Lituola? *baculiformis* n. sp., a new benthic foraminifer from Late Jurassic peri-reefal carbonates of the Western Tethyan domain

By

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with 5 figures

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Abstract

A new benthic foraminifer *Lituola*? *baculiformis* n. sp. is described from Late Jurassic peri-reefal carbonates which belong to the Plassen Carbonate Platform of the Northern Calcareous Alps (Austria). Other occurrences of this newly described foraminifera are the Late Jurassic of Southern France, Sicily (Italy) and Crimea (Ukraine). The finely agglutinating test of *Lituola*? *baculiformis* n. sp. characteristically shows a comparable short initial spire followed by a long rectilinear adult part. As all specimens derive from thin-sections, the architecture of the initial spire (planispiral or streptospiral coiling) remains unclear. So far some uncertainty of the generic assignment exist in moment; all other features fit with the diagnosis of the genus *Lituola* LAMARCK, 1804. Whereas the majority of Late Jurassic larger benthic foraminifera were reported from lagoonal facies or high-energy shoal facies, *Lituola*? *baculiformis* n. sp. is a rare example that is restricted to peri-reefal limestones of platform margins, where it also may become resedimented along the slope or in mass-flows intercalated in basinal deposits (e. g., Barmstein Limestones in hemipelagic Oberalm Formation).

Zusammenfassung

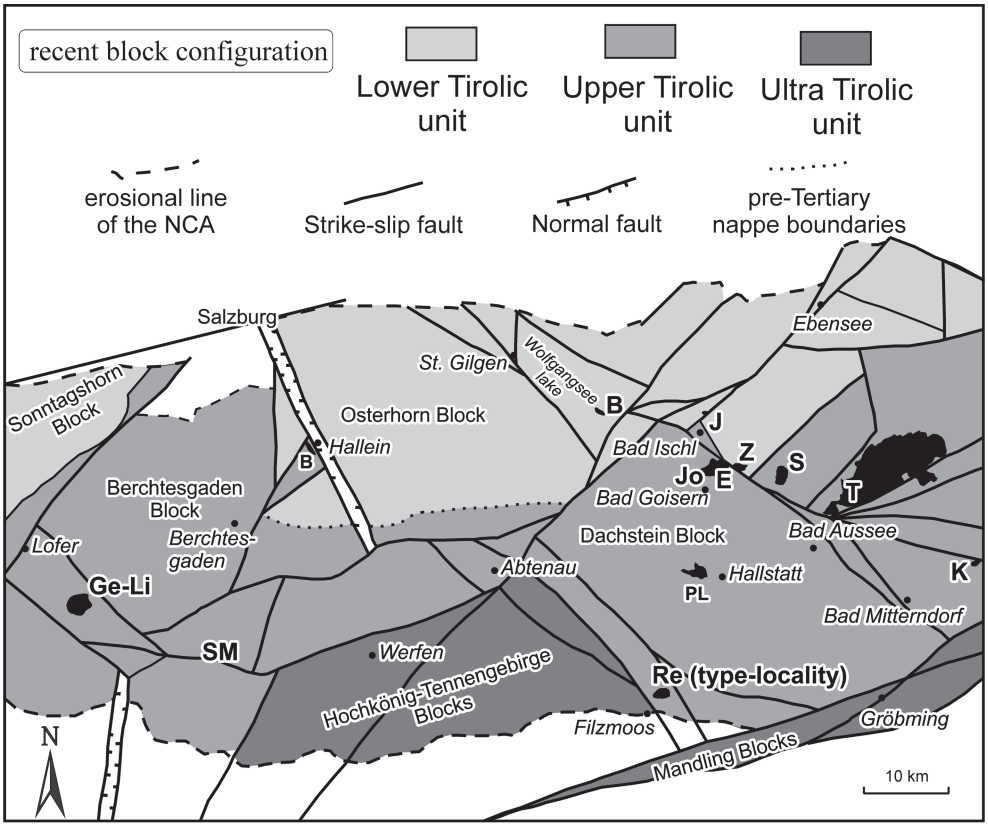
Eine neue benthonische Foraminifere wird als *Lituola*? *baculiformis* n. sp. aus oberjurassischen riffnahen Karbonaten der Nördlichen Kalkalpen (Österreich), beschrieben. Andere Vorkommen stammen aus dem Ober-Jura von Südfrankreich, Sizilien (Italien) und der Krim (Ukraine). Das fein-agglutinierende Gehäuse von *Lituola*? *baculiformis* n. sp. zeigt in charakteristischer Weise einen vergleichsweise kurzen aufgerollten Anfangsteil, gefolgt von einem langen rectilinearen Adultabschnitt. Da alle Exemplare aus Dünnschliffen stammen, ist die Architektur des Anfangsteils (planspirale oder streptospirale Aufrollung) zur Zeit noch unklar, was die generische Zuordnung etwas unsicher macht; alle anderen Eigenschaften dagegen stimmen mit der Gattungsdiagnose von *Lituola* LAMARCK 1804 überein. Während der Großteil der oberjurassischen Großforaminiferen aus der Lagunen- oder hoch-energetischer Shoal-Fazies beschrieben wurde, ist *Lituola*? *baculiformis* n. sp. ein seltenes Beispiel, in welchem benthische Großforaminiferen auf riffnahe Kalke der externen Plattform beschränkt sind, von wo diese auch resedimentiert entlang des Plattformhanges oder in Mass-Flow-Ablagerungen, die in Beckensedimente eingeschaltet sind (z. B. Barmsteinkalke in der Oberalm-Formation), auftreten.

