JAHRBUCH DER GEOLOGISCHEN BUNDESANSTALT

Jb. Geol. B.-A. | ISSN 0016-7800 | Band 145 | Heft 2 | S. 159–169 | Wien, Dezember 2005

# *Vercorsella halleinensis* n. sp. – A New Cuneoliniform Foraminifera from the Late Tithonian to Early Berriasian (Barmstein Limestones, Plassen Carbonate Platform) of the Northern Calcareous Alps (Austria)

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4 Text-Figures, 2 Tables and 1 Plate

*Salzburg*
*Nördliche Kalkalpen*
*Plassen*
*Karbonatplattform*
*Oberjura*
*Unterkreide*
*Barmsteinkalk*
*Benthosforaminiferen*
*Mikropaläontologie*
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*Österreichische Karte 1 : 50.000*
*Blatt 96*

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## *Vercorsella halleinensis* n. sp. – Eine neue cuneoliniforme Foraminifere aus dem Ober-Tithonium bis Unter-Berriasium (Barmsteinkalke, Plassen-Karbonatplattform) der Nördlichen Kalkalpen (Österreich)

### Zusammenfassung

Eine neue benthonische Foraminifere wird als *Vercorsella halleinensis* n. sp. von der Typlokalität der Barmsteinkalke bei Hallein, Österreich beschrieben. Die konische bis schwach flabelliforme Art zeichnet sich insbesondere durch eine massive Wand und Septen aus. Zusammen mit anderen Vorkommen in der Plassen-Karbonatplattform kann die stratigraphische Reichweite vorläufig mit Ober-Tithonium bis Unter-Berriasium angegeben werden. Systematische Kontroversen bezüglich der unterkretazischen cuneoliniformen Benthosforaminiferen werden diskutiert. *Vercorsella halleinensis* n. sp. repräsentiert den ersten Nachweis der Gattung *Vercorsella* ARNAUD-VANNEAU, 1980, die bisher nur aus dem Zeitbereich Valanginium bis Albium bekannt ist, aus dem Ober-Jura. Dies belegt, dass die Radiation der cuneoliniformen Benthosforaminiferen bereits im Ober-Jura begann und ihr Maximum dann in der Unter-Kreide erreichte.

### Abstract

A new benthic foraminifera is described as *Vercorsella halleinensis* n. sp. from the type-locality of the Barmstein limestones near Hallein, Austria. On base of their occurrences in the Plassen carbonate platform, its stratigraphic range can be indicated tentatively as Late Tithonian to Early Berriasian. Systematic controversies in the literature of Early Cretaceous cuneoliniform benthic foraminifera are discussed. *Vercorsella halleinensis* n. sp. represents the first record of the genus *Vercorsella* ARNAUD-VANNEAU, 1980 in the Late Jurassic, so far known from the Valangian to Albian interval, evidencing that radiation of cuneoliniform benthic foraminifera already started during Late Jurassic reaching its climax in the Early Cretaceous.

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## 1. Introduction

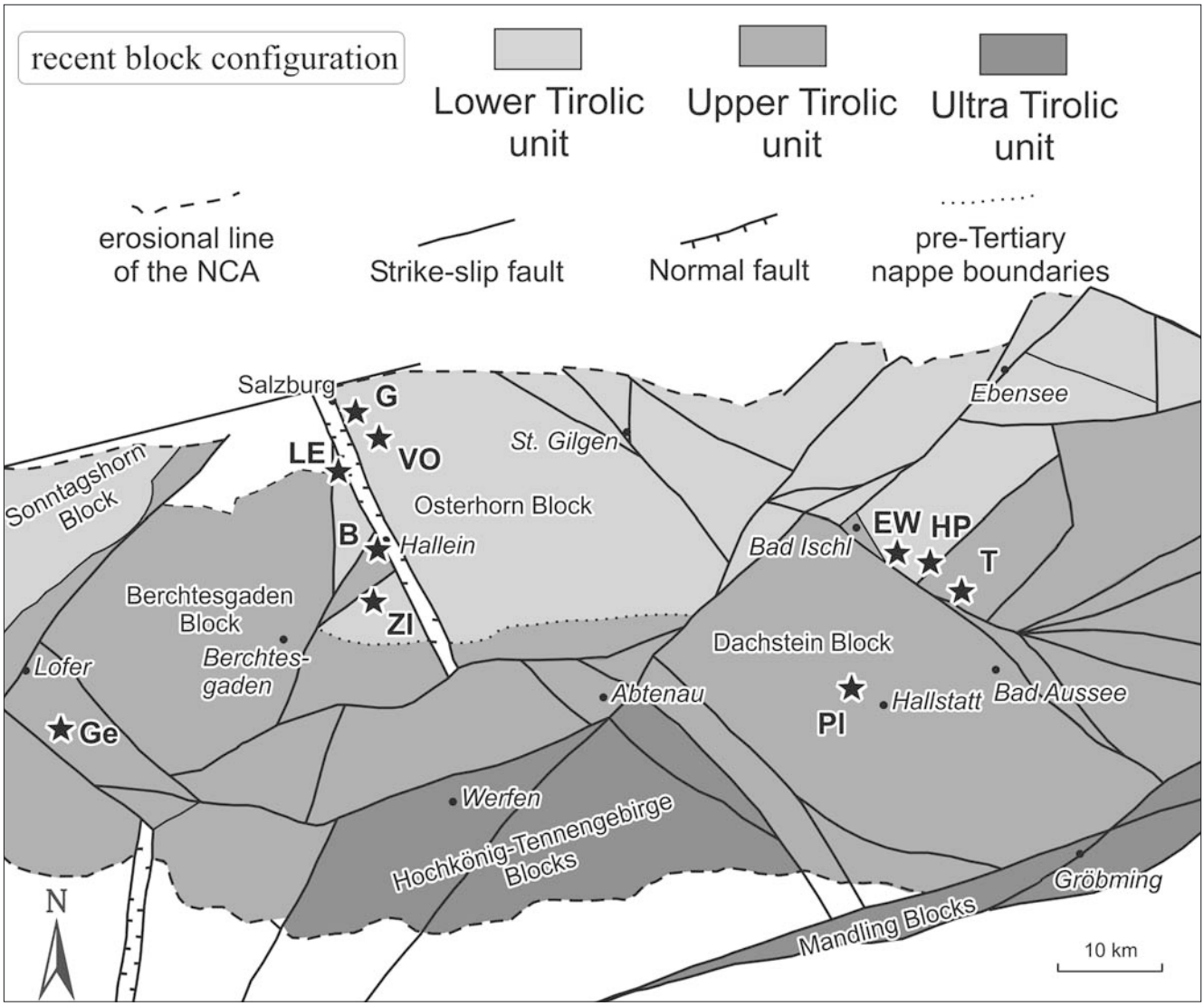
The type-locality of the Barmstein limestones, the Kleiner and Großer Barmstein in the Northern Calcareous Alps near Hallein south of Salzburg, Austria, was recently re-investigated by GAWLICK et al. (2005) following the fundamental work provided by STEIGER (1981).

