RAZPRAVE IV. RAZREDA SAZU	XLIV-1	239 - 283	Tab. 11	LJUBLJANA 2003

UPPER OLIGOCENE AND MIOCENE FORAMINIFERA FROM PLOHOV BREG NEAR PODČETRTEK (SLOVENIA)

ZGORNJEOLIGOCENSKE IN MIOCENSKE FORAMINIFERE S PLOHOVEGA BREGA PRI PODČETRTKU

KATARINA OBLAK

ABSTRACT

UDC: 563.12(118.1/.2)(497.4)
551.781/.782:563.12(497.4)

Upper Oligocene and Miocene Foraminifera from Plohov breg near Podčetrtek (Slovenia)

Throughout the Plohov breg profile I have studied particularly planktonic Foraminifera. I found out that the most diverse and abundant is the genus *Globigerina*. Foraminifers of genera *Globorotalia, Globigerinella* and *Globigerinoides* are numerous, foraminifers of genera *Orbulina* and *Globoquadrina* frequent and foraminifers of genus *Praeorbulina* rare. Benthic Foraminifera are classified mostly up to the genus level only. According to foraminiferal as well as other microfossil assemblage in my samples, I dated profile strata and roughly estimated paleoecological conditions, as depth and salinity, of the former sea. My results mainly coincide with statements of previous studies.

Key words: micropaleontology, Foraminifera, Upper Oligocene, Miocene, Central Paratethys, Slovenia

IZVLEČEK

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Zgornjeoligocenske in miocenske foraminifere s Plohovega brega pri Podčetrtku

V profilu Plohov breg sem raziskovala predvsem planktonske foraminifere. Ugotovila sem, da sta diverziteta in abundanca največji pri rodu *Globigerina*. Zelo številčni so tudi rodovi *Globorotalia, Globigerinella* in *Globigerinoides*, manj številčna, a še vedno pogosta sta rodova *Orbulina* in *Globoquadrina*, medtem ko je rod *Praeorbulina* manj številčen. Bentoške luknjičarke so določene večinoma le do stopnje rodu. Glede na vsebnost luknjičark in ostalih mikrofosilov v vzorcih sem po posameznih odsekih profila določila geološko starost ter ocenila globino in slanost nekdanjega morja. Moje ugotovitve večinoma sovpadajo z rezultati dosedanjih raziskav.

Ključne besede: mikropaleontologija, foraminifere, zgornji oligocen, miocen, Centralna Paratetida

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INTRODUCTION

In this paper, Upper Oligocene and Miocene Foraminifera from the Plohov breg profile (Podčetrtek, Slovenia, fig. 1) are presented. It is a roadside, 1300 meter-long profile on the Southwestern slope of the Tičenca and Western slope of the Kristan vrh. Lithologically, the profile could be devided into three parts; Egerian, Badenian and Sarmatian (Aničić & Juriša 1985a, b; fig. 2). The lower, most extensive Egerian part consists of alternated thick-bedded quartz sands and thin-bedded silts, clays, marls, sandy marls or clayey marls. Strata of lithified sediments are intercalated scarcely (pl. 1, figs. 1, 2). That part of the profile is limited with discordance, and after it Badenian beds are developed. They started with basal quartz conglomerate that is followed by alternated calcarenites and more or less lithified

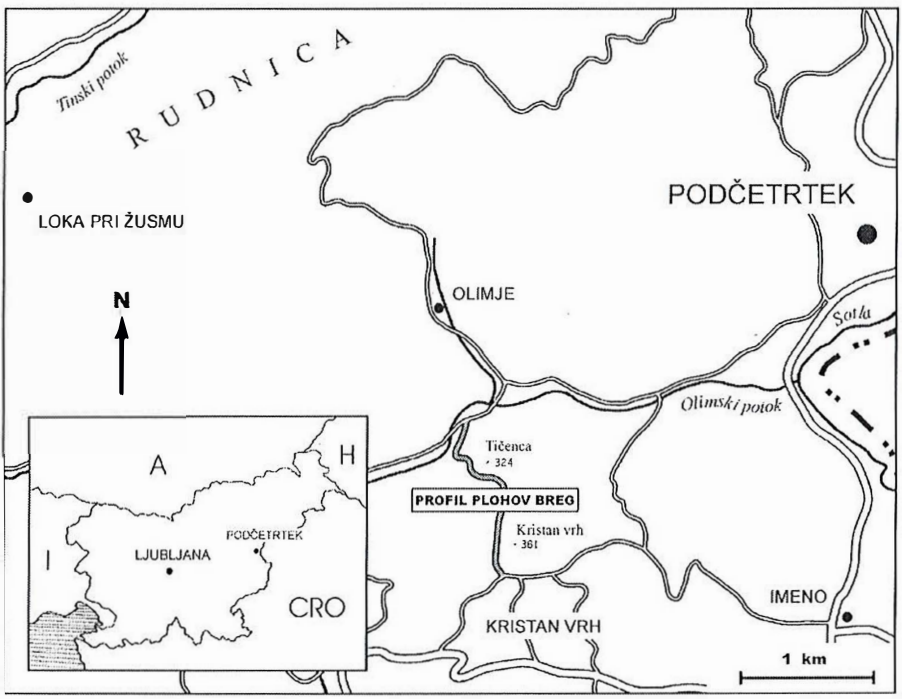


Figure 1. Location map of the Plohov breg profile
Slika 1. Položaj profila Plohov breg

marlstones and sandy marlstones (pl. 2, figs. 1, 2). For a short distance, the profile is discontinued due to vegetation. The upper part of the profile consists of Sarmatian thin-bedded marly limestones at the base, alternated marls and marlstones higher and calcarenites at the top of the profile (pl. 3, figs. 1, 2).

In geotectonical view, the studied area is located on the Southern flank of the Rudnica anticline and on the Northern flank of the Planina syncline. Both units belong to the bigger geotectonic unit of the Sava Folds (Aničić & Juriša 1985a, b).

For my research of Foraminifera assemblage I have sampled clays, silts and unlithified or weakly lithified marls. 61 samples had been taken throughout the profile. Planktonic Foraminifera from the profile have not been studied until now, so I focused more attention to that microfossil group. However, I classified also benthic Foraminifera, mostly to the genus level only. From each sample I kept other microfossils and fossil debris of other organisms, as well. In regard to the microfossil distribution in my samples I dated particular parts of the profile and roughly estimated paleoecological conditions, as depth and salinity of the former sea (Oblak 2002).

PREVIOUS MICROPALEONTOLOGICAL STUDIES

Micropaleontological studies, that have been made in profile sediments and sedimentary rocks before, indicate the rich microfossil content. Considering those microfossils, a detailed geological dating of the profile was established.

Rijavec (1977), who studied particularly benthic Foraminifera, determined the lowermost strata of the profile regarding the species *Planularia kubinyii* as Lower Egerian. In following Egerian beds this species does not appear any more so the author determined their age as Upper Egerian. Badenian strata are delimited to Lower Badenian strata (*Praeorbulina* and *Orbulina suturalis* Zone) including subspecies *Uvigerina aculeata aculeata* and numerous nodosariids, and to Middle Badenian strata ("Sandy shells" Zone) including subspecies *Uvigerina semiornata semiornata* and planktonic species *Orbulina suturalis*. The upper part of the profile is suggested to be, in respect to the species *Cibicides badenensis*, of the Lower Sarmatian age (*Cibicides badenensis* Zone). The uppermost strata, where foraminifers are absent, the Sarmatian is indicated by the bivalvia genus *Ervilia*.

Calcareous nannoplankton analyses (Pavšič & Aničič 1998, 1999) showed slightly different results about geological dating. The whole lower part of the profile is due to species *Cyclicargolithus abisectus*, *Helicosphaera euphratis* and *Reticulofenestra lockeri* described as Upper Egerian (NN1-NN2 Zone). Reworked Cretaceous, Palaeocene and Eocene species are present in these sediments, as well. The following Badenian beds are, in regard to nannoflora, of Lower Badenian age (NN5 Zone). The uppermost beds of the profile are considered to be Sarmatian (NN8 Zone). More exact dating is in view of coccolith content not possible. There were found numerous reworked Upper Oligocene and Lower Miocene species in those beds.

In 1999, both authors made a detailed study of two and a half meter long interval from Egerian strata, where apparently increased concentration of brackish opportunistic species *Braarudosphaera bigelowi* and *Micrantholithus vesper* had been noticed before.

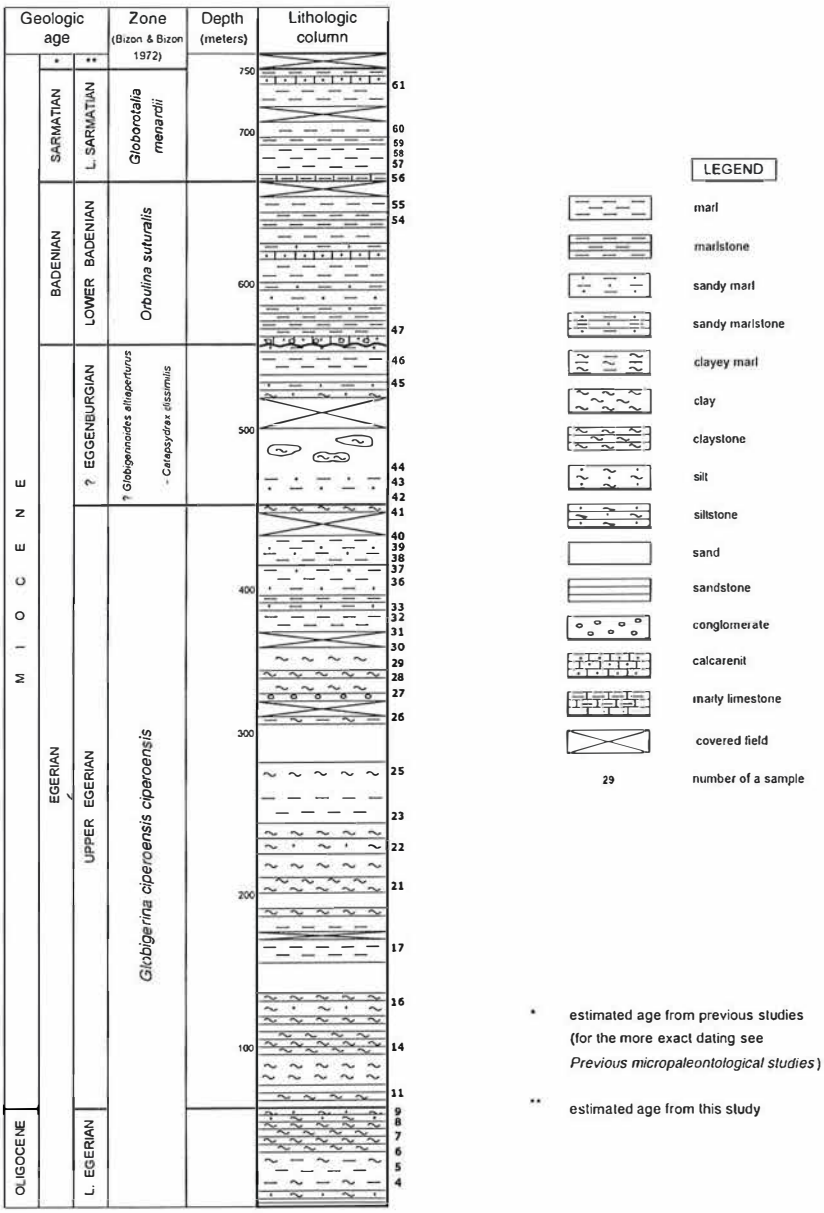


Figure 2. Stratigraphic column of the Plohov breg profile (modified after Pavšič & Aničič 1998: 65)
Slika 2. Stratigrafski stolpec profila Plohov breg (prirejeno po Pavšič & Aničič 1998: 65)

PALEONTOLOGICAL PART

Taxonomy of Foraminifera

Planktonic Foraminifera

The basis literature I have used for planktonic foraminiferal determining, was *Plankton Stratigraphy*, edited by BOLLI, SAUNDERS and PERCH-NIELSEN (1985). Therefore, some older synonyms are citied in my study. The foraminiferal zonation, determined by BIZONS in 1972, is referred from this book, as well. By citing these zones in the following writing, I do not mention authors anymore. In *Conclusions*, where foraminiferal zonations of BERGGREN et al. and GRILL are added, authors are mentioned strictly.

