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Rhaetian foraminiferal assemblage from the Dachstein Limestone of Mt. Begunjščica (Košuta Unit, eastern Southern Alps)

Retijska foraminiferna združba dachsteinskega apnenca Begunjščice (enota Košuta, vzhodne Južne Alpe)

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Abstract

Mt. Begunjščica (Karavanke Mts., northern Slovenia) structurally belongs to the Košuta Unit (eastern Southern Alps). The Dachstein Limestone, building the northern side of the mountain and its main ridge, was deposited on the Julian Carbonate Platform, while grey and red nodular Jurassic limestones of the southern slope represent sedimentation on the Julian High. The massive Dachstein Limestone contains a rich assemblage of benthic foraminifera. Typical representatives of the reef and back-reef area were recognized. The age of the assemblage is dated as Rhaetian, based on the co-presence of species with a Norian and Rhaetian time span, such as *Galeanella tollmanni*, "*Sigmoilina*" *schaeferae*, *Alpinophragmium perforatum*, *Aulotortus tumidus*, *Variostoma catilliforme*, *Variostoma cochlea* and *Variostoma helicta*, together with the Rhaetian to Lower Jurassic *Involutina turgida*.

Izvleček

Begunjščica (Karavanke, severna Slovenija) strukturno pripada tektonski enoti Košuta (vzhodne Južne Alpe). Dachsteinski apnenec, ki gradi severno stran gore in njen vršni greben, se je odlagal na Julijski karbonatni platformi, medtem ko sivi plastnati in rdeči gomoljasti jurski apnenci predstavljajo sedimentacijo na Julijskem platoju. Masivni del dachsteinskega apnenca vsebuje številne bentoške foraminifere, tipične za grebensko in zagrebensko okolje. Na podlagi prisotnosti vrst z norijsko-retijskim razponom kot so *Galeanella tollmanni*, "*Sigmoilina*" *schaeferae*, *Alpinophragmium perforatum*, *Aulotortus tumidus*, *Variostoma catilliforme*, *Variostoma cochlea* in *Variostoma helicta* z retijsko do zgodnjejursko vrsto *Involutina turgida* je združba retijske starosti.

Introduction

The Late Carnian sea-level rise (Budai & Haas, 1997; Gawlick & Böhm, 2000; Hallam, 2001; Gianolla et al., 2003; Berra et al., 2010) and a warm climate (Sattler & Schlaf, 1999; Flügel, 2004; Berra et al., 2010; Preto et al., 2010; Stefani et al., 2010) together with a suitable palaeogeographic position near the palaeoequator (Stampfli & Borel, 2002, 2004; Stampfli & Kozur, 2006; Golonka, 2007) created favourable conditions for the development of extensive epeiric carbonate platforms along the Neotethys Ocean (Haas, 2004; Vlahović et al., 2002, 2005; Bernecker, 2005; Haas et al., 2007; Golonka, 2007) and a co-temporal bloom of scleractinian coral reefs (Turnšek, 1997; Stanley Jr., 2003; Flügel, 2004; Bernecker, 2005; Russo, 2005). Extremly thick carbonate platforms developed during Norian and Rhaetian also in the NE corner of the Adria microplate: the Julian Carbonate Platform is now structurally mostly incorporated in the Julian Nappe of the Eastern Southern Alps, whereas the Dinaric Carbonate Platform belongs to the External Dinarides (Buser, 1986; Placer, 1999, 2008). The distinction between the two platforms is based on their position with respect to the intermediate deep-water Slovenian Basin, i.e. the Julian Carbonate Platform was situated to the north of the basin (in the present orientation), while the Dinaric Carbonate Platform bordered the Slovenian Basin to the south (Buser, 1986, 1989; Ogorelec & Rothe, 1993; Buser, 1996). The distinction between the platforms is also justified by their different stratigraphic developments: while the Dachstein Limestone constitutes the Julian Carbonate Platform (e.g. Buser, 1986, 1989; Ciarapica & Passeri, 1990; Buser, 1996; Sattler & Schlaf, 1999), early dolomitization resulted in a strong predominance of the Main Dolomite on the Dinaric Carbonate Platform, with the exception of its northern margin (e.g. Buser, 1989; Ogorelec & Rothe, 1993; Buser, 1996). Furthermore, several coral reefs are known from the Julian Carbonate Platform (Fig. 1), while none have been recorded south of the Slovenian Basin (Turnšek et al., 1984; Turnšek, 1997). Coral reefs from the southern brim of the Julian Carbonate Platform bordered the Slovenian Basin and are preserved in the southern Julian Alps (Buser et al., 1982; Turnšek & Buser, 1991; Turnšek, 1997). Reefs are known also from the northern Julian Alps (Buser et al., 1982; Turnšek & Ramovš, 1987; Ramovš & Turnšek, 1991; Turnšek, 1997) and from Mt. Begunjščica in the Karavanke Mts. (Flügel & Ramovš, 1961; Turnšek, 1997), bordering basins which are not preserved due to younger tectonic displacements (Placer, 1999). While reef-constructors from these reefs received considerable attention in the past studies, no such research has focused on associated organisms. Although benthic foraminifera are abundant in the Norian-Rhaetian reefs and can provide important additional information in recognizing peri-reef subenvironments (Senowbari-Daryan, 1980; Sadati, 1981; Flügel, 1981; Schäfer & Senowbari-Daryan, 1981; Senowbari-Daryan et al., 1982; Kristan-Tollmann, 1986, 1990; Zamparelli et al., 1995; Martini et al., 1997, 2004; Chablais et al., 2010b), only few were mentioned by Flügel and Ramovš (1961), Turnšek and Ramovš (1987), Ramovš and Turnšek (1991) and Turnšek and Buser (1991).

The scope of this paper is to give a more complete list of foraminifera found in the reef and back-reef massive Dachstein Limestone of Mt. Begunjščica, after a new research was initiated in 2010. Several taxa are described and the Rhaetian age for the youngest part of the reef confirmed.

Previous Research

The systematic geological research of Mt. Begunjščica (Karavanke Mts., northern Slovenia; Fig. 2) began with the geological mapping performed by the Geological Survey of Vienna in the second half of the 19th century (Lipold 1855-1859 - cf. Ramovš, 2001; Peters, 1855, 1856; Teller, 1899; see also Vetters, 1933a, 1933b). Its structure was later shown on the Celovec sheet of the Basic Geological Map of Yugoslavia (Buser & Cajhen, 1977) and by Brenčič and Poltnig (2008).

Two stratigraphic units dominate Mt. Begunjščica: red and grey nodular Jurassic limestones build large parts of its southern flank, while bedded and massive Dachstein Limestone outcrops on top and on the northern side of the mountain. Jurassic beds were investigated for their ammonoid assemblage by Mihajlović and Ramovš (1965), and are of economical significance due to manganese content (Herlec & Vidrih, 2006; Ogorelec et al., 2006).

The massive reef Dachstein Limestone was studied already by Flügel and Ramovš (1961) and Turnšek (1997). Numerous corals, sponges, solenoporaceans and hydrozoans were determined, some of them characteristic for the Rhaetian age (Flügel & Ramovš, 1961; Turšnek, 1997). Flügel and Ramovš (1961) reported on few foraminifera, namely *Aulotortus* cf. *A. communis* Kristan, 1957, members of the family Ophthalmidiidae and la-

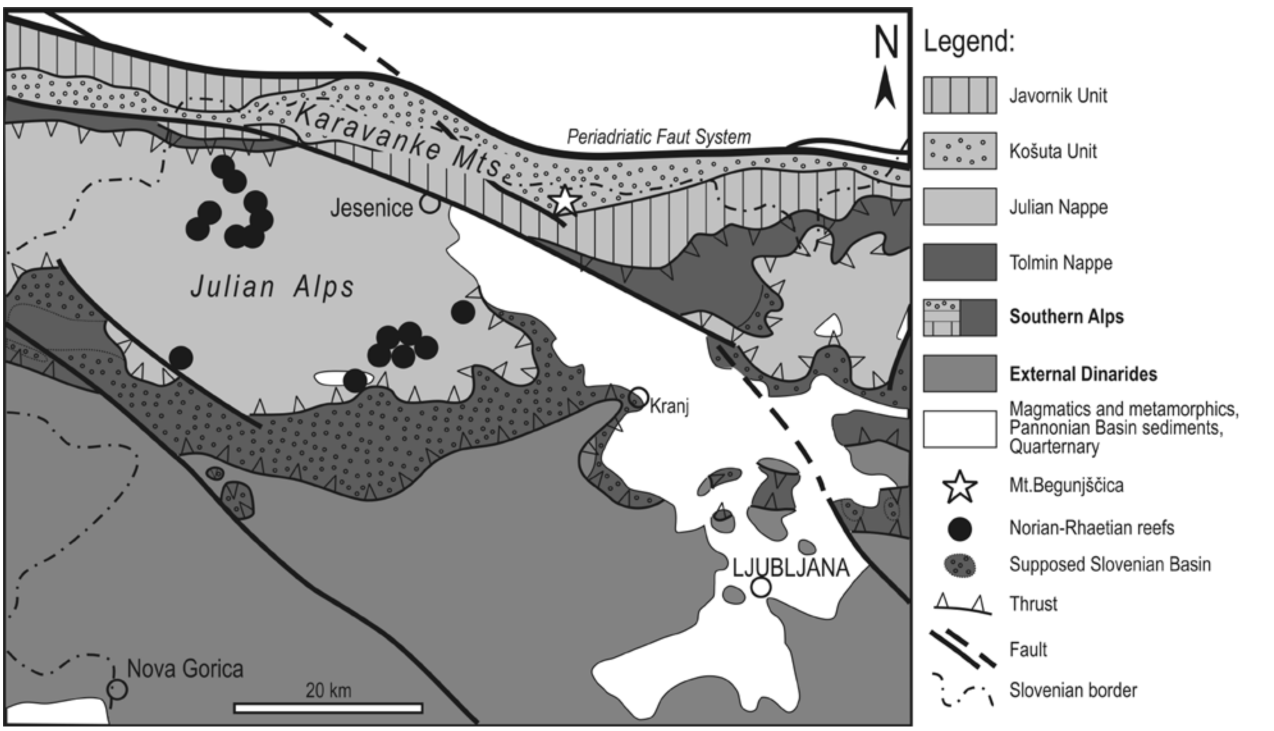

Fig. 1. Structural map of the Slovenian territory (simplified after Placer, 1999), with distributions of Norian and/or Rhaetian reefs (after Turnšek, 1997). The position of Mt. Begunjščica is marked with a star symbol.

Fig. 2. Geographic position of Mt. Begunjščica

genids. Buser (1980) added *Variostoma coniforme* Kristan-Tollmann, 1964, *Diplotremina* cf. *D. subangulata* Kristan-Tollmann, 1964, *Galeanella tollmanni* (Kristan, 1957), *Aulotortus sinuosus* Weynschenk, 1956, *Aulotortus tenuis* (Kristan, 1957) and "*Agerella martana* (Farinacci, 1959)" to the list.

Geological setting

Mt. Begunjščica structurally belongs to the Košuta Unit (Buser, 1980; Brenčič & Polting, 2008), a subunit of the Southern Alps (Placer, 1999, 2008). As such, it can be viewed as a northernmost preserved part of the Julian Carbonate Platform (Turnšek et al., 1984; Placer, 1999), severed from the Julian Nappe during younger tectonic movements and incorporated into the Periadriatic fault zone (Placer, 1999). The Norian-Rhaetian Dachstein Limestone outcrops in the northern part of Mt. Begunjščica, and is separated from gray bedded and red nodular Lower Jurassic limestones by a non-conformity surface (Mihajlović & Ramovš, 1965; Buser, 1980; Ogorelec et al., 2006; Brenčič & Poltnig, 2008) or by a reverse fault (Gale et al., submitted).

Material and methods

Samples were collected along the mountain crest, from bedded to massive Dachstein Limestone. Fifty-eight thin sections of size 47 × 28 mm and 75 × 49 mm were made and investigated with an optical microscope. Thin sections are stored at the Geological Survey of Slovenia (Department for Paleontology and Stratigraphy).

