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Early and middle Santonian Cephalopods from the Gosau Group (Upper Cretaceous, Austria)
1. Nautiloidea and non-heteromorph Ammonoidea

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13 Text-Figures, 16 Tables, 23 Plates

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Abstract

Five taxa of Nautiloidea and 37 taxa of non-heteromorph Ammonoidea are described from the early and middle Santonian part of the Gosau Group of Austria. New for the Gosau are *Angulithes westphalicus* (SCHLÜTER, 1876), *Cymatoceras* cf. *huxleyanum* (BLANFORD, 1861), *Hyporbulites woodsi* VAN HOEPEN, 1921, *Saghalinites nuperus* (VAN HOEPEN, 1921), *Anagaudryceras* sp., *Jimboiceras* cf. *reyi* COLLIGNON, 1983, *Hauericeras* (*Gardeniceras*) aff. *gardeni* (BAILY, 1855), *Damesites sugata* (FORBES, 1846), *Nowakites carezi* (DE GROSSOUVRE, 1894), *Nowakites savini* (DE GROSSOUVRE, 1894), *Patagiosites stobaei* (NILSSON, 1827), *Tragodesmoceras* aff. *clypeale* (SCHLÜTER, 1872), *Pseudoschloenbachia* (*Pseudoschloenbachia*) sp. and *Texasia cricki* (SPATH, 1921). *Muniericeras gosauicum* (HAUER, 1858) and *Hemitissotia randoi* GERTH, 1961, which is shown to be a synonym of *Eulophoceras natalense* HYATT, 1903 are revised.

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Cephalopoden des frühen und mittleren Santoniums der Gosau-Gruppe (Oberkreide, Österreich)
1. Nautiloidea und nicht-heteromorphe Ammonoidea

Zusammenfassung

Es werden fünf taxa Nautiloidea und 37 taxa nicht-heteromorphe Ammonoidea aus dem unteren und mittleren Santonium der österreichischen Vorkommen der Gosau-Gruppe beschrieben. Neu für die Gosau-Gruppe sind: *Angulithes westphalicus* (SCHLÜTER, 1876), *Cymatoceras* cf. *huxleyanum* (BLANFORD, 1861), *Hyporbulites woodsi* (VAN HOEPEN, 1921), *Saghalinites nuperus* (VAN HOEPEN, 1921), *Anagaudryceras* sp., *Jimboiceras* cf. *reyi* COLLIGNON, 1983, *Hauericeras* (*Gardeniceras*) aff. *gardeni* (BAILY, 1855), *Damesites sugata* (FORBES, 1846), *Nowakites carezi* (DE GROSSOUVRE, 1894), *Nowakites savini* (DE GROSSOUVRE, 1894), *Patagiosites stobaei* (NILSSON, 1827), *Tragodesmoceras* aff. *clypeale* (SCHLÜTER, 1872), *Pseudoschloenbachia* (*Pseudoschloenbachia*) sp. und *Texasia cricki* (SPATH, 1921). *Muniericeras gosauicum* (HAUER, 1858) und *Hemitissotia randoi* GERTH, 1961, die unter die Synonymie von *Eulophoceras natalense* HYATT, 1903 fallen, werden revidiert.

Introduction

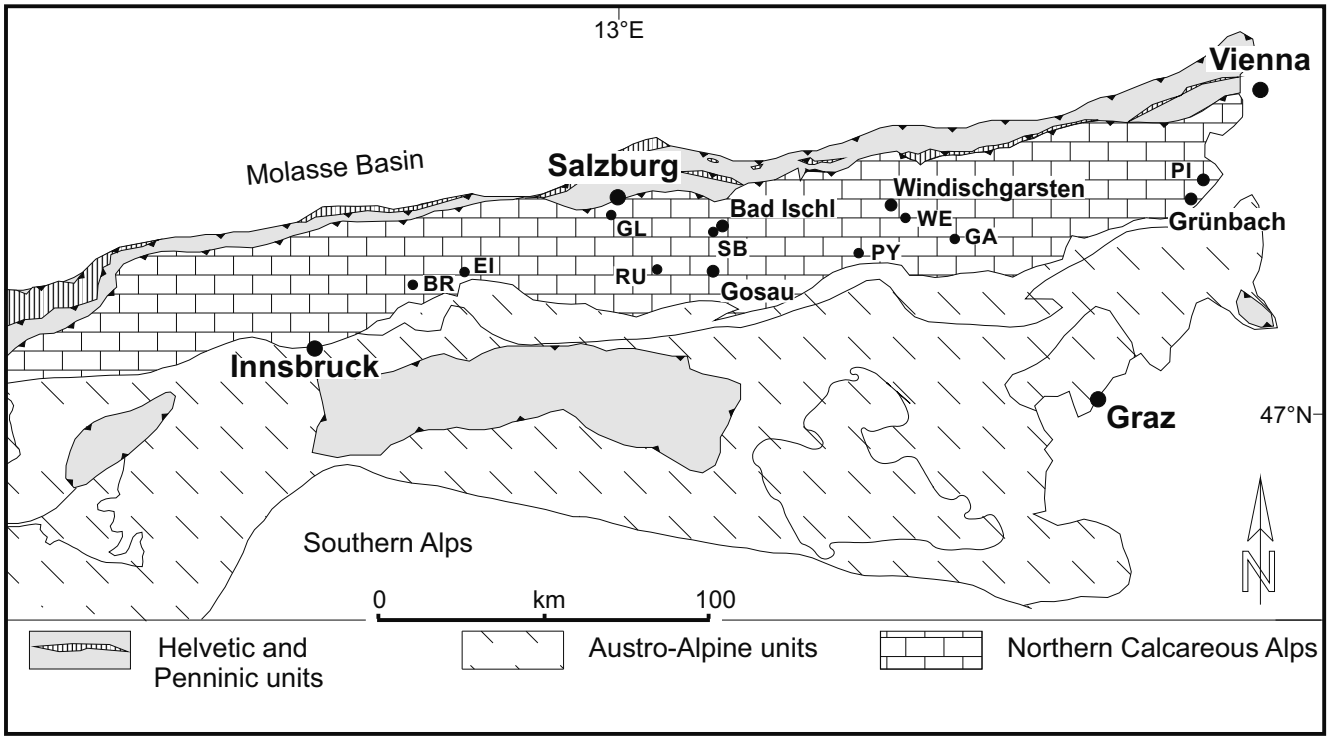
Following the description of the late Santonian cephalopods of the Gosau Group from the Schattaugraben outcrops of the Gosau Basin of Salzburg (SUMMESBERGER et al., 2017a; this volume) and Finstergrabenwandl, Upper Austria (WIEDMANN, 1978; SUMMESBERGER, 1979, 1980, 1992), we describe below the early and middle Santonian nautiloids and non-heteromorph ammonites of the Austrian Gosau Group. With the description of the lower and middle Santonian heteromorphs (SUMMESBERGER et al., 2017b; this volume)) the revision of the Austrian Gosau cephalopods will be continued.

The first ammonites described from the lower Santonian of the Gosau Group were *Ammonites gosauicus* HAUER (1858: 13, Pl. 2, Figs. 7–9) and *Ammonites texanus* ROEMER, 1849 (HAUER, 1858: 10, Pl. 2, Figs. 4–6). REDTENBACHER (1873: 9–140, Pls. 22–30) provided comprehensive descriptions of the cephalopods of the Gosau Group, although dealing with only a few early to middle Santonian localities:

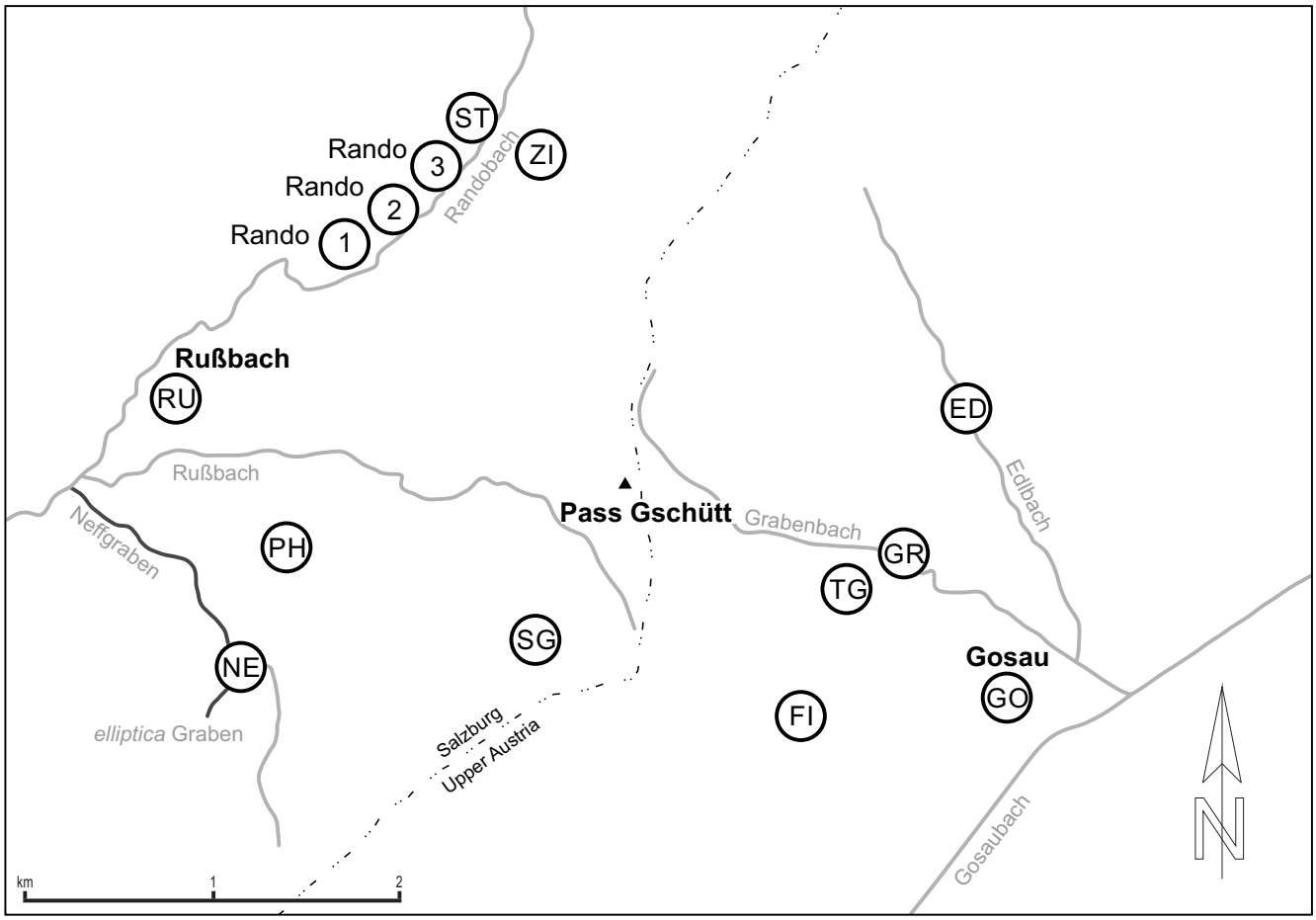
"Gosau" (possibly the Neffgraben and Randograben sections: see below);
"Stöcklwald" (possibly the Randograben);
"Tiefengraben" (possibly Grabenbach);
"St. Wolfgang" (possibly Schneiderwirtsbrücke);
"Strobl-Weißenbach" (possibly also Schneiderwirtsbrücke, as Strobl-Weißenbach is a late Turonian locality: fide SUMMESBERGER & KENNEDY, 1996);
"Weißenbach next Bad Aussee" (Styria) is a Coniacian locality;
"Wolfsbachau next Reifling" (Styria) is possibly Campanian.

KATSCHTHALER (1935) and BRINKMANN (1935) provided the first list of early Santonian cephalopods from Brandenberg (Tirol). GERTH (1956, 1961) was the first to describe early Santonian ammonites from the Gosau Basin and successfully logged and interpreted the extensive Neffgraben section (Rußbach, Salzburg). A revision of the Austrian Texanitinae was provided by KENNEDY et al. (1981). IMMEL et al. (1982) and IMMEL (1987) gave detailed descriptions of the early Santonian Brandenberg cephalopods.

From 1971 onwards H.A. Kollmann (NHMW) and H. Summesberger (NHMW) ran a stratigraphic program, collected numerous early Santonian fossils and acquired detailed knowledge of the fossil bearing sites of the Gosau Basin itself and the Gosau Group occurrences in the Northern Calcareous Alps (Text-Fig. 1).



Text-Fig. 1.
Distribution of Gosau Group localities mentioned in the text. BR – Brandenberg, EI – Eiberg, GA – Gams, GL – Glanegg, PI – Markt Piesting, PY – Pyhrnpass, RU – Rußbach, SB – Schneiderwirtsbrücke, WE – Weißwasser.



Text-Fig. 2.
Gosau Group localities in the Gosau area (Upper Austria and Salzburg) mentioned in the text: ED – Edlbachgraben, FI – Finstergrabenwandl, GO – Gosau, GR – Grabenbach, NE – Neffgraben, Pass Gschütt, PH – parking site Hornspitz cable-car, Rando (= Randograben) 1–3, RU – Rußbach, SG – Schattaugraben, ST – Stöcklwaldgraben, TG – Tauerngraben, ZI – Zimmergraben.

An account of the late Santonian Schattau locality (= Schattaugraben, Rußbach, Salzburg) with the main focus on biostratigraphy and lithostratigraphy was published by WAGREICH et al. (2010). A detailed description of the Schattaugraben is given in SUMMESBERGER et al., 2017a (this volume).

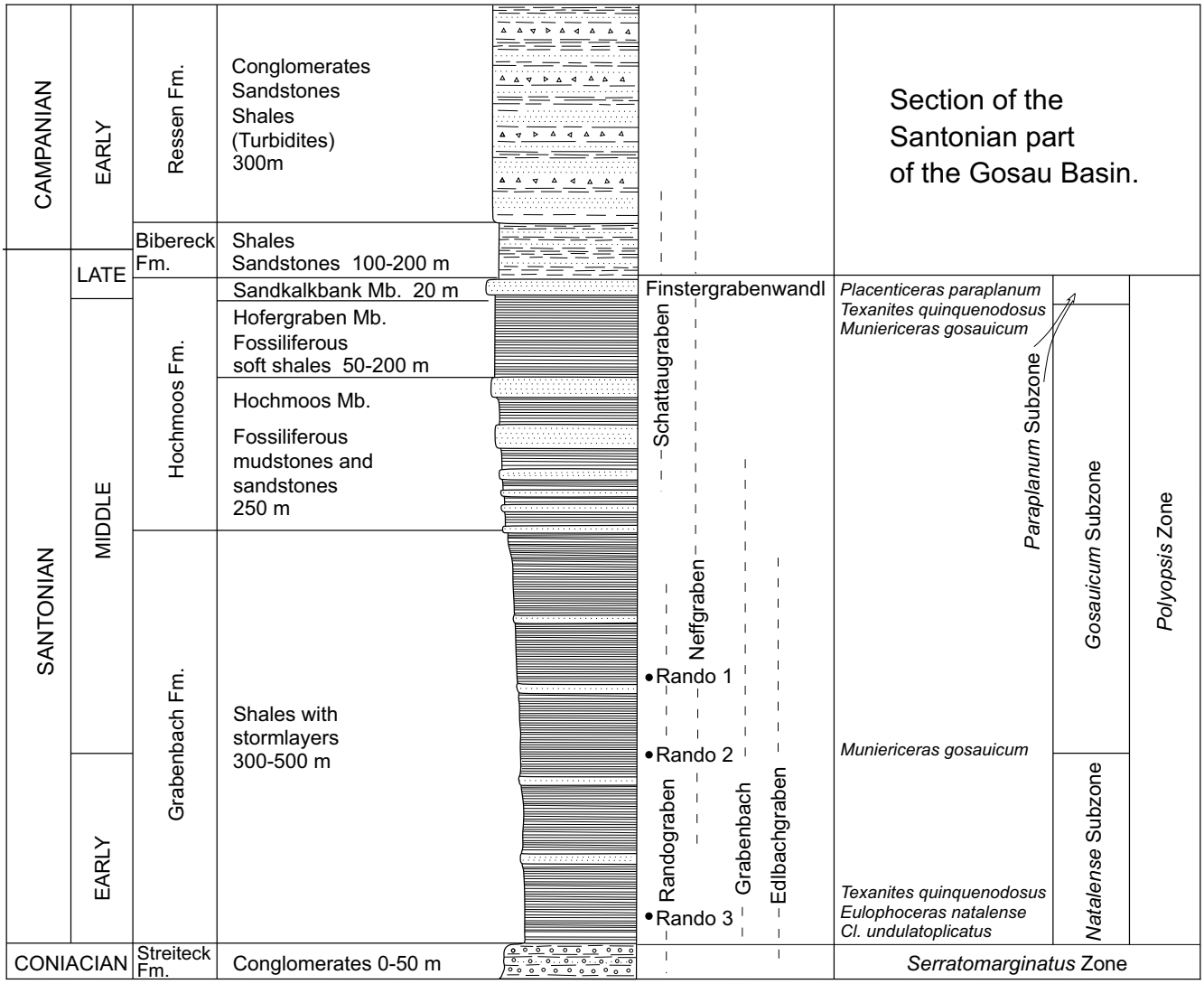
The base of the Santonian in the Gosau Group is indicated by the appearance of *Texanites quinquenodosus* (REDTENBACHER, 1873) and *Cladoceramus undulatoplicatus* (ROEMER, 1852).

During the present study it also became apparent that the presence of *Eulophoceras natalense* HYATT, 1903 was a distinctive local marker for the base of the Santonian in the Gosau Group (Gosau Basin, Brandenberg, Tyrol, Markt Piesting, Lower Austria). In the present account, the base of the middle Santonian in the Gosau Group is defined by the mass occurrence of *Muniericeras gosauicum* (HAUER, 1858) at the Rando(bach) 1 and 2 sites (Rußbach, Salzburg; Text-Figs. 2, 3). The first appearance of *Placenticeras paraplanum* WIEDMANN 1978 marks the base of the late Santonian, which coincides with the disappearance of *Texanites quinquenodosus* and *Muniericeras gosauicum*. In the field it can be observed in the Neffgraben site at the junction with the «*elliptica*» Graben (GERTH, 1961: Figs. 3, 4).

Careful collecting over more than 40 years by Kurt and Elisabeth Skoumal (†; Vienna), Josef Kastl (†; Linz, Upper Austria), Franz and Käthe Böhm (†; Salzburg), Wolf-Peter Maherndl (Bad Ischl, Upper Austria), Odo Mader (†; Brandenberg, Tyrol), Heinz A. Kollmann and two of the authors (P.S., H.S.) provide the basis for an overall revision of the early and middle Santonian cephalopod fauna of the Gosau localities, with a focus on *Muniericeras gosauicum* and *Eulophoceras natalense* (= *Hemitissotia randoi* GERTH, 1961). The rich assemblages of heteromorph ammonites will be described in the subsequent publication (SUMMESBERGER et al., 2017b, this volume).

Repositories of specimens

NHMW	Naturhistorisches Museum Wien, Vienna, Austria.
GBA	Geologische Bundesanstalt (Geological Survey of Austria, former k. k. Geologische Reichsanstalt), Vienna, Austria.
PIUW	Institute of Palaeontology, University of Vienna, Austria.
GIUW	Department of Environmental Geosciences, University of Vienna, Austria.
OÖLM	Oberösterreichisches Landesmuseum, Linz, Austria.



Text-Fig. 3.
Composite stratigraphic section of the Santonian parts of the Gosau Group with main focus on the cephalopods described in the text. With alterations after WAGREICH et al. (2010). Cl = *Cladoceramus.*

GPII	Geologisch-Paläontologisches Institut der Universität Innsbruck, Austria.
TUW	Collection of the Technical University (formerly Technische Hochschule), Vienna, now partly in the collection of PIUW, Vienna.
HNS	Haus der Natur, Salzburg, Austria.
GPIB	Geologisch-Paläontologisches Institut der Universität Bonn, Germany.
BSP	Bayerische Staatssammlung für Paläontologie und historische Geologie, Munich, Germany.
MAD	Collection Odo Mader, Bayerische Staatssammlung für Paläontologie und historische Geologie, Munich, Germany.
BMNH	British Museum of Natural History, London, UK.
CG	Collection Gustav Gapp, Gosau, Austria.
M	Collection Odo Mader, Rattenberg, Tyrol, Austria.
MA	Collection Wolf-Peter Maherndl, Bad Ischl, Austria.
SCH	Collection Schwaighofer, Rußbach, Salzburg, Austria.
SIM	Collection Simonsky, Vienna, Austria.
SK	Collection Dr. Peter Skoumal, Vienna, Austria.
TLMF/SM	Tiroler Landesmuseum Ferdinandeum, Innsbruck, Tyrol, Austria (formerly the Mader Collection).
SEIDL/CE	Collection Heinz Seidl, Salzburg, Austria.

Early and middle Santonian nautiloid and ammonite faunas of the Gosau Group (excluding heteromorphs) and key inoceramid bivalve occurrences

Brandenberg (Tyrol), Mühlbach

? *Cimomia* cf. *gosavica* (Redtenbacher, 1873)
Cymatoceras sp.
Hyporbulites woodsi (van Hoepen, 1921)
Anagaudryceras redtenbacheri (Immel et al., 1982), juv.
? *Anagaudryceras* cf. *subtililineatum* (Kossmat, 1895)
Gaudryceras mite (Redtenbacher, 1873)
Gaudryceras ex gr. *denseplicatum* Jimbo, 1894
Gaudryceras sp. indet.
Saghalinites nuperus (van Hoepen, 1921)
Nowakites carezi (de Grossouvre, 1894)
Nowakites carezi (de Grossouvre, 1894), juv.
Damesites sugata (Forbes, 1846)
Parapuzosia daubreei (de Grossouvre, 1894)
Parapuzosia corbarica (de Grossouvre, 1894)
Parapuzosia sp. indet.
Hauericeras (*Hauericeras*) *pseudogardeni* (Schlüter, 1872)
Hauericeras (*Gardeniceras*) aff. *gardeni* Baily, 1855
Kossmaticeras (*Kossmaticeras*) cf. *sparsicostatum* (Kossmat, 1897)
Patagiosites? sp.
Eupachydiscus isculensis (Redtenbacher, 1873), microconch
Paratexanites serratomarginatus (Redtenbacher, 1873)
Texanites quinquenodosus (Redtenbacher, 1873)
Eulophoceras natalense Hyatt, 1903
Cladoceramus undulatoplicatus (Roemer, 1852)

Eiberg (Kufstein, Tyrol), early to middle Santonian

Ammonite fauna after Immel, 1987:
Parapuzosia daubreei (de Grossouvre, 1894)
Hauericeras sp.
Eupachydiscus isculensis (Redtenbacher, 1873)
Texanites quinquenodosus (Redtenbacher, 1873)

Basin of Gosau (Rußbach, Salzburg), early Santonian

Randobach 3
Angulithes westphalicus (Schlüter, 1872)
Hyporbulites woodsi (van Hoepen, 1921)
Nowakites carezi (de Grossouvre, 1894)
Nowakites savini (de Grossouvre, 1894)
Parapuzosia daubreei (de Grossouvre, 1894)
Texasia cricki (Spath, 1921)
Eulophoceras natalense Hyatt, 1903
Cladoceramus undulatoplicatus (F. Roemer, 1852)

Stöcklwaldgraben
Texanites quinquenodosus (Redtenbacher, 1873)
Eulophoceras natalense Hyatt, 1903

Basin of Gosau (Rußbach, Salzburg), middle Santonian

Randobach 1
Angulithes westphalicus (Schlüter, 1872)
Muniericeras gosauicum (Hauer, 1858)
Texanites quinquenodosus (Redtenbacher, 1873)

Randobach 2
Angulithes westphalicus (Schlüter, 1872)
Gaudryceras mite (Hauer, 1866)
Parapuzosia corbarica (de Grossouvre, 1894)
Tragodesmoceras aff. *clypeale* (Schlüter, 1872)
Muniericeras gosauicum (Hauer, 1852)
Pseudoschloenbachia (*Pseudoschloenbachia*) sp.
Texanites quinquenodosus (Redtenbacher, 1873)

Zimmergraben
Texanites quinquenodosus (Redtenbacher, 1873)

Neffgraben
Damesites sugata (Forbes, 1846)
Nowakites draschei (Redtenbacher, 1873)
Muniericeras gosauicum (Hauer, 1852)
Texanites quinquenodosus (Redtenbacher, 1873)

Parking area Hornspitz – cable car, early Santonian
Hauericeras cf. *gardeni* (Baily, 1855)
Nowakites sp.
Texanites quinquenodosus (Redtenbacher, 1873)
Eulophoceras sp. indet.

Gosau (Upper Austria), early Santonian

Edlbachgraben
Angulithes westphalicus (Schlüter, 1872)
Hyporbulites woodsi van Hoepen, 1921
Saghalinites nuperus (van Hoepen, 1921)
Nowakites savini (de Grossouvre, 1894)
Parapuzosia daubreei (de Grossouvre, 1894)
Hauericeras cf. *gardeni* (Baily, 1855)
Texanites quinquenodosus (Redtenbacher, 1873)
Eulophoceras natalense (Hyatt, 1903)
Cladoceramus undulatoplicatus (Roemer, 1852)

Pass Gschütt (forest road Wegscheidgraben; middle Santonian)

(Collection Leiblfinger-Prömer)

Muniericeras gosauicum (HAUER, 1852)

Texanites quinquenodosus (REDTENBACHER, 1873)

Grabenbach (p.p. Tiefengraben), early and middle Santonian

Cymatoceras cf. *huxleyanum* (BLANFORD, 1861)

Muniericeras gosauicum (HAUER, 1852)

Pachydiscidae indet.

