ACTA PALAEONTOLOGICA ROMANIAE V. 4 (2004), P. 455-462

PINNATIPORIDIUM UNTERSBERGENSIS N. SP., A NEW SIPHONOUS GREEN ALGA OF THE FAMILY PROTOHALIMEDACEAE DRAGASTAN, LITTLER & LITTLER 2002 FROM THE UPPER JURASSIC OF THE NORTHERN CALCAREOUS ALPS (AUSTRIA)

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Abstract. The Alpine Plassen Formation (Kimmeridgian – Berriasian) yields a particularly diversified association of siphonous green algae and *Rivularia*-type Cyanophceans (former "Porostromata"). Most abundantly they occur within both, back-reef/open lagoon rud- to packstones and internal infralittoral wackestones. Thus, their occurrence/missing within certain localities can be explained by their different facies evolution. With a total of more than 30 species, the Plassen Formation of the Northern Calcareous Alps shows strong affinities to the East Carpathians, exhibiting the type-localties of many of these taxa. A new species is introduced as *Pinnatiporidium untersbergensis* n. sp. from the Upper Kimmeridgian of Mount Untersberg near Salzburg, Austria being distinctly smaller than the type-species *P. cylindricus* DRAGASTAN 1990 and *P. alpidicum* (DRAGASTAN, 1999) nov. comb.

Keywords: Protohalimedaceae, green siphonous algae, new taxon, Upper Jurassic, Northern Calcareous Alps, Austria

INTRODUCTION

Recent investigations have shown that siphonous green algae and *Rivularia*-type cyanophyceans (former "Porostromata") are widespread in the shallow water limestones of the Plassen Formation (Kimmeridgian-Berriasian) of the Northern Calcareous Alps exhibiting special facies dependencies (SCHLAGINTWEIT, GAWLICK & LEIN 2003). There are so far only a view previous works where some concrete taxa have been identified and illustrated (FENNINGER & HÖTZL 1967, DARGA & SCHLAGINTWEIT 1991, DYA 1992, SCHLAGINTWEIT, GAWLICK & LEIN 2003). The reinvestigation of many different localties of the Alpine Plassen Formation yielded rich associations of this alga group encompassing more than 30 different taxa exhibiting special facies dependencies. The species richness therefore is similar to that one from the East Carpathians representing the type-locality for many of the described taxa (e.g. DRAGASTAN 1985, 1989, 1990, 2001). In the present paper a new taxon is introduced as *Pinnatiporidium untersbergensis* n. sp. from the Upper Kimmeridgian of the Untersberg, southwest of Salzburg, Austria.

GEOLOGICAL SETTING

Mount Untersberg is located SW of the town of Salzburg, directly at the German-Austrian border (Fig.-Text 1). The mountain massif of the Untersberg belongs to the northernmost frontal parts of the nappe pile of the Northern Calcareous Alps that here rather abruptely raises up from the footplain of Salzburg up to 1993 m above sea-level. According to new tectonic concepts, the Untersberg is part of the large Berchtesgaden block (former Upper Juvavic Berchtesgaden nappe) being part of the Upper Tirolic Nappe sensu FRISCH & GAWLICK (in press).

Geologically, the main massiv of the Untersberg is built up of Upper Triassic Dachstein Limestone. At the northern side of Mount Untersberg, there are also Upper Jurassic and Upper Cretaceous sediments. The Upper Jurassic Plassen Formation of the Untersberg has so far been poorly investigated and there are just a few data on microfacies, stratigraphy and microfauna/microflora (DYA 1992, FENNINGER & HOLZER 1972, MOSHAMMER & SCHLAGINTWEIT 1999).

The whole succession, respectively the facies evolution and its stratigraphic context is yet poorly known. Also nothing is known about the underlying basement. In most overviews there is a hiatus between the Liassic and the Upper Jurassic Plassen Formation (e.g. SCHWEIGL & NEUBAUER 1997) that should, also at Mt. Untersberg initiate with transgressive basal conglomerates (SCHLAGER, 1930). According to FENNINGER & HOLZER (1972), the Plassen Formation of Mt. Untersberg could be about 700m in thickness.