The Barmstein limestones represent the typical resediments of the Plassen carbonate platform to the north in the area of the Lower Tirolic unit (Text-Fig. 1). They consist of allodapic limestones and mass flow deposits in basinal sediments (Oberalm Formation). In the framework of these studies a compilation of the micropaleontological inventory of the Barmstein limestones was made evidencing many taxa previously unrecorded from this location, but also new species were described (SCHLAGINTWEIT et al., 2004). The resedimented microfossil assemblages of the Barmstein limestones including benthic foraminifera, calcareous algae and microproblematica can be compared with the autochthonous shallow water carbonates of the Plassen Formation (SCHLAGINTWEIT et al., 2005).

During the re-investigation of the Barmstein limestones of the type-region a common benthic foraminifera was discovered, figured as *Vercorsella* sp. by GAWLICK et al. (2005), now identified as a new taxon. In this paper, it is described as *Vercorsella halleinensis* n. sp.

## 2. Geological Setting and Localities

In the Northern Calcareous Alps, Late Jurassic to Early Cretaceous shallow water carbonates are known as Plassen Formation (e.g. FENNINGER & HOLZER, 1972; TOLLMANN, 1976, 1985 – with references), recently these shallow water carbontes including the basinal sediments were termed as Plassen carbonate platform (SCHLAGINTWEIT et al., 2005; GAWLICK et al., 2005; GAWLICK & SCHLAGINTWEIT, in press). They evolved by shallowing upwards trends from mainly cherty basinal sediments during the Kimmeridgian (e.g., SCHLAGINTWEIT et al., 2003; GAWLICK et al., 2004). In the Late Kimmeridgian reefal limestones of a platform margin occurred followed by transgressive-regressive cycles during the latest Kimmeridgian and Early Tithonian. During the Late Tithonian lagoonal wackestones were deposited documenting an equilibrium between subsidence and carbonate accumulation. Around the Tithonian/Berriasian boundary a second reefal interval with corals and stromatoporoids occurred before the platform was drowned during the Berriasian (GAWLICK & SCHLAGINTWEIT, in press)




Text-Fig. 1.
Recent tectonic block configuration of central Northern Calcareous Alps after FRISCH & GAWLICK (2003) with occurrences of *Vercorsella halleinensis* n. sp.
B = Barmsteine (Kleiner and Großer Barmstein), EW = Ewige Wand, G = Glasenbach-Klamm, HP = Höherstein Plateau, PI = Plassen, T = Trisselwand, VO = east of Vollererhof, ZI = Zinken and localities mentionend in the text: LE = Leube quarry, Ge = Gerhardstein.

Table 1.
Comparative micropaleontological inventory of different occurrences of Barmstein-type limestones.
EW = Ewige Wand, KB = Kleiner Barmstein, GB = Großer Barmstein, LE = Leube, HP = Höherstein plateau, Z = Zinken, VO = east of Vollererhof (preliminary data).

| | KB | GB | ZI | LE | HP | EW | VO |
|---|---|---|---|---|---|---|---|
| **Dasycladales** | | | | | | | |
| *Actinoporella*? *geredeensis* FARINACCI & RADOICIC | S | — | — | — | — | — | — |
| *Anisoporella*? *jurassica* (ENDO) BUCUR | ● | ● | S | — | ● | ● | ● |
| *Clypeina*? *solkani* CONRAD & RADOICIC | ● | ● | ● | ● | ● | ● | S |
| *Clypeina marteli* EMBERGER | — | S | — | — | — | S | — |
| *Clypeina parasolkani* FARINACCI & RADOICIC | ● | ● | ● | ● | ● | ● | ● |
| *Clypeina sulcata* (ALTH) | ● | ● | ● | ● | ● | ● | ● |
| *Macroporella praturloni* DRAGASTAN | S | — | — | — | ● | ? | — |
| *Montenegrella florifera* BERNIER | ● | ● | ● | ● | ? | ? | — |
| *Otternstella lemmensis* (BERNIER) GRANIER et al. | — | S | — | — | — | — | — |
| *Rajkaella bartheli* (BERNIER) | — | ● | — | — | — | — | — |
| *Salpingoporella annulata* CAROZZI | ● | ● | ● | ● | ● | ● | — |
| *Salpingoporella* gr. *pygmaea* (GÜMBEL) | ● | ● | — | — | ● | ? | ● |
| *Salpingoporella johnsoni* (DRAGASTAN) | ● | ● | — | — | ? | — | S |
| *Salpingoporella sellii* (CRESCENTI) | S | — | S | S | — | — | — |
| *Selliporella neocomiensis* (RADOICIC) BUCUR & SASARAN | S | S | — | — | ? | — | — |
| *Thrysoporella alpina* DRAGASTAN & RICHTER | ● | — | — | — | — | — | — |
| **Benthonic Foraminifera** | | | | | | | |
| *Acruliammina* sp. | — | S | — | — | S | — | — |
| *Anchispirocyclina lusitanica* (EGGER) | ● | ● | — | — | — | ● | S |
| *Andersenolina alpina* (LEUPOLD) | ● | ● | ● | ● | ● | ● | ● |
| *Andersenolina* aff. *cherchiae* ARNAUD-VANNEAU et al. | — | S | S | — | ? | — | — |
| *Andersenolina elongata* (LEUPOLD) | ● | ● | ● | ● | ● | ● | ● |
| *Coscinophragma* aff. *cribrosa* (REUSS) | ● | ● | ● | ● | ● | ● | ● |
| *Kurnubia palastiniensis* HENSON | — | — | — | — | — | S | — |
| *Lenticulina* sp. | ● | ● | ● | ● | ● | ● | ● |
| *Mohlerina basiliensis* (MOHLER) | ● | ● | ● | ● | ● | ● | ● |
| *Nautiloculina oolithica* MOHLER | ● | ● | S | ● | ● | ● | ● |
| *Neotrocholina* sp. | ● | ● | S | — | ● | ● | ● |
| *Redmondoides* cf. *lugeoni* (SEPTFONTAINE) | ● | ● | ● | ● | ● | ● | ● |
| *Parinvolutina aquitanica* PELISSIE & PEYBERNES | — | S | — | — | — | — | — |
| *Protopeneroplis striata* WEYNSCHENK | ? | ● | — | S | S | ? | ● |
| *Protopeneroplis ultragranulata* (GORBATCHIK) | — | S | — | S | ● | ● | ● |
| *Pseudocyclammina lituus* (YOKOYAMA) | ● | ● | ● | ● | ● | ● | ● |
| *Trocholina* cf. *involuta* MANTSUROVA | ● | ● | — | S | ● | S | S |
| Troglotella incrustans WERNLI & FOOKES | ● | ● | ● | ● | ● | ● | ● |
| *Vercorsella halleinensis* n. sp. | ● | ● | ● | — | S | ● | S |
| **Others** | | | | | | | |
| *Bacinella irregularis* RADOICIC | ● | ● | ● | ● | ● | ● | ● |
| *Carpathocodium* cf. *anae* (DRAGASTAN) | — | S | — | — | — | S | — |
| *Carpathiella plassenensis* SCHLAGINTWEIT et al. | ● | ● | — | ● | ● | ● | S |
| *Carpathiella triangulata* MISIK, SOTAK & ZIEGLER | ● | ● | ● | ● | ● | ● | ● |
| *Coptocampylodon*? sp. | ● | ● | ● | ● | ● | ● | — |
| *Iberopora bodeuri* GRANIER & BERTHOU | — | ● | S | — | ● | ● | ● |
| *Koskinobullina socialis* CHERCHI & SCHROEDER | — | S | S | — | ● | ● | S |
| *Labes atramentosa* ELIASOVA | — | ● | — | — | — | S | — |
| *Lithocodium aggregatum* ELLIOTT | ● | ● | ● | ● | ● | ● | ● |
| *Mercierella*? *dacica* DRAGASTAN | — | ● | — | — | ● | ● | — |
| *Pinnatiporidium* n. sp. | ● | ● | — | — | S | — | ? |
| *P. untersbergensis* SCHLAGINTWEIT & DRAGASTAN | ● | ● | — | cf. | S | — | ● |
| *Radiomura cautica* SENOWBARI-DARYAN & SCHÄFER | ● | ● | S | ● | S | ● | — |
| *Rivularia barmsteinensis* SCHLAGINTWEIT et al. | ● | ● | — | — | ● | ● | ● |
| *Rivularia lissaviensis* (BORNEMANN) | ● | ● | ● | ● | ● | ● | ● |
| *Rivularia*? *loseri* SCHLAGINTWEIT et al. | ● | ● | — | — | — | ● | S |
| *Solenopora* sp. | — | S | — | — | — | ● | S |
| *Solenopora cayeuxiformis* LEINFELDER | ● | ● | — | — | S | ? | ? |
| *Terebella lapilloides* MUENSTER | ● | ● | S | — | ● | ● | — |
| *Thaumatoporella parvovesiculifera* RAINERI | ● | ● | ● | ● | ● | ● | ● |
| "*Tubiphytes*" *morronensis* CRESCENTI | ● | ● | ● | ● | ● | ● | ● |

