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Foraminifera and Ostracoda of the classic Callovian ammonite-rich bed of the Villány Mountains (Hungary)

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(with 3 figures and 3 plates)

This work presents the isolated microfauna association from two facies of the Middle Jurassic, condensed, iron oolitic, ammonite-rich bed of the Villány Mountains, southern Hungary. This is the first record of the isolated benthic foraminifera and ostracoda of this typical Bathonian-Middle Oxfordian condensed facies. The microfauna has been extracted by acetolysis from hard, indurated limestone. Altogether 30 foraminifera and 4 ostracod taxa are described in detail. The planktonic association is unique in diversity and preservation from the Callovian. The composition of benthic foraminifera and ostracod assemblages differs from the previously published Callovian faunas. This is probably due to the peculiar environment, the stromatolite-covered pelagic swell what they inhabited.

Introduction

During the Bathonian to Middle Oxfordian reduced carbonate sedimentation resulted in condensed levels with frequent sedimentary gaps in both epicontinental and epioceanic environments in the western Tethys. These sedimentary discontinuities appear in typical facies of hard limestones with hard-grounds and ferruginous ooids, oncolites or "snuff-box" nodules, often with stromatolites. Usually they are extremely rich in ammonites and belemnite rostra, and macroinvertebrates, as bivalves and brachiopods are occasionally also abundant. These limestones are dominantly characterized by biomicritic texture with large amount of thin, fragmented pelagic bivalve shells ("filaments", *Bositra* or *Paleotrix,* auct.) and planktonic foraminifera. Because of the "Lagerstätten" character of these layers macropaleontologists studied them for a long time and defined the age of the deposition. It is the base of all future sedimentological, taphonomical, palaeoenvironmental studies dealing with different aspects of their special sedimentological phenomena and their relation to tectonic processes of local and regional scale, as well as to eustatic and palaeoclimatic changes. In the last 25 years numerous papers were published about similar occurrences from several domains, including Spain, Switzerland, France and Poland (e.g. HUBER ET AL. 1987; GYGI & PERSOZ, 1987; NORRIS & HALLAM, 1995; COLLIN et al., 2005; RAIS et al., 2007; RAMAJO & AURELL, 2008; REOLID et al., 2008, 2010; NIETO et al., 2010). Recently, VÖRÖS (2010ab, 2012) published similar detailed studies about the occurrence in the Villány Mountains, Hungary.

The microfossils (foraminifera and ostracods) have been proven as very useful tools in palaeoenvironmental reconstructions. Despite of the extensive researches, knowledge about the microfossils of these layers is very poor and is based on identification from rock thin sections (e.g. OLÓRIZ et al., 2003; RAMAJO & AURELL, 2008; REOLID et al., 2008, 2010; NIETO et al., 2012; VÖRÖS, 2012), except NEAGU (1996). The reason is that the rocks are hard, indurated limestones from where microfauna cannot get free with traditional extraction methods. Ostracods cannot be identified in thin sections, and small benthic foraminifera can be usually classified only on genus level. Even for the family level identification of planktonic foraminifera the

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surface ornamentation of the wall as well as the shape of the aperture are fundamental criteria. Additionally, in this kind of rock, where the microfossil content is strongly inhomogeneous, estimating the quantity of specimens from thin rocks sections is uncertain. Thus the analysis of isolated forms is necessary for taxonomical as well as for palaeoecological purposes.

Hence, this present study is focused on isolated microfaunal elements extracted by acetolysis from the two different rock types of the classic Callovian ammonitic bed of the Villány Mountains. One type of is the "filament"-rich rock which can be found in the abandoned quarry on the Templom-hegy near Villány, which is the stratotype of the Villány Formation and of the Templomhegy Member within (VÖRÖS, 2010a,b). The other rock type is the iron oolitic limestone in the so-called Rózsa-bánya quarry on the Csukma Hill, near Siklós (Fig. 1).

Callovian small benthonic foraminifera and ostracod fauna of relatively thick, organic-rich clay/marl successions, isochronous with the condensed levels are well known for a long time worldwide: Great Britain (e.g. GORDON, 1967; BARNARD et al., 1981; COLEMAN, 1981; WHATLEY, 1970; SHIPP & MURRAY, 1981; MORRIS, 1982; MORRIS & COLEMAN, 1989; NAGY et al., 2001; WHATLEY et al., 2001); France (e.g. OERTLI, 1963; DÉPECHE, 1969); Germany (e.g. UHLIG 1883; BARTENSTEIN & BRAND, 1937; FRENTZEN, 1941; LUTZE, 1960; RIEGRAF, 1987, 1988; BEHER et al., 2010); Poland (e. g. BIELECKA, 1960; BIELECKA & STYK, 1981; OLSZEWSKA & WIECZOREK, 1988; OLEMPSKA & BŁASZYK, 2001); Netherlands (e. g. WITTE & LISSENBERG, 1994); Switzerland (WERNLI, 1971; PERSOZ & REMANE, 1973); Tunisia (METTE, 1995); Israel (ROSENFELD & HONIGSTEIN, 1991); Saudi Arabia (DÉPÈCHE et al., 1987); India (e.g. BHALLA & ABBAS, 1978; KALIA & CHOWDHURY, 1983; BHALLA & TALIB, 1991; KHOSLA et al., 1997; TALIB et al., 2007); Tanzania (BATE, 1975; KAREGA, 1992); Madagascar (GREKOFF, 1963; METTE & GEIGER, 2004); Alaska (TAPPAN, 1955); North America (LOEBLICH & TAPPAN, 1950); Argentina (BALLENT & WHATLEY, 2000); Russian Platform (e. g. LUBIMOVA 1955; PJATKOVA & PERMJAKOVA, 1978; TESAKOVA, 2003, 2008, 2009). These works focused on taxonomy and presented few quantitative analyses of faunas (e.g. BIELECZKA & STYK, 1981; MUNK 1978). Planktonic foraminifera are common in these rocks; abundance is up to 97%, but almost without exception, they are molds (e.g. FUCHS, 1973; MUNK, 1978; RIEGRAF, 1987, 1988). About the Callovian planktonic forms GÖRÖG & WERNLI (2003) gave a detailed review.

The main purpose of this work is to give detailed taxonomic description about the microfauna in isolated forms as well as in rock thin sections. Additional goal is to compare the microfossil assemblages of the two studied localities on the faunal basis of composition, abundance, dominance, diversity, lifestyle as well as preservation and size of the specimens. Comparisons will be also made with assemblages described from thin sections of other condensed "Lagerstätten" of the Bathonian to Middle Oxfordian stages.

Geological setting

The studied localities are situated in the Villány Mountains, which tectonically belong to the Villány zone of the Tisza Megatectonic Unit, within the intra-Carpathian region (CSONTOS & VÖRÖS, 2004; HAAS & PÉRÓ, 2004). The strongly condensed Middle Jurassic beds with the overlying Oxfordian limestones are outcropped in many parts of the Villány Mountains. The most complete Liassic-Middle Jurassic section can be studied in the large abandoned quarry at the top of the Templom-hegy (Templom Hill) (VÖRÖS, 1972, VÖRÖS, 2010ab, 2012). The studied ammonite-rich Callovian bed is the part of Upper Bathonian-Callovian Villány Formation (VÖRÖS, 2010ab, 2012) which is mentioned traditionally as "Ammonitenhorizont" (TILL, 1906), "Ammonitenschichten des Callovien" (LÓCZY, 1915) and "Banc à ammonites de Villány" (GÉCZY, 1971). Recently VÖRÖS (2010a b, 2012) published the history of the researches of the Templom-hegy and gave detailed description of the formations with sedimentary cycles, palaeotectonics and subsidence history. Thus, in this work we present shortly the Jurassic sequences of the Templom-hegy quarry focusing on the Callovian bed (Fig. 1).

The Villány Formation follows, with a great hiatus, the Lower Pliensbachian Somsichhegy Limestone in the section of this quarry. The exceptionally condensed Middle Jurassic bed (up to 50 cm) starts with a few centimeter thick yellowish-brown or grey Bathonian limestone bearing unrounded quartz grains and tiny dolomite fragments. The majority of fossils are ammonites with some nautiloids and belemnites (VÖRÖS, 1972, 2012; GÉCZY & GALÁCZ, 1998). The Lower

Callovian limestone with limonite-encrusted clasts, quartz and dolomitic grains is a greenish brown, discontinuous bed or infillings on the surface of earlier beds (GÉCZY & GALÁCZ, 1998). The classical Middle to Upper (?) Callovian ammonite-rich limestone layer has relatively large thickness (25-30 cm) in this section compared to other occurrences in the Villány Mountains. RADWAŃSKI & SZULCZEWSKI (1965, 1966), VÖRÖS (1972) and GÉCZY & GALÁCZ (1998) distinguished three horizons within this main fossiliferous bed.