The "Upper Cretaceous" Gosau Group of Mt. Untersberg, besides others, is interesting from the stratigraphic point of view with a profile running through the Cretaceous-Tertiary boundary (Herm.). The Gosau Group of Mt. Untersberg is especially well - known for its Naturwerkstein, the so-called Untersberg Marmoe. The latter has been broken in several quarries, the Kiefer quarry, the Reindl quarry and the Veitl quarry (e.g. KIESLINGER 1964). For the geology and sedimentology of the formation of the Untersberger Marmor as a typical shore zone deposit see LEISS (1988) and SANDERS (1997).

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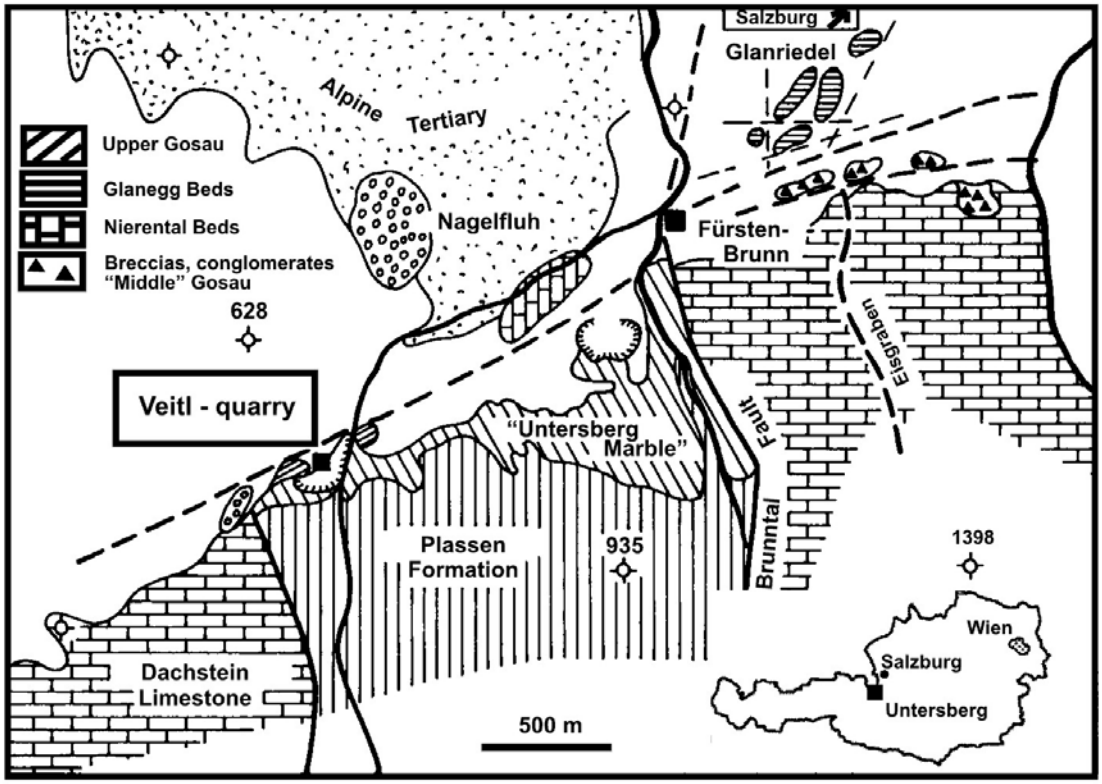

Fig.-Text 1. Map of the northern part of Mount Untersberg with the Veitl quarry, the type-locality of *Pinnatiporidium untersbergensis* n. sp. (modified from HERM et al, 1981 and MOUSSAVIAN, HERM & HÖFLING 1990).

According to the latter author, the facies typically corresponds to a "shore zone deposit" built up of small clast debris (fine breccia) of the underlying Plassen Formation (Pl. II, figs. 1, 3). From this transitional zone, Gosau group – Plassen Formation samples have been taken containing the new taxon.