delivering large masses of resediments, known as Barmstein limestones, into the basinal realm of the Tauglboden Basin (Oberalm Formation).

*Vercorsella halleinensis* n. sp. was discovered at the following localities: Barmsteine and Zinken near Hallein (type-locality), Ewige Wand near Bad Goisern, Höherstein plateau, section east of Vollererhof and Glasenbach-Klamm south of Salzburg, Mount Plassen near Hallstatt and the Trisselwand near Altaussee (all Austria, see Text-Fig. 1). Mount Plassen and Mount Trisselwand comprise the Plassen carbonate platform, whereas Barmsteine, Höherstein plateau, section east of Vollererhof and Ewige Wand belong to the Barmstein type sediments.

**Barmsteine**

Type locality of the Barmstein limestones (KB = Kleiner Barmstein and GB = Großer Barmstein in Tab. 1) in the Salzburg Calcareous Alps (STEIGER, 1981; GAWLICK et al., 2005). In our new study, *Vercorsella halleinensis* n. sp. was discovered in more than 10 % of the investigated thin-sections (about 200 samples). It was discovered at both Kleiner and Großer Barmstein; no preferred occurrence (either near the base or the top) of the studied area was observed.

**Ewige Wand**

The Ewige Wand (EW in Tab. 1) composed of Late Jurassic to Early Cretaceous mass flow deposits and located northeast of Bad Goisern in the Austrian Salzkammergut was investigated recently with about 200 thin-sections. The results of the ongoing studies will be published separately. At the Ewige Wand, *Vercorsella halleinensis* n. sp. is rare (samples E 41, E 379, E 399), although all other microfossil assemblages and the general microfacies of the clast spectrum correspond very well with the type-locality of the Barmstein limestones. With respect to the Barmsteine, however, more clasts of slope facies occur expressed also by the common occurrence of certain microfossils such as *„Tubiphytes" morronensis* CRESCENTI, 1969 or *Terebella lapilloides* MÜNSTER in GOLDFUSS, 1833 (see Tab. 1). Striking is the single finding of the benthic foraminifera *Kurnubia palastiniensis* HENSON, 1948, indicating that occasionally also sediments of the Plassen carbonate platform, older than the Late Tithonian may be reworked in Barmstein limestones (BASSOULET [1996] for details on stratigraphy).

**Glasenbach-Klamm**

At the Glasenbach-Klamm near Elsbethen south of Salzburg Barmstein limestones occur following a Jurassic sequence studied by DIERSCHE (1980). *Vercorsella halleinensis* n. sp. was observed in sample 238 (material leg. V. DIERSCHE).

**Höherstein Plateau**

The Höherstein plateau (HP in Tab. 1) is situated north of Altaussee in the central Salzkammergut area (ÖK 96 Bad Ischl) and was studied recently by GAWLICK et al. (2003). Within the Barmstein limestones of the Höherstein plateau, *Vercorsella halleinensis* n. sp. is extremely rare and was found with only one specimen.

**Vollererhof**

At the locality Vollererhof (VO in Tab. 1) south of Salzburg a sequence of brownish mass flow deposits occurs intercalated in pelagic, partly cherty sediments (Oberalm Formation). These resediments can be compared with the Barmstein limestones, but also show some differences. As this locality is currently under investigation no more data are provided at the moment. Besides *Pseudocyclammina lituus* (YOKOYAMA, 1890), *Andersenolina elongata* (LEUPOLD, 1935), *Vercorsella halleinensis* n. sp. is a common microfossil at the section east of Vollererhof where it occurs as single bioclasts not within lithoclasts. By comparison with the results from Mount Plassen (SCHLAGINTWEIT et al., 2005), this assemblage points to a Late Tithonian age.