1. Introduction

Benthic foraminifers occurring in the Late Jurassic to Early Cretaceous Plassen Carbonate Platform (GAWLICK & SCHLAGINTWEIT 2006) of the Northern Calcareous Alps of Austria display an inconsistent stratigraphic appearance due to facies changes within the Kimmeridgian to Early Berriasian time span. Only in the Tithonian lagoonal facies prevailed for a comparable longer time span (SCHLAGINTWEIT et al. 2003, 2005). Within two reefal horizons, the older in the Kimmeridgian (e.g., SCHLAGINTWEIT et al. 2005, AUER et al. 2009) and the younger around the Tithonian-Berriasian boundary (SCHLAGINTWEIT et al. 2005; GAWLICK & SCHLAGINTWEIT 2006) benthic foraminifers are mainly represented by forms, which are attached to hard substrates, e.g., *Coscinophragma cribrosa* (REUSS, 1846). Taxa usually refered to as larger benthic foraminifera (e. g., BASSOULLET 1997) generally occur in the lagoonal environment (e.g.

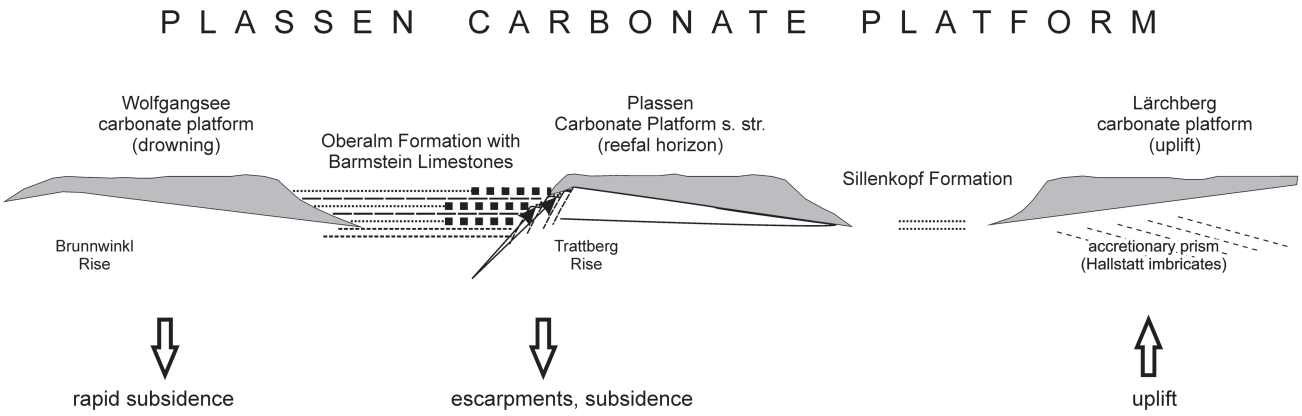
Fig. 1: **A)** Tectonic framework of the central Northern Calcareous Alps after FRISCH & GAWLICK (2003) and location of Mount Rettenstein (Re) (**), the type-locality of *Lituola*? *baculiformis* n. sp., and other occurrences. B = Mount Bürgl (**), Ge-Li = Mount Gerhardstein-Litzelkogel (**), J = Mount Jainzen (**), E = Mount Ewige Wand (*), Jo = Mount Jochwand (*), Krah = Mount Krahstein (**), Re = Mount Rettenstein (**), S = Mount Sandling (*), SM = Steinernes Meer (*), TW = Mount Trisselwand (**). * Resediments of the Plassen Carbonate Platform (mostly Barmstein Limestones); ** autochthonous sediments of the Plassen Carbonate Platform. PL = type locality of the Plassen Formation and most complete section with the two reefal intervals (compare SCHLAGINTWEIT et al. 2003, GAWLICK & SCHLAGINTWEIT 2006). B = type locality of the Barmstein Limestones. **B)** Palaeogeography of the Plassen Carbonate Platform with intermediate basins in the Kimmeridgian and around the Jurassic/Cretaceous boundary (based on GAWLICK & SCHLAGINTWEIT 2009).

A

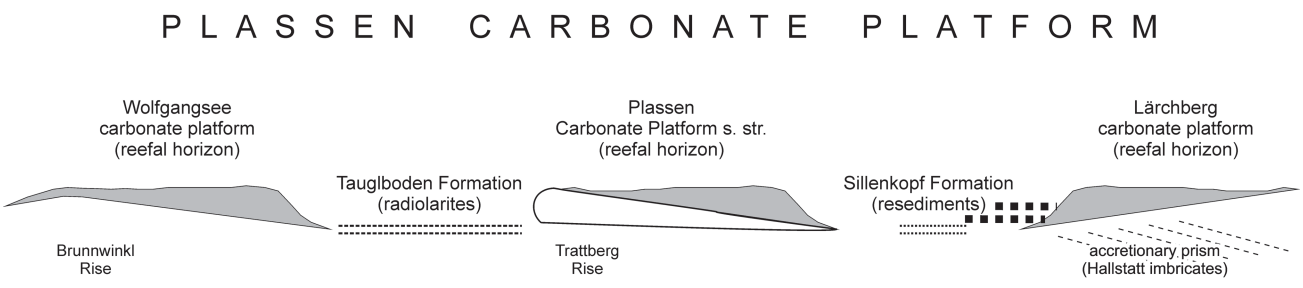


B

Jurassic/Cretaceous boundary



Kimmeridgian



genera *Kilianina*, *Kurnubia*, *Pseudocyclammina*) or in high-energy shoal to back-reef areas (e.g. genus *Labyrinthina*). The diversity of taxa in the central reef-facies is in general comparable low, but becomes higher in the peri-reefal limestones. Here, the same taxa of the reef-facies may occur, if hard substrates are available, probably they occur on mechanically broken components. Therefore, the general question of their autochthony is difficult to assess. Contrasting the numerous contributions on Late Jurassic larger benthic foraminifers from lagoonal carbonates, some of them are of biostratigraphic importance (e.g. BASSOULLET 1997, VELIC 2007), only rare publications deal with those forms flourishing the platform reefal margins (e.g. BUCUR et al. 1996, KOLODZIEJ & DECROUEZ 1997).
In the present paper, a characteristic larger foraminifera, already illustrated several times in the literature from various locations mostly of the Tethyan domain and attributed to different taxa is described as the new species *Lituola*? *baculiformis* n. sp.