Foraminiferal assemblage

The total foraminiferal assemblage contains the following species (Plates 1–3):

Gandinella falsofriedli (Salaj, Borza & Samuel, 1983), *Glomospirella* sp., *Tolypammina* sp., *Kaeveria fluegeli* (Zaninetti, Altiner, Dager & Ducret, 1982), *Ammobaculites pulcher* Kristan-Tollmann, 1964; *Ammobaculites* spp., *Reophax rudis* Kristan-Tollmann, 1964, *Reophax* spp., *Gaudryinella clavuliniformis* Trifonova, 1967, "*Trochammina*" *almtalensis* Koehn-Zaninetti, 1969, "*Trochammina*" *jaunensis* Brönnimann & Page, 1966, *Duotaxis metula* Kristan, 1957, *Duotaxis birmanica* Zaninetti & Brönnimann in Brönnimann et al., 1975, *Alpinophragmium perforatum* Flügel, 1967, "*Tetrataxis*" *humilis* Kristan, 1957, *Endotriada* sp., *Aulotortus sinuosus* Weynschenk, 1956, *Aulotortus tenuis* (Kristan, 1957), *Aulotortus friedli* (Kristan-Tollmann, 1962), *Aulotortus tumidus* (Kristan-Tollmann, 1964) emend. Piller, 1978, *Auloconus permodiscoides* (Oberhauser, 1964), *Trocholina umbo* Frentzen, 1941, ?*Trocholina crassa* Kristan, 1957, *Trocholina*? *parva* Blau, 1987a, *Trocholina* sp., *Involutina turgida* Kristan, 1957, ?*Triasina hantkeni* Majzon, 1954, *Turrispirillina minima* Pantić, 1967, *Hoyenella* sp., *Agathammina*

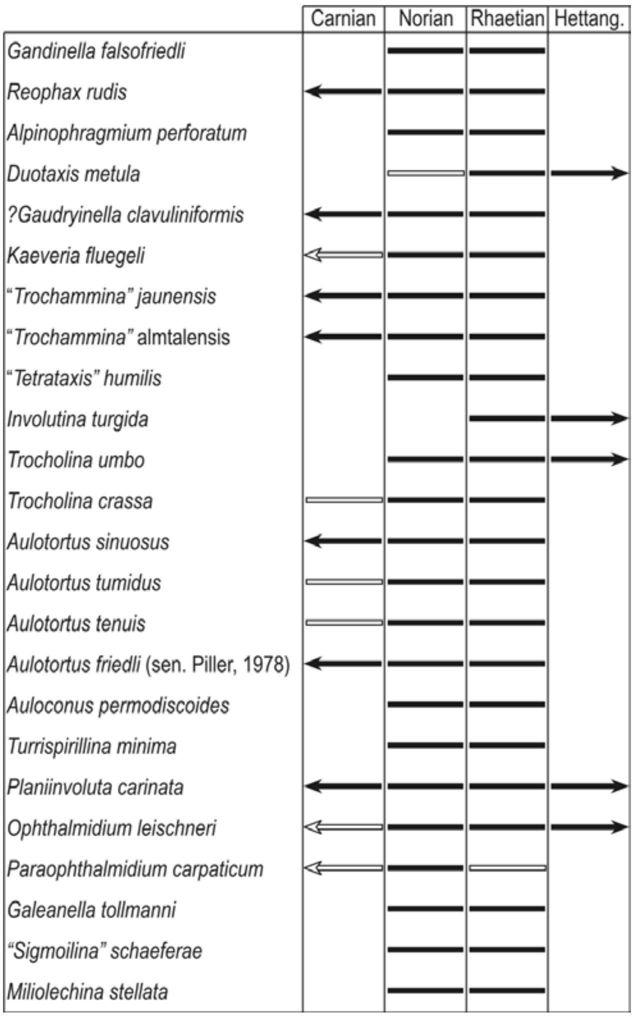

Fig. 3. Stratigraphic ranges of described species from the reef limestone of Mt. Begunjščica

austroalpina Kristan-Tollmann & Tollmann, 1964, *Paraophthalmidium carpaticum* Samuel & Borza, 1981, *Ophthalmidium leischneri* (Kristan-Tollmann, 1962), *Ophthalmidium* sp., *Planiinvoluta carinata* Leischner, 1961, *Miliolechina stellata* Zaninetti, Ciarapica, Cirilli & Cadet, 1985, *Galeanella tollmanni* (Kristan, 1957), "*Sigmoilina*" *schaeferae* Zaninetti, Altiner, Dager & Ducret, 1982, *Miliolipora cuvillieri* Brönnimann & Zaninetti in Brönnimann et al., 1971, *Miliolipora* sp., "*Orthotrinacria expansa* Zaninetti, Altiner, Dager & Ducret, 1982" auct., *Duostomina turboidea* Kristan-Tollmann, 1960, *Duostomina biconvexa* Kristan-Tollmann, 1960, ?*Duostomina astrofimbriata* Kristan-Tollmann, 1960, *Diplotremina placklesiana* Kristan-Tollmann, 1960, *Diplotremina subangulata* Kristan-Tollmann, 1960; *Variostoma coniforme* Kristan-Tollmann, 1960, *Variostoma catilliforme* Kristan-Tollmann, 1960, *Variostoma cochlea* Kristan-Tollmann, 1960, *Variostoma helicta* (Tappan, 1951), "*Frondicularia woodwardii* Howchin, 1895" auct., *Lenticulina* sp.

Only a portion of species is described in detail in the systematic part of the paper. The focus lies on palaeoecologically and stratigraphically important taxa, and the species rarely or poorly described in the literature, especially when remarks on their systematics are needed.

Systematic palaeontology

Suprageneric classification used in this paper follows Loeblich and Tappan (1987, 1992). The synonymy list consists of selected references only, while other reports are cited in the *Geographic distribution and stratigraphic range* paragraphs.

Class Foraminiferea J. J. Lee, 1990
Order Lituolida Lankester, 1885
Superfamily Ammodiscidea Reuss, 1862
Family Ammodiscidae Reuss, 1862
Subfamily Ammovertellininae Saidova, 1981
Genus *Gandinella* Ciarapica & Zaninetti, 1985
(type species: *Gandinella apenninica* Ciarapica & Zaninetti, 1985)

Gandinella falsofriedli (Salaj, Borza & Samuel, 1983)
Pl. 1, figs. 1, 2

*p.p. 1983 *Pilamminella falsofriedli* n. sp. – Salaj et al., p. 67-68, pl. 15, figs. 7, 8, 10, 11 [non pl. 15, figs. 9, 12].
• 1985 *Gandinella apenninica* Ciarapica et Zaninetti, n. gen., n. sp. – Ciarapica and Zaninetti, p. 307-308, pl. 1, figs. 1-14.
1994 *Gandinella falsofriedli* (Salaj, Borza & Samuel, 1983) – Kamoun et al., p. 372-374, pl. 1, figs. 1-8; pl. 2, figs. 1-3.

Material: Thin sections 181, 184, 185, 186C, 186D, 187A, 188A, 188B, 191B, 195A, 236, 249.

Description: The test is free, roughly elliptical in outline. Globular proloculus is followed by an undivided second chamber. The initial mode of coiling is not distinguishable. It is followed by three to four coils in a sigmoidal arrangement. The next one or two coils are perpendicular to the preceding coiling axis. The second sigmoidal stage (two to five coils) forms the last ontogenetic stage. The test wall is thin and dark, probably finely agglutinated.

The test diameter is 0.18-0.36 mm.

Remarks: *Gandinella apenninica* Ciarapica & Zaninetti, 1985 was initially distinguished from *G. falsofriedli* on the basis of smaller size (0.25-0.35 mm) and in the absence of the final, second sigmoidal stage. Kamoun et al. (1994) established the synonymy between the two species.

Gandinella falsofriedli was first marked as typical for the lagoon environment (Salaj et al., 1983), later as a lagoon and shelf-to-basin species (Peybernes et al., 1991; Kamoun et al., 1994). Vachard et al. (1990) found specimens also in a more turbulent environment.

Geographic distribution and stratigraphic range: Undivided Late Triassic of Taurus, Turkey (Brönnimann et al., 1970; Poisson et al., 1985); Norian of China (He, 1982); Norian of Transdanubian Range, Hungary (Oravecz-Scheffer, 1987); Norian of Bulgaria (Trifonova, 1992); Norian and Rhaetian of Apennines, Italy (Ciarapica & Zaninetti, 1985; Ciarapica et al., 1987; Chiocchini et al., 1994; Zamparelli et al., 1995; Mancinelli et al., 2005); Norian and/or Rhaetian of Carpathians (Salaj et al., 1983); Rhaetian of Northern Calcareous Alps, Austria (Senowbari-Daryan, 1980; Kuss, 1983); Rhaetian of Pyrenees (Vachard et al., 1990); Rhaetian of Wombat Plateau, Australia (Zaninetti et al., 1992); Rhaetian of Corsica, France (Peybernes et al., 1991).

Superfamily Hormosinidea Haeckel, 1894
Family Reophacidae Cushman, 1927
Genus *Reophax* de Montfort, 1808
(type species: *Reophax scorpiurus* de Montfort, 1808)

Reophax rudis Kristan-Tollmann, 1964
(non *Reophax rudis* Brady, 1881 [nomen nudum])
Pl. 1, figs. 9-11

*1964a *Reophax rudis* n. sp. – Kristan-Tollmann, p. 39-30, pl. 2, fig. 1.
• 1982 *Reophax tauricus*, n. sp. – Zaninetti et al., p. 106-107, pl. 8, figs. 7, 8, 10, 11.

Material: Thin sections 244A, 245A, 246.

Description: The test is elongated, large, with three to four chambers in an irregular uniserial arrangement. Chambers are wider than high, the last one markedly larger, of equal width and height, distally tapered. Chamber sutures are well pronounced. The test wall is thick, coarsely agglutinated, sometimes including tests of smaller foraminifera.

Tests are 0.76-1.63 mm long.

Remarks: *Reophax rudis* was described on the basis of isolated material (Kristan-Tollmann, 1964a). Because determinations of Late Triassic foraminifera mostly base on material from thin sections, this species was almost never recognized at other localities. Zaninetti et al. (1982) later described a new species, *R. tauricus*, on the basis of specimens found in thin sections, thus making its identification much easier. This species was often found in a reef facies (Zaninetti et al., 1982; He, 1984; Bernecker, 1996; Chablais et al., 2011). *Reophax tauricus* is here treated as a junior synonym of *R. rudis*.

Geographic distribution and stratigraphic range: Anisian of Dinarides, Bosnia and Herzegovina (Brönnimann et al., 1973a); Anisian of China (He, 1984; He & Cai, 1991); Ladinian of Bulgaria (Trifonova, 1992); Ladinian of Apennines, Italy (Ciarapica et al., 1990); Carnian of Oman (Bernecker, 1996); Carnian and/or Norian of Greece (Courtin et al., 1982); Norian and/or Rhaetian of Taurus, Turkey (Zaninetti et al., 1982); Norian and/or Rhaetian of Sambosan Accretionary Complex, Japan (Chablais et al., 2011); Rhaetian of Northern Calcareous Alps (Kristan-Tollmann, 1964a).

Superfamily Coscinophragmatidea Thalmann, 1951
Family Coscinophragmatidae Thalmann, 1951
Genus *Alpinophragmium* Flügel, 1967
(type species: *Alpinophragmium perforatum* Flügel, 1967)

Alpinophragmium perforatum Flügel, 1967
Pl. 1, figs. 5, 6

*1967 *Alpinophragmium perforatum* n. sp. – Flügel, p. 383-395, pls. 1, 2; text-figs. 2-8.

Material: Thin sections 189A, 191B, 242A, 243A, 243B, 244A, 244B, 245B, 284, 291B.

Description: Numerous large, well preserved specimens, fragmented or still attached to the substrate. The basal part of the test is attached, the second part of the test raised above the substrate and elongated. Chambers of the second part are in a rectilinear arrangement, wider then high. The aperture is multiple. The test wall is thick, agglutinated.

The largest specimen measures 3 mm in height.

Remarks: *Alpinophragmium perforatum* is typical for the central reef area (e.g. Hohenegger & Lobitzer, 1971; Schäfer & Senowbari-Daryan, 1978; Senowbari-Daryan, 1980; Sadati, 1981; Senowbari-Daryan et al., 1982; Wurm, 1982; Zaninetti et al., 1982; Kuss, 1983; Matzner, 1986; Kristan-Tollmann, 1990; Bernecker, 2005; Chablais et al., 2010b).

Geographic distribution and stratigraphic range: Undivided Late Triassic of Rhodopes, Macedonia (Urošević & Dumurđanov, 1976); Norian and/or Rhaetian of Northern Calcareous Alps, Austria (Flügel, 1967; Hohenegger & Lobitzer, 1971; Schäfer & Senowbari-Daryan, 1978; Senowbari-Daryan, 1980; Senowbari-Daryan et al., 1982); Norian and/or Rhaetian of Oman (Bernecker, 1996); Norian and Rhaetian of Sambosan Accretionary Complex, Japan (Kristan-Tollmann, 1990; Chablais et al., 2010b); Rhaetian of Carpathians (Gaździcki, 1974); Rhaetian of Northern Calcareous Alps, Austria (Gaździcki et al., 1979; Schäfer, 1979; Matzner, 1986). Vachard and Fontaine (1988) report this species from Upper Ladinian and/or Carnian beds, but their determination is here considered erroneous.

Superfamily Verneuilinidea Cushman, 1911
Family Verneuilinidae Cushman, 1911
Subfamily Verneuilinoidinae Suleymanov, 1973
Genus *Duotaxis* Kristan, 1957
(type species: *Duotaxis metula* Kristan, 1957)

Duotaxis metula Kristan, 1957
Pl. 1, figs. 16, ?17

*1957 *Duotaxis metula* nov. gen. nov. spec. – Kristan, p. 295, pl. 27, figs. 5a-5d, 6.

Material: Thin sections 185, 243A.

Description: The test is highly conical, with up to six trochospiral whorls. The apical end is only slightly rounded, the umbilical side flat, with a very short umbilical opening. Chambers are wider than high, gradually increasing in size. The last chamber is more inflated. The aperture is interiomarginal. The test wall is thick, agglutinated.

The test height is 0.61-0.94 mm, the maximum test width 0.64-0.94 mm. The ratio height/width is 0.95-1.00 mm.

Remarks: *Duotaxis metula* differs from "*Tetrataxis*" *nanus* Kristan-Tollmann, 1964a, which has a similar height/width ratio, in having a larger test. Other Triassic species of genera *Duotaxis* Kristan, 1957 and "*Tetrataxis*" Ehrenberg, 1854 have flatter tests.