PALEONTOLOGIC COMMENTARIES

The new taxon going to be described is ascribed to the genus *Pinnatiporidium* DRAGASTAN 1990, originally established as belonging to the Order Caulerpales SETCHELL, 1929 with the family Udoteaceae (ENDLICHER) AGARDH 1888. According to the new phylogenetic revision and interpretation provided by DRAGASTAN, LITTLER & LITTLER (2002), the genus *Pinnatipordium* has been enclosed in the new created family of the Protohalimedeaceae. Representatives of this family are composed of "*thalli cylindrical, subcylindrical, rarely spheroidal or fan-shaped (somewhat flattened in Mesozoic), builts by segments variable in shape. The segments are crossed by uni- or multi-axial medullary siphons and the cortex has both simple or dichotomously branched primary and secondary siphons in Paleozoic material and multiseries siphons (1-4, not more) in Mesozoic taxa*." (DRAGASTAN et al. 2002: p. 15). Worth mentioning besides the distinction of a medullar zone and cortical zone, DRAGASTAN (1990) in describing the genus *Pinnatiporidium* applies only the last order branches (4th order) to the cortical zone, whereas the first to third order branches are summarized as lateral zone. An allied genus of the family Protohalimedaceae with at first look has a similar appearance, is the genus *Felixporidium* DRAGASTAN 1999. Initially, the genus was assigned in 1999 to the Family Halimedaceae LINK, 1932. The genus *Felixporidium*, however, is different from the genus *Pinnatiporidium*, because the thallus contains hemisphaerical segments or flabellae disposed bilaterally along the axis (Fig.-Text 2).

The thallus is also crossed by an uniaxial medullary siphon being more regularly in shape in comparison with that one of *Pinnatiporidium*. The cortex system of both taxa is represented by multiseries siphons (I – IV order). Within the flabellae, the cortical siphons have a radial-symmetrical disposition (Fig.-Text 2) totally different in comparison to the genus *Pinnatiporidium*. Taking into account these new data and reconsideration of thallus morphology, the species *Felixporidium alpidicum* DRAGASTAN, 1999 must be transferred to the genus *Pinnatiporidium*, thus, becoming *P. alpidicum* (DRAGASTAN, 1999) SCHLAGINTWEIT & DRAGASTAN. Thus, the genus *Felixporidium* DRAGASTAN 1999 becomes monospecific with the species *Felixporidium atanasiuii* (DRAGASTAN, 1978 non 1971) DRAGASTAN 1999 from the Tithonian of

the East Carpathians.

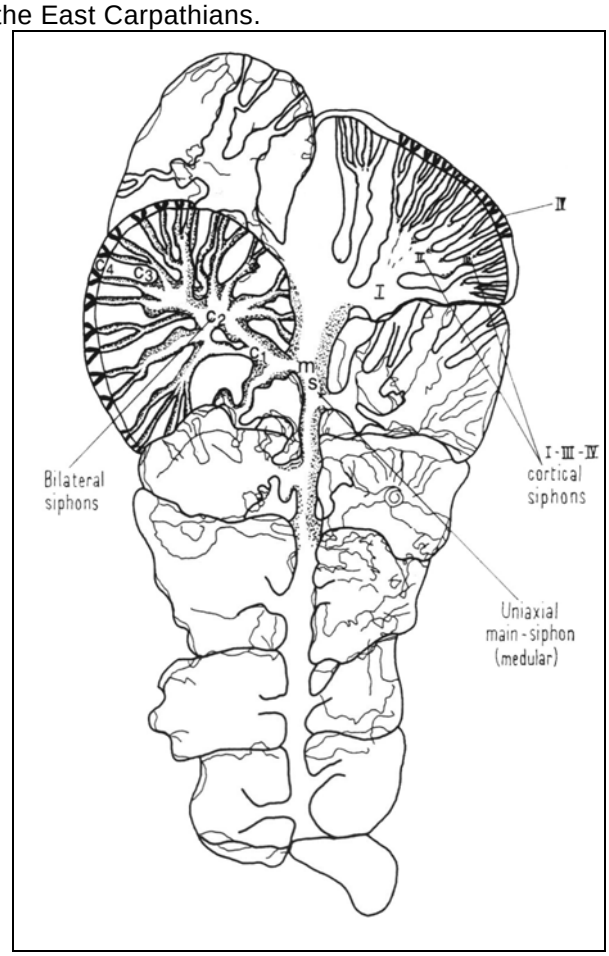

Fig.-Text. 2. Thallus organization of the genus *Felixporidium* DRAGASTAN 1999.

Phylum CHLOROPHYTA
Class BRYOPSIDOPHYCEAE
Order Bryopsidales
Family Protohalimedaceae DRAGASTAN, LITTLER & LITTLER 2002

Genus ***Pinnatiporidium*** DRAGASTAN, 1990, emend.