**Zinken**

The Barmstein limestones north of the Zinken (Z in Tab. 1) and south of Bad Dürrnberg in the Salzburg Calcareous Alps were studied recently by GAWLICK et al. (2005). The occurrence of *Vercorsella halleinensis* n. sp. can directly be compared with the Barmsteine type region.

**Mount Plassen**

Mount Plassen westward of Hallstatt in the Austrian Salzkammergut is the type-locality of the Plassen carbonate platform or Plassen Formation. *Vercorsella halleinensis* n. sp. was discovered in one sample (A-3168) at the northern side of Mount Plassen in lagoonal wackestones that were referred to the Late Tithonian (see Fig. 3 in SCHLAGINTWEIT et al., 2005).

**Trisselwand**

The Trisselwand near Altaussee in the Austrian Salzkammergut is part of a huge mountain massif mainly build up of Late Jurassic to Early Cetaceous shallow-water limestones of the Plassen carbonate platform. *Vercorsella halleinensis* n. sp. was discovered as single bioclast in one sample (TK 7, figured in Pl. 1, Fig. 4) of a slope resediment that was referred to the Berriasian (SCHLAGINTWEIT & EBLI, 1999).

*

The limited occurrences of the new species *Vercorsella halleinensis* n. sp. with only a few localities seem to depend on facies-stratigraphic reasons, meaning lagoonal wackestone facies of Late Tithonian (or younger) age. Some localities of the Plassen carbonate platform can be approached as incomplete lacking Tithonian to Berriasian sediments such as the Krahstein near Bad Mitterndorf (GAWLICK et al., 2004) or the Falkenstein at Lake Wolfgang (KÜGLER et al. 2003). On the other side many other localities are still under reinvestigation.

## 3. Micropalaeontology

The suprageneric classification follows the systematic revision provided by LOEBLICH & TAPPAN (1988). The species description is based on the analysis of random thin sections as the new species was found only in indurated carbonate rocks.

**Family Textulariellidae GRONHAGEN & LUTERBACHER, 1966**
**Family Cuneolinidae SAIDOVA, 1981**
**Subfamily Cuneolininae SAIDOVA, 1981**
**Genus *Vercorsella* ARNAUD-VANNEAU, 1980 emend. ARNAUD-VANNEAU & SLITER, 1995**

Remarks: The genus *Vercorsella* belongs to the group of biserial Textulariellidae with a complex test and was established by ARNAUD-VANNEAU (1980) with the type-species *Vercorsella arenata* ARNAUD-VANNEAU, 1980 from the Early Aptian of France. ARNAUD-VANNEAU (1980: p. 522) also tentatively ascribed the species *Cuneolina tenuis* VELIĆ & GUSIČ, 1973 (Neocomian of Croatia), *Cuneolina scarsellai* DE CASTRO, 1963 (Neocomian of Italy) and *Cuneolina camposaurii* SARTONI & CRESCENTI, 1962 (Early Cre-

taceous of Italy) to the genus *Vercorsella*, a view that was generally accepted in the literature (e.g. ZANINETTI et al., 1987; ARNAUD-VANNEAU et al., 1991; SCHINDLER & CONRAD, 1994; KIRMACI et al., 1996; BUCUR et al., 2004). Later on also *Cuneolina laurentii* SARTONI & CRESCENTI, 1962 (Early Cretaceous of Italy) was treated as a species of *Vercorsella* (e.g. BUCUR et al., 2004). Following ARNAUD-VANNEAU, 1980) the aperture of *Vercorsella* represented by a basal slit is the main characteristic distinguishing it from *Cuneolina* with a row of apertural pores at the base of the chamber. In the generic diagnosis of LOEBLICH & TAPPAN (1988: p. 148) also the „less well-developed horizontal partitions present in later chambers" of *Vercorsella* also is markedly different from *Cuneolina* with both vertical (or radial) and horizontal chamber partitions. Furthermore, higher evolved representatives of *Cuneolina* may show an embryonic apparatus of proloculus and deuteroloculus (SCHLAGINTWEIT, 1992) whereas *Vercorsella* is characterized by a simple, unilocular proloculus followed by an undivided deuterconch (e.g. ARNAUD-VANNEAU & PREMOLI SILVA, 1995). ARNAUD-VANNEAU & SLITER (1995: p. 553) also remark a keriothecal test wall in *Cuneolina*, missing in *Vercorsella*. This feature was so far not evidenced from many *Cuneolina* species, but, for example, from *Dicyclina schlumbergeri* MUNIER-CHALMAS, 1887 (CHERCHI & SCHROEDER, 1990).

From the Valanginian of Serbia, BUCUR et al. (1995: Pl. 4, Figs. 1–8) figured *Vercorsella* n. sp. 1 and *Vercorsella* n. sp. 2. Due to the well visible existence of secondary radial partitions in the former (op. cit. Pl. 4, fig. 3) at least this form cannot be included in the genus *Vercorsella*. It fits better to the genus *Pseudotextulariella* BARNARD in BARNARD & BANNER, 1953 (e.g. BRÖNNIMANN, 1966). *Vercorsella* n. sp. 2 of BUCUR et al. (1995) shows horizontal partitions in the marginal area of the latest chambers a feature that may be present in *Vercorsella*. Another form still undescribed so far is *Pseudotextulariella?* n. sp. figured by CHIOCCHINI et al. (1994: Pl. 5, Fig. 12, 15, 17–18).

In contrast to the couplet *Vercorsella-Cuneolina* with clear criteria for distinction, there are still some incongruences with the genus *Scythiolina* NEAGU, 2000. *Scythiolina*, with the type-species *Scythiolina flabellii* NEAGU, 2000 also represents a flabelliform, compressed foraminifer with biserial chamber arrangement and radial partitions. According to the generic diagnosis of NEAGU (2000) vertical partitions are missing. Although *Scythiolina* is much closer to *Vercorsella*, it was only compared with *Cuneolina*, and nothing was provided concerning the former genus. The absence of horizontal partitions in *Scythiolina* and the „less well-developed horizontal partitions .... in later chambers" that may be also missing does not seem to be sufficient for a clear distinction between both; the aperture of *Scythiolina* is also an interiomarginal slit. As remaining distinctive criteria the wall structure of *Scythiolina* is said to be composed of two layers, „a thin compact epidermal layer and a thicker reticulate hypodermal layer" (NEAGU, 2000: p. 366). Whether this criterion alone is sufficient for separation on genus level is questionable. Also in some orbitolinid taxa a test wall consisting of two parts (thin outer layer of clear calcite) was evidenced (e.g. DOUGLASS, 1960), but genus separation is based on differences in the internal test structure. NEAGU (2000) also provided the new combination *Scythiolina camposaurii* (SARTONI & CRESCENTI, 1962) without discussing the results of ARNAUD-VANNEAU (1980), as already critically remarked by BUCUR et al. (2004: p. 214). In our opinion, the genus *Scythiolina* should be reconsidered carefully to clearly elaborate that it is not a younger synonym of *Vercorsella*. Although washed-out specimens are desirable for deciphering the exact test morphology, the most important criterion of generic distinction is without doubt the inner test structure discernible in thin-sections.