Eulophoceras natalense HYATT, 1903 (lowest part of Grabenbach)

Platyceramus cycloides ahsenensis (SEITZ, 1961)

Tauerngraben (middle Santonian)

Muniericeras gosauicum (HAUER, 1852)

Bad Ischl N (Upper Austria)

Schneiderwirtsbrücke, road bridge over the Ischl river near the confluence with the Nussenseebach (middle Santonian)

Saghalinites nuperus (VAN HOEPEN, 1921)

Eupachydiscus isculensis (REDTENBACHER, 1873)

Tragodesmoceras cf. *clypeale* (SCHLÜTER, 1872)

Muniericeras gosauicum (HAUER, 1852)

Texanites quinquenodosus (REDTENBACHER, 1873), holotype

Kohlbüchl (Upper Austria, Santonian)

Eupachydiscus isculensis (REDTENBACHER, 1873, holotype); Santonian

Weißwasser (Upper Austria), early and middle Santonian

Bergeralm, Breitenberg, Blahberg

Saghalinites nuperus (VAN HOEPEN, 1921)

Muniericeras gosauicum (HAUER, 1858)

Texanites quinquenodosus (REDTENBACHER, 1873)

Eulophoceras natalense HYATT, 1903

Windischgarsten (Upper Austria, Pyhrnpass), early Santonian

Eulophoceras natalense HYATT, 1903

Markt Piesting (Lower Austria), early Santonian

Eulophoceras natalense HYATT, 1903

Conventions

Dimensions are given in millimeters: D = diameter, Wb = whorl breadth, Wh = whorl height, U = umbilicus, c = costal dimension, ic = intercostal dimension. Figures in parentheses are dimensions as a percentage of the diameter. The suture terminology is that of KORN et al. (2003): E = external lobe, A = adventive lobe (= lateral lobe, L, of KULLMANN & WIEDMANN, 1970), U = umbilical lobe, I = internal lobe.

Systematic Palaeontology

Class Cephalopoda CUVIER, 1797
Subclass Nautiloidea AGASSIZ, 1847
Order Nautilida AGASSIZ, 1847
Superfamily Nautilaceae DE BLAINVILLE, 1825
Family Nautilidae DE BLAINVILLE, 1825
Genus *Angulithes* MONTFORT, 1808

Type species: *'Nautilites' triangularis* MONTFORT, 1808 by subsequent designation of SPATH (1927: 21).

Angulithes westphalicus (SCHLÜTER, 1876)

(Pl. 1, Figs. 1–3, Pl. 2, Figs. 1–3, Pl. 3, Figs. 4–5, Pl. 4, Figs. 1–3, Tab. 1)

1872 *Nautilus westphalicus* SCHLÜTER: 13.

1876 *Nautilus westphalicus* SCHLÜTER: 175, Pl. 47, Figs. 1, 2.

1906 *Nautilus westphalicus* SCHLÜTER; MÜLLER & WOLLEMANN: 1, Pl. 1, Figs. 1, 2.

1991 *Deltoidonautilus westphalicus* (SCHLÜTER, 1876); RIEGRAF & SCHEER: 426.

1999 *Deltoidnautilus* (sic!) *westphalicus* (SCHLÜTER, 1872c); WITTLER et al.: 37, Figs. 51a, b, 52a, b.

2001 *Angulithes* cf. *westphalicus* (SCHLÜTER, 1872); FÖZY: 34, Pl. 5.

2010 *Angulithes westphalicus* (SCHLÜTER, 1872); FRANK: 490, Figs. 3A–N (with additional synonymy).

Type: The lectotype by the subsequent designation of FRANK (2010: 490) is GMB 97, the original of SCHLÜTER, 1872 (Pl. 47, Figs. 1, 2) from the lower Campanian *Scaphites binodosus* Zone of Dülmen, Westphalia, Germany, housed in the Goldfuss Museum, Bonn.

Material: Eight specimens: two large individuals (SIM 1996/1, SCH 2012/1) from the early Santonian of the Randobach (Rußbach, Salzburg), three specimens from the early Santonian of the Edlbachgraben (Gosau, Upper Austria): NHMW 2012/1082/0001, SK/EB/1985/10, 11, and two further unregistered specimens in the the Skoumal collection, NHMW 2012/1086/0001.

Description: SIM 1996/1 (Pl. 1, Figs. 1–3) is a large internal mould, with a maximum preserved diameter of 185 mm, with remnants of thick shell adhering. The general shape

is strongly inflated with the greatest breadth at mid-flanks. The outer flanks are slightly convex, converging to the distinctly angular venter. The umbilicus is small with a vertical umbilical wall. The position of the siphuncle cannot be established. Where shell material is absent, the internal mould exposes several slightly flexuous sutures. They are prorsiradiate on the umbilical shoulder and innermost flank, forming a small saddle, sweep back into a large shallow lobe that extends across the middle of the flanks and forwards into a large and shallow saddle (Pl. 1, Fig. 3).

SCH 2012/1 (Pl. 2) is a large internal mould, 200 mm in diameter, with extensive areas of the thick shell (up to 4.7 mm) preserved. *Post mortem* crushing has produced a secondarily deformed discoidal, very compressed shell with an acute 'keel'. The originally narrowly rounded venter is preserved on the penultimate whorl and is visible in the apertural view of the specimen (Pl. 2, Fig. 2). The flanks are slightly convex, converging towards the venter. The umbilicus appears to be closed, probably a result of crushing. The surface of the shell preserves very faint and narrow growth striae, arising at the umbilicus and crossing the flanks in a broad convexity. Eleven sutures cross the flanks parallel to the growth striae. A shallow lobe extends across the flanks and a shallow saddle across the venter. The position of the siphuncle cannot be established.

NHMW 2012/0182/0001 (Pl. 3, Figs. 4, 5) is a large part of the body chamber, retaining the original proportions. The phragmocone is broken away. The umbilicus is missing.

SK/EB/1985/10 (Pl. 4, Figs. 1–3) is an undeformed specimen with extensive areas of the shell preserved. Where the shell is broken away the shape of the aperture is visible; it runs parallel to the growth lines on the shell of the body chamber. These cross the flank in a broad convexity, flexing back in a wide concavity that extends across the angular venter. Very faint growth striae are also visible on NHMW 2012/0182/0001.

Discussion: SCH 2012/1 differs in details only from SIM 1996/1. Its narrow and sharp "keel" is due to *post mortem* crushing. The umbilicus is smaller, which may reflect an original difference, or deformation. We believe the specimens to be conspecific.

There is a difference in sutures between SCHLÜTER's original (1872: Pl. 47, Figs. 1, 2) and the specimens described herein. The sutures of the Gosau specimens are less flexuous. Concerning the variability of the sutures of *Angulithes* (KUMMEL, 1956: 453–454, Fig. 32) the sutures of the specimens described here are regarded as being within the limits of intraspecific variation.

Inventory No.	D (mm)	Wh (mm)	Wb (mm)	U (mm)	U (%)
SIM 1996/1	185	90	83	15	8
SCH 2012/1	200	115.2	64.2	--	--
NHMW 2012/0182/0001	--	113	66	--	--
SK/EB/1985/10	132	79.1	80.1	10.4	7.9
SK/EB/1985/11	114	72.8	--	11.5	10
SK/EB $_{unreg.}$	--	126	--	18	--

Tab. 1.
Angulithes westphalicus (SCHLÜTER, 1876) from the early to middle Santonian of the Basin of Gosau (Upper Austria and Salzburg). U % of D. $_{unreg.}$ = unregistered.

Occurrence: *Angulithes* (*A.*) *westphalicus* (SCHLÜTER, 1872) is said to be an early Campanian species (SCHLÜTER, 1872: 175). It is recorded from the late Campanian of Spain (WILMSEN, 2000: 37). There are also records from the middle Santonian of Westphalia (WITTLER et al., 1999: 41). SIM 1996/1 and SCH 2012/1 are from the Santonian of the Randobach section (Rußbach, Salzburg), from a level above the occurrence of *Texanites* (*T.*) *quinquenodosus* at its confluence with the Zimmergraben. NHMW 2012/0182/0001 is from the basal Santonian of the Edlbachgraben (Gosau, Upper Austria), where it co-occurs with *Texanites* (*T.*) *quinquenodosus* and *Cladoceramus undulatoplicatus*.

Family Cymatoceratidae SPATH, 1927
Genus *Cymatoceras* HYATT, 1883

Type species: *Nautilus pseudoelegans* D'ORBIGNY, 1840 (70, Pls. 8, 9) by the original designation of HYATT (1883: 301).

Cymatoceras sp.

(Pl. 4, Figs. 4–6)

not 1876 *Nautilus Sharpei* SCHLÜTER: 171, Pl. 46, Figs. 4–6

1982 *Cymatoceras sharpei* (SCHLÜTER, 1876); IMMEL et al.: 8, Pl. 1, Figs. 1, 2.

Material: Three specimens: SK/RA/1982/54 from Randobach (Rußbach, Salzburg); M 31, 32 from the Lower Santonian of Brandenberg (Mühlbach, Tyrol).

Description: All of the specimens are strongly deformed internal moulds with areas of adherent shell. The original dimensions and proportions cannot be established. The original diameter of SK/RA/1982/54 (Pl. 4, Figs. 4–6) is estimated as 40 mm approximately. The estimated diameters of the specimens from Mühlbach/Brandenberg (Tyrol) are 52 and 54 mm. The whorl section is depressed and increases rapidly in width. The umbilicus is small and closed by matrix (IMMEL et al., 1982: Pl. 1, Fig. 2a). Where the shell is preserved, all specimens show a distinct pattern of coarse subparallel ribs covering the whole surface. They are prorsiradiate at the umbilical shoulder, cross the flanks in a broad convexity, flex back on the ventrolateral shoulder and cross the venter in a broad, shallow concavity. Some bifurcations occur on the ventrolateral shoulder. The internal mould is smooth. The sutures visible on a specimen from Tyrol (M 32; IMMEL et al., 1982: Pl. 1, Fig. 2a) are near-straight on the flanks, with the shallowest of lobes.

Discussion: IMMEL et al. (1982: 8, Pl. 1, Figs. 1, 2) referred two of the specimens discussed here to *Cymatoceras sharpei* (SCHLÜTER, 1872). The figured syntype (SCHLÜTER, 1872: Pl. 46, Figs. 5–7) is from the Lower Cenomanian of Essen-Altessen in the Münster basin, Westphalia, Germany. It is not the holotype, as stated by IMMEL et al. (1982) as SCHLÜTER (1872: 171) also refers to specimens from 'Tournay' [Tournai] in Belgium. It is much larger than the present

specimens and differs in its globular shape, closed umbilicus and very widely separated septa. The sutures are prorsiradiate at the umbilical shoulder, with a small, very shallow saddle, with a very broad, very shallow lobe that extends across most of the flanks, with the shallowest of lobes that extends across the venter. No shell is preserved and there is no feature that supports reference to *Cymatoceras sharpei* (SCHLÜTER, 1872). KUMMEL (1956: 420) records 64 species of *Cymatoceras*: "*All of these are characterised by the ribbing and the slightly sinuous septa*." This was already mentioned by HYATT (1883: 301). The present specimens are a species of *Cymatoceras* HYATT, 1883 but not *Nautilus sharpei* SCHLÜTER, 1872.

Pseudocenoceras ? *deslongchampsianum* (D'ORBIGNY, 1840: Pl. 20; TINTANT & GAUTHIER, 2006: Pl. 6, Fig. 4) from the Cenomanian of Rouen, Seine-Maritime, France, is a *Cymatoceras* in our view. It differs from the present specimens in its distinctive umbilical edge and conic umbilicus (SCHLÜTER, 1872: Pl. 47, Figs. 7–9; SHARPE, 1853: Pl. 3, Figs. 1, 2). *Deltocymatoceras rugatum* (FRITSCH & SCHLÖNBACH, 1872: 23, Pl. 12, Fig. 2, Pl. 15, Fig. 2), from the Turonian of the Czech Republic is much more coarsely ribbed, and juveniles have a ventral keel (see revision in FRANK et al., 2013: 98, Text-Figs. 6, 8a–i). *Cymatoceras bayfieldi* (FOORD & CRICK, 1890: 405, Text-Fig. 7) from the upper Campanian of England and Northern Ireland is more coarsely ribbed. *Cymatoceras elegans* (D'ORBIGNY, 1840) from the Cenomanian of France (TINTANT & GAUTHIER, 2006: 23, Pl. 6, Figs. 4, 5) and England (KENNEDY in SMITH & BATTEN, 2002: 226, Pl. 43, Figs. 3, 7) is much more finely ribbed and has a larger umbilicus. *Cymatoceras huxleyanum* (BLANFORD, 1861: 19, Pl. 7, Figs. 3, 4, Pl. 8, Figs. 1–3, Pl. 9, Figs. 1–4) is closely related but differs in its rapid increase in whorl width.

Occurrence: Lower to middle Santonian of the Austrian Gosau Group (Randobach; Rußbach, Salzburg); M 31, 32 are from the lower Santonian of Brandenberg (Mühlbach, Tyrol).

Cymatoceras cf. *huxleyanum* (BLANFORD, 1861)

(Pl. 3, Figs. 1–3)

Compare

1861 *Nautilus Huxleyanus* BLANFORD, 1861: 19, Pl. 7, Figs. 3, 4, Pl. 8, Fig. 1–3, Pl. 9, Figs. 1–4.

1865 *Nautilus Huxleyanus* BLANFORD; STOLICZKA: 205.

1891 *Nautilus Huxleyanus* BLANFORD; FOORD: 294.

? 1910 *Nautilus Huxleyanus* BLANFORD; SPENGLER: 140, 152, Pl. 12, Figs. 4, 5.

1913 *N. Huxleyanus*; SPENGLER, 1913: 118.

? 1957 *Cymatoceras huxleyanus* (BLANFORD) 1861; KUMMEL: 425.

1975 ? *Cymatoceras huxleyanum* (BLANFORD, 1861); SHIMANSKY: 107, Pl. 24, Fig. 2.

Types: The species is based on numerous syntypes, of which at least five were figured (BLANFORD, 1861: 19, Pl. 7, Figs. 3, 4, Pl. 8, Figs. 1–3, Pl. 9, Figs. 1–4). They come from a variety of localities in Tamil Nadu, South India, and are recorded from both the upper part of the Utatur Group and the Trichinopoly Group, an interval spanning the middle Turonian to middle Coniacian.

Material: A single specimen SK/GR/1983/30 from early to middle Santonian of the Grabenbach (Gosau, Upper Austria).

Description: SK/GR/1983/30 (Pl. 3, Figs. 1–3) is a strongly deformed internal mould with adherent light brownish shell. The whorl section is depressed, the whorl width increasing rapidly, from about 6 mm to about 24 mm within a single whorl. The umbilicus is wide, with steep umbilical wall. The ribbing is very weak and only slightly stronger than growth lines.

Discussion: *Nautilus huxleyanus* is assigned to the genus *Cymatoceras* on the basis of the presence of ribbing, illustrated by both BLANFORD (1861: Pl. 7, Figs. 1, 2) and SPENGLER (1910: 140, Pl. 12, Figs. 4, 5). *C. huxleyanum* differs from *C. deslongchampsianum* in its distinctly larger umbilicus and finer ribbing.

Occurrence: *Cymatoceras huxleyanum* (BLANFORD, 1861) was originally described from the lower Turonian to middle Coniacian of South India. There is a doubtful record from the Turonian to Santonian of the Caucasus (SHIMANSKY, 1975: 108).

Family Hercoglossidae SPATH, 1927

Genus *Cimomia* CONRAD, 1866

Type species: *Nautilus Burtini* GALEOTTI, 1837: 140; from the Eocene of Belgium, by the original designation of CONRAD (1866: 102). We follow KUMMEL (1956: 441) and place *Cimomia* as a distinct genus into the subfamily Hercoglossinae SPATH, 1927.

Cimomia ? cf. *gosavica* (REDTENBACHER, 1873)

(not figured)

Compare

1873 *Nautilus gosavicus* REDTENBACHER: 96, Pl. 22, Figs. 2a, b.

1982 ?*Eutrephoceras* cf. *gosavicum* (REDTENBACHER, 1873); IMMEL et al.: 8.

Discussion: For description and discussion, see IMMEL et al. (1982: 8), who did not figure the specimen, which we ourselves have not seen. They compared it to *Nautilus gosavicus* (REDTENBACHER, 1873: Pl. 22, Figs. 2a, b), which was assigned to *Cimomia* by SUMMESBERGER et al. (2017b).

Occurrence: *Cimomia gosavica* occurs in the late Santonian of the Finstergrabenwandl (Gosau, Upper Austria). The type specimen is from the Santonian of the Neffgraben (Gosau Group, Rußbach, Salzburg). ?*Eutrephoceras* cf. *gosavicum* (REDTENBACHER, 1873) was described by IMMEL et al. (1982) from the early Santonian Gosau Group of Mühlbach (Brandenberg, Tyrol, Austria).

Nautilidae, gen. et sp. indet., juv.

(Pl. 4, Figs. 7, 8)

Material: SK/1983/15 from the Tauerngraben, a tributary of the Grabenbach (Gosau, Upper Austria).

Discussion: SK/1983/15 (Pl. 4, Figs. 7, 8) is a specifically indeterminate internal mould of a nautilid 20 mm in diameter that is distinguished from all of the other nautilids from the lower and middle Santonian parts of the Gosau Group on the basis of the very depressed whorl section.

Occurrence: As for material.

Order Ammonoidea Zittel, 1884
Suborder Phylloceratina Arkell, 1950
Superfamily Phylloceratoidea Zittel, 1884
Family Neophylloceratidae Joly, 1993
Subfamily Hyporbulitinae Joly, 1993
Genus *Hyporbulites* Breistroffer, 1947

Type species: *Phylloceras Velledae* var. *Seresitensis* Pervinquière, 1907 by original designation.

Hyporbulites woodsi (van Hoepen, 1921)

(Pl. 5, Fig. 1)

1906 *Phylloceras* sp. Woods: 331, Pl. 41, Fig. 4.

1921 *Phylloceras Woodsi* van Hoepen: 3, Pl. 2, Figs. 1–6, Text-Fig. 1.

1977b *Phylloceras* (*Hypophylloceras*) *woodsi woodsi* van Hoepen, 1921; Kennedy & Klinger: 366, Pl. 13, Figs. 3–5, Text-Figs. 4–6. With synonymy.

1982 *Phylloceras* (*Hypophylloceras*) *velledaeforme* (Schlüter, 1871); Immel et al.: 8, Pl. 1, Figs. 3, 4.

1985 *Phylloceras* (*Hypophylloceras*) *woodsi woodsi* van Hoepen, 1921; Klinger: 3, Figs. 2G, H.

1987 *Phylloceras* (*Hypophylloceras*) *velledaeforme* (Schlüter, 1871); Immel: 57.

1993 *Hyporbulites woodsi* (van Hoepen); Joly: 71, Pl. 4, Figs. 3a, b, Pl. 9, Figs. 3–7, Pl. 29, Fig. 4. With synonymy.

2009 *Hyporbulites woodsi* (van Hoepen, 1921); Klein et al.: 97 (with additional synonymy).

Types: The holotype is no. 537 in the collections of the Transvaal Museum, the original of van Hoepen (1921: 331, Pl. 41, Figs. 3, 4), refigured by Kennedy & Klinger (1977b: Pl. 13, Fig. 6); there are four paratypes, nos. 529, 530, 533, 534 in the same collection. All are from the Santonian to lower Campanian Mzamba Formation at the Mzamba Estuary in north-eastern Eastern Cape Province, South Africa.

Material: Five specimens, two are in the former Mader collection (M 21, 22), one in the collection of Innsbruck University (GPII, P. 8163). Two specimens were figured by Immel et al. (1982: Pl. 1; M 21 is Fig. 3, GPII, P. 8163 is Fig. 4); two further specimens are from the Skoumal Collection (SK/RA/1999/142a, b).

Description: Three specimens from the Mühlbach locality (Brandenberg, Tyrol) are internal moulds lacking any trace of the original shell material. They are flattened as a result of *post mortem* compaction. The original whorl section appears to have been compressed oval. A small specimen, 25 mm in diameter, has an open umbilicus (Immel et al., 1982: Pl. 1, Fig. 3), that of the adult phragmocones at diameters of 78 and 52 mm is closed (Immel et al., 1982: Pl. 1, Fig. 4). Dense and straight rectiradiate lirae arise at the umbilicus and extend across the flanks and venter. The specimens from the Randobach (Rußbach, Salzburg; SK/RA/1999/142a, b) are fragments, with some original aragonitic shell present. The largest, a body chamber fragment (Pl. 5, Fig. 1), has an estimated diameter of 66 mm and a whorl height of 37.3 mm. The umbilicus is tiny. The ornament of lirae is very fine and crosses the flanks in a very shallow convexity. On the adapertural part of the fragment, the lirae are grouped in narrow bundles. The smallest individual, 33 mm in diameter, is badly crushed; the tiny umbilicus comprises 8.8 % of the diameter.

Discussion: The Campanian/Maastrichtian *Phylloceras* (*Hypophylloceras*) *velledaeforme* (Schlüter, 1972: 60, Pl. 18, Figs. 4, 5, 7, non 6) from Lüneburg (Germany) differs from *Hyporbulites woodsi* in its slightly sinuous lirae. According to the late Tove Birkelund (personal communication to H.C. Klinger, 1982; cited in Klinger, 1985) *P.* (*H.*) *velledaeforme* is also more inflated. The Campanian *Phylloceras* (*Neophylloceras*) *bodei* (Müller & Wollemann, 1906: Pl. 8, Figs. 1, 2) from northern Germany is similar, with flattened flanks, a narrow umbilicus, and more or less straight liration that is delicate on the inner third of the flanks and increases in strength towards the venter. Joly (1993: 62) regarded *Hyporbulites infundibuliformis* (Collignon, 1956) as close to *Hyporbulites woodsi* (van Hoepen, 1921) whereas Kennedy & Klinger regarded *Phylloceras* (*Hypophylloceras*) *hoepeni* and its subspecies *P.* (*H.*) *hoepeni infundibuliformis* (Collignon, 1956) as synonyms of *P. woodsi* (van Hoepen, 1921).

Occurrence: Brandenberg/Mühlbach, Randobach/Rußbach and Edlbach are the only early Santonian localities of the Gosau Group yielding Phylloceratina. The species also occurs in the Santonian–Lower Campanian of the Western Cape Province in South Africa and in the Santonian of Madagascar.

Suborder Lytoceratina Hyatt, 1889
Superfamily Tetragonitoidea Hyatt, 1900
Family Gaudryceratidae Spath, 1927
Genus *Anagaudryceras* Shimizu, 1934

Type species: *Ammonites sacya* Forbes, 1846 (113, Pl. 14, Fig. 10) by the original designation of Shimizu (1934: 67).

Anagaudryceras redtenbacheri (Immel, Klinger & Wiedmann, 1982)

(not figured)

1982 *Gaudryceras* sp., Immel et al.: 10, Pl. 1, Fig. 6.

1982 *Patagiosites redtenbacheri* Immel et al.: Pl. 5, Fig. 7, Pl. 6, Figs. 5–7, Pl. 7, Figs. 1a, b.

1987 *Patagiosites redtenbacheri* Immel et al.; Immel: 94.

2017a *Anagaudryceras redtenbacheri* (Immel, Klinger & Wiedmann, 1982); Summesberger et al.: 172, Pl. 8, Fig. 1.

Type: The holotype, by original designation is BSP 1982 I9, the original of *Patagiosites redtenbacheri* Immel, Klinger & Wiedmann, 1982, from the lower Santonian of Brandenberg/Mühlbach.

Material: BSP 1982 I 9; M 13, M 51, M 63, M 64 and M 70 all from the Lower Santonian of Brandenberg/Mühlbach.

Description: The juvenile stage is polygyral with a low expansion rate; this increases in the later growth stages. A detailed description is provided by Immel et al. (1982). An increasing number of irregularly spaced collar ribs develop in the later growth stages (e.g. Immel et al., 1982: Pl. 6, Figs. 5, 6, Pl. 7, Fig. 1).

Discussion: The specimens described and figured as *Patagiosites redtenbacheri* by Immel et al. (1982: Pl. 1, Fig. 6, Pl. 5. Fig. 7, Pl. 6, Figs. 5–7) are clearly Gaudryceratidae. The inner whorls are polygyral (Immel et al., 1982: 19, Pl. 5, Fig. 7, Pl. 6, Figs. 5–7, Pl. 7, Fig. 1) and have irregularly spaced collar ribs, crowded at maturity are also a common feature of gaudryceratid ornamentation (see Matsumoto, 1995: Text-Figs. 23, 32, 35, 36, 37). As Kennedy in Kennedy et al. (1995: 396) noted: "*if* [*Patagiosites redtenbacheri* is] *not a gaudryceratid, the species is a remarkable homoeomorph of that group*". Redtenbacher (1873: 125, Pl. 30, Fig. 4) described a specimen from the upper Coniacian of Glanegg as *Ammonites* spec. indet. cfr. *Ammonites Sacya* Forbes, 1846. Immel et al. (1982: 19) placed Redtenbacher's specimen in the synonymy of their *Patagiosites redtenbacheri*. We follow Kennedy in Kennedy et al. (1995: 395) who assigned Redtenbacher's specimen with a query to *Jimboiceras* Matsumoto, 1954. Species referred to the genus *Patagiosites* Spath, 1953, are more involute, with a smaller umbilicus and a compressed oval whorl section (Kaplan et al., 1996; Kennedy & Christensen, 1997).

Occurrence: *Anagaudryceras redtenbacheri* occurs in the Austrian Gosau Group at three localities of different age: Glanegg/Salzburg (late Coniacian, *Paratexanites serratomarginatus* Zone); Brandenberg/Tyrol (early Santonian, *Cladoceramus undulatoplicatus* Zone) and the Schattaugraben (late Santonian, *Placenticeras paraplanum* Subzone).