Foraminifers are classified according to LOEBLICH & TAPPAN (1987).

Ordo Foraminiferida Eichwald, 1830
Subordo Globigerinina Delage & Herouard, 1896
Superfamilia Globorotaliacea Cushman, 1927
Familia Globorotaliidae Cushman, 1927
Genus *Globorotalia* Cushman, 1927

Globorotalia acrostoma Wezel, 1966
(pl. 4, figs. 1-4)

1966 *Globorotalia acrostoma* sp. n. – WEZEL, 1298-1306, Tav. 101, Fig. 1-8.
1971 *Globorotalia acrostoma* Wezel - NICORA, 183, tav. 7, fig. 1a-c, 3a-c.
1972 *Globorotalia acrostoma* Wezel – BIZON, G. & BIZON, J. J., 15-19, fig. 1-6.
1985 *Globorotalia acrostoma* Wezel - IACCARINO, 304-306, Fig. 6.13.
1998 *Paragloborotalia ? acrostoma* (Wezel) - RÖGL, 148, Taf. 8, Fig. 14-15, Taf.10, Fig.8.

Material: Frequent tests from two samples.
Description: The test consists of low trochospirally arranged subglobular chambers. In the last whorl there are four and a half to five chambers. The umbilical side is convex, while the spiral side is flattened or slightly convex. The outline of the test is oval. The high arched aperture is placed on a large flattened apertural face. A lip is present.
Size: The maximum diameter of tests is around 0.3 mm.
Occurrence: In the Central Paratethys, the species existed from the middle Ottnangian (*Globigerinoides trilobus* Zone) until the end of the Middle Badenian (*Globorotalia mayeri* Zone) (RÖGL 1985).

Globorotalia mayeri Cushman & Ellisor, 1939
(pl. 4, figs. 5-8)

1971 *Globorotalia mayeri* Cushman & Ellisor - POSTUMA, 332-333.

1972 *Globorotalia mayeri* Cushman & Ellisor - Bizon, G. & Bizon, J. J., 75-78, fig. 1-6.
1978 *Globorotalia mayeri* Cushman & Ellisor - Papp et al., 278. Taf. 7, Fig. 10-12.
1985 *Globorotalia mayeri* Cushman & Ellisor - Bolli & Saunders, 203-206, Figs. 26.31-43.

Material: Numerous tests from two samples.

Description: Low trochospiral test is made up of subglobular chambers. The last whorl consists of five to six chambers. The form of the test resembles the species *Globorotalia acrostoma* but it differs in a round outline and a lower aperture.

Size: The maximum diameter of tests is around 0.3 mm.

Occurrence: In the Central Paratethys, the species is known from the beginning of the Upper Egerian (*Globigerina ciperoensis ciperoensis* Zone) to the end of the Badenian (*Globorotalia menardii* Zone) (Rögl 1985). According to Papp et al. (1978), that species lived only in the first half of the Badenian.

Globorotalia transsylvanica Popescu, 1970
(pl. 5, figs. 1-4)

1985 *Globorotalia transsylvanica* Popescu - Rögl, 324, Figs. 5.14-17.

Material: Frequent tests from two samples.

Description: The test is low trochospiral and is characterized by five to six chambers in the last whorl. The wall is smooth and transparent. The umbilical side is convex and the spiral side is mostly flattened. The aperture is by a position and a shape similar to that of the species *Globorotalia mayeri*.

Size: The maximum diameter of tests is around 0.25 mm.

Occurrence: In the Central Paratethys area, the species is recorded from the Lower and the Middle Badenian, from the beginning of *Praeorbulina glomerosa* Zone to the middle of *Globorotalia mayeri* Zone (Rögl 1985).

Familia *Catapsydracidae* Bolli, Loeblich & Tappan, 1957
Genus *Globoquadrina* Finlay, 1947

Globoquadrina altispira (Cushman & Jarvis, 1936)
(pl. 5, figs. 5-8)

1971 *Globoquadrina altispira* (Cushman & Jarvis) - Postuma, 310-311.
1972 *Globoquadrina altispira* (Cushman & Jarvis) - Bizon, G. & Bizon, J. J., 259-262, fig. 1-8.
1985 *Globoquadrina altispira altispira* (Cushman & Jarvis) - Bolli & Saunders, 183-185, Fig. 15.1.

Material: Frequent tests from five samples.

Description: Trochospirally arranged chambers are globular in the early stage but compressed laterally in the last whorl. The last whorl is formed of four to five chambers. The umbilicus is wide and deep. The spiral side is convex and the aperture is high arched.

Remark: All my specimens possess four chambers in the last whorl.

Size: The maximum diameter of tests ranges from 0.25 to 0.4 mm.

Occurrence: In the Central Paratethys, this species occurred in the Badenian, from the beginning of *Praeorbulina glomerosa* Zone to the end of *Globorotalia mayeri* Zone (RÖGL 1985).

Superfamilia Globigerinacea Carpenter, Parker & Jones, 1862
Familia Globogerinidae Carpenter, Parker & Jones, 1862
Subfamilia Globigerininae Carpenter, Parker & Jones, 1862
Genus *Globigerina* d'Orbigny, 1826

Globigerina praebulloides Blow, 1959
(pl. 6, figs. 1-4)

1971 *Globigerina praebulloides* Blow – POSTUMA, 268-269.
1978 *Globigerina praebulloides* Blow - PAPP et al., 269, Taf. 1, Fig. 1-4.
1985 *Globigerina praebulloides* Blow - BOLLI & SAUNDERS, 181, Figs. 13.12-14.

Material: Numerous tests from twelve samples.

Description: The small trochospiral test is made up of globular chambers. They increase rapidly in size as added so the test appears elongated. The last whorl consists of four chambers.

Size: The maximum diameter of tests is around 0.2 mm.

Occurrence: In the Central Paratethys, the species existed from the beginning of the Egerian (*Globorotalia opima opima* Zone) until the end of the Badenian (*Globorotalia menardii* Zone) (RÖGL 1985). It is especially characteristic of the time from the Eggenburgian to the Karpatian (PAPP et al. 1978).

Globigerina regularis d'Orbigny, 1846
(pl. 6, figs. 5-8)

1978 *Globigerina regularis* d'Orbigny - PAPP et al., 270, Taf. 2, Fig. 5-8.
1985 *Globigerina regularis* d'Orbigny - PAPP & SCHMID, 62, Taf. 53, Fig. 8-12.
1985 *Globigerina regularis* d'Orbigny - RÖGL, 323, Figs. 4.13-16.

Material: Numerous tests from three samples.

Description: Globular chambers are added very low trochospirally. The last whorl consists of four to four and a half rapidly enlarging chambers. The spiral and the umbilical sides are flattened to concave.

Size: The maximum diameter of tests ranges from 0.25 to 0.4 mm.

Occurrence: In the Central Paratethys, the species lived from the beginning of the upper Lower Badenian (*Orbulina suturalis* Zone) until the end of the Badenian (*Globorotalia menardii* Zone) (RÖGL 1985).

Globigerina tarchanensis Subbotina & Chutzieva, 1950
(pl. 8, figs. 1-4)

1978 *Globigerina tarchanensis* Subbotina & Chutzieva – PAPP et al., 272, Taf.3, Fig.11-14, Taf.8, Fig.16-27
1985 *Globigerina tarchanensis* Subbotina & Chutzieva - RÖGL, 323, Fig. 5.2.

Material: Numerous tests from eight samples.

Description: The small trochospiral test is made up of slowly enlarging globular chambers. In the last whorl there are five chambers. The aperture is bordered by a lip.

Size: The maximum diameter of tests does not exceed 0,2 mm.

Occurrence: In the Central Paratethys, the species existed from the beginning of the upper Lower Badenian (*Orbulina suturalis* Zone) until the end of the Badenian (*Globorotalia menardii* Zone) (RÖGL 1985). According to PAPP et al. (1978), this species occurred already in the Eggenburgian (*Globigerinoides altiaperturus - Catapsydrax dissimilis* Zone for that geological period according to RÖGL (1985)).

Globigerina woodi connecta Jenkins, 1964
(pl. 7, figs. 1-7)

1985 *Globigerina woodi connecta* Jenkins – JENKINS, 275, Fig. 6.22.
1997 *Globoturborotalita connecta* (Jenkins) - MCGOWRAN & LI, Pl.1, Fig.8.

Material: Frequent tests from four samples.

Description: The small low trochospiral test consists of subglobular chambers. Three chambers of the last whorl are added very tightly. The aperture is low.

Remark: There are two forms of tests in my samples. Tests from samples 23 and 27 are a bit smaller and have more parallel sides in outline than tests from samples 7, 41 and 23. I decided to treat the latter ones as *Globigerina* cf. *woodi connecta*.

Size: The maximum diameter of tests does not exceed 0.2 mm.

Occurrence: In the Tethys area, the species existed for a short time around the Oligocene/Miocene boundary (JENKINS 1985).

Genus *Globigerinella* Cushman, 1927

Globigerinella megaperta Rögl, 1994
(pl. 8, figs. 5-8)

1994 *Globigerinella megaperta* n. sp. - RÖGL, 142, Pl. 3, Fig. 7-13.

Material: Numerous tests from five samples.

Description: The test is large and made up of very low trochospirally arranged globular chambers. There are five to six chambers in the last whorl. It is very common for the last few chambers or just the last one to be aberrant sacklike. The umbilicus is wide. Long high aperture is bordered with a thickened rim.

Remark: Although tests from my samples are rather deformed, the characteristics of the species are still recognizable.

Size: The diameter of deformed tests ranges from 0.4 to 0.6 mm.

Occurrence: In the Central Paratethys, the species is known from the Lower and the Upper Oligocene (for that geological period according to RÖGL (1985) *Globorotalia opima opima* Zone, maybe also a part of *Globigerina ciperoensis ciperoensis* Zone) (RÖGL 1994).

Genus *Globigerinoides* Cushman, 1927

Globigerinoides bisphericus Todd, 1954
(pl. 9, figs. 1-4)

1985 *Globigerinoides bisphericus* Todd – BOLLI & SAUNDERS, 199, Fig. 24.8.

Material: A few tests from two samples.

Description: The test consists of trochospirally arranged globular chambers. The last chamber is bigger than the whole older stage of the test. Beside a primary aperture, there is also a secondary aperture on the base of the last chamber. Other supplementary apertures can be developed on the spiral side.

Size: The maximum diameter of tests ranges from 0.4 to 0.6 mm.

Occurrence: In the Central Paratethys, the species lived in the upper Karpatian (*Globigerinoides trilobus* Zone) and the lower Lower Badenian (*Praeorbulina glomerosa* Zone) (RÖGL 1985).

Globigerinoides quadrilobatus (d'Orbigny, 1846)
(pl. 9, figs. 5-8)

1985 *Globigerinoides quadrilobatus* (d'Orbigny) - BOLLI & SAUNDERS, 196-198, Fig. 20.17.
1985 *Globigerinoides quadrilobatus* (d'Orbigny) - PAPP & SCHMID, 63, Taf. 54, Fig. 8-12.

Material: Numerous tests from four samples.

Description: The test is made up of trochospirally added globular chambers. The last whorl consists of three and a half to four chambers. Beside the primary aperture on the base of the last chamber, there are also secondary apertures on the spire present

Size: The maximum diameter of tests ranges from 0.4 to 0.7mm.

Occurrence: In Central Paratethys, the species is characteristic for the upper Lower Badenian and the Middle Badenian (PAPP et al., 1978). According to RÖGL (1985), it still existed in the Upper Badenian (*Orbulina suturalis* Zone and *Globorotalia mayeri* Zone).

Globigerinoides trilobus (Reuss, 1850)
(pl. 11, figs. 1-4)

1978 *Globigerinoides trilobus* (Reuss) – PAPP et al., 273, Taf. 4, Fig. 9-11.
1985 *Globigerinoides trilobus trilobus* (Reuss) - BOLLI & SAUNDERS, 196-198, Fig. 20.15.

Material: Frequent tests from three samples.

Description: The test consists of trochospirally arranged globular chambers. For the last whorl, three chambers are significant. Beside the primary aperture on the base of the last chamber, there are also one to three secondary apertures on the spire developed.