In the same work, an allied genera was established by NEAGU (2000: p. 369) as *Histerolina* (type-species: *H. pileiformis* NEAGU, 2000, Neocomian of Romania) differing from *Scythiolina* „by the general conical or ellipso-conical shape of the test (never flattened) and by the flat-concave apertural face with an acute peripheral margin". The allied Early Cretaceous genus *Sabaudia* CHAROLLAIS & BRÖNNIMANN, 1965 includes both species with compressed test such as the type-species *Sabaudia minuta* (HOFKER, 1965) and also with uncompressed test such as *Sabaudia briacensis* ARNAUD-VANNEAU, 1980. This example, however, clearly demonstrates that test morphologies alone can not be taken as generic criterion in benthic foraminifera.

In conclusion, there is still a need for further taxonomic considerations of Late Jurassic to Early Cretaceous „cuneolinid foraminifera" at both the generic and of course also the species level since 5 new species of *„Scythiolina"* were introduced by NEAGU (2000).

### *Vercorsella halleinensis* n. sp.

(Pl. 1, Figs. 1–23)

2005 *Vercorsella* sp. – GAWLICK et al.: Fig. 9b-2, Barmstein limestones of the type-locality.

Derivation of the name: The species name refers to the occurrence at the type-locality of the Barmstein limestones near Hallein where the new species has been detected.

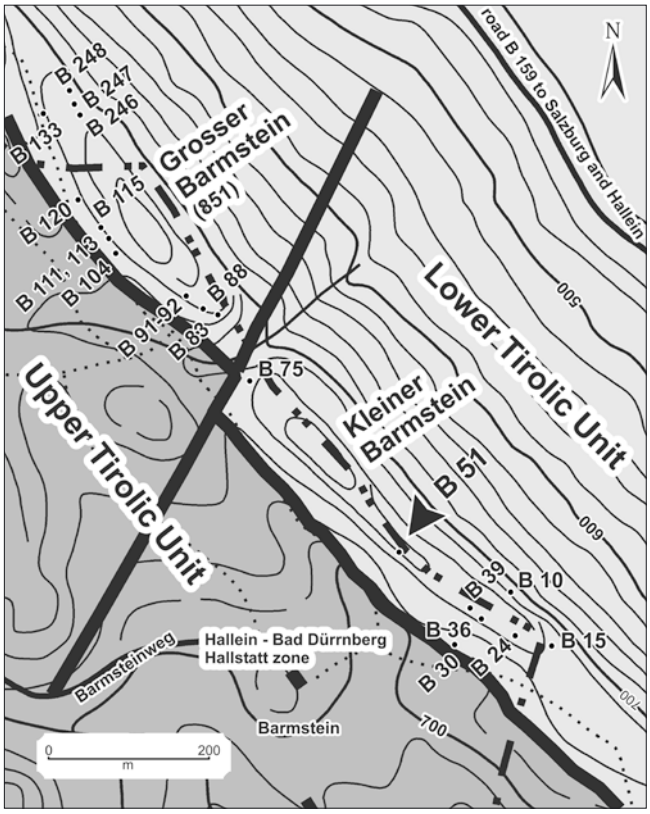
Material: About 30 specimens in different thin-sections from the Barmsteine: samples B 10, B 15, B 24, B 30, B 36, B 39, B 51, B 75, B 83, B 88, B 91, B 92, B 104, B 111, B 113, B 115, B 120, B 133, B 246, B 247, B 248. Samples B 10 to B 75 are from the Kleiner Barmstein, B 83 to B 248 belong to the Großer Barmsteine (see Text-Fig. 2).

Holotype and depository: The holotype is the vertical section of the specimen figured in Plate 1, Fig. 2, sample B 51. The whole material figured from the Barmsteine is stored at the University Leoben, Department of Applied Geosciences and Geophysics, Leoben.

Type Locality: Kleiner Barmstein northwest of Hallein, Topographic Map of Austria 1 : 50 000 ÖK 94 Hallein (see Text-Fig. 2).

Type Stratum: Mass flow deposits of the Barmstein limestones referred to the Late Tithonian to Early Berriasian stratigraphic interval (STEIGER, 1981). *Vercorsella halleinensis* n. sp. occurs within clasts of lagoonal wackestones. The components deriving from the shallow water carbonates of the Plassen carbonate platform are mainly wackestones of the closed lagoon but there are also clasts that can be referred to platform margin to upper slope deposits. The former contain oncoids, dasycladales with *Clypeina? solkani* CONRAD & RADOIČIĆ, 1972, *Salpingoporella annulata* CAROZZI, 1953, *Clypeina sulcata* (ALTH, 1882) and more rarely also *Otternstella lemmensis* (BERNIER, 1971) GRANIER, MASSE & BERTHOU, 1994 (Pl. 1, Fig. 16). The most frequent benthic foraminifera are *Pseudocyclammina lituus* (YOKOYAMA, 1890), *Andersenolina elongata* (LEUPOLD, 1935) and *Mohlerina basiliensis* (MOHLER, 1938). Common bioclasts are stromatoporoids such as *Sarmentofascis cretacica* (TURNŠEK, 1968) or *Actinostromaria shimizui* YABE & SUGIYAMA, 1935 (see LEINFELDER et al., 2005).

Indications for Berriasian parts of the Barmstein limestones are indicated by the dasycladales *Actinoporella? geredeensis* FARINACCI & RADOIČIĆ, 1991, *Macroporella praturloni*




Text-Fig. 2.
Topographic map of the Barmsteine west of Hallein and sample localities of *Vercorsella halleinensis* n. sp.
The sample containing the holotype is B 51.

DRAGASTAN, 1971 or *Selliporella neocomiensis* (RADOIČIĆ, 1975) BUCUR & SARASTAN, 2003 (see GAWLICK et al., 2005).

Diagnosis: Representative of *Vercorsella* with rounded-triangular to slightly flabelliform test distinctly compressed parallel to the plane of biseriality; septa massif; radial partitions numerous and thin, horizontal partitions missing.