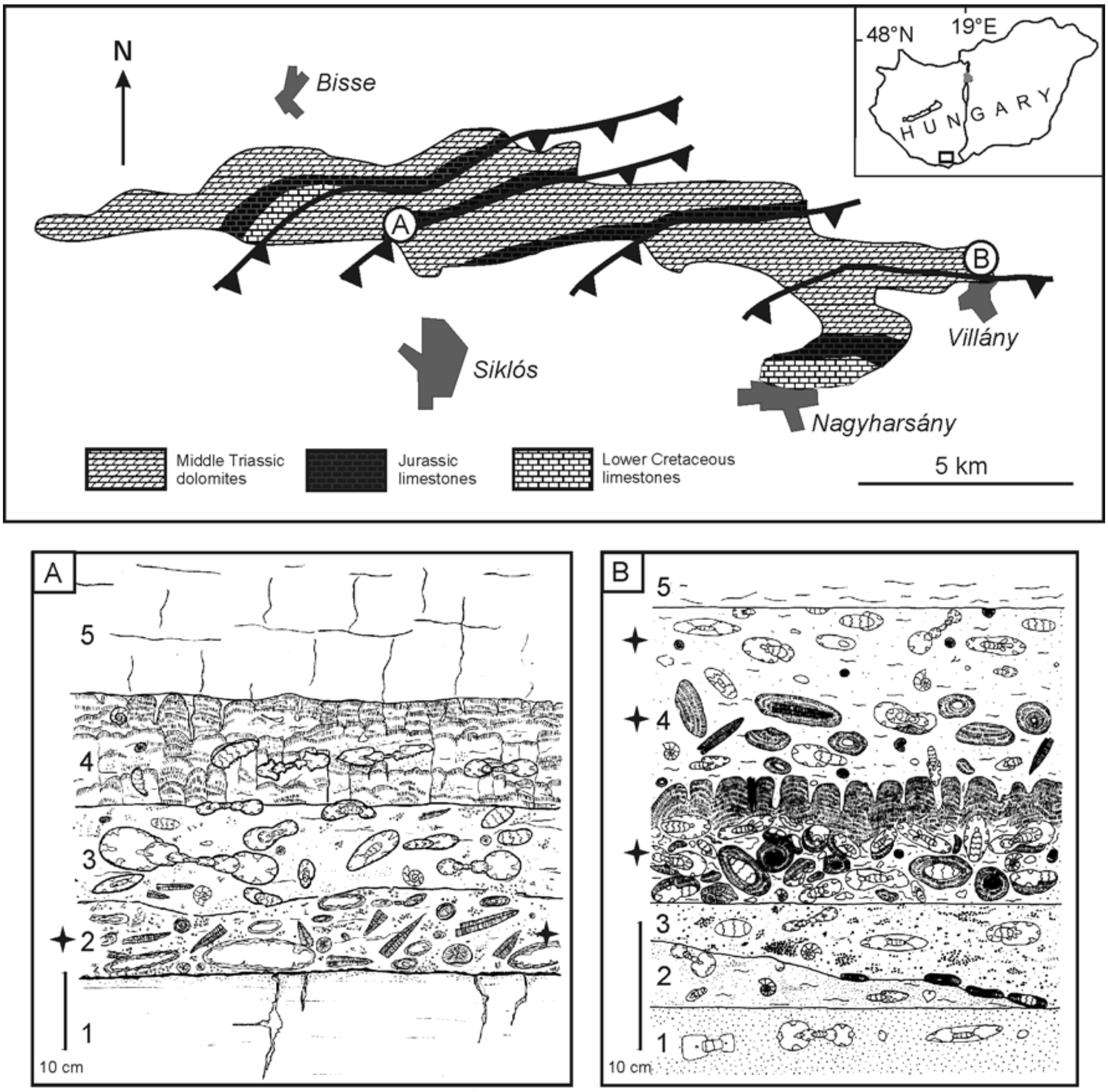

Fig. 1. Geological sketch map of Villány Hills indicating location of the studied outcrops. Callovian sections of Rózsa-bánya quarry (A) and Templom-hegy quarry (B) with the position of studied samples (modified after GÉCZY and GALÁCZ (1998), GALÁCZ (2007) and VÖRÖS (2011)). Rózsa-bánya quarry: 1 – Anisian (Middle Triassic) Csukma Dolomite, 2 – 4 Middle Jurassic ammonite-rich bed (Villány Formation), 2 – concretions and oolites bearing bed with belemnites, 3 – ammonite-rich layer, 4 – bed with stromatolites, 5 – Upper Jurassic Szársomlyó Limestone; Templom-hegy quarry: 1 – Pliensbachian (Lower Jurassic) Somsich-hegy Limestone, 2 – 4 Villány Formation, 2 – Bathonian sandy limestone , 3 – Lower Callovian ferruginous ooid bearing limestone, 4 – Middle and Upper (?) Callovian stromatolite and ammonite bearing layer, 5 – Oxfordian limestone (Szársomlyó Limestone).

The lower and upper horizons are light-colored limestones with biomicrite texture bearing filaments and stromatolitic oncoids with ammonite shells or belemnite rostra in their cores. The middle part (~5 cm) is more or less continuous hemispheroidal stromatolite mat with polygonal surface. Descriptions and interpretations about the extremely diverse and rich Callovian ammonite fauna of the Templom-hegy quarry were given by TILL (1910-1911), LÓCZY (1915), AGER & CALLOMON (1971) and GÉCZY (1982, 1984). Based on the ammonites the Callovian part of the Villány Formation (Templomhegy Member) belongs to eight successive ammonoid subzones (from the uppermost Patina Subzone of the Early Callovian Gracilis Zone to the Athleta Zone (i.e., the lower part of the Late Callovian) which can be explained by heterogeneous condensation (GÉCZY, 1982, 1984). The belemnite rostra were studied by GALÁCZ & VÖRÖS (1969), the bivalves by VÖRÖS (1971) and the brachiopods by VÖRÖS (1997). VÖRÖS (1972, 2012) dealt with the microfacies of the layer in detail. He mentioned relatively rich foraminifera fauna in thin sections, 12-21 specimens/cm^2 and plankton : benthos ratios from 2,3:1 to 10:1, where the stromatolite horizon gave the highest values. He identified protoglobigerinids, rotaloids, and *Lenticulina,* but did not figure them.

The other occurrence of the Callovian ammonite-rich bed is situated about 15 km west of the Templom-hegy, in the abandoned Rózsa-bánya quarry on the Csukma-hegy (Fig. 1). KASZAP (1958) was the first who gave lithological description and identification of the ammonite fauna (KASZAP, 1959, 1961, 1963). Based on the revision of the ammonite fauna this layer belongs to the Middle Callovian Anceps Zone (GALÁCZ, 2007). The lithological development of this layer starts with a 0.5-1 cm thick ferruginous crust on the top of the underlying Triassic Csukma Dolomite Formation. Similarly to the occurrence of the Templom Hill, the ammonite-rich layer can be divided into three horizons (GALÁCZ, 2007). The lower horizon (8-10 cm) is a yellow-colored limestone, rich in echinoderm fragments and belemnite rostra, and contains slightly flattened "snuff box"-type limonitic concretions with usually dolomite pebbles in their core. This horizon locally shows iron-oolitic-ooidic texture. It is covered by weathered ferruginous oolitic limestone extremely rich in ammonites, somewhat squeezed into each other. Ammonites are partly fragmented, most of them are molds, but specimens with recrystallized and stromatolite-encrusted shells are also present. Belemnite rostra are also very abundant. In the 10-12 cm thick, reddish-purple uppermost horizon the limonitic concretions, oolites and ooids are missing, but stratiform, columnar and branching types of stromatolites appear. The ammonites are less frequent than below. It is overlain by the Oxfordian Szársomlyó Limestone.

KASZAP (1959) mentioned echinoderm fragments, foraminiferas, fish teeth and "0,2-0,5 mm ant egg-like" *incertae sedis* grains from the washing residue of the mud on the surface of the weathered limestone and from the rock thin sections.

Material and methods

Three samples from the Callovian ammonitic bed of the Templom-hegy and one sample from the Rózsa-bánya locality were collected (Fig. 1. A, B). From each samples (about 10 cm^3 each) several thin sections were made and the microfauna was extracted by using pure acetic acid. Generally, after the acetic treatment different amount of unsolved rock remains, and the solution can be selective, depending on different factors, as wall structure, texture, preservation, etc. So the total quantity of the microfossils can be estimated only from thin sections. Now it did not work, because we have very condensed, strongly bioturbated rock where the fossil content changes from cm to cm horizontally and vertically as well. This phenomenon is reflected in the very variable preservation, especially of protoglobigerinids and ostracods. In the samples from both occurrences, we could find protoglobigerinids where the fine structures (pores, wall structure) and surface ornamentation of the originally aragonitic wall were preserved, together with ones which remained only as ferruginous internal molds. Ostracods are preserved as molds, as valves covered by ferruginous crusts or as carapaces with original calcite wall. From thin sections the foraminifera were identified on generic level, while from the dissolving residual, similarly to the ostracods, species level identification was possible, depending on the actual preservation. Thirty foraminifera and four ostracod species were distinguished and described in detail and figured by SEM images altogether. More than 700 foraminifera specimens were picked for the quantitative analysis. To evaluate the diversity, Fisher's α index was used, whose mathematical expression is $S = \alpha \ln (1 + n / \alpha)$, where S: number of species and n: sample size. To characterize proportional abundance of species the Shannon–Wiener index (H') was applied. Its mathematical expression is $H' = -\Sigma p_i \ln p_i$, where $p_i=n_i /n$, being n_i: number of specimens of each species and n: total number of specimens. The lowest value of this index (H' = 0) corresponds to a single taxon in the assemblage, while the highest values indicate a diverse assemblage (HAMMER & HARPER, 2006). Calculation of these indices was performed using PAST, a computer program conceived by HAMMER et al. (2001).

JONES & CHARNOCK (1984), dealing principally with modern foraminifera, distinguished morphological units (morphotypes or morphogroups) based on the relationship between the feeding habit, life position and test morphology. We also followed this method improved by several authors, e.g. BERNHARD, 1986; CORLISS, 1991; NAGY, 1992; TYSZKA, 1994; NAGY et al., 1995, 2001; FUGAGNOLI, 2004; REOLID et al., 2008; NAGY et al., 2001, OLÓRIZ et al., 2012.

Results of microfaunal studies of the sampled sections of the Callovian ammonite-rich beds

Microfauna of the Middle-Upper Callovian bed of the Templom-hegy quarry in thin section (Pl. I, A-C)

In the studied samples the microfauna content is very similar, differing only in the quantity of specimens. The texture of the rock is biomicrite, wackestone with the dominance of fine bivalve shells, “filaments”. Iron spots are frequent. Randomly oriented “filaments” became finer towards the inner chambers of the ammonite shells. The foraminifera fauna is dominated by planktonic protoglobigerinids. Their wall is uniform in thickness (about 6-7 µm), which is always recrystallised in sparry calcite. Some are partially, generally in the early whorls, filled by sparry calcite, leaving only the last chambers filled with sediment. The most frequent sections of protoglobigerinids are middle sized, about 170-220 µm in the largest diameter, a few reaching 300 µm. There are very few small sized forms, about 130 µm in the largest diameter, with 3-3,5 chambers on the last whorl. All forms show low trochospiral test in the sections. Besides planktonic foraminifera, there are some lenticulinids (Pl. 1, fig. A); epistominids, spirillinids (Pl. 1, fig. B). Other forms are less frequent: *Glomospira* sp. (Pl. 1, fig. C), other bi- or triserial agglutined ones, *Paalzowella* sp. and other nodosariids. Very few sections of ostracods can be recognised also.

Microfauna of the Middle Callovian of the Rózsa-bánya quarry in thin section (Pl. I, D-F)

The microfacies of our sample of the Rózsa-bánya quarry is ferruginous micritic wackstone characterized by great abundance of planktonic foraminifera (80%) and microgastropods. It is not easy to distinguish them in sections. Epistominids are common, but some lenticulinids and spirillinids, echinoderms and ammonite fragments and very few “filaments” are also present. The assemblage of the protoglobigerinids is homogeneous in wall structure, in wall-thickness and in size of the tests (average is about 180 µm). The wall thickness is nearly uniform, about 6-8 µm throughout all whorls. Thin sections show low and high trochospiral protoglobigerinids. Wall is recrystallized in fine calcite spar, indicating an aragonitic primary composition. The shells are usually entirely filled with limonitic micrite, sometimes the initial part filled with sparry calcite.

Microfauna of the Middle-Late Callovian of the Templom-hegy quarry in isolated forms (Pl. 1-3)

Residual of each samples of the Templom-hegy is dominantly quartz and iron oncolite fragments, and very poor in microfossils. The lowermost sample contains the relatively richest association (Fig. 1A). It is dominated by foraminifera, especially planktonic ones giving the half of the foraminifera fauna (Fig. 2). Echinoid spines, crinoid fragments, bivalve and gastropod embryos. and few ostracods are also present.

Protoglobigerinids are diverse, four species could be identified (Fig. 3, Pl. 3, Figs 13-14): *Conoglobigerina*? *avariformis* forma sphaerica, *G.* aff. *balakhmatovae*, *G. dagestanica* and *G. oxfordiana.* All forms have low trochospiral tests. There are few large (~300 µm) forms as *C.*? *avariformis* forma sphaerica and few small (~130 µm) *G.* aff. *balakhmatovae*. The middle-sized (~200 µm) forms, as *G. dagestanica* and *G. oxfordiana,* show the highest proportions. Preservation of the wall strongly varies from the nearly original condition (Pl. 3, fig. 14) to that of recrystallized in coarse calcite (Pl. 3, Fig. 23). The second abundant group (20%) is of the agglutinated forms. It is relatively diverse with *Lagenammina difflugiformis*, *Ammodiscus siliceus*, *Glomospira variabilis*, *Reophax fusiformis* and *Tritaxis lobata*. The spirillinid-paalzowellid group (*Spirillina polygyrata*, *S. tenuissima, Paalzowella* *feifeli feifeli, P. turbinella*) and the nodosariids, dominantly lenticulinids (mainly *L. muensteri*) appeared nearly in the same quantity (10 and 13%). The less frequent group is of the aragonitic shelled epistominids (*Epistomina conica, E. uhligi*). Few specimens of *Topalodiscorbis paraspis* and *T.* aff. *scutuliformis* also occur (Fig. 2-3).