Anagaudryceras sp.

(Pl. 5, Fig. 2, Tab. 2)

Material: A single specimen, OÖLM 2014/10, labelled in the hand of Helmuth Zapfe "angeblich Bad Ischl" (supposedly Bad Ischl). This is a Coniacian locality, but the preservation is such that it may be from some other Santonian locality, and it is on this basis that we include it here.

Description: OÖLM 2014/10 is a partially exfoliated, crushed internal mould with traces of whitish shell material. Coiling appears to have been moderately evolute with a moderate expansion rate. The whorl section has been deformed into an ellipse with flattened flanks and an arched venter. The umbilicus is of moderate size, comprising 25 % approximately of the diameter. The dimensions are as follows:

Inventory No.	D (mm)	Wh (mm)	Wb (mm)	U (mm)	U (%)
OÖLM 2014/10	93.5	45.2	35	2.41	25.8

Tab. 2.
Anagaudryceras sp., OÖLM 2014/10. U % of D.

The umbilical wall is flat to slightly convex. More than 120° of the outer whorl is body chamber. Ornament consists of very fine dense lirae, invisible to the naked eye on all but the last quarter whorl. The lirae are prorsiradiate the innermost flank, feebly convex below and on the mid-flank region and sweep backwards across the outer flank, where they are essentially straight, as they are on the venter. There are delicate, narrow, low, rounded collar-like ribs on the outer whorl, which are parallel to the lirae. They are spaced at regular intervals and presumably mark the site of constrictions on the internal mould; some are followed by a distinct constriction on the partially exfoliated shell. The sutures are not exposed.

Discussion: Proportions, strength and direction of lirae together with the number of ribs suggest this specimen should be referred to *Anagaudryceras*. There are a number of species that have the same style of ornament to a relatively large diameter, before developing the coarse fold-like ribs of the adult. Although specifically indeterminate there are thus comparisons to be made with a number of species reviewed by Matsumoto (1995), including *Anagaudryceras yamashitai* (Yabe, 1903) (Matsumoto, 1995: 62, Figs. 32–34).

Occurrence: As for material.

? *Anagaudryceras* cf. *subtililineatum* (Kossmat, 1895)

(not figured)

Compare

1895 *Lytoceras* (*Gaudryceras*) *subtililineatum* n.sp.; Kossmat: 123, Pl. 19, Figs. 1, 2.

1979 *Anagaudryceras subtilineatum* (sic) (Kossmat); Kennedy & Klinger: 155, Text-Fig. 3, Pl. 14, Figs. 3, 12. With synonymy.

1982 *Anagaudryceras* cf. *subtililineatum* (KOSSMAT, 1895); IMMEL et al.: 9, Pl. 1, Fig. 7.

1987 *Anagaudryceras* cf. *subtilineatum* (sic) (KOSSMAT 1895); IMMEL: 64.

2009 *Anagaudryceras subtililineatum* (KOSSMAT, 1895); KLEIN et al.: 169 (with additional synonymy).

Type: The lectotype, by the subsequent designation of KENNEDY & KLINGER (1975: 155), is the original of KOSSMAT (1895: Pl. 19, Figs. 1a–c), from the Arialoor Group of South India.

Material: M 18, from the Lower Santonian of Brandenberg/Mühlbach.

Description: M 18 is an internal mould of a phragmocone, 48 mm diameter, with a short sector of the body chamber preserved. The position of the final suture is indicated by an arrow with a query in IMMEL et al. (1982: Pl. 1, Fig. 7). Coiling is gaudryceratid with a low expansion rate. The surface of the mould is smooth; the suture is gaudryceratid (after IMMEL et al., 1982: 9).

Discussion: This poor specimen is said to be a juvenile in the plate explanation of IMMEL et al. (1982: Pl. 1, Fig. 7). It differs from *A. redtenbacheri*, discussed above, in its higher expansion rate. Lack of diagnostic features limits further comparisons.

Occurrence: Early Santonian of Brandenberg/Mühlbach. There are records from South India and Eastern Cape Province, South Africa. The stratigraphic range is Santonian to early Campanian (KENNEDY & KLINGER, 1979: 157).

Genus *Gaudryceras* DE GROSSOUVRE, 1894

Type species: *Ammonites mitis* HAUER, 1866 (305, Pl. 2, Figs. 3, 4) by the subsequent designation of BOULE, LEMOINE & THÉVENIN (1906: 11).

Gaudryceras mite (HAUER, 1866)

(not figured)

1866 *Ammonites mitis* HAUER: 305, Pl. 2, Figs. 3, 4.

1873 *Ammonites mitis* HAUER; REDTENBACHER: 119, Pl. 27, Fig. 4.

1873 *Ammonites glaneggensis* HAUER; REDTENBACHER: 119, Pl. 27, Fig. 3.

1961 *Gaudryceras* cf. *mite* v. HAUER; GERTH: 120, Pl. 24, Figs. 10a, b.

1979 *Gaudryceras mite* (HAUER); SUMMESBERGER: 113, Pl. 1, Fig. 1.

1979 *Gaudryceras mite* (HAUER); KENNEDY & SUMMESBERGER: 74, Pls. 1, 2 (with synonymy).

1979 *Gaudryceras glaneggense* (REDTENBACHER); KENNEDY & SUMMESBERGER: 76, Pls. 3, 4 (with synonymy).

1980 *Gaudryceras mite* (HAUER); SUMMESBERGER: 276, Pl. 1, Fig. 2.

1987 *Gaudryceras mite* (HAUER, 1866); IMMEL: 65.

1987 *Gaudryceras glaneggense* (REDTENBACHER 1873), IMMEL: 65.

1995 *Gaudryceras mite* (HAUER, 1866); KENNEDY et al.: 390, Pl. 1, Figs. 20, 21.

1996 *Gaudryceras mite* (HAUER, 1866); SUMMESBERGER & KENNEDY: 112, Pl. 1, Figs. 1–4. (with synonymy).

2000 *Gaudryceras mite* (HAUER); SUMMESBERGER in EGGER et al.: 26.

2000 *Gaudryceras mite* (HAUER, 1866); WIESE, 2000: 128, Pl. 1, Fig. 1.

2009 *Gaudryceras denseplicatum denseplicatum* (JIMBO, 1894); KLEIN et al.: 177.

2009 *Gaudryceras glaneggense* (REDTENBACHER, 1873); KLEIN et al.: 179 (with synonymy).

2009 *Gaudryceras mite* (HAUER, 1866); KLEIN et al.: 184 (with additional synonymy).

2010 *Gaudryceras mite* (HAUER, 1866); REMIN: 161, Fig. 12 D.

2012 *Gaudryceras mite* (HAUER, 1866); SUMMESBERGER & ZORN: 103, Pl. 4, Figs. 4a, b, Pl. 5, Figs. 1a, b.

2017a *Gaudryceras mite* (HAUER, 1866); SUMMESBERGER et al.: 172

Types: The holotype, by monotypy, is GBA 1866/01/3, the original of HAUER (1866: Pl. 2, Figs. 3, 4), probably from the late Turonian Gosau Group of Strobl/Weißenbach (Salzburg). It was refigured by KENNEDY & SUMMESBERGER (1979: Pl. 1, Figs. 1–4). The holotype of *Gaudryceras glaneggense* (REDTENBACHER, 1873: 119, Pl. 27, Fig. 3) is no. 6373 in the collections of the Haus der Natur, Salzburg, and from the upper Coniacian Gosau Group of Glanegg, near Salzburg. It was refigured by KENNEDY & SUMMESBERGER (1979: Pl. 3).

Material: GPIB 788, the original of GERTH (1961: Pl. 24, Fig. 10a) from the early Santonian of Edlbachgraben (Gosau, Upper Austria). An unregistered specimen from the early Santonian of Mühlbach/Brandenberg (see IMMEL, 1987: 65); NHMW 1978/1963/0021, the original of SUMMESBERGER (1979: 113, Pl. 1, Fig. 1) and SK/1979/4, the original of SUMMESBERGER (1980: 276, Pl. 1, Fig. 1), both from the late Santonian Sandkalkbank Member (Gosau, Upper Austria).

Discussion: *Gaudryceras mite* (HAUER, 1866) was revised by KENNEDY & SUMMESBERGER (1979: 74). SUMMESBERGER & KENNEDY (1996: 112) pointed out that *Gaudryceras glaneggense* (REDTENBACHER, 1873) is the adult body chamber of *G. mite* and thus a synonym. This view was followed by WIESE (2000). *Gaudryceras denseplicatum* (JIMBO, 1894: 182, Pl. 23, Fig. 1) is a further synonym.

Occurrence: *Gaudryceras mite* (HAUER, 1866) is a long-ranging species occurring in the Gosau Group from the late Turonian of Strobl/Weißenbach and Gams, late Coniacian of Glanegg (IMMEL, 1987: 65), early Santonian of Brandenberg/Mühlbach (IMMEL, 1987) and late Santonian of Gosau (Upper Austria; SUMMESBERGER, 1979, 1980). Elsewhere it ranges into the early Campanian, with records from northern Spain, Romania, Eastern Cape Province and northern KwaZulu-Natal in South Africa, Madagascar, Japan, Sakhalin and California.

Gaudryceras sp. indet. 1

(not figured)

1982 *Gaudryceras* ex gr. *denseplicatum* YABE 1903 (sic); IMMEL et al.: 9, Pl. 1, Fig. 5.

Material: GPII P.8179 from the early Santonian Mühlbach locality (Brandenberg, Tyrol).

Description: GPII P.8179 is the internal mould of the phragmocone and part of the body chamber 42 mm in diameter (the figure of this specimen in IMMEL et al., 1982: Pl. 1, Fig. 5 is enlarged x 1.5). No trace of the original shell material survives. The surface is covered in straight narrow lirae and more or less regular collar ribs.

Discussion: In our opinion *Gaudryceras* sp. indet. 1 cannot be compared with *Gaudryceras denseplicatum* (JIMBO, 1894). This species was treated as a junior synonym of *Gaudryceras glanneggense* by KENNEDY & SUMMESBERGER (1979), in turn regarded as a junior synonym of *Gaudryceras mite* by SUMMESBERGER & KENNEDY (1996). The Brandenberg specimen has more lirae (about 10) and wider interspaces, than the originals of JIMBO (1894: Pl. 7, Fig. 1) and REDTENBACHER (1873: Pl. 27, Fig. 3), refigured by KENNEDY & SUMMESBERGER (1979: Pl. 3). Ribbing and liration of the Brandenberg specimen are almost straight whereas they are falcoid in the above mentioned examples. The specimen is specifically indeterminate in our view.

Occurrence: Lower Santonian of Brandenberg/Mühlbach.

Gaudryceras sp. indet. 2

(not figured)

1982 *Gaudryceras* sp. indet.; IMMEL et al.: 10, Pl. 1, Fig. 6.

Material: M 51, the original of IMMEL et al. (1982: Pl. 1, Fig. 6), from the early Santonian of the Mühlbach locality (Brandenberg, Tyrol).

Description: M 51 is a small fragment of the phragmocone. Compared to other gaudryceratids the whorl height increases relatively rapidly. The surface is covered with fine, dense, falcoid lirae and some indistinct collar ribs.

Discussion: We follow IMMEL et al. (1982: 10) in regarding this specimen as specifically indeterminate.

Occurrence: As for material

Family Tetragonitidae HYATT, 1900
Subfamily Tetragonitinae HYATT, 1900

Genus *Saghalinites* WRIGHT & MATSUMOTO, 1954

Type species: *Ammonites cala* FORBES, 1846 (104, Pl. 8, Fig. 4), by original designation of WRIGHT & MATSUMOTO (1954: 110).

Saghalinites nuperus (VAN HOEPEN, 1921)

(Pl. 5, Figs. 3–10)

1921 *Tetragonites nuperus* VAN HOEPEN: 13, Pl. 3, Figs. 3, 4.

1956 *Saghalinites nuperus* (VAN HOEPEN, 1921); COLLIGNON: 81, 95, Pl. 11, Figs. 1, 1a, 1b.

1966 *Saghalinites nuperus* VAN HOEPEN; COLLIGNON: 3, Pl. 456, Fig. 1856, 21, Pl. 463, Fig. 1893.

1977a *Saghalinites nuperus* (VAN HOEPEN, 1921); KENNEDY & KLINGER: 177, Figs. 16A–E, 17A, B, 18 (with synonymy).

1982 *Saghalinites* aff. *wrighti* BIRKELUND; IMMEL et al.: 10, Pl. 2, Figs. 1, 2.

1982 *Pseudophyllites latus* (MARSHALL, 1926); IMMEL et al.: 10, Pl. 2, Figs. 3, 4).

1985 *Saghalinites nuperus* (VAN HOEPEN, 1921); KLINGER: 4, Figs. 2N–S, 3A–C.

1987 *Saghalinites wrighti* BIRKELUND; IMMEL: 67.

1987 *Pseudophyllites latus* (MARSHALL, 1926); IMMEL: 67.

1995 *Saghalinites nuperus* (VAN HOEPEN, 1921); KENNEDY in KENNEDY et al.: 389, Pl. 3, Figs. 3, 4, 10, 11.

2009 *Saghalinites nuperus* (VAN HOEPEN, 1921); KLEIN et al.: 255 (with additional synonymy).

Types: The holotype, by original designation, is no. 532 in the collections of the Transvaal Museum, Pretoria, from the Santonian to early Campanian Mzamba Formation of the Mzamba Estuary in Eastern Cape Province, South Africa, the original of VAN HOEPEN (1921: Pl. 3, Figs. 3, 4), refigured by KENNEDY & KLINGER (1977a: Text-Figs. 1a–c). There are two paratypes from the same unit and locality.

Material: We have eight specimens: NHMW 1982/0035/0001 from the basal Santonian of Edlbachgraben (Gosau, Upper Austria); SK/SB/1989/5 from the middle Santonian of Schneiderwirtsbrücke (bed of the Ischl river, Upper Austria); NHMW 2012/0186/0010 from the middle Santonian of Randobach (Rußbach, Salzburg); NHMW 2013/0015/0004–5 from the early Santonian of Breitenberg near Weißwasser (Upper Austria); NHMW 2013/0015/0003 from the early Santonian of Schwarzenbach near Weißwasser (Upper Austria); GBA 1935 (unregistered) from the middle Coniacian of Nussenseebach; NHMW 2013/0016/0001 from the upper Coniacian of Glanegg.

Description: All of the specimens are preserved as internal moulds with traces of adherent shell material. All are deformed into an ellipse as a result of *post mortem* crushing. As a result, dimensions can only be estimated. The umbilicus comprises 30–40 % of the diameter. The whorl section, so far as can be observed, was rounded-polygonal, with a flattened venter and feebly convex flanks. All specimens retain part of the body chamber. The surface of the internal moulds is smooth, but for more or less distinct constrictions, with an associated adapical collar rib.

In NHMW 2013/0015/0004–5 the projected aperture is well preserved (NHMW 2013/0015/0005: Pl. 5, Figs. 3, 4). Five of the specimens (NHMW 1982/0035/0001, NHMW 2013/0015/0004–5, GBA 1935 (unregistered), SK/SB 1989/5) show a faint mid-ventral ridge and feeble flanking grooves (Pl. 5, Figs. 8, 9). Only traces of the sutures are visible.

The best information about the shell parameters are from the Breitenberg specimens (NHMW 2013/0015/0004–5; Pl. 5, Figs. 3–6), two internal moulds with traces of brownish shell, impregnated with iron-oxide. The general shape is that of a *Saghalinites*, with polygonal whorl section. The outer whorl which seems to be the body chambers shows a lower expanding rate. The weak constrictions are strongly prorsiradiate in NHMW 2013/0015/0004 (Pl. 5, Fig. 5).

Discussion: *Saghalinites nuperus* is described in detail by KENNEDY & KLINGER (1977a: 177), who discuss differences from *Saghalinites wrighti* BIRKELUND, 1965 (30, Pl. 1, Fig. 5, Pl. 2, Figs. 1–5, Pl. 3, Fig. 1, Text-Figs. 14–15) and *Saghalinites cala* (FORBES, 1846: 104, Pl. 8, Fig. 4). A mid-ventral ridge and parallel flanking grooves, as seen in NHMW 1982/0035/0001 (Pl. 5, Figs. 8, 9) are also known in *Tetragonites superstes* VAN HOEPEN, 1921 (KENNEDY & KLINGER, 1977a: Text-Figs. 7D, H) and *Saghalinites cala* (KENNEDY & KLINGER, 1977a: Text-Fig. 13E). The mid ventral ridge and flanking grooves of GPII P.8164 suggest that it, together with M 48 and GPII P.8164, figured by IMMEL et al. (1982: Pl. 2, Figs. 3, 4) as *Pseudophyllites latus* (MARSHALL) are better assigned *Saghalinites nuperus*. This conclusion is supported by the lower expansion rate of these specimens compared to that of species of *Pseudophyllites* (see: KENNEDY & KLINGER, 1977a: Figs. 25, 26).

Occurrence: Middle Coniacian of Nussenseebach (Salzburg, Austria); late Coniacian of Glanegg (Salzburg, Austria); early Santonian of Brandenberg/Mühlbach (Tyrol); early Santonian of the Edlbachgraben (Gosau, Upper Austria); middle Santonian of the Schneiderwirtsbrücke site (Bad Ischl) and basal Santonian in the case of the Schwarzenbach/Weißwasser specimen, indicated by the presence of co-occurring *Cladoceramus undulatoplicatus*. There are also records from the Corbières in southern France, Eastern Cape Province in South Africa, Madagascar and Japan, with a possible record from northern Spain.

Suborder Ammonitina HYATT, 1889
Superfamily Desmoceratoidea ZITTEL, 1895
Family Desmoceratidae ZITTEL, 1895
Subfamily Puzosiinae SPATH, 1922
(= Hauericeratinae MATSUMOTO, 1938)

Genus *Jimboiceras* MATSUMOTO, 1954

Type species: *Desmoceras planulatiforme* JIMBO, 1894 (27, Pl. 1, Fig. 4) by the original designation of MATSUMOTO (1954: 95).

Jimboiceras cf. *reyi* COLLIGNON, 1983

(Pl. 6, Figs. 1–4, 6, 7, Text-Fig. 4, Tab. 3)

Compare

1873 *Ammonites* spec. indet. cfr. *Ammonites Sacya* FORBES; REDTENBACHER (1873: 125, Pl. 30, Fig. 4).

1983 ? *Jimboiceras reyi* COLLIGNON; BILOTTE & COLLIGNON: 189, Pl. 2, Fig. 2.

1995 *Jimboiceras* ? *reyi* COLLIGNON; KENNEDY in KENNEDY et al.: 394, Pl. 4, Figs. 8–11, 15, 16, Pl. 6, Figs. 1, 2.

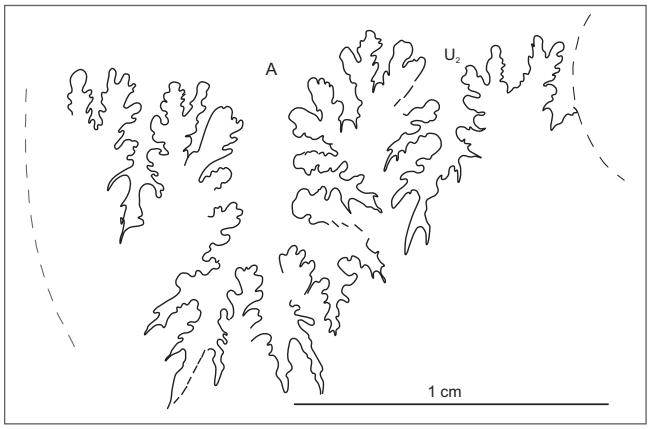
Material: Four specimens: NHMW 2013/0015/0001–2, two from the early Santonian of Unterlaussa (Weißwasser, Upper Austria), NHMW 2013/0016/0001, an unregistered HNS specimen and the original of *Ammonites* spec. indet. cfr. *Ammonites Sacya* FORBES of REDTENBACHER (1873: Pl. 30, Figs. 4a, b (which could not be traced in the collections of the "Haus der Natur", Salzburg), both are from the late Coniacian of Glanegg (Salzburg).

Description: NHMW 2013/0015/0001 (preserved in fine sandstone) and 0002 together with NHMW 2013/0016/0001 are brownish internal moulds. NHMW 2013/0015/0001 and 2 retain traces of shell, partially removed in the latter to expose the suture. Coiling is evolute, the whorls expanding slowly. All specimens are somewhat crushed and deformed into an ellipse by *post mortem* deformation. The original whorl section appears to have been compressed, with a whorl breadth to height ratio of about 0.6. The umbilicus is relatively narrow and shallow with a distinct umbilical edge. The umbilical wall is vertical. The flanks are feebly convex, the maximum breadth at mid-flank, the venter narrowly rounded. NHMW 2013/0015/0001 (Pl. 6, Figs. 6, 7) has about 10 narrow prorsiradiate and biconcave constrictions accompanied by a weak collar rib arising at the umbilical edge with a distinct elongated bulla, strengthening and crossing the venter in a marked convexity. Irregularly spaced short ribs are present on the ventrolateral shoulders between the more or less regularly spaced collar ribs, NHMW 2013/0015/0002 (Pl. 6, Figs. 1, 2) shows a similar but even more irregular style of ribbing, several ribs arising at the umbilical shoulder and crossing the flanks parallel to constrictions and collar ribs. Feeble riblets are visible on the ventrolateral shoulders and venter on a very small area, suggesting that ventrolateral riblets were originally present overall of the specimen. NHMW 2013/0016/0001 (Pl. 6, Figs. 3, 4) has only four constrictions with parallel collar ribs per half whorl. The external suture (Text-Fig. 4) is typically puzosiid, with a more or less regular trifid E/A, deeply incised E and A and narrowly rounded folioles.

Discussion: Despite minor differences the specimens are conspecific in our view. They are assigned with some doubt to *Jimboiceras* cf. *reyi* COLLIGNON, 1981 (sensu KENNEDY in KENNEDY et al., 1995: 394, Pl. 4, Figs. 8–11). They agree in the form of the constrictions, but differ from the French specimens in their more numerous intercalated ribs, more compressed section and smaller umbilicus. *Jimboiceras planulatiforme* (JIMBO, 1894: 173 (27), Pl. 17 (1), Fig. 4); see revision of MATSUMOTO 1988 in MATSUMOTO et al. 1988: 89, Text-Figs. 36–41) is more densely and more evenly ribbed. We confirm the interpretation of KENNEDY in KENNEDY et al. (1995: 394) that *Ammonites* sp. indet. cfr. *sacya*

Inventory No.	D (mm)	Wh (mm)	Wb (mm)	U (mm)	U (%)
NHMW 2013/0015/0001	62	26.9	15.8	13	20.9
NHMW 2013/0015/0002	39.4	18.7	11.4	8.1	20.5

Tab. 3.
Jimboiceras cf. *reyi* COLLIGNON, 1981 from the early Santonian of the Weißwasser area (Unterlaussa, Upper Austria). U % of D.



Text-Fig. 4.
External suture of *Jimboiceras* cf. *reyi* COLLIGNON, 1983, Unterlaussa, Upper Austria; NHMW 2013/0015/0002.

FORBES from the upper Coniacian of Glanegg (Salzburg, Austria) (REDTENBACHER, 1873: 125, Pl. 30, Fig. 4) may possibly be conspecific with the present material. IMMEL et al. (1982: 19, Pl. 5, Fig. 7 (?), Pl. 6, Figs. 5–7, Pl. 7, Fig. 1) listed *Ammonites* sp. indet. cfr. *sacya* FORBES in the synonymy of "*Patagiosites redtenbacheri*" but this is not a *Patagiosites*, but a gaudryceratid, as already pointed out by KENNEDY in KENNEDY et al. (1995: 396) and noted above.

Occurrence: The Austrian specimens are from the basal Santonian of Unterlaussa (Upper Austria): NHMW 2013/0015/0001 from the early Santonian of the Breitenberg forest road; NHMW 2013/0015/0002 occurs together with *Cladoceramus undulatoplicatus* in the early Santonian of the Blahberg forest road; NHMW 2013/0016/0001 and an unregistered HNS specimen are from the upper Coniacian Gosau Group of Glanegg (Salzburg). The French examples are from the middle and late Coniacian of the Corbières (France).

Genus and Subgenus *Parapuzosia* NOWAK, 1913

Type species: *Sonneratia daubreei* DE GROSSOUVRE, 1894 (154, Pl. 28, Fig. 1) by subsequent designation of SPATH (1922: 126).

Parapuzosia (Parapuzosia) daubreei (DE GROSSOUVRE, 1894)

(not figured)

1894 *Sonneratia Daubréei* DE GROSSOUVRE: 154, Pl. 28, Fig. 1.

1906 *Sonneratia Daubréei* DE GROSSOUVRE; MÜLLER & WOLLEMANN: 8, Pl. 5.

1913 *Parapuzosia Daubréei* DE GROSSOUVRE sp.; NOWAK: 363, Pl. 43, Fig. 32, Pl. 44, Fig. 40.

1982 *Parapuzosia daubreei* (DE GROSSOUVRE); KOLLMANN & SUMMESBERGER: 72.

1982 *Parapuzosia daubréei* (DE GROSSOUVRE); IMMEL et al.: 11, Pl. 2, Fig. 9 only, Pl. 3, Figs. 1, 2, Pl. 4, Fig. 2.

1987 *Parapuzosia daubreei* (DE GROSSOUVRE 1894); IMMEL: 89.

1995 *Parapuzosia* (*Parapuzosia*) *daubreei* (DE GROSSOUVRE, 1894); KENNEDY & KAPLAN: 26, Pls. 31, 32.

1995 *Parapuzosia* (*Parapuzosia*) *daubreei* (DE GROSSOUVRE, 1894); KENNEDY in KENNEDY et al.: 391, Figs. 10, 11 (with synonymy).