Description: Test free consisting of microcrystalline calcite with no evidence of agglutinated foreign material. The general forms of the medially compressed (= parallel to the plane of biseriality) tests vary from triangular with rounded periphery and convex apertural face to slightly flabelliform. The measured apical angles lie between 30° and 60°.

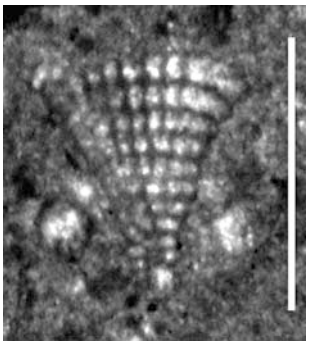
The test starts with a simple, unilocular proloculus of subspherical shape measuring 0.04 to 0.09 mm (Pl. 1, Figs. 14, 19) being part of a very short spiral part and followed by an undivided deuteroconch (Pl. 1, Fig. 17). The initial part is followed by up to 16 biserially (= alternating from one layer to the next) arranged chambers, hook-shaped in axial sections (Pl. 1, Fig. 8). In the first $^1/_3$ part of the test the chambers gradually increase in size (in axial sections), then remaining more or less constant. Each (primary) chamber is subdivided by radial partitions into chamberlets (= secondary chambers) rounded quadrangular in median sections (e.g. Pl. 1, Figs. 2, 23). In transverse sections the chamberlets show quadrangular elongation. Thickness of septa and height of chambers are approximately equal. The thickness of the radial partitions is less than that of the septa (Pl. 1, Figs. 4, 23). Depending on the level of sectioning (juvenile vs. adult part), 6 to 12 radial partitions (or beams) can be observed. Horizontal partitions (or rafters) and secondary radial partitions were not observed. Aperture an interiomarginal slit.

Table 2.
Dimensions of *Vercorsella halleinensis* n. sp. [measurements in mm].

| | |
|---|---|
| Test height (or length) | Up to 0.72 |
| Test width (adult part) | 0.28 – 0.56 |
| Test thickness | 0.18 – 0.21 |
| Thickness of septa | 0.03 – 0.06 |
| Thickness radial beams | 0.015 – 0.025 |
| Apical angle | 30° to 60° |
| Diameter proloculus | 0.04 – 0.09 |

Remarks and comparisons: The microgranular wall structure could depend on the microfacies, fine-grained muddy lagoonal wackestones, since there is no (silici-)clastic material available in the autochthonous shallow-water limestones of the Plassen carbonate platform. Thus, also a finely agglutinating wall structure must be taken into consideration.

Although test dimensions are comparable, *Vercorsella halleinensis* n. sp. can be distinguished easily from *Vercorsella tenuis* (VELIĆ & GUSIČ, 1973) from the Neocomian of Central Croatia by its thicker septa and radial partitions (0.0025–0.003 mm according to VELIĆ & GUSIČ [1973], see also Text-Fig. 3).



Text-Fig. 3.
*Vercorsella tenuis* (VELIĆ & GUSIČ, 1973) from the Valanginian? of the Kurbnesh area, Albania (GAWLICK et al., 2004 for details).
Sample Al 1512, scale bar = 0.5 mm.

*Vercorsella arenata* ARNAUD-VANNEAU, 1980 from the Early Aptian of South-France has larger dimensions, a more high conical test shape with apical angles between 30° and 40° and oval transverse sections. Both Early Cretaceous (Hauterivian to Albian) taxa, *Vercorsella laurentii* (SARTONI & CRESCENTI, 1962) and *Vercorsella camposaurii* (SARTONI & CRESCENTI, 1962) are comparable large representatives of Vercorsella with test thicknesses of 0.16 to 0.32 mm in the former and 0.26 to 0.46 mm in the latter (*Vercorsella halleinensis* n. sp.: 0.18–0.21 mm). Nonetheless, *Vercorsella laurentii* is a species showing some similarities with *Vercorsella halleinensis* n. sp. *Cuneolina scarsellai* DE CASTRO, 1963 was transferred to the genus *Pseudotextulariella* BARNARD in BANNER & BARNARD, 1953 by BRÖNNIMANN & CONRAD (1968) with reservation and lateron to *Vercorsella* by ARNAUD-VANNEAU (1980) followed by many workers in recent contributions (e.g. KIRMACI et al., 1996; BARRAGÁN-MANZO & DÍAZ-OTERO, 2004; MASSE et al., 2004). *Vercorsella scarsellai* (DE CASTRO, 1963) was taken as a zonal marker for the Barremian to Early Aptian interval in Turkey (VAROL et al., 1988; ALTINER et al., 1999). It shows rounded-ellipsoidal transverse sections different from *Vercorsella halleinensis* n. sp. (compare ARNAUD-VANNEAU, 1980: Fig. 190c). In addition, *V. scarsellai* is distinctly larger with test heights up to 1.4 mm (BRÖNNIMANN & CONRAD, 1968: table, p. 99).

Another form is *Vercorsella wintereri* ARNAUD-VANNEAU & SLITER, 1995 recently described from the Hauterivian of Mid-Pacific Mountains (Guyots, DSDP leg 143) west of

Hawaii reported also from the Early Cretaceous of Mexico (MURILLO-MUNETON & DOROBEK, 2003). It is a small form (maximum height 0.3 mm) showing only slight compression of the test. Last but not least, *Vercorsella immaturata* HE, 1982 was described from the Early Cretaceous of Xizang, China, also a small conical form with reduced number of „incomplete" radial beams not reaching to the plane of biseriality, also not comparable with *Vercorsella halleinensis* n. sp.

Concerning the taxa introduced by NEAGU (2000), *Vercorsella halleinensis* n. sp. can be distinguished from

- *„Scythiolina" flabellii* NEAGU, 2000 by the test shape and distinctly thicker septa and wall
- *„Scythiolina" crumenaeformis* NEAGU, 2000 by the test shape (acute apex in the latter) and also distinctly thicker septa and wall
- *„Scythiolina" cuneata* NEAGU, 2000 by the test shape (elongated triangular in the latter) and by its rounded quadrangular chamberlets in median sections; in *„S." cuneata* they are twice as high as thick
- *„Scythiolina" filiformae* NEAGU, 2000 by the test shape being filiform elongated in the latter and chamberlets being much higher than wide (> quadrangular in *Vercorsella halleinsis* n. sp.)
- *„Scythiolina" infundibuliformae* NEAGU, 2000 especially by much thinner septa and radial partitions being comparable with *Vercorsella tenuis* (VELIĆ & GUSIČ, 1973).