Both genera, *Duotaxis* and "*Tetrataxis*", are most abundant in the wider platform area (Hohenegger & Lobitzer, 1971; Martini et al., 2004). They were found also in an oncoid facies and in the central reef area (Schäfer & Senowbari-Daryan, 1978; Wurm, 1982), preferentially on a sandy substrate (Schäfer & Senowbari-Daryan, 1978).

Geographic distribution and stratigraphic range: Norian and/or Rhaetian of Taurus, Turkey (Tuzcu et al., 1982); Rhaetian of Northern Calcareous Alps, Austria (Kristan, 1957; Kristan-Tollmann, 1964b; Matzner, 1986); Rhaetian of Papua New Guinea (Kristan-Tollmann, 1990);

Early Jurassic of Venetian Prealps, Italy (Fugagnoli, 1996) and Apennines, Italy (Mancinelli et al., 2005).

?Genus *Gaudryinella* Plummer, 1931
(type species: *Gaudryinella delrioensis* Plummer, 1931)

?*Gaudryinella clavuliniformis* Trifonova, 1967
Pl. 1, fig. 7

*1967 *Gaudryinella clavuliniformis* sp. nov. – Trifonova, p. 3-4, pl. 1, figs. 11, 12.

Material: Thin section 187A.

Description: A single specimen is in a longitudinal section. The test is elongated, chambers in a rectilinear arrangement. The proloculus is followed by a flaring triserial part (three chambers' length), at the end of which the greatest width of the test is achieved. This part extends along one-third of the test's length. It is followed by a biserial part (three chambers' length), followed finally by a short uniserial part (one chambers' length). Chambers are rounded, sutures slightly depressed. The test wall is agglutinated.

The test is 0.38 mm long and 0.13 mm wide.

Remarks: *Gaudryinella clavuliniformis* differs from *Gaudryinella elegantissima* Kristan-Tollmann, 1964a in a better developed triserial part of the test, which is more than one-third of the test's length long. *Aaptotoichus valis* (Trifonova, 1962) has flatter chambers and better developed three- and biserial parts of the test; the test of *A. valis* also constantly increases in width, so there is no marked difference in the width of the biserial and uniserial parts. *Gaudryinella kotlensis* Trifonova, 1967 has a very short uniserial part and better developed three- and biserial parts.

Geographic distribution and stratigraphic range: Anisian and Carnian of Carpathians (Salaj et al., 1983, 1988); Carnian of Bulgaria (Trifonova, 1967); Carnian of Transdanubian Range, Hungary (Oravecz-Scheffer, 1987); Norian and/or Rhaetian of Sambosan Accretionary Complex, Japan (Chablais et al., 2011); Rhaetian of Northern Calcareous Alps, Austria (cf. Salaj et al., 1983).

Superfamily Ataxophragmiidea Schwager, 1877
Family Ataxophragmiidae Schwager, 1877
Subfamily Pernerininae Loeblich & Tappan, 1964
Genus *Kaeveria* Senowbari-Daryan, 1984
(type species: *Palaeolituonella fluegeli* Zaninetti, Altiner, Dager & Ducret, 1982)

Kaeveria fluegeli (Zaninetti, Altiner, Dager & Ducret, 1982)
Pl. 1, figs. 3, 4

*1982 *Palaeolituonella fluegeli*, n. sp. – Zaninetti et al., p. 107-108, pl. 8, figs. 1, 2, 4, 5.
1984 *Kaeveria fluegeli* (Zaninetti, Altiner, Dager & Ducret 1981) – Senowbari-Daryan, p. 87-89, pl. 1, figs. 1, 2, 5-7, 9-11; pl. 2, fig. 9.
2009 *Kaeveria fluegeli* (Zaninetti, Altiner, Dager et Ducret, 1982) – Korchagin, p. 66-67, fig. 3d.

Material: Thin sections 184, 243A, 244A, 245, 245A, 249.

Description: The test is conical, initially coiled in a low trochospire, consisting of at least seven chambers. Three chambers in a rectilinear arrangement form the last part of the test. The height of these chambers remains virtually constant, while they gradually increase in size. Chamber sutures are pronounced, chambers slightly flaring distally, giving the outline of the test a ragged appearance. Chambers are subdivided into chamberlets by irregularly distributed septulae. These are distally thickened, appearing triangular in cross-section. The aperture is simple, central. The central part of the apertural face is slightly bent inwards. The test wall is thick, agglutinated.

The height of the test is 0.39-0.43 mm and it is 0.43 mm wide in the final part.

Remarks: *Kaeveria fluegeli* is the only species of the genus *Kaeveria*. It is distinguished from the genus *Palaeolituonella* Bérczi-Makk, 1981 by the presence of septulae. The genus *Agglutisolena* Senowbari-Daryan, 1984 differs from the two in the presence of entosolenian tube.

Kaeveria fluegeli was a typical reef-dwelling foraminifera (Zaninetti et al., 1982; Senowbari-Daryan et al., 1982; Senowbari-Daryan, 1984; Bernecker, 1996; Senowbari-Daryan & Flügel, 1996), mostly found in intra-reef cavities (Schäfer & Senowbari-Daryan, 1978; Senowbari-Daryan, 1980). In contrast to *Galeanella*, "*Sigmoilina*" and large species of *Ophthalmidium*, it required arenaceous substrate (Schäfer & Senowbari-Daryan, 1978). Korchagin (2009) instead as a typical facies states clastic slopes of reefs and platforms.

Geographic distribution and stratigraphic range: Undivided Late Ladinian? to Late Triassic of Dinarides, Albania (Pirdeni, 1988); Late Carnian or Norian? to Rhaetian of Cyprus (Martini et al., 2009); Norian of Northern Calcareous Alps, Austria (Wurm, 1982; Senowbari-Daryan & Flügel, 1996); Norian of Palermo Mts., Sicily (Senowbari-Daryan et al., 1982; Senowbari-Daryan, 1984); Norian of Pamir, Turkey (Korchagin, 2009); Norian and/or Rhaetian of Greece (Tsaila-Monopolis, 1988); Norian and/or Rhaetian of Oman (Bernecker, 1996); Norian and/or Rhaetian of Taurus, Turkey (Zaninetti et al., 1982).

Kristan-Tollmann (1990) illustrates washed-out specimens from the Rhaetian strata of Papua New Guinea, but the initial coiled part is not visible, nor is it possible to see the inner structure of the test. Senowbari-Daryan and Flügel (1996) cite a Ladinian to Norian (to Rhaetian?) age, while Korchagin (2009) excludes its occurrence before the Norian.

Order Trochamminida Saidova, 1981
Superfamily Trochamminidea Schwager, 1877
Family Trochamminidae Schwager, 1877
Subfamily Trochammininae Schwager, 1877
Genus *Trochammina* Parker & Jones, 1859
(type species: *Nautilus inflatus* Montagu, 1808)

"*Trochammina*" *jaunensis* Brönnimann & Page, 1966
Pl. 1, fig. 13

1976 *Trochammina jaunensis* Brönnimann & Page, 1966 – Zaninetti, p. 115, pl. 23, figs. 4, 5 [kop. Brönnimann & Page, 1966].

Material: Thin sections 186A, 186B, 186C, 195A, 195B, 241, 249.

Description: The test is relatively small. Chambers are arranged in a low trochospire and strongly increase in size. They are subglobular, arranged in three whorls. The apical side is widely rounded, with an apical angle around 120°. The umbilical side opens into a wide umbilicus, which has a ragged outline. The wall is thin, presumably finely agglutinated.

Tests are 0.11-0.12 mm high and 0.27-0.33 mm wide.

Remarks: "*Trochammina*" *jaunensis* differs from "*Trochammina*" *alpina* and "*Trochammina*" *almtalensis* Koehn-Zaninetti, 1969 in a very flat test with a larger apical angle.

"*Trochammina*" can be found in different facies of the back-reef area (e.g. Hohenegger & Lobitzer, 1971; Schäfer & Senowbari-Daryan, 1978; Wurm, 1982; Abate et al., 1984; Chiocchini et al., 1994; Martini et al., 2004; Mancinelli et al., 2005) and rarely in the central reef area (Kristan-Tollmann, 1986).

Geographic distribution and stratigraphic range: Anisian of Apennines, Italy (Premoli-Silva, 1971); Anisian of Pakistan (Zaninetti & Brönnimann, 1975); Anisian (Gaździcki & Zawidzka, 1973) and Carnian to Rhaetian of Carpathians (Salaj et al., 1983); Late Triassic of Switzerland (Brönnimann & Page, 1966- cf. Zaninetti, 1976); Late Triassic of Transdanubian Range, Hungary (Oravecz-Scheffer, 1987); Carnian of Alsó Hill, Hungary (Bérczi-Makk, 1996); Carnian of Bulgaria (Trifonova, 1978); Carnian of Taurus, Turkey (Zaninetti et al., 1982); Norian and/or Rhaetian of Wombat Plateau, Australia (Zaninetti et al., 1992); Rhaetian of Northern Calcareous Alps, Austria (Schäfer, 1979; Senowbari-Daryan, 1980; Matzner, 1986).

"*Trochammina*" *almtalensis* Koehn-Zaninetti, 1969
Pl. 1, figs. 14, 15

v*1969 *Trochammina almtalensis*, n. sp. – Koehn-Zaninetti, p. 38-39, pl. 5, figs. E, F; text-figs. 6A-6P.

Material: Thin sections 186C, 186D, 187B, 195A, 241, 245B, 246.

Description: Chambers are arranged in a high trochospire in up to 4.5 coils. The apical part of the test is rounded, with sides diverging at 90°. Chambers are subglobular. The umbilical opening has a ragged appearance. The test wall is thin, presumably finely agglutinated.

Tests are 0.19-0.31 mm high and 0.26-0.34 mm wide at the base.

Remarks: The difference between "*Trochammina*" *almtalensis* and "*Trochammina*" *alpina* Kristan-Tollmann, 1964 was not established upon introduction of the former. An obvious difference between the two species is their size, i.e. the type specimens of "*T.*" *alpina* are twice as large. Unfortunately, "*T.*" *alpina* was described on the basis of only two specimens, so variation in size is not known. According to the survey of the literature, intermediate forms between "*T.*" *almtalensis* and "*T.*" *alpina* exist. The comparison between the two species is additionally rendered by the fact that the type material for "*T.*" *alpina* constitutes isolated specimens, while "*T.*" *almtalensis* was described from thin-sections. A possibility for the synonymy of the two species should be further investigated.

Geographic distribution and stratigraphic range: Anisian of Northern Calcareous Alps, Austria (Koehn-Zaninetti, 1969); Middle Triassic of Dinarides, Albania (Pirdeni, 1988) and Serbia (Urošević, 1971; Sudar, 1986); Middle Triassic of Bulgaria (Trifonova, 1977a, 1977b, 1992); Anisian to Carnian of Kocaeli Peninsula, Turkey (Dager, 1978); Carnian of Transdanubian Range, Hungary (Oravecz-Scheffer, 1987; Bérczi-Makk, 1996); Norian of Carpathians (Gaździcki, 1983); Late Norian and/or Rhaetian of Sulawesi, Indonesia (Martini et al., 1997); Rhaetian of Northern Calcareous Alps, Austria (Senowbari-Daryan, 1980).

Order Fusulinida Fursenko, 1958
Superfamily Tetrataxidea Galloway, 1933
Family Tetrataxidae Galloway, 1933
Genus *Tetrataxis* Ehrenberg, 1854
(type species: *Tetrataxis conica* Ehranberg, 1854)

"*Tetrataxis*" *humilis* Kristan, 1957
Pl. 1, fig. 18

*1957 *Tetrataxis humilis* nov. spec. – KRISTAN, p. 292-293, pl. 27, figs. 1a-c, 2a-c, 3.

Material: Thin section 236, 237, 241, 276A.

Description: The test is low conical in shape, with wide chambers in a trochospiral arrangement in four whorls. The apical end of the test is well rounded. Chambers of the last whorl are slightly keeled. The umbilical side is flat. The test wall is dark, probably finely agglutinated.

Tests are 0.12-0.19 mm high and 0.33-0.51mm wide at the base.

Remarks: As pointed out by ZANINETTI (1976) and LOEBLICH and TAPPAN (1987), Triassic species ascribed to the genus *Tetrataxis* lack the two-layered wall of the Palaeozoic species of this genus. A long stratigraphic gap between the two groups additionally suggests that Triassic species belong to a different genus, which should be placed among agglutinated foraminifera and is homeomorphous to the true *Tetrataxis* (see also HAIG et al., 2007).

Geographic distribution and stratigraphic range: Norian of Carpathians (SALAJ et al., 1983); Norian of China (HE & WANG, 1990); Norian and/or Rhaetian of Transdanubian Range, Hungary (ORAVECZ-SCHEFFER, 1987); Norian and/or Rhaetian of Wombat Plateau, Australia (ZANINETTI et al., 1992); Rhaetian of Northern Calcareous Alps, Austria (KRISTAN, 1957).

Order Spirillinida Gorbachik & Mantsurova, 1980
Suborder Involutinina Hohenegger & Piller, 1977
Family Involutinidae Bütschli, 1880
Subfamily Involutininae Bütschli, 1880
Genus *Involutina* Terquem, 1862
(type species: *Involutina jonesi* Terquem & Piette, in Terquem, 1862)

Involutina turgida Kristan, 1957
Pl. 2, fig. 3

*1957 *Involutina turgida* nov. spec. – KRISTAN, p. 275-276, pl. 22, figs. 5-10.

