjevo – Loznica road in Komirić village on southern slope of the Vlašić Mountain (coordinates x 4918588, y 7985697, text-fig. 1). In this section the Permian-Triassic sequence has a thickness of 78m and is represented by the Upper Permian “Bituminous Limestone” and the Lower Triassic Svileuva Formation. Only a nineteen meters interval of the Permian-Triassic boundary deposits was sampled for microfauna. The 7m uppermost Permian interval consists of dark grey and black massive to thick-bedded bituminous bioclastic limestone with abundant foraminifers, conodonts, and other fossils. It is in fault contact with the lowest Triassic interval (12m) consisting of thick to thin-bedded grey fine crystalline limestone with stylolites and laminates in some levels and contains only ostracods (text-fig. 2).

FORAMINIFERS

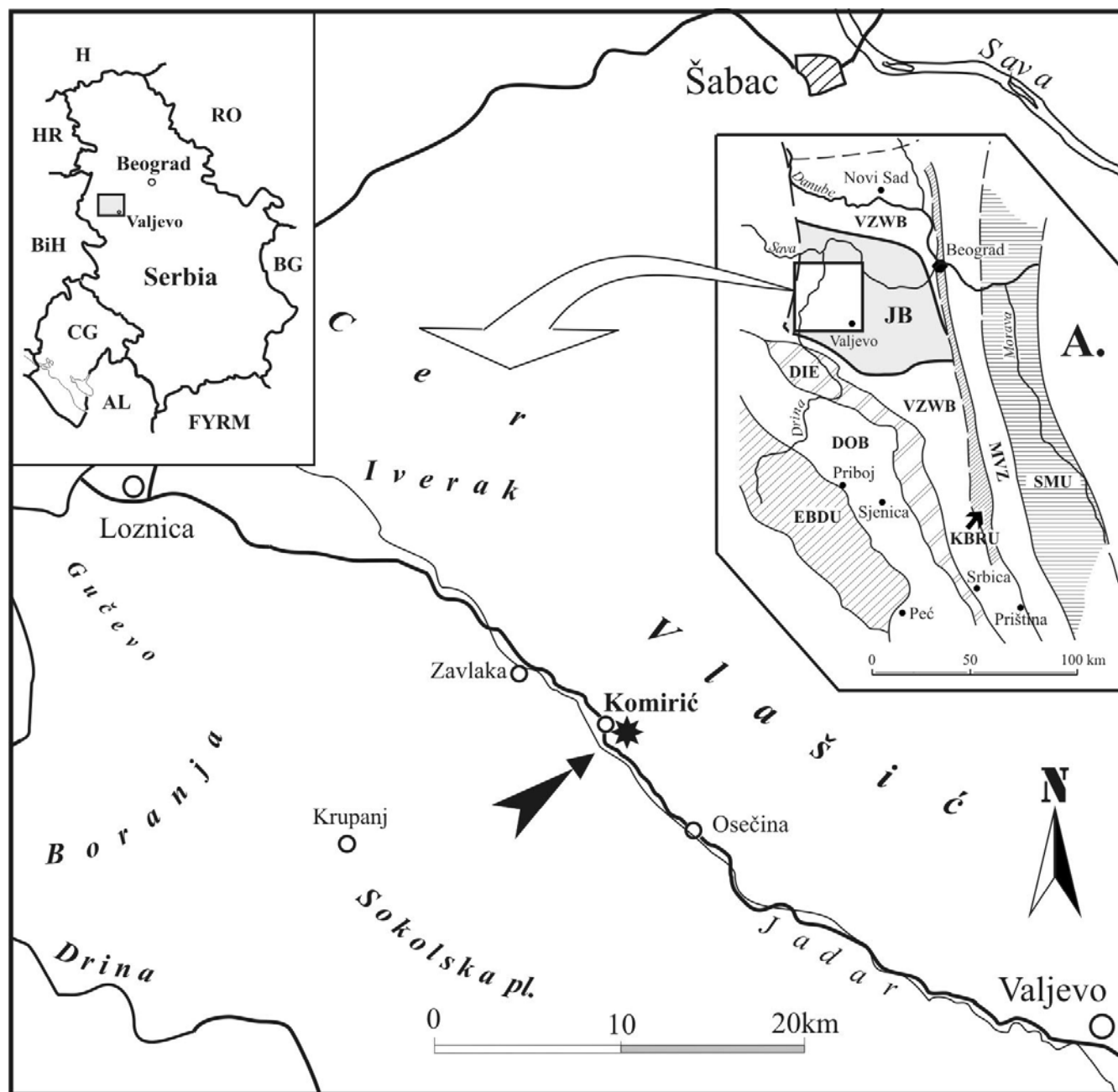
Method of investigation

Fourteen samples were taken from the uppermost part of the Upper Permian “Bituminous Limestone” and foraminifers were found in all of them, but conodonts were discovered only in 4 samples (Sudar et al. 2007, fig. 2; text-fig. 2). Eleven samples were taken from the lowest part of the Lower Triassic Svileuva Formation, but only sample MS 1196 (11m above the Permian-Triassic boundary) produced a single section of an indeterminate foraminifer that we refer to the Order *Nodosariida*. Thin sections were made from all of the samples and then the remaining part of each sample was dissolved for obtaining conodonts. Many free specimens of recrystallized foraminifers were obtained in conodont residues (samples MS 1203/1, MS 1203/2, MS 1203/3, MS 1203/4, MS 1181, MS 1184, MS 1185). Thin sections of some free specimens were made in this study to aid in the identifications of species.

Analysis of the foraminiferal assemblage

Previously, in the Komirić (Panića Cave) section Pantić-Prodanović (1996) listed but did not illustrate the following species of foraminifers in the Upper Permian limestones (= “Bituminous Limestone”): *Codonofusiella nana* Erk, *Nankinella orbicularis* Lee, *Reichelina* sp., *Hemigordius harltoni* Cushman and Waters, *H. schlumbergeri* (Howchin), *H. grozdilovae* Igonin, *Pachyphloia lanceolata* K. Miklukho-Maklay, *Fronicularia* ex gr. *F. ornata* K. Miklukho-Maklay, *Globivalvulina graeca* Reichel and *G. vonderschmitti* Reichel. At the base of the Lower Triassic she mentioned the presence of rare *Earlandia tintiniformis* (Mišik).

Because of the lack of illustrations of the foraminifers identified by Pantić-Prodanović, we cannot compare our sections of



TEXT-FIGURE 1

Location maps of the Komirić section in northwestern Serbia, Jadar Block, Vardar Zone (after Sudar et al. 2007). A. Terranes of a part of the Balkan Peninsula (Karamata et al. 2000; Karamata 2006): SMU – Serbian-Macedonian Unit; MVZ – Main Vardar Zone; KBRU – Kopaonik Block and Ridge Unit; VZWB – Vardar Zone Western Belt; JB – Jadar Block; DIE – Drina-Ivanjica Element; DOB – Dinaridic Ophiolite Belt; EBDU – East Bosnian-Durmitor Unit.

foraminifers with her determination of species. But, the close examination of her list of species leads us to conclude that some of her identifications were erroneous. For instance, *Hemigordius harltoni* is characteristic for the Carboniferous, Pennsylvanian (Cushman and Waters 1928; Groves 1984), *H. schlumbergeri* – for the Early Permian (Crespin 1958), and *H. grozdilovae* is characteristic for the Early Permian, Kungurian (Igonin 1967). All these species do not extend into the Late Permian, Lopingian. Furthermore, *Pachyphloia lanceolata* and

Fronicularia ornata are considered as *nomen dubium* (Pronina-Nestell and Nestell 2001).

In the Komirić section, diverse assemblage of Late Permian foraminifers is present in the uppermost part of the Late Permian consisting of 40 taxa belonging to 23 genera of the orders Hemigordiopsida, Nodosariida, Vaginulinida, Biseriamminida, Ozawainellida and Staffellida (text-fig. 2). All species of foraminifers present in the upper part of the “Bituminous Lime-

stone” are known in the Upper Permian of the Tethyan Realm. Fifteen species: *Hemigordius nikitiniensis* Pronina-Nestell in Pronina-Nestell and Nestell (2001), *Midiella bronnimanni* (Altiner), *M. zaninetiae* (Altiner), *Pseudomidiella labensis* Pronina-Nestell in Pronina-Nestell and Nestell (2001), *Neodiscus milliloides* A. Miklukho-Maklay, *Protonodosaria* (generic affinity in sense of Karavaeva and Nestell 2007) *camerata* (K. Miklukho-Maklay), *Pseudolangella conica* (K. Miklukho-Maklay), *Geinitzina orientalis* (K. Miklukho-Maklay), *Froncina paraconica* (K. Miklukho-Maklay), *Robuloides lens* Reichel, *R. acutus* Reichel, *Rectostipulina quadrata* Jenny-Deshusses, *?Paraglobivalvulina globosa* (Wang), *P. sp. 1*, *Dagmarita caucasica* G. Vuks and *Nankinella* cf. *N. changhsingensis* (Jing) occur in the upper Changhsingian Belolabinskaya Group (Nikitian and Urushtenian lithofacies) of the northwestern Caucasus (Kotlyar et al. 1983; Pronina-Nestell and Nestell 2001; Kotlyar et al. 2004). *Paraglobivalvulina globosa* (Wang), *Hemigordius latispiralis* Lin, Li and Sun, *Froncina laxa* (Lin, Li and Sun), *Protonodosaria delicata* (Wang) are known from the Changhsingian of China (Wang 1976; Zhao et al. 1981; Lin et al. 1990; Zhang and Hong 2004; Song et al. 2006; Song et al. 2007, for the generic affinity see Karavaeva and Nestell 2007). The species *Hemigordius komiricensis* n. sp., *H. smiljkae* n. sp., *H. hungaricus* Bérczi-Makk, Csontos and Pelikán, *Multidiscus vlasticensis* n. sp. and *Eomarginulinella serbica* n. sp. are known in the Nagyvisnyó Limestone Formation of northeastern Hungary (Bérczi-Makk 1978, Bérczi-Makk et al. 1995). Some species of nodosariids such as *Eomarginulinella serbica* n. sp., *Protonodosaria camerata*, *Rectostipulina quadrata*, *R. pentamerata* Groves, Altiner and Rettori, *Robuloides lens* occur in the Dorashamian (= Changhsingian) *Paratirolites kittli* ammonoid Zone of Transcaucasia (Pronina 1989), in the Permian-Triassic boundary interval of central Taurides of Turkey (Groves et al. 2005), in the Bulla Member of the upper part of the Bellerophon Formation, southern Alps, northern Italy (Groves et al. 2007), and in the Changhsingian of China (Song et al. 2007). *Rectostipulina quadrata* occur in the Lopingian of Saudi Arabia (Gaillot and Vachard 2007).