2. Geological setting and sample localities

Lituola? *baculiformis* n. sp. was identified within the two reefal intervals (Kimmeridgian and around the Tithonian-Berriasian boundary) of the Plassen Carbonate Platform sensu lato and in platform-derived resediments (e.g. Barmstein Limestones) shedded into basinal sediments. The Barmstein Limestones are made up of proximal reef debris with allochthonous components (STEIGER 1981, GAWLICK et al. 2005), and represent mass-flows and turbiditic layers in a basinal succession (Oberalm Formation) with components mainly deriving from the adjacent Plassen Carbonate Platform sensu stricto (Fig. 1).

2.1. Investigated localities of Plassen Carbonate Platform with occurrences of *Lituola*? *baculiformis* n. sp.

The Plassen Carbonate Platform in the Northern Calcareous Alps is subdivided in three independent platform areas: the northernmost platform is called Wolfgangsee carbonate platform, the central, main platform Plassen Carbonate Platform sensu stricto and the southern platform Lärchberg carbonate platform (Fig. 1).

Wolfgangsee carbonate platform

Mount Bürgl: is located at the southern end of Lake Wolfgang in the Salzkammergut area and belongs to the Wolfgangsee carbonate platform (GAWLICK et al. 2007a) (Fig. 1), topographic map of Austria ÖK 95 1 : 50.000 St. Wolfgang. For more details on the facies distribution and stratigraphy of Mount Bürgl see GAWLICk et al. (2007) and SCHLAGINTWEIT et al. (2008).

Mount Jainzen: The exposed limestones of the Wolfgangsee Carbonate Platform of Mount Jainzen are located north of Bad Ischl in the Austrian Salzkammergut (Fig. 1), topographic map of Austria ÖK 96 1 : 50.000 Bad Ischl. The exposed succession covers an area of about 0.6 km^2 and is of approximately 400 m in thickness. The succession of Mount Jainzen comprises mainly platform margin deposits with corals and stromatoporoids. DIENER (1899) indicated a Tithonian age on the basis of the occurring corals, gastropods and stromatoporoids. Stratigraphic more diagnostic microfossils such as benthic foraminifera or dasycladales have not been found despite the study of several hundreds of thin-sections. Thus, an affiliation to the first reefal interval of Kimmeridgian age (see introductory notes) can also not be excluded.

Plassen Carbonate Platform sensu stricto

Mount Krahstein: Mount Krahstein is located about 4 km NE of Bad Mitterndorf (Fig. 1) in the Styrian Salzkammergut, topographic map of Austria ÖK 97 1:50.000 Bad Mitterndorf. The locality was first investigated by FLÜGEL (1964), later by STEIGER & WURM (1980) and GAWLICK et al. (2004). The occurring reefal platform margin facies is of (Late?) Kimmeridgian age.

Mount Rettenstein: Mount Rettenstein, the type-locality of *Lituola*? *baculiformis* n. sp., is located near Filzmoos in the Salzburg Calcareous Alps southwest of the Dachstein Block, topographic map of Austria ÖK 126 1 : 50.000 Radstadt (Fig. 1). Mount Rettenstein represents the today southernmost major incidence of Late Jurassic Plassen carbonate platform rocks in quite a distance to all the other prominent occurrences. The Jurassic succession of Mount Rettenstein with special reference to the limestones of the Plassen Carbonate Platform was investigated recently by AUER et al. (2009) and SCHLAGINTWEIT et al. (2007). Based on benthic foraminifera (*Labyrinthina mirabilis* WEYNSCHENK, 1951, "*Kilianina*" *rahonensis* FOURY & VINCENT, 1967), the main succession of the Plassen Carbonate Platform of Mt. Rettenstein can be assigned to the Kimmeridgian; obviously the first resediments of Late Jurassic shallow-water debris intercalated in cherty sediments already appear in the Late Oxfordian (AUER et al. 2009).

Mount Trisselwand complex: Mount Trisselwand complex represents the largest occurrence of the Plassen Carbonate Platform in the Northern Calcareous Alps and is located east of Bad Aussee (Grundlsee area) in the Austrian Salzkammergut, located on the topographic maps of Austria sheets 96 Bad Ischl and 97 Bad Mitterndorf. Mount Trisselwand itself is the western peak of a very huge Late Jurassic platform carbonate area (~ 55 km^2), and belongs to the so-called Totes Gebirge (see FENNINGER & HOLZER 1972, SCHLAGINTWEIT & EBLI 1999). Whether the specimens from Mount Trisselwand are from the second Late Tithonian reefal interval is unclear.