2010 *Parapuzosia* (*Parapuzosia*) *daubreei* (DE GROSSOUVRE, 1894); REMIN: 167, Figs. 8A–D, 9A, 10A, B.

Type: The lectotype, by subsequent designation of KENNEDY in KENNEDY et al. (1995: 391), is the original of DE GROSSOUVRE (1894: 154, Pl. 28).

Material: One specimen from the early Santonian of the Randobach (Rußbach, Salzburg) in the OÖLM collection, seven specimens (two of them questionable) from Brandenberg, Mühlbach (IMMEL et al., 1982: 11), one fragment from the Edlbachgraben (Gosau, Upper Austria).

Description and Discussion: See KENNEDY in KENNEDY et al. (1995: 391, Figs. 10, 11). The specimen in the OÖLM collection is a phragmocone of about 500 mm diameter (now apparently lost). When complete with body chamber, it must have measured about 900 mm in diameter. *Mesopuzosia yubarensis* (JIMBO) of IMMEL et al. (1982: 12, Pl. 4, Fig. 3) and IMMEL (1987: 89) is a fragment of *Parapuzosia* (*P.*) *daubreei* in our view. An almost identical fragment was figured by IMMEL et al. (1982: Pl. 2, Figs. 10a, b) as *P. daubreei*.

Occurrence: The occurences in the Gosau Group are early Santonian date (IMMEL et al., 1982). In the Corbières it occurs in the Santonian *gallicus* and *paraplanum* Zones (KENNEDY in KENNEDY et al., 1995: 391). MÜLLER & WOLLEMANN (1906: 8, Pl. 5) recorded the species from the early Campanian of Braunschweig, Germany.

Parapuzosia (Parapuzosia) corbarica (DE GROSSOUVRE, 1894)

(Pl. 6, Fig. 9, Pl. 9, Fig. 9)

1894 *Puzosia corbarica* DE GROSSOUVRE: 174, Pl. 27, Fig. 1.

1982 *Parapuzosia corbarica* (DE GROSSOUVRE 1894); IMMEL et al.: 12, Pl. 3, Fig. 3, Pl. 4, Figs. 1, 3.

1982 ? *Mesopuzosia yubarensis* (JIMBO); IMMEL et al.: 12, Pl. 4, Fig. 3.

1982 *Parapuzosia daubréei* (DE GROSSOUVRE 1894); IMMEL et al.: 11, Pl. 2, Fig. 10 (only), Pl. 3, Figs. 1, 2.

1987 *Parapuzosia corbarica* (DE GROSSOUVRE 1894); IMMEL: 89.

1995 *Parapuzosia* (*Parapuzosia*) *corbarica* (DE GROSSOUVRE, 1894); KENNEDY & KAPLAN: 27, Pl. 34.

1995 *Parapuzosia* (*Parapuzosia*) *corbarica* (DE GROSSOUVRE, 1894); KENNEDY in KENNEDY et al.: 391, Pl. 2, Fig. 9, Pl. 5, Figs. 1–3, 12, 13 (with synonymy).

2017a *Parapuzosia corbarica* (DE GROSSOUVRE, 1894); SUMMESBERGER et al.: 174, Pl. 8, Fig. 4, Text-Fig. 14.

Types: The holotype by original designation is the original of DE GROSSOUVRE (1894: Pl. 27, Fig. 1); there are two paratypes and all are from the Santonian of the Corbières in southern France.

Material: M43 and GPII P.8176 from Brandenberg/Mühlbach are early Santonian. SK/RA/2015/165 and SK/RA/1982/78 from the Randobach 2 site (Rußbach, Salzburg) is middle Santonian. NHMW 1978/1955/0003 from the Schattaugraben (Rußbach, Salzburg) is late Santonian age.

Description and Discussion: The species was described and discussed at length by KENNEDY in KENNEDY et al. (1995: 391–393).

Occurrence: Early Santonian of the Gosau Group of Brandenberg/Mühlbach (Tyrol), middle Santonian of Randobach 2 site (Rußbach, Salzburg); late Santonian of Schattau/Rußbach. In the Corbières, in southern France it occurs in the late Coniacian *Serratomarginatus* Zone and in the early Santonian *Gallicus* and *Paraplanum* Zones.

Parapuzosia sp. indet.

(not figured)

? 1982 *Mesopuzosia* sp. indet., IMMEL et al.: 13, Pl. 2, Fig. 8, Text-Fig. 3.

Description and Discussion: The specimen figured and described by IMMEL et al. (1982) differs from *Parapuzosia corbarica* and *P. daubreei* in its very weak ornament and greater rate of increase in whorl height. The well-preserved external suture supports assignment to the Puzosiinae (IMMEL et al., 1982: Text-Fig. 3).

Occurrence: Early Santonian, Gosau Group of Brandenberg/Mühlbach.

Genus and subgenus *Hauericeras* DE GROSSOUVRE, 1894

Type species: *Ammonites pseudo-gardeni* SCHLÜTER, 1872 by original designation.

Hauericeras (Hauericeras) pseudogardeni (SCHLÜTER, 1872)

(Pl. 6, Fig. 8)

1872 *Ammonites pseudo-Gardeni* SCHLÜTER: 54, Pl. 16, Figs. 3–6.

1906 *Hauericeras pseudo-Gardeni* SCHLÜTER sp.; MÜLLER & WOLLEMANN: 14, Pl. 4, Figs. 1–4, Pl. 8, Fig. 3.

1982 *Desmophyllites* cf. *larteti* (SEUNES); IMMEL et al.: 15, Pl. 4, Fig. 4, Text-Fig. 4.

1987 *Desmophyllites larteti* (SEUNES); IMMEL: 91, Pl. 9, Fig. 1.

1995 *Hauericeras* (*Hauericeras*) *pseudogardeni* (SCHLÜTER, 1872); KENNEDY & KAPLAN: 18, Pls. 1–4, Pl. 5, Figs. 1, 2, 6, Pl. 6, Figs. 1, 7, Pl. 7, Figs. 1–4 (with synonymy).

1995 *Hauericeras pseudogardeni* (SCHLÜTER, 1872); LOMMERZHEIM: 53, Pl. 2, Fig. 5, 6 (with additional synonymy).

1997 *Hauericeras* (*Hauericeras*) *pseudogardeni* (SCHLÜTER, 1872); KENNEDY & CHRISTENSEN: 85, Figs. 5E, 6.

1999 *Hauericeras* cf. *pseudogardeni* (SCHLÜTER 1872); SUMMESBERGER et al.: 159, Pl. 1, Fig. 1.

2004 *Hauericeras pseudogardeni* (SCHLÜTER, 1872); SUMMESBERGER & KENNEDY: 169, Text-Fig. 2.

2005 *Hauericeras pseudogardeni* (SCHLÜTER, 1872); KAPLAN et al.: 52, Pl. 3, Figs. 1–9, Pl. 52, Figs. 1, 2.

2006 *Hauericeras* (*Hauericeras*) *pseudogardeni* (SCHLÜTER, 1872); KAPLAN et al.: 31, Pl. 1, Figs. 4, 7, 9, 11, 12.

Type: The lectotype, by subsequent designation of MATSUMOTO in MATSUMOTO et al. (1990: 440), is no. 48 in the Schlüter Collection, housed in the Goldfuss Museum, Bonn, the original of *Ammonites pseudo-Gardeni* SCHLÜTER, 1872 (Pl. 16, Figs. 5, 6). It was refigured by KENNEDY & KAPLAN (1995: Pls. 1–3).

Material: Two specimens, M 46, the original of *Desmophyllites* cf. *larteti* (SEUNES) of IMMEL et al. (1982: 15, Pl. 4, Fig. 4, Text-Fig. 4) and MAD 1987 I 11, the original of *Desmophyllites larteti* (SEUNES) of IMMEL (1987: 91, Pl. 9, Fig. 1).

Description: M 46, the original of IMMEL et al. (1982: 15, Pl. 4, Fig. 4, Text-Fig. 4), is an internal mould, lacking any trace of adherent shell material. It is very compressed, high-whorled, with feebly convex flanks, a sharp umbilical edge and a broadly rounded ventrolateral shoulder. The umbilicus is relatively narrow, 20.5 % of the diameter, with a vertical or subvertical umbilical wall. The venter appears to be fastigiated. There are about five shallow falcoid constrictions per half whorl with faint but distinct ribs between, effacing on the outer flank as size increases.

Discussion: *Hauericeras* (*Hauericeras*) *pseudogardeni* from Brandenberg/Mühlbach is very close to specimens with a narrow umbilicus figured by MÜLLER & WOLLEMANN (1906: Pl. 4, Fig. 4) and KENNEDY & KAPLAN (1995: Pl. 5, Fig. 2, Pl. 6, Fig. 1, Pl. 7, Fig. 3). According to KENNEDY & KAPLAN (1995) the umbilicus of smaller (juvenile) specimens from the Münster Basin comprises 17–20 % of the diameter; in larger (adult) specimens, including the lectotype, it is 24–26 % of the diameter.

The specimens from the early Santonian of Brandenberg/Mühlbach were identified as *Desmophyllites* cf. *larteti* (SEUNES) by IMMEL et al. (1982: 15, Pl. 4, Fig. 4) and under *Desmophyllites larteti* (SEUNES) by IMMEL (1987: 91, Pl. 9, Fig. 1). *D. larteti* actually occurs in the late Campanian *Nostoceras hyatti* Zone (e.g. Tercis, France: HANCOCK & KENNEDY, 1993; Gschliefgraben, Austria: KENNEDY & SUMMESBERGER, 1984, 1999) and is also described from the late Maastrichtian of the French Pyrénées (KENNEDY & HANCOCK, 1993). *D. larteti* has a narrow umbilicus, much narrower than the specimen figured by IMMEL et al. (1982) and a broadly rounded umbilical shoulder (e.g. KENNEDY & SUMMESBERGER, 1984: 156, Pl. 2, Figs. 1–3, 5, 6; KENNEDY & HENDERSON, 1992: Pl. 17, Fig. 9, Pl. 18, Figs. 1–6; KENNEDY & HANCOCK, 1993: Pl. 1, Figs. 1–3, 8–10). In contrast the specimen from Brandenberg has a very narrowly rounded umbilical shoulder and an apparently steep umbilical wall. These differences and the considerable age difference between well-dated occurrences of *D. larteti* make the assignment of the Brandenberg specimens to this species unlikely. The specimen figured by IMMEL et al. (1982: Pl. 4, Fig. 4) is closest to one of the narrowly umbilicated representatives of *H.* (*H.*) *pseudogardeni* (SCHLÜTER, 1872) figured by MÜLLER & WOLLEMANN (1906: Pl. 4, Figs. 1–4). The specimen figured by IMMEL (1987: Pl. 9, Fig. 1) also appears to belong here. Further

comparable specimens of *H.* (*H.*) *pseudogardeni* are figured by KENNEDY & KAPLAN (1995: Pls. 1–4, Pl. 5, Figs. 1, 2, 6, Pl. 7, Figs. 1, 7, Pls. 7, 8). A fine example of *H.* (*H.*) *pseudogardeni* (NHMW 2013/0017/0001) from Broitzem, Braunschweig, Germany, is figured here (Pl. 6, Fig. 8) for comparison. For further discussion, see also KENNEDY & CHRISTENSEN (1997).

Occurrence: *Hauericeras* (*Hauericeras*) *pseudogardeni* occurs in the late Santonian and early Campanian of Germany (KENNEDY & KAPLAN, 1995: 20) and Sweden (KENNEDY & CHRISTENSEN, 1997). KAPLAN & KENNEDY (2000: Fig. 10) record it from the late Santonian and early Campanian of the Münster Basin (Germany) with rare occurrences in the early Santonian and even late Coniacian. *Hauericeras* (*Hauericeras*) cf. *pseudogardeni* (SCHLÜTER, 1872) was described from the Campanian Austrian Gosau Group of Gams (SUMMESBERGER et al., 1999) and the species is now recorded from the early Santonian of Brandenberg/Tyrol.

Subgenus *Gardeniceras* MATSUMOTO & OBATA, 1955

Type species: *Ammonites gardeni* BAILY, 1855 (450, Pl. 11, Fig. 3), by the original designation of MATSUMOTO & OBATA (1955: 134).

Hauericeras (*Gardeniceras*) aff. *gardeni* (BAILY, 1855)

(Pl. 6, Fig. 5, Pl. 7, Figs. 1–3, 6–8, Tab. 4)

1855 *Ammonites Gardeni* BAILY: 450, Pl. 11, Fig. 3

1982 *Hauericeras gardeni* (BAILY, 1855); IMMEL et al.: 16, Pl. 5, Figs. 1–4, Pl. 6, Fig.1, non Pl. 6, Figs. 2–4.

1987 *Hauericeras gardeni* (BAILY, 1855); IMMEL: 47.

Material: In addition to the nine specimens in the collections from Brandenberg/Mühlbach (IMMEL et al., 1982: 17), there are eight individuals from the lower Santonian of the Gosau area: NHMW 2010/0355/0027 from the parking site of the cable car (Rußbach, Salzburg), SK/EB/2001/26, SK/EB/2001/27, SK/EB/2010/48, SK/EB/2010/49, 50 from Edlbachgraben (Gosau, Upper Austria) and SK/GR/1983/35 from Grabenbach (Gosau, Upper Austria).

Description: The specimens from Brandenberg (Tyrol) were described by IMMEL et al. (1982: 16, Text-Fig. 5) including a table of measurements in the text.

The largest specimen (Pl. 7, Fig. 1) from Rußbach (NHMW 2010/0355/0027) is preserved on a slab of grey marl. It is flattened and deformed into a feeble ellipse as a result of *post mortem* compaction. The whitish aragonitic shell is almost completely preserved. The coiling is evolute, the umbilicus broad and shallow. Four whorls are visible with 51 % of the previous whorl being covered. The whorl height increases regularly; the whorl breadth to height ratio cannot be measured due to lateral compaction. The umbilical wall is vertical and gently convex, the umbilical shoulder narrowly rounded. In spite of the compaction the flanks are slightly convex, with maximum breadth below mid-flank. The feebly convex ventrolateral shoulders converge towards the fastigiate venter and sharp siphonal keel. No ornament is visible on the surface of the shell. Five to six sinuous constrictions per whorl are present on the internal mould. They are feebly concave on the flanks, project strongly forwards on the ventrolateral shoulder and extend forwards subparallel to the ventral keel.

Inventory No.	D (mm)	Wh (mm)	Wb (mm)	U (mm)	U (%)
NHMW 2010/0355/0027	74	31	--	25.6	34.5
SK/EB/2010/49	83.5	33.4	--	26.3	31.5
SK/EB/2010/50	52.5	19.4	--	21.6	41.1
SK/EB/2010/48	23.8 $_{rest}$	10.8	--	11.2	37
SK/GR/1983/35	53.4	26.5	--	18.8	35

Tab. 4.
Hauericeras (*Gardeniceras*) aff. *gardeni* (BAILY, 1855). U % of D. For the measures of the Brandenberg specimens see IMMEL et al. (1982: 17).

SK/EB/2010/49 from Edlbachgraben is similar. Traces of sutures indicate it to be a phragmocone. The surface is covered by whitish shell and underlying nacreous layer; the keel is narrow and entire. SK/EB/2010/50 also retains the original shell material. The umbilical diameter decreases with increasing total diameter. Only parts of the constrictions are visible on these specimens. SK/EB/2010/48 is a juvenile with most of the original shell material preserved; constrictions cannot be observed. SK/GR/1983/35 (Pl. 7, Fig. 8) is laterally crushed. The constrictions are relatively broad and slightly sinuous, projecting strongly forwards close to the ventral margin.

Discussion: NHMW 2010/0355/0027 from the parking site of the cable car of Rußbach and those from Edlbachgraben and SK/GR/1983/35 from the Grabenbach site are thought to be conspecific with the Brandenberg material on the basis of the form of the constrictions. Three fragmentary specimens, SK/EB/2001/26 (Pl. 7, Fig. 6), SK/EB/2001/27 (Pl. 7, Fig. 7); SK/GR/1983/35, from the early Santonian Gosau Group of Edlbachgraben and Grabenbach (Gosau, Upper Austria) may also belong here. The material is poor and insufficient to establish a new species, hence the present assignation. KENNEDY & KLINGER (2011: 45) excluded the Brandenberg specimens from the synonymy of *H.* (*G.*) *gardeni* on the basis of the course of their constrictions: concave in *H.* (*G.*) *gardeni* and sinuous in the Brandenberg specimens. *Hauericeras welschi* DE GROSSOUVRE, 1894 (222, Pl. 35, Fig. 9); see revision in KENNEDY in KENNEDY et al. (1995: 396, Pl. 3, Fig. 12, Pl. 4, Figs. 3–5, Text-Fig. 14) also differs in its sinuous constrictions. *Hauericeras* (*Gardeniceras*) *lagarum* (REDTENBACHER, 1873: 112, Pl. 25, Fig. 3) from the Coniacian Gosau beds of Austria, a close ally of *Hauericeras* (*Gardeniceras*) *gardeni* and *H.* (*G.*) *angustum* (YABE, 1904) from India and Japan, differing in having a wider umbilicus. In *H. angustum* it is 37–44 % after MATSUMOTO in MATSUMOTO et al. (1990: 445).

Occurrence: *Hauericeras* (*Gardeniceras*) aff. *gardeni* (BAILY, 1855) occurs in the lower Santonian Gosau Group of Brandenberg/Mühlbach (Tyrol), at the parking site of the Hornspitz cable car at Rußbach (Salzburg) and in the early Santonian at the Edelbachgraben site (Gosau, Upper Austria).

Hauericeras (*Gardeniceras*) *lagarum* (Redtenbacher, 1873)

(Text-Fig. 5)

1873 *Ammonites lagarus* Redtenbacher: 112, Pl. 25, Figs. 3a, b.

1901 *Hauericeras lagarum* Redtenbacher; de Grossouvre: 638.

1925 *Hauericeras lagarum* Redtenbacher; Diener: 95.

1935 *Hauericeras lagarum* Redt.; Brinkmann: 3.

1961 *Hauericeras lagarum* Redtenbacher; Collignon: 95.

1985 *Hauericeras lagarum* (Redtenbacher); Summesberger: 152.

1995 *Hauericeras* (*Gardeniceras*) *lagarum* (Redtenbacher, 1873); Kennedy in Kennedy et al.: 397, Pl. 4, Fig. 17 (with synonymy).

2012 *Hauericeras lagarum* (Redtenbacher, 1873); Summesberger & Zorn: 106, Pl. 13, Fig. 2.

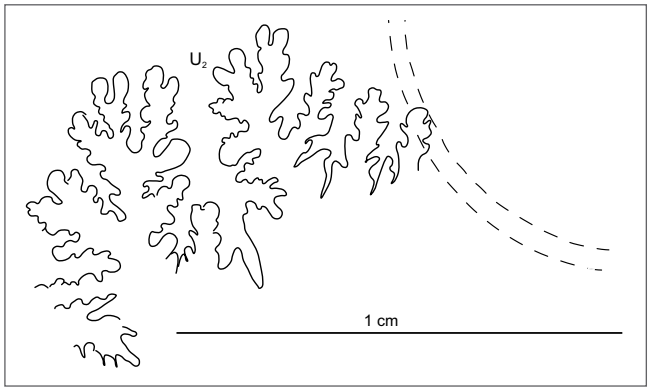
2017a *Hauericeras* (*Gardeniceras*) *lagarum* (Redtenbacher, 1873); Summesberger et al.: 176, Pl. 8, Figs. 2, 3, Pl. 9, Fig. 7, Text-Fig. 15, Tab. 7.

Types: *Ammonites lagarus* Redtenbacher (1873: 112, Pl. 25, Figs. 3a, b) was based upon two syntypes combined by Redtenbacher in his original figure. One of the originals, HNS 6391 is designated lectotype by Summesberger et al. (2017a: 176, Pl. 9, Figs. 7a, b).

The second paralectotype, GBA 1873/001/0007, is an external mould from the middle Coniacian Gosau Group of the Schmolnauer Alpe (Strobl/Weißenbach, Salzburg, housed in the collections of the Geological Survey of Austria in Vienna (Summesberger & Zorn, 2012: Pl. 13, Fig. 2).

Material: Three specimens from the late Santonian *paraplanum* Subzone of the Hochmoos Formation of the Schattaugraben section (Rußbach, Salzburg): NHMW 1978/1955/0001 without locality details and SK/SG/1984/3 from the *Micraster* Bed. The preservation of NHMW 1978/1955/0001 suggests that it might be from the same level. A juvenile specimen, NHMW 2006/0203/0001, from the *Micraster* Bed is referred with some doubt to the same species.

Description: The whorl section, somewhat deformed by compaction, appears to have been strongly compressed with flattened inner flanks, convergent outer flanks, a sharp and entire siphonal keel. Both specimens from the Schattaugraben section are flattened and deformed into an ellipse by *post mortem* compaction; both are internal moulds with yellowish shell preserved. The umbilical wall is low and distinctly convex, the umbilical edge narrowly rounded. Coiling is evolute, with a very small overlap over the preceding volution, the umbilicus wide and shallow, the expansion rate low. The phragmocones are badly crushed. The Schattaugraben individuals are of equal size, the best-preserved, SK/SG/1984/3, is 59 mm in diameter, with a whorl height of 11.8 mm and a whorl breadth of Wb 7.2 mm. The flanks are smooth except for an estimated 4–5 slightly flexuous constrictions per whorl, projected strongly forwards on the ventrolateral shoulder. These are only visible on the internal mould. The suture is partially visible in NHMW 1978/1955/0001 (Text-Fig. 5).



Text-Fig. 5.
External suture of *Hauericeras lagarum* (Redtenbacher, 1873), NHMW 1978/1955/0001 from the late Santonian of the Schattaugraben (Rußbach, Salzburg).

HNS 6391, preserved in hard brownish sandstone, compares well with the Schattau specimens, differing only in its more rapidly increasing whorl height.

Discussion: *Hauericeras* (*Gardeniceras*) *lagarum* (Redtenbacher, 1873) is a close ally of *Hauericeras* (*Gardeniceras*) *gardeni* (Baily, 1855) differing in the smaller overlap between successive whorls and the slightly sinuous rather than concave constrictions. *Hauericeras* (*Gardeniceras*) *welschi* (de Grossouvre, 1894: 222, Pl. 35, Fig. 9) from the French and Austrian Santonian and its ally *H. angustum* (Yabe, 1904: 33, Pl. 5, Figs. 5, 6; see revision in Matsumoto & Obata, 1955 (137, Pl. 24, Fig. 6, Pl. 28, Figs. 1, 2, Pl. 29, Figs. 1–5, Text–Figs. 5, 7; Matsumoto et al., 1990: 443, Text-Figs. 2–7) from Japan and South India differ in their greater whorl height and sharp umbilical edge. *Hauericeras schlueteri* (Redtenbacher, 1873: 114, Pl. 26, Fig. 2) from the middle Coniacian of the Schmolnauer Alpe (Strobl/Weißenbach, Salzburg, Austria) is based on a juvenile with a distinctly narrower umbilicus.

Occurrence: *Hauericeras* (*Gardeniceras*) *lagarum* ranges from the middle Coniacian of the Corbières (Kennedy in Kennedy et al., 1995) and Schmolnauer Alpe, Salzburg, Austria (the paralectotype) through the late Coniacian (Glanegg, Salzburg, the lectotype) and the late Santonian *Paraplanum* Subzone of the Hochmoos Formation (Schattaugraben section). Its presence is to be expected in the early and middle Santonian, although we have found no specimens to date.

Hauericeras (*Gardeniceras*) sp. indet.

(Pl. 7, Figs. 4, 5)

Material: NHMW 2013/0015/0003 from the early Santonian of Schwarzenbach near Weißwasser, Unterlaussa (Upper Austria).

Description: NHMW 2013/0015/0003 is a fragment with most of the shell preserved. When complete, it would have been about 35 mm in diameter; the Wh_{max} about 19 mm. Coiling is evolute, serpenticone. The umbilical shoulder is rounded, the flanks converging towards the fastigiate venter, forming a sharp siphonal keel. The surface of the shell is smooth, apart from collar-ribs. The sutures are not exposed.

Discussion: Due to its poor preservation the specimen (NHMW 2013/0015/0003) cannot be identified to species level and is left in open nomenclature.

Occurrence: As for material.

Subfamily Desmoceratinae Zittel, 1895
Genus *Damesites* Matsumoto, 1942

Type species: *Desmoceras damesi* Jimbo, 1894 (172, Pl. 1, Figs. 2, 3); ICZN opinion 555, 1959.

Damesites sugata (Forbes, 1846)

(Pl. 8, Figs. 1, 2, 4, 5, Text-Fig. 6, Tab. 5)

1846 *Ammonites Sugata* Forbes: 113, Pl. 10, Figs. 2a–c.

1865 *Ammonites Sugata* Forbes; Stoliczka: 60, Pl. 32, Figs. 4–6, Pl. 33, Figs. 1, 2.

Non 1890 *Desmoceras sugata* Forbes; Yokoyama: 185, Pl. 20, Fig. 11 (= *Damesites damesi intermedius* Matsumoto, 1942).

1898 *Desmoceras Sugata* Forbes; Kossmat: 111 (176), Pl. 18 (24), Fig. 11, Pl. 19 (25), Fig. 1.

1921b *Hauericeras*? *sugata* (Forbes sp.); Spath: 46, Pl. 6, Fig. 3.

1921 *Desmoceras compactum* van Hoepen: 21, Pl. 4, Figs. 5–7, Text-Fig. 12.

1922 *Hauericeras*? *sugata* (Forbes); Spath: 131.

1925 *Latidorsella Sugata* Forbes; Diener: 126.

?1931 *Desmoceras sugata* Forbes; Basse: 21, Pl. 2, Figs. 19, 20.

?1935 *Pachydiscus obscurus* (Schlüter); Brinkmann: 2.