Size: The maximum diameter of tests ranges from 0.4 to 0.6 mm.

Occurrence: In the Central Paratethys, the species lived from the Eggenburgian (*Globigerinoides altiaperturus - Catapsydrax dissimilis* Zone) until the end of the Badenian (*Globorotalia menardii* Zone) (RÖGL 1985).

Subfamilia Orbulininae Schultze, 1854
Genus *Orbulina* d'Orbigny, 1839

Orbulina suturalis Brönnimann, 1951
(pl. 10, figs. 1-8)

1978 *Orbulina suturalis* Brönnimann - PAPP et al., 275, Taf. 5, Fig. 1,2.
1978 *Orbulina suturalis* Brönnimann – RIJAVEC, 214, tab.2, sl. 6.
1985 *Orbulina suturalis* Brönnimann - BOLLI & SAUNDERS, 198-201, Figs. 23.2, 24.1,3.
1987 *Candoorbulina universa* Jedlitschka - LOEBLICH & TAPPAN, 493, Pl. 542, figs. 5-6.

Material: Numerous tests from three samples.

Description: The large test is made up of trochospirally added globular chambers. The strongly enlarged last chamber overlaps most of the previous stage, so the test appears more or less spherical. Numerous sutural and areal secondary apertures are developed on the surface of the last chamber. A large primary aperture is present by the overlapped chambers only.

Remark: The bilobate form, where the last two chambers are strongly enlarged, occurred in all three samples. Due to presence of sutural and areal secondary apertures I have classified it into a treated species.

Size: The diameter of tests ranges from 0.3 to 0.8 mm.

Occurrence: In the Central Paratethys, the species existed from the upper Lower Badenian (*Orbulina suturalis* Zone) until the end of the Badenian (*Globorotalia menardii* Zone) (RÖGL 1985).

Genus *Praeorbulina* Olsson, 1964

Praeorbulina glomerosa circularis (Blow, 1956)
(pl. 11, figs. 5-7)

1978 *Praeorbulina glomerosa* (Blow)- PAPP et al., 274, Taf. 4, Fig. 1, 2, Taf. 5, Fig. 4.

1985 *Praeorbulina glomerosa circularis* (Blow) - BOLLI & SAUNDERS, 198-199, Figs. 23.3, 24.4.
1987 *Praeorbulina glomerosa* (Blow) - LOEBLICH & TAPPAN, 495, Pl. 543, figs. 4-6.

Material: A few tests from three samples.

Description: The structure of the test is similar to that of *Orbulina suturalis* but without such strong overlapping of the last chamber. A result is a less spherical test. It differs also by a smaller size and by an absence of areal secondary apertures. Numerous sutural secondary apertures are small and rounded.

Size: The diameter of tests is around 0.3 mm.

Occurrence: In the Central Paratethys, the species lived in the lower Lower Badenian (*Praeorbulina glomerosa* Zone) and at the beginning of the upper Lower Badenian (*Orbulina suturalis* Zone) (RÖGL 1985). According to PAPP et al. (1978), the species is characteristic of the lower Lower Badenian only.

Benthic Foraminifera

Ammodiscus Reuss, 1862
Glomospira Rzehak, 1885
Spiroplectammina Cushman, 1927 (*S. carinata* (d'Orbigny))
Undetermined agglutinated foraminifers
Spiroloculina d'Orbigny, 1826
Hauerinidae (undetermined genera)
Frondicularia Defrance, 1826
Lenticulina Lamarck, 1804 (*L. vortex* (Fichtel & Moll))
Marginulina d'Orbigny, 1826
Vaginulinopsis Silvestri, 1904 (*V. pedum* (d'Orbigny))
Guttulina d'Orbigny, 1839
Fissurina Reuss, 1850
Glandulina d'Orbigny, 1839
Nodosariidae (undetermined genera)
Bolivina d'Orbigny, 1839
Brizalina O.G. Costa, 1856
Cassidulina d'Orbigny, 1826
Ehrenbergina Reuss, 1850
Bulimina d'Orbigny, 1826 (*B. costata* d'Orbigny)
Globobulimina Cushman, 1927
Uvigerina d'Orbigny, 1826 (*U. semiornata* d'Orbigny and *U. pygmaea* d'Orbigny)
Trifarina Cushman, 1923
Fursenkoina Loeblich & Tappan, 1961
Rosalina d'Orbigny, 1826
Sphaeroidina d'Orbigny, 1826 (*S. bulloides* d'Orbigny)
Schackoinella Weinhandl, 1958 (*S. imperatoria* (d'Orbigny))
Siphonina Reuss, 1850

Cibicides de Montfort, 1808
Asterigerinata Bermúdez, 1949
Nonionella Cushman, 1926
Melonis de Montfort, 1808 (*M. soldanii* (d'Orbigny) and *M. pompilioides* (Fichtel & Moll))
Pullenia Parker & Jones, 1862 (*P. bulloides* (d'Orbigny))
Almaena Samoylova, 1940
Allomorphina Reuss, 1849 (*A. trigona* Reuss)
Chilostomella Reuss, 1849
Anomalinoides Brotzen, 1942
Gyroidinoides Brotzen, 1942
Florilus de Montfort, 1808
Ammonia Brünnich, 1772
Elphidium de Montfort, 1808 (*E. aculeatum* (d'Orbigny))

Distribution of foraminifera and other microfossils throughout the profile
(Figs. 3, 4)

Egerian beds

Diversity and abundance of Foraminifera are highest in samples of lowermost (4-7) and uppermost strata (40-42). In samples of other strata, tests are scarce or even absent.

In lowermost strata the preservation of tests is bad; deformations and brokennesses are common. A share of planktonic Foraminifera is high. A species *Globigerinella megaperta* is numerous, and so are benthic genera *Ammodiscus, Glomospira, Spiroplectammina, Lenticulina, Bolivina, Bulimina, Sphaeroidina, Siphonina, Cibicides, Melonis, Almaena, Gyroidinoides*, nodosariids, undetermined agglutinated foraminifers and porcelaneous foraminifers (hauerinids and spiroloculins). Of other fossils, echinoid spines, ostracod shells, juvenile shells of gastropods and bivalves, otoliths, and fish teeth are present.

In most samples of following strata, planktonic foraminiferal species, nodosariids, echinoids, otoliths and ostracods are missing. Diversity of benthic Foraminifera is low and limited mainly to agglutinated species. The exceptions are samples 23, 27 and 40-42, where diversity and abundance are increased. Planktonic Foraminifera, among them a subspecies *Globigerina woodi connecta,* as well as echinoid spines, occur in these samples. Samples 42 and 45 are interesting in view of two *Globigerina tarchanensis* tests, which were noticed in.

Badenian beds

In Badenian samples, abundance of microfossils is strongly increased. A share of planktonic Foraminifera is high. In a sample 47, *Globigerina tarchanensis* prevails and *Globigerinoides quadrilobatus* is present scarcely, while in samples 54 and 55, foraminifers of some new genera appear the first time; as *Globorotalia, Orbulina* and *Praeorbulina*. From benthic Foraminifera, the most abundant in all three samples are cibicids, bolivins and nodosariids. Porcelaneous and

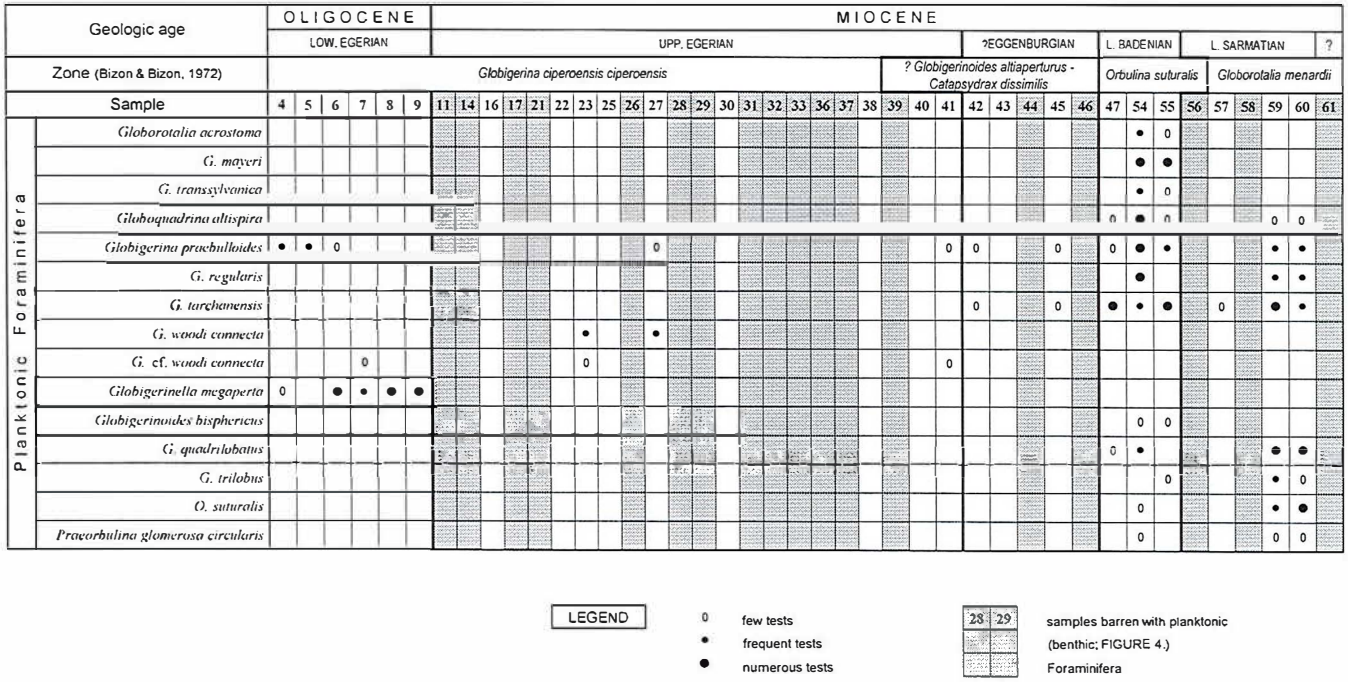


Figure 3. Distribution of planktonic Foraminifera in the Plohov breg profile
Slika 3. Pojavljanje planktonskih foraminifer v profilu Plohov breg