Lärchberg carbonate platform

Mount Gerhardstein and Mount Litzelkogel: The Litzlkogel-Gerhardstein-complex is situated in the southwestern

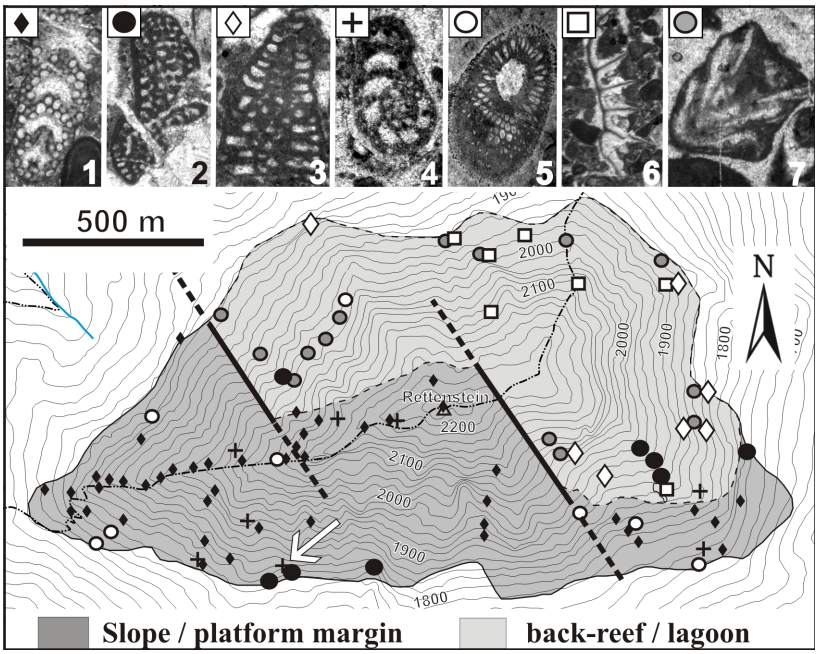


Fig. 2: Type-locality of *Lituola? baculiformis* n. sp. Mount Rettenstein, distribution of facies and selected microfossils (1-4 benthic foraminifera, 5-7 dasycladalean algae). White arrow shows the location of the sample containing the holotype.
1: *Reophax*? *rhaxelloides* SCHLAGINTWEIT, AUER & GAWLICK, 2007.
2: *Labyrinthina mirabilis* WEYNSCHENK, 1951.
3: *Kilianina*? *rahonensis* FOURY & VINCENT, 1967.
4: *Lituola*? *baculiformis* n. sp.
5: *Petrascula bursiformis* (ETTALON, 1858).
6: *Clypeina sulcata* (ALTH, 1881).
7: *Campbelliella striata* (CAROZZI, 1954).

Berchtesgaden Alps east of Lofer (Fig. 1), topographic map of Austria ÖK 92 1 : 50.000 Lofer (Fig. 1). and consists of the Late Jurassic Lärchberg Formation (e.g. DYA 1992), which belongs to the Lärchberg carbonate platform (SCHLAGINTWEIT & GAWLICK 2007, MISSONI & GAWLICK in press). These mountains show different slope lithologies widespread around the whole mountainous massif. Whereas the youngest sediments at the top of Mount Gerhardstein are of Latest Kimmeridgian or Earliest Tithonian age, sedimentation in the Litzlkogel succession continues up to the Jurassic/Cretaceous boundary or even the Early Berriasian (SCHLAGINTWEIT 2005). The sample with *Lituola*? *baculiformis* n. sp. is of Kimmeridgian age, evidenced by the occurrence of *Labyrinthina mirabilis* WEYNSCHENK, 1951 in near-by samples.

Barmstein Limestones and other resediments

Mount Ewige Wand: Mount Ewige Wand is a steep mountain wall extending for more than 1 km in E-W direction at the western side of Mount Predigtstuhl (1278 m) northeast of Bad Goisern in the central Salzkammergut area, topographic map of Austria ÖK 96 1 : 50.000 Bad Ischl (Fig. 1). The succession is composed of resediments (mass-flow breccias, calciturbidites) deriving from the Plassen Carbonate Platform senso stricto and refered to the Barmstein Limestone intercalated in calpionellid-bearing limestones (Oberalm Formation). Late Tithonian is evidenced by the occurrence of *Crassicollaria intermedia* (DURAND-DELGA, 1957) (e. g., REMANE 1985).

Mount Jochwand: Mount Jochwand is the western continuation of the Ewige Wand, located northwest of Bad Goisern, topographic map of Austria ÖK 96 1 : 50.000 Bad Ischl (Fig. 1). Stratigraphy and sedimentology is identical as for Mount Ewige Wand.

Mount Sandling: Mount Sandling is exposed in the central Salzkammergut area west of the city Altaussee, topographic map of Austria ÖK 96 1:50.000 Bad Ischl (Fig. 1). The sedimentary succession at Mount Sandling consists of cherty sediments of the Sandlingalm Formation (Callovian to Late Oxfordian - dated by means of radiolarians, e.g., WEGERER et al. 2001, GAWLICK et al. 2007b), which is overlain by wackestones, probably of Kimmeridgian age. From ?latest Kimmeridgian onwards progradation of shallow water carbonates started resulting in the deposition of a Tithonian shallow water carbonate sequence with reefal debris. The age of the sample containing *Lituola*? *baculiformis* n. sp. remains unclear (Kimmeridgian or Tithonian).

Mounts Steinernes Meer: In the Mounts Steinernes Meer, topographic map of Austria ÖK 93 1 : 50.000 Bad Reichenhall (Fig. 1) the Kimmeridgian to ?Tithonian Sillenkopf Formation contains several resediments of the Lärchberg carbonate platform (MISSONI et al. 2001). In the higher mountainous parts of the Steinernes Meer area the Sillenkopf Formation is represented by more coarse-grained resediments as in the more northern parts. These resediments are intercalated in radiolarites (MISSONI et al. 2001; compare DIERSCHE 1980).