1942 *Damesites sugata* (Forbes); Matsumoto: 27, Text-Fig. 1f.

1955 *Damesites sugata* (Forbes); Matsumoto & Obata: 128, Pl. 26, Figs. 4, 5, Pl. 27, Figs. 3, 4, Text-Fig. 3.

1965 *Damesites sugatus* Forbes; Collignon: 20, Pl. 421, Fig. 1753.

?1980 *Damesites compactus* (van Hoepen); Summesberger: 278, Pl. 1, Figs. 3, 4, Text-Fig. 4.

1983 *Damesites* aff. *compactus* (van Hoepen); Collignon: 191, Pl. 2, Fig. 3.

?1982 *Damesites* sp.; Immel et al.: 15, Pl. 2, Fig. 7.

?1982 *Damesites* cf. *compactus* (van Hoepen 1921); Immel et al.: 14, Pl. 2, Fig. 6.

?1982 *Damesites obscurus* (Schlüter, 1872); Immel et al.: 15.

1983 *Damesites sugatus* (Forbes); Collignon: 190, Pl. 2, Fig. 4.

1983 *Damesites* aff. *compactus* (van Hoepen); Collignon: 191, Pl. 2, Fig. 3.

1987 *Damesites compactus* (van Hoepen 1921); Immel: 90, Pl. 8, Fig. 5.

1989 *Damesites sugata* (Forbes, 1846); Haggart: 195, Pl. 8.4, Figs. 14–23 (with additional synonymy).

?1991 *Gaudryceras obscurus* (Schlüter, 1872); Riegraf & Scheer: 374 (= Schlüter, 1872: Pl. 22, Figs. 9, 10).

1991 *Damesites sugata* (Forbes, 1846); Kennedy & Henderson: 471, Text-Figs. 1, 2.

1993 *Damesites sugata* (Forbes, 1846); Alabushev & Wiedmann: 553, Text-Figs. 1, 2.

1995 *Damesites sugata* (Forbes, 1846); Kennedy in Kennedy et al.: 398, Pl. 3, Figs. 5, 6, 17, Pl. 4, Fig. 21.

?1996 *Damesites damesi* (Jimbo, 1894); Cooper & Greyling: 19, Figs. 7i–l.

1993 *Damesites sugata* (Forbes); Alabushev & Wiedmann: 22, Pl. 6, Figs. 6, 7, Pl. 11, Fig. 2, Text-Figs. 4a, 7.

2000 *Damesites compactus* (van Hoepen, 1921); Summesberger in Egger et al.: 26.

2003 *Damesites sugata* (Forbes, 1846); Cooper: 155, Text-Figs. 6e, f, 7d.

2013a *Damesites sugata* (Forbes, 1846); Kennedy & Klinger: 44, Text-Figs. 7a–j.

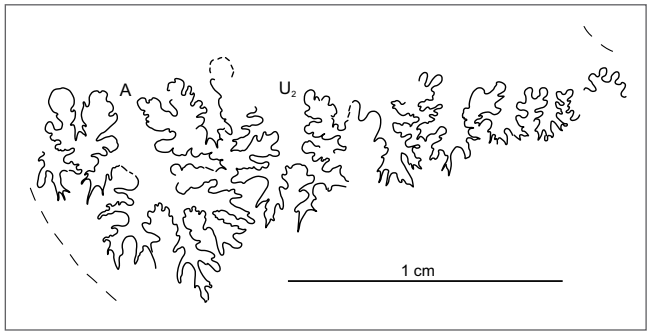
2017a *Damesites sugata* (Forbes, 1846); Summesberger et al.: 177.

Types: The lectotype is BMNH C22647, the original of Forbes (1846: Pl. 10, Figs. 2a–c). It was figured by Kennedy & Henderson (1991: Text-Figs. 1A, B) and Kennedy & Klinger (2013a: Text-Figs. 7D, E). There are three paralectotypes, BMNH C22675, of which BMNH C3561a is a further fragment, and BMNH 24196a, b, while BMNH C3561b may be a further paralectotype. The type material is from Vridachellum (Verdachellum), South India.

Material: NHMW 2013/0466/0001 from the top of the middle Santonian of the Neffgraben site (Rußbach, Salzburg); GPII P. 8191-2 from the early Santonian of Brandenberg/Mühlbach. SK/1979/7 from the late Santonian Sandkalkbank Member (Hochmoos Formation; Finstergrabenwandl; Gosau, Upper Austria), BSP 1959 VI 39 from Eiberg (Tyrol, Austria); GPII P.8192, SK/NE/1991/15 from the middle Santonian Hochmoos Formation of the Neffgraben and SK/SG/1992/15 from the late Santonian Hochmoos Formation of the Schattaugraben (both Rußbach, Salzburg).

Description: NHMW 2013/0466/0001 (Pl. 8, Figs. 1, 2) is an internal mould with partial preservation of the whitish shell. It is slightly deformed into an ellipse. Lateral compaction is negligible. The whorl section is compressed and successive whorls cover the greatest part of the preceding ones. The whorl height increases slowly. The open umbilicus is small. The umbilical wall is convex, the flanks are slightly convex and the umbilical shoulder is narrowly rounded. The flanks are smooth. Delicate growth lines are visible under oblique light only. About six biconvex constrictions per half whorl are distinct on the internal mould and almost invisible on the surface of areas of preserved shell. The entire keel is narrow and sharp. The suture (Text-Fig. 6) is typical for the genus. Crowding of the sutures indicate the adult stage of the specimen.

SK/1979/7, described by Summesberger (1980) and SK/NE/1991/15 (Pl. 8, Figs. 4, 5) are internal moulds with ad-



Text-Fig. 6.
External suture of *Damesites sugata* (FORBES, 1846), NHMW 2013/0466/0001.

herent whitish shell fragments. Both specimens are small with almost closed umbilicus and are laterally compressed to a certain degree. SK/NE/1991/15 shows seven slightly falcoid constrictions per whorl, as does BSP 1959 VI 39 from Eiberg, Tyrol (IMMEL, 1987: Pl. 8, Fig. 5), whereas SK/1979/7 has none.

Due to *post mortem* deformation measurements are slightly altered but at least the relations are believed to be meaningful.

Discussion: *Damesites compactus* (VAN HOEPEN, 1921) is a doubtful taxon based upon a very small juvenile. VAN HOEPEN's original (1921: 21, Pl. 4, Figs. 5–7) has a diameter of 18 mm. Comparison with any adult taxon of the genus is problematic and KENNEDY & KLINGER (2013a: 45) regarded it as a synonym of *sugata*. Earlier authors (e.g. COLLIGNON, 1961: 70) noted, that „*plusieurs auteurs* (*Basse, Matsumoto*) *ont assimilé* [compactus] à Damesites sugatus (sic) *Forbes*". Nevertheless, COLLIGNON (1961: 70–71, Nr. 3335, Pl. 26, Fig. 4, figured apparently erroneously under 2335) maintained *Damesites compactus* as a distinct taxon, whereas KENNEDY in KENNEDY et al., (1995: 398) united all specimens from the Santonian of the Corbières (France) under *Damesites sugata* (FORBES, 1846), due to the lack of correspondence between the Madagascan and the Pondoland representatives of the genus and because of the lack of topotypes from Pondoland.

Ammonites obscurus SCHLÜTER, 1872 was discussed by IMMEL et al. (1982: 15) as a further representative of *Damesites*. KENNEDY & SUMMESBERGER (1984: 153, Pl. 2, Figs. 10–12) regarded *Ammonites obscurus* SCHLÜTER (1872) as a species of *Tetragonites*, a view which was followed by KENNEDY & KAPLAN (1995: 17), LOMMERZHEIM (1995: 46) and KAPLAN et al. (1996: 26; discussion: 27).

Occurrence: *Damesites sugata* (FORBES, 1846) ranges from the late Coniacian through the Santonian of the Corbières and in the Circumpacific Realm (KENNEDY in KENNEDY et al., 1995). Furthermore, it occurs in the Coniacian to Santonian of India, Madagascar and South Africa. In Japan and Saghalin it occurs "approximately" (MATSUMOTO & OBATA, 1955: 133, Pl. 26, Figs. 4a, b, 5a, b, Pl. 27, Figs. 3a, b, 4a–d) in the Santonian. NHMW 2013/0466/0001 is from the top of the middle Santonian Hochmoos Formation (Gosau Group) of the Neffgraben site (Rußbach, Salzburg). BSP 1959 VI 39 is possibly from the early Santonian of Eiberg (Tyrol, Austria), GPII P. 8191, 8192 from the early Santonian of Brandenberg/Mühlbach. SK/1979/7 from the late Santonian Sandkalkbank Member (Hochmoos Formation; Finstergrabenwandl; Gosau, Upper Austria); SK/NE/1991/15 from the middle Santonian Hochmoos Formation of the Neffgraben and SK/SG/1992/15 from the late Santonian Hochmoos Formation of the Schattaugraben (both Rußbach, Salzburg).

Inventory No.	D (mm)	Wh (mm)	Wb (mm)	U (mm)	U (%)
NHMW 2013/0466/0001	63.4	32.2	19.9	8.7	13.7
SK/1979/7	30	14.4	10.4	2.2	7.3
BSP 1959 VI 39	34.8	22.6	10.7	1.7	4.9
SK/NE/1991/15	31	19.3	10	0.9	2.9

Tab. 5.
Damesites sugata (FORBES, 1846). U % of D.

Damesites sp. indet.

(not figured)

Compare

1982 *Damesites* sp.; IMMEL et al.: 15, Pl. 2, Fig. 7.

Material: Two specimens: GPII P. 8192 from the early Santonian of Brandenberg/Mühlbach and SK/RA/1982/74d from the middle Santonian of Randobach 2 (Rußbach, Salzburg).

Discussion: GPII P. 8192, the specimen figured by IMMEL et al. (1982), is too poorly preserved for specific determination; SK/RA/1982/74 d is a juvenile 9 mm in diameter. It is also specifically indeterminate.

Occurrence: Early Santonian of Brandenberg/Mühlbach (Tyrol, Austria) and middle Santonian of Randobach 2.

Family Kossmaticeratidae Spath, 1922
Subfamily Kossmaticeratinae Spath, 1922
Genus and Subgenus *Kossmaticeras* de Grossouvre, 1901

Type species: *Ammonites theobaldianus* Stoliczka, 1865 (161, Pl. 78, Figs. 1–3), by the subsequent designation of Diener (1925: 96).

Kossmaticeras (Kossmaticeras) cf. *sparsicostatum* (Kossmat, 1897)

(not figured)

Compare

1865 *Ammonites denisonianus* Stoliczka: 133, Pl. 66, Figs. 1, 2 only.

1897 *Holcodiscus sparsicostatus* Kossmat: 38, Pl. 6, Fig. 5.

1955 *Kossmaticeras sparsicostatum* Kossmat; Collignon: 22, Pl. 3, Fig. 1, Pl. 4, Fig. 1.

1982 *Kossmaticeras* (*Kossmaticeras*) cf. *sparsicostatum* (Kossmat, 1897); Immel et al.: 18, Pl. 5, Fig. 5.

1985 *Kossmaticeras* (*Kossmaticeras*) *sparsicostatum* (Kossmat, 1897); Kennedy & Klinger: 179, Text-Figs. 7A–E.

1987 *Kossmaticeras* (*Kossmaticeras*) cf. *sparsicostatum* (Kossmat, 1897); Immel: 92.

Types: There are two syntypes; the original of of *Ammonites denisonianus* Stoliczka, 1865: 133 (pars), Pl. 66, Fig. 1 only, and the original of Kossmat, 1897: Pl. 6 (17), Fig. 5.

Material: A single fragment GPII P.8182, from Brandenberg/Mühlbach (Tyrol).

Description and Discussion: The poor fragment was described and discussed by Immel et al. (1982: 18, Pl. 5, Fig. 5).

Occurrence: Early Santonian of Brandenberg/Mühlbach (Tyrol).

Family Pachydiscidae Spath, 1922
Genus *Nowakites* Spath, 1922

Type species: *Pachydiscus carezi* de Grossouvre, 1894 (190, Pl. 25, Fig. 3, Pl. 37, Fig. 5), by the original designation by Spath (1922: 124).

Nowakites carezi (de Grossouvre, 1894)

(Pl. 8, Figs. 3, 6, 7, Pl. 9, Figs. 3–5, Tab. 6)

1894 *Pachydiscus carezi* de Grossouvre: 190, Pl. 25, Fig. 3, Pl. 37, Fig. 5.

1982 *Eupachydiscus isculensis* (Redtenbacher, 1873); Immel et al.: Pl. 7, Figs. 8, 9 only.

1882 *Kitchinites stenomphalus* Summesberger, 1979; Immel et al.: 14, Pl. 2, Fig. 5.

1987 *Kitchinites stenomphalus* Summesberger, 1979; Immel: 90.

1987 *Eupachydiscus isculensis* (Redtenbacher, 1873); Immel: 94.

1995 *Nowakites carezi* (de Grossouvre, 1894); Kennedy in Kennedy et al.: 400, Pl. 6, Figs. 3, 6–8, Pl. 7, Figs. 4, 5, Pl. 8, Figs. 13–15, Pl. 9, Figs. 2–4 (with synonymy).

Type: The holotype, by original designation is the original of de Grossouvre (1894: Pl. 25, Fig. 3), refigured by Kennedy in Kennedy et al. (1995: Pl. 9, Figs. 2–4).

Material: NHMW 1861/0001/0192 and SK/RA/2002/144 from the Randobach and NHMW 2013/0466/0002 from the Neffgraben (Rußbach, Salzburg), both from the middle Santonian, BSP 1974 I. 339 and M 40 and M 47 from the early Santonian of Mühlbach (Brandenberg, Tyrol).

Description: NHMW 1861/0001/0192 (Pl. 8, Figs. 6, 7) is a crushed subadult internal mould with large parts of the aragonitic shell preserved. The specimen is deformed into an ellipse (D_{max} 41.4 mm). It is moderately involute and shows the change in ornament typical of *carezi*: finely ribbed early whorls (see also Pl. 9, Fig. 5, a juvenile), the ribbing coarsening towards the adult aperture. Narrow ribs arise in groups of two and three from six umbilical bullae.The interspaces are somewhat wider than the ribs, which are generally prorsiradiate, concave or slightly flexuous, sweeping over the venter in a broad convexity. Two indistinct constrictions are visible. In contrast, NHMW 2013/0466/0002 (Pl. 8, Fig. 3), a juvenile, is a smaller internal mould with partially preserved shell. Narrow, slightly flexuous prorsiradiate ribs arise from small bullae, divide into bundles of ribs on the flanks and cross the venter in a distinct convexity. Three narrower constrictions are followed by a much wider one close to the aperture. The body chamber comprises about half a whorl; the last suture is visible through the transparent inner shell layer.

Discussion: NHMW 2013/0466/0002, apparently a juvenile or microconch, is very close to PM G5c5 from the middle Santonian *Gallicus* Subzone of Sougraigne (Corbières) figured by Kennedy in Kennedy et al. (1995: Pl. 6, Fig. 3) and also close to the missing paratype (de Grossouvre, 1894: Pl. 37, Fig. 5; Kennedy in Kennedy et al., 1995: 400). NHMW 1861/0001/0192 (Pl. 8, Fig. 6, 7) is interpreted as a subadult individual, the juvenile ornament present on the adapical part of the outer whorl, the change to coarser adult ornament appearing on the adapertural part of the phragmocone. Comparable specimens from the Corbières were figured by Kennedy in Kennedy et al. (1995: Pl. 6, Figs. 11, 12, Pl. 7, Figs. 4, 5, Pl. 8, Figs. 13–15, Pl. 9, Fig. 3). We interpret specimens figured by Immel et al. (1982: Pl. 2, Fig. 5) as *Kitchinites stenomphalus* Summesberger, 1979 and as *Eupachydiscus isculensis* (Redtenbacher, 1873) (Immel et al., 1982: Pl. 7, Figs. 8, 9) as juvenile and subadult representatives of *Nowakites carezi*.

Inventory No.	D (mm)	Wh (mm)	Wb (mm)	U (mm)	U (%)
NHMW 2013 0466/0002	D_{max} 22.1	83.2	Wb_{max} 61.4	4.5	20

Tab. 6.
Nowakites carezi (de Grossouvre, 1894), NHMW 2013/0466/0002. $_{max}$ = maximum. U % of D.

Occurrence: *Nowakites carezi* (DE GROSSOUVRE, 1894) occurs in the lower and middle Santonian *carezi* and *gallicus* subzones of the Corbières (KENNEDY in KENNEDY et al., 1995), in the Santonian parts of Gosau Group (this paper) and in the Coniacian of Romania, Bulgaria and Armenia.

Nowakites draschei (REDTENBACHER, 1873)

(Pl. 8, Figs. 8–12, Text-Fig. 7)

1873 *Ammonites Draschei* REDTENBACHER: 123, Pl. 30, Fig. 1.

1908 *Puzosia Draschei* REDT.; FELIX: 292.

1922 *Nowakites draschei* RDTB. sp.; SPATH: 124.

1925 *Nowakites Draschei* REDTENBACHER; DIENER: 113.

1935 *Pachydiscus draschei* (REDT.); BRINKMANN: 2, 4.

1979 *Eup. draschei* REDT.; WIEDMANN: Fig. 4.

1979 *Nowakites draschei* (REDTENBACHER); SUMMESBERGER: 138, Pl. 8, Figs. 33–36, Text-Figs. 23–25 (with synonymy).

1982 *Nowakites draschei* (REDTENBACHER); KOLLMANN & SUMMESBERGER: 49.

1987 *Nowakites draschei* (REDTENBACHER 1873); IMMEL: 93.

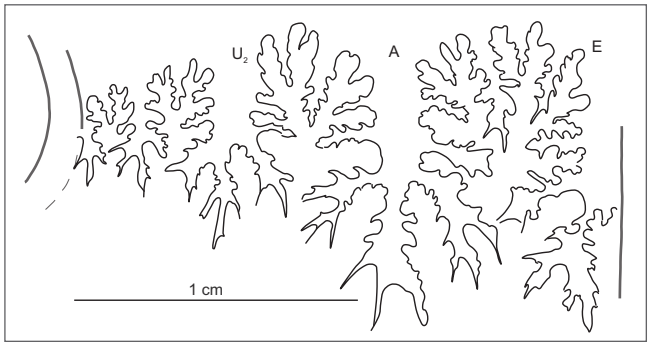
2000 *Nowakites draschei* (REDTENBACHER); SUMMESBERGER in EGGER et al.: 26.

Type: The holotype, by monotypy, is the original of *Ammonites Draschei* REDTENBACHER, 1873 (123, Pl. 30, Figs. 1a, b); OÖLM 1938/30, from Neffgraben (Rußbach, Salzburg).

Material: NHMW 2013/0467/0001 (formerly KA/1977/1) and SK/1977/8 from the late Santonian Sandkalkbank Member of the Gosau Basin.

Description: The holotype (Pl. 8, Figs. 10–12) is an imperfectly preserved crushed specimen retaining much of the aragonitic shell. The maximum diameter is 53 mm. Coiling is involute, with a small, deep umbilicus (U = 23 %). The umbilical wall is steep and the whorl section was probably depressed, with the greatest breadth at the umbilical bulla, the inner flanks are flattened, with broadly rounded ventrolateral shoulders and venter. There are four strong umbilical bullae on the last half whorl, connected to the umbilical seam by a narrow, rapidly weakening rib. From the bulla a high, narrow, strong rib passes forward across the inner flank, flexing forward to become concave on the outer flank and cross the venter in a broad, shallow convex curve. Between these major ribs are up to seven nonbullate, somewhat weaker ribs of variable length, some extending to the umbilical shoulder, others arising low on the flank. Marked constrictions are present, generally parallel to the major bullate ribs. The incompletely visible suture of NHMW 2013/0467/0001 (Pl. 8, Figs. 8, 9) which is the closest specimen to the holotype is shown in Text-Figure 7. It includes deeply incised lobes and saddles of pachydiscid pattern.

Discussion: Six species of *Nowakites* were described by KENNEDY in KENNEDY et al. (1995: 400–403) from the Corbières. The closest relative of *Nowakites draschei* appears to be *Nowakites carezi*, described above. It is most readily distinguished by the finely ribbed early whorls with distinct constrictions, the ornament coarsening markedly on the adapical part of the phagmocone and the body chamber.



Text-Fig. 7.
External suture of *Nowakites draschei* (REDTENBACHER, 1873), NHMW 2013/0467/0001.

Occurrence: The holotype, OÖLM 1938/30, is from the middle Santonian of the Neffgraben (Rußbach, Salzburg) where it occurs well below the Sandkalkbank Member of the Hochmoos Formation. NHMW 2013/0467/0001 and SK/1977/8 are from the late Santonian Sandkalkbank Member of the Gosau Basin. The stratigraphic position of two specimens of *Pachydiscus draschei* (REDTENBACHER, 1873) from Eiberg (Tyrol) mentioned by BRINKMANN (1935: 2) is uncertain.

Nowakites savini (DE GROSSOUVRE, 1894)

(Pl. 9, Figs. 1, 2, Pl. 10, Fig. 1, Tab. 7)

1894 *Sonneratia savini* DE GROSSOUVRE: 152 (pars), Pl. 25, Fig. 4, *non* Pl. 27, Fig. 4 (= microconch of *Nowakites tallavignesi* (D'ORBIGNY, 1850)).

1922 *Nowakites savini* DE GROSSOUVRE; SPATH: 124.

1925 *Nowakites savini* DE GROSSOUVRE; DIENER: 113.

1939 *Nowakites savini* DE GROSS.; BASSE: 47.

1952 *Nowakites savini* DE GROSSOUVRE; COLLIGNON: 29, 85.

1955 *Nowakites savini* DE GROSSOUVRE; COLLIGNON: 30, 78.

1982 *Nowakites savini* (DE GROSSOUVRE, 1894); TZANKOV: 35, Pl. 27, Fig. 2.

1983 *Nowakites savini* (DE GROSSOUVRE); COLLIGNON: 192, Pl. 2, Fig. 6.

1983 *Nowakites tallavignesi* (D'ORBIGNY); COLLIGNON: 192 (pars), Pl. 2, Fig. 8.

1983 *Nowakites lemarchandi* (DE GROSSOUVRE); COLLIGNON: 193 (pars), Pl. 2, Fig. 9.

? 1988 *Nowakites savini thomeli* (COLLIGNON, 1981); THOMEL: 34, Pl. 3, Figs. 1–3, Pl. 4, Fig. 3, Pl. 22, Fig. 1.

1995 *Nowakites savini* DE GROSSOUVRE, 1894; KENNEDY et al.: 402, Pl. 8, Figs. 16–23, Pl. 9, Figs. 1, 6, 7, Pl. 19, Fig. 7, Pl. 22, Figs. 1, 2, 4, Text-Fig. 20C.

2010 *Nowakites savini*; LUKENEDER et al.: 109, Fig. 1c.

2010 *Nowakites savini*; REMIN: 174, Figs. 13A–G.

2017a *Nowakites savini* (DE GROSSOUVRE, 1894); SUMMESBERGER et al.: 179, Pl. 8, Fig. 9.

Type: The holotype by original designation is the original of DE GROSSOUVRE (1894: Pl. 25, Fig. 4). It has not been traced (KENNEDY in KENNEDY et al., 1995: 402) and is presumed lost.

Inventory No.	D_{max} (mm)	$Wh_{intercost}$ (mm)	Wb (mm)	U (mm)	U (%)
NHMW 2010/0082/0001	105.8	51.0	31.8	24.8	23.4

Tab. 7.
Nowakites savini (DE GROSSOUVRE, 1894); NHMW 2010/0082/0001. D_{max} = max. diameter, $Wh_{intercost}$ = intercostal measurement, U % of D.

Material: MA/1982/19 from the Bad Ischl road tunnel section, Upper Austria, middle Coniacian; NHMW 2010/0082/0001 from the early Santonian of the Edlbachgraben and SK/RA/2014/164 from Randobach 3 (Gosau, Upper Austria); NHMW 2010/0081/0001 from the late Santonian *Micraster* Bed of the Schattaugraben.

Description: NHMW 2010/0082/0001 (Pl. 9, Figs. 1, 2, Tab. 7) is an internal mould of a phragmocone with partially preserved body chamber. Whitish shell material is present throughout, the inner layer transparent, rendering the sutures visible, the outer layer brittle and fragmentary. The greater part of the body chamber is broken away. The specimen is distorted into an ellipse as a result of *post mortem* crushing. In spite of this, it is one of the best preserved known individuals of the species.

Coiling is relatively involute, with more than two thirds of the previous whorl covered. The umbilical wall is steep and slightly convex. The umbilical shoulder is narrowly rounded, the flanks are feebly convex, the ventrolateral shoulder broadly rounded, the venter convex. Ornament consists of 11 strong bullae that give rise to very strong, narrow and sharp ribs, either singly or in pairs. Intercalated ribs are somewhat weaker and arise on the inner third of the flanks. Ribbing is more or less regular on the phragmocone, but strengthens on the surviving fragment of the body chamber, the interspaces deepening markedly. There are an estimated 40 ribs on the outer whorl. They are prorsiradiate and feebly concave, projecting forwards over the ventrolateral shoulder and crossing the venter in a marked convexity. Occasional interspaces are strengthened into poorly defined constrictions. MA 1982/19 is a very similar but smaller individual with less regular ribbing.