Diagnosis emended: Thallus isolate, cylindrical built by small, hemisphaerical or fan like segments, more or less equal as height, overlapping each others vertically to the axis (Fig.-Text 3a). The segments of the thallus are crossed by an uniaxial medullar siphon, which can be uneven and somehow constricted between the limit of the segments. The cortex system is crossed by siphons disposed more or less in alternating or opposite manner, primary simple, short with large diameter, secondary moniliform, short dichotomic branched followed by tertiary, long trichotomic siphons and ending with fourth short, fine dichotomic branched siphons (Fig.-Text 3b).

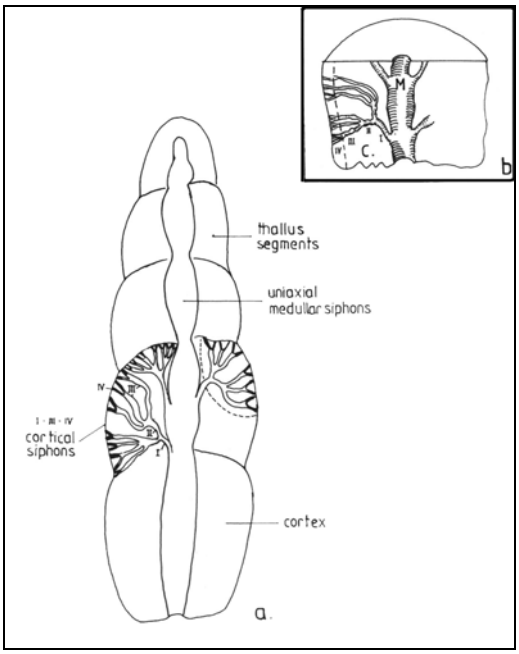

Fig-Text 3. Thallus organization of the genus *Pinnatiporidium* DRAGASTAN 1990, emend.
a. entire thallus; b. reconstruction of thallus with uniaxial medullar siphon (M) and cortex system (C) from DRAGASTAN 1990.

Pinnatiporidium untersbergensis n. sp.
(Pl. 1, figs. 1-4, 6)

Origin of name: The specific name refers to the type-locality Mount Untersberg SSW-Salzburg, Austria.

Holotype: Pl. 1, fig. 6, Thin-section BSP 2002-I-23, deposited at the Bayerische Staatssammlung für Paläontologie und historische Geologie, Munich. The thin-section with the holotype also contains the isotypes (Pl. 1, fig. 1, 3)

Isotypes: All other specimens from the type-locality figured on plate 1, figures 1-3.

Type-locality: Veitl quarry ("Veitlbruch" in german), 616 m above s.-l., at the northern side of Mount Untersberg, east of Bad Reichenhall where the so-called "Untersberger Marmor" is excavated (Fig-Text 1).

Type stratum: Whitish limestones of the Plassen Formation forming packstones and wackestones where the new taxon occurs predominantely in the former. These limestones (preferentially the wackestones) contain dasycladales with *Salpingoporella annulata* CAROZZI, *Salpingoporella* sp., most abundant *Clypeina sulcata* (ALTH) and rare *Campbelliella striata* (CAROZZI). Nodules of *Lithocodium aggregatum* ELLIOTT with *Troglotella incrustans* WERNLI & FOOKES are present as well as the serpulid tube *Carpathiella plassenensis* SCHLAGINTWEIT & GAWLICK. Benthonic foraminifera

include *Redmondoides lugeoni* (SEPTFONTAINE), *Pseudomarsonella* sp., *Kurnubia palastiniensis* HENSON and more rarely *Labyrinthina mirabilis* WEYNSCHENK, "*Kilianina" rahonensis* FOURY & VINCENT and *Everticyclammina virguliana* (KOECHLIN) inferring an Upper Kimmeridgian (? Lowermost Tithonian) age. Besides *Pinnatiporidium untersbergensis* n. sp. there are other, so called "Porostromata", included now in Cyanophyta, Family Scytonemataceae such us *Ortonella robusta* DRAGASTAN and Chlorohyta, Family Pseudoudoteaceae such us *Hedstroemia teres* DRAGASTAN, *Garwoodia fissa* DRAGASTAN and *Garwoodia toomeyi* DRAGASTAN (DRAGASTAN, 2002).

Description: Thallus cylindrical to cylindro-conical (Pl. 1, fig. 6) built by fan-like segments equal as height which overlapping each others vertically to the axis. The segments of the thallus are crossed by uniaxial medullar siphons, smaller in diameter and sometimes presenting constriction between the limit of the segments (Pl. 1, fig. 4). The cortex system is composed by siphons disposed in opposite manner, primary simple, short with large diameter, secondary also short followed by tertiary long, trichotomic siphons ending with short, fine dichotomic branched siphons. The primary siphons are arranged at low angle to the main axis then together with the higher order siphons are bending towards the outside. Shallow tangential sections show a close-set honeycomb pattern.