Thus, the assemblage of the foraminifers from the upper part of the “Bituminous Limestone” in the Komirić section is similar to the latest Permian foraminiferal assemblage of the Tethyan Realm, especially to the latest Permian assemblages of the northwestern Caucasus and Hungary areas. In Serbia, the northwestern Caucasus, and Hungary, the latest Permian foraminiferal assemblage is represented by numerous specimens of each species of hemigordiosids with a subordinate quantity of nodosariids and other groups of foraminifers present. Such a ratio of hemigordiosids/nodosariids points to a very shallow water environment. This conclusion is supported by the absence of ammonoids in the uppermost part of the Permian of these regions. Rare ammonoids such as *Neoglossoceras caasicus* Zakharov and *Dushanoceras valeriae* Zakharov are found in the northwestern Caucasus in the uppermost part of the Urushtenian lithofacies which is represented by argillaceous shale and is characterized by the absence of foraminifers (Pronina-Nestell and Nestell 2001; Kotlyar et al. 2004).

It is very interesting to notice that the representatives of the genus *Colaniella* that are widespread in the Changhsingian of the Tethyan Realm are absent in the Komirić section, perhaps because of environmental considerations. However, *Colaniella* is present in the Belolabinskaya Group of the northwestern Caucasus, but not in the youngest beds (upper Urushtenian

lithofacies) of the Upper Permian. In the global stratotype Permian-Triassic boundary Meishan D section in South China, the last *Colaniella* is known from bed 22 (Song et al. 2006). Thus, in our opinion, the uppermost beds of the “Bituminous Limestone” in the Komirić section can probably be correlated with beds 23 – 27a, b of the Changxing Formation in the Meishan D section in China, and with the uppermost Urushtenian lithofacies represented by argillaceous shale and lacking foraminifers of the northwestern Caucasus, because the underlying deposits of the Nikitian lithofacies and reefal limestone of the lower part of the Urushtenian lithofacies of the Belolabinskaya Group contain abundant *Colaniella*. The assemblage of foraminifers from beds 23 – 27a, b in the Meishan D section is represented by 33 species and only 3 species are common with the Komirić assemblage of foraminifers. Such differences are, probably because of the deeper water depositional setting in the Meishan D section (Zhang et al. 2007).

In the Permian-Triassic boundary interval in the Meishan D section two conodont zones were proposed in the uppermost Permian: a lower *Neogondolella* (= *Clarkina*) *changxingensis yini* – *Hindeodus praeparvus* Zone (beds 24a–24e) and an upper *Neogondolella* (= *Clarkina*) *meishanensis meishanensis* – *Hindeodus eurypyge* Zone (beds 25–26 and beds 27a–27b). The first appearance (FAD) of the species *Hindeodus parvus* (Kozur and Pjatakova) in bed 27c marks the lower boundary of the Triassic System (Zhang et al. 2007). In the *Neogondolella* (= *Clarkina*) *changxingensis yini* – *Hindeodus praeparvus* Zone the first appearance of the species *Hindeodus praeparvus* Kozur is in bed 24c (Zhang et al. 2007). In the Komirić section the first appearance of *H. praeparvus* is in sample MS 1203/2 in the upper part of bed 1 (Sudar et al. 2007, fig. 2; text-fig. 2). Thus, we can definitely correlate levels of the FAD of *H. praeparvus* in the Meishan D and Komirić sections.

In Transcaucasia, the first appearance of the conodont species *Hindeodus praeparvus* is in the *Pleuronodoceras occidentale* – *Xenodiscus jubilaearis* ammonoid Zone established in the Sovetashen section, Armenia (Zakharov et al. 2005) which overlies the *Paratirolites kittli* ammonoid Zone containing a rich assemblage of small foraminifers and very rare species of fusulinaceans (Pronina 1989). Unfortunately, small foraminifers are absent in the *P. occidentale* – *X. jubilaearis* Zone which is represented by redish-brown mudstone with a thickness of 0.15m. This thin interval is followed by 3.4m of red algal limestone containing the conodont species *Hindeodus parvus*, the lower boundary marker of the Triassic (Zakharov et al. 2005).

SYSTEMATIC PALEONTOLOGY

The authors use the revised system of higher protozoan taxa proposed by Cavalier-Smith (2002) in which he decreased the rank of Foraminifera from phylum to subphylum, the higher foraminiferal taxa on the class and subclass level proposed by Mikhalevich (1998, 2000), the scope of the order Hemigordiosida in sense of Pronina (1994) and the scope of the family Marginulinidae Wedekind in sense of Grigelis (1977). Definitions of some terminology for hemigordiosids (such as pseudotubular chamber and pseudoinvolute test) are given in Nestell and Nestell (2006). The collection of foraminifers is deposited in the Department of Paleontology, Faculty of Mining and Geology, University of Belgrade, Belgrade, Serbia under the number from 1 to 106 corresponding to certain samples and thin sections in the collection of Milan Sudar (MS).

Kingdom PROTOZOA Goldfuss 1817; emend. Owen 1858
 Subkingdom GYMNOMYXA Lankester 1878 stat. nov. emend.
 Cavalier-Smith 2002
 Infrakingdom RHIZARIA Cavalier-Smith 2002
 Phylum RETARIA Cavalier-Smith 1999 stat. nov. Cavalier-Smith 2002
 Subphylum FORAMINIFERA (d'Orbigny 1826) Eichwald 1830 stat. nov. Margulis 1974; stat. emend. Cavalier-Smith 2002 [pro phylum Foraminifera by Cavalier-Smith 2002]
 Class SPIRILLINATA Mikhalevich 1992; emend. Mikhalevich 1998 [=Spirillinata Maslakova 1990 *nomen nudum*; =Spirillinata Maslakova in Maslakova et al. 1995]

Remarks: Maslakova (1990) proposed a new name *Spirillinata* at the rank of class including in it only the order *Spirillinida* Hoheneger and Piller 1975, but she did not give a description of the class. She described the new class only in 1995 (Maslakova et al. 1995). Meanwhile, Mikhalevich (1992) used the name *Spirillinata* for her class of bichambered coiled foraminifers and described it in detail. According to the International Code of Zoological Nomenclature (1999, articles 13, 21, 50), Mikhalevich is considered to be the author of the class *Spirillinata* and not Maslakova.

Subclass AMMODISCANA Mikhalevich 1980 [nom. correct. Mikhalevich 1998 pro subclass Ammodiscata Mikhalevich 1980]

Order HEMIGORDIOPSIDA Mikhalevich 1987 [nom. transl. Pronina 1990 ex Hemigordiopsina Mikhalevich 1987]

Suborder HEMIGORDIOPSINA Mikhalevich 1987

Family HEMIGORDIIDAE Reitlinger in Vdovenko et al. 1993

Genus *Hemigordius* Schubert 1908 [= *Discospirella* Okimura and Ishii 1981. – non *Discospirella* Fuchs 1967. – *Okimuraites* Reitlinger in Vdovenko et al. 1993, nom. subst. pro *Discospirella* Okimura and Ishii 1981].

Type species: *Cornuspira schlumbergeri* Howchin 1895.

Range: Carboniferous, Mississippian, Visean – Permian, Lopingian, Changhsingian.

Hemigordius komiricensis Nestell, Sudar, Jovanović and Kolar-Jurkovšek, n. sp.

Plate 1, figures 12-14; Plate 3, figures 4-9

Foram. indet. sp. - BÉRCZI-MAKK et al. 1995, pl. 21, fig. 5, pl. 24, fig. 7.

Description: Test free, bichambered, with pseudotubular second chamber, disk-shaped, with parallel lateral sides, pseudoinvolute in the umbilical area and evolute in the last 2-3 whorls. Proloculus is spherical, small, with diameter 0.02-0.04mm. Number of whorls is 7-9. First two whorls are displaced at a small angle relative to the axis of coiling, the successive whorls are planispiral. The height (h) and width (w) of the first 4-5 whorls is very small and increases gradually (h = 0.01-0.02mm and w = 0.02-0.03mm); the height of the last two but one whorls increases rapidly (0.03-0.04mm) and the width insignificantly (0.04-0.05mm), the height (h) and width (w) of the last whorl increases significantly: h = 0.04-0.07mm and w = 0.07-0.09mm. Wall is calcareous, microgranular and thin (0.001mm). Lateral thickenings are developed in the umbilical area enveloping 4-5 whorls. Aperture is simple, terminal, at the

end of a pseudotubular chamber. Dimensions: test diameter (D) 0.32-0.54mm, width (W) 0.09-0.12mm, the ratio of D/W 3.5-4.5; in the holotype correspondingly 0.48mm, 0.12mm, 4.0.