Discussion: *Nowakites carezi* (DE GROSSOUVRE, 1894), described above, differs in the distinct change in ornament from the finely ribbed inner whorls with occasional constrictions to the coarsely ribbed outer whorls. *Nowakites draschei* (REDTENBACHER, 1873), also described above, is more involute and has less regular ribbing. *Nowakites talavignesii* (D'ORBIGNY, 1850: 212; see revision by KENNEDY in KENNEDY et al. (1995: 401; Pl. 6, Figs. 15–19, Pl. 8, Figs. 1–5, 8–12, Pl. 10, Fig. 16)) is a small, relatively evolute, relatively sparsely ribbed species with fewer umbilical bullae. *Nowakites pailletteanus* (D'ORBIGNY, 1841: 339, Pl. 102, Figs. 3, 4; KENNEDY in KENNEDY et al., 1995: 401, Pl. 6, Figs. 20, 21, 24, Pl. 7, Figs. 1–3, 6–12, Pl. 9, Fig. 8, Pl. 10, Fig. 16) and its synonym *Nowakites lemarchandi* (DE GROSSOUVRE, 1894: 173, Pl. 22, Fig. 5), a Coniacian species, is a larger, less evolute species with less pronounced even ornament.

Occurrence: NHMW 2010/0082/0001 is from the basal Santonian of the Edlbachgraben (Gosau, Upper Austria) and SK/RA/2014/164 is from Randobach, where they co-occur with *Cladoceramus undulatoplicatus* and *Eulophoceras natalense*. MA 1982/19 is from the middle Coniacian of the road tunnelsection north of Bad Ischl, where it co-occurs with *Peroniceras tridorsatum* (SCHLÜTER, 1867) and *Forresteria* (*F.*) *alluaudi* (BOULE et al., 1907). It also occurs in the lower and middle Santonian *carezi* and *gallicus* Zones in the Corbières, southern France.

Genus *Patagiosites* SPATH, 1953

Type species: *Ammonites patagiosus* SCHLÜTER, 1867 (22, Pl. 4, Figs. 4, 5) by the original designation of SPATH (1953: 38) = *Ammonites stobaei* NILSSON (1827: 5, Pl. 1, Figs. 1, 2 (see KENNEDY & CHRISTENSEN, 1997: 95)).

Patagiosites? sp.

(not figured)

1867 *Ammonites patagiosus* SCHLÜTER: 22, Pl. 4, Figs. 4–5.

1872 *Ammonites patagiosus* SCHLÜTER: 66, Pl. 20, Figs. 7–8.

1982 *Patagiosites patagiosus* (SCHLÜTER, 1867); IMMEL et al.: 18, Pl. 5, Fig. 6.

1982 *Menuites sturi* (REDTENBACHER, 1873); IMMEL et al.: 21, Pl. 7, Figs. 6, 7.

Material: M 25, the original of *Patagiosites patagiosus* (SCHLÜTER) of IMMEL et al. (1982: Pl. 5, Fig. 6) and two doubtful specimens, M 23 and M 55, the originals of *Menuites sturi* (REDTENBACHER 1873) of IMMEL et al. (1982: Pl. 7, Figs. 6, 7) from the early Santonian of Brandenberg, Tyrol.

Description: M 25 is a crushed internal mould 20 mm in diameter, described and figured by IMMEL et al. (1982: 18, Pl. 5, Fig. 6) as *Patagiosites patagiosus* (SCHLÜTER, 1867). It is characterised by involute coiling and a narrow umbilicus. Five deep constrictions are flanked by weak collar-ribs. Two further crushed specimens (M 23 and M 55) described and figured as *Menuites sturi* (REDTENBACHER, 1873) by IMMEL et al. (1982: 21, Pl. 7, Figs. 6, 7) are also characterised by involute coiling, five constrictions per whorl on the internal mould, flanked by collar ribs. There are occasional ribs between the successive groups of constrictions plus collar ribs. One such rib in M 55 (IMMEL et al., 1982: Pl. 7, Fig. 6) is strengthened markedly on the ventrolateral shoulder.

Discussion: The specimens referred by IMMEL et al. (1982: 18, Pl. 5, Fig. 6; 21, Pl. 7, Figs. 6, 7) to the Campanian *Patagiosites patagiosus* (SCHLÜTER, 1867) (a synonym of *Ammonites stobaei* (NILSSON, 1827): see KENNEDY & CHRISTENSEN, 1997: 95, Text-Figs. 13–17) and the Maastrichtian *Menuites sturi* (REDTENBACHER, 1873) are, in our view, conspecific. The former appear to be microconchs; the latter (M 25) appears to be a juvenile of a presumed macroconch. The age difference between the Austrian early Santonian specimens and the type material of the species they were referred to by IMMEL et al. (1982) is such that we doubt their assignations. The material appears to be a species of the early Santonian to Maastrichtian *Patagiosites*.

Occurrence: As for material.

Genus *Eupachydiscus* Spath, 1922

Type species: *Ammonites isculensis* Redtenbacher, 1873 (122, Pl. 29, Fig. 1) by the original designation of Spath (1922: 124).

Eupachydiscus isculensis (Redtenbacher, 1873)

(Pl. 9, Figs. 6–8, Pl. 10, Fig. 3)

1873 *Ammonites isculensis* Redtenbacher: 122, Pl. 29, Fig. 1.

1894 *Pachydiscus isculensis* (Redtenbacher, sp.); de Grossouvre: 185, Pl. 22, Fig. 2, Pl. 37, Fig. 1, Text-Fig. 66.

1922 *Eupachydiscus isculensis* (Redtenbacher); Spath: 124.

1925 *Eupachydiscus isculensis* (Redtenbacher); Diener: 110.

1935 ? *Scaphites* sp.; Katschthaler: 178.

1935 *Pachydiscus isculensis* (Redt.); Brinkmann: 4.

1957 *Eupachydiscus isculensis* (Redtenbacher, 1873); Wright: 380, Fig. 295,2.

1961 *Eupachydiscus isculensis* (Redtb.); Gerth: 124, Pl. 24, Fig. 7.

1964 *Scaphites* sp.; Fischer: 131.

1966 *Eupachydiscus isculensis* Redt.; Collignon: 90, Pl. 492, Fig. 1977.

1979 *Eupachydiscus isculensis* (Redtenbacher); Wiedmann in Herm et al.: 49, Pl. 8A.

1979 *Eupachydiscus isculensis* (Redtenbacher); Summesberger: 136, Pl. 7, Figs. 30, 31, Pl. 8, Fig. 32, Text-Figs. 20–22.

1982 *Eupachydiscus isculensis* (Redtenbacher); Martinez: 64, Pl. 7, Fig. 3.

1982 *Eupachydiscus isculensis* (Redtenbacher); Kollmann & Summesberger: 49.

1982 *Eupachydiscus isculensis* (Redtenbacher); Immel, Klinger & Wiedmann: 22, Pl. 7, Figs. 8–11, non Figs. 8, 9 (= *N. carezi* Gross., see above).

1982 *Pseudomenuites katschthaleri* Immel et al.: 20, Pl. 7, Figs. 2–5.

1986 *Eupachydiscus isculensis* (Redtenbacher, 1873); Kennedy: 52, Text-Fig. 19 (with synonymy).

1987 *Pseudomenuites katschthaleri* Immel et al.: Immel: 96.

1987 *Eupachydiscus isculensis* (Redtenbacher, 1873); Immel: 94.

? 1995 *Nowakites* ? aff. *katschthaleri* (Immel, Klinger & Wiedmann, 1982); Kennedy in Kennedy et al.: 403, Pl. 6, Figs. 4, 5.

1995 *Eupachydiscus isculensis* (Redtenbacher, 1873); Kennedy in Kennedy et al.: 404, Text-Fig. 18 (with full synonymy).

? 1998 *Eupachydiscus isculensis* (Redtenbacher); Küchler: Pl. 13, Figs. 7, 8.

2000 *Eupachydiscus isculensis* (Redtenbacher); Summesberger in Egger et al.: 26.

? 2000 *Pseudomenuites katschthaleri* Immel et al.; Kennedy & Kaplan: 60.

2000 *Eupachydiscus isculensis* (Redtenbacher, 1873); Kennedy & Kaplan: 60, Pls. 5–7.

2006 *Eupachydiscus isculensis* (Redtenbacher, 1873); Kennedy & Klinger: 34, Figs. 15, 16 (with additional synonymy).

2010 *Eupachydiscus isculensis* (Redtenbacher, 1873); Remin: 175, Figs. 14 F, 17 I.

2017a *Eupachydiscus isculensis* (Redtenbacher, 1873); Summesberger et al.: 179, Pl. 8, Fig. 7

Type: The holotype, by monotypy, is the original of Redtenbacher (1873: Pl. 29, Fig. 1) from the Santonian Gosau Group of Kohlbüchl, ENE of Bad Ischl, Upper Austria, preserved in the OÖLM collections. It was refigured by Wright (1957: Fig. 495, 2a), Kennedy (1986: Text-Fig. 19), Kennedy in Kennedy et al. (1995: Text-Fig. 18), Wright et al. (1996: Fig. 77/3) and Kennedy & Kaplan (2000: Pls. 6, 7).

Material: About 24 individuals from the early Santonian of Mühlbach (Brandenberg, Tyrol); four specimens listed by Summesberger (1979: 136) are from the late Santonian of Finstergrabenwandl (Gosau, Upper Austria). The holotype (OÖLM 1938/30) is from a stratigraphically uncertain horizon. SK/SB/1989/6 is from the middle Santonian of Schneiderwirtsbrücke (bridge over the Ischl river). Additional unregistered specimens, including those in private collections, make *Eupachydiscus isculensis* one of the most common ammonites in the Santonian part of the Gosau Group.

Description and Discussion: The much-figured and described holotype of the type species is a macroconch. A further macroconch is SK/RA/1983/84 from the middle Santonian of Randobach 2. A macroconch and a microconch were described from the Santonian part of the Mzamba Formation of South Africa (Kennedy & Klinger, 2006: 34, Figs. 15, 16). The earliest interpretation of *Pseudomenuites katschthaleri* Immel et al. (1982) from the early Santonian of Brandenberg (Tyrol) as the microconch of *Eupachydiscus isculensis* (Redtenbacher, 1873) was given by Kennedy (1986: 52–54) and repeated by Kennedy & Klinger (2006: 34–36). An additional individual (SK/SB/1989/6) also interpreted as a microconch, from the middle Santonian of Schneiderwirtsbrücke (Pl. 10, Fig. 3) supports this interpretation.

Occurrence: *Eupachydiscus isculensis* co-occurs with *Texanites quinquenodosus* and *Cladoceramus undulatoplicatus* in the early Santonian part of the Austrian Gosau Group. It is also present in the late Santonian Gosau Group of the Finstergrabenwandl locality (Gosau, Upper Austria; Summesberger, 1979) together with *Placenticeras paraplanum* and *Boehmoceras.* South African representatives are also of Santonian date. Elsewhere, there are records from the Santonian of Germany, France, Spain, Romania and from the Santonian and Campanian of Madagascar.

Family Muniericeratidae Wright, 1952

Genus *Tragodesmoceras* Spath, 1922

Type species: *Desmoceras clypealoides* Leonhard, 1897 (57, Pl. 6, Fig. 2) by original designation by Spath (1922: 127).

Tragodesmoceras aff. *clypeale* (Schlüter, 1872)

(Pl. 10, Figs. 2, 5, Text-Fig. 8, Tab. 8)

Compare

1872 *Ammonites clypealis* Schlüter: 51, Pl. 15, Figs. 9–14.

1931 *Hauericeras clypeale* Schlüt.; Riedel: 693, Pl. 79, Fig. 1.

? 1995 *Tragodesmoceras clypeale* (Schlüter, 1872); Lommerzheim: Pl. 4, Figs. 2, 3. non 1995 *Tragodesmoceras clypeale* (Schlüter, 1872); Lommerzheim: Pl. 3, Fig. 8.

2000 *Tragodesmoceras* aff. *clypeale* (Schlüter, 1872); Kennedy & Kaplan: 68, Pl. 12, Fig. 2, Pl. 13, Figs. 1, 2 (with synonymy).

2003 *Tragodesmoceras* aff. *clypeale* (Schlüter, 1872); Kennedy & Kaplan: 312, Fig. 5 (with synonymy).

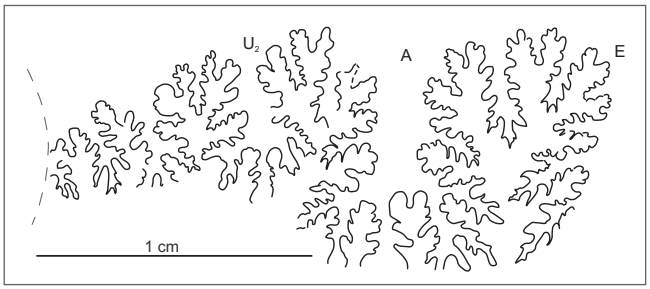
Types: Schlüter mentioned five specimens in the Ewald Collection in Berlin and two in the Witte Collection in Hannover that are the syntypes of *clypeale*. Kennedy & Kaplan (2003: 312) designated specimen C. 609.2 in the Collections of the Museum für Naturkunde, Berlin, lectotype. They state, in error, that this is the original of Schlüter (1872: Pl. 15, Figs. 9, 10); it is in fact the original of Schlüter (1872: Pl. 15, Figs. 11, 12). They figure C. 609.2 and refer to it as lectotype in the explanation of their Text-Figures 2a, b. They also describe the surviving paralectotypes.

Material: Two specimens of the Skoumal collection, SK/RA/1999/140 from the middle Santonian of the Randobach (Rußbach, Salzburg), SK/SB/1989/4 (Pl. 10, Figs. 2, 5) from the middle Santonian of Schneiderwirtsbrücke (Bad Ischl, Upper Austria).

Description: Both specimens are crushed internal moulds with extensive areas of shell preserved, nacreous aragonite in the case of SK/SB/1989/4. Both are flattened as a result of *post mortem* crushing. The original whorl section was high oval, the whorl height increasing rapidly, the coiling involute, with an estimate 80 % of the preceding whorl being covered. The umbilicus comprises 27 % of the diameter and is shallow, partially the result of crushing. The umbilical wall is low, subvertical with a narrowly rounded umbilical shoulder. The flanks are slightly convex, the ventrolateral shoulder gently rounded, the venter, where preserved, is narrowly rounded. Ornament consists of low ribs and constrictions. Single ribs arise close to the umbilicus, some of them bifurcate on the inner third of the flanks; short intercalated ribs arise on the outer third. The primary ribs are concave at mid-flank and project strongly forward on the outer flank. There are a total of 50 ribs at the ventrolateral shoulder of the outer whorl. Eight deep constrictions per whorl are succeeded by strong collar ribs that strengthen markedly over the venter. The suture line of SK/RA/1999/140 (Text-Fig. 8) is deeply incised with a large trifid A. The dimensions, given in Table 8 have been modified by *post mortem* distortion.

Inventory No.	D (mm)	Wh (mm)	Wb (mm)	U (mm)	U (%)
SK/RA/1999/140	93.8	36.6	----	25.4	27
SK/SB/1989/4	98.1	37	----	26.4	26.9

Tab. 8.
Tragodesmoceras aff. *clypeale* (Schlüter, 1872). U % of D.



Text-Fig. 8.
External suture of *Tragodesmoceras* aff. *clypeale* (Schlüter, 1872); SK/RA/1999/140.

Discussion: *Hauericeras clypeale* Schlüter of Riedel (1931: Pl. 79, Fig. 1) has about 32 narrow concave ribs on the outermost flank, ventrolateral shoulders and venter, and very feeble constrictions. The umbilicus comprises 20 % approximately of the diameter and differs from that of the present one in the shape of the umbilical shoulder recalling *Hauericeras*. *Tragodesmoceras clypealoides* (Leonhard, 1897: 57, Pl. 6, Fig. 2) differs in its crowded sinuous ribbing without the marked projection on the outermost flank shown by the present material. The Gosau specimens match well with specimens referred to as *T.* aff. *clypeale* by Kennedy & Kaplan (2000: Pl. 12, Fig. 2, Pl. 13, Fig. 1; 2003: Fig. 5), although these have a wider umbilicus. *Tragodesmoceras* (?) *mengedene* (Schlüter, 1876: 154, Pl. 40, Fig. 9) from the Coniacian to Santonian of Westphalia (Germany) is a close ally. Its ribbing (Kaplan & Kennedy, 1994: 40, Pl. 6, Figs. 1–3, 7) is weaker and more flexuous. Differences in shape and ornamentation between the type material of *clypeale* and material from the middle Santonian of the Münster Basin led Kennedy & Kaplan (2000: 68, Pl. 12, Fig. 2, Pl. 13, Figs. 1, 2; 2003: 316, Fig. 5) to refer to their material as *Tragodesmoceras* aff. *clypeale*; the present material is clearly conspecific and their terminology is used here.

Occurrence: In Westphalia (Germany), *Tragodesmoceras* aff. *clypeale* (Schlüter, 1867) occurs in the middle Santonian. This dating agrees well with that of the specimens from the Gosau Group of the Randobach 2 site where it is found with the mass occurrence of *Muniericeras gosauicum*, with which it also co-occurs at the Schneiderwirtsbrücke locality in the Bad Ischl area.

Genus *Muniericeras* de Grossouvre, 1894

Type species: *Muniericeras lapparenti* de Grossouvre, 1894 (158, Pl. 29, Figs. 1, 5, Pl. 35, Fig. 3) by the original designation of de Grossouvre (1894: 185).

Muniericeras gosauicum (Hauer, 1858)

(Pl. 11, Figs. 1–13, Pl. 12, Figs. 1–11, Pl. 13, Figs. 1–8, Pl. 14, Figs. 1–3, Pl. 15, Figs. 1–8, Pl. 16, Figs. 1–7, Pl. 17, Figs. 1, 3–9, Text-Figs. 9–11, Tab. 9, 10)

1858 *Ammonites Gosauicus* Hauer: 13, Pl. 2, Figs. 7–9.

1873 *Ammonites Gosauicus* Hauer; Redtenbacher: 124.

1894 *Am. gosavicus*; de Grossouvre: 156.

1894 *Ammonites gosavicus* Hauer; de Grossouvre: 158, Text-Fig. 66.

1894 *M. gosavicum* Hauer; de Grossouvre: 159.

1925 *M. gosavicum* v. Hauer; Diener: 154.

1935 *Muniericeras gosauicum* (Hauer); Brinkmann: 4.

non 1935 *Muniericeras gosauicum* v. Hau.; Brinkmann: 5, 7 (= *Barroisiceras minimus* (Hayasaka & Fukada 1951); fide Summesberger & Kennedy, 1996).

1961 *Muniericeras* cf. *gosauicum* (Hauer); Gerth: 127, Pl. 24, Fig. 3.

1961 *Barroisiceras* cf. *haberfellneri* (Hauer); Gerth: 130, Pl. 24, Fig. 5.

? 1963 *Muniericeras* aff. *gosauicum* (Hauer); Fabre-Taxy: 8, Pl. 1, Fig. 2.

non 1982 *Muniericeras gosauicum* (Hauer); Kollmann & Summesberger: 31 (= *Barroisiceras minimus* (Hayasaka & Fukada 1951), fide Summesberger & Kennedy, 1996).

non 1987 *Muniericeras gosauicum* (v. Hauer 1858); Immel: 96, Pl. 9, Fig. 5 (= *Barroisiceras minimus* (Hayasaka & Fukada, 1951), fide Summesberger & Kennedy, 1996).

1994 *Muniericeras gosauicum* (Hauer); Tröger & Summesberger: 185.

1995 *Muniericeras gosauicum* (Hauer, 1858); Kennedy in Kennedy et al.: 408.

2000 *Muniericeras gosauicum* (Hauer); Summesberger in Egger et al.: 23, Fig. 13/2.

2012 *Muniericeras gosauicum* (Hauer 1858); Summesberger & Zorn: 102, Pl. 2, Fig. 1.

Type: Hauer's original specimen (1858: Pl. 2, Figs. 7–9) from Gosau is lost (Summesberger & Zorn, 2012: 102). We designate as neotype NHMW 2013/0581/0001 (Pl. 11, Figs. 1–3; formerly SK/RA/1997/133). It is from the Santonian Grabenbach Formation of Randobach 2 (Rußbach, Salzburg) which is believed to be the source of Hauer's specimen.

Material: 109 specimens, mostly in the Skoumal Collection, all from the middle Santonian of the Grabenbach and Hochmoos Formations of the Gosau Group. All are from five localities in the Gosau type region (Randobach 1, 2), Grabenbach, Neffgraben and Schneiderwirtsbrücke (Bad Ischl).

Skoumal Collection

Randobach 1, 2 (SK/RA):

SK/RA/1981/4–6, 10–14, 20 (2), 21–27, 34, 35, 40–42

SK/RA/1982/46–51, 53, 56, 57, 77, 79, 80

SK/RA/1983/81, 83, 85, 94a, 97(2); SK/RA/1984/101, 102, 104, 106, 107, 109, 110

SK/RA/1986/111; SK/RA/1988/115, 116; SK/RA/1989/120;

SK/RA/1990/121–123; SK/RA/1995/126, 127; SK/RA/1996/128, 129;

SK/RA/1997/131, 132; SK/RA/1998/138; SK/RA/1999/139, 141, 142;

SK/RA/2003/147–149; SK/RA/2004/151, 152

Neffgraben (SK/NE); SK/NE/1989/1, 3, 5, 6 (2 specimens), 7, 8, 9; SK/NE/1990/13, SK/NE/2001/16;

Grabenbach (SK/GR): SK/GR/1981/1, 15, 16, 19, 21, 25; SK/GR/1983/26; SK/GR/1993/43, 44; SK/GR/2002/47 (Pl. 15, Fig. 7);

Schneiderwirtsbrücke (Ischl river; SK/SB), SK/SB/1989/1–3;

NHMW Collection (16 specimens): NHMW 1982/0028, NHMW 1982/0029; NHMW 2012/0186/0004–0009, 00013, NHMW 2013/0472/0001–2 (Neffgraben), NHMW 2013/0473/0001–2; NHMW 2013/0581/0001 (neotype ex coll. Skoumal);

Maherndl Collection: MA 1977/10 (Randobach, 70 m "after the first bridge" = Randobach 2 of this paper;

GIUW Collection: Gosau, Stöckl (2 specimens), unregistered;

PIUW Collection: Gosau, OÖ (1 specimen), unregistered;

OÖLM Collection: OÖLM 36/1938, 1 specimen, probably Randobach, erroneously labelled: St. Wolfgang;

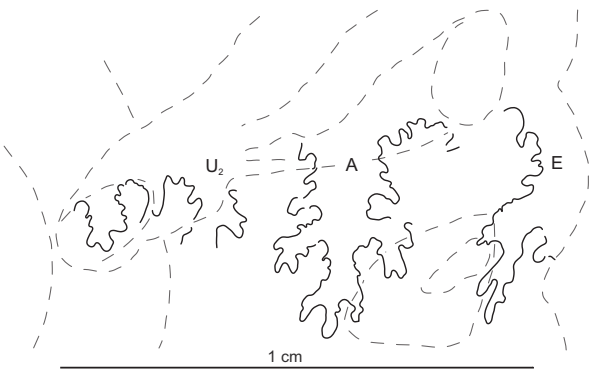
GBA Collection: The holotype, by monotypy, of *Ammonites gosauicus* Hauer, 1858 apparently lost (Summesberger & Zorn, 2012).

Inventory No.	D (mm)	Wh (mm)	Wb (mm)	U (mm)	U (%)
NHMW 2013/0581/0001	45.6	20.5	11.5	9.5	20.8
NHMW 2013/0472/0001	27	13.2	11.9	7.1	26.3
NHMW 2013/0472/0002	61.5	27.8	11.6	13.5	21.9
NHMW 2012/0186/0004	24.9	13.6	8.6	4.9	19.6
NHMW 2013/0473/0001	65.5	27.3	12.1	13.6	20.7
NHMW 2013/0473/0002	59.8	22	7.2	12	20
GBA (lost holotype)	25.4	12.2	7.6	5.6	22
GIUW$_{not\ reg.}$	52.2	22.8	15	10.8	20.7
PIUW/$_{not\ reg.}$	26.6	12.6	6.1	6	22.5
MA 1977/10	49.9	23.8	15	11.9	23.8
MA 1977/10$_{max}$	61.5	26.2	12.9	16	26.1
SK/GR/1981/1	38.7	18.2	5.5	8.4	21.7
SK/GR/1981/16	51.3	--	--	11	21.5
SK/GR/1981/16$_{max}$	83	34.8	10.6	20.3	24.51
SK/GR/1981/21	43.2	26.3	7.8	10.2	23.6
SK/RA/1981/4	18.8	10.5	10.9	3.4	18.1
SK/RA/1981/5	32.6	15.9	16.4	5.2	15.9
SK/RA/1981/10	100$_{est}$	39.6	15.7	18.3	18.3
SK/RA/1981/13	52.3	28.1	12.9	8.14	15.6
SK/RA/1981/13$_{max}$	60.4	30.7	11.9	12.9	21.3
SK/RA/1981/14	49.9	23.6	12.3	12	24
SK/RA/1981/14$_{max}$	78.4	26.4	12.4	16.4	20.9
SK/RA/1981/20/a$_{est}$	22	11	7	5	22.7
SK/RA/1981/22$_{max}$	36.4	14.2	5.8	8.3	22.8
SK/RA/1981/22	25.6	11.8	4.6	5.1	20
SK/RA/1982/48	57	25.8	15.1	14.1	24.7
SK/RA/1982/57	25.3	8.8	6.2	4.8	18.3
SK/RA/1982/79	45.8	19.3	16.8	10.3	22.4
SK/RA/1983/94a	23	12.6	6.5	4.5	19.5
SK/RA/1990/121	72.9	37.7	12.2	15.3	20.9
SK/RA/1996/128	62	31.5	--	12	19.3
SK/RA/1997/132	76.3	31.5	12.5	14.8	19.4
SK/RA/1998/138$_{max}$	63.7	37.3	17.4	18.3	28.7
SK/RA/1998/138	47.8	23.6	--	11.6	24.3
SK/RA/1999/142	90.5	41.8	19.2	28.7	31.7
SK/RA/2003/147	55.5	25.4	--	13.5	24.3
SK/RA/2003/148$_{max}$	65.8	33.1	17.9	12.9	19.6
SK/RA/2003/148	39.5	20.8	15.3	9.2	23.3

Tab. 9.
Muniericeras gosauicum (HAUER, 1858). Measurements of microconchs from the middle Santonian Gosau Group of the Gosau area (Rußbach, Salzburg; Gosau, Upper Austria). $_{est}$ = estimated average, $_{max}$ = measured maximum, $_{fragm}$ = fragment, $_{not\ reg.}$ = not registered, U % of D. NHMW 2013/0581/0001 is the neotype. The measurements of the lost holotype are recalculated following HAUER (1858: 13).