Material: Thin sections 242A, 243B.

Description: The test has an elliptical outline, with the second tubular chamber planispirally coiled. The last whorl is clearly evolute, in contrast with the rest of the test which is covered in secondary material, transected in poorly visible pillars. The test wall is recrystallized and was originally aragonitic.

Diameter of the test is 0.27-0.85 mm.

Remarks: *Involutina turgida* is similar to the stratigraphically younger, but better known species *Involutina liassica* Jones, 1853. The difference lies in the evolute nature of the last whorl, i.e. the deuteroloculus is tubular and not semi-tubular. GUŠIĆ (1975) declined the difference in size of the test and in the shape of the chamber lumen. As strongly recrystallized specimens of both species often cannot be distinguished one from another, BLAU (1987b) proposed to group such specimens under the name *Involutina* ex gr. *I. liassica*. The stratigraphic value of these specimens, however, is much lower than that of the each individual species.

Geographic distribution and stratigraphic range: Rhaetian of Northern Calcareous Alps, Austria (KRISTAN, 1957; KOEHN-ZANINETTI, 1969); Lower Jurassic of Karavanke Mts., Slovenia (RAMOVŠ & KRISTAN-TOLLMANN, 1967; PILLER, 1978); Lower Jurassic of Exmouth Plateau, Australia (KRISTAN-TOLLMANN & COLWELL, 1992; COLWELL et al., 1994). The First Occurrence of *Involutina turgida* in the Slovenian Basin closely coincides with the First Appearance Datum of *Misikella posthernsteini* Kozur & Mock, 1974 (GALE et al., 2011), which is considered the most probable candidate for the base of the Rhaetian (MCROBERTS et al., 2008; ROŽIČ et al., 2009; GIORDANO et al., 2010; LUCAS, 2010).

Genus *Trocholina* Paalzow, 1922
(type species: *Involutina conica* Schlumberger, 1898)

Trocholina umbo Frentzen, 1941
Pl. 2, figs. 6, 7

• 1957 *Trocholina* (*Trocholina*) *granosa* Frentzen, 1941 – KRISTAN, p. 283-284, pl. 24, figs. 1, 2.
? 1957 *Trocholina* (*Trochonella*) *laevis* nov. subgen. nov. spec. – KRISTAN, p. 286-288, pl. 24, fig. 12-14.
• 1976 *Trocholina granosa* Frentzen, 1941 – ZANINETTI, p. 177, pl. 10, fig. 24.
1978 *Trocholina umbo* Frentzen, 1941 – PILLER, p. 81-83, pl. 20, figs. 9-11, 13, 14, 16, 17.
1987a *Trocholina umbo* Frentzen, 1941 – BLAU, p. 500, pl. 1, figs. 1-11.
1999 *Trocholina umbo* Frentzen, 1941 – BÖHM et al., p. 181, pl. 18, figs. 4-12.
2010 *Trocholina umbo* Frentzen, 1941 – SENOWBARI-DARYAN et al., p. 569-571, figs. 3a-j/1, k, l, 4a-f.

Material: Thin sections 180B, 242A, 249, 278C, 292.

Description: Strongly recrystallized or well preserved specimens in axial sections. The test is low conical, with a broadly rounded apical end. The umbilical side is flat or slightly convex. The circular proloculus is followed by a trochospirally coiled tubular deuteroloculus in five or more whorls. Chambers of the last whorl are detached from the umbilical mass, which is divided into numerous short pillars (knots). The chamber lumen is elliptical in cross-section. Sutures are not visible on the outer surface. The test wall is often recrystallized and was originally aragonitic.

Tests measure 0.44-0.64 mm in diameter and 0.21-0.36 mm in height.

Remarks: As pointed out by Piller (1978), *Trocholina granosa* Frentzen, 1941 represents a junior synonym of *Tr. umbo*. *Trocholina laevis* Kristan, 1957, which is very similar to *Tr. umbo*, was instead placed under the synonymy of *Trocholina crassa* Kristan, 1957. The latter species is larger and relatively higher than *Tr. umbo*.

Geographic distribution and stratigraphic range: Norian of China (He, 1999); Norian and/or Rhaetian of Dinarides, Croatia (Gušić, 1975); Rhaetian of Dolomites, Italy (Cros & Neumann, 1964); Rhaetian of Papua New Guinea (Kristan-Tollmann, 1986, 1990); Rhaetian of Pyrenees (Márquez et al., 1994); Rhaetian of Iran (Senowbari-Daryan et al., 2010); Rhaetian and Lower Jurassic of Exmouth Plateau, Australia (Kristan-Tollmann & Colwell, 1992; Kristan-Tollmann & Gramann, 1992); Rhaetian and Lower Jurassic of Northern Calcareous Alps, Austria (Kristan, 1957; Kuss, 1983; Blau, 1987a, b; Ebli, 1993; Böhm et al., 1999); Lower Jurassic of Carpathians (Gaździcki, 1983); Lower Jurassic of Transdanubian Range, Hungary (Blau & Haas, 1991).

Trocholina crassa Kristan, 1957
Pl. 2, figs. 4, 5

*1957 *Trocholina* (*Trochonella*) *crassa* nov. subgen. nov. spec. – Kristan, p. 285-286, pl. 24, fig. 5-11.

Material: Thin sections 242A, 243A, 243B, 244A.

Description: Strongly recrystallized tests are highly conical, with up to seven coils of tubular deuteroloculus following a globular proloculus. The umbilical side is convex, knotted. The last whorl is continuous with the umbilicus. Sutures are not visible on the surface of the test and the chamber lumen is deeply buried under secondary lamellae covering the spiral side of the test.

The test diameter is 0.53-0.96 mm. Tests are 0.50-1.64 mm high.

Remarks: Piller (1978) upon revision of the material by Kristan (1957) concluded that *Tr. laevis* is a junior synonym of *Tr. crassa*. His opinion was not followed by later authors.

Geographic distribution and stratigraphic range: Late Triassic of Dinarides, Croatia (Grgasović, 1997); Carnian and/or Norian of Bulgaria (Trifonova, 1993); Norian of China (He, 1982); Norian and/or Rhaetian of Carpathians (Gaździcki & Zawidzka, 1973; Salaj et al., 1983); Rhaetian of Northern Calcareous Alps, Austria (Kristan, 1957; Senowbari-Daryan, 1980; Matzner, 1986); Rhaetian of Papua New Guinea (Kristan-Tollmann, 1986, 1990); Rhaetian of Exmouth Plateau, Australia (Kristan-Tollmann & Gramann, 1992); Rhaetian of Pyrenees (Márquez et al., 1994).

Subfamily Aulotortinae Zaninetti, 1984
Genus *Aulotortus* Weynschenk, 1956
(type species: *Aulotortus sinuosus* Weynschenk, 1956)

Aulotortus sinuosus Weynschenk, 1956
Pl. 2, figs. 8?, 14, 15

*1956 *Aulotortus sinuosus* Weynschenk, n. sp. – Weynschenk, p. 27, pl. 6, figs. 1-3; text-figs. 1, 2.
• 1967 *Aulotortus brönnimanni* Salaj, nov. sp. – Salaj et al., p. 127-128, pl. 4, fig. 3.
• 1967 *Arenovidalina hybensis* Salaj, nov. sp. – Salaj et al., p. 125, pl. 4, fig. 4.
• 1967 *Rakusia oberhauseri* Salaj, nov. gen., nov. sp. – Salaj et al., p. 129, pl. 5, fig. 3; pl. 8, fig. 4.
• 1967 *Arenovidalina ovulum* Salaj, nov. sp. – Salaj et al., pl. 5, sl. 1 [nom. non rite public].
• 1972 *Involutina muranica* n. sp. – Jendrejáková, p. 197-200, figs. 1-6.
p.p. 1978 *Aulotortus sinuosus* Weynschenk, 1956 – Piller, p. 45-51, pl. 2, figs. 1-7; pl. 3; pl. 4, figs. 1-3, 5-11, 15, 16; pl. 5, figs. 8, 10-16; text-fig. 4 [non pl. 4, figs. 13, 14; ?non pl. 5, figs. 1-7, 9; ?pl. 4, figs. 4, 12].
• 1982 *Aulotortus columnaris* He sp. nov. – He, pl. 4, figs. 1-4.
• 1983 *Permodiscus subsphaericus* n. sp. – Salaj et al., p. 141, pl. 105, fig. 1.
• 1994 *Aulotortus sinuosus* Weynschenk, 1956 – Di Bari & Laghi, p. 106-108, pl. 1, figs. 1-7; pl. 2, figs. 1-2; text-fig. 8.

Material: Thin sections 180B, 181, 184, 185, 186A, 186B, 186C, 186D, 187A, 187B, 188A, 188B, 189A, 189B, 191B, 192, 195A, 240, 241, 245A, 276A, 278C, 279, 280, 282, 290A.

Description: Specimens are numerous and display various degrees of preservation. Most tests are completely recrystallized, but some display the original lamellar structure of the test (see Piller, 1978; di Bari & Laghi, 1994). Preservation of the original aragonitic mineralogy, however, is not proven. Tests are oval and ranging from inflated to completely flat (Pl. 2, fig. 8). Globular proloculus is followed by an undivided tubular deuteroloculus, which winds in a single plane or slightly oscillates around previous whorls in up to seven involute coils.

The test diameter is 0.30-1.64 mm.

Remarks: Large variations in size and shape of *A. sinuosus* reflect environmental influence

(Piller, 1978). The degree of oscillation of the deuteroloculus, on the basis of which several species and subspecies were once distinguished, likewise represents a phenotypic character (Di Bari & Laghi, 1994). Piller (1978) considered *Angulodiscus communis* Kristan, 1957 a junior synonym of *A. sinuosus* and the name *An. communis* rarely appears in the literature since. Di Bari and Laghi (1994) later expressed an opinion that *Angulodiscus* is a valid genus, but no sufficient explanation has been given. Recrystallized specimens of *Triadodiscus eomesozoicus* (Oberhauser, 1957) are also very similar to *A. sinuosus*. The *Triadodiscus* species is nevertheless usually smaller and the last whorls can be evolute.

The genus *Aulotortus* is typical for shallow water carbonate platforms (Hohenegger & Lobitzer, 1971; Piller, 1978; Schäfer & Senowbari-Daryan, 1978; Sadati, 1981; Abate et al., 1984; Kristan-Tollmann, 1986; Martini et al., 2004, 2009).

Geographic distribution and stratigraphic range: *Aulolortus sinuosus* is common in peri-Tethyan and platform carbonates and Panthalassan sea-mounts. Its stratigraphic range is from the Anisian to the Rhaetian (cf. Di Bari & Laghi, 1994).

Aulotortus tumidus (Kristan-Tollmann, 1964)
emend. Piller, 1978
Pl. 2, figs. 12, 13

*1964b *Angulodiscus tumidus* n. sp. – Kristan-Tollmann, p. 141-142, figs. 3.1-3.7.
• p.p. 1969 *Involutina minuta*, n. sp. – Koehn-Zaninetti, p. 132-133, figs. 40a-k, m-n [non fig. 40f].
p.p. 1978 *Aulotortus tumidus* (Kristan-Tollmann, 1964) – Piller, p. 51-55, pl. 6, figs. 1-7; pl. 7, figs. 1, 2, 4-10 [non pl. 6, fig. 8; ?pl. 7, figs. 3, 11, 12].
• p.p. 1983 *Permodiscus praetenuis* n. sp. – Salaj et al., pl. 93, figs. 2-10, 13-18 [?pl. 93, figs. 11, 19].
? 1983 *Permodiscus praecommunis* n. sp. – Salaj et al., p. 139, pl. 85, figs. 1-6; pl. 86, figs. 1-6.
• 1983 *Angulodiscus falsotumidus* n. sp. – Salaj et al., p. 144, pl. 121, figs. 8, 10-12; pl. 122, figs. 1-2.

Material: Thin sections 186A, 187A, 188B, 195A, 236, 237, 241, 243A.

Description: Strongly recrystallized specimens are elliptical, with bulging last whorls (presumably evolute).

Tests measure 0.43-1.01 mm in diameter.

Geographic distribution and stratigraphic range: Late Triassic of Taurus, Turkey (Brönnimann et al., 1970); Late Triassic of Seram, Indonesia (Al-Shaibani et al., 1983) and Burma (Brönnimann et al., 1975); Norian of Lienz Dolomites, Austria (Blau & Schmidt, 1990); Norian of Iran (Zaninetti & Brönnimann, 1974); Norian of China (He, 1982; He & Wang, 1990); Norian of Dinarides, Croatia (Gušić, 1975); Norian of Wombat Plateau, Australia (Zaninetti et al., 1992); Norian of Sambosan Chichibu Zone, Japan (Kristan-Tollmann, 1990); Norian and/or Rhaetian of Exmouth Plateau, Australia (Colwell et al., 1994); Norian and/or Rhaetian of Oman (Bernecker, 1996); Norian and Rhaetian of Apennines, Italy (Ciarapica et al., 1987; Chiocchini et al., 1994; Zamparelli et al., 1995; Mancinelli et al., 2005); Norian and Rhaetian of Carpathians (Gaździcki, 1974, 1983; Salaj et al., 1983); Norian and Rhaetian of Northern Calcareous Alps, Austria (Kristan-Tollmann, 1964b; Koehn-Zaninetti, 1969; Matzner, 1986); Rhaetian of Dolomites, Italy (Bosellini & Broglio-Loriga, 1965); Rhaetian of Pyrenees (Márquez et al., 1994).