Species	***P. cylindricus*** DRAGASTAN 1990	***P. alpidicum*** (DRAGASTAN, 1999) nov. comb.	***P. untersbergensis* n. sp.**
Stratigraphy	Tithonian-Neocomian of Eastern Carpathians	Late Tithonian or Early Berriasian, Dietrichshorns, Salzburg; Early Valanginian, Fagetul Ciucului, East Carpathians	Upper Kimmeridgian-Tithonian (?Lower Berriasian) of NCA
Thallus length	6 – 9 mm	6 mm	Up to 6,2 mm
Outer diameter	3 – 3,2 mm	1,25 - 2,30 mm	1,6 – 1,85 mm
dms	0,50 – 0,52 mm	0,25 – 0,30 mm	0,20 – 0,25 mm
dc1	0,15 (base) – 0,06 mm	0,030 – 0,060 mm	0,080 – 0,13 mm
dc2	0,06 – 0,07 mm	0,040 - 0,045 mm (0,050)	0,030 – 0,055 mm
dc3	About 0,03 mm	0,010 – 0,020 mm	0,016 – 0,030 mm
dc4	0,015 – 0,020 mm	0,05 – 0,010 mm	About 0,016 mm

Similarities and differences: The genus *Pinnatiporidium* DRAGASTAN 1990 has two species, till now, the type species *P. cylindricus* DRAGASTAN, 1990 found in Tithonian-Neocomian of the Eastern Carpathians and the second *P. alpidicum* (DRAGASTAN, 1999) nov. comb. which has the holotype from the Uppermost Tithonian (or lowermost Berriasian) of Mount Dietrichshorns, Salzburg Calcareous Alps, Austria. For the dasycladales, differences of branch morphology and dimensions can be used for species distinction (e.g. BASSOULLET et al. 1975). Equivalent criteria can be applied also to the siphonous green algae. As can be seen from the above table, *P. untersbergensis* n. sp. is distinctly smaller than *P. cylindricus*. The species *P. alpidicum* differes from the new taxon by the hemisphaerical segments, not so extend on height and by the cortex system crossed by siphons disposed more or less in alternanting manner. The cortical siphons (dc1 to dc4) have smaller diameter in comparison with the new species.

Stratigraphic position: At the type-locality, the algal-bearing packstones are associated with wacke- to packstones with benthic foraminifera and dasycladales. The latter include *Clypeina sulcata* (ALTH) and *Salpingoporella annulata* CAROZZI; benthic foraminifera with *Kurnubia palastiniensis* HENSON, "*Kilianina" rahonensis* FOURY & VINCENT, *Pseudomarssonella* sp., *Redmondoides lugeoni* (SEPTFONTAINE) and *Labyrinthina mirabilis* WEYNSCHENK. In the Northern Calcareous Alps, this assemblage has been refered to the Upper Kimmeridgian (e.g. SCHLAGINTWEIT, GAWLICK & LEIN 2003). On the other side, however, lowermost Tithonian cannot be excluded for sure (see BASSOULLET 1997a, b) since right now no biostratigraphic marker is available for the strict separation of Kimmeridgian and Tithonian strata of shallow water facies.

Further occurrences of *Pinnatiporidium untersbergensis* n. sp. are from the Tithonian of Mount Plassen, the type-locality of the Plassen Formation and the Trisselwand near Altaussee/Salzkammergut of Austria. Resedimented, it has also been detected within the Barmstein Limestones, that are attributed to the interval Middle Tithonian-Berriasian (STEIGER 1981, 1992). Summarizing, the new species is well recorded from the Upper Kimmeridgian and Tithonian, but perhaps may also reach into the Berriasian.

Acknowledgements

Thin-sections from the Barmstein limestones have kindly been provided by Prof. H.-J. Gawlick (University of

Leoben, Austria).