Inventory No.	D (mm)	Wh (mm)	Wb (mm)	U (mm)	U (%)
NHMW 2012/0186/0007	27.8	13.3	7.1	5.7	20.5
NHMW 2013/0472/0002	46.2	25.7	8.1	11	23.8
PIUW/TUW/1884	26.5	12.2	7.8	6.3	23.8
SK/SB/1989/2	60	22.7	11.2	12.2	20.3
SK/GR/1981/19	69.3	35.6	--	16.1	23.2
SK/GR/1981/19$_{max}$	108.5	55.9	--	25$_{est}$	23
SK/GR/2002/47	70.3	33.4	--	22.5	32
SK/GR/2002/47$_{max}$	121.5	53	--	29.7	24.4
SK/NE/1989/5$_{max}$	52.7	25	10.2	10.3	19.5
SK/NE/2001/16	46.4	22.2	8.7	8.3	17.9
SK/RA/1981/6	65.7	39.7	11.6	--	--
SK/RA/1981/11	145	56.4	--	38.1	26.2
SK/RA/1981/34	63.3	31.4	14.2	14.3	22.6
SK/RA/1981/35	37.5	20	8.4	8.2	21.8
SK/RA/1981/35$_{max}$	47.9	21.9	8	10.3	21.5
SK/RA/1981/41	30.6	15.6	7.7	5.7	18.6
SK/RA/1981/41$_{max}$	51.2	22.2	10.3	10.2	19.9
SK/RA/1982/50	37.3	19.4	9.7	8	21.4
SK/RA/1982/50$_{max}$	75.7	33.8	11.9	15.3	18.9
SK/RA/1982/51	52.2	23.1	12.4	12.5	23.9
SK/RA/1982/51$_{max}$	74.9	28.9	22	19.2	25.6
SK/RA/1982/53	43.5	24.3	10.4	9	20.6
SK/RA/1982/53$_{max}$	90.6	--	--	16.3	18
SK/RA/1982/77$_{max}$	75.8	35.6	11.8	11.3	14.9
SK/RA/1982/80	50.8	30.6	12.4	9.4	18.5
SK/RA/1983/81	89$_{est}$	43.7	20	20.6	23
SK/RA/1983/97	114.1	43.4	19.4	25$_{est}$	21.9
SK/RA/1984/107	44.8	20	10.9	12.4	27.6
SK/RA/1984/109	53.4	24.8	12	10.2	19.1
SK/RA/1984/109$_{max}$	69.1	30.1	11.5	14.6	21.1
SK/RA/1988/115$_{max}$	67.5	30	11.8	12	17.98
SK/RA/1988/115	33.9	19.3	8.3	7.1	20.9
SK/RA/1997/131	93.2	41.7	--	20.3	21.8

Tab. 10.
Muniericeras gosauicum (HAUER, 1858). Measurements of macroconchs from the middle Santonian Gosau Group of the Gosau area (Rußbach, Salzburg; Gosau, Upper Austria). $_{est}$ = estimated average, $_{max}$ = measured maximum, U % of D.



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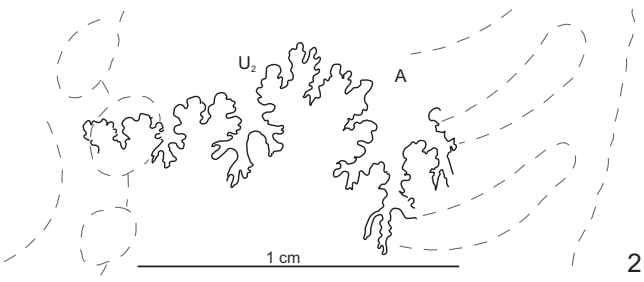

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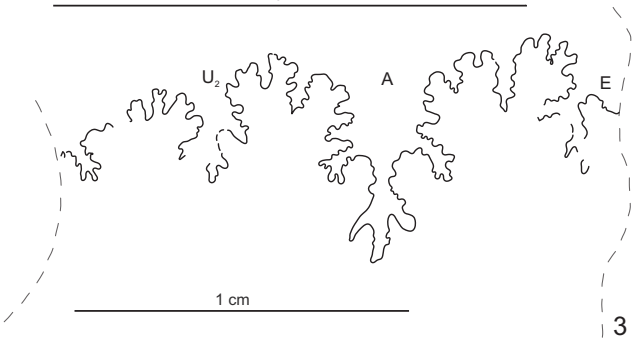

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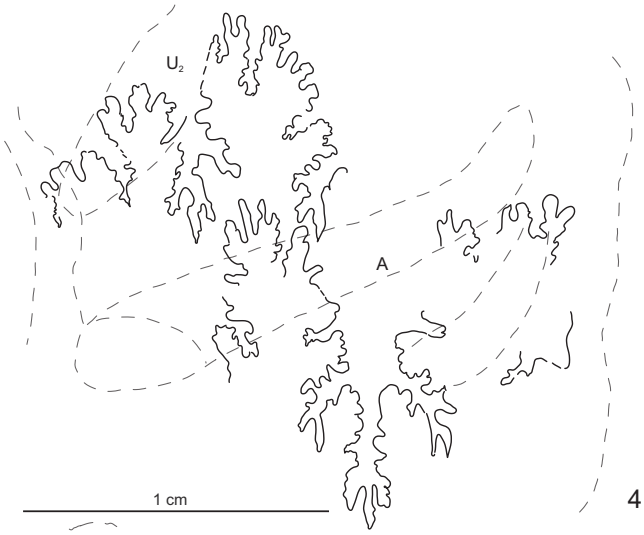

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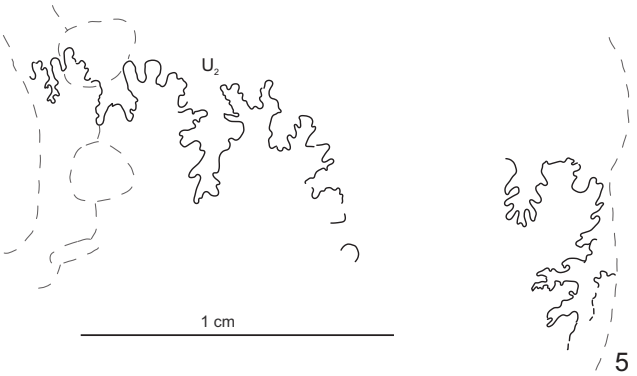

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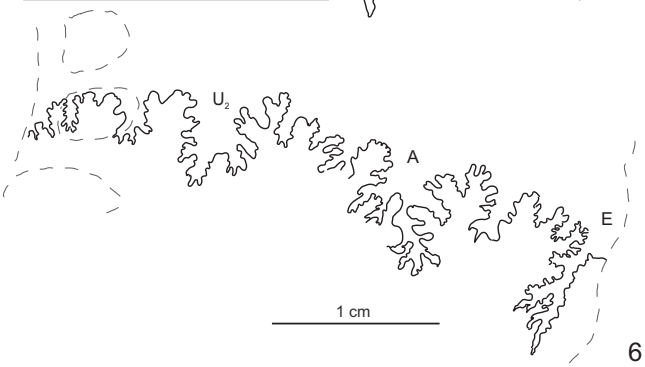

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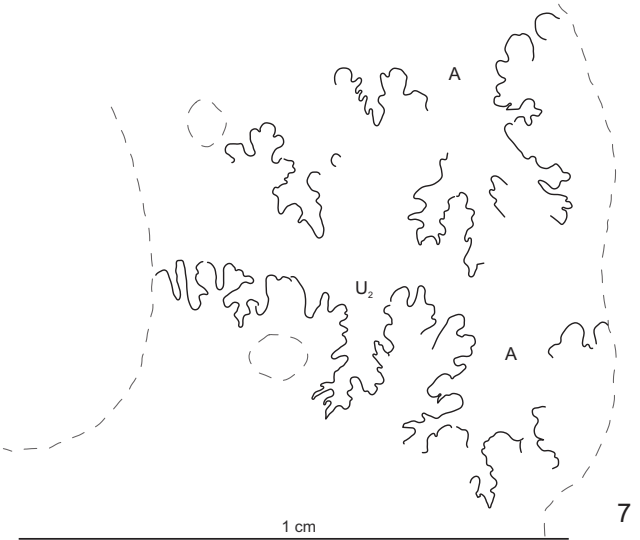

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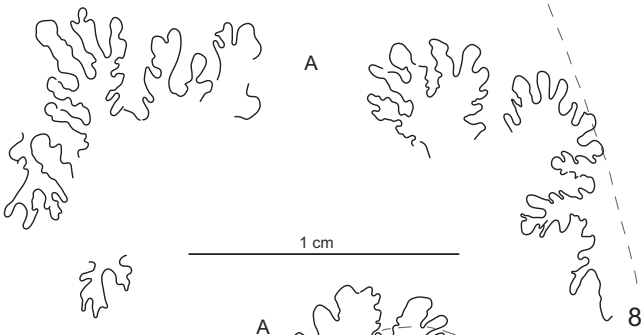

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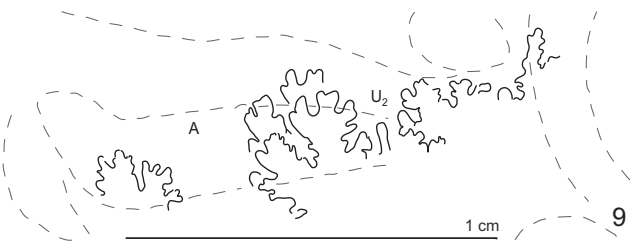

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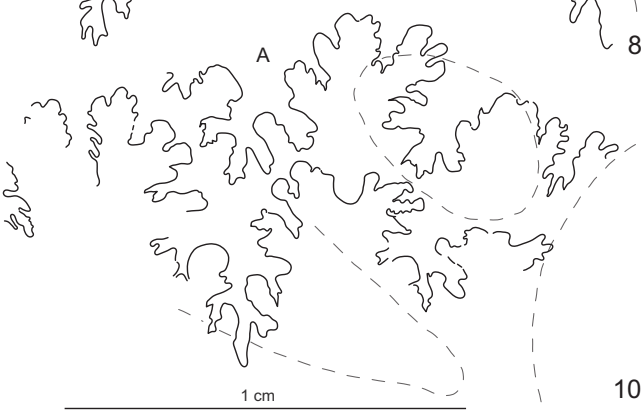
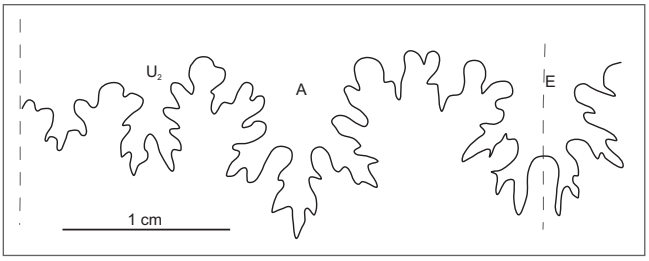


10

◀ Text-Fig. 9.
External sutures of *Muniericeras gosauicum* (HAUER, 1858). Fig. 1: NHMW 2013/0581/0001 (neotype), Fig. 2: SK/RA/1986/107, Fig. 3: GIUW Stöckl 2, Fig. 4: SK/RA/1989/120, Fig. 5: NHMW 2013/0472/0002, Fig. 6: SK/RA/1981/11, Fig. 7: SK/RA/1981/22, Fig. 8: SK/RA/1997/131, Fig. 9: SK/RA/1997/132, Fig. 10: SK/RA/1999/142.



Text-Fig. 10.
External suture of Hauer's lost specimen; after HAUER (1858: Pl. 2, Fig. 9).

Description: *Muniericeras gosauicum* (HAUER, 1858) is a highly variable, dimorphic species. All variants are moderately involute and, with a few exceptions, have a compressed, lanceolate whorl section and a high expansion rate. The umbilicus typically comprises about 20 % of the diameter; the range is 15–31 %. A keel is present throughout ontogeny and extends as a rostrum at the adult aperture (Text-Fig. 11). All variants are characterised by falcoid ribbing. All individuals are internal moulds, in many cases preserved with parts of the whitish shell. Some show remains (e.g. the neotype, Pl. 11, Figs. 1–3) of a thin layer of unknown composition between the shell and the internal mould. This broadens with the growth of the individual. Most individuals are more or less crushed and deformed into an ellipse by *post mortem* crushing. Body chambers are commonly preserved and extend to over half of the outer whorl, and an adult aperture with rostrum is preserved in several individuals (Pl. 15, Fig. 8, Pl. 16, Fig. 3, Pl. 11, Fig. 10, Text-Fig. 11). The umbilical shoulder is narrowly rounded. The flanks are slightly convex, converging towards the ventrolateral shoulder; the venter is fastigiate. A common feature of all variants is the falcoid ribbing, arising at the umbilical shoulder with or without developing an umbilical bulla, straight and prorsiradiate on the inner flank, flexing back and feebly convex at mid-flank, flexing forwards and concave on the outer flank and projected strongly forwards on the ventrolateral shoulders and venter, where they strengthen into a strongly prorsiradiate incipient bulla. The suture is visible in some specimens (Text-Figs. 9, 10).

Microconchs (for dimensions see Table 9) are characterised by coarser ornament and an undulose to serrate keel. Most of the microconchs are smaller than the macroconchs. Seven to 14 prominent umbilical tubercles give rise to from 26 to 40 falcoid ribs, arising at the umbilical shoulder in bundles of twos and threes and terminating, together with some intercalatories, in a marginal swelling at the ventrolateral shoulder, close to the serrate keel. In some cases the keel becomes entire as in macroconchs. In a few individuals the ribs weaken at mid-flank. Umbilical tubercles are strong. The neotype NHMW 2013/0581/0001 (formerly SK/RA/1997/133) (Pl. 11, Figs. 1–3; for the suture see Text-Figure 10) is a microconch. The umbilicus comprises about 20 % of the diameter and is shallow, with a vertical wall. The ribs are almost completely effaced at mid-flank, before strengthening again at the ventrolateral shoulder.

Some macroconchs are quite large (108, 114, 121, 108 mm in diameter), some are of medium size (50–70 mm, for the whole range see Table 10). The ornament is weaker than that of typical microconchs, the ribs effacing on the inner flanks. Umbilical tubercles are of moderate strength, number about 13 per whorl, and give rise to falcoid ribs in groups of two or three. In some individuals the umbilical tubercles are very small, or are not developed. The primary ribs weaken or efface on the inner third of the flanks, before strengthening on the outer flanks, where additional ribs intercalate to give a total of 30–40 ribs per whorl. The ribs strengthen into an incipent bulla close to the typically entire, undulose or irregular keel. Some body chambers are ornamented by falcoid growth lines only (Pl. 14, Fig. 1, Pl. 15, Fig. 7, Pl. 16, Figs. 1, 4, Pl. 17, Figs. 5, 7).

Discussion: HAUER's lost holotype of *Ammonites gosauicus* (1858: 13, Pl. 2, Figs. 7–9) matches well with specimens in the new collections from the Gosau Group. It is highly likely that the few meters of the Grabenbach Formation at the Randobach 2 locality (Rußbach, Salzburg) is the source of this specimen (SUMMESBERGER & ZORN, 2012). The specimens from this section (Pls. 11–17, all Figs., but Pl. 17, Fig. 2) thus rank as topotypes. DE GROSSOUVRE (1894: 156) recognised *Ammonites gosauicus* as a close ally of *Muniericeras*

Text-Fig. 11.
Muniericeras gosauicum (HAUER, 1858); SK/RA/1998/138; ventral view of the broken aperture with rostrum and keel.

lapparenti (DE GROSSOUVRE, 1894: 158, Pl. 29, Figs. 1, 5, Pl. 35, Fig. 3), the type species of *Muniericeras*.

Within the present collection of variable topotypes of *M. gosauicum*, some specimens approach *Texasia* (e.g. SK/RA/1997/132: Pl. 13, Figs. 2, 3; SK/RA/1981/10: Pl. 17, Fig. 9). *Muniericeras lapparenti* (DE GROSSOUVRE, 1894) differs in its somewhat larger umbilicus (25.8 to 28.03 % after KENNEDY in KENNEDY et al., 1995: 407), fewer umbilical tubercles (5–9 per whorl) and less markedly falcoid ribs (KENNEDY in KENNEDY et al., 1995: Pl. 16, Figs. 4–7). *Muniericeras triplicatum* (COLLIGNON, 1966: 41, Pl. 422, Fig. 1924) is a synonym of *M. rectecostatum* COLLIGNON (1966: 40, Pl. 472, Fig. 1919) (teste KENNEDY in WALASZCZYK et al., 2014: 119) and differs in its obtusely fastigiate venter without an entire or serrate keel (KENNEDY et al., 2008: 287). *'Praemuniericeras' boriesi* COLLIGNON (1981: 195, Pl. 3, Fig. 1) is the microconch of *Texasia cricki* (SPATH, 1921) (KENNEDY & KLINGER, 2013b: 39); it differs from *M. gosauicum* in its broad and shallow ribs that efface on the inner third of the flank. *Muniericeras bilottei* (COLLIGNON, 1981: 195, Pl. 3, Figs. 2–4; KENNEDY in KENNEDY et al., 1995: 407, Pl. 13, Figs. 2, 4, 10, Pl. 14, Figs. 2, 3, 10, 11, Pl. 17, Fig. 1) differs in its moderate to weak sculpture and more numerous (10–16) umbilical bullae (KENNEDY in KENNEDY et al. (1995: 408). *Muniericeras rennense* (DE GROSSOUVRE, 1894: 160, Pl. 35, Fig. 2) was interpreteted by KENNEDY in KENNEDY et al. (1995: 415) as a *Pseudobarroisiceras* SHIMIZU, 1932, and *Muniericeras inconstans* DE GROSSOUVRE (1894: 159, Pl. 35, Figs. 4, 5) as a *Pseudoschloenbachia* (*Pseudoschloenbachia*) SPATH, 1921. The Lower Santonian *Texasia cricki* (SPATH, 1921) and all of its synonyms listed by KENNEDY & KLINGER (2013b) differ in their coarser sculpture and a somewhat wider umbilicus.

Occurrence: *Muniericeras gosauicum* appears in a mass occurrence in the middle Santonian in its presumed type area (Randobach 2, Rußbach, Salzburg) in the Gosau Basin, where it co-occurs with baculitids, *Parapuzosia corbarica* (DE GROSSOUVRE, 1894) and *Tragodesmoceras* aff. *clypeale* (SCHLÜTER, 1872). It is not present in the early Santonian of the Randobach 3 locality that yields *Parapuzosia daubreei, Eulophoceras natalense* (HYATT, 1903) and *Cladoceramus undulatoplicatus*. It is present in the middle Santonian of the Schneiderwirtsbrücke locality (Bad Ischl, Upper Austria). In the nearby Neffgraben section it extends into higher parts of the middle Santonian, close to the first occurrence of *Placenticeras paraplanum*. *Muniericeras gosauicum* has not been recognised from outside the Gosau occurrences and has not been found in the early Santonian of Brandenberg (Mühlbach, Tyrol).

Genus *Texasia* REESIDE, 1932

Type species: *Ammonites dentato-carinatus* ROEMER, 1852 by subsequent designation of WRIGHT (1957: Part L, 432).

Texasia cricki (SPATH, 1921)

(Pl. 18, Fig. 2, Tab. 11)

1921b Gen. nov. (*Muniericeras*?) *cricki* SPATH: 44, Pl. 7, Figs. 4a, b.

1966 *Lehmaniceras sornayi* COLLIGNON: 50, Pl. 475, Fig. 1933.

1968 *Barroisiceras umzambiense* VAN HOEPEN: 161, Pl. 6.

2013b *Texasia cricki* (SPATH, 1921); KENNEDY & KLINGER: 34, Figs. 1 A–E; ?G, I–L, 2 A, B, ? C, D–F, 3 A–G; with complete synonymy.

Types: The holotype of Gen. nov. (*Muniericeras*?) *cricki* SPATH, 1921 is an unregistered specimen in the Durban Museum. The holotype of *Barroisiceras umzambiense* VAN HOEPEN 1968 (a synonym) is SAM-PCP022448 (see KENNEDY & KLINGER, 2013b: 36).

Material: A single specimen, SEIDL/CE 00002 from Rußbach (Salzburg) in the Seidl collection.

Description: SEIDL/CE 00002 (measurement Table 11) is a laterally crushed internal mould with the original aragonitic shell preserved. The whorl height increases rapidly, covering about 60 % of the preceding whorl, the umbilicus of about 30 % of the diameter is relatively shallow, the umbilical wall is convex, the umbilical shoulder narrowly rounded. The flanks are dominated by an extremely coarse ornament. Eight umbilical tubercles give rise to broad and coarse pairs or single ribs which diminish about midflanks, recovering in the outer third of the flank and culminating in about 16 elongated bullae. Some of the ribs are prorsiradiate. At the end of what we believe to be the body chamber they are rectiradiate. They end at the ventrolateral shoulder corresponding with about 16 undulated clavi forming a relatively broad keel.

Discussion: A detailed discussion of *Texasia cricki* (SPATH, 1921) was given by KENNEDY & KLINGER (2013b: 36). SEIDL/CE 00002 is very close to the coarser ornamented variants of *T. cricki* (e.g. *Barroisiceras umzambiensis* VAN HOEPEN, 1968, refigured by KENNEDY & KLINGER, 2013b: Figs. 1E, F; or *Lehmaniceras sornayi* COLLIGNON, 1966, refigured by KENNEDY & KLINGER, 2013b: Fig. 2A).

Differences to *Texasia dentatocarinata* from the late Santonian of the Schattaugraben (Rußbach, Salzburg) were discussed by SUMMESBERGER et al. (2017a; this volume).

Occurrence: The holotype is imprecisely located within the Santonian Mzamba Formation of Eastern Cape Province, South Africa. Material from Madagascar referred to the

Inventory No.	D (mm)	Wh (mm)	Wb (mm)	U (mm)	U (%)
SEIDL/CE 00002	50	24.3	13_{est}	12.3	24.6

Tab. 11.
Texasia cricki (SPATH, 1921) (SEIDL/CE 00002). $_{est}$ = estimated; U % of D.

species by KENNEDY & KLINGER comes from the Niveau à *Lehmaniceras* of COLLIGNON (1966: 50), some way above the base of the stage. The present specimen is from the lower Santonian of Randobach 3 (Rußbach, Salzburg).

Genus and Subgenus *Pseudoschloenbachia* SPATH, 1921

Type species: *Ammonites umbulazi* BAILY, 1855 (456, Pl. 11, Fig. 4).

Pseudoschloenbachia (*Pseudoschloenbachia*) sp.

(Pl. 18, Fig. 1)

Compare

1894 *Muniericeras inconstans* DE GROSSOUVRE: 159, Pl. 35, Figs. 4, 5.

1981 *Pseudoschloenbachia inconstans* (DE GROSSOUVRE); COLLIGNON: 197, Pl. 4, Figs. 1–5.

1995 *Pseudoschloenbachia* (*Pseudoschloenbachia*) *inconstans* (DE GROSSOUVRE, 1894); KENNEDY in KENNEDY et al.: 409, Pl. 14, Figs. 7, 8, 12, 13, Pl. 15, Figs. 1–6, 13–16, Pl. 16, Figs. 3, 8, 9.

Material: NHMW 1982/0031/0001, a single specimen.

Description: NHMW 1982/0031/0001 is a fragment of an internal mould of a body chamber with traces of the original aragonitic shell material. The aperture is well preserved. Wh is 31.1, Wb is 23.9, the umbilicus is not preserved. The diameter must have measured about 90 mm. The whorl section is lanceolate, the flanks are feebly convex, passing gradually into the ventrolateral shoulder. The entire keel is sharp and narrow. There are an estimated 40 shallow falcoid ribs per whorl correct, prorsiradiate on the inner flank, they flex back at mid-flank, and are concave on the outer flank, sweeping forwards to the siphonal keel. The course of the aperture parallels that of the ribs, the keel projected forwards as a short rostrum.

Discussion: The specimen is closest to adult individuals of *P.* (*P.*) *inconstans* (DE GROSSOUVRE, 1894) from the Santonian of the Corbières (KENNEDY in KENNEDY et al., 1995: Pl. 14, Figs. 10–13, Pl. 15, Fig. 13), but is too fragmentary for confident assignation to the species. It is also comparable to macroconchs of *Muniericeras gosauicum* (HAUER, 1858) from the Randograben with which it co-occurs.

Occurrence: NHMW 1982/0031/0001 is from the Randobach 2 locality.

Superfamily Hoplitoidea H. DOUVILLÉ, 1890

Family Placenticeratidae HYATT, 1900

Genus *Placenticeras* MEEK, 1876

Type species: *Ammonites placenta* DEKAY, 1828 (278, Pl. 5, Fig. 2) by the original designation of MEEK (1876: 442).

Placenticeras paraplanum WIEDMANN, 1978

(Pl. 10, Fig. 4, Tab. 12)

1978 *Placenticeras paraplanum* WIEDMANN: 666, Pl. 1, Figs. 3, 4, Text-Fig. 2a.

1979 *Placenticeras paraplanum* WIEDMANN; SUMMESBERGER: 152, Pl. 13, Figs. 53–57.

1983 *Placenticeras paraplanum* WIEDMANN, 1978; KENNEDY & WRIGHT: 866.