Aulotortus tenuis Kristan, 1957
Pl. 2, fig. 9

*1957 *Angulodiscus tenuis* nov. gen. nov. spec. – Kristan, p. 280, pl. 22, fig. 18.
1978 *Aulotortus tenuis* (Kristan, 1957) – Piller, p. 62-64, pl. 12, figs. 1-12.

Material: Thin section 181A.

Description: A single specimen in a longitudinal section displays a well developed inner part of the test with an irregularly coiled tubular deuteroloculus and an outer stage with four planispiral whorls. The globular central part of the test is wider than the planispiral part. The last of the planispiral whorls again increases in width. The test margin is broadly rounded. The chamber lumen is flat, crescent-shaped. The test wall is recrystallized into spar.

The test diameter is 0.98 mm; the test thickness is 0.36 mm.

Remarks: The irregularly coiled initial part of the test is diagnostic for this species. *Aulotortus tumidus* also has evolute final coils, but is planispiral throughout the ontogeny.

Geographic distribution and stratigraphic range: Carnian or Norian of North America Cordillera (Wallowa terrane), Oregon, U.S.A. (Rigaud et al., 2010); Rhaetian of Northern Calcareous Alps, Austria (Kristan, 1957; Koehn-Zaninetti, 1969); Rhaetian of Apennines, Italy (Ciarapica et al., 1987); Rhaetian of Dinarides, Croatia (Grgasović, 1997).

Aulotortus friedli (Kristan-Tollmann, 1962)
emend. Chablais, 2010a, sensu Piller (1978)
(jun. syn. *Aulotortus praegaschei* (Koehn-Zaninetti, 1969) emend. Ciarapica & Zaninetti, 1984)
Pl. 2, figs. 10, 11

*1978 *Aulotortus friedli* (Kristan-Tollmann, 1962) – Piller, p. 55-60, pl. 8, figs. 1-8; pl. 9, figs. 1-16; pl. 10, figs. 1-15.
• 1983 *Rakusia ploechingeri* nov. sp. – Salaj et al., p. 143, pl. 104, fig. 5; pl. 105, fig. 4; pl. 114, fig. 3b.
• 1984a *Aulotortus praegaschei* (Koehn-Zaninetti, 1968) – Ciarapica & Zaninetti, p. 126-128, pl. 1, figs. 5-7.
• 1984b *Aulotortus praegaschei* (Koehn-Zaninetti, 1968) – Ciarapica & Zaninetti, p. 53-54, pl. 1, figs. 1-8; pl. 2, figs. 1-15.
1985 *Aulotortus friedli* (Kristan-Tollmann, 1962) – Ciarapica & Zaninetti, p. 71-86, pl. 1, figs. 1-9; pl. 2, figs. 1-8; pl. 3, figs. 1-9; tex-figs. 1A-F.
1990 *Aulotortus friedli* (Kristan-Tollmann, 1962) emend. Ciarapica & Zaninetti, 1985a – Vachard et al., p. 525-526. pl. 1, fig. 5; pl. 2, fig. 12; pl. 3, figs. 3-5, 7-9.
2010 *Aulotortus friedli* (Kristan-Tollmann), 1962 – Senowbari-Daryan et al., p. 578-580, figs. 12a-d, 13.
2010a *Aulotortus friedli* Kristan-Tollmann (1962) – Chablais et al., p. 141-145, figs. 6.4.1-6.4.9; figs. 6.5.1-6.5.11; fig. 6.6.

Material: Thin sections 184, 186B, 186C, 187A, 189B, 237, 248, 278C, 282.

Description: The test has an irregular elliptical outline, with the coiling of the undivided deuteroloculus in various plains, partly in a sigmoidal arrangement (see Chablais et al., 2010a). The mineralogy of the test wall is difficult to distinguish. It is here interpreted as still aragonitic or recrystallized (in contrast to finely agglutinated of glomospiroid taxa).

The test size is very variable, ranging in diameter from 0.33 to 0.78 mm.

Remarks: The synonymy between *Glomospirella friedli* Kristan-Tollmann, 1962 and *Involutina gaschei* Koehn-Zaninetti & Brönnimann, 1968 was finally established after a long period of debate concerning the original nature of the wall in both species (Ciarapica & Zaninetti, 1985) – a problem also concerning here illustrated specimens. Another problem related to the species *A. friedli* is its relation to *Aulotortus praegaschei* (Koehn-Zaninetti, 1969). Although Ciarapica and Zaninetti (1984b, 1985) distinguished between both species, the opinion of Piller (1978), which treated the later for a junior synonym of *A. friedli*, is followed in this paper. Chablais et al. (2010a) gave a very detailed description of *A. friedli* on the basis of well preserved material from Japan, but did not discuss its relation with *A. praegaschei*.

Aulotortus praegaschei was at first considered a subspecies of *Involutina gaschei*, the absence of the final planispiral phase being a diagnostic character (Koehn-Zaninetti, 1969). According to Piller (1978), the presence/absence of the planispiral phase depends on the environment. In contrast, Ciarapica and Zaninetti (1984b) separated the species on the basis of size (0.25-0.40 mm for *A. praegaschei* and 0.20-1 mm or larger for *A. friedli*), number of coils (10 for *A. praegaschei*, 10-15 for *A. friedli*), the absence/presence of the planispiral phase and their stratigraphic ranges (Ladinian to Carnian for *A. praegaschei*, Norian to Rhaetian for *A. gaschei*). Based on the survey of the literature, the size is also not a diagnostic character. The size, the number of coils and the presence of the planispiral phase can all be viewed as phenotypic characters. Despite these objections, most authors follow the opinion of Ciarapica and Zaninetti (1984b, 1985), with the exception of Velledits and Blau (2003).

Geographic distribution and stratigraphic range: Both species have a Tethys-wide occurrence. *Aulotortus friedli* is known also from the Panthalassan Ocean (Chablais et al., 2010a, 2011; Rigaud et al., 2010). Koehn-Zaninetti (1969) and later Ciarapica and Zaninetti (1984b, 1985), which treat both species valid, cite the Ladinian to Carnian range for *A. praegaschei* and Norian to Rhaetian range for *A. friedli*. Colwell et al. (1994) gave *A. praegaschei* the range from the Ladinian to the Norian. Piller (1978), with the concept of one species, cites the Ladinian to Rhaetian age for *A. friedli*. The same range is cited by Senowbari-Daryan et al. (2010), although they did not include *A. praegaschei* into its synonymy. Chablais et al. (2010a) consider *A. friedli* as Carnian to Rhaetian in age.

Genus *Auloconus* Piller, 1978
(type species: *Trocholina permodiscoides*
(Oberhauser, 1964)

Auloconus permodiscoides (Oberhauser, 1964)
Pl. 2, fig. 16

*1964 *Trocholina permodiscoides* nov. sp. – Oberhauser, p. 207-208, pl. 2, figs. 13-15, 18, 20, 22; pl. 3, fig. 1.
1978 *Auloconus permodiscoides* (Oberhauser, 1964) – Piller, p. 74-76, pl. 20, figs. 1-8.

Material: Thin sections 187A, 187B.

Description: The test is moderately conical, with a broadly rounded apical side. The umbilical side is convex, the umbilicus filled and smoothly rounded. A globular proloculus is followed by a second, tubular chamber which winds in five trochospiral coils. The last whorl is divided from the umbilical mass. The test wall is recrystallized or well preserved, originally aragonitic.

The test diameter is 0.82 mm; the test height is 0.47 mm.

Geographic distribution and stratigraphic range: Upper Triassic of Iran (Zaninetti & Brönnimann, 1974); Norian of Hellenides, Greece (Zaninetti & Thiebault, 1975); Norian of China (He, 1982); Norian and/or Rhaetian of Büdöskút

Olistolith, Bükk Mts., Hungary (Velledits & Blau, 2003); Norian and Rhaetian of Exmouth Plateau, Australia (Zaninetti et al., 1992; Colwell et al., 1994); Norian and Rhaetian of Dinarides, Croatia (Gušić, 1975; Grgasović, 1997); Norian and Rhaetian of Carpathians (Gaździcki & Zawidzka, 1973; Gaździcki, 1974; Gaździcki, 1983; Salaj et al., 1983); Norian and Rhaetian of Northern Calcareous Alps, Austria (Koehn-Zaninetti, 1969; Kuss, 1983; Matzner, 1986); Rhaetian of Dolomites, Italy (Cros & Neumann, 1964); Rhaetian of Apennines, Italy (Ciarapica et al., 1987; Chiocchini et al., 1994); Rhaetian of Alsó Hill, Hungary (Bérczi-Makk, 1980).

Suborder Spirillinina Hohenegger & Piller, 1975
Family Spirilliniadae Reuss & Fritsch, 1861
Genus *Turrispirillina* Cushman, 1927
(type species: *Spirillina conoidea* Paalzow, 1917)

Turrispirillina minima Pantić, 1967
Pl. 2, fig. 18

*1967 *Turrispirillina minima* n. sp. – Pantić, p. 255-256, pl. 1, figs. 1-8; pl. 2, figs. 1, 2.

Material: Thin sections 195A, 243B.

Description: The test is small, highly conical. Proloculus is followed by an undivided tubular chamber in five trochospiral coils. The umbilical side is hollow, with a large umbilical opening. The spiral angle measures 30°, the umbilical angle 130°. The test wall is thin, recrystallized.

The test height is 0.18-0.21 mm, the test diameter 0.28-0.32 mm.

Remarks: Important criteria for distinguishing between species of the genus *Turrispirillina* are the size of the test, the spiral angle (the openness of the umbilicus), the apical angle and the number of chambers. *Turrispirillina minima* has a relatively small number of coils (5-6) and a large umbilical angle compared to its spiral angle. In this features, it is similar to *Turrispirillina*? *licia licia*, from which it differs in smaller size.

Geographic distribution and stratigraphic range: Norian of Dinarides, Monte Negro (Pantić, 1967) and Serbia (Pantić, 1967); Norian of Transdanubian Range, Hungary (Bérczi-Makk et al., 1993). Other specimens figured in the literature are in inappropriate sections (e.g. in Piller, 1978; Salaj et al., 1983; Blau & Schmidt, 1990). Although Velledits and Blau (2003) cite this species as limited to the Norian, Gaździcki and Michalik (1980) mention this species in association with typically Rhaetian fossils. He and Norling (1991) also give the species range from the Norian to the Rhaetian.

Order Miliolida Lankester, 1885 (nom. corr. Calkins, 1909)
Suborder Miliolina Delage & Herouard, 1896
Superfamily Cornuspiridea Schultze, 1854
Family Cornuspiracea Schultze, 1854
Subfamily Calcivertellinae Loeblich & Tappan, 1964
Genus *Planiinvoluta* Leischner, 1961
(type species: *Planiinvoluta carinata* Leischner, 1961)

Planiinvoluta carinata Leischner, 1961
Pl. 3, fig. 1

*1961 *Planiinvoluta carinata* n. g. n. sp. – Leischner, p. 11, pl. 10, figs. 1-14; pl. 12, figs. 6, 7a, 8a.
1971 *Planiinvoluta carinata* Leischner, 1971 – Wernli, p. 222-225, pl. 1, figs. 1-7; pl. 2, figs. 1-6; pl. 3, figs. 1-8.
• 1971 *Planiinvoluta* ? *mesotriasica*, n. sp. – Baud et al., pp. 86-87, pl. 4, figs. 1, 2, 4.
• 1990 *Planiinvoluta multitabulata* n. sp. – Kristan-Tollmann, p. 232, fig. 11.4; pl. 4, figs. 3-6.
1999 *Planiinvoluta carinata* Leischner, 1961 – Böhm et al., p. 182, pl. 5, fig. 5; pl. 22, figs. 1-15.

Material: Thin sections 245A, 288C, 289.

Description: Tests were originally attached to the substrate (see Pl. 3, fig. 1). The globular proloculus is followed by a planispirally coiled deuteroloculus, which follows the surface of the substrate in up to four coils. The test wall is dark, originally probably porcelaneous.

The test diameter 0.57 mm.

Remarks: As *Planiinvoluta* needed a firm substrate for attachment, it is most abundant in the reef area (e.g. Wurm, 1982; Kristan-Tollmann, 1986; Martini et al., 2004; Chablais et al., 2011). However, it is expected in other facies units as well.

Geographic distribution and stratigraphic range: Middle Triassic of Pakistan (Zaninetti & Brönnimann, 1975); Anisian of Germany (Martini et al., 1996); Ladinian (?) and Carnian of Transdanubian Range, Hungary (Oravecz-Scheffer, 1987; Góczán & Oravecz-Scheffer, 1996); Ladinian and/or Norian of Bulgaria (Trifonova, 1993); Norian and Rhaetian of Carpathians (Gaździcki & Zawidzka, 1973; Gaździcki, 1974, 1983; Salaj et al., 1983); Norian and Rhaetian of Exmouth Plateau, Australia (Zaninetti et al., 1992); Rhaetian of Seram, Indonesia (Al-Shaibani et al., 1983; Martini et al., 2004); Rhaetian of Papua New Guinea (Kristan-Tollmann, 1986, 1990); Norian, Rhaetian and Lower Jurassic of Northern Calcareous Alps, Austria (Leischner, 1961; Kristan-Tollmann, 1964a; Schäfer & Senowbari-Daryan, 1978; Kuss, 1983; Matzner, 1986 Ebli, 1993; Böhm et al., 1999). *Planiinvoluta*? *mesotriasica* was described from the Anisian beds of Switzerland (Baud et al., 1971).