Designation of types: The specimen illustrated on plate 1, figure 12 is designated as the holotype (no. 12), and specimens on plate 1, figure 13 (no. 13) and plate 3, figures 4-9 (4 - no. 75, 5 - no. 76, 6 - no. 77, 7 - no. 78, 8 - no. 79, 9 - no. 80) as paratypes. They are from northwestern Serbia, Vlašić Mountain, Komirić village, Komirić section, the uppermost part of the "Bituminous Limestone"; the holotype is from bed 2, sample MS 1181, paratypes are from bed 1, nos. 13, 77, 79 from sample MS 1203/1, nos. 75, 80 from sample MS 1203/4, no. 76 from sample MS 1181 and no. 78 from sample MS 1203/2. Upper Permian, upper Changhsingian.

Etymology: After the Komirić section, Komirić village, Vlašić Mountain, northwestern Serbia.

Material: 50 free specimens and 5 were used for making thin sections.

Discussion: Based on its disk-shaped test, *Hemigordius komiricensis* n. sp. is similar to *Hemigordius discoides* Lin, Li and Sun non K. Miklukho-Maklay 1968 (Lin et al. 1990, p. 210, pl. 24, figs. 6-9), but differs from it by the larger size of the test, development of lateral thickenings only in the umbilical area (first 4-5 whorls), evolute last 1-3 whorls, and significantly increasing of the height and width of the last whorls. The lack of a distinct umbilical area, fewer volutions, and thinner wall distinguish our species from, for example, *Brunsiopirella lineae* (Vachard and Gaillot in Vachard et al. 2005) illustrated by Gaillot and Vachard (2007) on pl. 56, fig. 12. For a complete discussion about the species *B. lineae* see in the remarks to the species *Hemigordius smiljkai* n. sp.

Occurrence: Upper Permian, upper Changhsingian; northwestern Serbia, Vlašić Mountain, Komirić village, Komirić section, "Bituminous Limestone", beds 1-3, samples MS 1204, MS 1203/1, MS 1203/2, MS 1203/3, MS 1203/4, MS 1180, MS 1181 and MS 1184; Upper Permian, northeastern Hungary, Bükk Mountains, southeast of Mályinka, Nagyvisnyó Limestone, borehole Mályinka-8, depth 195.0-220.5m.

Hemigordius smiljkai Nestell, Sudar, Jovanović and Kolar-Jurkovšek, n. sp.

Plate 1, figures 15-17; Plate 3, figure 10

Glomospirella sp. - BÉRCZI-MAKK 1978, pl. 1, fig. 5.

Glomospirella spirillinoides Grozdilova and Glebovskaya - ZHAO et al. 1981, pl. 1, figs. 8-9.

Description: Test free, bichambered, with second pseudotubular chamber, disk-shaped with concave umbilical area, pseudoinvolute, with 1-2 last evolute whorls displaced to the axis of the coiling. Proloculus is small, spherical, with diameter 0.015mm. Number of whorls is 5-9. First 1-3 whorls insignificantly displaced relatively to each other, following 3-4 whorls are planispiral, and next 1-2 whorls insignificantly displaced relatively to previous. The height and width of the whorls increases gradually: height from 0.01mm to 0.04mm and width from 0.02mm to 0.06mm. Wall is calcareous, microgranular, recrystallized in some tests and becomes of vitreous appearance, and very thin (0.01mm). Lateral thickenings are thin, developed along the test except in the 1 1/2 last whorl. Aperture is simple, terminal, located at the end of a pseudotubular chamber. Dimensions: test diameter (D) 0.29-0.49mm, width (W)

0.07–0.11 mm, the ratio of D/W 3.7–4.8; in the holotype correspondingly 0.48 mm, 0.10 mm, 4.8.

Designation of types: The specimen illustrated on plate 1, figure 17 is designated as the holotype (no. 17), and specimens on plate 1, figure 16 (no. 16) and plate 3, figure 10 (no. 81) as paratypes. They are from northwestern Serbia, Vlašić Mountain, Komirić village, Komirić section, the uppermost part of the “Bituminous Limestone”; the holotype and paratypes are from bed 1, sample MS 1203/1. Upper Permian, upper Changhsingian.

Etymology: After Smiljka Pantić-Prodanović who was a pioneer in the studying of Permian-Triassic foraminifers in Serbia.

Material: 37 free specimens, two were used for making thin sections, and one close to axial section.

Discussion: Based on its disk-shaped with concave umbilical area, *Hemigordius smiljkae* n. sp. is similar to *Glomospirella*? (= *Brunsispirella*) *linae* (Vachard and Gaillot in Vachard et al. 2005, p. 157, pl. 4, figs. 3–17; Gaillot and Vachard 2007), but differs from it by smaller size of the test, larger number of whorls, smaller height of the whorls, and consistently very thin wall.

Remarks: Vachard and Gaillot (in Vachard et al. 2005) first described their new species as *Glomospirella*? *linae* and stated that the specimens have “1–2 oscillating whorls and 4–5 aligned to planispiral whorls” and “well preserved specimens have their primary porcelaneous (amber-colored), becoming black” wall (Ibid., p. 159). According to this statement, the authors should have referred the species to some genus of the miliolids, a group that has a true porcelaneous wall, but not to *Glomospirella* with an agglutinated (siliceous) wall. Later, Gaillot and Vachard (2007) established a new genus *Brunsispirella* with *Glomospirella*? *linae* Vachard and Gaillot (in Vachard et al. 2005) as the type species. They include the new genus into the composition of the family Neodiscidae Lin 1984, superfamily Cornuspiroidea Schultze 1854, order Miliolida Delage and Herouard 1896, and class Miliolata Lankester 1885 based on the porcelaneous structure of the wall. According to Gaillot and Vachard (2007, p. 98), the genus *Brunsispirella* has two chambers, “planispiral coiled, involute, rarely evolute in the last whorls. Some initial whorls are slightly glomospirally coiled. Aperture terminal, simple. Proportionally medium-sized porcelaneous wall with buttresses” (probably, by the word buttresses Gaillot and Vachard mean lateral thickenings, a term that is used by many foraminiferal workers). In the comparison of the genus these authors stated that it is homeomorphic to the genus *Brunsia* but differs from it by a porcelaneous wall and not microgranular wall, and higher stratigraphic interval. They also gave the differences between the genera *Brunsispirella* and *Okimuraites* expressed by the presence of lateral thickenings (or buttresses in sense of Gaillot and Vachard) and larger size of the test in *Brunsispirella*. But the genus *Okimuraites* also has an involute (= pseudoinvolute) test, lateral thickenings, average size of the tests and planispiral coiling with a weak fluctuation of the whorls in the initial part and a thin wall (Okimura and Ishii 1981; Vdovenko et al. 1993). Moreover, in the comparison of the species *Brunsispirella linae*, Gaillot and Vachard (2007) wrote that this species differs from *Okimuraites* (without a given name of species) “by a larger size, thicker wall, very small streptospiral initial part, and the strictly planispiral terminal part” (Ibid., p. 99). One can see that in the description of the genus *Brunsispirella*, according to the authors, the initial part is

“glomospirally coiled”, in the comparison of the type species, *B. linae*, it is “streptospiral coiled”, but in the description of the type species, the initial coiling is described as follows: “the irregularly coiled initial part consists of 1–2 oscillating whorls. The adult second part consists of 4–5 aligned to planispiral whorls” (Gaillot and Vachard 2007, p. 99). The last description corresponds to the diagnosis of the genus *Okimuraites* (Vdovenko et al. 1993).

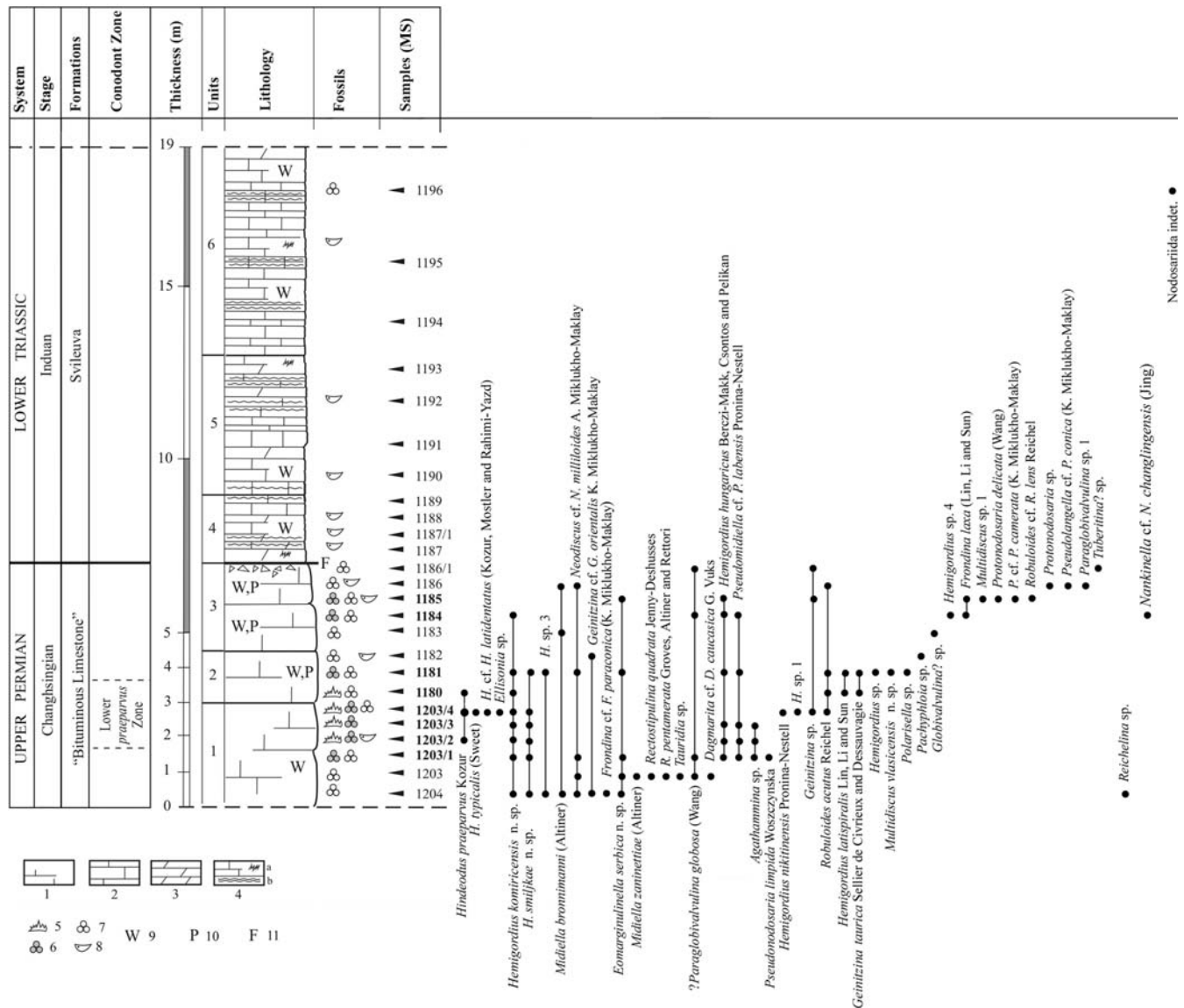
Moreover, the size of the test is not a generic feature, even according to Gaillot and Vachard (2007), because in their paper they included the genus *Neohemigordius* Wang and Sun 1973, which is characterized by large size of the tests in the synonymy of the genus *Multidiscus* A. Miklukho-Maklay 1953 and whose tests have both small and large size.