Twenty-five species of foraminifera could be distinguished altogether (Fig. 3). Fischer's α and Shannon-Wiener indices are 9.5 and 2.5, which suggest a relative high diversity.

In the studied samples mainly undeterminable fragmented ostracod molds and carapaces with concentric limonitic crusts occur in low abundance. From the lowermost sample only two specimens could be determined in species level (*Bairdia (Akidobairdia) delicate* and *Pontocyprella izjumicaformis*) beside the specimens of *Bairdia* cf. *caudifera* and ?*Praeschuleridea* sp..

Microfauna of the Middle Callovian of the Rózsa-bánya quarry from isolated forms
(Pl. 2-3)

Residual of the samples from the Rózsa-bánya quarry dominantly consists of fragmented iron oolites. Fossils are rare except the planktonic foraminifera. Besides them benthic foraminifera, bivalve, ammonite and gastropod embryos, aptychi, serpulinid tubes and fish teeth appeared. Very few poorly preserved, undeterminable ostracod moulds also occur.

Protoglobigerinids are dominant (84%), classifying into four species: *G.* aff. *balakhmatovae*, *G. bathoniana, G. dagestanica* and *G. oxfordiana.* These latter, middle-sized (~200 μm) forms are the most frequent, but the same sized *G. bathoniana* is also common, while the small *G.* aff. *balakhmatovae* is relatively rare. Except the high trochospiral *G. bathoniana* all other forms have low trochospiral test. Most specimens are preserved only as internal ferruginous mold, but there are some with extremely well preserved wall structure and surface.

Among the benthic foraminifera, sprillinid forms are the most frequent, limited exclusively to *Spirillina polygyrata*. Proportions of the other benthic foraminifera groups, namely agglutinated forms, lenticulinids and epistominids are nearly uniform: 2%, 4% and 4% (Fig. 3).

The association displays low species diversity, with 15 species (Fig. 2, 3), and Fischer α-index of 3.5 and Shannon-Wiener index of 1.7. This suggests definitively less diverse association that of the Templom-hegy quarry.

Species	Templom-hegy quarry	Rózsa-bánya quarry
Lagenammina difflugiformis	O	
?*Thurammina* sp.	O	
Ammodiscus siliceus	▲	O
Glomospira variabilis	O	O
Reophax fusiformis	O	
Tritaxis lobata	X	
Pseudomarshonella dumortieri		O
Spirillina polygyrata	▲	▲
Spirillina tenuissima	X	
Dentalina spp.	X	
Nodosaria fontinensis	O	
Nodosaria spp.		O
Lenticulina munsteri	X	X
Lenticulina cf. *tumida*	X	
Lenticulina spp.	X	X
Saracenaria cf. *oxfordiana*	X	
Astacolus varians	X	O
Eoguttulina liassica	O	
Eoguttulina oolithica		O

Species	Templom-hegy quarry	Rózsa-bánya quarry
Epistomina conica	X	
Epistomina uhligi	X	X
Topalodiscorbis paraspis	O	
Topalodiscorbis aff. *scutuliformis*	O	
Paalzowella feifeli feifeli	X	O
Paalzowella turbinella	O	
Conoglobigerina? *avariformis* forma sphaerica	X	
Globuligerina aff. *balakhmatovae*	X	X
Globuligerina bathoniana		■
Globuligerina dagestanica	■	
Globuligerina oxfordiana	■	■
protoglobigerina	■	■

Fig. 2. List of foraminifera taxa with their frequency in studied Callovian ammonite-rich layers.
O 1-2% **X** 2-5% ▲ 5-10% ■ 10%<

Comparisons and conclusions

Microfaunas of the two types of the condensed Callovian ammonite-rich bed of the Villány Mountains were studied: the “filament”-rich layers of the Templom-hegy quarry and the iron oolitic layer of the Rózsa-bánya quarry. In both studied occurrences the foraminifera fauna is relatively rich and dominated by planktonic forms, but ostracods are very scarce. The average preservation of the foraminifera assemblages is moderate, of the ostracods is poor, but in both groups it varies; there are partly or completely preserved shells and limonite molds, too.

Altogether five protoglobigerinids, 25 benthic foraminifer and four ostracod taxa were identified and described in detail. One third of the foraminifera species (10 species) occur in both localities, while determinable ostracod specimens are present only in the bed of the Templom-hegy quarry.

Abundance of the protoglobigerinids is higher (84%) in the Rózsa-bánya quarry than in the Templom-hegy quarry (51%). In both localities four planktonic foraminifera species were identified, *Globuligerina* aff. *balakhmatovae*, *G. dagestanica* and *G. oxfordiana* are common, but in the Templom-hegy quarry the high trochospiral *G. bathoniana*, while in the Rózsa-bánya quarry the large compact low trochospiral forms, *Conoglobigerina*? *avariformis* forma sphaerica are missing. Both occurrences are dominated by low trochospiral, middle-sized (~200 µm) *G. dagestanica* and *G. oxfordiana*.

The benthic foraminifera association of the Rózsa-bánya is less diverse (11 taxa) than the one of the Templom-hegy quarry (21 taxa). Among the benthonic foraminifera, proportions of spirillinids, nodosariids and epistominids are nearly similar in the two localities. Agglutinated forms are more frequent and divers in the Templom-hegy quarry (Fig. 2, 3).

In both localities morphogroups of epifaunal, epiphytal or epibiont with active to passive herbivore or detrivore feeding strategy dominate as the flattened-planispirally coiled *Spirillina* and *Ammodiscus*, flattened and trochospiral *Paalzowella*. The recent *Tritaxis* has similar mode of life. Some adult specimens are attached to the substrate by a spongy calcareous substance or “puffermasse” (Loeblich & Tappan, 1988). Definitively infaunal forms occur only in the layer of the Templom-hegy quarry, these are the subcylindrical, tapered *Lagenammina difflugiformis* and *Reophax fusiformis*. Based on these facts the benthic foraminifera fauna reflects an epifaunal “epi-stromatolitic” mode of life. In the poor ostracod assemblage 4 taxa were identified (*Bairdia (Akidobairdia) delicata*, *Bairdia* cf. *caudifera*, *Pontocyprella izjumicaformis* and ?*Praeschuleridea* sp.) which are represented by single specimens (Pl. 1.). The ostracods are characterized by benthic habitat and the presence of genus *Pontocyprella* suggests deep sublittoral or upper bathyal environments in the oligophotic or aphotic zone (e.g. BOLD, 1981; DUCASSE & PEYPOUQUET, 1978, 1979; MONOSTORI, 1995ab; FERNÁNDEZ-LÓPEZ et al., 2009).

From the literature, we know only the paper of NEAGU (1996) where isolated foraminifera fauna of reddish or yellowish condensed, iron oolitic, ammonite-rich limestone was published from the Lower Callovian of the Bucegi Mountains (Romania). The relatively rich foraminifera fauna with mostly planktonics (*Globuligerina oxfordiana* and *G. bathoniana*) was extracted by formic acid. The preservation is similar to that of the Villány Mountains: there are specimens with original shells together with many limonitic molds of planktonic and benthonic calcareous ones: *Trocholina, Epistomina, Ophthalmidium, Lenticulina* and very rare agglutinated forms. NEAGU (1996) described and figured by drawings only the planktonics, their average size (150-200 µm) also corresponds to that of the Villány Mountains.

Comparison with faunas described from thin sections of other condensed Bathonian-Middle Oxfordian layers is also not easy, because of the very few illustrations of good quality. Authors mentioned foraminifera only on genus level, which are not illustrated or these are on microfacies pictures in few mm size. From all these rocks planktonic forms were mentioned; protoglobigerinids, globigerinids or *Globuligerina* sp. are the most often cited names (e.g. NORRIS & HALLAM, 1995; REOLID & NIETO, 2010; VÖRÖS, 2012). We have to note that the two latter names are incorrect; "globigerinids" is a vernacular, informal name, signifying globigerina-like foraminifera. Genus *Globigerina* appear in the Middle Eocene and has calcitic shells in contrast to the aragonitic walled protoglobigerinids. Moreover it is impossible to distinguish *Globuligerina* from the other early planktonic genus in thin section. Among the benthonic foraminifera the most commonly mentioned genera, similarly to that in the Villány Mountains are *Lenticulina*, epistominids, *Spirillina* and *Reophax* (e.g. OLÓRIZ et al., 2003, 2012). Some other genera which are missing from the Villány Mountains but are important elements of the other localities: miliolinids (e.g. free *Ophthalmidium*, encrusting *Nubecularia* and *Nubeculinella*), agglutinated encrusting taxa (like *Subdelloidina*, *Thurammina*, *Placopsilina* and *Tolypammina*) and polymorphid attached forms (*Bullopora*) (e.g. REOLID et al., 2005, 2008; REOLID et al., 2007, RAMAJO & AURELL, 2008; REOLID & NIETO, 2010).

Comparing the foraminifera associations of the Villány Mountains to the "classic" Callovian isolated faunas from marl or clay facies we can establish the follows:

– There are very few records of Callovian isolated protoglobigerinids (Simmons et al., 1997; Görög & WERNLI, 2003), but in some localities protoglobigerinids are predominant, usually as glauconitic molds (e.g. FUCHS, 1973; MUNK, 1978; RIEGRAF 1987).

– At this time besides the well documented *G. bathoniana* and *G. oxfordiana* (e.g. NEAGU, 1996; RIEGRAF, 1988) the validity of the other Callovian protoglobigerinid species (*Globigerina jurassica* HOFMAN, 1958; *Globuligerina calloviensis* KUZNETSOVA, 1980, *G. meganomica* K. KUZNETSOVA, 1980 and the numerous species described by FUCHS (1973)) is doubtful, because of the poor preservation and/or illustration (SIMMONS et al., 1997; GÖRÖG & WERNLI, 2003).

– The first descriptions of *Conoglobigerina*? *avariformis* and *G*. aff. *balakhmatovae* from the Callovian are given here.

– The benthic faunal assemblages of the Callovian condensed layer of the Villány Mountains show also peculiarities. The most common and characteristic forms of the "classical" fauna associations are entirely missing, like miliolinids, small agglutinated forms (e.g. *Trochammina, Haplophragmium, Ammobaculites*); ornamented lenticulinids (e.g. *L. quenstedti*, *L. tricarinella*) and trocholinas. Unfortunately, due to the poor preservation of ostracods similar comparison with the well preserved Callovian faunas (e. g. OLEMPSKA & BŁASZYK, 2001; TESAKOVA, 2003, 2008, 2009) is not possible.