3. Micropalaeontology

Genus *Lituola* LAMARCK, 1804

Remarks: As we only provisionally refer our specimens to the genus *Lituola* LAMARCK, 1804, it is necessary to provide some taxonomic considerations here. Many species of *Lituola* were described as isolated specimens; these forms can be classified due to their coiling type and final aperture, but without information on interior structures. Within the Lituolidae "*the most reliable criterion of generic distinction*

is certainly the inner structure laid bare by thin-sections" (MAYNC 1952: p. 43). Therefore, some "*Lituola*" species were lateron transfered to a variety of other genera such as, for example, *Lituola cylindrica* to the genus *Axicolumella* (HERCOGOVA, 1988) or *Lituola rugosa* d´ORBIGNY, 1850 to the genus *Pseudocyclammina* (MAYNC, 1952) because of revealing labyrinthic inner structures in thin-section material. *Lituola* exhibits a planspiral coiling and a simple non-labyrinthic interior structure as emphasized by MAYNC (1952), who studied topo-type material of the type-species *Lituola nautiloidea* LAMARCK, 1804. Specimens showing the same inner structure as *Lituola*, but possessing a streptospiral initial spire, were transfered to the new genus *Bulbophragmium* by MAYNC (1952). Following the diagnosis of LOEBLICH & TAPPAN (1988: p. 85), *Bulbophragmium* shows "*short and thick radiating vertical partitions*". Last but not least, it must be noted, that also forms with a slightly streptospiral coiled initial portion of the test were included within the genus *Lituola* such as *Lituola strogguloides* ARNAUD-VANNEAU, 1980 ("*legèrement streptospiralé*") from the Early Cretaceous of France. Generally different from streptospiral coiling may be an inclination of the uncoiled portion towards the equatorial plane of the coiled stage, for example recognizable in isolated specimens of Late Cretaceous representatives (e. g., RIEGRAF 1998: Pl. 4, Fig. 15 or Pl. 8, Fig. 2) or modern *Lituola salsa* (CUSHMAN & BRÖNNIMANN, 1948) (BRÖNNIMANN & ZANINETTI 1965: Fig. 7b or 10b). For *Lituola*-type foraminifera having "*a slightly arcuate early stage of a few chambers*", LOEBLICH & TAPPAN (1984) introduced the genus *Atactolituola*. Forms with a reduced initial spire of our new species (e.g. Fig. 5h, j) can be compared with *Atactolituola* (e.g. LOEBLICH & TAPPAN 1988: pl. 64, fig. 14). As our material, however, shows all transitions from only a small spire to a more prominent initial coil (e.g. Fig. 5a-b), it cannot be ascribed to *Atactolituola*. Some previous workers ascribed our new species to *Bulbophragmium* (see synonymy). In fact, these clearly lack any internal partitions and some slightly oblique equatorial sections (Fig. 5a-b) rather seem to evidence a planispiral coiling than a streptospiral type. The remaining uncertainties about the initial type of coiling are expressed by the question mark we put behind the generic assignment. Also, an assignment of our specimens to the genus *Cribratina* SAMPLE, 1932 (see synonymy) is not justified as this genus posesses an alveolar wall structure (see STEFFAHN & HELM, 2001 for details).

As can be seen from the thin-sections of the Campanian type-species *Lituola nautiloidea* LAMARCK, 1804 (see MAYNC 1952: Pl. 9, fig. 4-5, 7) or the recent *Lituola salsa* (CUSHMAN & BRÖNNIMANN, 1948) (see BRÖNNIMANN & ZANINETTI 1965: Fig. 3.1-2), there are no multiple chamber connections throughtout the whole test of *Lituola*. Instead the aperture is simple (central or near the base of the septa) in the coiled portion becoming multiple at the transition to the uncoiled portion. This observation from *Lituola* and also known from other genera, was stressed by MAYNC (1959: p. 203, "*die anfangs einfache Mündung im Reifestadium durch eine multiple ersetzt wird*").

According to LOEBLICH & TAPPAN (1988: p. 79) the stratigraphic range of *Lituola* is Late Triassic to Holocene. Following RIEGRAF (1998), the genus does not seem to appear earlier than the Campanian ("*Lituola* events") and older dubious reports could belong to the genera *Haplophragmium* or *Ammobaculites* (see also synonymy below). Both *Haplophragmium* and *Ammobaculites*, however, have a simple terminal aperture, *Haplophragmium* additionally an alveolar wall (see LOEBLICH & TAPPAN 1988, for details) thus being different from *Lituola* and the Late Jurassic representative described here.

Lituola? *baculiformis* n. sp.
(Fig. 4a (pars), 4b, 4c-d (pars), Fig. 5a-o)

1992 *Bulbophragmium*? sp. - BODEUR: Pl. 23, Fig. 9-11, Tithonian of South-France.
1996 ?*Cribratina* sp. – BUCUR et al.: Pl. 1, Fig. 4, Tithonian of Sicily (Italy).
1996 *Bulbophragmium* sp. - BUCUR et al.: Pl. 5, Fig. 1-2, Tithonian of Sicily (Italy).
2006 *Everticyclammina virguliana* (KOECHLIN, 1943) - KRAJEWSKI & OLSZEWSKA: Fig. 5c, Late Jurassic of the Crimea (Ukraine).
2008 *Ammobaculites celatus* ARNAUD-VANNEAU, 1980 - IVANOVA, KOLODZIEJ, KOLEVA-REKALOVA & RONIEWICZ: Fig. 7V, Berriasian-Valanginian of Moesian Platform (Bulgaria).

Derivatio nominis: The species name refers to the elongated, rod-shaped test morphology (latin baculum = rod).

Material: More than 30 specimens in thin-sections from various localities in the Northern Calcareous Alps (see chapter 2); most specimens recovered are from locality Mount Rettenstein.

Holotype: Slightly oblique equatorial section of the specimen figured on figure 5h, sample Rö 172.

Depository: All thin-sections are stored at the University of Leoben, Department of Applied Geosciences and Geophysics.