Brunsispirella linae probably does not have a porcelaneous wall because, according to Vachard et al. (2005, p. 159), the wall of this species is “primary porcelaneous (amber-colored), becoming black”. In G. Nestell’s observations dealing with representatives of Paleozoic bichambered foraminifers (order Hemigordiopsida) for many years, the microgranular wall is originally black in color and changes from amber-colored to white vitreous under recrystallization. So, *Brunsispirella linae* of Vachard and Gaillot probably had an original microgranular wall, but not porcelaneous. Moreover, specimens illustrated by Vachard and Gaillot (in Vachard et al. 2005) have a clear pseudotubular second chamber, not a tubular chamber. Based on the type of coiling, the presence of the pseudotubular second chamber and the development of lateral thickenings, and a microgranular wall, *Brunsispirella linae* should be assigned to the order Hemigordiopsida, suborder Hemigordiopsina (Gaillot and Vachard 2007 placed the Hemigordiopsina into the Miliolida), and not to the Miliolida which has a tubular second chamber and a truly porcelaneous wall.

The specimens of *Brunsispirella linae* illustrated by Vachard and Gaillot, especially the holotype (Vachard et al. 2005, pl. 4, figs. 3–17, the holotype is fig. 6; Gaillot and Vachard 2007), have distinct lateral thickenings from less developed to more developed that are characteristics for the suborder Hemigordiopsina (Pronina 1994).

We do not agree with Gaillot and Vachard (2007) who include the following species in the synonymy of the species *Brunsispirella linae*: *Glomospirella spirillinoides* of Lin (1978), *G. spirillinoides* of Zhao et al. (1981), *Discospirella* (now *Okimuraites*) *plana* and *D. (= O.) minima* of Baghbani (1993). These authors included *G. spirillinoides* of Zhao et al. (1981, pl. 1, fig. 8–9) probably only on the basis of the shape of the test and did not take into consideration the small size of the test and thin wall that are not characteristic for *Brunsispirella*. They should also not include *G. spirillinoides* of Lin in the synonymy of *Brunsispirella linae*, because the sections illustrated by Lin (1978, pl. 1, fig. 11–12) belong to the genus *Hoyenella* Rettori 1994 based on the glomospirally coiled initial and planispiral terminal part, and the absence of lateral thickenings. *Discospirella plana* (type species for the genus) and *D. minima* of Baghbani (1993, pl. 6, figs. 3, 4) belong to the species of the genus *Okimuraites* originally described by Okimura and Ishii (1981) as *Discospirella*, which Gaillot and Vachard (2007) accepted as the valid genus *Okimuraites*, following Vdovenko et al. (1993).

So, the description of the genus *Brunsispirella* is inconsistent and contradictory so that the acceptance of this genus is ques-



TEXT-FIGURE 2

Distribution of conodonts and foraminifers in the Permian-Triassic boundary interval in the Komirić section, Vlačić Mountain, northwestern Serbia (geological column is modified from Sudar et al. 2007). Legend: 1, massive to thick-bedded limestone; 2, thick- to thin-bedded limestone; 3, dolomitic limestone; 4a, limestone with stylolites; 4b, laminated limestone; 5, conodonts; 6, free specimens of foraminifers; 7, foraminifers in thin sections; 8, ostracods; 9, wackestone; 10, packstone; 11, fault.

tionable and requires further discussion about its generic affinity. It is G. Nestell's opinion that the genus *Brunsirospirella* is probably a synonym of the genus *Hemigordius* on the base of morphological features.

Occurrence: Upper Permian, upper Changhsingian; northwestern Serbia, Vlačić Mountain, Komirić village, Komirić section, "Bituminous Limestone", beds 1-2, samples MS 1204, MS 1203/1, MS 1203/2, MS 1203/3, MS 1203/4, MS 1181; Upper Permian, Hungary, southeast of Budapest, borehole Si-2, depth 1217-1217.8m; upper Changhsingian, China.

Genus *Multidiscus* A. Miklukho-Maklay 1953; emend. Gaillot and Vachard 2007 [= *Neohemigordius* Wang and Sun 1973]

Type species: *Nummulostegina padangensis* Lange 1925.

Remarks: According to the original description, the genus *Multidiscus* is characterized by a large test, with planispiral coiling of the entire test or with some fluctuation of the axis of coiling, and with significant lateral thickenings (A. Miklukho-Maklay 1953). The genus *Neohemigordius* described by Wang and Sun (1973) is characterized by a large test, with an axis of coiling of the first whorl displaced with respect to the next ones that are planispirally coiled, and with developed lateral thicken-

ings. Thus, *Neohemigordius* has morphological features which match the description of the genus *Multidiscus* and is a junior synonym of the latter genus, in agreement with the opinion of Gaillot and Vachard (2007).

Range: Lower Permian, Cisuralian, Asselian – Upper Permian, Lopingian, Changhsingian.

Multidiscus vlasicensis Nestell, Sudar, Jovanović and Kolar-Jurkovšek, n. sp.

Plate 1, figure 23

Hemigordius ex gr. *padangensis* (Lange)-PANTIĆ-PRODANOVIĆ 1989/90, pl. 10, figs. 5-6.

Hemigordius zaminettiae Altiner - BÉRCZI-MAKK et al. 1995, pl. 20, figs. 1a, 2.

Description: Test free, large, lens-shaped, bichambered, with pseudotubular second chamber, and pseudoinvolute. Coiling is planispiral with insignificant fluctuation of the axis of coiling. Number of whorls is 6½. Proloculus is spherical, small, with diameter 0.035mm. The first three whorls increase gradually in the height and width, and the last 2½ whorls increase very rapidly in height and width. The height of the first whorls is 0.02mm, fourth – 0.04mm, fifth – 0.06mm, and the last one

PLATE 1

All specimens are from the uppermost part of the “Bituminous Limestone”, Komirić section, Vlašić Mountain, northwestern Serbia; Upper Permian, upper Changhsingian.

- 1 *Tuberitina?* sp., no. 1, axial section, ×100, sample MS 1186/1, thin section MS 1186/1A.
- 2 *Hemigordius nikitinensis* Pronina-Nestell, no. 2, axial section, ×100, sample MS 1203/4, thin section MS 1203/4.
- 3-6 *Hemigordius latipiralis* Lin, Li and Sun. 3, axial section, ×100, sample MS 1180, thin section MS 1180A; 4, axial section, ×100, sample MS 1180, thin section MS 1180A; 5, tangential section, ×100, sample MS 1180, thin section MS 1180A; 6, axial section of recrystallized specimen, ×100, sample MS 1181, thin section MS 1181.60006.
- 7 *Hemigordius* sp. 1, no. 7, axial section, ×100, sample MS 1203/4, thin section MS 1203/4.
- 8-11 *Hemigordius hungaricus* Bérczi-Makk, Csontos and Pelikán. 8, tangential section, ×100, sample MS 1181, thin section MS 1181.60006; 9, axial section, ×100, sample MS 1181, thin section MS 1181.60006; 10, tangential axial section, ×100, sample MS 1181, thin section MS 1181.60006; 11, axial section, ×100, sample MS 1181, thin section MS 1181B.
- 12-14 *Hemigordius komiricensis* Nestell, Sudar, Jovanović, Kolar-Jurkovšek, n. sp. 12, holotype, close to axial section, ×100, sample MS 1181, thin section MS 1181C; 13, paratype, close to axial section, ×100, sample MS 1203/1, thin section MS 1203/1B; 14, tangential axial section, ×100, sample MS 1203/2, thin section MS 1203/2B.
- 15-17 *Hemigordius smiljkae* Nestell, Sudar, Jovanović, Kolar-Jurkovšek, n. sp. 15, close to axial section, ×100, sample MS 1181, thin section MS 1181A; 16, paratype, close to axial section, ×100, sample MS 1203/1, thin section MS 1203/1C; 17, holotype, close to axial section, ×100, sample MS 1203/1, thin section MS 1303/1D.
- 18 *Hemigordius* sp. 3, no. 18, close to axial section, ×100, sample MS 1181, thin section MS 1181A.
- 19 *Hemigordius* sp. 4, no. 19, close to axial section, ×100, sample MS 1184, thin section MS 1184A.
- 20-21 *Midiella bronnimanni* (Altiner) 20. axial section, ×100, sample MS 1183, thin section MS 1183A. 21, close to axial section, ×100, sample MS 1186, thin section MS 1186A.
- 22 *Multidiscus* sp. 1, no. 22, axial section, ×100, sample MS 1185, thin section MS 1185.59997.
- 23 *Multidiscus vlasicensis* Nestell, Sudar, Jovanović, Kolar-Jurkovšek, n. sp., no. 23, holotype, axial section of recrystallized specimen, ×100, sample MS 1181, thin section MS 1181.60006.
- 24-29 *Pseudomidiella* cf. *P. labensis* Pronina-Nestell in Pronina-Nestell and Nestell (2001). 24, axial section of megalospheric specimen, ×70, sample MS 1181, thin section MS 1181D; 25, equatorial section along the wide side, ×70, sample MS 1181, thin section MS 1181E; 26, equatorial section along the wide side, ×70, sample MS 1203/2, thin section MS 1203/2C; 27, equatorial section along the narrow side, ×70, sample MS 1203/2, thin section MS 1203/2D; 28, equatorial section along the wide side, ×70, sample MS 1203/2, thin section MS 1203/2E; 29, transverse section, ×70, sample MS 1203/2, thin section MS 1203/2F.
- 30-31 *Neodiscus* cf. *N. milliloides* A. Miklukho-Maklay. 30, tangential axial section of recrystallized specimen, ×100, sample MS 1204, thin section MS 1204A; 31, tangential axial section of recrystallized specimen, ×100, sample MS 1203, thin section MS 1203.60016.
- 32-33 *Agathammina* sp. 32, close to axial section along the wide side of recrystallized specimen, ×70, sample MS 1203/2, thin section MS 1203/2G; 33, close to axial section along the wide side of recrystallized specimen, ×70, sample MS 1203/1, thin section MS 1203/1E.