Summarizing, our study gave very important results about the microfauna of the particular Callovian ammonite-rich beds of the Villány Mountains. It is the first time when the isolated benthic foraminifera and ostracods are described and figured from this kind of condensed beds of the Bathonian-Middle Oxfordian. The very well preserved planktonic foraminifera association is the most diverse known from Callovian. The assemblages are unique in their composition, probably because the benthic forms lived on the stromatolite substrate in the deep sublittoral zone, under the oligo- or aphotic zone, developed on a swell of the pelagic region of the western Tethys.

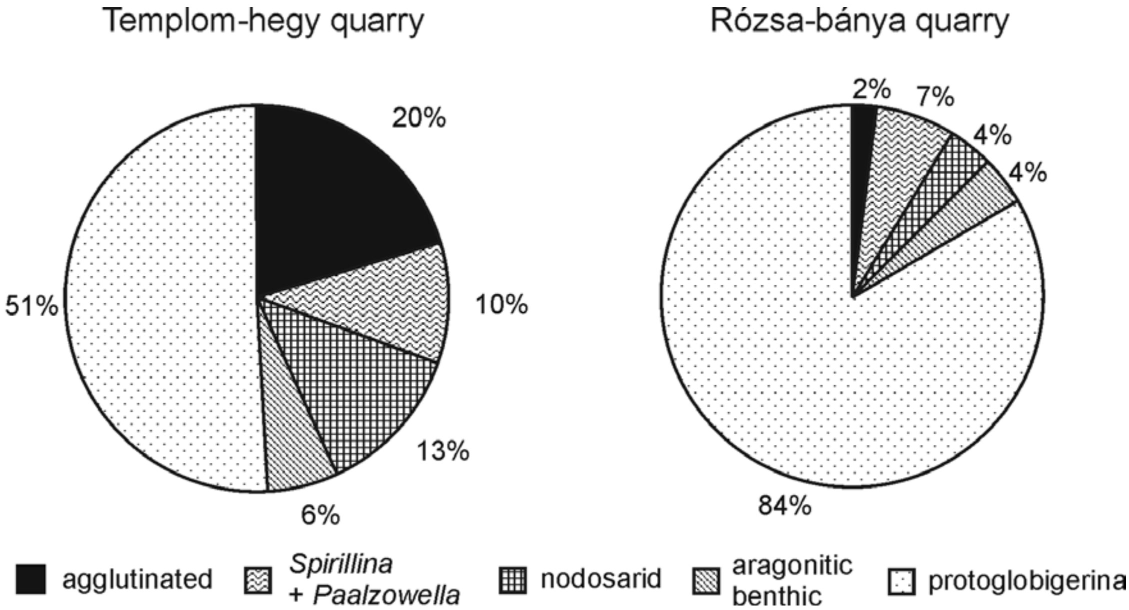

Fig. 3. Percentage distribution of different foraminiferal groups in Callovian layers of Templom-hegy and Rózsa-bánya quarries.

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Systematic descriptions of Callovian foraminifera and ostracods

Classification of the foraminifera follows that of LOEBLICH & TAPPAN (1988) and KAMINSKI (2004) and the ostracods that of MARTIN & DAVIS (2001). The specimens are deposited in the Department of Palaeontology of the Eötvös University and in the Eötvös Museum of Natural History (Budapest, Hungary). Abbreviations: L=length and H=height.

Class Foraminifera J. J. LEE, 1990
Order Astrorhizina LANKESTER, 1885
Suborder Saccamminina LANKESTER, 1885
Superfamily Saccamminacea BRADY, 1884
Family Saccamminidae BRADY, 1884
Subfamily Saccammininae BRADY, 1884

Genus *Lagenammina* RHUMBLER, 1911

Lagenammina difflugiformis (BRADY, 1879)
Pl. 2, Fig. 1.

1879. *Reophax difflugiformis* n. sp.; BRADY, H.B. Notes on some of the reticularian Rhizopoda of the "Challenger" expedition. Quart. Jour. Micr. Sci. London, n. s. vol. 19, p. 51, pl. 4, figs 3 a,b. fide Catalogue Ellis & Messina.
1937. *Proteonina difflugiformis* (H. B. BRADY, 1879); BARTENSTEIN & BRAND, p. 128, pl. 1A, fig. 1; pl. 1B, figs 1-2; pl. 2A, fig. 1; pl. 2B, fig. 3; pl. 3, fig. 1; pl. 4, fig. 1; pl. 5, fig. 1; pl. 6, figs 2a-b; pl. 8, figs 1a-d; pl. 10, figs 1a-c; pl. 11A, figs 1a-c.
1941. *Proteonina ampullacea* (BRADY); FRENTZEN, p. 300, pl. I, figs 2-4.
1961. *Reophax difflugiformis* BRADY, 1879; PIETRZENUK, p. 51, pl. 9, fig. 1.

1968. *Reophax difflugiformis* BRADY, 1879; WELZEL, p. 6, pl. 1, fig. 4.
1971. *Proteonia difflugiformis* (BRADY), 1879; WERNLI, p. 309, pl. 1, figs 1-3.
1984. *Lagenammina jurassica* (BARNARD, 1950); RIEGRAF et al., p. 679, pl. 1, fig. 7.
1985. *Lagenammina jurassica* (BARNARD, 1950); RIEGRAF, p. 92, pl. 5, figs 19, 20.
1986. *Reophax difflugiformis* BRADY, 1879; FISCHER et al., p. 83, pl. 16, fig. 6.
1990. *Proteonina difflugiformis* (BRADY), 1896; BOUTAKIOUT, p. 96, pl. 4, fig. 1; fig. 25.

Material. 2 specimens.

Description. Test unilocular usually flask-shaped; initial part rounded, following a shorter or longer neck, aperture circular and situated at the end of the neck; wall finely agglutinated.

Remarks. *Lagenammina difflugiformis* was originally described by BRADY (1879) from recent material of the North Atlantic and the South Pacific, but these Jurassic specimens resemble very much to the original material.

Distribution. Hettangian – Oxfordian.

Subfamily Thuramminae MIKLUKHO-MAKLAY, 1963
Genus *Thurammina* BRADY, 1879

?*Thurammina* sp.
Pl. 2, Fig. 2.

1988. *Thurammina* sp. II ; RIEGRAF, pl. 2, figs 3-4.

Material. One broken isolated specimen and one in thin section.

Description. Test is irregular, with characteristic distinct honeycomb ornamentation.

Remarks. The specimen strongly resembles that of figured by RIEGRAF (1988). In thin section it shows the characteristic honeycomb structure, but the wall seems to be calcareous not agglutinated.

Distribution. Middle Callovian.

Superfamily Ammodiscacea REUSS, 1862
Family Ammodiscidae REUSS, 1862
Subfamily Ammodiscinae REUSS, 1862
Genus *Ammodiscus* REUSS, 1862

Ammodiscus siliceus (TERQUEM, 1862)
Pl. 2, Fig. 3.

1861. *Involutina silicea* TERQUEM; TERQUEM, p. 450, pl. 6, figs 11a-b.
1863. *Involutina aspera* TERQUEM; TERQUEM, p. 221, pl. 10, figs 21a-b.
1908. *Ammodiscus infimus* STRICKLAND; ISSLER, p. 40, pl. I, figs 4-6.
1936. *Ammodiscus infimus* (STRICKL.); FRANKE; p.15, pl. 1, figs 14a-b.
pars 1937. *Ammodiscus incertus* (D'ORBIGNY, 1839); BARTENSTEIN & BRAND, p. 130, pl. 2B, fig. 4; pl. 3, figs 5a-c; pl. 4, fig. 4; pl. 5, figs 5a-b; pl. 8, fig. 5; pl. 10, fig. 4; non pl. 11A, fig. 3.
1950. *Ammodiscus asper* (TERQUEM); BARNARD, p. 351, figs 1a, i, ii.
1959. *Ammodiscus siliceus* (TERQUEM); BARNARD, p. 132, pl. 11, figs 1-4.
1960. *Involutina silicea* TERQUEM 1862; BIZON, p. 4, pl. 1, figs 2a, b; pl. 4, fig. 1.
1967. *Ammodiscus siliceus* (TERQUEM, 1862); DREYER, p. 508, pl. VIII, fig. 1.
1968. *Ammodiscus siliceus* (TERQUEM, 1862); WELZEL, p. 5, pl. 1, fig. 11.
1978. *Ammodiscus infimus* (STRICKLAND, 1846); PJATKOVA & PERMJAKOVA, p. 16, pl. 2, figs 6a-c.
1984. *Ammodiscus siliceus asper* (TERQUEM, 1863); RIEGRAF et al., p. 679, pl. 4, figs 114, 117.
pars 1985. *Ammodiscus siliceus* (TERQUEM, 1862); RIEGRAF, p. 94, pl. 5, fig. 23, non pl. 5, figs 21-22.
1988. *Ammodiscus siliceus* (TERQUEM, 1862); KOPIK, p. 26, pl. 1, fig. 1.
1989. *Ammodiscus siliceus* (TERQUEM, 1862); EBLI, p. 66, pl. 2, fig. 2.
1990. *Ammodiscus siliceus* (TERQUEM), 1862; BOUTAKIOUT, p. 97, pl. 4, figs 2-3, fig. 25.
1995b. *Ammodiscus siliceus* (TERQUEM, 1862); GÖRÖG, p. 32, pl. 1, fig. 3.
1997. *Ammodiscus incertus* (D'ORBIGNY), 1839; JÄGER, p. 20, pl. 1, fig. 9.

Material. 6 specimens.

Description. Test discoidal; proloculus globular; the second tubular chamber planispirally enrolled in 4 to 8 whorls; periphery rounded; wall finely agglutinated; aperture round at the end of the tube.

Distribution. Early and Middle Jurassic.

Family Ammodiscidae REUSS, 1862
Subfamily Usbekistaninae VYALOV, 1981

Genus *Glomospira* RZEHAK, 1885

Glomospira variabilis (KÜBLER & ZWINGLI, 1870)
Pl. 2, Fig. 4.

1870. *Cornuspira variabilis*; KÜBLER & ZWINGLI, p. 33, pl. 4, Oxfordian, figs 4a-b.
1941. *Glomospira gordialis* (JONES et PARKER); FRENTZEN, p. 307, pl. 1, figs 15-17.
1960. *Glomospira variabilis* (KÜBLER and ZWINGLI 1870); SEIBOLD, E. & I., p. 324, text-figs 2q-s.
1968. *Glomospira variabilis* (KÜBLER and ZWINGLI); OESTERLE, p. 711, figs 8-9, 10a-d. cum. syn.
1978. *Glomospira gordialis* (PARKER et JONES); PJATKOVA & PERMJAKOVA, p. 15, pl. 1, fig. 15.
1984. *Glomospira variabilis* (KÜBLER & ZWINGLI); RIEGRAF et al., p. 679, pl. 4, figs 115-116.
1989. *Glomospira variabilis* (KÜBLER & ZWINGLI, 1870); EBLI, p. 67, pl. 2, figs 3-4.
1989. *Glomospira variabilis* (KÜBLER & ZWINGLI); RIEGRAF & LUTERBACHER, p. 1019, pl. 1, figs 9-10.
1995a. *Glomospira variabilis* (KÜBLER & ZWINGLI, 1870); GÖRÖG, p. 26, pl. 1, fig. 3.
1997. *Glomospira variabilis* (KÜBLER & ZWINGLI, 1870); EBLI, p. 27, fig. 8, text-fig. 33.