Type-locality: Mount Rettenstein near Filzmoos in the central Northern Calcareous Alps of Austria. For the location of the sample containing the holotype and the general

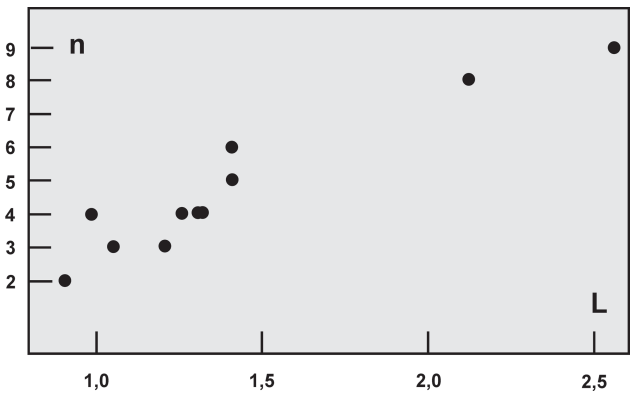


Fig. 3: Diagramm showing relationship of test length (L) (in mm) to the number of chambers in the uncoiled uniserial part (n).

distribution of *Lituola*? *baculiformis* n. sp. at Mount Rettenstein see text-figure 2.

Type-stratum: Kimmeridgian reefal platform margin deposits and slope facies of the Plassen Carbonate Platform.

Diagnosis: Medium-sized representative of *Lituola* with an uncoiled part becoming very long and more or less constant in thickness.

Description: The test consists of an initial, presumably planispirally coiled portion and an uncoiled part. Test wall and septa thick, finely to more coarsely agglutinated. In some specimens it can be observed, that coarser agglutinated grains are concentrated at the outer part of the test wall (e.g. Fig. 5j). There are specimens showing a prominent initial coiling with only some chambers in the uncoiled part (e.g. Fig. 5a-b), others show a comparable small reduced spire and an elongated uncoiled part with numerous (up to nine) uniserially arranged chambers (e.g. Fig. 5h, j). The uncoiled portion may be straight or slightly bended (e.g. Fig. 5i). The coiled portion is made up of two to maximum three and a half whorls with chambers succesively increasing in size as added. The shape of the chamber lumen is slightly rhombic in equatorial sections becoming slightly longer than high during ontogeny. The number of chambers in the last coiled whorl is six to eight. The aperture is single within the coiled portion lying close to the base of the septum (Fig. 5a); in the uncoiled part are multiple openings (cribrate) in the central part of the septum communicating between two adjacent chambers clearly visible in more or less centered longitudinal sections. (Fig. 5k-l, m). In tangential-longitudinal sections, however, only one intercameral