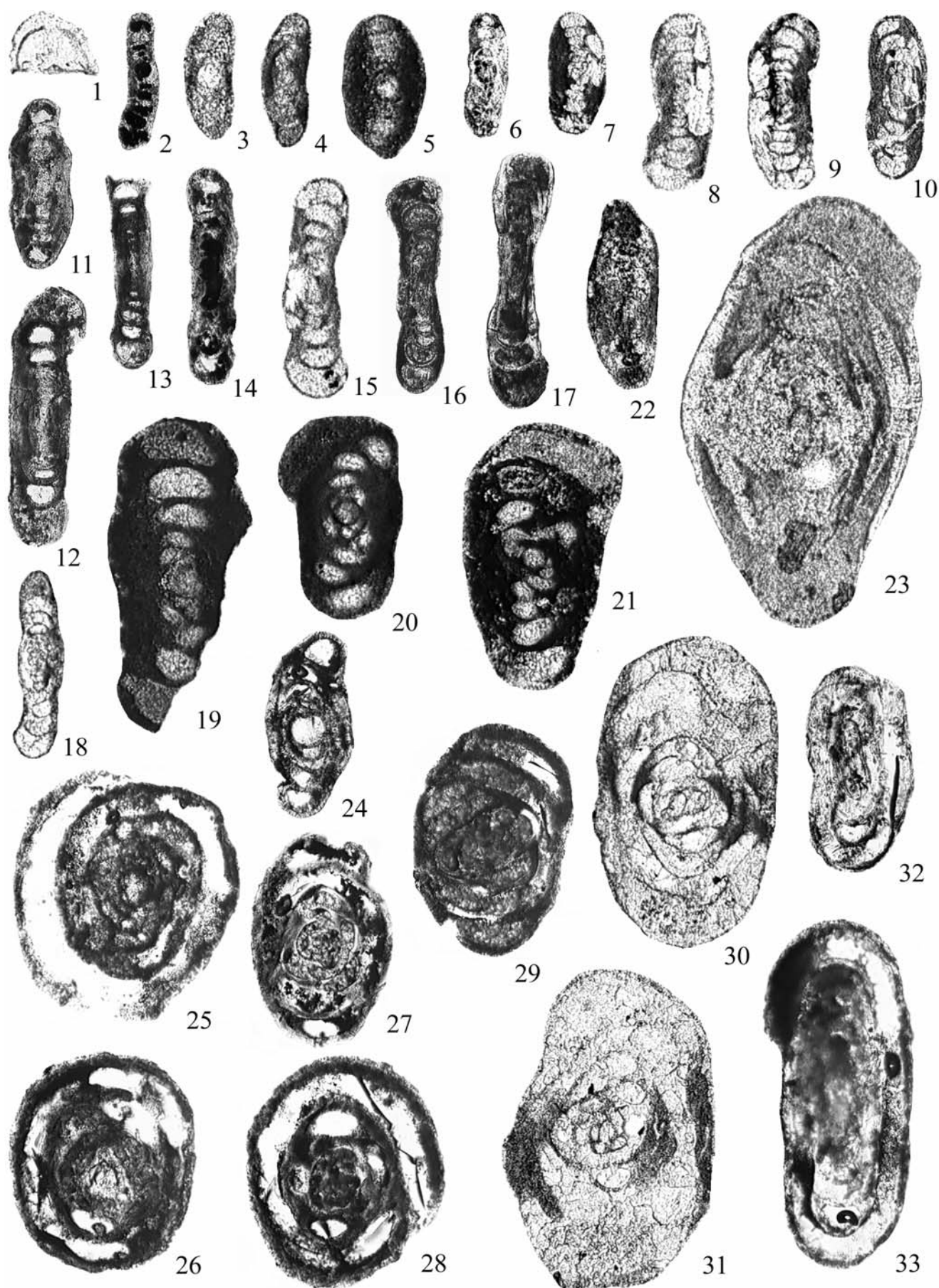
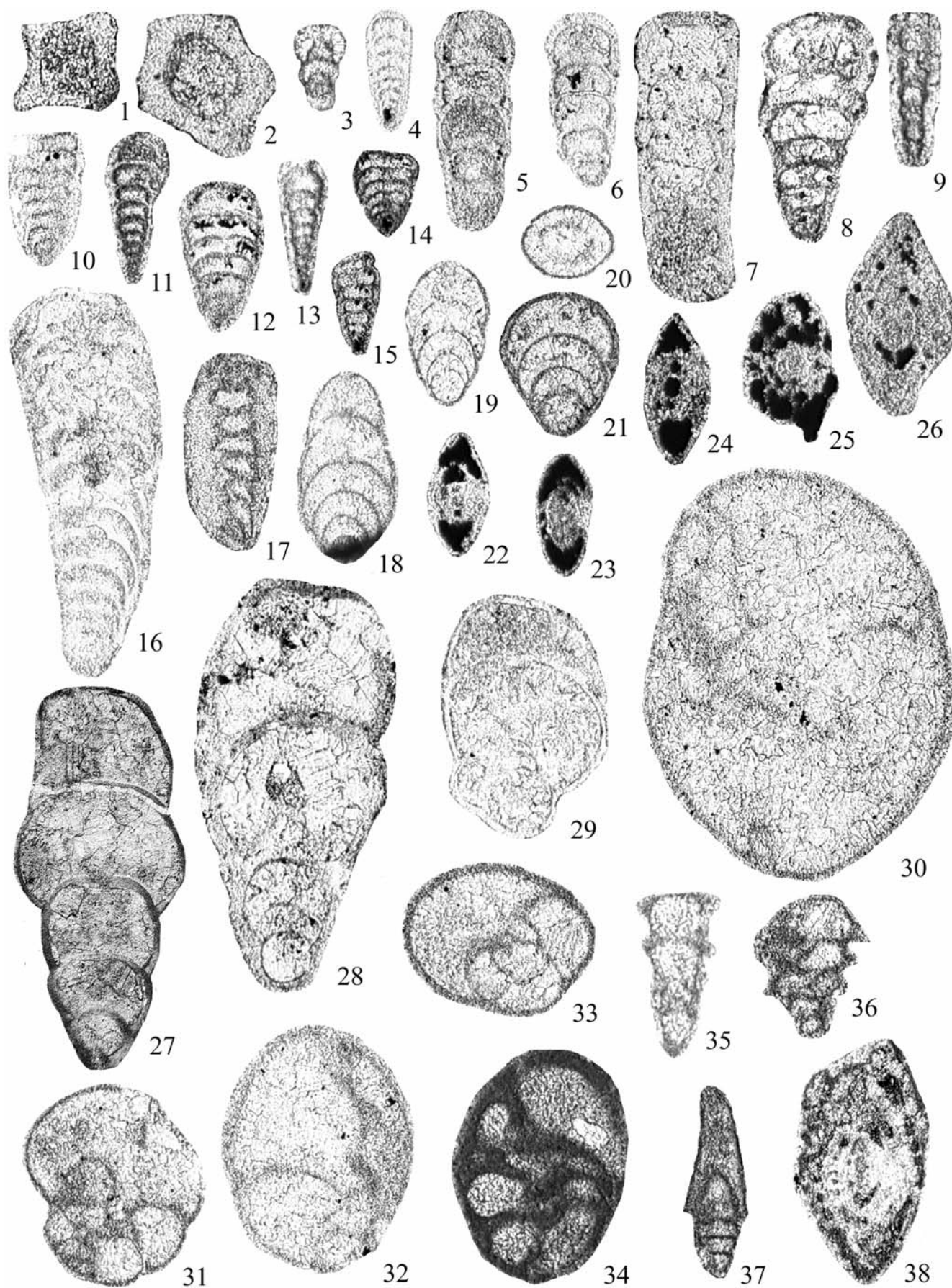


PLATE 2

All specimens are from the uppermost part of the “Bituminous Limestone”, Komirić section, Vlašić Mountain, northwestern Serbia; Upper Permian, upper Changhsingian; excluding fig. 9 – Svileuva Formation; Lower Triassic, lower Induan.