All species of *„Histerolina"* are characterized by ellipsoidal to rounded transverse sections and therefore not comparable with *Vercorsella halleinensis* n. sp. In conclusion, *Vercorsella halleinensis* n. sp., the first Late Jurassic representative of *Vercorsella*, is distinguished by its comparably large tests showing distinct compressing in the plane of biseriality (Text-Fig. 4).

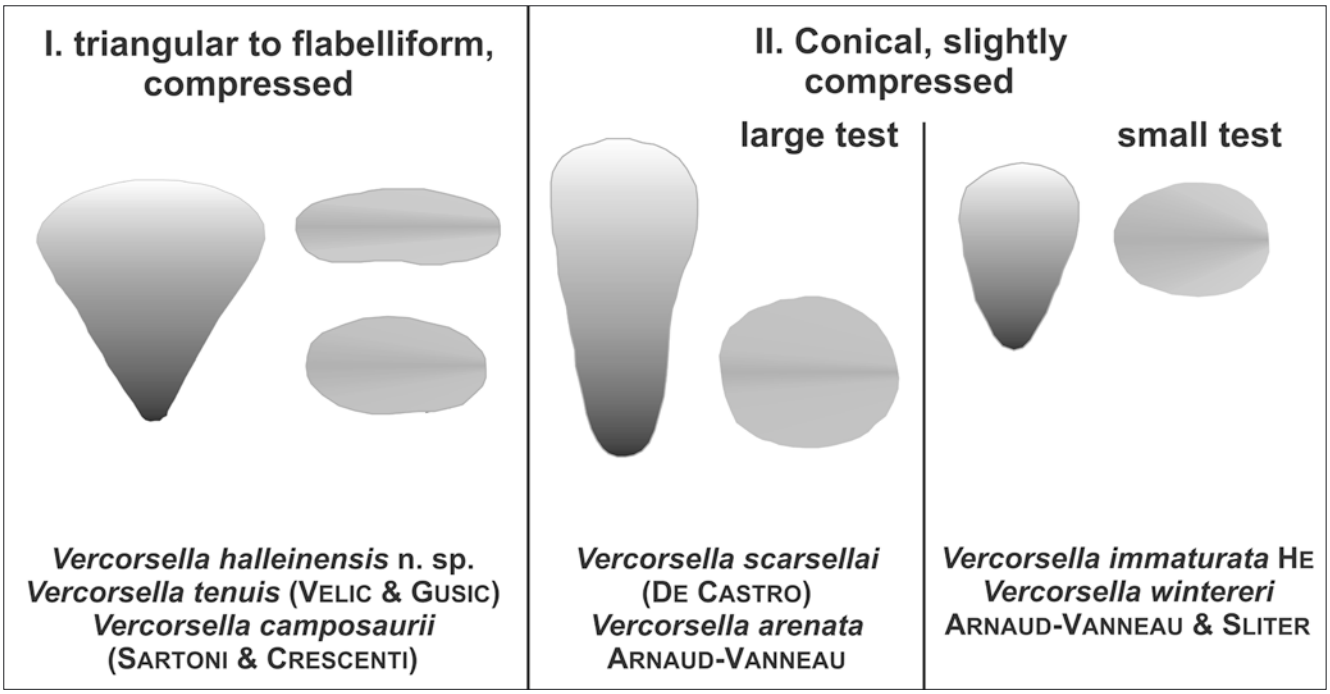
Stratigraphy: At Mount Plassen, *Vercorsella halleinensis* n. sp. was detected within lagoonal wackestones that were assigned to the Late Tithonian (SCHLAGINTWEIT et al., 2005 for details). The specimen found at the locality Trisselwand can be refered to the Berriasian based on the results of SCHLAGINTWEIT & EBLI (1999).

Although the total stratigraphic range of *Vercorsella halleinensis* n. sp. is not known so far, it was never observed in strata older than the Late Tithonian in the Northern Calcareous Alps, thus it can be used biostratigraphically on a regional scale.

## 4. Conclusions

Besides taxa like *Pseudocyclammina lituus* (YOKOYAMA, 1890), *Mohlerina basiliensis* (MOHLER, 1938) or *Andersenolina elongata* (LEUPOLD, 1935), *Vercorsella halleinensis* n. sp. is one of the most significant benthic foraminifera of this assemblage found in the Barmstein limestones of various localities. At Mount Plassen it was observed in wackestones with other benthic foraminifers and dasycladalean algae indicating a quiet-water lagoonal paleohabitat. From all data available up to now, *Vercorsella halleinensis* n. sp. seems to be useful for stratigraphy of the Alpine shallow-water Plassen carbonate platform indicating a minimum age of Late Tithonian. Thus, *Vercorsella halleinensis* n. sp. can be expected only in sequences of the Plassen carbonate platform with preserved Late Tithonian quiet-water lagoonal facies. Therefore, the species is lacking in „incomplete" sequences that don´t surpass the Kimmeridgian/Tithonian boundary significantly such as the Krahstein (GAWLICK et al., 2004), the Falkenstein at Lake Wolfgang (KÜGLER et al., 2003) or the Gerhardstein SE of Lofer (unpubl. results).

The finding of *Vercorsella* in Late Jurassic strata necessitates a revision of older phylogenetic relationships proposed in the literature. Thus, the assumption that *Vercorsella* split off from *Cuneolina* during the Barremian (ZANINETTI et al. [1987]: Fig. 1) is no longer substantiated. The differences in the wall structure (keriothecal in *Cuneolina* acc. to ARNAUD-VANNEAU & SLITER, 1995) are a characteristic of suprageneric taxonomic importance in benthonic foraminifera. So far, both, *Cuneolina* and *Vercorsella*, are still placed in the familiy Cuneolinidae, subfamily Cuneolininae by ARNAUD-VANNEAU & SLITER (1995) and ARNAUD-VANNEAU & PREMOLI SILVA (1995) although they evidenced differences in the wall structure. According to LOEBLICH & TAPPAN (1988: p. 148)




Text-Fig. 4.
Test morphology of representatives of *Vercorsella* ARNAUD-VANNEAU, 1980 allowing the distinction of two major groups, one composed of two subgroups depending on test size and grade of test compression.

the Cuneolininae should possess an agglutinating (non-kerithecal) wall, a characteristic valid for *Vercorsella*, but not for *Cuneolina* necessitating a higher taxonomic regrouping.

**Acknowledgement**

The resarch has been done with financial support of the FWF project P 16812-B06.

# Plate 1

*Vercorsella halleinensis* n. sp. from the Barmstein limestones, mostly of the type locality (Fig. 1–3, 5–23) and the Plassen carbonate platform (Fig. 4).