Material. 4 specimens.
Remarks. Oesterle (1968) dealt with variability of this species in detail.
Distribution. Sinemurian – Campanian (RIEGRAF & LUTERBACHER, 1989).

Order Lituolida LANKESTER, 1885
Suborder Hormosinina MIKHALEVICH, 1980
Superfamily Hormosinacea HAECKEL, 1894
Family Reophacidae CUSHMAN, 1927

Genus *Reophax* de MONFORT, 1808

Reophax fusiformis (WILLIAMSON, 1858)
Pl. 2, Fig. 5.

1858. *Proteonina fusiformis*; WILLIAMSON, p.1, pl. 1, fig. 1.
1890. *Reophax fusiformis* WILLIAMSON; HAEUSLER, p. 27, Taf. V, Abb. 22.
1937. *Proteonina fusiformis* WILLIAMSON, 1858; BARTENSTEIN & BRAND, p. 128, pl. 3, fig. 2; pl. 8, figs 3a-c, pl. 10, figs 3a-b; pl. 11A, figs 2a-c; pl. 11B, figs 1a-b; pl. 12A figs 1a-b; pl. 15A, fig. 1.

Material. 1 specimen.
Description. Test nearly fusiform, tapering on both ends, but asymmetrically; aperture is round; wall coarsely agglutinated.
Distribution. Liassic and Dogger.

Suborder Trochamminina SAIDOVA, 1981
Superfamily Trochamminacea SCHWAGER, 1877
Family Trochamminidae SCHWAGER, 1877
Subfamily Trochammininae SCHWAGER, 1877

Genus *Tritaxis* SCHUBERT, 1921

Tritaxis lobata (SEIBOLD, E. & I., 1960)
Pl. 2, Figs 6-7.

1960. *Valvulina*? *fusca* (WILLIAMSON 1858); LUTZE, p. 447, pl. 28, fig. 4.
1960. *Valvulina lobata* n. sp.; SEIBOLD, E. & I., p. 336, figs 4f, g, pl. 8, fig. 11.
1971. "*Paalzowella*" sp. A; WERNLI, p. 341, pl. 8, fig. 13.
1995a *Tritaxis lobata* (SEIBOLD, E. and I., 1960); GÖRÖG, p. 30, pl. I, figs 8-9.

Material. 4 specimens.
Description. Test trochospiral; conical in shape; periphery rounded; 4-6 whorls with only 3 chambers per whorl; chambers crescent-shaped, lobate and gradually increasing in size as added; sutures strongly depressed and oblique on the spiral side; on umbilical side flat or slightly depressed in the centre, with radial sutures; two and half chambers visible on the umbilical side; wall finely agglutinated; aperture interiomarginal arch.
Distribution. Middle Jurassic.

Order Textulariida DELAGE & HEROUARD, 1896 emend. KAMINSKI, 2004
Suborder Textulariina DELAGE & HEROUARD, 1896
Superfamily Chrysalidinacea NEAGU, 1968
Family Paravalvulinidae Banner, SIMMONS & WHITTAKER, 1991
Subfamily Paravalvulininae Banner, SIMMONS & WHITTAKER, 1991

Genus *Pseudomassonella* REDMOND, 1965

Pseudomarssonella dumortieri (SCHWAGER, 1866)
Pl. 2, Fig. 8.

1866. *Textularia dumortieri* m.; SCHWAGER, p. 309, fig. 14.

1995a. *Pseudomarssonella dumortieri* (SCHWAGER, 1866); GÖRÖG, p. 32, pl. II, figs 5-7. cum. syn.

Material. 3 specimens.

Description. Test high conical; trochospirally coiled; periphery subacute; 5 to 7 whorls with 3 to 5 chambers per whorl; sutures between whorls slightly depressed, within the whorl indistinct; umbilicus depressed; aperture cribrate, consisting of numerous pores on a termatophore plate that cover the umbilical region; surface somewhat rough.

Distribution. Bathonian – Lower Oxfordian.

Suborder Spirillinina HOHENEGGER & PILLER, 1975

Family Spirillinidae REUSS & FRITSCH, 1861

Genus *Spirillina* EHRENBERG, 1843

Spirillina polygyrata GÜMBEL, 1862
Pl. 2, Fig. 9.

1862. *Spirillina polygyrata* n. sp. GÜMBEL; p. 214, pl. 4, figs 11a-c.
1937. *Spirillina polygyrata* GÜMBEL, 1862; BARTENSTEIN & BRAND, 131, pl. 4 fig. 10; pl. 6, fig. 7; pl. 14C, fig. 3; 15A, figs 2a-c; pl. 15C, figs 1a-d.
1955. *Spirillina polygyrata* GÜMBEL, 1862; SEIBOLD, p. 230, pl. 5, figs f-h.
1960. *Spirillina polygyrata* GÜMBEL, 1862; BIELECKA, p. 86, pl. VIII, figs 66-67.
1978. *Spirillina polygyrata* GÜMBEL, 1862; BHALLA & ABBAS, p. 188, pl. 13, figs 3-4.

Material. About 40 specimens.

Remarks. This is a well-known species. BHALLA & ABBAS (1978) dealt with the dimorphism of this species in details.

Distribution. Early – Late Jurassic.

Spirillina tenuissima GÜMBEL, 1862
Pl. 2, Fig. 10.

1862. *Spirillina tenuissima* n. sp.; GÜMBEL, p. 214, pl. 4, fig. 12.
pars 1937. *Ammodiscus tenuissimus* GÜMBEL, 1862; BARTENSTEIN & BRAND, p. 130, pl. 8, figs 6a-c; pl. 11A, figs 4a-c; pl. 13, figs 2a-b. non pl. 10, figs 5a-c (= *Spirillina elongata* (BIELECKA & POZARSKY, 1954))
1981. *Spirillina tenuissima* GUEMBEL, 1862; BARNARD et al., p. 428, pl. 4, figs 4, 8.
1995a. *Spirillina tenuissima* GÜMBEL, 1862; GÖRÖG, p. 35, pl. 2, fig. 11. cum. syn.

Material. 6 specimens.

Description. Test planispirally enrolled, strongly flattened; periphery rounded; proloculus small and globular, which is surrounded by the relatively thin and evolute second chamber; initial coiling consists of 3 to 4 closely enrolled whorls; following by 5 to 7 involute whorls which are perpendicular to the plane of initial whorls; the last whorl may be involute; umbilicus nearly flush; sutures distinct; aperture circular at the end of the tube; surface smooth.

Distribution. Aalenian – Lower Oxfordian.

Suborder Lagenina DELAGE & HÉROUARD, 1896

Superfamily Nodosariacea EHRENBERG, 1838

Family Nodosariidae EHRENBERG, 1838

Subfamily Nodosariinae EHRENBERG, 1838

Genus *Dentalina* RISSO, 1826

Dentalina sp.
Pl. 2, Fig.11.

Material. One broken specimen.

Description. Relatively large, broken specimen, with strongly elongated chambers.

Genus *Nodosaria* LAMARCK, 1812

Nodosaria fontinensis TERQUEM, 1870
Pl. 2, Fig.12.

pars 1870. *Nodosaria fontinensis*, TERQ.; TERQUEM, p. 251, pl. 26, figs 1-4. non 5.
1886. *Nodosaria fontinensis*, TERQUEM; TERQUEM, p. 11, pl. 1, figs 22-24.
1995a. *Nodosaria fontinensis* TERQUEM, 1870; GÖRÖG, p. 46, pl. V, fig. 4.

Material. One broken specimen.

Description. Test uniserial with two low and broad chambers slowly increasing in size; sutures depressed; aperture terminal, small and round; surface covered by 9 longitudinal costae.

Distribution. Bajocian – Oxfordian.

Family Vaginulinidae Reuss, 1860

Subfamily Lenticulininae CHAPMAN, PARR & COLLINS, 1934

Genus *Lenticulina* LAMARCK, 1804

Lenticulina muensteri (ROEMER, 1839)
Pl. 3, Fig.1.

1863. *Cristellaria Münsteri* RÖM. sp.; REUSS, p. 77, pl. 9, figs 3-4.

1995a. *Lenticulina muensteri* (ROEMER, 1839); GÖRÖG, p. 53, pl. VII, fig. 6. cum. syn.

Material. Nearly 30 specimens, most of them are damaged.

Remarks. Degree of the inflation of the chambers varies. Umbilical plug or boss can be present or absent. JENDRYKA-FUGLEWICZ (1975) dealt with this species in detail.

Distribution. Pliensbachian – Oxfordian.

Lenticulina cf. *tumida* MJATLIUK, 1961
Pl. 3, Fig. 2.

1981. *Lenticulina tumida* MJATLIUK, 1961; BIELECKA & Styk, p. 30, pl. III, fig. 4.

Material. 4 specimens.

Description. Test nearly circular in outline, lenticular with subrounded periphery, involute; 12-13 chambers are on the last whorl; sutures are flush, surface is smooth; aperture is radial.

Remarks. The specimens from the Villány Mts are only about half in size of the ones described by BIELECKA & STYK (1981).

Genus *Saracenaria* DEFRANCE, 1824

Saracenaria cf. *oxfordiana* TAPPAN, 1955
Pl. 3, Fig. 3.

1955. *Saracenaria oxfordiana* n. sp; TAPPAN, p. 64, pl. 26, fig. 27.

Material. 3 specimens.

Description. Test small, nearly; triangular in all views; initial part consists of 3-4 chambers, small and coiled, later rectilinear and consists of 5-6 wider than high chambers; aperture peripheral, and radiate; dorsal and ventral peripheries subrounded; sutures flush; surface smooth.

Remarks. Specimens from the Templom-hegy quarry differ from the holotype in their rather blunt periphery, probably due to the extraction method.

Distribution. Lower Oxfordian.

Subfamily Marginulininae WEDEKIND, 1937

Genus *Astacolus* DE MONTFORT, 1808

Astacolus varians (BORNEMANN, 1854)
Pl. 3, Fig. 4.

1854. *Cristellaria varians* m.; BORNEMANN, p. 41, pl. 4, figs 32-34a-c.
1941. *Cristellaria varians* BORNEMANN; MACFADYEN, p. 35, pl. 2, figs 28a-b.
1951. *Astacolus varians* (BORNEMANN); BARNARD, p. 8, pl. II, figs 3-6, text-fig. 2.
1958. *Astacolus* (*Astacolus*) *varians* (BORNEMANN 1854); DREXLER, p. 495, pl. 20, fig. 16e.
1960. *Astacolus varians* (BORNEMANN); BARNARD, p. 45, pl. 4, figs 18-21, pl. 6, figs 1-9, pl. 7, figs 1-10.
1961. *Astacolus* (*Astacolus*) *varians* (BORNEMANN 1854); PIETRZENUK, p. 66, pl. 5, figs 2, 8a-b.
1963. *Astacolus* (*Astacolus*) *varians* (BORNEMANN 1854); RABITZ, p. 203, pl. 16, figs 1-3, 6.
1968. *Astacolus varians varians* (BORNEMANN, 1854); WELZEL, p. 43, pl. 2 figs 32-33.
1970. *Astacolus* gr. *varians* (BORNEMANN 1854); RUGET & SIGAL, p. 86, pl. I, figs 31-32.
1985. *Astacolus varians* (BORNEMANN, 1854); RIEGRAF, p. 120, pl. 8, fig. 11.
1986. *Astacolus varians* (BORNEMANN 1854); FISCHER et al., p. 87, pl. 17, figs 4-5.
1987. *Astacolus varians* (BORNEMANN 1854); TRÖSTER, pl. 2 figs 18-20.
1995b. *Astacolus varians* (BORNEMANN, 1854); GÖRÖG, p. 42, pl. 4, figs 2-3. cum. syn
1997. *Astacolus varians* (BORNEMANN, 1854); EBLI, p. 113, pl. 32, figs 15-16.
1997. *Astacolus varians* (BORNEMANN), 1854; JÄGER, p. 31, pl. 2, figs 23-24.