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PLATES

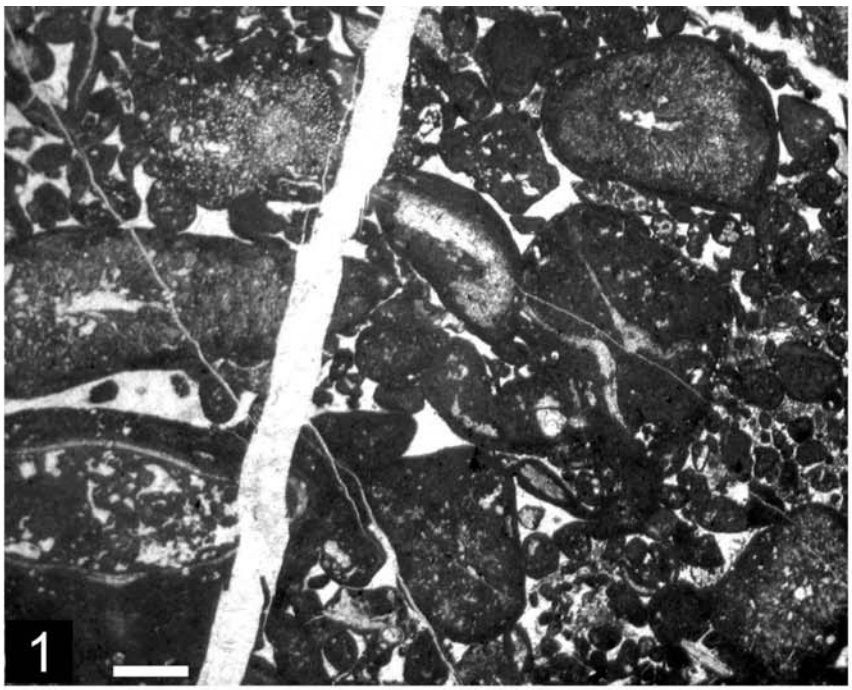
PLATE I

1-4, 6. *Pinnatiporidium untersbergensis* n. sp. from the Upper Jurassic of the Northern Calcareous Alps;
1. Open lagoonal packstone with *Pinnatiporidium untersbergensis* n. sp. Plassen, Formation, locality Veitl quarry, Untersberg; sample BSP 2002-I-23, scale bar = 1 mm;
2. Longitudinal oblique section. Plassen Formation, locality Veitl quarry, Untersberg; sample Veitl-4, scale bar = 1 mm;
3. Longitudinal oblique section (left) and oblique section. Plassen Formation, locality Veitl quarry, Untersberg; sample BSP 2002-I-23, scale bar = 1 mm;
4. Longitudinal section showing the uniaxial medullar siphon with swellings (= constrictions), Barmstein Limestone, locality scale bar = 1 mm;
5. Oblique longitudinal section of *Pinnatiporidium alpidicum* (DRAGASTAN) nov. comb.. Lofer Member, locality Dietrichshorn; sample Die-2, scale bar = 2 mm;
6. Longitudinal-tangential to longitudinal-oblique section. Plassen Formation, locality Veitl quarry, Untersberg; sample BSP 2002-I-23, scale bar = 1 mm.

PLATE II

Fig. 1, 3: Transgressive contact of the Upper Cretaceous Gosau (GO) Group (above) and the Upper Jurassic Plassen (Pl) Formation (below). Fig. 1 thin-section Veit-6 and Fig. 3 thin-section Veit-10, scale bars = 2 mm.
Fig. 2: *Hedstroemia teres* DRAGASTAN, 1989. Thin-section Veit-5, scale-bar = 0,5 mm.
Fig. 4: *Ortonella robusta* DRAGASTAN, 1989 together with benthic foraminifera *Kurnubia palastiniensis* HENSON. Thin-section Veit-5, scale-bar = 0,5 mm.
Fig. 5: Packstone with *Clypeina sulcata* (ALTH) and enrolled specimen of *Labyrinthina mirabilis* WEYNSCHENK. Thin-section Veit-5, scale-bar = 1 mm.
Fig. 6: Packstone with dasycladale *Campbelliella striata* (CAROZZI) (Camp), serpulid tube *Carpathiella plassenensis* SCHLAGINTWEIT & GAWLICK (Carp), benthonic foraminifera "*Kilianina" rahonensis* FOURY & VINCENT (Kil) and microproblematicum *Lithocodium aggregatum* ELLIOTT with foraminifera *Troglotella incrustans* WERNLI & FOOKES inside (Lith). Thin-section Veit-9, scale-bar = 2 mm.
Fig. 7: *Garwoodia fissa* DRAGASTAN, 1989. Thin-section Veit 12, scale-bar = 1 mm.
Fig. 8: *Garwoodia* ? sp. Thin-section Veit-1, scale-bar = 0,5 mm.
Fig. 9: *Garwoodia toomeyi* DRAGASTAN, 1989. Thin-section Veit-1, scale-bar = 0,5 mm.