Fig. 1: Median (= equatorial) section.
Locality Kleiner Barmstein, sample B 39.

Fig. 2: Median (= equatorial) section, noting partly test dissolution by stylolitization (right side), holotype.
Locality Kleiner Barmstein, sample B 51.

Fig. 3: Median (= equatorial) section.
Locality Kleiner Barmstein, sample B 39.

Fig. 4: Median (= equatorial) section, noting the downward bending of the chamberlets at the test margins.
Locality Trisselwand, sample TK 7.

Fig. 5: Locality Kleiner Barmstein, sample B 36.

Fig. 6: Oblique median section.
Locality Kleiner Barmstein, sample B 43.

Fig. 7: Median (= equatorial) section.
Locality Großer Barmstein, sample B 247.

Fig. 8: Axial section showing thick septa.
Locality Kleiner Barmstein, sample B 15.

Fig. 9: Median (= equatorial) section.
Locality Kleiner Barmstein, sample B 39.

Fig. 10: Oblique median section.
Locality Kleiner Barmstein, sample B 24.

Fig. 11: Vertical section.
Locality Kleiner Barmstein, sample B 10.

Fig. 12: Median (= equatorial) section.
Locality Großer Barmstein, sample B 91.

Fig. 13: Median (= equatorial) section.
Locality Kleiner Barmstein, sample B 39.

Fig. 14: Oblique median section showing proloculus (arrow).
Locality Kleiner Barmstein, sample B 75.

Fig. 15: Oblique section.
Locality Großer Barmstein, sample B 88.

Fig. 16: Lagoonal wackestone with *Vercorsella halleinensis* n. sp. (V) and dasycladales *Clypeina? solkani* CONRAD & RADOIČIĆ, 1972 and *Otternstella lemmensis* (BERNIER, 1971) GRANIER, MASSE & BERTHOU, 1994.
Locality Großer Barmstein, sample B 91.

Fig. 17: Oblique median section showing proloculus (arrow) and the connection the following first postembryonic chamber.
Locality Großer Barmstein, sample B 83.

Fig. 18: Median (= equatorial) section.
Locality Großer Barmstein, sample B 111.

Fig. 19: Oblique median section showing proloculus.
Locality Großer Barmstein, sample B 104.

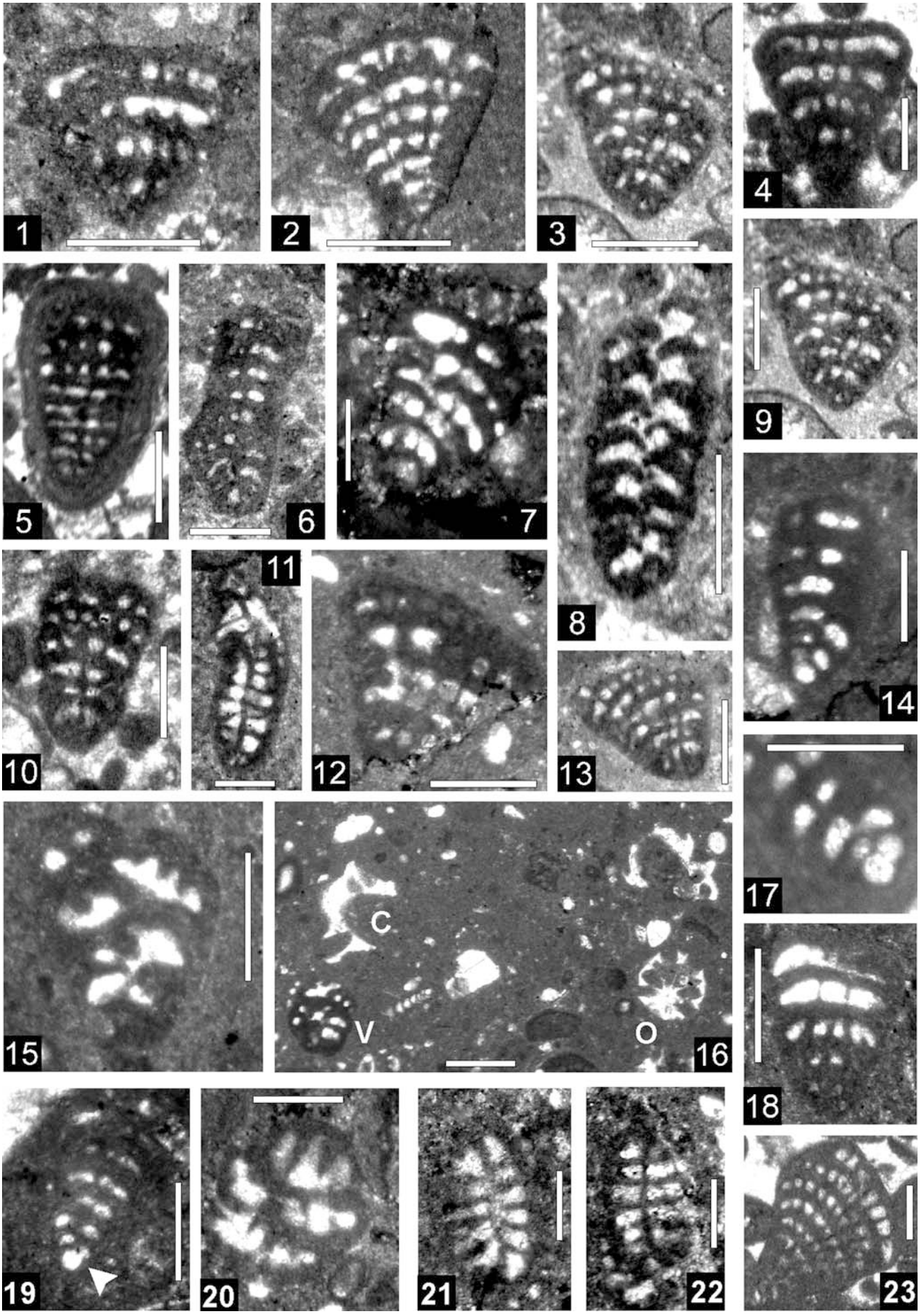
Fig. 20: Oblique section.
Locality Großer Barmstein, sample B 92.

Fig. 21: Oblique vertical section.
Locality Großer Barmstein, sample B 248.

Fig. 22: Vertical section.
Locality Großer Barmstein, sample B 113.

Fig. 23: Median (= equatorial) section.
Locality Ewige Wand, sample E 400.

Scale bar = 0.2 mm, except figure 16 = 0.5 mm.



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Manuskript bei der Schriftleitung eingelangt am 25. August 2005