- 1 *Rectostipulina quadrata* Jenny-Deshusses, no. 34, transverse section, ×200, sample MS 1203, thin section MS 1203A.
- 2 *Rectostipulina pentamerata* Groves, Altiner and Rettori, no. 35, transverse section, ×200, sample MS 1203, thin section MS 1203A.
- 3 *Polarisella* sp., no. 36, close to axial section, ×100, sample MS 1181, thin section MS 1181A.
- 4 *Protonodosaria* cf. *P. delicata* (Wang), no. 37, axial section, ×100, sample MS 1185, thin section MS 1185.59997.
- 5-6 *Protonodosaria* sp. 5, no. 38, tangential section, ×100, sample MS 1186, thin section MS 1186A; 6, no. 39, tangential section, ×100, sample MS 1186, thin section MS 1186A.
- 7 *Protonodosaria* cf. *P. camerata* (K. Miklukho-Maklay), no. 40, tangential section, ×100, sample MS 1185, thin section MS 1185.59997.
- 8 *Geinitzina?* sp., no. 41, lateral section, ×100, sample MS 1204, thin section MS 1204.59994.
- 9 *Nodosariida* indet., no. 42, lateral? section, ×100, sample MS 1196, thin section MS 1196.60009.
- 10-11 *Geinitzina taurica* Sellier de Civrieux and Dessauvage, no. 43, axial section, ×100, sample MS 1181, thin section MS 1181.60006; 11, no. 44, lateral section, ×100, sample MS 1180, thin section MS 1180A.
- 12-13 *Geinitzina* sp. 12, no. 45, tangential axial section, ×100, sample MS 1185, thin section MS 1185.59997; 13, no. 46, lateral section, ×100, sample MS 1186/1, thin section MS 1186/1.
- 14-15 *Geinitzina* cf. *G. orientalis* K. Miklukho-Maklay, no. 47, axial section, ×100, sample MS 1204, thin section MS 1204A; 15, no. 48, lateral section, ×100, sample MS 1182, thin section MS 1182.60019.
- 16 *Tauridia* sp., no. 49, tangential section, ×100, sample MS 1203, thin section MS 1203A.
- 17 *Pachyphloia* sp., no. 50, tangential lateral section, ×100, sample MS 1182, thin section MS 1182.60019.
- 18-19 *Fronkina laxa* (Lin, Li and Sun), no. 51, close to axial section, ×100, sample MS 1185, thin section MS 1185.59997; 19, no. 52, axial section, ×100, sample MS 1184, thin section MS 1184.60002.
- 20-21 *Fronkina* cf. *F. paraconica* (K. Miklukho-Maklay), no. 53, transverse section, ×100, sample MS 1204, thin section MS 1204A; 21, no. 54, tangential axial section, ×100, sample MS 1204, thin section MS 1204A.
- 22-25 *Robuloides acutus* Reichel, no. 55, axial section, ×200, sample MS 1181, thin section MS 1181A; 23, no. 56, axial section, ×200, sample MS 1180, thin section MS 1180A; 24, no. 57, axial section, ×200, sample MS 1186, thin section MS 1186.60003; 25, no. 58, equatorial section, ×200, sample MS 1181, thin section MS 1181.60006.
- 26 *Robuloides* cf. *R. lens* Reichel, no. 59, axial section, ×200, sample MS 1185, thin section MS 1185.59997.
- 27-29 *Eomarginulinella serbica* Nestell, Sudar, Jovanović, Kolar-Jurkovšek, n. sp. 27, no. 60, close to axial section, ×50, sample MS 1204, thin section MS 1204A; 28, no. 61, holotype, close to axial section, ×100, sample MS 1204, thin section MS 1204.59994; 29, no. 62, paratype, close to axial section, ×100, sample MS 1203, thin section MS 1203A.
- 30 *Paraglobivalvulina* sp. 1 (in Pronina-Nestell and Nestell 2001), no. 63, axial section, ×100, sample MS 1186, thin section MS 1186A.
- 31-33 *?Paraglobivalvulina globosa* (Wang), no. 64, close to axial section, ×100, sample MS 1186/1, thin section MS 1186/1A; 32, no. 65, close to axial section, ×100, sample MS 1184, thin section MS 1184.60002; 33, no. 66, oblique section, ×100, sample MS 1203, thin section MS 1203A.
- 34 *Globivalvulina?* sp., no. 67, oblique section, ×100, sample MS 1183, thin section MS 1183A.
- 35-36 *Dagmarita* cf. *D. caucasica* G. Vuks, no. 68, lateral section, ×100, sample MS 1203, thin section MS 1203A; 36, no. 69, close to axial section, ×100, sample MS 1203, thin section MS 1203A.
- 37 *Reichelina* sp., no. 70, oblique axial section, ×100, sample MS 1203, thin section MS 1203A.
- 38 *Nankinella* cf. *N. changlingensis* (Jing), no. 71, oblique axial section, ×40, sample MS 1184, thin section MS 1184.60002.



0.09mm, the width is correspondingly 0.03mm, 0.08mm, 0.2mm and 0.25mm. Wall is recrystallized, of vitreous appearance, but in some places it is of microgranular structure and black in color. Lateral thickenings are well developed. Aperture is simple, at the end of a pseudotubular chamber. Dimensions: test diameter 0.8mm, width 0.44-0.52mm.

Designation of types: The specimen illustrated on plate 1, figure 23 is designated as the holotype (no. 23). It is from northwestern Serbia, Vlašić Mountain, Komirić village, Komirić section, the uppermost part of the "Bituminous Limestone", bed 2, sample MS 1181. Upper Permian, upper Changhsingian.

Etymology: After the Vlašić Mountain, northwestern Serbia.

Material: One axial section of the holotype, 17 partly broken free specimens, and one specimen was used for a thin section.

Discussion: Based on its large test, *Multidiscus vlasticensis* n. sp. is similar to *Multidiscus obesus* Lin, Li and Sun (Lin et al. 1990, p. 206, pl. 23, figs. 1-6), but differs from it by unevenly increasing of height and width of whorls and smaller size of the test.

Occurrence: Upper Permian, upper Changhsingian; northwestern Serbia, Vlašić Mountain, Komirić village, Komirić section, "Bituminous Limestone", bed 2, sample MS 1181, Pomijača section, Cer Mountain; Upper Permian, northeastern Hungary, Bükk Mountains, southeast of Mályinka, Nagyvisnyó Limestone, borehole Mályinka-8, depth 209.0m and 220.5m.

Class NODOSARIATA Mikhalevich 1992

Subclass NODOSARIANA Mikhalevich 1992 [nom. correct. Mikhalevich 1998 pro subclass Nodosariata Mikhalevich 1992; =Lagenata Maslakova 1990 *nomen nudum*; =Lagenata Maslakova in Maslakova et al. 1995)

Remarks: Maslakova (1990) proposed the new subclass name Lagenata for nodosariids with orders Lagenida Lankester 1885 and Polymorphinida Mikhalevich 1980 in its composition, but she did not give a description of the subclass. She described this taxon only in 1995 (Maslakova et al. 1995). Mikhalevich (1992) established and described a new subclass Nodosariana also for the nodosariids, but earlier than Maslakova. Thus, according to the International Code of Zoological Nomenclature (1999), the name Lagenata Maslakova 1995 is a junior synonym of Nodosariana Mikhalevich 1992.

Order VAGINULINIDA Reuss 1860 [nom. transl. Mikhalevich 1993 ex family Vaginulinidae Reuss 1860]
Family MARGINULINIDAE Wedekind 1937

Genus *Eomarginulinella* Sosnina 1969 [nom. subst. pro *Marginulinella* Sosnina 1967; = *Marginulinella* Sosnina 1967, non *Marginulinella* Wedekind 1937]; reinstated herein

Type species: *Marginulinella typica* Sosnina 1967 = *Eomarginulinella typica* Sosnina 1969.

Diagnosis (given after Sosnina 1967): Test is polythalamous; uniserial, asymmetrical, completely involute, coiled in the ini-

PLATE 3

All specimens are from the uppermost part of the "Bituminous Limestone", Komirić section, Vlašić Mountain, northwestern Serbia; Upper Permian, upper Changhsingian. Scale bar - 100µm.

1-3 *Hemigordius hungaricus* Bérczi-Makk, Csontos and Pelikán. 1, no. 72, equatorial view, sample MS 1203/1; 2, no. 73, equatorial view, sample MS 1203/2; 3, no. 74, equatorial view, sample MS 1181.

4-9 *Hemigordius komiricensis* Nestell, Sudar, Jovanović, Kolar-Jurkovšek, n. sp. 4, no. 75, paratype, equatorial view, sample MS 1203/4; 5, no. 76, paratype, equatorial view, sample MS 1181; 6, no. 77, paratype, equatorial view, sample MS 1203/1; 7, no. 78, paratype, equatorial view, sample MS 1203/2; 8, no. 79, paratype, equatorial view, sample MS 1203/1; 9, no. 80, paratype, equatorial view, sample MS 1203/4.

10 *Hemigordius smiljkae* Nestell, Sudar, Jovanović, Kolar-Jurkovšek, n. sp. 10, no. 81, paratype; 10a – view of 10b tilted at 40° shows depression in the umbilical area, 10b – equatorial view; sample MS 1203/1.