All figurations of Plate II are from the Veitlbruch, Mt. Untersberg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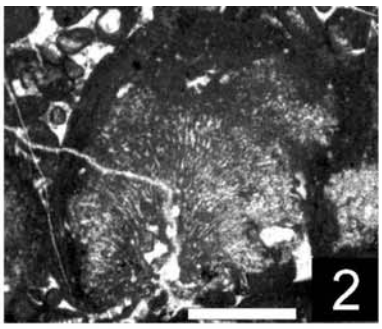
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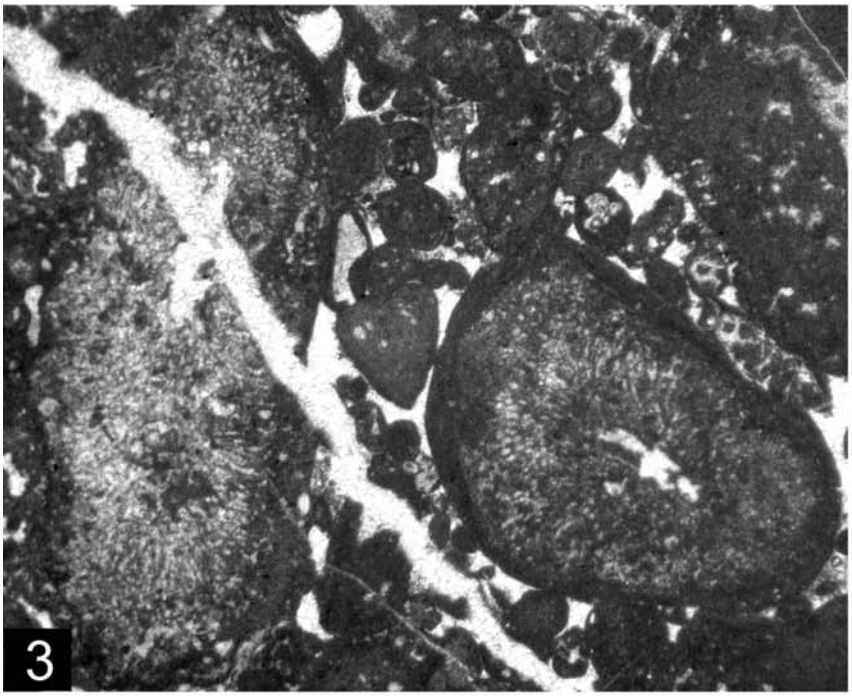