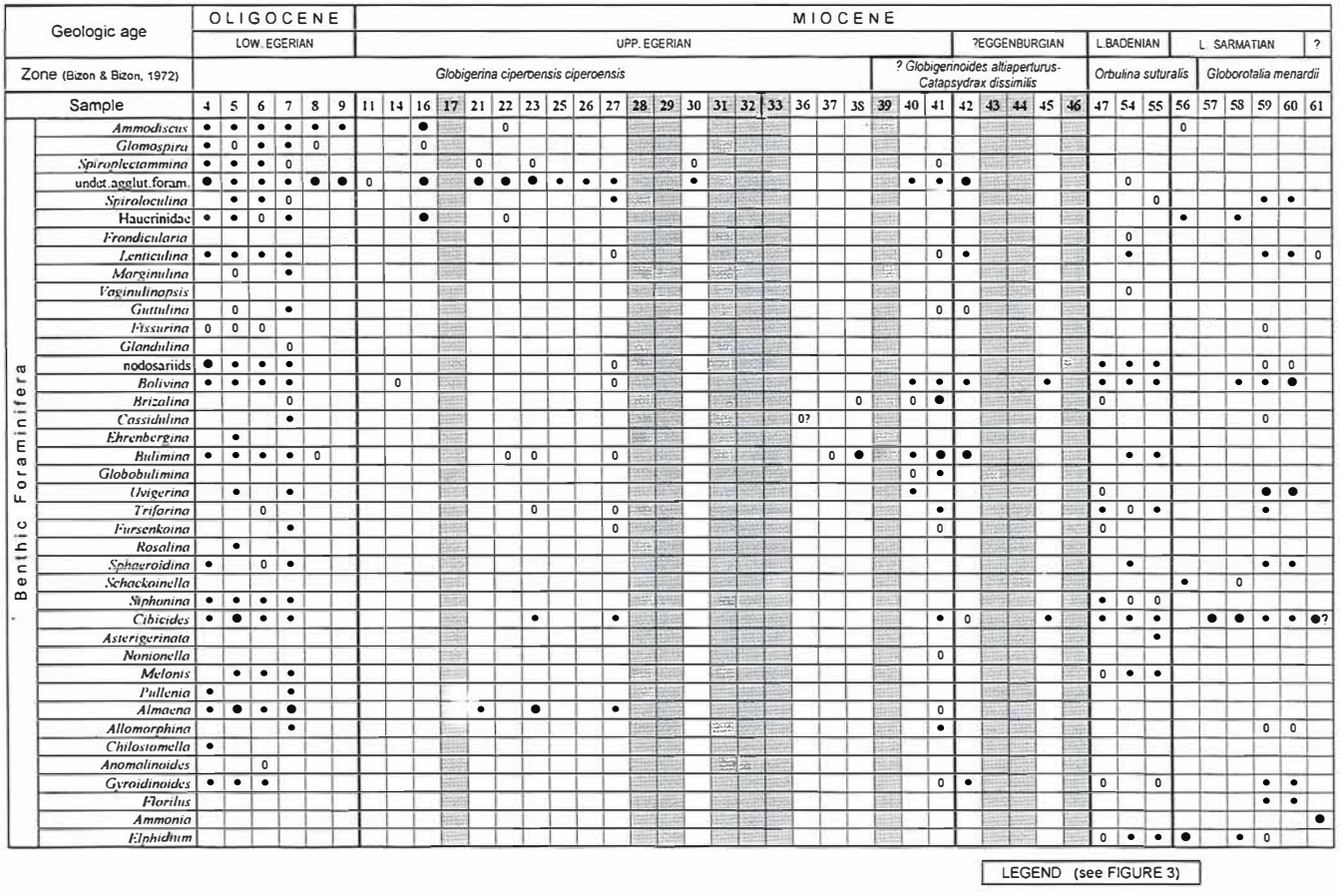


Figure 4. Distribution of benthic Foraminifera in the Plohov breg profile
Slika 4. Pojavljanje bentoških foraminifer v profilu Plohov breg

agglutinated tests are scarce. Echinoid spines and corona debris, ostracod shells and calcitic spicules are numerous. In a sample 54 I have found some fish teeth.

Sarmatian beds

Foraminifers of Sarmatian samples show a strong reduction in abundance and diversity, compared to Badenian samples. Planktonic Foraminifera are for that geological period of Paratethys area uncommon. Nevertheless, in sample 57 I have found a test of the species *Globigerina tarchanensis* and a test of one other globigerina. In samples 59 and 60, planktonic Foraminifera are very abundant. The assemblage of benthic Foraminifera differs from sample to sample. Diversity is, ignoring samples 59 and 60 (see *Conclusions*), low. However, some genera could be very abundant in single samples, like *Elphidium* in a sample 56, *Cibicides* in samples 57, 58 and maybe 61, and *Ammonia* in a sample 61. Echinoid spines are abundant in samples 59 and 60. Regarding other fossils, ostracod shells and scolecodonts are present in a sample 56, fish teeth in a sample 58 and calcitic spicules in a sample 59.

CONCLUSIONS

In my samples, the most abundant and diverse among planktonic Foraminifera is a genus *Globigerina*. Foraminifers of genera *Globorotalia* and *Globigerinoides* with at least three species per genus, and *Globigerinella* with at least one species, are also numerous. Genera *Orbulina* and *Globoquadrina* with at least one species per genus are still frequent, while foraminifers of genus *Praeorbulina* are rare. Among benthic Foraminifera the most abundant are agglutinated foraminifers, nodosariids, bolivins, bulimins, uvigerins, cibicids, almaens and elphidies.

The age of beds, according to my results, mainly coincides with earlier estimates. The lower part of the profile belongs to the Egerian (*Globigerina ciperoensis ciperoensis* Zone). Lowermost beds of this part (samples 4-9) are, considering the presence of planktonic Foraminifera *Globigerinella megaperta,* of the Lower Egerian age (Zone P22 Berggren et al.; BERGGREN et al. 1995). In upper beds (samples 11-41) the above mentioned species does not occur any more but the planktonic subspecies *Globigerina woodi connecta* is present, so the Upper Egerian age can be supposed (Zone M1 Berggren et al.). In samples of highest beds of this part (samples 42-46) the planktonic species *Globigerina tarchanensis* was found, which suggests the Eggenburgian (*Globigerinoides altiaperturus - Catapsydrax dissimilis* Zone, Zones M2 and M3 Berggren et al.). The species is represented with only two tests and moreover, other chronostratigraphic species are absent, so the supposed dating is not certain at all.

In the middle part of the profile some characteristic Badenian species occur, as *Globorotalia transsylvanica, Globoquadrina altispira, Globigerina regularis, Globigerinoides quadrilobatus, Orbulina suturalis* and *Praeorbulina glomerosa*. In respect to occurrence of *G. quadrilobatus* already in a sample 47, and, *G. regularis, O. suturalis* as well as *G. bisphericus* and *P. glomerosa circularis* in samples 54 and 55, all these strata are established to be of upper Lower Badenian age (*Orbulina suturalis* Zone, Zone M6 Berggren et al., or "Lagenid Zone" Grill 1943

(referring to PAPP et al. 1978a)). This age indicates a benthic species *Vaginulinopsis pedum* (PETRICA et al. 1995) in a sample 54, as well.

The uppermost part of the profile (samples 56-60) is, considering the presence of benthic Foraminifera *Elphidium aculeatum* and *Schackoinella imperatoria* (BRESTENSKA 1974) of Lower Sarmatian age (*Globorotalia menardii* Zone). In samples 59 and 60, reworked Badenian foraminifers prevail, however, the species *Elphidium aculeatum* and the stratigraphic position suggest that strata were sedimented in the Lower Sarmatian. In the highest sampled stratum, 61, foraminifers are still frequent, so the Sarmatian age can be supposed. Owing to the absence of characteristic species no exact dating is possible.

In the lowermost part of the profile (samples 4-9) the share of deep-sea indicators, as nodosariids and bulimins (CHERIF et al. 1994), and marine indicators, as uvigerins (RIJAVEC 1978), planktonic foraminifers and echinoid spines, are high, which indicates marine and deep-sea conditions in the Lower Egerian. In Upper Egerian and eventual Eggenburgian (samples 11-46) beds, decrease of deep-sea indicators and increase of agglutinated foraminifers reflect sea shallowing in that time. Badenian samples contain numerous deep-sea and marine microfossils, which proves the substantial sea deepening. In Sarmatian samples, the absence of nodosariids, uvigerins, planktonic foraminifers and echinoids on one hand and the presence of numerous foraminifers *Ammonia* and *Elphidium* on the other hand suggest that these sediments were deposited under brackish conditions. Such paleoecological conditions were already assumed by PLENIČAR and NOSAN (1958). According to them, the tectonics at the beginning and in the middle of the Badenian caused the sea deepening in the Slovenian area. At the beginning of the Sarmatian, the Paratethys-Tethys connection interrupted and consequently, the Paratethys Sea began to shallow and to freshen.

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POVZETEK

Zgornjeoligocenske in miocenske foraminifere s Plohovega brega pri Podčetrtku

UVOD

V članku predstavljam zgornjeoligocenske in miocenske foraminifere iz profila Plohov breg pri Podčetrtku (sl. 1). Profil se razteza v tisočtristometrski razdalji vzdolž ceste na jugozahodnem pobočju Tičence in zahodnem pobočju Kristan vrha. Glede na litologijo lahko razdelimo profil na tri dele; egerijski, badenijski in sarmatijski (ANIČIĆ & JURIŠA 1985a, b; sl. 2).

Za najobsežnejši spodnji, egerijski del je značilno menjavanje debelejših plasti peska in tanjših plasti melja, gline, laporja, peščenega laporja in glinastega laporja. Plasti litificiranih sedimentov so redkejše (tab. 1, sl. 1, 2). Po diskordanci, ki zaključuje spodnji del profila, so razvite badenijske plasti. Te začenjajo z bazalnim kremenovim konglomeratom, ki mu sledijo menjajoče se plasti kalkarenita ter bolj ali manj litificiranega laporovca in peščenega laporovca (tab. 2, sl. 1, 2). Profil se nato v krajši razdalji zaradi poraščenosti terena prekine. V zgornjem, sarmatijskem delu profila so na bazi razviti tankoplastnati laporasti apnenci, sledijo menjajoče se plasti laporja in laporovca ter v najvišjem delu plasti kalkarenita (tab. 3, sl. 1, 2).

Danes leži obravnavano področje na južnem pobočju Rudniške antiklinale oziroma na severnem pobočju Planinske sinklinale. Obe enoti uvrščamo v večjo geotektonsko enoto Posavskih gub (Aničić & Juriša 1985a, b).

Za preučevanje foraminifer v profilu sem vzorčila plasti gline, melja, laporja in slabše litificiranega laporovca. Vzdolž profila sem pobrala 61 vzorcev. Planktonske foraminifere do sedaj še niso bile raziskane, zato sem se osredotočila predvsem na to mikrofosilno skupino. Bentoške foraminifere sem določila večinoma le do stopnje rodu. Iz vzorcev sem izločila tudi fosilne ostanke drugih organizmov. Glede na zastopanost mikrofosilov v vzorcih sem določila geološko starost ter ocenila globino in slanost nekdanjega morja po posameznih odsekih profila (Oblak 2002).

DOSEDANJE MIKROPALEONTOLOŠKE RAZISKAVE

Dosedanje mikropaleontološke raziskave sedimentov in sedimentnih kamnin so pokazale, da so mikrofosili v profilu bogato zastopani. Glede na vsebnost teh mikrofosilov so bile določene natančne geološke starosti posameznih delov profila.

Foraminifere, predvsem bentoške, je v profilu Plohov breg raziskovala že Rijavčeva (1977). Plasti najnižjega dela profila je na osnovi vrste *Planularia kubinyii* uvrstila v spodnji egerij. V višjih egerijskih plasteh omenjena vrsta izgine, zato jim avtorica pripisuje zgornjeegerijsko starost. Nižje badenijske plasti so po podvrsti *Uvigerina aculeata aculeata* in številnih nodosariidah uvrščene v spodnji badenij, v biocono *Praeorbulina* in *Orbulina suturalis*. Višje plasti naj bi glede na prisotnost podvrste *Uvigerina semiornata semiornata* in vrste *Orbulina suturalis* pripadale srednjebadenijski bioconi "peščenih hišic". Nižjim sarmatijskim plastem je Rijavčeva na podlagi vrste *Cibicides badenensis* določila spodnjesarmatijsko starost, in sicer prvo sarmatijsko biocono *Cibicides badenensis*. V najvišjih plasteh profila, kjer luknjičarke niso bile opažene, dokazuje sarmatijsko starost školjka ervilija.

Pavšič in Aničić (1998, 1999) sta v profilu obdelala kalcitni nanoplankton. Celotnemu spodnjemu delu profila sta na osnovi vrst *Cyclicargolithus abisectus, Helicosphaera euphratis* in *Reticulofenestra lockeri* pripisala zgornjeegerijsko starost (biocona NN1 - NN2). Tu so prisotne še presedimentirane kredne, paleocenske in eocenske vrste. Badenijsko nanofloro uvrščata avtorja v biocono NN5 (spodnji badenij). Najvišje plasti profila so glede na prisotno nanofloro najverjetneje sarmatijske starosti (biocona NN8). Natančnejša datacija zaradi odsotnosti značilnih vrst ni možna. V teh plasteh se pojavljajo tudi številne presedimentirane zgornjeoligocenske in spodnjemiocenske vrste.

Omenjena avtorja sta nekoliko kasneje (1999) podrobneje raziskala 2,5 metrski interval egerijskih sedimentov, kjer sta predhodno odkrila močno povečano koncentracijo brakičnih oportunističnih vrst *Braarudosphaera bigelowi* in *Micrantholithus vesper*.

PALEONTOLOŠKI DEL
Razporeditev mikrofosilov vzdolž profila (sl. 3, 4)

Egerijske plasti

Diverziteta in pogostnost luknjičark sta največji v vzorcih najnižjih (4-7) in najvišjih (40-42) egerijskih plasti. V vzorcih vmesnih plasti so hišice maloštevilne ali jih ni.