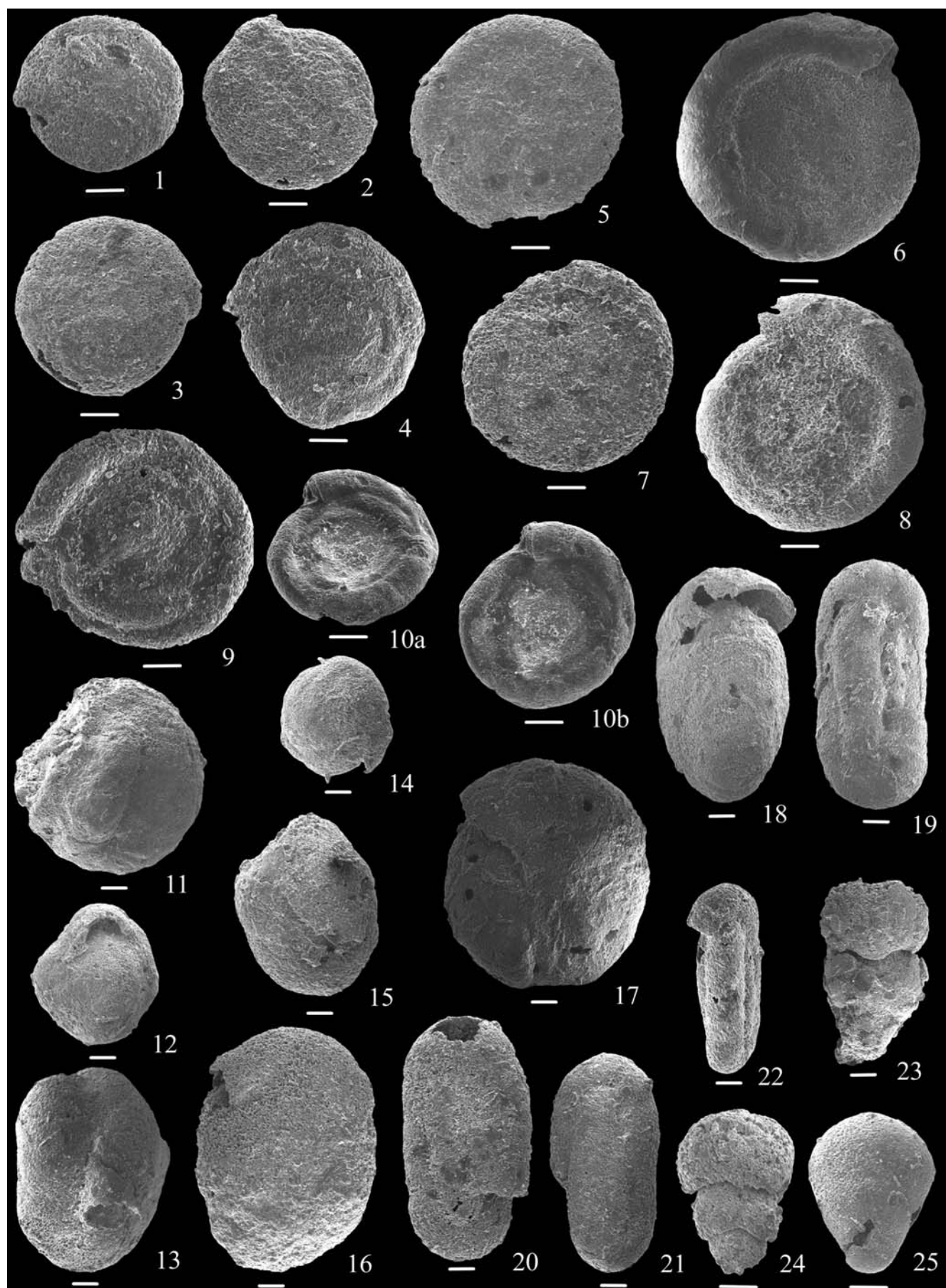
11-18 *Pseudomidiella* cf. *P. labensis* Pronina-Nestell in Pronina-Nestell and Nestell (2001). 11, no. 82, equatorial view of broken specimen, sample MS 1203/1;

12, no. 83, axial (apertural) view, sample MS 1203/1; 13, no. 84, axial view, sample MS 1203/1; 14, no. 85, equatorial view of juvenile specimen, sample MS 1203/1; 15, no. 86, equatorial view, sample MS 1203/2; 16, no. 87, equatorial view, sample MS 1203/2; 17, no. 88, equatorial view, sample MS 1181; 18, no. 89, axial (apertural) view, sample MS 1181.

19-22 *Agathammina* sp. 19, no. 90, axial view, sample MS 1203/1; 20, no. 91, axial (apertural) view, sample MS 1203/2; 21, no. 92, axial view, sample MS 1203/2; 22, no. 93, axial lateral view, sample MS 1203/2.

23-24 *Eomarginulinella serbica* Nestell, Sudar, Jovanović, Kolar-Jurkovšek, n. sp. 23, no. 94, axial view, sample MS 1203/1; 24, no. 95, axial view, sample MS 1203/1.

25 *Pseudonodosaria limpida* Woszczyńska, no. 96, axial view, sample MS 1203/1.



tial part and uncoiled in the terminal part, usually always curved at different degrees, rarely straight, and rounded or irregularly rounded in transverse section. Chambers are globular; in the initial part small, trochospiral and form an incomplete volution; chambers are large, relatively wide in the terminal part, at the beginning strongly and then moderately enveloping, the last ones sometimes almost adjacent. Sutures are straight, perpendicular to the axis, indistinct in the initial part and weakly excavated and distinctly expressed only at the end of the test. Wall is calcareous, vitreous, radial, and relatively thick; in all chambers excluding the last chamber it is multilayered and formed by stratification of the walls of two-three following chambers (poly-monolamellar in the sense of Grönlund and Hansen 1976 or ortho-polylamellar in the sense of Eiland and Gudmundsson 2004). Septa are long, arcuate, usually thickened and slightly turned down at the ends, and of a similar structure as the wall. Aperture is terminal, central, radiate, located in the axial part of the test, apertural surface wide, convex, slightly flattened near the aperture, sometimes slightly depressed downward.

Remarks: Sosnina (1967) described a new genus under the name *Marginulinella* from the *Metadoliolina lepida* Zone, Chandalaz Horizon (Middle Permian, Capitanian) of South Primorye, Russian Far East. Later, she (1969) replaced this name with *Eomarginulinella* because the name *Marginulinella* was preoccupied by Wedekind (1937). Loeblich and Tappan (1987) in their last classification placed the genus *Eomarginulinella* as a synonym of the genus *Calvezina* Sellier de Civrieux and Dessauvage 1965 with which we disagree because these two genera have totally different morphologies. *Calvezina* is characterized by a compressed uniserial test with an elliptic transverse section, with high spear-shaped crescentiform chambers, chambers growing very rapidly and curvilinear in one plane, enveloping of chambers is weak, without apertural thickenings near the borders of the septa and an unknown structure of an aperture (Sellier de Civrieux and Dessauvage 1965). The genus *Eomarginulinella* is characterized by an uncompressed test with a rounded or irregularly rounded transverse section, chamber growth is trochospiral, chambers are globular, enveloping strongly at the beginning, then moderately and becoming adjacent at the terminal part of the test, septa are arcuate, thickened at the end and slightly turned downward, and with a terminal, central and radiate aperture (Sosnina 1967). Based on such morphological differences, we consider *Eomarginulinella* to be a valid genus, and thus reinstate the genus herein.

Composition of the genus: We include the following species in the composition of the genus *Eomarginulinella*: *Eomarginulinella amplituda* (Sosnina 1967), *E. typica* (Sosnina 1967), *E. composita* (Sosnina 1967), *E. cubiformis* (Sosnina 1967), *E. vulgaris* (Sosnina 1967), *E. parvula* Sosnina 1977, *E. urbana* Sosnina 1980, and *Langella imbecilla* Lin, Li and Sun 1990.

Range: Middle Permian (Wordian) – Upper Permian (Changhsingian).

Eomarginulinella serbica Nestell, Sudar, Jovanović and Kolar-Jurkovšek, **n. sp.**

Plate 2, figures 27-29; Plate 3, figures 23-24; Plate 4, figures 1-10

Protonodosaria praecursor (Rausser-Chernoussova) - BÉRCZI-MAKK et al. 1995, pl. 28, fig. 4.

Calvezina ottomana Sellier de Civrieux and Dessauvage - GROVES et al. 2005, figs. 23-23, 24, 25, 30, fig. 24-2.

Description: Test is polythalamous, rectilinear, slightly curved or straight, slowly or rapidly expanding to the apertural end, and is from oval to egg-shaped in transverse section. Number of chambers is 2-5. There are three different varieties of the test that possibly represent trimorphism. Generation B (microspherical) has an almost unexpanded test and is oval in transverse section, with small initial chamber with diameter 0.05-0.075mm, five chambers of which the second and third ones are crescentiform and grows trochospirally, enveloping moderately each other, and the two last chambers are adjacent (Plate 4, figs. 8-9). Generation A₁ (megalospheric) has a large initial chamber with diameter 0.13-0.18mm, two-four successive chambers (second chamber is globular and asymmetrical with short height on the ventral side and enveloping the initial chamber on ½ of its diameter, the following chambers are almost adjacent, forming a weakly expanded and slightly curved test that is oval in transverse section (Plate 4, figs. 5-7, 10). Generation A₂ (megalospheric) has a large initial chamber with diameter 0.09-0.13mm, four-five globular chambers, slightly curved, and with a weakly expanded to rapidly expanded test with egg-shaped transverse section and with last chamber enveloping completely the preceding chamber from the ventral side. The last chamber is very large (Plate 4, figs. 1-4).

Unfortunately, the free tests of the species are casts and not much can be said about the wall structure. But, the wall is preserved in specimens in thin sections. Wall is calcareous and hyaline. In specimens illustrated on Plate 3, figs. 27-28, the wall is poly-monolamellar in the first three-four chambers, and in the last one-two it is atelo-monolamellar. In specimens illustrated on Plate 3, fig. 29, the wall is atelo-monolamellar. The different wall ultrastructure probably depends on the generations of the species. Septa have thickenings near the apertural border. Aperture is terminal, central, probably radiate, located on the apertural projection. Dimensions: test height (H) – 0.32-0.75mm, width (W) – 0.23-0.48mm, some specimens reach a height up to 1.47mm and width 0.61mm; ratio H/W – 1.4-1.6, rare 2.4.