Superfamily Nubeculariidea Jones, 1875
(nom. transl. Mikhalevich, 1988)

Family Ophthalmidiidae Wiesner, 1920
Genus *Ophthalmidium* Kübler & Zwingli, 1870
(type species: *Oculina liassica* Kübler & Zwingli, 1866)

Ophthalmidium leischneri (Kristan-Tollmann, 1962)
Pl. 3, fig. 2

1976 *Ophthalmidium leischneri* (Kristan-Tollmann, 1962) – Zaninetti, p. 144-145, pl. 7, figs. 14-16 [kop. Kristan-Tollmann, 1962].

Material: Thin section 242A.

Description: The test is in axial section biconcave, with a well rounded margin. Chambers are in a planispiral arrangement, slightly deviating from the coiling axis in around three coils. The test wall is dark, micritic, originally porcelaneous.

The specimen measures 0.3 mm in diameter and is 0.12 mm thick.

Remarks: In the opinion of Gušić (1975), *O. leischneri* and *Ophthalmidium carinatum* (Leischner, 1961) represent different axial sections of the same species. To solve this issue, oriented sections of the type material are needed (Böhm et al., 1999). *Ophthalmidium carinatum* is currently distinguished from *O. leischneri* on the basis of a keeled test margin.

Geographic distribution and stratigraphic range: Norian of China (He & Wang, 1990); Norian and Rhaetian of Exmouth Plateau, Australia (Kristan-Tollmann & Gramann, 1992); Rhaetian of Carpathians (Gaździcki, 1983); Rhaetian of Papua New Guinea (Kristan-Tollmann, 1990); Late Triassic to Lower Jurassic of Transdanubian Range, Hungary (Oravecz-Scheffer, 1987); Norian and Lower Jurassic of Northern Calcareous Alps, Austria (Wurm, 1982; Ebli, 1993); Norian and/or Rhaetian and Lower Jurassic of Taurus, Turkey (Brönnimann et al., 1970; Zaninetti et al., 1982). Bérczi-Makk (1996) illustrates specimens corresponding to *O. leischneri* from (undivided) Anisian to Carnian of Alsó Hill, Hungary. He and Wang (1990) show some questionable specimens from the Norian of China and Trifonova (1993) from the Ladinian of Bulgaria. Trifonova (1993) at the same time cites stratigraphic range from the Norian to the Lower Jurassic.

Genus *Paraophthalmidium* Samuel & Borza, 1981
(type species: *Paraophthalmidium carpaticum* Samuel & Borza, 1981)

Paraophthalmidium carpaticum Samuel & Borza, 1981 auct.
Pl. 3, fig. 3

*1981 *Paraophthalmidium carpaticum* nov. sp. – Samuel & Borza, p. 68, pl. 19, fig. 4.

1982 *Paraophthalmidium carpathicum* [sic] Samuel & Borza, 1981 – Zaninetti et al., p. 110, pl. 6, figs. 4?, 5?, 6, 7.

Material: Thin sections 243B, 245A, 247, 283, 288C.

Description: An excellent, almost complete specimen is presented in Plate 3, figure 3. Chambers are in a planispiral arrangement, half-of-coil in length, separated by pronounced septa. Three whorls are visible. The aperture is situated at the end of a long neck, surrounded by a lip. The test wall is dark, micritic, porcelaneous.

The test height (neck excluded) is 0.44 mm, its width 0.16 mm. The neck is 0.13 mm long.

Remarks: The genus and species are in need of a further research, as they are based on one specimen in an axial section only. It has become a common practice to name every planispiral ophthalmidiid form with a neck and a lip-bordered aperture *P. carpaticum* without the critical comparison with the type specimen.

Geographic distribution and stratigraphic range: Ladinian and/or Carnian of Hellenides, Greece (Tsaila-Monopolis, 1988); poorly divided Late Triassic of Seram, Indonesia (Martini et al., 2004) and Cyprus (Martini et al., 2009); Carnian of Carpathians (Samuel & Borza, 1981; Salaj et al., 1983); Carnian of Bulgaria (Trifonova, 1993); Carnian of North America Cordillera, Washington, U.S.A. (Igo & Adachi, 1992); Norian and/or Rhaetian of Taurus, Turkey (Zaninetti et al., 1982).

Superfamily Milioliporidea Brönnimann & Zaninetti, 1971
Family Milioliporidae Brönnimann & Zaninetti, 1971
Subfamily Galeanellinae Zaninetti, Altiner, Dager & Ducret, 1982
Genus *Galeanella* Kristan, 1958 emend. Zaninetti & Brönnimann, 1973
(type species: *Galea tollmanni* Kristan, 1957)

Remarks: Despite being one of the most common genera of the Norian-Rhaetian reefs, some issues exist concerning the taxonomy of *Galeanella* (see also Senowbari-Daryan et al., 2010), originating from different types of the type material (i.e. thin section studies or isolated specimens), poorly researched ontogeny, insufficient quantity of type specimens, ignorance of orientation of sections and ignorance of the diagenetic changes to the test wall when distinguishing *Galeanella* from forms such as *Cucurbita* Jablonský, 1973.

Galeanella tollmanni was described by Kristan (1957) on the basis of isolated specimens, washed-out from Zlambach marlstone. Successive sections of the test were likewise illustrated, though made in one orientation only. Brönnimann et al. (1973b) later emended the description of the genus, gave a further description of *G. tollmanni* and introduced a new species, *Galeanella panticae* Zaninetti & Brönnimann in Brönnimann et al., 1973, on the basis of specimens found in thin sections. Especially illustrative is their three-dimensional reconstruction of the test and its possible sections in various planes. *Galeanella panticae* was supposed to differ from *G. tollmanni* in an incomplete overlapping of chambers and in age (Norian for *G. panticae* and Rhaetian for *G. tollmanni*). Both species are of the same size and it soon became known that the stratigraphic ranges of both species overlap (e.g. Schäfer, 1979; Salaj et al., 1983; Matzner, 1986; Kristan-Tollmann, 1990).

In practice, it is impossible to distinguish between the two species and they are here regarded as synonymous, an opinion already expressed by Kristan-Tollmann (1990).

Zaninetti et al. (1982) described three new species of the genus *Galeanella*. *Galeanella expansa* Zaninetti, Altiner, Dager & Ducret, 1982 was later transferred to the genus *Orthotrinacria* Zaninetti, Senowbari-Daryan, Ciarapica & Cirilli, 1985 (Zaninetti et al., 1985; Zaninetti & Martini, 1993). The other two species, *Galeanella minuta* and *Galeanella variabilis*, were distinguished from one another on the basis of a better developed foot in the latter. In my opinion, there is no difference between the two species and *Galeanella minuta* should hold the priority. Characteristic feature of this species is its small size (diameter 0.30-0.35 mm), though it must be noted, that specimens of this size form an early ontogenetic stage of *G. tollmanni* (personal research of the author)!

Galeanella lucana Miconneti, Ciarapica & Zaninetti, 1983 was established on a single, unsuitably oriented specimen and is here treated as a junior synonym of *G. tollmanni*.

Galeanella laticarinata Al-Shaibani, Carter & Zaninetti, 1983 has a small test (as in *G. minuta*) and an elongated foot (Al-Shaibani et al., 1983). The specimen illustrated in Kristan-Tollmann (1964a) as *G. tollmanni* corresponds to this description. Senowbari-Daryan et al. (2010) believe that *G. laticarinata* is similar to *G. tollmanni*. Truly, most of the specimens described as *G. laticarinata* cannot be distinguished from *G. tollmanni* on that feature alone. The exceptions are specimens figured by Martini et al. (2004).

To summarize, the valid species of the genus *Galeanella* are herein considered *G. tollmanni*, *G. minuta* and (questionably) *G. laticarinata*.

Galeanella tollmanni (Kristan, 1957)
Pl. 3, figs. 4, 5

*1957 *Galea tollmanni* nov. gen. nov. spec. – Kristan, p. 291-292, pl. 25, figs. 7-9; pl. 26, figs. 1-5.
1973b *Galeanella tollmanni* (Kristan), 1957 – Brönnimann et al., p. 416-420, pl. 1, figs. 1-6.
• 1973b *Galeanella panticae* Zaninetti & Brönnimann, n. sp. – Brönnimann et al., p. 420-426, pl. 2, figs. 1-21; pl. 3, figs. 1-13.
• 1982 *Galeanella panticae* Zaninetti et Brönnimann in Brönnimann, Cadet, Ricou et Zaninetti, 1973 – Zaninetti et al., p. 112, pl. 1, figs. 1-3, 4?, 5-11.
• 1983 *Galeanella panticae* Zaninetti and Brönnimann in Brönnimann, Cadet, Ricou and Zaninetti, 1973- Al-Shaibani et al., p. 304-305, pl. 3, figs. 22-24, 25?.
• 1983 *Galeanella* sp. 1 or overgrown *Galeanella panticae* Zaninetti and Brönnimann, 1973 – Al-Shaibani et al., p. 305, pl. 2, figs. 5, 6, 9, 10.
• 1983 *Galeanella lucana* Miconnet, Ciarapica et aZaninetti, n.sp. – Miconnet et al., p. 136-137, pl. 1, figs. 1-3.

Material: Thin sections 242A, 242B, 243A, 243B, 244A, 245, 245A, 245B, 246, 283, 284, 288C, 289, 290A, 292, 293.

Description: Numerous specimens in different sections and with different degrees of test preservation. The test is relatively large, subglobular. Chambers are coiled closely together, with a proximally larger lumen which narrows towards the distal end and a typically thick, coarsely perforated wall. Each coil is formed by two chambers. The aperture is simple, rounded, set into a slightly depressed center of a wide apertural face (in the literature often referred to as the “foot”).

Tests are 0.38-0.65 mm long.

Remarks: *Galeanella* is a typical dweller of the reef area (Hohenegger & Lobitzer, 1971; Schäfer & Senowbari-Daryan, 1978; Sadati, 1981; Senowbari-Daryan et al., 1982; Zaninetti et al., 1982; Wurm, 1982; Abate et al., 1984; Kristan-Tollmann, 1986; Zaninetti et al., 1992; Martini et al., 2004; Chablais et al., 2011). Only Martini et al. (1997) give reports on its occurrence from the lagoon facies.

Geographic distribution and stratigraphic range: Norian of Dinarides, and Zagros Mts., Iran (Brönnimann et al., 1973b); Norian and Rhaetian of Northern Calcareous Alps, Austria (Kristan, 1957; Kristan-Tollmann, 1964a; Schäfer, 1979; Senowbari-Daryan et al., 1982; Wurm, 1982; Matzner, 1986); Norian and Rhaetian of Julian Alps, Slovenia (Buser, 1986; Rožič et al., 2009); Norian and/or Rhaetian of Seram (Al-Shaibani et al., 1983) and Sulawesi, Indonesia (Martini et al., 1997); Norian and Rhaetian of Taurus, Turkey (Zaninetti et al., 1982); Norian and Rhaetian of Apennines, Italy (Miconnet et al., 1983); Rhaetian of Papua New Guinea (Kristan-Tollmann, 1990).

Superfamily Miliolidea Ehrenberg, 1839
Family Hauerinidae Schwager, 1876
Subfamily Sigmoilinitinae Luczkowska, 1974
Genus *Sigmoilina* Schlumberger, 1887
(type species: *Planispirina sigmoidea* Brady, 1884)

"*Sigmoilina*" *schaeferae* Zaninetti, Altiner, Dager & Ducret, 1982
Pl. 3, fig. 11

* 1982 "*Sigmoilina*" *schaeferae*, n. sp. – Zaninetti et al., p. 110-111, pl. 8, figs. 3, 6, 9, 12, 13.
1986 *Sigmoilina* aff. *schaeferae* Zaninetti, Altiner, Dager & Ducret – Matzner, pl. 4, fig. 3.

Material: Thin sections 186C, 244A, 245A, 245B, 246, 247, 249, 283, 284, 286A, 290A, 293.

Description: The test is oval in shape. Chambers are in a sigmoidal arrangement. The last pair bears a characteristic keel on the outer surface of the wall. The wall is porcelaneous, coarsely perforated.

Tests measure 0.28-0.78 mm in diameter.

Remarks: Zaninetti et al. (1982) classified the new species as belonging to the genus *Sigmoilina* due to the characteristic chamber arrangement and its porcelaneous wall. Observations were made from thin sections, so they were unable to see the aperture of the new species (thus their uncertainty with the genus attribution). However, according to our specimens, "*Sigmoilina*" *schaeferae* possesses large perforations of its wall (see also Matzner, 1986), which are not present in true *Sigmoilina*, and should be placed in a new genus of the superfamily Milioliporidea.

"*Sigmoilina*" *schaeferae* favourized micritic substrate (Bernecker, 2005) of the central-reef area (Hohenegger & Lobitzer, 1971; Schäfer & Senowbari-Daryan, 1978; Wurm, 1982; Senowbari-Daryan et al., 1982; Chablais et al., 2010b) or reef flanks (Martini et al., 2004).