V najnižjih plasteh je ohranjenost skeletov slaba; hišice so pogosto poškodovane in deformirane. Delež planktonskih foraminifer je visok. Zelo številčna je vrsta *Globigerinella megaperta*, prav tako bentoški rodovi *Ammodiscus, Glomospira, Spiroplectammina, Lenticulina, Bolivina, Bulimina, Sphaeroidina, Siphonina, Cibicides, Melonis, Almaena, Gyroidinoides*, nodosariide, nedoločene aglutinirane in porcelanaste (haverinide in spirolokuline) foraminifere. Od ostalih fosilov sem v vzorcih našla bodice morskih ježkov, ostrakodne lupinice, lupinice juvenilnih polžev in školjk, ribje zobe in otolite.

V večini vzorcev sledečih plasti so planktonske foraminifere, nodosariide in fosilni ostanki ostalih organizmov odsotni. Diverziteta bentoških foraminifer je nizka in omejena predvsem na aglutinirane vrste. Izjema so vzorci 23, 27 in 40-42, kjer sta diverziteta in abundanca povečani. V teh vzorcih se ponovno pojavijo planktonske foraminifere, med njimi podvrsta *Globigerina woodi connecta*, in bodice morskih ježkov. V vzorcih 42 in 45 sem opazila hišici vrste *Globigerina tarchanensis*.

Badenijske plasti

V badenijskih vzorcih se številčnost mikrofosilov močno poveča. Delež planktonskih foraminifer je visok. V vzorcu 47 prevladuje vrsta *G. tarchanensis*, našla pa sem tudi maloštevilne skelete, ki pripadajo vrsti *Globigerinoides quadrilobatus*. V vzorcih 54 in 55 se prvič pojavijo rodovi *Globorotalia, Orbulina* in *Praeorbulina*.

Med bentoškimi foraminiferami so z največjo diverziteto in abundanco v vseh treh badenijskih vzorcih zastopani cibicidi, bolivine in nodosariide. Porcelanaste in aglutinirane hišice so zelo maloštevilne.

Pogoste so bodice in ostanki koron morskih ježkov, ostrakodne lupinice in kalcitne spikule, v vzorcu 54 pa je bil najden tudi ribji zob.

Sarmatijske plasti

Abundanca in diverziteta foraminifer v sarmatijskih vzorcih sta glede na predhodne badenijske vzorce močno zmanjšani. Čeprav so planktonske foraminifere na področju Para-

tetide za to geološko obdobje neznačilne, sem v vzorcu 57 našla hišico vrste *Globigerina tarchanensis* in hišico, ki pripada neki drugi globigerini. V vzorcih 59 in 60 so planktonske foraminifere zelo množično zastopane.

Zastopanost bentoških foraminifer se od vzorca do vzorca precej razlikuje. Diverziteta je, neupoštevaje vzorca 59 in 60 (glej poglavje *Zaključki*), nizka, medtem ko so nekateri rodovi v posameznih vzorcih zelo abundančni; na primer *Elphidium* v vzorcu 56, *Cibicides* v vzorcih 57, 58 in morda 61 ter *Ammonia* v vzorcu 61.

Od ostalih fosilov se pojavljajo bodice morskih ježkov v vzorcih 59 in 60, ostrakodne lupinice in skolekodonti v vzorcu 56, ribji zobje v vzorcu 58 in kalcitne spikule v vzorcu 59.

ZAKLJUČKI

V vzorcih preučenega profila je med planktonskimi foraminiferami po številu vrst in hišic najštevilčneje zastopan rod *Globigerina*. Zelo pogoste so foraminifere rodov *Globorotalia* in *Globigerinoides*, ki pripadajo vsaj trem vrstam ter roda *Globigerinella*, ki pripadajo vsaj eni vrsti. Pogoste so še foraminifere rodov *Orbulina* in *Globoquadrina* z vsaj po eno vrsto, medtem ko so foraminifere roda *Praeorbulina* manj pogoste. Med bentoškimi foraminiferami so zelo številčne aglutinirane oblike, prav tako nodosariide, bolivine, bulimine, uvigerine, cibicidi, almaene in elfidiji.

Starost plasti večinoma sovpada z dosedanjimi ugotovitvami. Obsežen spodnji del profila je egerijske starosti (biocona *Globigerina ciperoensis ciperoensis* Bizon & Bizon; Bizon & Bizon 1972). Najnižje plasti teh sedimentov (vzorci 4-9) uvrščam na osnovi planktonske vrste *Globigerinella megaperta* v spodnji egerij (biocona P22 Berggren et al.; Berggren et al. 1995), medtem ko pripisujem višjim plastem (vzorci 11-41) glede na odsotnost vrste *G. megaperta* in prisotnost podvrste *Globigerina woodi connecta* zgornjemu egeriju (biocona M1 Berggren et al.). V krajšem delu profila nad temi plastmi (vzorci 42-46) se pojavlja planktonska vrsta *Globigerina tarchanensis*, ki nakazuje eggenburgijsko starost (biocona *Globigerinoides altiaperturus - Catapsydrax dissimilis* Bizon & Bizon; biocona M2 in M3 Berggren et al.). Našla sem le dve hišici omenjene vrste, poleg tega v vzorcu ni drugih značilnih vrst, zato določena starost ni povem zanesljiva.

V srednjem delu profila se pojavijo nekatere značilne badenijske vrste; *Globorotalia transsylvanica, Globoquadrina altispira, Globigerina regularis, Globigerinoides quadrilobatus, Orbulina suturalis* in *Praeorbulina glomerosa*. Glede na to, da se *G. quadrilobatus* pojavi že v vzorcu 47 in da so v vzorcih 54 in 55 hkrati prisotne vrste *G. regularis, G. bisphericus, O. suturalis* in *P. glomerosa* ter bentoška vrsta *Vaginulinopsis pedum* (vzorec 54; Petrica et al. 1995), uvrščam celoten del v mlajši spodnji badenij (biocona *Orbulina suturalis* Bizon & Bizon, biocona M6 Berggren et al., »lagenidna cona« Grill 1943 (Papp et al. 1978a)).

Plastem najvišjega dela profila (vzorci 56-60) pripisujem na osnovi bentoških vrst *Elphidium aculeatum* in *Schackoinella imperatoria* (Brestenska 1974) spodnjesarmatijsko starost (biocona *Globorotalia menardii* Bizon & Bizon). V vzorcih 59 in 60 prevladujejo sicer presedimentirane badenijske foraminifere, vendar dokazujeta vrsta *Elphidium aculeatum* in stratigrafski položaj obeh vzorčnih mest spodnjesarmatijsko starost. V najvišji vzorčeni plasti,

61, so luknjičarke številne, kar dokazuje, da gre še vedno za sarmatijske sedimente. Značilne vrste, s katero bi lahko določila natančnejšo starost, nisem zasledila.

Glede na visok delež (vzorci 4-9) globokovodnih indikatorjev, kot so nodosariide in bulimine (CHERIF et al. 1994) ter morskih indikatorjev, kot so uvigerine (RIJAVEC 1978), planktonske foraminifere in bodice morskih ježkov, je bilo okolje na tem prostoru v spodnjem egeriju morsko in globlje. Upad pogostnosti globokomorskih foraminifer ter povečanje pogostnosti aglutiniranih luknjičark v zgornjem egeriju in morebitnem eggenburgiju (vzorci 11-46) kažeta na poplitvenje morja. V badenijskih kamninah je delež globokomorske favne zelo visok, zato sklepam na znatno poglobitev morja v tem času. Odsotnost nodosariid, uvigerin, planktonskih luknjičark in morskih ježkov ter množično prisotnost luknjičarskih rodov *Ammonia* in *Elphidium* v najvišjih plasteh profila dokazujeta, da se je slanost morja v spodnjem sarmatiju znižala. Podobne paleoekološke razmere sta predpostavila že PLENIČAR in NOSAN (1958), ki trdita, da se je zaradi tektonike na začetku in v sredini badenija morje na širšem področju Slovenije poglobilo. Na začetku sarmatija se je povezava med Tetido in Paratetido prekinila, zaradi česar je začela Paratetida plitveti in se oslajevati.

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PLATE 1 – TABLA 1

Fig. 1 Outcropping of Egerian beds (sampling localities 17-20).
Sl. 1 Izdanjanje egerijskih plasti (vzorčna mesta 17-20).

Fig. 2 Alternated marlstones (arrowed) and sands; Egerian (sampling locality 19).
Sl. 2 Menjavanje plasti laporovca (označeno) in peska; egerij (vzorčno mesto 19).

PLATE 1 – TABLA 1

1



2

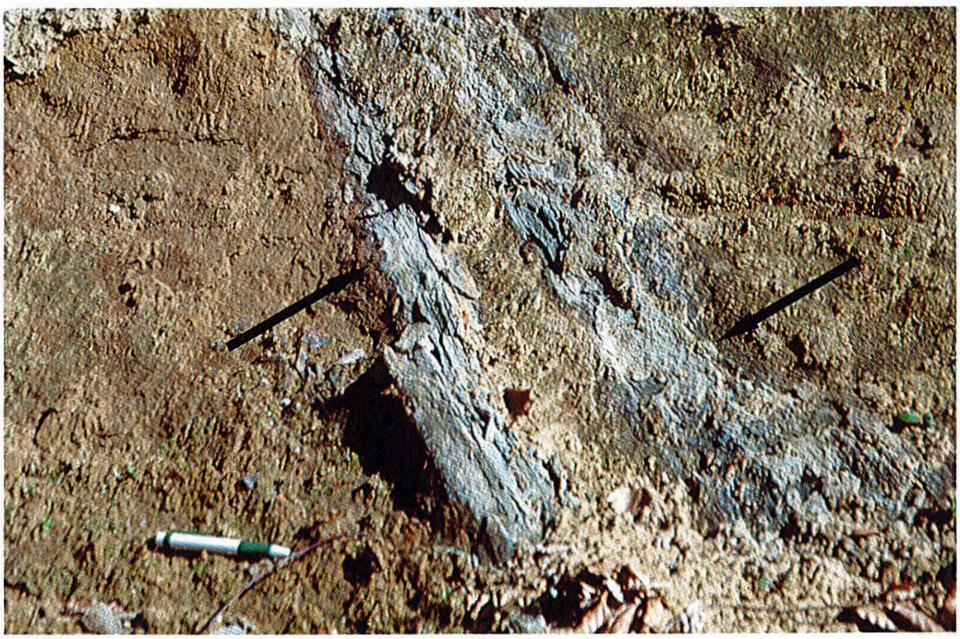


PLATE 2 – TABLA 2

Fig. 1 Outcropping of Badenian beds (sampling localities 48 and 49).
Sl. 1 Izdanjanje badenijskih plasti (vzorčni mesti 48 in 49).

Fig. 2 Alternated marlstones and calcarenites (brighter) (sampling locality 52).
Sl. 2 Menjavanje plasti laporovca in kalkarenita (svetlejši) (vzorčno mesto 52).

PLATE 2 – TABLA 2

1



2



PLATE 3 – TABLA 3

Fig. 1 Outcropping of Sarmatian beds.
Sl. 1 Izdanjanje sarmatijskih plasti.

Fig. 2 Alternated marls, marlstones and calcarenits (arrowed); Sarmatian (sampling locality 61).
Sl. 2 Menjavanje plasti laporja, laporovca in kalkarenita (označeno); sarmatija (vzorčno mesto 61).