Material. 6 specimens.

Description. Test planispiral, oval in outline, biconvex; periphery acute or subacute, initial portion planispirally coiled, the final 1 or 2 chambers elongated and uncoiled; 7 to 10 chambers are on the last whorl; sutures distinct, flush, arcuate on the spiral portion, nearly straight on the uncoiled portion; aperture radiate, terminal and peripheral; surface smooth.

Distribution. Rhaetian – Callovian. It is common in the Middle Jurassic.

Family Polymorphinidea D'ORBIGNY, 1839
Subfamily Polymorphininae D'ORBIGNY, 1839

Genus Eoguttulina CUSHMAN and OZAWA, 1930

Eoguttulina liassica (STRICKLAND, 1846)
Pl. 3, Fig. 5.

1846 *Polymorphina liassica* n. sp.; STRICKLAND, p. 31, pl. p. 30, fig. b.
1941 *Polymorphina* (*Eoguttulina) liassica* STRICKLAND; MACFADYEN, p. 65, pl. 4, fig. 66.

1950. *Eoguttulina liassica* (STRICKLAND); BARNARD, p. 376, figs 6b, f.
1952. *Eoguttulina liassica* (STRICKLAND 1846); USBECK, p. 396, pl. 17, fig. 49.
1962. *Eoguttulina liassica* (STRICKLAND); LLOYD, p. 370, pl. 1, figs 1a-d, 2a-c, 3a-c; text-figs 2A-E.
1970. *Eoguttulina liassica* (STRICKLAND, 1846); FUCHS, p. 110-111, pl. 8, fig. 16.
1983. *Guttulina pera* LALICKER, 1950; MEDD, p. 233, pl. 1, fig. 9.
1985. *Eoguttulina liassica* (STRICKLAND, 1846); RIEGRAF, p. 152, pl. 11, figs 29-30.
1995a. *Eoguttulina liassica* (STRICKLAND, 1846); GÖRÖG, p. 67, pl. 10, fig. 1. cum. syn.
1997. *Eoguttulina liassica* (STRICKLAND, 1846); EBLI, p.118, pl. 34, fig. 13.
1997. *Eoguttulina liassica* (STRICKLAND, 1846); JÄGER, p. 46, pl. 4, fig. 22.
1998. *Eoguttulina liassica* (STRICKLAND); HERRERO, pl. 1, fig. 4.

Material. 2 specimens.

Description. Test chestnut-shaped; lower part rounded, apertural end tapered; oval in cross-section; three or four chambers are visible; sutures more or less depressed and longitudinal except the suture of the final chamber, which is oblique and cut the previous sutures; aperture radial; surface smooth.

Remarks. The specimens of Villány Mts resemble most the forma-type “*Guttulina pera* Lalicker, 1950”.

Distribution. Late Rhaetian – Late Jurassic.

Eoguttulina oolithica (TERQUEM, 1874)

1874. *Polymorphina oolithica* TERQ.; TERQUEM, p. 299, pl. 32, figs 1-10.
1995a. *Eoguttulina oolithica* (TERQUEM, 1874); GÖRÖG, p. 68, pl. X, fig. 2.

Material. 3 specimens.

Description. Test oval in outline, with somewhat tapered ends; oval in cross-section; periphery rounded; three chambers can be seen on both sides; sutures smooth or slightly depressed; aperture radiate and terminal; surface smooth.

Distribution. It is as a common species in the Middle Jurassic as well as in the Oxfordian.

Suborder Rotaliina DELAGE & HÉROUARD, 1896
Superfamily Ceratobuliminacea CUSHMAN, 1927
Family Epistominidae WEDEKIND, 1937
Subfamily Epistomininae WEDEKIND, 1937

Genus *Epistomina* TERQUEM, 1883

Epistomina conica TERQUEM, 1883
Pl. 3, Figs 6-7.

1883. *Epistomina conica* TERQ.; TERQUEM, p. 375, pl. XLII, figs 10a-b, 11.
1960. *Conorboides*? (*Epistomina*?) conica (TERQUEM, 1883); BIELECKA, p. 95, pl. X, fig. 79. cum. syn.
1971. *Epistomina parastelligera* (HOFKER, 1954); WERNLI, p. 345, pl. III, figs 13-14, 16-17.

Material. 2 specimens.

Description. Test is trochospiral with circular outline; umbilical side is strongly convex, spiral side slightly convex or nearly flat with umbilical boss; periphery subrounded; sutures indistinct, surface smooth; aperture is oblique low arch at the outer periphery of the umbilical side.

Remarks. *Epistomina conica* differs from *E. parastelligera* in its more elevated umbilical side, less sharp periphery, and more flush sutures and smaller umbilical boss.

Distribution. Middle Jurassic.

Epistomina uhligi MJATLIUK, 1953
Pl. 3, Figs 8-9.

1954. *Brotzenia parastelligera* n. sp.; HOFKER, p. 180, figs 4-6.
1960. *Epistomina parastelligera* (HOFKER, 1954); BIELECKA, p. 92, pl. X, fig.76.
1967. *Epistomina uhligi* MJIATLIUK, 1953; Ohm, p. 128, pl. 18, fig. 4. cum. syn.
non 1971. *Epistomina parastelligera* (HOFKER, 1954; WERNLI, pl. III, figs 13-17.
1981. *Epistomina parastelligera* (HOFKER, 1954) BIELECKA & STYK, p. 36, pl. IV, Fig. 10.
1971. *Epistomina parastelligera* (HOFKER, 1954); WERNLI, p. 345, pl. III, figs 13-17.
1976. *Epistomina uhligi* MJATLIUK; ASCOLI, p. 722, fig. 30, tbl. 4, pl. 3, fig. 1.
? 1988. *Epistomina uhligi* MJATLIUK; WILLIAMSON & STAM, p. 146, pl. 5, figs 8-9. no illustration in the paper.

Material. 16 specimens.

Remarks. Ohm (1967) dealt with this species in detail, giving a precise description. Specimens from the Rózsa-bánya quarry are relatively small. Williamson & Stam (1988) gave a detailed discussion about this species, but figures are missing from the plate as well as from the paper.

Based on the description their specimens are more resembled to *Epistomina conica* Terquem, 1883.

Distribution. Middle – Late Jurassic.

Superfamily Discorbacea EHRENBERG, 1838
Family Conorbinidae REISS, 1963

Genus *Topalodiscorbis* NEAGU, 1970

Topalodiscorbis paraspis (SCHWAGER, 1866)
Pl. 3, Fig.10.

1866. *Rosalina paraspis* n. sp; SCHWAGER, p. 310, fig. 16.
1937. *Discorbis paraspis* (SCHWAGER, 1866); BARTENSTEIN & BRAND, p. 193, pl. 5, fig. 77.
1960. *Conorboides*? *paraspis* (SCHWAGER 1866); SEIBOLD, E. & I., p. 382, text-fig. 7s, t.
?1968. *Discorbis*? *paraspis* (SCHWAGER, 1866); OESTERLE, p. 774, fig. 49.
1971. *Discorbis paraspis* (SCHWAGER), 1866; WERNLI, p. 337, pl. 7, figs 1-10.
1986. *Discorbis paraspis* (SCHWAGER, 1866); STAM, p. 117, pl. 5.

Material. 2 specimens.

Description. Test oval in outline, trochospirally coiled in 1,5-2 whorls; spiral side convex, umbilical side concave; periphery rounded; 11 to 14 chambers gradually increasing in size; the last 6 to 8 chambers visible; umbilicus relatively wide and slightly depressed; sutures depressed; aperture at the end of the final chamber; surface smooth.

Distribution. Lower Jurassic – Oxfordian.

Topalodiscorbis aff. *scutuliformis* (SEIBOLD E.& I., 1960)
Pl. 3, Fig. 11.

1960. *Conorbina scutuliformis* n. sp.; SEIBOLD, E. & I., pp. 380 381, figs 8c, d.

Material. 2 specimens.

Description. Test is low trochospiral, broad oval in outline; only two whorls; 9 chambers in the last whorl; chambers quicky enlarge in size, last one is two times large then the precedent; spiral side is convex; umbilical side somewhat concav; aperture at the umbilical side covering by flap.

Remarks. Specimens from the Templom-hegy are distinguished from the holotype by a more convex dorsal side with nearly perpendicular edge.

Distribution. The original specimens were identified from the Lower Oxfordian.

Family Placentulinidae G.K. KASIMOVA, POROSHINA & GEODAKCHAN, 1980
Subfamily Ashbrookiinae LOEBLICH & TAPPAN, 1984

Genus *Paalzowella* CUSHMAN, 1933

Paalzowella feifeli feifeli (PAALZOW, 1932)
Pl. 3, Fig.12.

1932. *Trocholina feifeli* nov. spec.; PAALZOW, p. 140, pl. 11, figs 6-7.
1995a. *Paalzowella feifeli feifeli* (PAALZOW, 1932); GÖRÖG, p. 71, pl. X, fig. 8. cum. syn.

Material. 5 specimens.

Description: Test small, trochospirally coiled; low cone, height somewhat smaller than the diameter; numerous chambers arranged in 4 to 7 whorls visible on the spiral side; periphery of the chambers ornamented by carinae, showing a spiral line on the dorsal side, giving step-like appearance; spiral line cuts the sutures; sutures indistinct; umbilical side flat or concave; 3 chambers on the final whorl; aperture interiomarginal, slit, extending nearly from the periphery to the umbilicus.

Distribution. Upper Aalenian – Lower Oxfordian.

Paalzowella turbinella (GÜMBEL, 1862) emend. SEIBOLD E. & I., 1955

?1862. *Rotalina turbinella* n. sp.; GÜMBEL, p. 230, pl. 4, figs 10a-b.
1955. *Paalzowella turbinella* (GÜMBEL, 1862); SEIBOLD, E. & I., p. 126, text-figs 5i-m; pl. 13, fig. 12.
1989. *Paalzowella turbinella* (GÜMBEL); RIEGRAF & LUTERBACHER, p. 1026, pl. 2, fig. 21.
1995a. *Paalzowella turbinella* (GÜMBEL, 1862) emend. SEIBOLD E. and I., 1955; GÖRÖG, p. 72, pl. 10, figs 10-11. cum. syn.

Material. 6 specimens.

Description. Test trochospirally coiled; low cone; umbilical side concave; periphery sharp. Dorsal side: 5 to 7 whorls, the inner 4 to 5 whorls narrow, the last 2 whorls occupy half of the diameter; sharp spiral line runs along the chambers, giving a distinct step-like appearance in side view; sutures indistinct. Ventral side: the last 4 chambers visible; umbilicus depressed; sutures slightly depressed; in half part of each chambers a narrow, deep striae appears, start out umbilicus and up to 3/4 part of radius; aperture on the end of the last chamber, extending above an older chamber.