Geographic distribution and stratigraphic range: Norian of Bulgaria (Trifonova, 1993); Norian and/or Rhaetian of Taurus, Turkey (Zaninetti et al., 1982); Norian and/or Rhaetian of Seram, Indonesia (Al-Shaibani et al., 1983); Norian and Rhaetian (?) of Carpathians (Salaj et al., 1983); Rhaetian of Iran (Senowbari-Daryan et al., 2010); Rhaetian of Northern Calcareous Alps (Matzner, 1986).

Family Miliolechinidae Zaninetti, Ciarapica, Cirilli & Cadet, 1985
Genus *Miliolechina* Zaninetti, Ciarapica, Cirilli & Cadet, 1985
(type species: *Miliolechina stellata* Zaninetti, Ciarapica, Cirilli & Cadet, 1985)

Miliolechina stellata Zaninetti, Ciarapica, Cirilli & Cadet, 1985
Pl. 3, fig. 12

*1985 *Miliolechina stellata* Zaninetti, Ciarapica, Cirilli & Cadet, n. gen., n. sp. – Zaninetti et al., p. 331-334, pl. 1, figs. 1-9; pl. 2, figs. 1-9.

Material: Thin section 243B.

Description: The test is small, with chambers in a quinqueloculine-like arrangement. Hollow spines protrude from the outer surface of chambers. The wall is dark, micritic, originally porcelaneous.

The diameter of the test is 0.21 mm.

Remarks: Characteristic spines of this species served for anchoring on the sea-floor (Ciarapica et al., 1988).

Geographic distribution and stratigraphic range: Norian of Dinarides (Zaninetti et al., 1985), Rhaetian of Northern Calcareous Alps, Austria (Schäfer, 1979).

Discussion

Biostratigraphy

Stratigraphic ranges of the species described above are summarized in Figure 3. Based on the overlapping Norian-Rhaetian ranges of *G. falsofriedli*, *A. perforatum*, "*T.*" *humilis*, *Au. permodiscoides*, *T. minima*, *G. tollmanni*, "*S.*" *schaeferae* and *M. stellata* with a Rhaetian-Lower Jurassic range of *I. turgida*, the upper part of the reef limestone belongs to the Rhaetian. The finding of ?*T. hantkeni* (Pl. 3, fig. 17) confirms this age, but the mentioned specimen is too poorly preserved to allow a reliable determination of age on its own.

Some discussion is needed about the previous determination of "*Agerella martana*" at the same locality (Buser, 1980), because the latter species is often used as indicative of the Lower Jurassic age (e.g. Chiocchini et al., 1994):

The original description of *Vidalina martana* by Farinacci (1959) is not valid, firstly because no type specimen was determined and, secondly, because the proposed reconstruction of the species does not match the specimens illustrated. Furthermore, Farinacci's (1959) material is probably polyspecific and even polygeneric (see also Wernli, 1972). The emendation of the species was prepared in 1991, when a new genus, *Agerina*, was established because of the difference in wall structure to the type specimen of the genus *Vidalina* Schlumberger, 1900, *Vidalina hispanica* Schlumberger, 1900 (Farinacci, 1991). However, the equatorial sections of the specimens illustrated by Farinacci (1991), clearly show a chambered nature of the test and should thus be regarded as *Ophthalmidium*. The correct species name is thus *Ophthalmidium martana* (Farinacci, 1991). The later replacement by Turvey (2003) of the genus *Agerina* Farinacci with *Agerella*, is based solely on the preoccupation of the name *Agerina*, so the name *Agerella* also becomes a junior synonym of *Ophthalmidium*. The importance of the species "*Agerina martana*" (correctly *Ophthalmidium martanum*) is that it is often treated as indicative of a Lower Jurassic age (e.g. Chiocchini et al., 1994). A further complication arises, because it has been often cited from Triassic beds as well, usually under the name *Ophthalmidium martanum* (e.g. Brönnimann et al., 1970; Gaździcki et al., 1979; Wurm, 1982; Senowbari-Daryan et al., 1982; Gaździcki, 1983; Oravecz-Scheffer, 1987; Góczan & Oravecz-Scheffer, 1996). These determinations are all based on axial sections, which differ from the true *Ophthalmidium martana* (*sensu* this work) in the number of coils and/or the test size. *Ophthalmidium martana* (*sensu* this work) for the present remains indicative of the Lower Jurassic, but its stratigraphic range and environmental requirements should be more thoroughly researched, as monospecific associations (personal observations) indicate an opportunistic nature of this species. Because no specimens were illustrated by Buser (1980), the presence of *O. martana* on Mt. Begunjščica cannot be confirmed. Moreover, it is very likely, that the specimens observed were wrongly assigned to this species, as many Triassic specimens before.

Foraminifera as facies indicators

Although the determined assemblage gives a relatively good biostratigraphic result due to the finding of *I. turgida*, Late Triassic foraminifera usually prove to be more useful as facies indicators. Constraints of some species to typical facies units of the peri-reef environments are allready indicated in the systematic part of the paper. Table 1 shows the spatial distribution of individual species on Mt. Begunjščica according to the position of samples. The distinction between the central-reef area, the transitional zone and the back-reef area is based on sedimentological criteria alone (work in progress) and is extremely well supported by foraminiferal data. At the same time, spatial distributions on Mt. Begunjščica correspond to palaeoecological zonations established for reefs from the Northern Calcareous Alps (Hohenegger & Lobitzer 1971; Hohenegger & Piller, 1975; Schäfer & Senowbari-Daryan, 1978; Schäfer, 1979; Senowbari-Daryan, 1980; Flügel, 1981; Piller, 1981; Sadati, 1981; Schäfer & Senowbari-Daryan, 1981; Kuss, 1983), Sicily (Senowbari-Daryan et al., 1982; Martini et al., 2007), Cyprus (Martini et al., 2009), Oman (Bernecker, 2007), Seram in Indonesia (Al-Shabani et al., 1983; Martini et al., 2004), Sulawesi in Indonesia (Martini et al., 1997), from Sambosan Accretionary Complex in Japan (Chablais et al., 2010a, 2010b, 2011), and from the Palawan Block in Philippines (Kiessling & Flügel, 2000). As typical markers of the central-reef area, we note *K. fluegeli*, *A. perforatum*, *Tr. umbo*, *Tr. crassa*, *Tr.*? *parva*, *I. turgida*, *P. carpaticum*, *M. stellata*, *G. tollmanni*, "*S.*" *schaeferae* and *O. expansa* auct. Though some other species were found only in the central-reef area, our data alone is not enough to consider them as indicators of the central-reef area. In addition, some genera (namely *Trocholina* and *Involutina*) may be present also in the fore-reef area (see Piller, 1978), which is not preserved on Mt. Begunjščica. On the other hand, species such as *G. falsofriedli*, "*T.*" *almtalensis*, "*T.*" *jaunensis*, "*Te.*" *humilis*, *Aulotortus* spp., *Auloconus permodiscoides*, ?*T. hantkeni*, *A. austroalpina* and *M. cuvillieri* are good indicators for the back-reef zone.

Conclusions

A rich foraminiferal assemblage, consisting of 32 genera and over 41 species was determined from massive peri-reef Dachstein limestone of Mt. Begunjščica. Stratigraphically the most important species are *Galeanella tollmanni*, "*Sigmoilina*" *schaeferae*, *Alpinophragmium perforatum*, *Aulotortus tumidus*, *Variostoma catilliforme*, *Variostoma cochlea* and *Variostoma helicta* (all with the Norian to Rhaetian range), which in combination with *Involutina turgida* (Rhaetian to Lower Jurassic range) give a Rhaetian age for the topmost preserved part of the reef. The spatial distribution of species gives a clear distinction between the central reef and back-reef areas, with the transitional zone in between (Table 1), thus providing a good basis for the future palaeoenvironmental studies.

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Tab. 1. Spatial distribution of foraminifera in the transect from the back-reef to the central-reef area, with the transitional zone in between. The two end-members of the peri-reef area were distinguished on the basis of sedimentological criteria alone.

Species	Thin sections	central-reef	transition	back-reef
Gandinella falsofriedli	181; 184; 185; 186c,d; 187a; 188a,b; 191b; 195a; 236; 249			
Kaeveria fluegeli	184; **243a**; **244a**; 245a; **249**		×	×
Ammobaculites pulcher	**243a**			
Reophax rudis	**244a**; *245a*; **246**		×	
?*Gaudryinella clavuliniformis*	187a			
“*Trochammina*” *almtalensis*	186c,d; 187b; 195a; 241; *245b*; **246**	×	×	
“*Trochammina*” *jaunensis*	186a,b,c; 195a, b; 241; 249			
Duotaxis metula	185; **243a**	×		×
Duotaxis birmanica	180b; 185; 186d; 187a; 188a; 195a			
Alpinophragmium perforatum	189a; 191b; **242a**; **243a,b**; **244a,b**; *245b*; *284*; **291b**		×	×
“*Tetrataxis*” *humilis*	236; 237; 241; 276a			
Aulotortus sinuosus	180b; 181; 184; 185; 186a,b,c,d; 187a,b; 188a,b; 189a,b; 191b; 192; 195a; 240; 241; *245a*; 276a; 278c; 279; 280; *282*; **290a**	×	×	
Aulotortus friedli	184; 186b,c; 187a; 189b; 191b; 237; 248; 278c; *282*		×	
Aulotortus tumidus	186a; 187a; 188b; 195a; 236; 237; 241; **243a**	×		
Aulotortus tenuis	181a			
Auloconus permodiscoides	187a,b			
Trocholina umbo	180b; **242a**; 249; 278c; **292**			
?*Trocholina crassa*	**242a**; **243a,b**; **244a**			
Trocholina? *parva*	**291b**			
Involutina turgida	**242a**; **243b**			
?*Triasina hantkeni*	187b; *245a*		×	
Turrispirillina minima	195a; **243a**		×	×
Agathammina austroalpina	185;186a,b,d; 191b; 195a; 240; 241; **242a**; **244a**; *245b*; **246**; *281*; *284*; **288c**; **292**	×	×	
Paraophthalmidium carpathicum	**243b**; *245a*; **247**; *283*; **288c**		×	
Ophthalmidium leischneri	**242a**			
Planiinvoluta carinata	**245a**; **288c**; **289**			
Miliolechina stellata	**243b**			
Galeanella tollmanni	**242a,b**; **243a,b**; **244a**; *245a,b*; **246**; *283*; *284*; **288c**; **289**; **290a**; **292**; **293**		×	
“*Sigmoilina*” *schaeferae*	186c; **244a**; *245a,b*; **246**; **247**; 249; *283*; *284*; **286a**; **290a**; **293**		×	×
Miliolipora cuvillieri	180b; 181; 185; 186a,c,d; 187a,b; 191b; 192; 195a,b; 240; 241; **244a**; *245a,b*; 279; 280; *281*; *284*; **290a**	×	×	
Orthotrinacria expansa auct.	**242b**			
Duostomina turboidea	187a			
Duostomina biconvexa	*245*			
?*Duostomina astrofimbriata*	**243a**			
Diplotremina placklesiana	185; 236; **244a**; *245*	×	×	
Diplotremina subangulata	195a; 236			
Variostoma coniforme	180b; 186d; **244a**; *245a*; **286a**; **293**			
Variostoma catilliforme	*245a,b*			
Variostoma cochlea	*245a*; *283*			
Variostoma helicta	195a			
Frondicularia woodwardi auct.	195b			

Remarks: thin sections written in nomal-case numbers (e.g. 181a) are from the back-reef area; numbers written in bold (e.g. **293**) are for the central-reef area, and numbers in italics (e.g. *283*) for the transition zone

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PLATE 1

Foraminifera from the Rhaetian reef limestone of Mt. Begunjščica

1-2 *Gandinella falsofriedli*; 1 thin section 184; 2 thin section 186C
3-4 *Kaeveria fluegeli*; 3 thin section 244A; 4 thin section 243A
5-6 *Alpinophragmium perforatum*; 5 thin section 242A; 6 thin section 244B
7 ?*Gaudryinella clavuliniformis*; thin section 187A
8 *Reophax* sp.; thin section 251
9-11 *Reophax rudis*; 9 thin section 245A; 10 thin section 246; 11 thin section 244A
12 *Ammobaculites pulcher*; thin section 243A
13 "*Trochammina*" *jaunensis*; thin section 253
14-15 "*Trochammina*" *almtalensis*; 14 thin section 248; thin section 241
16-17(?) *Duotaxis metula*; 16 thin section 243A; 17 thin section 244B
18 "*Tetrataxis*" *humilis*; thin section 241

Figures 1-4, 7, 13-18 scale bar 200 μm; figures 9-12 scale bar 500 μm; figures 5-6, 8 scale bar 1500 μm.