PLATE 3 – TABLA 3

1



2

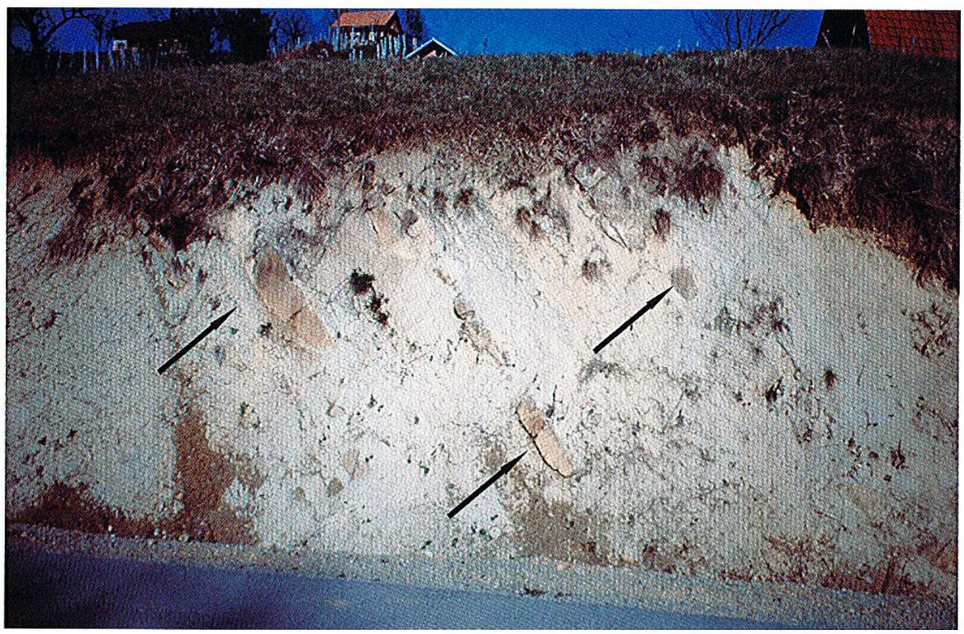


PLATE 4 – TABLA 4

Fig. 1 *Globorotalia acrostoma* Wezel, spiral side; 54
Sl. 1 *Globorotalia acrostoma* Wezel, spiralna stran; 54

Fig. 2 *G. acrostoma* Wezel, umbilical side; 54
Sl. 2 *G. acrostoma* Wezel, umbilikalna stran; 54

Fig. 3 *G. acrostoma* Wezel, lateral view; 54
Sl. 3 *G. acrostoma* Wezel, pogled s strani; 54

Fig. 4 *G. acrostoma* Wezel, test surface; specimen from fig. 1
Sl. 4 *G. acrostoma* Wezel, površina hišice; primerek s sl. 1

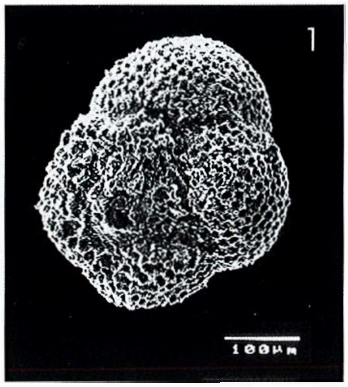
Fig. 5 *Globorotalia mayeri* Cushman & Ellisor, spiral side; 54
Sl. 5 *Globorotalia mayeri* Cushman & Ellisor, spiralna stran; 54

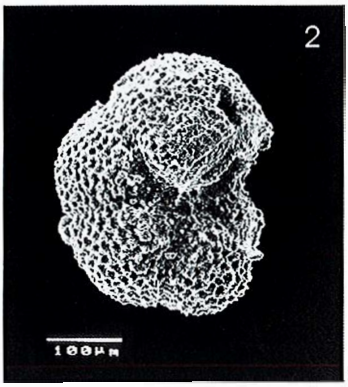
Fig. 6 *G. mayeri* Cushman & Ellisor, umbilical side; 54
Sl. 6 *G. mayeri* Cushman & Ellisor, umbilikalna stran; 54

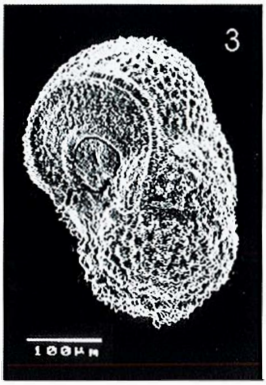
Fig. 7 *G. mayeri* Cushman & Ellisor, lateral view; 54
Sl. 7 *G. mayeri* Cushman & Ellisor, pogled s strani; 54

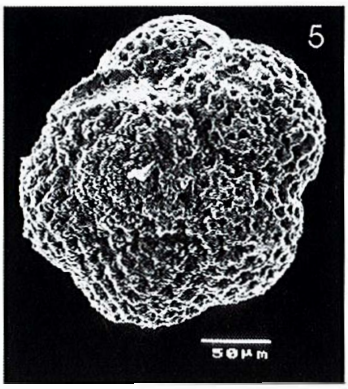
Fig. 8 *G. mayeri* Cushman & Ellisor, test surface; specimen from fig. 5
Sl. 8 *G. mayeri* Cushman & Ellisor, površina hišice; primerek s sl. 5

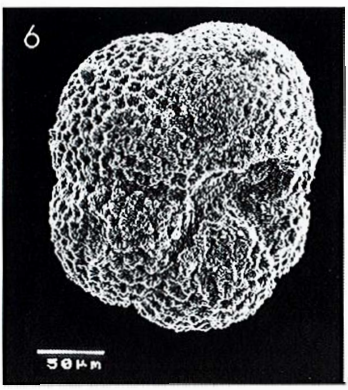
PLATE 4 – TABLA 4

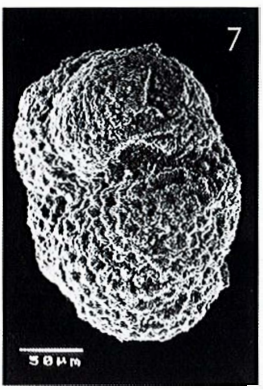


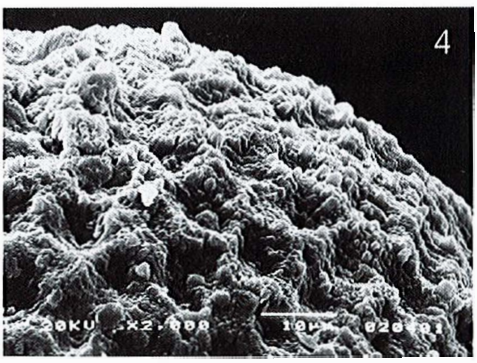












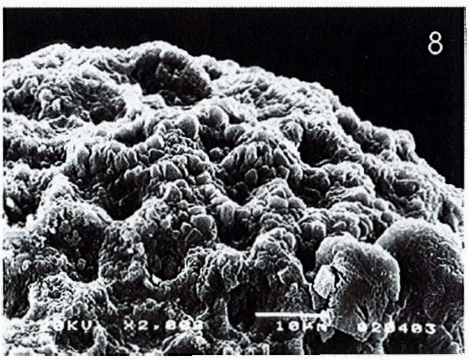


PLATE 5 – TABLA 5

Fig. 1 *Globorotalia transsylvanica* Popescu, spiral side; 54
Sl. 1 *Globorotalia transsylvanica* Popescu, spiralna stran; 54

Fig. 2 *G. transsylvanica* Popescu, umbilical side; 54
Sl. 2 *G. transsylvanica* Popescu, umbilikalna stran; 54

Fig. 3 *G. transsylvanica* Popescu, lateral view; 54
Sl. 3 *G. transsylvanica* Popescu, pogled s strani; 54

Fig. 4 *G. transsylvanica* Popescu, test surface; 54
Sl. 4 *G. transsylvanica* Popescu, površina hišice; 54

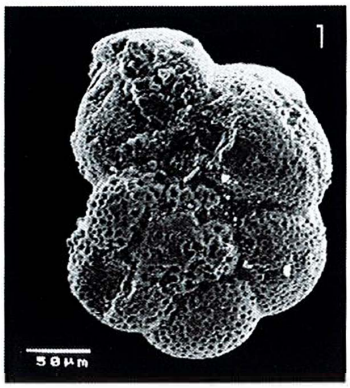
Fig. 5 *Globoquadrina altispira* (Cushman & Jarvis), spiral side; 54
Sl. 5 *Globoquadrina altispira* (Cushman & Jarvis), spiralna stran; 54

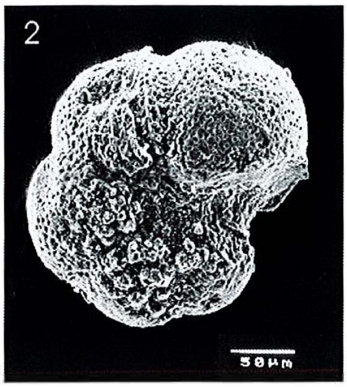
Fig. 6 *G. altispira* (Cushman & Jarvis), umbilical side; 54
Sl. 6 *G. altispira* (Cushman & Jarvis), umbilikalna stran; 54

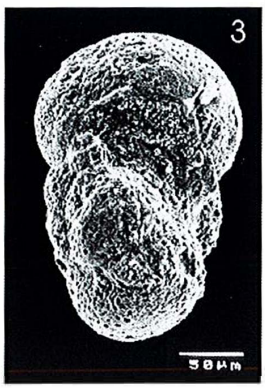
Fig. 7 *G. altispira* (Cushman & Jarvis), lateral view; 54
Sl. 7 *G. altispira* (Cushman & Jarvis), pogled s strani; 54

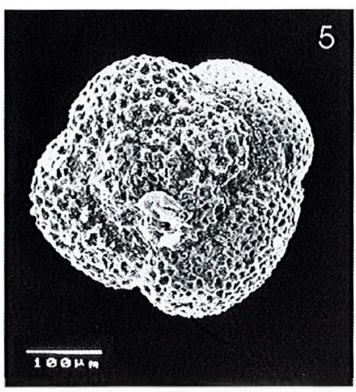
Fig. 8 *G. altispira* (Cushman & Jarvis), test surface; specimen from fig. 5
Sl. 8 *G. altispira* (Cushman & Jarvis), površina hišice; primerek s sl. 5

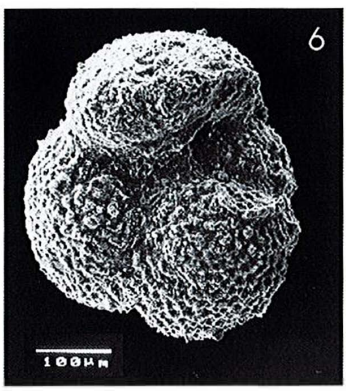
PLATE 5 – TABLA 5

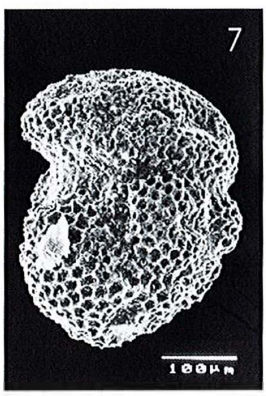


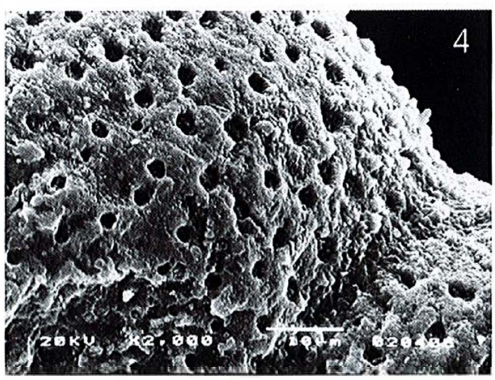












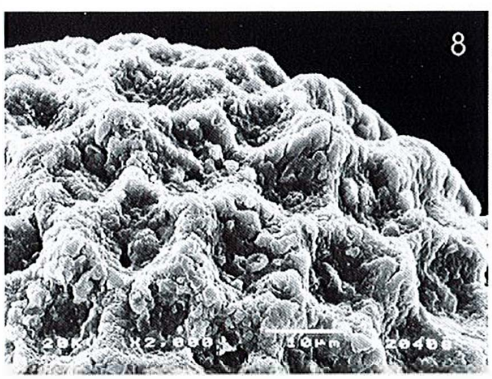


PLATE 6 – TABLA 6

Fig. 1 *Globigerina praebulloides* Blow, spiral side; 54
Sl. 1 *Globigerina praebulloides* Blow, spiralna stran; 54

Fig. 2 *G. praebulloides* Blow, umbilical side; 54
Sl. 2 *G. praebulloides* Blow, umbilikalna stran; 54

Fig. 3 *G. praebulloides* Blow, lateral view; 54
Sl. 3 *G. praebulloides* Blow, pogled s strani; 54

Fig. 4 *G. praebulloides* Blow, test surface; specimen from fig. 1
Sl. 4 *G. praebulloides* Blow, površina hišice; primerek s sl. 1