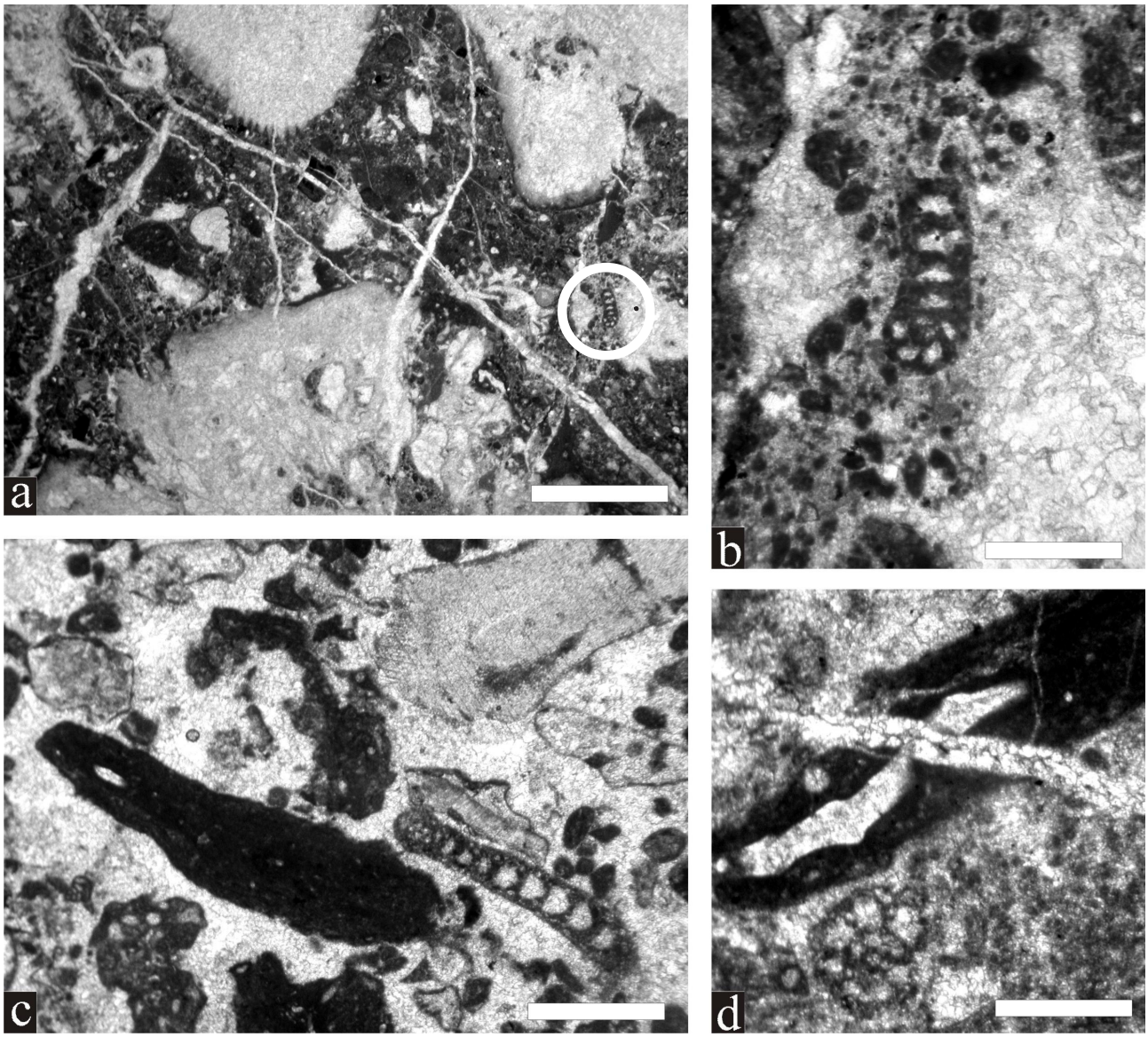
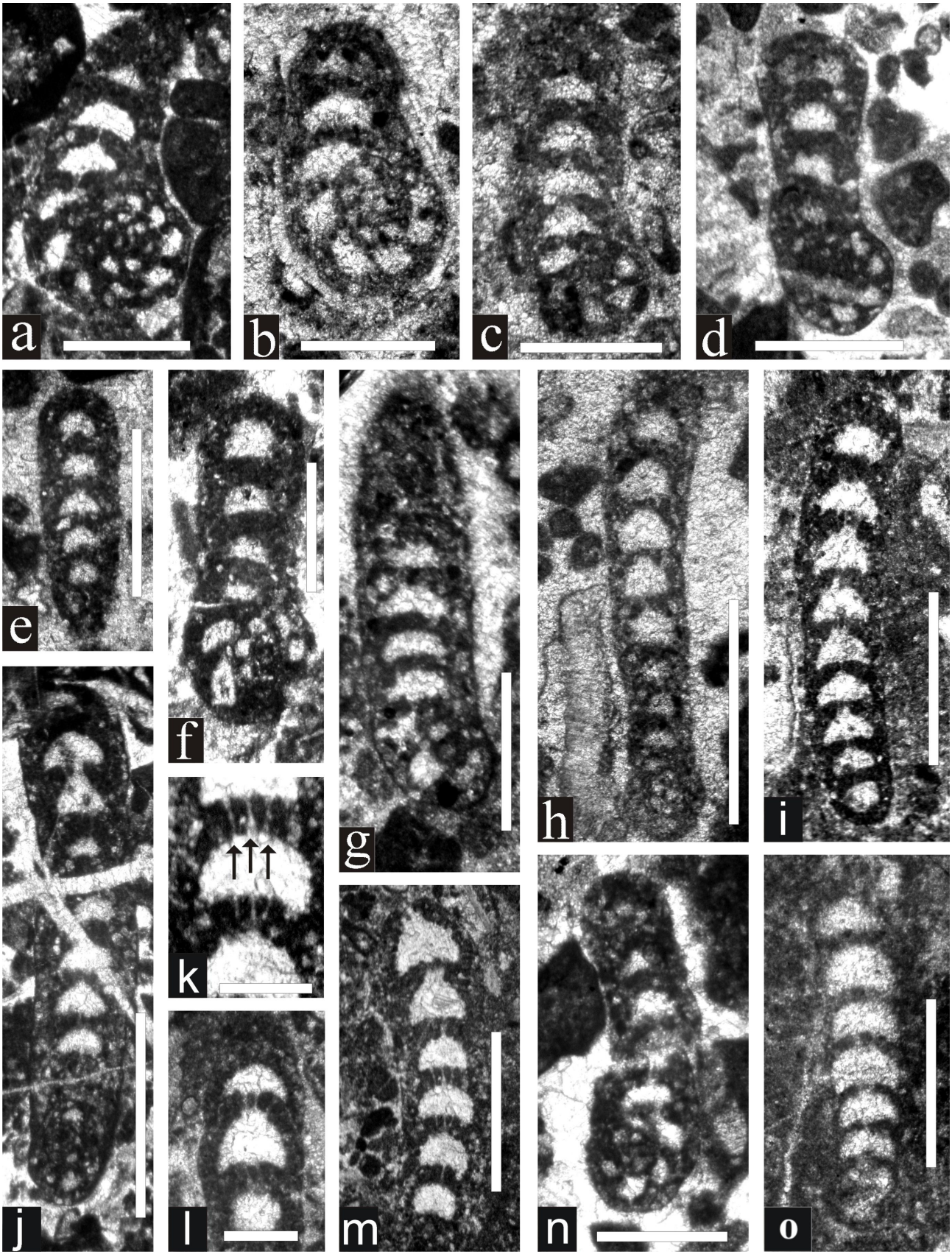


Fig. 4: Microfacies of samples with *Lituola*? *baculiformis* n. sp. **a**: Poorly washed-out bioclastic packstone with corals/ stromatoporoids and *Lituola*? *baculiformis* n. sp. (white circle). Mount Litzelkogel-Gerhardstein, sample DM 76. **b**: Detail from a with equatorial section of *Lituola*? *baculiformis* n. sp. **c**: Well washed-out packstone with debris of molluscs, echinoids, *Crescentiella morronensis* (Crescenti, 1969). The holotype specimen of *Lituola*? *baculiformis* n. sp. is shown in detail in fig. 5h. Mount Rettenstein, sample Rö 172. **d**: Juvenile specimen of *Lituola*? *baculiformis* n. sp. without uncoiled part together with *Crescentiella morronensis* (Crescenti, 1969). Mount Rettenstein, sample Rö 6.

aperture or no communication at all are recognizable. As in all sections (equatorial or in other planes) the shape of the chambers in the uncoiled portion is hemi-circular to lunate , it can be inferred that the uncoiled portion is uncompressed, rounded throughout (as we are lacking transverse sections!). Within the uncoiled part the chambers are more or less constant in size. In some cases the latest (Fig. 5m) or the penultimate chambers (Fig. 5o) are the greatest in size.