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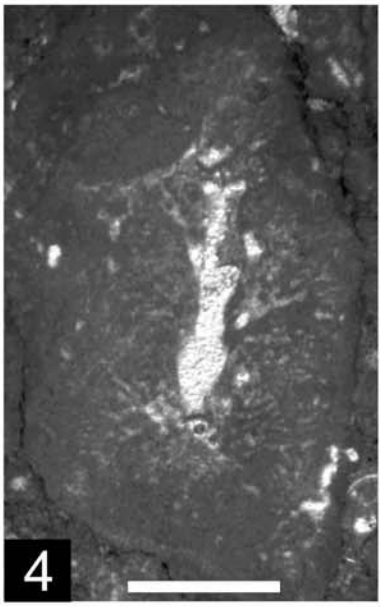
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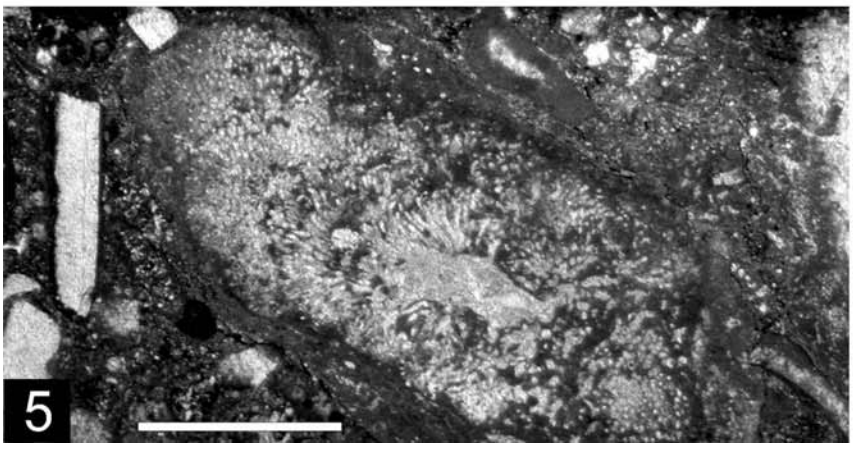
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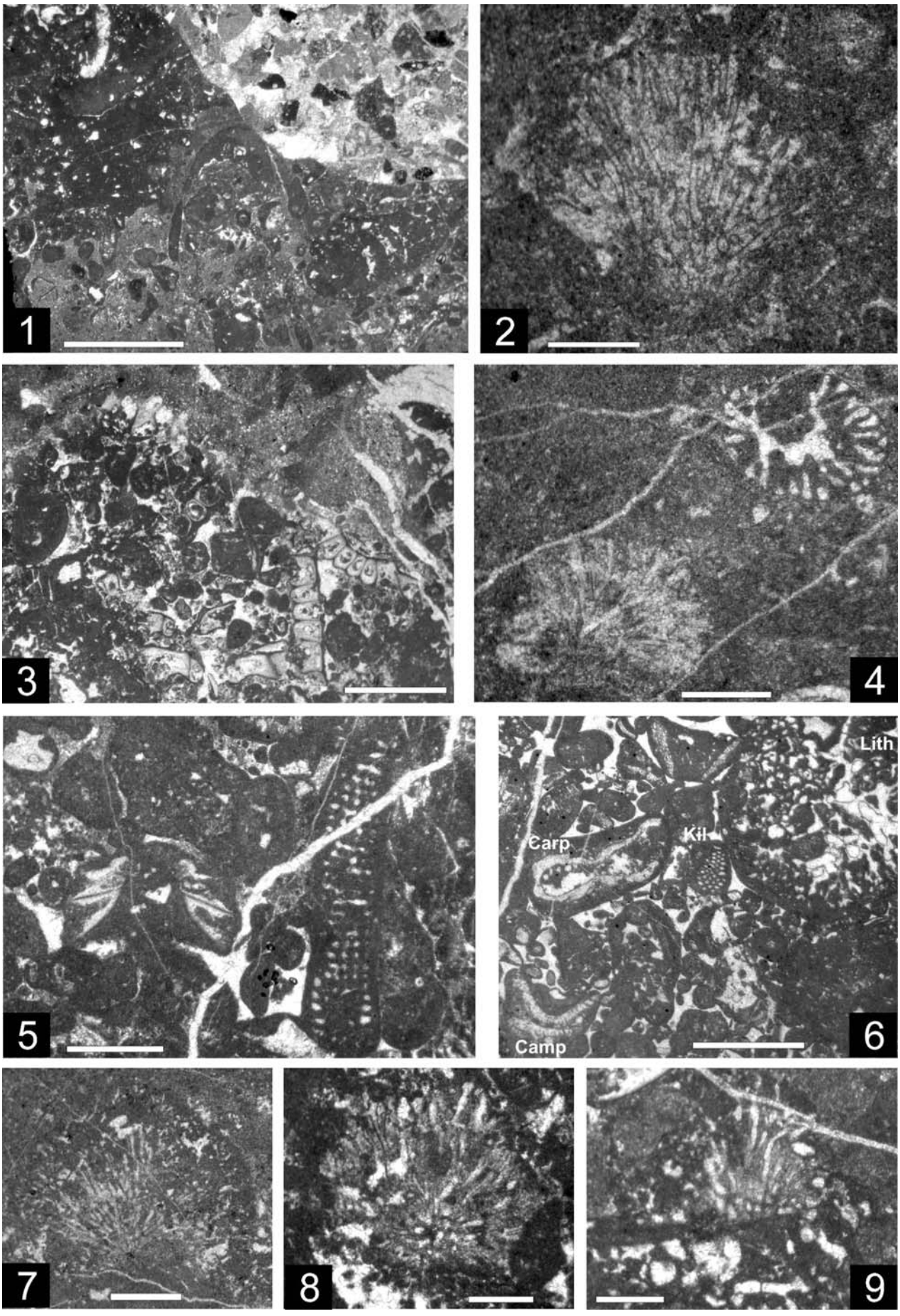
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