PLATE 1

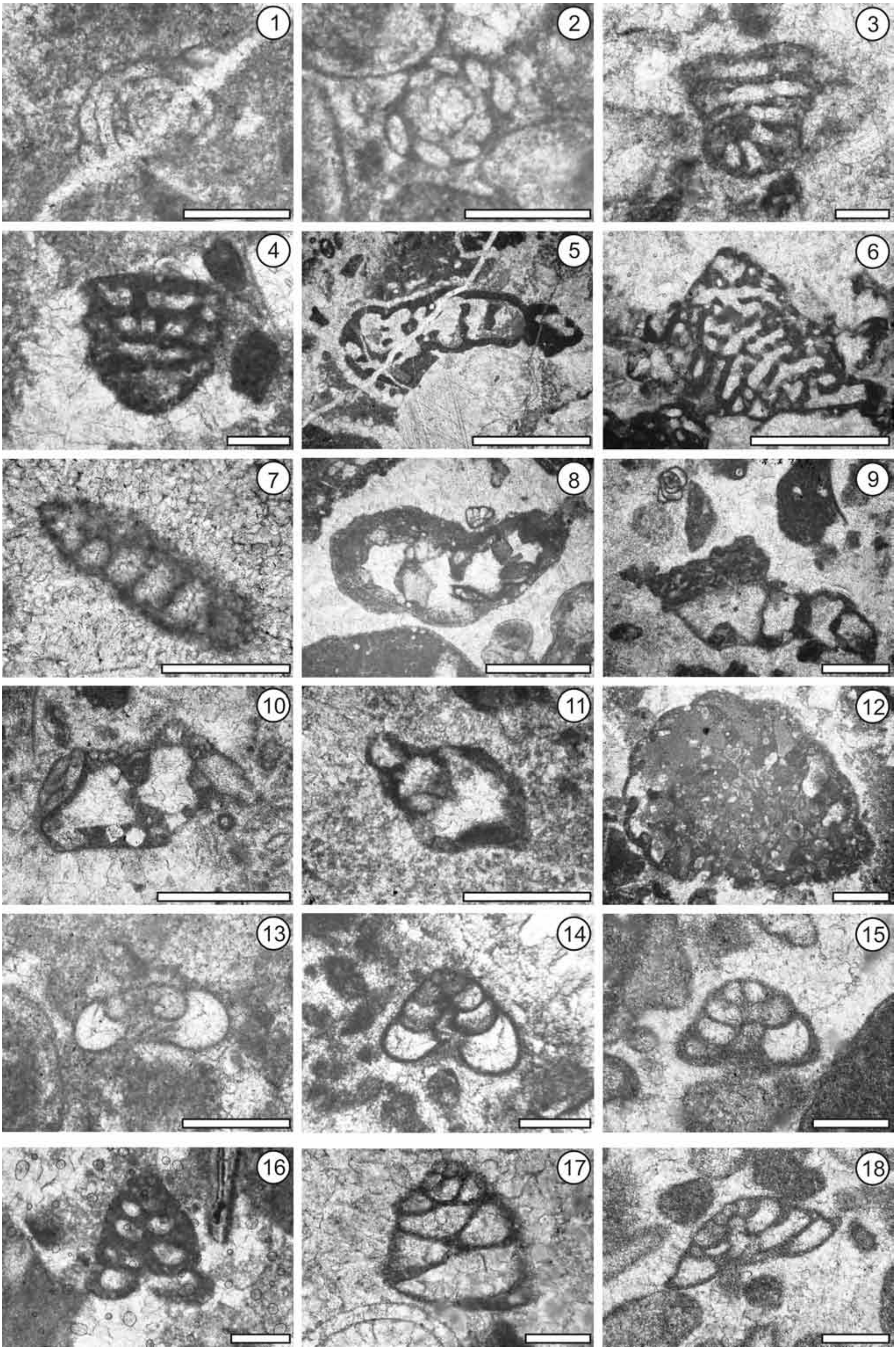

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PLATE 2

Foraminifera from the Rhaetian reef limestone of Mt. Begunjščica

1 *Ammobaculites* sp.; thin section 245A
2 *Endotriada* sp.; thin section 244B
3 *Involutina turgida*; thin section 243B
4-5 *Trocholina umbo*; thin section 244A
6-7 *Trocholina crassa*; 6 thin section 242A; 7 thin section 249
8 ?*Aulotortus sinuosus*; note the very flat test, but an involute coiling; thin section 186D
9 *Aulotortus tenuis*; thin section 249
10-11 *Aulotortus friedli*; thin section 249
12-13 *Aulotortus tumidus*; 12 thin section 252; 13 thin section 241
14-15 *Aulotortus sinuosus*; 14 thin section 187A; 15 thin section 195A
16 *Auloconus permodiscoides*; thin section 187A
17 ?*Triasina hantkeni*; thin section 187B
18 *Turrispirillina minima*; thin section 195B

Figures 6-7, 10-11, 14, 17-18 scale bar 200 µm; figures 1-5, 8-9, 12-13, 15-16 scale bar 500 µm.

PLATE 2

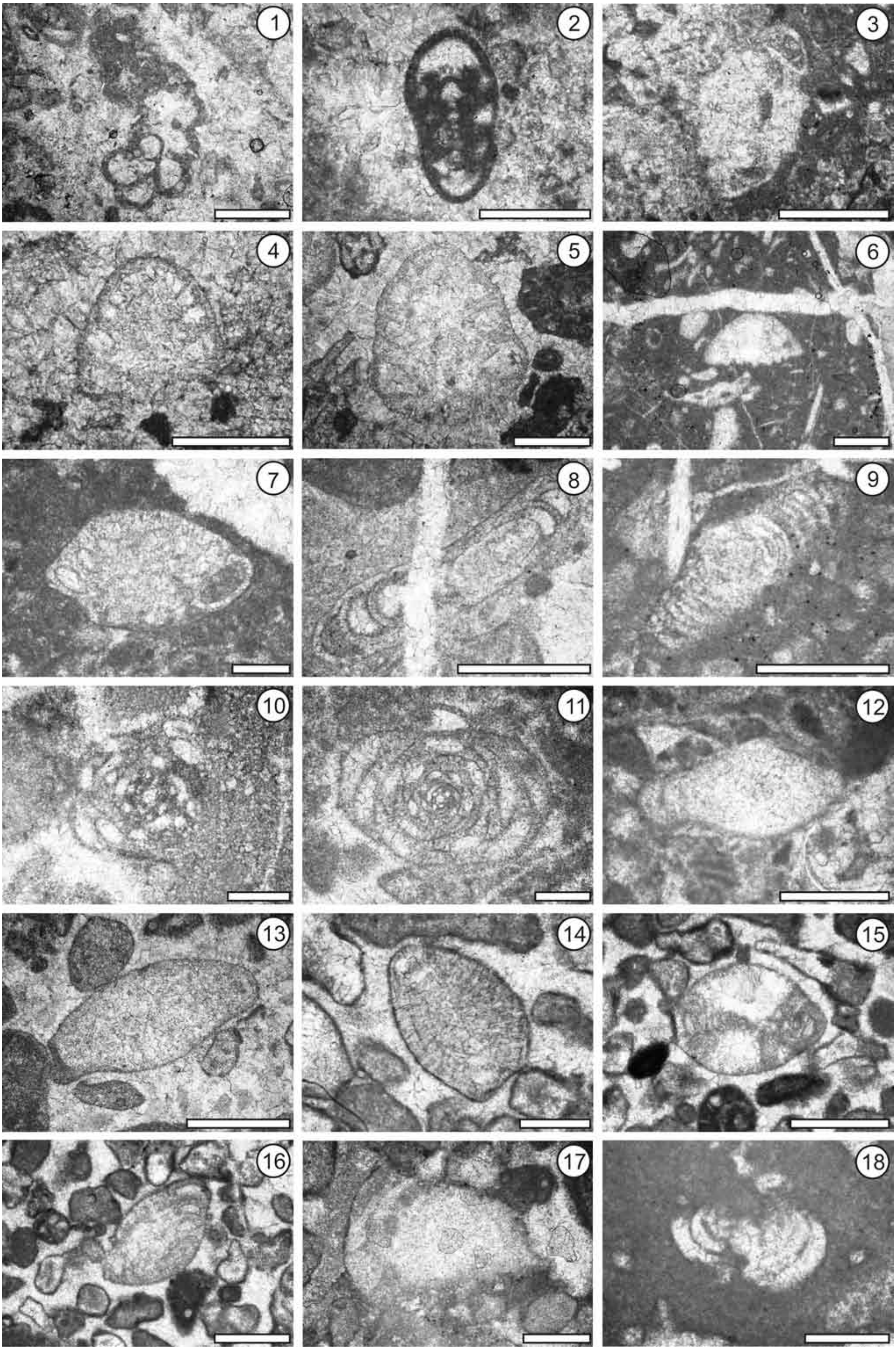

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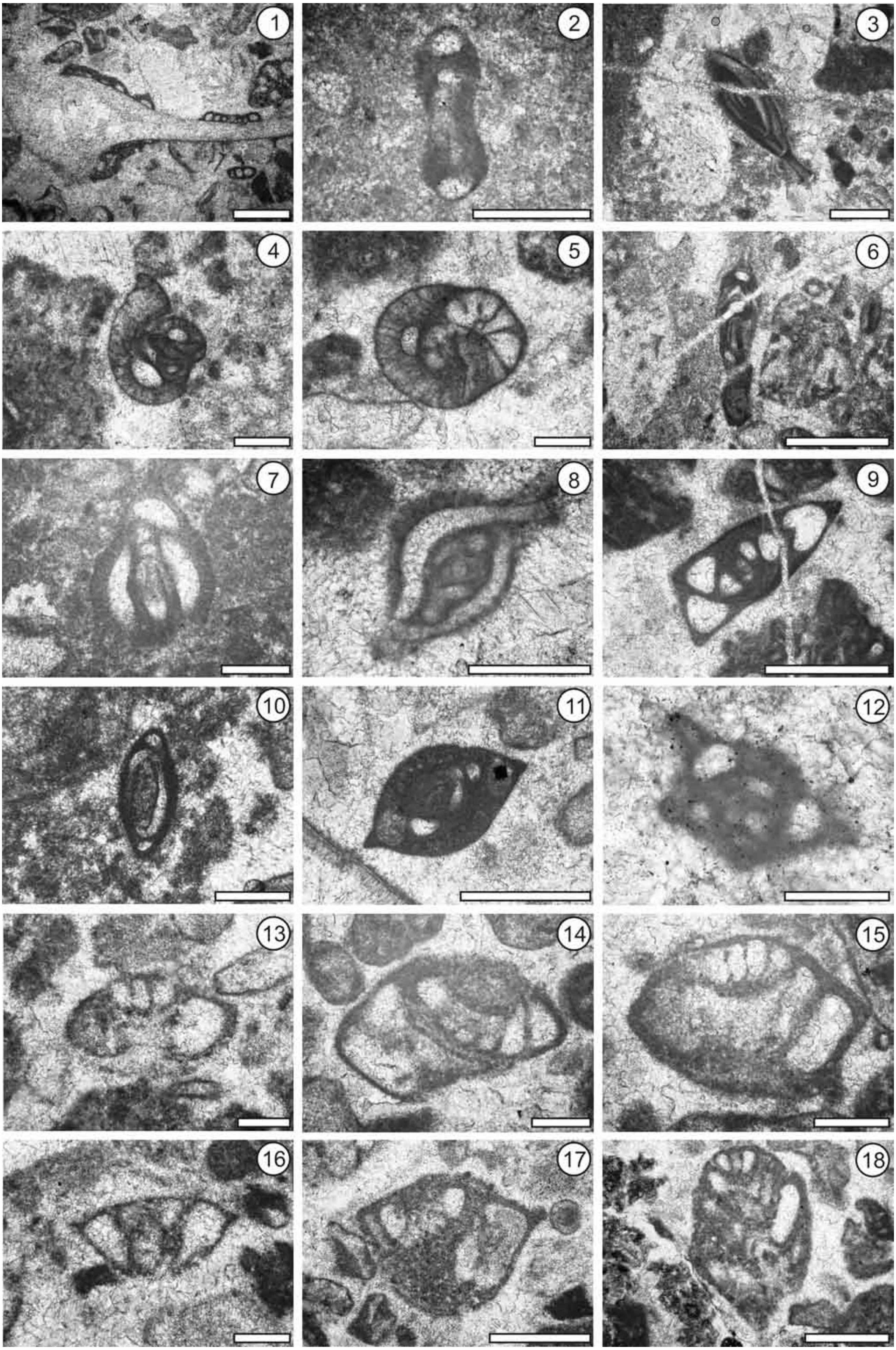
PLATE 3

Foraminifera from the Rhaetian reef limestone of Mt. Begunjščica

1 *Planiinvoluta carinata*; thin section 245A
2 *Ophthalmidium leischneri*; thin section 242A
3 *Paraophthalmidium carpathicum*; thin section 247
4-5 *Galeanella tollmanni*; 4 thin section 245A; 5 thin section 245B
6 "*Orthotrinacria expansa*" auct.; thin section 242
7-8 *Miliolipora cuvillieri*; thin section 249
9 Milioliporidea; thin section 245B
10 *Agathammina austroalpina*; thin section 240
11 "*Sigmoilina*" *schaeferae*; thin section 245A
12 *Miliolechina stellata*; thin section 243B
13 *Diplotremina placklesiana*; thin section 245A
14 *Duostomina* sp.; thin section 253
15 *Duostomina biconvexa*; thin section 249
16 *Variostoma catilliforme*; thin section 245A
17 *Variostoma coniforme*; thin section 245A
18 *Variostoma cochlea*; thin section 245A

Figures 2-5, 7-8, 10, 13-16 scale bar 200 μm; figures 1, 6, 9, 11, 17-18 scale bar 500 μm.

PLATE 3



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