Remarks: The assignment of *Lituola*? *baculiformis* n. sp. to other genera unlike *Lituola* was discussed already in a previous part of the paper. The type-species of *Lituola*, *L. nautiloidea* (LAMARCK, 1804) (Late Cretaceous of France), however, is different from *Lituola*? *baculiformis* n. sp. in possessing a distinctly more prominent coiled portion with 11 to 13 chambers in the last whorl (6 to 8 in *Lituola*? *baculiformis* n. sp.) and a reduced uncoiled part of up to 3 chambers (up to 9 in *Lituola*? *baculiformis* n. sp.). The equatorial diameter of *L. nautiloidea* reaches up to 2.5 mm (measured from MAYNC 1952); in *Lituola*? *baculiformis* n. sp. it is much smaller, ranging always below 0.8 mm. Moreover, as the type-species derives from Campanian marls, differences in the palaeoenvironment of both taxa may be infered.

Lituola strogguloides ARNAUD-VANNEAU, 1980 (Early Cretaceous of France) differs from *Lituola*? *baculiformis* n. sp. above all by the missing of an rectilinear uncoiled portion; only the last two chambers of the uncoiled portion show a slight tendency to enroll, but are still in lateral contact with the spire.

Concerning the comparable large representatives of Late Cretaceous age (Campanian-Maastrichtian), the following differences with the isolated specimens of these forms can be remarked:

- *Lituola grandis* (REUSS, 1854) (Late Cretaceous of Austria) is distinctly larger and has a more reduced uncoiled part with mostly 2-3 chambers in the later (maximum 5) (RIEGRAF 1998: see plate 8-9). Specimens with a test length of about 3 mm may have 2-3 chambers in the uncoiled part; in *Lituola*? *baculiformis* n. sp., specimens may have up to 8 (9?) chambers in the uncoiled part in tests of up to 2.3 mm in length.
- *Lituola westfalica* BARTENSTEIN, 1952 (Late Cretaceous of Germany) may reach test length of up to 5 mm (see RIEGRAF 1998). The thickness of the uncoiled part of *L. westfalica* has a reduced number of chambers and nearly equals the width of the uncoiled stage
- *Lituola irregularis* (ROEMER, 1841) shows a much more reduced uncoiled portion of maximum 5 chambers and an overall larger test (see figures in RIEGRAF 1998). Other differences are difficult to assess as the work of RIEGRAF (1998) is based on isolated specimens (no thin-sections!).

Stratigraphy: *Lituola*? *baculiformis* n. sp. was detected in Kimmeridgian to Tithonian carbonates in the Northern Calcareous Alps of Austria; IVANOVA et al. (2008) figured the new species from the Berriasian-Valanginian of Crimea (Ukraine). The stratigraphic interval from which the new species was reported so far is Kimmeridgian to Valanginian; the total stratigraphic range is unknown.

Palaeoenvironment: RIEGRAF (1998) was discussing the palaeoenvironment of *Lituola*; he concluded, that the marly lithologies containing the Late Cretaceous representatives were deposited in water depth of approximately 50 to 100 metres. In contrast hereto, *Lituola*? *baculiformis* n. sp. derives from reefal platform margin deposits with corals, stromatoporoids and dasycladalean algae indicating depths of some metres to maximum 10 or 20 metres. Microfacies are bioclastic packstones, occassionally also boundstones (see Fig. 3). The packstones maybe poorly or well washed-out indicating differing water energy. Note that this is the same palaeoenvironment from which *Lituola*? *baculiformis* n. sp. was reported from France, Italy and Ukraine (see synonymy).

4. Conclusions

Lituola? *baculiformis* n.sp. is the first representative of *Lituola* reported from Late Jurassic strata and also the first one detected in reefal facies; all Late Cretaceous representatives occur in marly facies of a deeper water palaeoenvironment. As one outstanding feature, its extremly long uncoiled portion (more or less constant in diameter) is worth mentioning. *Lituola*? *baculiformis* n. sp. must have had a palaeogeographically wide distribution in platform margin facies in the Western Tethyan domain, so far reported from the Kimmeridgian to Valanginian stratigraphic interval.

Fig. 5: *Lituola? baculiformis* n. sp. from the Late Jurassic of the Northern Calcareous Alps, Austria. Scale bars: Fig. a-c, f, n, o = 0.5 mm; m, i-j = 1 mm; l-k = 0.3 mm.
Fig. a: Equatorial section. Mount Ewige Wand, sample E 819.
Fig. b: Equatorial section; note single aperture in the coiled portion of the test. Mount Rettenstein, sample Rö 163.
Fig. c: Subequatorial section. Mount Rettenstein, sample Rö 138.
Fig. d: Subequatorial section. Mount Trisselwand, sample MT 434.
Fig. e: Oblique section of the uncoiled part. Mount Jainzen, sample A-3440-2.
Fig. f: Subequatorial section. Mount Jochwand, sample E 258.
Fig. g: Slightly oblique equatorial section. Mount Krahstein, sample Krah 114.
Fig. h: Slightly oblique equatorial section of a specimen with long uncoiled part consisting of 8 chambers. Mount Rettenstein, sample Rö 172, holotype.
Fig. i: Longitudinal section through uncoiled portion of the test consisting of 9 chambers. Mount Sandling, sample D 783.
Fig. j: Slightly oblique equatorial section. Mount Rettenstein, sample Rö 342.
Fig. k: Detail from m showing multiple chamber connections (arrows). Mount Trisselwand, sample MT 151.
Fig. l: Mount Rettenstein, sample Rö 67.
Fig. m: Specimen showing multiple chamber connections in the uncoiled part. Mount Trisselwand, sample MT 151.
Fig. n: Equatorial section. Steinernes Meer, sample SM 118.
Fig. o: Oblique equatorial section. Mount Rettenstein, sample Rö 350.

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