Remarks. Description and figuration of *Rotalia turbinella* in GÜMBEL (1862) differ from the neotypes of this species in SEIBOLD, E. & I. (1955) in rounded periphery and in absence of the characteristic spiral line.

Distribution. Bathonian – Kimmeridgian.

Suborder Globigerinina DELAGE & HÉROUARD, 1896
Superfamily Favusellacea Longoria, 1974, emend. BANNER & DESAI, 1988
Family Conoglobigerinidae Simmons, BOUDAGHER-FADEL, BANNER & WHITTAKER, 1997

Genus *Conoglobigerina* Morozova, 1961 emend. Simmons, BOUDAGHER-FADEL, BANNER & WHITTAKER, 1997

Conoglobigerina? *avariformis* Kasimova 1984 forma sphaerica WERNLI & GÖRÖG, 1999
Pl. 3, Figs 13-14.

1984. *Conoglobigerina avariformis* n. sp.; in KASIMOVA & ALIEVA, p. 2, pl. 1, figs 1 a-c, 2-4.
1997. *Conoglobigerina avariformis* KASIMOVA, 1984; SIMMONS et al., p. 23, pl. 2.7, figs, 8-10, pl. 2.8, fig. 8(=forma alta); fig. 2.2.
1999. *Conoglobigerina avariformis* KASIMOVA 1984 forma sphaerica; WERNLI & GÖRÖG, p. 424, pl. II, figs 6-10.
2002. *Conoglobigerina*? *avariformis* KASIMOVA 1984 forma sphaerica; GÖRÖG & WERNLI, p. 30, pl. II, figs 5-18.

Material. 8 specimens.

Remarks. Detailed description of this species is given by WERNLI & GÖRÖG (1999) and GÖRÖG & WERNLI (2002).

Distribution. *Conoglobigerina*? *avariformis* has been mentioned from the Bajocian –Bathonian and Kimmeridgian (GÖRÖG et al., 2010).

Genus Globuligerina BIGNOT & GUYADER, 1971 emend. SIMMONS, BOUDAGHER-FADEL, BANNER & WHITTAKER, 1997

Globuligerina aff. *balakhmatovae* Morozova, 1961
Pl. 3, Figs 18-19.

2007. *Globuligerina* aff. *balakhmatovae* (MOROZOVA, 1961); WERNLI & GÖRÖG, p. 201, pl. 4, figs 19-22.

Material. 10 specimens.

Remarks. The forms correspond well to the specimens described by WERNLI & GÖRÖG (2007). The poor preservation did not allow to study the aperture and the wall surface.

Distribution. Previously it was described from the Late Bajocian – Late Bathonian (WERNLI & GÖRÖG, 2007).

Globuligerina bathoniana (PAZDROWA, 1969)
Pl. 3, Figs 15-17.

?1961. *Globigerina conica* n. sp.; IOVČEVA & TRIFONOVA, p. 343, pl. II, figs 1-8.
pars 1969. *Globigerina bathoniana* n. sp; PAZDROWA, p. 45, pl. I, figs 1, 2, 4, (non fig. 3),
figs 5-9, pl. II, figs 1-5, 7?, 8, 9, pl. III, fig. 5, pl. IV, figs 1-3. non pl. II, figs 6 ab.
1996. *Conoglobigerina bathoniana* (PAZDROWA) 1969; NEAGU, p. 308, pl. 1, figs 1-12.
2010. *Globuligerina bathoniana* (PAZDROWA, 1969); GÖRÖG & WERNLI, p. 94, pl. I, figs 1-11. cum. syn.

Material. More than 80 specimens.

Remarks. *G. bathoniana* is a very well known and much-cited species. Detailed synonym list and discussion are given by GÖRÖG & WERNLI (2010). It is the only high trochospiral form in the associations, and appeared only in the Rózsabánya quarry, but in large quantity. The preservation varies from limonite mold to conserved wall structure and surface.

Distribution. Bajocian – Tithonian.

Globuligerina aff. *dagestanica* (MOROZOVA, 1961)
Pl. 3, Figs 21-22.

?1961. *Globigerina (Conoglobigerina) dagestanica* sp. nov.; MOROZOVA in MOROZOVA & MOSKALENKO, p. 24, pl. 1, figs 13–15, pl. 2, figs 14–19, texte-fig. 7, no 1–24.
1997. *Conoglobigerina dagestanica* MOROZOVA, 1961; SIMMONS et al., p. 20, pl. 2.4, fig. 13, figs 13, 15.
1999. *Conoglobigerina* aff. *dagestanica* MOROZOVA, 1961; WERNLI & GÖRÖG, p. 422, pl. 2, figs 1–5.
2002. *Conoglobigerina*? aff. *dagestanica* MOROZOVA; GÖRÖG & WERNLI, p. 30, pl. 2, figs 1–4.
non 2007. *Globuligerina* aff. *dagestanica* (MOROZOVA, 1961); WERNLI & GÖRÖG, p. 201, pl. 4, figs 23-27.

Material. More than 100 specimens.

Remarks. *Globuligerina* aff. *dagestanica* of WERNLI & GÖRÖG (2007) differs from these forms in having smaller size and more compact appearance. Based on this material we can demonstrate that this species has a globuligerine aperture, which classifies it to the genus *Globuligerina.* It is relatively abundant in the Templom-hegy, but missing from the Rózsa-bánya quarry.

Distribution. Bajocian – Bathonian.

Globuligerina oxfordiana (GRIGELIS, 1958)
Pl. 3, Fig. 20.

1958. *Globigerina oxfordiana* n. sp.; GRIGELIS, pp. 109-110, figs 1a-c.
1996. *Globuligerina oxfordiana* (GRIGELIS) 1958; NEAGU, p. 308, pl. 1, figs 13-26.
1997. *Globuligerina oxfordiana* (GRIGELIS, 1958); SIMMONS et al., p. 26, pl. 1.1, fig.1; pl. 1.2, figs 1-5; pl. 2.9, figs 1-15; fig. 2.2. cum. syn.
1999. *Globuligerina oxfordiana* (GRIGELIS, 1958); WERNLI & GÖRÖG, p. 421, pl. I, figs 1-4, 7-10.
2000. *Globuligerina oxfordiana* (GRIGELIS); WERNLI & GÖRÖG, p. 400, pl. I, figs 1, 3-18, pl. III, figs 5-7, 9, 12.
2002. *Globuligerina oxfordiana* (GRIGELIS); GÖRÖG & WERNLI, p. 28, pl. I, figs 1-27.

Material. More than 100 specimens

Remarks. *Globuligerina oxfordiana* is the most frequently cited protoglobigerina from the isolated samples and from rock thin sections as well as. However, we have to note its identification from thin sections higly doubthful. This species has been well documented by different authors and emendation given by Simmons et al. (1997).

Distribution. Bajocian – Oxfordian.

Class Ostracoda LATREILLE, 1802
Subclass Podocopa MÜLLER, 1894
Order Podocopida MÜLLER, 1894
Suborder Bairdiocopina SARS, 1865
Superfamily Bairdioidea SARS, 1865
Family Bairdiidae SARS, 1865

Genus *Bairdia* MCCOY, 1844

Bairdia (Akidobairdia) delicata MONOSTORI, 1995
Pl. 1, Fig. 1.

1995a. *Bairdia (Akidobairdia) delicata* n. sp.; MONOSTORI, p. 157, pl. 23, fig. 7.

Material. Templom-hegy quarry: 1 valve.

Remarks. The shape of the specimen is almost identical to that of the type species described by Monostori (1995) but the size of the Callovian form is larger than that of Bajocian.

Dimensions. L=1.3 mm, H=0.56 mm, L/H=2.32.

Distribution. Bajocian: Som Hill, Bakony Mts (Hungary) (MONOSTORI, 1995a).

Bairdia cf. *caudifera* MONOSTORI, 1995
Pl. 1, Fig. 2.

Material. Templom-hegy quarry: 1 carapace.

Remarks. In the studied material a single damaged carapace can be found with outlines similar to the *Bairdia caudifera* described by Monostori (1995b) from the Bathonian of the Mecsek Mts (Hungary).

Dimensions. L=0.81 mm, H=0.54 mm, L/H=1.5.

Suborder Cytherocopina BAIRD, 1850
Superfamily Cytheroidea BAIRD, 1850
Family Schulerideidae MANDELSTAM, 1959

Genus *Praeschuleridea* BATE, 1963

?*Praeschuleridea* sp.
Pl. 1, Fig. 4.

Material. Templom-hegy quarry: 1 valve.

Remarks. Due to the ferruginous crust on the valve surface, the details of morphological features can not be studied. Only the valve shape and the presence of eye-tubercle indicate a relationship of the specimen with the family Schulerideidae.

Dimensions: L=1.2 mm, H=0.67 mm, L/H=1.79.

Suborder Cypridocopina JONES, 1901
Superfamily Pontocypridoidea MÜLLER, 1894
Family Pontocyprididae MÜLLER, 1894

Genus *Pontocyprella* LIUBIMOVA, 1955

Pontocyprella izjumicaformis MONOSTORI, 1995
Pl. 1, Fig. 3.

1995b. *Pontocyprella izjumicaformis* n. sp.; MONOSTORI, p. 163, pl. 3, fig. 8.

Material. Templom-hegy quarry: 1 carapace.

Remarks. The outline of the Callovian form is significantly smaller than that of the Bathonian type species described by Monostori (1995). The studied specimen may be juvenile or ecological variation.

Dimensions. L= 0.38 mm, H=0.21 mm, L/H= 1.81.

Distribution. Bathonian: Mecsek Mts, South Hungary (MONOSTORI, 1995b).

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Plate 1

(Scale bar: A-G 100 µm; 1-4 250 µm)

A – C Characteristic microfacies of Callovian ammonite-rich bed from Templom-hegy quarry.

A – Biomicrite with strongly fragmented bivalve filaments, protoglobigerinids and lenticulinids.

B – Biomicrite with ferruginous spots and *Glomospira* sp.

C – Biomicrite with filaments and *Spirillina* sp.

D – G Characteristic microfacies of Callovian ammonite-rich layer from Rózsa-bánya quarry.

D – Biomicrite with microgastropods.

E – Biomicrite with high and low trochospiral protoglobigerinids, tiny filaments and microgastropods.

F – Biomicrite with epistominids and protoglobigerinids.

G – Biomicrite with protoglobigerinids.

1-4 Ostracods from Callovian ammonite-rich bed of Templom-hegy quarry.

1 – *Bairdia (Akidobairdia) delicata* MONOSTORI, 1995. Right valve in lateral view.

2 – *Bairdia* cf. *caudifera* MONOSTORI, 1995. Carapace in left view.

3 – *Pontocyprella izjumicaformis* MONOSTORI, 1995. Carapace in right view.

4 – ?*Praeschuleridea* sp. encrusting by ferruginous crusts. Left valve in lateral view.