Fig. 5 *Globigerina regularis* d'Orbigny, spiral side; 54
Sl. 5 *Globigerina regularis* d'Orbigny, spiralna stran; 54

Fig. 6 *G. regularis* d'Orbigny, umbilical side; 54
Sl. 6 *G. regularis* d'Orbigny, umbilikalna stran; 54

Fig. 7 *G. regularis* d'Orbigny, lateral view; 54
Sl. 7 *G. regularis* d'Orbigny, pogled s strani; 54

Fig. 8 *G. regularis* d'Orbigny, test surface; specimen from fig. 5
Sl. 8 *G. regularis* d'Orbigny, površina hišice; primerek s sl. 5

Errata corrige
Popravi številke samo na slikah:
Številke 1 do 4 = 5 do 8 in 5 do 8 = 1 do 4
Numbers on Figures should be corrected as follows:
1 to 4 = 5 to 8 and 5 to 8 = 1 to 4

PLATE 6 – TABLA 6

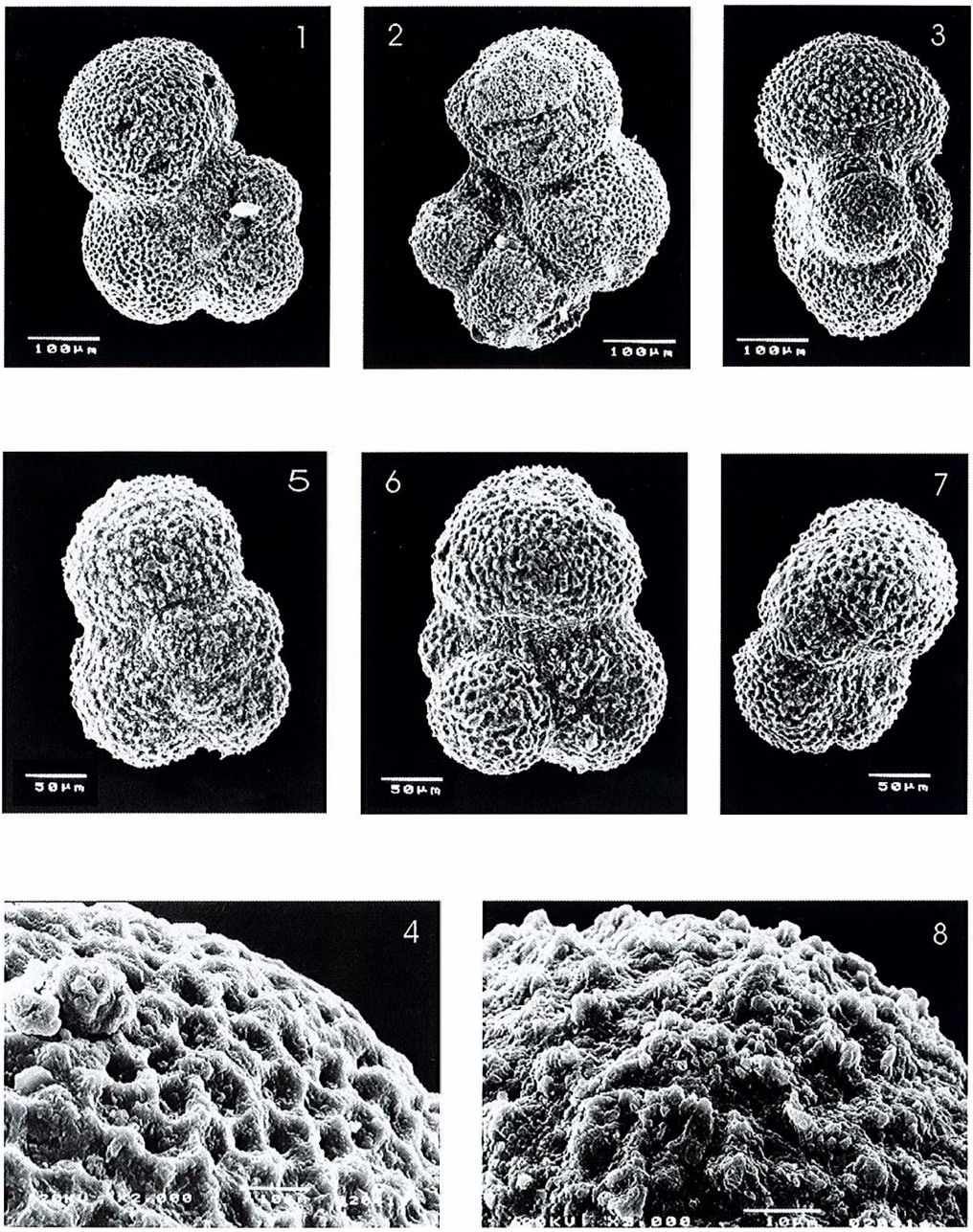


PLATE 7 – TABLA 7

Fig. 1 *Globigerina woodi connecta* Jenkins, spiral side; 27
Sl. 1 *Globigerina woodi connecta* Jenkins, spiralna stran; 27

Fig. 2 *G. woodi connecta* Jenkins, umbilical side; 27
Sl. 2 *G. woodi connecta* Jenkins, umbilikalna stran; 27

Fig. 3 *G. woodi connecta* Jenkins, test surface; specimen from fig. 1
Sl. 3 *G. woodi connecta* Jenkins, površina hišice; primerek s sl. 1

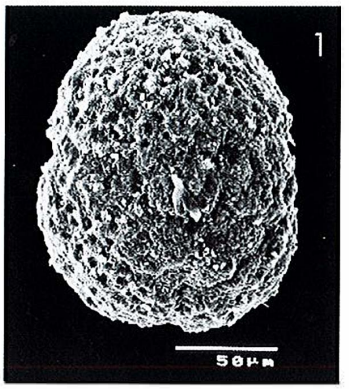
Fig. 4 *Globigerina* cf. *woodi connecta* Jenkins, spiral side; 23
Sl. 4 *Globigerina* cf. *woodi connecta* Jenkins, spiralna stran; 23

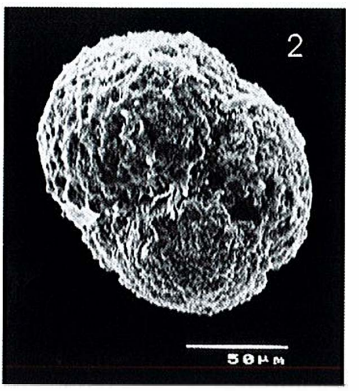
Fig. 5 *G.* cf. *woodi connecta* Jenkins, umbilical side; 23
Sl. 5 *G.* cf. *woodi connecta* Jenkins, umbilikalna stran; 23

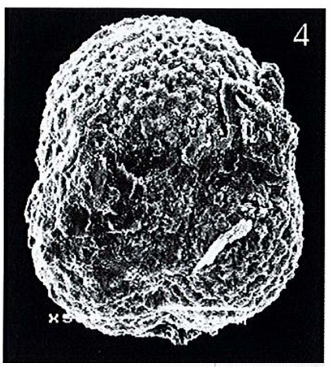
Fig. 6 *G.* cf. *woodi connecta* Jenkins, lateral view; 23
Sl. 6 *G.* cf. *woodi connecta* Jenkins, pogled s strani; 23

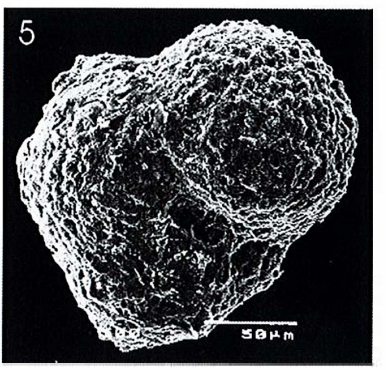
Fig. 7 *G.* cf. *woodi connecta* Jenkins, test surface; specimen from fig. 5
Sl. 7 *G.* cf. *woodi connecta* Jenkins, površina hišice; primerek s sl. 5

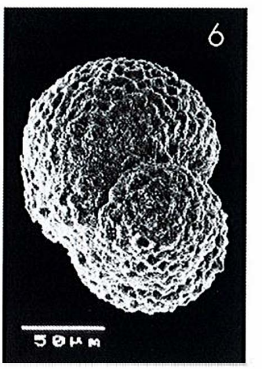
PLATE 7 – TABLA 7













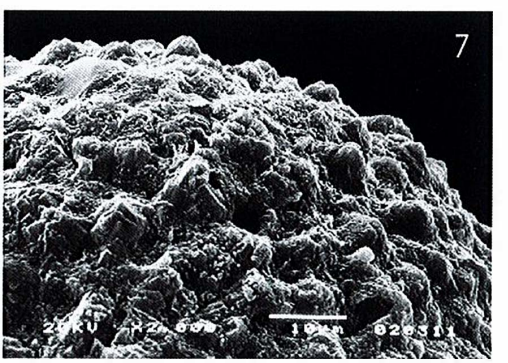


PLATE 8 – TABLA 8

Fig. 1 *Globigerina tarchanensis* Subbotina & Chutzieva, spiral side; 54
Sl. 1 *Globigerina tarchanensis* Subbotina & Chutzieva, spiralna stran; 54

Fig. 2 *G. tarchanensis* Subbotina & Chutzieva, umbilical side; 54
Sl. 2 *G. tarchanensis* Subbotina & Chutzieva, umbilikalna stran; 54

Fig. 3 *G. tarchanensis* Subbotina & Chutzieva, lateral view; 54
Sl. 3 *G. tarchanensis* Subbotina & Chutzieva, pogled s strani; 54

Fig. 4 *G. tarchanensis* Subbotina & Chutzieva, test surface; specimen from fig. 1
Sl. 4 *G. tarchanensis* Subbotina & Chutzieva, površina hišice; primerek s sl. 1

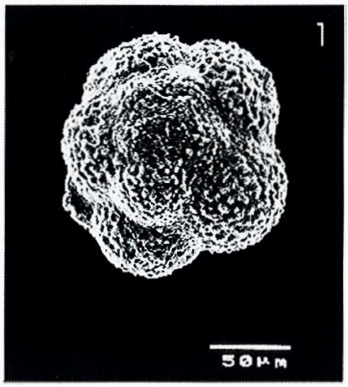
Fig. 5 *Globigerinella megaperta* Rögl, umbilical side; 6
Sl. 5 *Globigerinella megaperta* Rögl, umbilikalna stran; 6

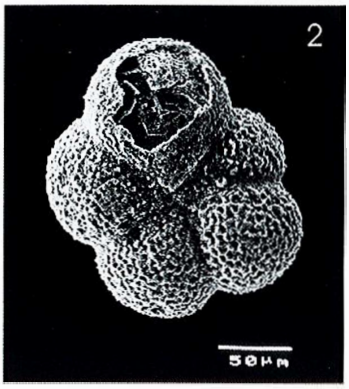
Fig. 6 *G. megaperta* Rögl, ?umbilical side; 6
Sl. 6 *G. megaperta* Rögl, ?umbilikalna stran; 6

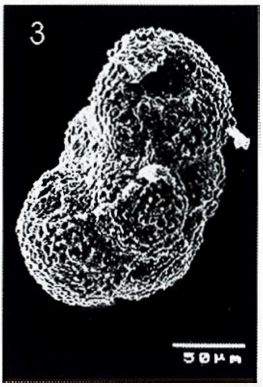
Fig. 7 *G. megaperta* Rögl, lateral view; 6
Sl. 7 *G. megaperta* Rögl, pogled s strani; 6

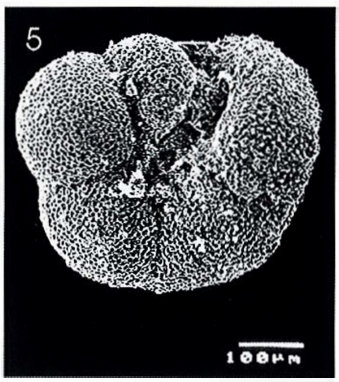
Fig. 8 *G. megaperta* Rögl, test surface; specimen from fig. 5
Sl. 8 *G. megaperta* Rögl, površina hišice; primerek s sl. 5