Designation of types: The specimen illustrated on plate 2, figure 28 is designated as the holotype (no. 61), and specimens on plate 2, figure 29 (no. 62) and plate 4, figures 1-10 (1 - no. 97, 2 - no. 98, 3 - no. 99, 4 - no. 100, 5 - no. 101, 6 - no. 102, 7 - no. 103, 8 - no. 104, 9 - no. 105, 10 - no. 106) as paratypes. They are from northwestern Serbia, Vlašić Mountain, Komirić village, Komirić section, the uppermost part of the "Bituminous Limestone", the holotype is from bed 1, sample MS 1204, paratypes: fig. 29 is from bed 1, sample MS 1203, figs. 1-10 from bed 3, sample MS 1185. Upper Permian, upper Changhsingian.

Etymology: After the location in Serbia.

Material: Twelve whole tests and four close to axial sections.

Discussion: *Eomarginulinella serbica* n. sp., based on peculiar morphological features, cannot be compared with any known species of the genus *Eomarginulinella*. Sosnina's (1967, 1977, 1980) species were described based on oriented sections. All of them have a distinct coiled initial part and numerous chambers, and occur in the Wordian – Capitanian interval of the Permian. The new species described herein is from the uppermost part of the Late Permian. *E. serbica* n. sp. also occurs in the upper Changhsingian Nikitian calcareous lithofacies of the Belolabinskaya Group of the northwestern Caucasus and in the upper Dzhulfian (Wuchiapingian), *Paradagmarita flabelliformis* Zone of Transcaucasia (unpublished data of G. Nestell).

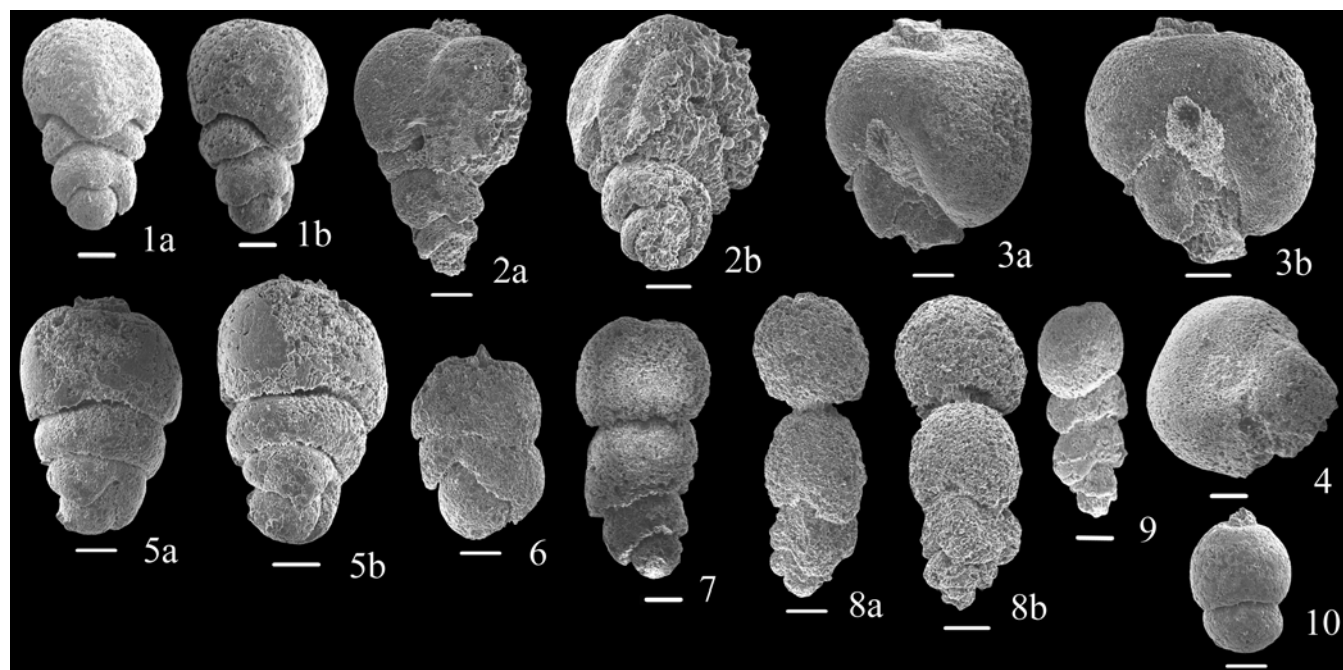


PLATE 4

All specimens are from the uppermost part of the “Bituminous Limestone”, Komirić section, sample MS 1185, Vlašić Mountain, northwestern Serbia; Upper Permian, upper Changhsingian. Scale bar - 100µm.

1-10 *Eomarginulinella serbica* Nestell, Sudar, Jovanović, Kolar-Jurkovšek, n. sp.

- | | |
|---|--|
| <p>1 no. 97, paratype, 1a – ventral view, 1b – the same specimen tilted at 40°; megalospheric generation (A₂).</p> <p>2 no. 98, paratype, 2a – ventral view, 2b – view from the initial end of the same specimen tilted at 40°; megalospheric generation (A₂).</p> <p>3 no. 99, paratype, 3a – ventral view, 3b – lateral view of the same specimen tilted at 40°; megalospheric generation (A₂).</p> <p>4 no. 100, paratype, apertural view; megalospheric generation (A₂).</p> <p>5 no. 101, paratype, 5a – lateral view, 5b – lateral view of the same specimen tilted at 40°; megalospheric generation (A₁).</p> | <p>6 no. 102, paratype, lateral view of three-chambered specimen; megalospheric generation (A₁).</p> <p>7 no. 103, paratype, lateral view; megalospheric generation (A₁).</p> <p>8 no. 104, paratype, 8a – dorsal view, 8b – dorsal view of the same specimen tilted at 40°; microspheric generation (B).</p> <p>9 no. 105, paratype, lateral/ventral view of microspheric (B) specimen.</p> <p>10 no. 106, paratype, axial view of juvenile megalospheric (A₁) specimen.</p> |
|---|--|

Alternation of generations in *Eomarginulinella serbica* n. sp. is a very interesting feature, but not unusual, because such alternation (trimorphism) has also been described for the genus *Marginulina* d'Orbigny 1826 (Basov et al. 1975). One of the megalospheric generations has a terminal and central position of the aperture whereas others have the aperture displaced to the dorsal margin. Based on this feature, the genus *Eomarginulinella* with a terminal and central aperture in each generation probably is an ancestor for the genus *Marginulina*, the first appearance of which is in the Triassic.

Occurrence: As the holotype and paratypes; and Upper Permian, upper Changhsingian, Turkey, Central Taurides, Taşkent section, Çekiç Dagı Formation, Yellice Member, and Demirtaş section, Yüglük Tepe Limestone; northeastern Hungary, Bükk Mountains, southeast of Mályinka, Nagyvisnyó Limestone, borehole Mályinka-8, depth 113.0m.

CONCLUSIONS

Foraminifers from Permian-Triassic boundary strata from the upper part of the "Bituminous Limestone" in the Komirić section, Vlašić Mountain, northwestern Serbia, are described and illustrated here for the first time. Four new species of foraminifers are described from the orders Hemigordiopsida and Vaginulinida: *Hemigordius komiricensis* n. sp., *H. smiljkæ* n. sp., *Multidiscus vlasicensis* n. sp., and *Eomarginulinella serbica* n. sp. The genus *Eomarginulinella* Sosnina 1969 is considered to be a valid genus and reinstated herein.

These Late Permian foraminifers are found together with conodonts of the Lower *praeparvus* Zone (in sense of Perri and Farabegoli 2003), the next to the last of the youngest conodont zones of the Upper Permian (Sudar et al. 2007). The assemblage of foraminifers from the upper part of the "Bituminous Limestone" in northwestern Serbia has most similarity with coeval foraminiferal assemblages from the upper Changhsingian Belolabinskaya Group of the northwestern Caucasus, and the Nagyvisnyó Limestone of the Bükk Mountains in northeastern Hungary. These similarities could be explained by the previous location of these blocks on the northern part of the Tethyan Realm (Filipović et al. 2003).

The Serbian Permian-Triassic boundary assemblage of foraminifers has less similarity with the foraminiferal assemblages of the Bulla Member of the Bellerophon Formation in the southern Alps of northern Italy (five common species); the Changhsingian of China (three common species) and Transcaucasia (five common species with the *Paratirolites kittli* Zone); the Yellice Member of the Çekiç Dagı Formation and the upper part of the Yüglük Tepe Limestone in the central Taurides of Turkey (five common species). In spite of the data about similarity in the deposition of the "Bituminous Limestone" of the Jadar Block, the Nagyvisnyó Limestone of the Bükk Mountains and the Bellerophon Formation of the Carnic Alps (Filipović et al. 2003), we cannot make an exact correlation of the Serbian Permian-Triassic foraminiferal assemblage with the foraminiferal assemblage of the Bulla Member of the Bellerophon Formation because only a nodosariid assemblage was described from this locality (Groves et al. 2007), and only five nodosariid species are common to the two localities. The differences in the foraminiferal assemblages of Serbia in contrast with those of China, Turkey, and Transcaucasia could be explained by a deeper water depositional setting in the sections of the latter three regions.

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APPENDIX

List of described taxa.

Hemigordius komiricensis Nestell, Sudar, Jovanović and Kolar-Jurkovšek, **n. sp.**

Plate 1, figures 2–14; Plate 3, figures 4–9

Hemigordius smiljkai Nestell, Sudar, Jovanović, Kolar-Jurkovšek, **n. sp.**

Plate 1, figures 15–17; Plate 3, figure 10

Multidiscus vlasicensis Nestell, Sudar, Jovanović and Kolar-Jurkovšek, **n. sp.**

Plate 1, figure 23

Eomarginulinella serbica Nestell, Sudar, Jovanović and Kolar-Jurkovšek, **n. sp.**

Plate 2, figures 27–29; Plate 3, figures 23–24; Plate 4, figures 1–10