Plate 1

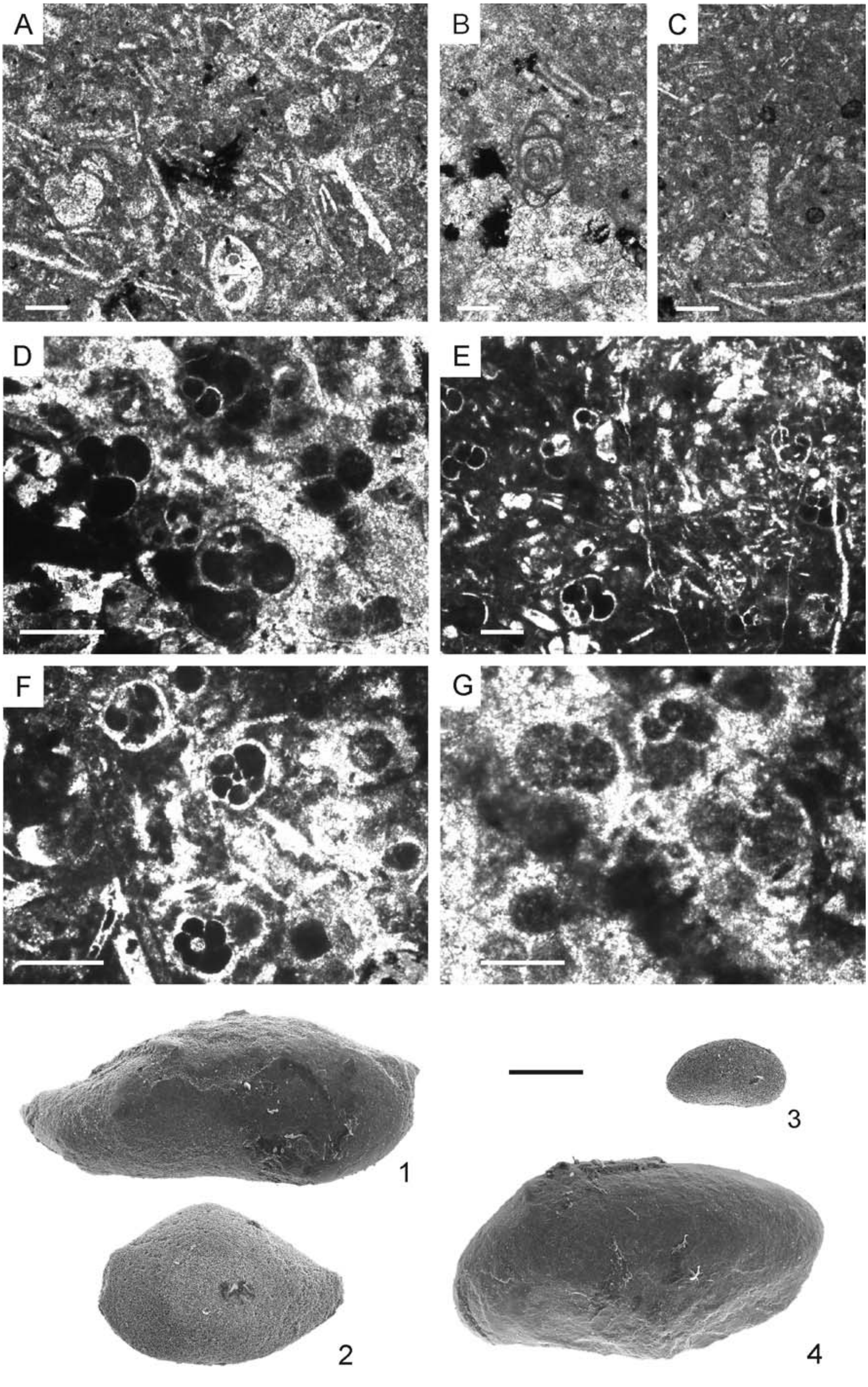

Plate 2

(Scale bar: 100 µm)

Fig. 1. *Lagenammina difflugiformis* (BRADY, 1879). Side view. Templom-hegy quarry.

Fig. 2. ?*Thurammina* sp. Side view. Templom-hegy quarry.

Fig. 3. *Ammodiscus siliceus* (TERQUEM, 1862). Side view. Rózsa-bánya quarry.

Fig. 4. *Glomospira variabilis* (KÜBLER & ZWINGLI, 1870). Side view. Rózsa-bánya quarry.

Fig. 5. *Reophax fusiformis* (WILLIAMSON, 1858). Side view. Templom-hegy quarry.

Figs 6-7. *Tritaxis lobata* (SEIBOLD, E. & I., 1960). Templom-hegy quarry.

6. Spiral view.

7. Umbilical view.

Fig. 8. *Pseudomarssonella dumortieri* (SCHWAGER, 1866). Spiral side. Rózsa-bánya quarry.

Fig. 9. *Spirillina polygyrata* GÜMBEL, 1862. Side view. Rózsa-bánya quarry.

Fig. 10. *Spirillina tenuissima* GÜMBEL, 1862. Side view. Templom-hegy quarry.

Fig. 11. *Dentalina* sp. Side view. Templom-hegy quarry.

Fig. 12. *Nodosaria fontinensis* TERQUEM, 1870. Side view. Templom-hegy quarry.

Plate 2

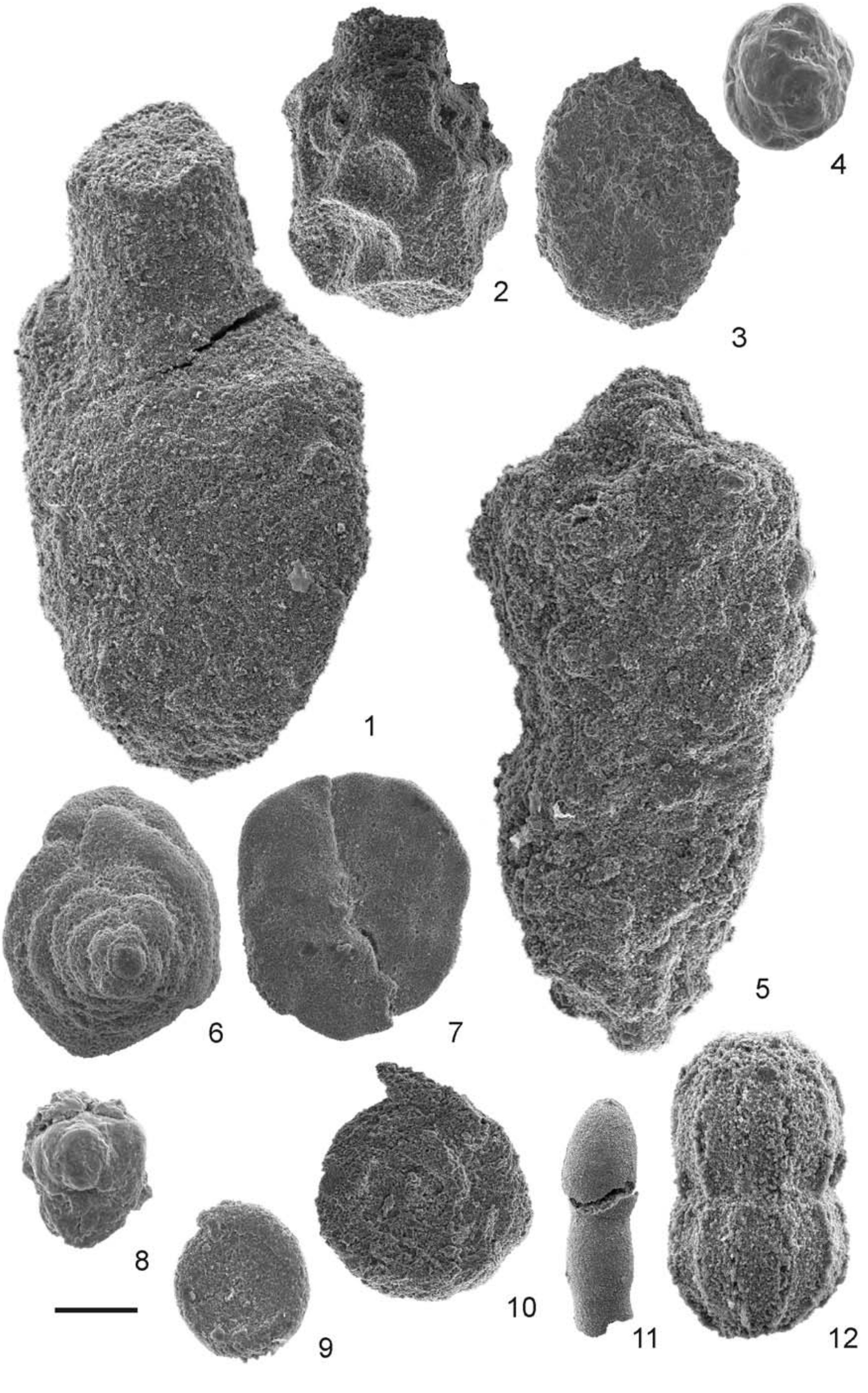

Plate 3

(Scale bar: 100 µm)

Fig. 1. *Lenticulina muensteri* (ROEMER, 1839). Side view. Templom-hegy quarry.

Fig. 2. *Lenticulina* cf. *tumida* MJATLIUK, 1961. Side view. Templom-hegy quarry.

Fig. 3. *Saracenaria* cf. *oxfordiana* TAPPAN, 1955. Side view. Templom-hegy quarry.

Fig. 4. *Astacolus varians* (BORNEMANN, 1854). Side view. Templom-hegy quarry.

Fig. 5. *Eoguttulina liassica* (STRICKLAND, 1846). Side view. Templom-hegy quarry.

Figs 6-7. *Epistomina conica* TERQUEM, 1883. Templom-hegy quarry.

6. Umbilical view.

7. Spiral view.

Figs 8-9. *Epistomina uhligi* MJATLIUK, 1953. Templom-hegy quarry.

8. Umbilical view.

9. Spiral view.

Fig. 10. *Topalodiscorbis paraspis* (SCHWAGER, 1866). Umbilical view. Templom-hegy quarry.

Fig. 11. *Topalodiscorbis* aff. *scutuliformis* (SEIBOLD E.& I., 1960). Umbilical view. Templom-hegy quarry.

Fig. 12. *Paalzowella feifeli feifeli* (PAALZOW, 1932). Spiral view. Templom-hegy quarry.

Figs 13-14. *Conoglobigerina*? *avariformis* KASIMOVA 1984 forma sphaerica WERNLI & GÖRÖG, 1999. Templom-hegy quarry.

13. Recrystallized specimen in side view.

14. Specimen with well preserved shell showing the original surface ornamentation.

Figs 15-17. *Globuligerina bathoniana* (PAZDROWA, 1969). Rózsa-bánya quarry.

15. Internal molds in side view with remnants of the original shell. Initial part broken.

16. Recrystallized specimen in side view.

17. Internal molds in side view with remnants of the original shell.

Figs 18-19. *Globuligerina* aff. *balakhmatovae* MOROZOVA, 1961.

18. Recrystallized specimen in side view. Templom-hegy quarry.

19. Recrystallized specimen in side view. Rózsa-bánya quarry.

Fig. 20. *Globuligerina oxfordiana* (GRIGELIS, 1958). Recrystallized specimen in umbilical view. Templom-hegy quarry.

Figs 21-22. *Globuligerina* aff. *dagestanica* (MOROZOVA, 1961).

21. Recrystallized specimen in umbilical view. Templom-hegy quarry.

22. Recrystallized specimen in side view. Rózsa-bánya quarry.

Fig. 23. Protoglobigerina in spiral view with strongly recrystallized wall. Rózsa-bánya quarry.

Plate 3