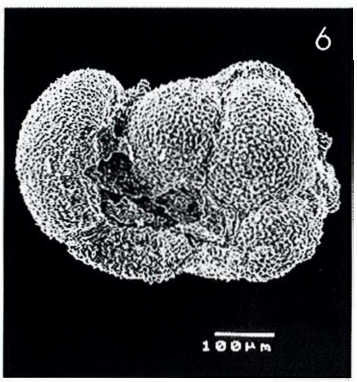
PLATE 8 – TABLA 8

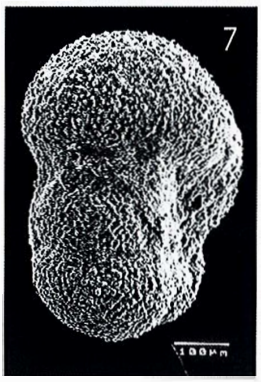


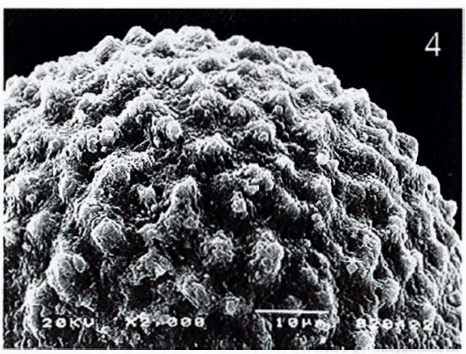












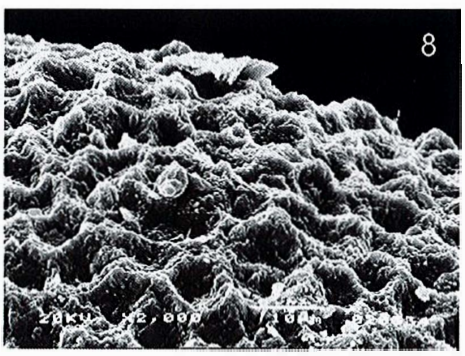


PLATE 9 – TABLA 9

Fig. 1 *Globigerinoides bisphericus* Todd, spiral side; 54
Sl. 1 *Globigerinoides bisphericus* Todd, spiralna stran; 54

Fig. 2 *G. bisphericus* Todd, umbilical side; 54
Sl. 2 *G. bisphericus* Todd, umbilikalna stran; 54

Fig. 3 *G. bisphericus* Todd, lateral view; 54
Sl. 3 *G. bisphericus* Todd, pogled s strani; 54

Fig. 4 *G. bisphericus* Todd, test surface; specimen from fig. 3
Sl. 4 *G. bisphericus* Todd, površina hišice; primerek s sl. 3

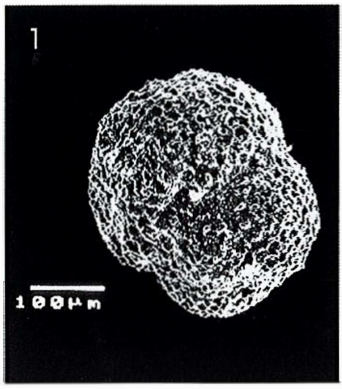
Fig. 5 *Globigerinoides quadrilobatus* (d'Orbigny), spiral side; 59
Sl. 5 *Globigerinoides quadrilobatus* (d'Orbigny), spiralna stran; 59

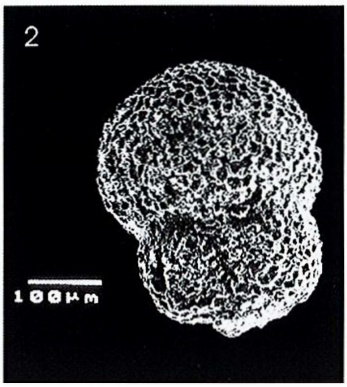
Fig. 6 *G. quadrilobatus* (d'Orbigny), umbilical side; 59
Sl. 6 *G. quadrilobatus* (d'Orbigny), umbilikalna stran; 59

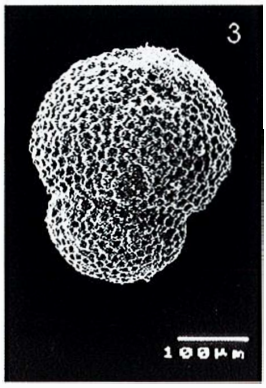
Fig. 7 *G. quadrilobatus* (d'Orbigny), lateral view; 59
Sl. 7 *G. quadrilobatus* (d'Orbigny), pogled s strani; 59

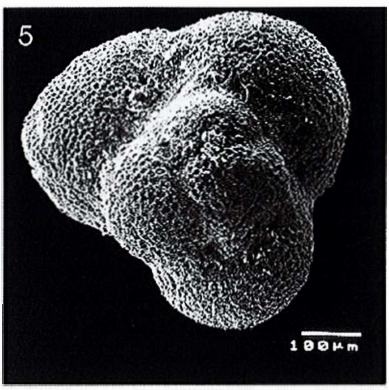
Fig. 8 *G. quadrilobatus* (d'Orbigny), test surface; specimen from fig. 5
Sl. 8 *G. quadrilobatus* (d'Orbigny), površina hišice; primerek s sl. 5

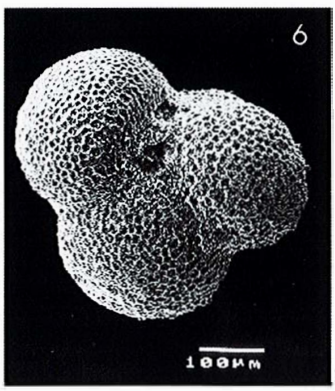
PLATE 9 – TABLA 9

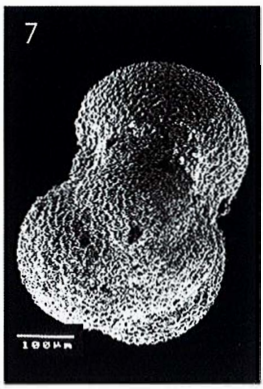














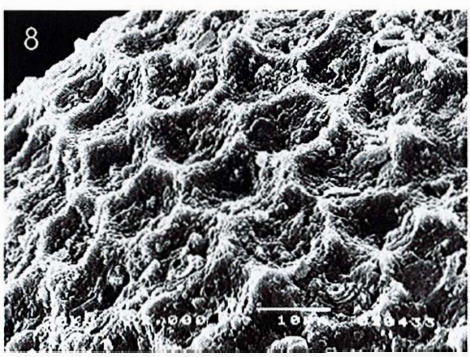


PLATE 10 – TABLA 10

Fig. 1 *Orbulina suturalis* Brönnimann, spiral side; 60
Sl. 1 *Orbulina suturalis* Brönnimann, spiralna stran; 60

Fig. 2 *O. suturalis* Brönnimann, lateral view; 60
Sl. 2 *O. suturalis* Brönnimann, pogled s strani; 60

Fig. 3 *O. suturalis* Brönnimann, lateral view; 60
Sl. 3 *O. suturalis* Brönnimann, pogled s strani; 60

Fig. 4 *O. suturalis* Brönnimann, test surface; specimen from fig. 2
Sl. 4 *O. suturalis* Brönnimann, površina hišice; primerek s sl. 2

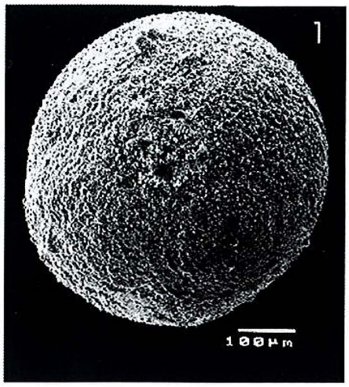
Fig. 5 *O. suturalis* Brönnimann, bilobate form, spiral side; 60
Sl. 5 *O. suturalis* Brönnimann, bilobate form, spiralna stran; 60

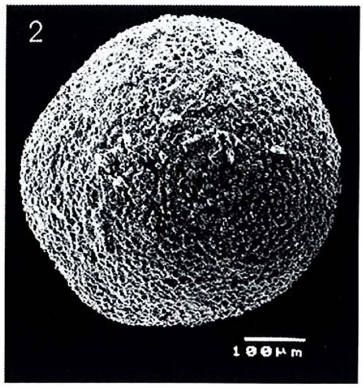
Fig. 6 *O. suturalis* Brönnimann, bilobate form, view from the prelast to the last chamber; 60
Sl. 6 *O. suturalis* Brönnimann, bilobatna oblika, pogled od predzadnje proti zadnji kamrici; 60

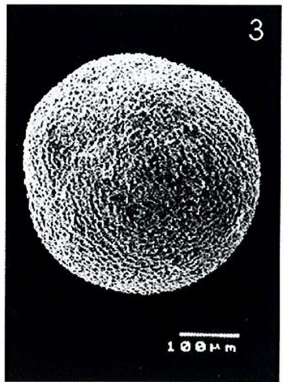
Fig. 7 *O. suturalis* Brönnimann, bilobate form, lateral view; 60
Sl. 7 *O. suturalis* Brönnimann, bilobatna oblika, pogled s strani; 60

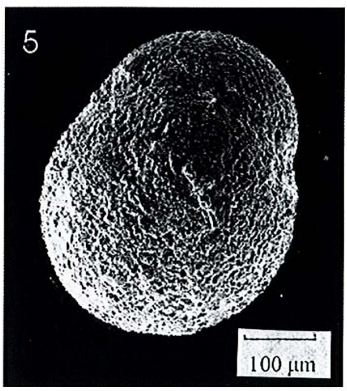
Fig. 8 *O. suturalis* Brönnimann, bilobate form, test surface; specimen from fig. 5
Sl. 8 *O. suturalis* Brönnimann, bilobatna oblika, površina hišice; primerek s sl. 5

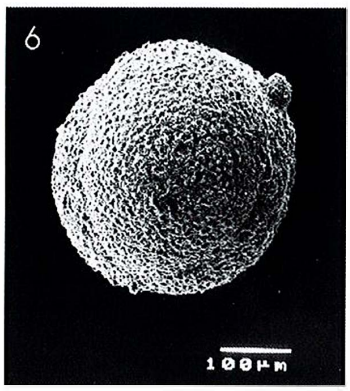
PLATE 10 – TABLA 10

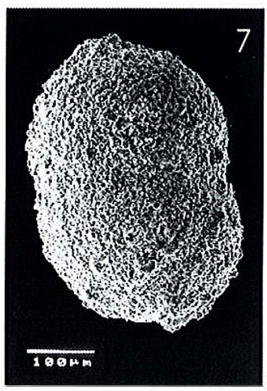














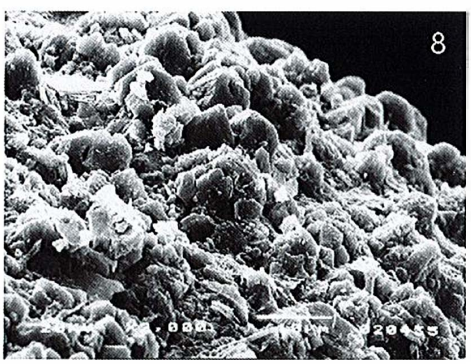


PLATE 11 – TABLA 11

Fig. 1 *Globigerinoides trilobus* (Reuss), spiral side; 59
Sl. 1 *Globigerinoides trilobus* (Reuss), spiralna stran; 59

Fig. 2 *G. trilobus* (Reuss), umbilical side; 59
Sl. 2 *G. trilobus* (Reuss), umbilikalna stran; 59

Fig. 3 *G. trilobus* (Reuss), lateral view; 59
Sl. 3 *G. trilobus* (Reuss), pogled s strani; 59

Fig. 4 *G. trilobus* (Reuss), test surface; specimen from fig. 1
Sl. 4 *G. trilobus* (Reuss), površina hišice; primerek s sl. 1

Fig. 5 *Praeorbulina glomerosa circularis* (Blow), spiral side; 60
Sl. 5 *Praeorbulina glomerosa circularis* (Blow), spiralna stran; 60

Fig. 6 *P. glomerosa circularis* (Blow), lateral view; 54
Sl. 6 *P. glomerosa circularis* (Blow), pogled s strani; 54

Fig. 7 *P. glomerosa circularis* (Blow), test surface; specimen from fig. 5
Sl. 7 *P. glomerosa circularis* (Blow), površina hišice; primerek s sl. 5

PLATE 11 – TABLA 11