1985 *Placenticeras* aff. *paraplanum* WIEDMANN; AMEDRO & HANCOCK: 24, Text-Figs. 11a–c, f, g.

1987 *Placenticeras paraplanum* WIEDMANN 1978; IMMEL: 98.

1987 *Placenticeras paraplanum* WIEDMANN, 1978; KENNEDY: 769, Pl. 80, Figs. 1–3, 8–10.

1989 *Placenticeras paraplanum* WIEDMANN; KLINGER & KENNEDY: 268.

1995 *Placenticeras paraplanum* WIEDMANN, 1978; KENNEDY in KENNEDY et al.: 411, Pl. 17, Figs. 11, 12, Pl. 18, Figs. 1–4.

2017a *Placenticeras paraplanum* WIEDMANN, 1978; SUMMESBERGER et al.: 183, Pl. 9, Fig. 5.

Type: The holotype, by the original designation of WIEDMANN (1978: 666) is no. CG 01 in the Gapp Collection, the original of WIEDMANN (1978: Pl. 1, Figs. 3, 4, Text-Fig. 2A), from the late Santonian of the Gosau Basin, Upper Austria.

Material: NHMW 2014/0090/0001 and a fragment, NHMW 2014/0090/0002, from the base of the late Santonian of the Hochmoos Formation (Gosau Group) of the Neffgraben site (Rußbach, Salzburg).

Description: NHMW 2014/0090/0001 (Pl. 10, Fig. 4, Tab. 12) is an internal mould of an adult individual with large areas of the aragonitic nacreous layer of the shell preserved. The last suture is partially visible: the body chamber extends over half of the outer whorl. The proportions of the specimen are close to those of the holotype, with slowly increasing whorl height and whorl breadth. The umbilicus is deep, with a slightly oblique umbilical wall. The growth lines are well-preserved and are rursiradiate on the umbilical wall with a deep concavity, sweeping back over the flank in a shallow convexity parallel to the ribs. These arise from faint bullate swellings on the umbilical shoulder and are single, feebly rursiradiate and feebly concave across the flanks, and are separated by shallow, broad interspaces. They link to well-developed inner ventrolateral tubercles. The venter bears outer ventrolateral clavi that alternate in position on either side of a broad, shallow midventral depression. The incompletely exposed suture line is typical for the genus.

Inventory No.	D (mm)	Wh (mm)	Wb (mm)	U (mm)	U (%)
NHMW 2014/0090/0001	106.8	43	27.6	24.3	22.7

Tab. 12.
Placenticeras paraplanum WIEDMANN, 1978. U % of D.

Discussion: *Placenticeras paraplanum* WIEDMANN, 1978, from the late Santonian "Sandkalkbank Member" of the Finstergrabenwandl site (Gosau, Upper Austria) is a distinctly dimorphic species. It was originally based upon a single specimen (WIEDMANN, 1978: 666, Pl. 1, Figs. 3, 4, Text-Fig. 2A). SUMMESBERGER (1979: 153), on the basis of four additional specimens, distinguished two characteristic forms: "Form A" interpreted as the macroconch and "Form B" interpreted as the microconch. The holotype (WIEDMANN, 1978: Pl. 1, Figs. 3, 4) and the present specimen from the Neffgraben site (Rußbach, Salzburg) are macroconchs, SK/1977/13 (SUMMESBERGER, 1979: Pl. 13, Figs. 53, 54) is a microconch. SUMMESBERGER (1979: 154) discussed the evolutionary lineage from the late Santonian *P. paraplanum* to the early Campanian *P. bidorsatum*. KENNEDY (1987: 770) concluded *P. bidorsatum* was "a hypermorphic giant derivative of *paraplanum*". This was followed by KLINGER & KENNEDY (1989: 268). The predecessors of *P. paraplanum* may be seen the fragments of smooth forms from the middle Santonian part of the Gosau Group.

Occurrence: NHMW 2014/0090/0001 is from the base of the late Santonian Hochmoos Formation of the Neffgraben site, approximately 20 meters below the base of the Sandkalkbank Member in the section. Accordingly, *Placenticeras paraplanum* is the earliest strongly ornamented placenticeratid in the Gosau Group, succeeding compressed and smooth predecessors (see below) in the middle Santonian, and giving rise the three dimorphic species present in the "Sandkalkbank Member". Furthermore the present specimens are from below the last occurrence of *Texanites quinquenodosus* in the Neffgraben (see page 37). *Placenticeras paraplanum* occurs in the late Santonian *Paraplanum* Subzone of the Corbières and in the Santonian of Aquitaine (France; KENNEDY, 1984; KENNEDY in KENNEDY et al., 1995).

Placenticeras sp. indet.

(not figured)

Discussion: Poor fragments of compressed, high-whorled, unornamented *Placenticeras*, recognisable by their distinctive sutures, occur in the middle Santonian part of the Gosau Group in the Grabenbach and Neffgraben sections, where they overlap with the occurrence of *Muniericeras*.

Superfamily Acanthoceratoidea DE GROSSOUVRE, 1894

Family Collignoniceratidae WRIGHT & WRIGHT, 1951

Subfamily Texanitinae COLLIGNON, 1948

Genus and Subgenus *Texanites* (*Texanites*) SPATH, 1932

Type species: *Ammonites texanus* ROEMER, 1852 (31, Pl. 3, Fig. 1) by the original designation of SPATH (1932: 379).

Texanites (*Texanites*) *quinquenodosus* (REDTENBACHER, 1873)

(Pl. 18, Figs. 3–7, Text-Fig. 12, Tab. 13)

1854 *Ammonites texanus* ?; REUSS: 24, 41.

1858 *Ammonites texanus* HAUER (non RÖMER, 1852): 10, Pl. 2, Figs. 4–6.

1873 *Ammonites quinquenodosus* REDTENBACHER: 108, Pl. 24, Fig. 3.

1925 *Mortoniceras quinquenodosum* REDTENBACHER; DIENER: 147.

1935 *Mortoniceras texanum* ROEM. var. *quinquenodosum* REDT.; BRINKMANN: 3, 4.

1935 *Mortoniceras quinquenodosum* REDT.; BRINKMANN: 6.

1948 *Texanites quinquenodosus* (REDT.); COLLIGNON: 69.

1966 *Texanites quinquenodosus* (REDT.); COLLIGNON: 128, Pl. 510, Fig. 2021.

1970 *Texanites* (*Texanites*) *quinquenodosus* (REDTENBACHER); MATSUMOTO: 273.

1979 *Texanites quinquenodosus* (REDTENBACHER); WIEDMANN in HERM et al.: 48, Pl. 7, Figs. C, D.

1980 *Texanites quinquenodosus* (REDTENBACHER, 1873); KLINGER & KENNEDY: 135, Figs. 102, 103.

1981 *Texanites quinquenodosus* (REDTENBACHER, 1873); KENNEDY et al.: 126, Figs. 8–16 (with synonymy).

1982 *Texanites* (*Texanites*) *quinquenodosus* (REDTENBACHER 1873); IMMEL et al.: 23, Pl. 9, Fig. 1.

1987 *Texanites quinquenodosus* (REDTENBACHER 1873); IMMEL: 112.

1994 *Texanites quinquenodosus* (REDTENBACHER); TRÖGER & SUMMESBERGER: 185.

1995 *Texanites* (*Texanites*) *quinquenodosus* (REDTENBACHER); KENNEDY et al.: 420, Pl. 22, Figs. 8, 10, Pl. 23, Figs. 3–5, Text-Fig. 26.

1998 *Texanites quinquenodosus* (REDTENBACHER, 1873); KÜCHLER: Pl. 14, Figs. 7a, b.

2000 *Texanites quinquenodosus* (REDTENBACHER); SUMMESBERGER in EGGER et al.: 22.

2000 *Texanites* (*Texanites*) *quinquenodosus* (REDTENBACHER, 1873); KENNEDY & KAPLAN: 88, Pl. 24.

2012 *Texanites quinquenodosus* (REDTENBACHER, 1873); SUMMESBERGER & ZORN: 6–7, Pl. 15, Fig. 1, Pl. 16, Fig. 1.

2017c *Texanites* (*Texanites*) *quinquenodosus* (REDTENBACHER, 1873); SUMMESBERGER et al.: 125.

Type: The lectotype by the subsequent designation of MATSUMOTO (1970: 273) is GBA 1873/01/13/1, the original of REDTENBACHER (1873: Pl. 24, Fig. 3) from the middle Santonian Gosau Group of Schneiderwirtsbrücke, between Bad Ischl (Upper Austria) and Strobl (Salzburg). There are two paralectotypes, GBA 1873/01/13/2 and OÖLM/41/1938, from the Schneiderwirtsbrücke (road bridge) over the Ischl river (Bad Ischl, Upper Austria).

Material: NHMW 1935/0003/0039–40 from the Grabenbach Formation of Grabenbach (Gosau, Upper Austria), NHMW 1926/0002/2469 and NHMW 2014/0104/0002 (former Böhm Collection) from the Hochmoos Formation of Neffgraben (Rußbach, Salzburg); NHMW 2012/0186/0016 from Zimmergraben (Rußbach, Salzburg; former collection Kastl). NHMW 2015/0031/0001 (Pl. 18, Fig. 7), NHMW/1864/0730 from Hofergraben (Gosau, Upper Austria); an unregistered fragment in the GBA collection; TLMF/SM 596, 597 from the Lower Santonian of Brandenberg/Mühlbach and TLMF/SM 598 from the confluence of Mühlbach and Brandenberger Ache (WIEDMANN in HERM et al., 1979).

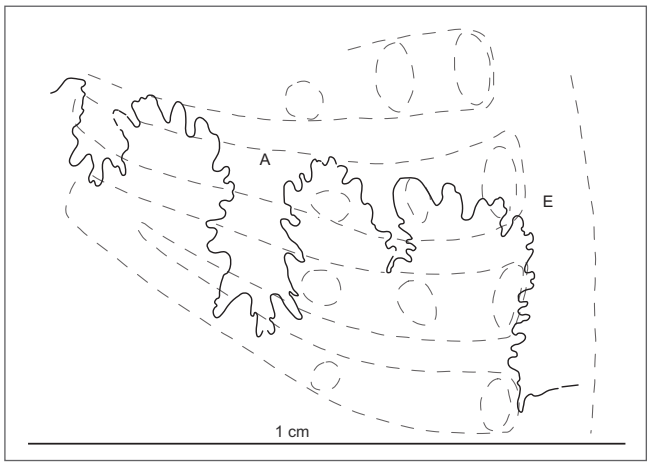
Other specimens are GPII P.8161 (the original of WIEDMANN in HERM et al., 1979: 48, Pl. 7, Figs. C, D) and M 20 (IMMEL et al., 1982: 23, Pl. 9, Fig. 1) from the early Santonian of Brandenberg/Mühlbach; one specimen from Wolfsbachau, an additional one from Weißenbach near Bad Aussee (both Steiermark, not seen) and from Unterlaussa (Upper Austria; coll. Schüssler, pers. comm.). 14 specimens from the Skoumal collection: SK/RA/1981/15, 16, 17, 19; SK/RA/1982/45, 55, 58; SK/RA/1983/82; SK/RA/2009/155; SK/GR/1981/13, 18, 22; SK/NE/1990/14; SK/EB/2008/45.

Discussion: A revision of the Austrian material was given by KENNEDY et al. (1981: 126). The lectotype (GBA 1873/01/13/1) was refigured by KENNEDY et al. (1981: Figs. 8, 9); KENNEDY in KENNEDY et al. (1995: Fig. 26); KENNEDY & KAPLAN (2000: Pl. 24) and SUMMESBERGER & ZORN (2012: Pl. 15, Fig. 1). Paralectotype GBA 1873/01/13/2) was figured by KENNEDY et al. (1981: Figs. 9 A–D) and by SUMMESBERGER & ZORN (2012: Pl. 16, Figs. 1 a–d). An additional paralectotype (OÖLM/LL 41/1938) was figured by KENNEDY et al. (1981: Figs. 15, 16).

Texanites collignoni KLINGER & KENNEDY, 1980: 126, Text-Figs. 95, 96a, 97, 98, 99b–c, 100, 101) from the early Santonian of Madagascar, Santonian I and Santonian II of northern KwaZulu-Natal (South Africa) and Japan, is similar but differs in its rounded tubercles. KLINGER & KENNEDY (1980: 135) discuss the possibility that *Texanites oliveti* (BLANCKENHORN, 1905: 10) might be a junior synonym of *T. quinquenodosus*.

Inventory No.	D (mm)	Wh (mm)	Wb (mm)	U (mm)	U (%)
NHMW 1935/0003/0040$_{max}$	118.5	40	32	51	43
NHMW 2012/0186/0016	102	34.3	24	44.6	43.7
SK/RA/1981/17$_{est}$	23	7.8	11.4	9.5	41.3

Tab. 13.
Texanites (*T.*) *quinquenodosus* (REDTENBACHER, 1873). $_{max}$ = maximum, $_{est}$ = estimated; U % of D.



Text-Fig. 12.
External suture of *Texanites* (*T.*) *quinquenodosus* (REDTENBACHER, 1873), SK/RA/1981/17.

Occurrence: The type locality of the lectotype of *Ammonites quinquenodosus* was stated by REDTENBACHER (1873: explanation of Pl. 24, Fig. 3) to be St. Wolfgang in Upper Austria, but the species has not in fact been found in this area. As discussed by SUMMESBERGER & ZORN (2012: 107) it is probably from the middle Santonian of Schneiderwirtsbrücke (road bridge) in the bed of the Ischl river close to the confluence with the Nussenseebach. The species is also recorded from Gosau (Upper Austria), Rußbach (Salzburg), Unterlaussa (Upper Austria) and from the early Santonian of Brandenberg/Mühlbach (Tyrol; IMMEL et al., 1982).

T. quinquenodosus appears together with *Cladoceramus undulatoplicatus* in the early Santonian Grabenbach Formation. Its local range extends upwards and it ovelaps with the first occurrence of the late Santonian *Placenticeras paraplanum* in the Neffgraben and Rußbach sections, and in the Hochmoos Formation below the Sandkalkbank Member. Elsewhere it occurs in France, Spain, Japan and possibly Angola and Madagascar. Higher in the section (e.g. Neffgraben (Rußbach) or Finstergrabenwandl (Gosau, Upper Austria) *Reginaites gappi* WIEDMANN, 1978 is the only Gosau representative of the Texanitidae.

Family Sphenodiscidae HYATT, 1900
Subfamily Lenticeratinae HYATT, 1900
Genus *Eulophoceras* HYATT, 1903

Type species: *Eulophoceras natalense* HYATT, 1903 by original designation.

Eulophoceras natalense HYATT, 1903

(Pl. 17, Fig. 2, Pl. 19, Figs. 1–5, Pl. 20, Figs. 1–8, Pl. 21, Figs. 1–11, Pl. 22, Figs. 1–6, Pl. 23, Figs. 1–19, Text-Figs. 13a, b, Tabs. 14–16)

1903 *Eulophoceras natalense* HYATT: 86, Pl. 11, Figs. 2–6.

1906 *Eulophoceras natalense* HYATT; WOODS: 337, Pl. 42, Fig. 3.

1921 *Eulophoceras natalense* HYATT; VAN HOEPEN: 47, Pl. 6, Figs. 2, 3.

1921 *Pelecodiscus umzambiensis* VAN HOEPEN: 30, Pl. 5, Fig. 10, Pl. 6, Fig. 1.

1921 *Pelecodiscus capensis* VAN HOEPEN: 32, Pl. 5, Fig. 11.

1921 *Pelecodiscus amapondensis* VAN HOEPEN: 33, Pl. 7, Figs. 1, 2.

1921a *Eulophoceras natalense* HYATT; SPATH: 242, Text-Fig. C 2.

1921a *Spheniscoceras africanum* (Crick MS); SPATH: 242, Fig. C 1a.

1921a *Spheniscoceras tenue* (Crick MS); SPATH: 242, Text-Fig. C 1e.

1921a *Spheniscoceras minor* (Crick MS); SPATH: 242, Text-Fig. C 1b.

1921b *Eulophoceras natalense* HYATT; SPATH: table opposite page 50.

1921b *Spheniscoceras africanum* (Crick MS); SPATH: table opposite page 50.

1921b *Spheniscoceras tenue* (Crick MS); SPATH: table opposite page 50.

1921b *Spheniscoceras minor* (Crick MS); SPATH: table opposite page 50.

1922 *Eulophoceras natalense* HYATT; SPATH: 142.

1922 *Spheniscoceras africanum* (Crick MS); SPATH: 143, Pl. 6, Fig. 1.

1922 *Spheniscoceras tenue* (Crick MS); SPATH: 144, Pl. 8, Fig. 3.

? 1922 *Spheniscoceras tenue* (Crick MS); SPATH: 144, Pl. 7, Fig. 3.

1922 *Spheniscoceras minor* (Crick MS); SPATH: 144, Pl. 6, Fig. 2.

1922 *Spheniscoceras amapondense* (V. HOEPEN); SPATH: 144, Pl. 7, Fig. 2.

1922 *Spheniscoceras umzambiense* (V. HOEPEN); SPATH: 145.

1961 *Hemitissotia randoi* GERTH: 131, Pl. 24, Figs. 1, 2.

1982 *Eulophoceras natalense* HYATT 1903; IMMEL et al.: 24, Pl. 8, Fig. 5 (with synonymy).

1982 *Hemitissotia*; SUMMESBERGER in KOLLMANN & SUMMESBERGER: 59.

? 1982 *Tissotia*; SUMMESBERGER in KOLLMANN & SUMMESBERGER: 59.

1982 *Hemitissotia randoi* GERTH, 1961; SUMMESBERGER in KOLLMANN & SUMMESBERGER: 68, 69, 72.

1985 *Hemitissotia randoi* GERTH; SUMMESBERGER: 156, Tab. 3.

1987 *Hemitissotia randoi* GERTH 1961; IMMEL: 114.

1988 *Eulophoceras natalense* HYATT, 1903; COOPER: 209, Figs. 1 A, B (with synonymy).

1994 *"Hemitissotia" randoi* GERTH; TRÖGER & SUMMESBERGER: 185, Text-Fig. 4.

non 1995 *Eulophoceras* cf. *natalense* HYATT, 1903; KENNEDY et al.: 425, Pl. 26, Figs. 3, 4, 7, Text-Fig. 32 (= *Eulophoceras losaense* SANTAMARIA ZABALA, 1995).

1995 *Hemitissotia randoi* GERTH, 1961; KENNEDY et al.: 412, Pl. 14, Fig. 9, Pl. 15, Fig. 9.

2000 *"Hemitissotia" randoi* GERTH; SUMMESBERGER in EGGER et al.: 23, Fig. 13/1.

2012a *Eulophoceras natalense* HYATT, 1903; KENNEDY & KLINGER: 33, Figs. 5–11, 12A–C, (with synonymy).

Types: The holotype of *Eulophoceras natalense* HYATT, 1903, is no. 956 in the collections of the Peabody Museum of Yale University, the original of HYATT (1903: 86, Pl. 11, Figs. 2–6). The lectotype of *Hemitissotia randoi* GERTH, 1961, by subsequent designation of KENNEDY in KENNEDY et al., (1995: 412) is the original of GERTH (1961: Pl. 24, Fig. 2), the paralectotype is the original of GERTH (1961: Pl. 24, Fig. 1). Both of Gerth's originals (GPIB 408a, b) are apparently lost.

Material: 26 registered macroconchs, eight registered subadults, 61 registered microconchs and many unregistered specimens from the Gosau Basin (Salzburg, Upper Austria; Edlbachgraben, Randobachgraben, Schattaugraben, parking site of the Hornspitz cable car), Markt Piesting (Lower Austria), Brandenberg (Mühlbach locality, Tyrol) were available for study.

Description: *Eulophoceras natalense* HYATT, 1903 is a highly variable dimorphic species. Macroconchs are described below as *natalense* type, microconchs as "*Hemitissotia randoi*" type.

Macroconchs (*natalense* type)

Macroconchs are large oxycone shells 63 to 136 mm in diameter, with a tiny umbilicus. The venter is narrow, with an entire keel on the phragmocone, becoming rounded on the body chamber in large adults (e.g. Pl. 19, Fig. 4, Pl. 20, Figs. 3, 8). The whorl height increases rapidly, the whorls overlapping almost completely. Adult ornament, where present, consists in 1–5 low, broad, straight or slightly falcoid undulations on the adapertural part of the body chamber, often visible under oblique light only (Pl. 19, Fig. 3; NHMW 2014/0139/0001). Many adult macroconchs are completely smooth (e.g. MA/1975/0001, Pl. 20, Figs. 2, 4, Pl. 19, Fig. 4). The umbilicus is deep with a steep subvertical umbilical wall, passing into the flank with a narrowly rounded umbilical shoulder. The flanks are gently inflated or subparallel, converging towards the ventrolateral region and passing into the feebly convex ventrolateral shoulder. Inner whorls of macroconchs are identical to those of juvenile microconchs. As diameter increases, the umbilical diameter decreases, from 7–10 % in juveniles to about 4 % in adults. The suture is often irregular, moderately incised, with short folioles. E is wide and shallow, E/A large and shallow, A is moderately deep. In many cases whitish or iridescent shell is preserved. Specimens from the Gosau area are preserved in marlstone to siltstone, those from Windischgarsten (Upper Austria) in hard black limestone.

Microconchs ("*Hemitissotia randoi*" type)

The microconchs of *Eulophoceras natalense* from the Randobach and Edlbach sites are internal moulds preserved with areas of adherent whitish shell, some with the original nacreous layer. Four specimens from downstream of

Inventory No.	D (mm)	Wb (mm)	Wh (mm)	Wb/Wh	U (mm)	U (%)
SK/EB/1987/11	92.5	16.8	50	0.33	4.5	4.8
SK/EB/1987/13a	106	21.4	58.6	0.36	4.2	3.9
SK/EB/1987/13b	81.7	11.1	49	0.22	3.7	4.5
SK/EB/1992/14	91.8	20.8	50.1	0.41	2.6	2.8
SK/EB/2000/18	83.3	16.6	45.8	0.36	4.8	5.7
SK/EB/2000/19	93	16.4	57.8	0.28	4.4	4.7
SK/EB/2000/25	65.9	15	43.2	0.35	4.4	6.7
SK/EB/2004/35	75.3	10.4	44.6	0.23	3	4
SK/EB/2004/37	81.6	--	44.8	--	4.4	5.4
SK/EB/2005/39	76.9	18.9	48.2	0.39	3.4	4.4
SK/EB/2005/40	80.9	--	46.9	--	2.9	3.1
SK/EB/2007/43	88.6	14.3	55.9	0.25	3	3.4
SK/EB/2011/51	136	28.4	75.9	0.37	5.6	4.1
SK/EB/2013/63	76.1	14.7	40.9	0.36	2.9	3.8
SK/EB/2013/71	87	11.6	46.6	0.25	3.6	4.1
SK/EB/2013/73	75	--	48	--	3.5	4.7
SK/RA/1981/9	70.2	9.7	34.3	0.28	3.1	4.4
SK/RA/1981/7	63.1	13.1	32.4	0.4	2.5	3.9
NHMW 2014/0206/0001	90.4	10	52	0.19	4.7	5.2
NHMW 2014/0139/0001	91	--	50	--	2.1	2.3
NHMW 2014/0139/0002	93_{est}	13.2	53.8_{est}	0.25	2.8	3
NHMW 2014/0139/0003	70.2	18.6	42.4	0.43	4.6	6.5
MA/1975/1	93.3	18.8	50	0.37	--	--
BSP 1981 I 109	77	13	43	0.3	4	5.2

Tab. 14.
Adult macroconchs of *Eulophoceras natalense* HYATT, 1903. U % of D; Dimensions of BSP 1981 I 109 after IMMEL et al. (1982).

Inventory No.	D (mm)	Wb (mm)	Wh (mm)	Wb/Wh	U (mm)	U (%)
NHMW 1983/0034/0002	45.2	5.3	27.4	0.19	1.9	4.2
NHMW 2014/0206/0001	41.3	--	22.3	--	2.2	5.3
SK/EB/1985/1a	45.8	9.1	25.9	0.35	1.4	3.1
SK/EB/2000/21	31.8	--	18.9	--	1.2	3.8
SK/EB/2000/22	40.4	10.9	18.3	0.59	1.6	3.9
SK/EB/2013/68	37.4	--	21.4	--	2.2	4.6
SK/RA/1981/31	60_{est}	9	35.5	0.25	2.4	4
SK/RA/1983/86	47.9	7	29.5	0.23	2.1	4.3
SK/SG/2000/31a	40_{est}	9.4	21.7	0.43	2.2	5.5

Tab. 15.
Subadults of *Eulophoceras natalense* HYATT, 1903. U % of D. for NHMW 2014/0206/0001, see adults.

Inventory No.	D (mm)	Wb (mm)	Wh (mm)	Wb/Wh	U (mm)	U (%)
SK/RA/1981/1a	21.5	4.3	14.2	0.3	2	9.3
SK/RA/1981/1b	27.8	4.4	17.8	0.24	2.6	9.3
SK/RA/1981/1c	24.8	4	16	0.25	2	8
SK/RA/1981/1d	28	4.2	18	0.23	1.9	6.8
SK/RA/1981/1e	21.6	3.7	12.5	0.29	2	9.2
SK/RA/1981/1f	27.4	3.9	16.1	0.24	2.1	7.6
SK/RA/1981/1g	3	3.7	14.3	0.26	2	8.7
SK/RA/1981//28b	21	4	10.7	0.37	2.1	10
SK/RA/1981/43	35_{est}	9.9	16.3	0.6	--	--
SK/RA/1981/44	27.7	4.1	16.8	0.24	2.8	10.1
SK/RA/1982/65	14.4	--	9.6	--	1.4	9.7
SK/RA/1982/73	24.9	7	14.3	0.49	2.1	8.4
SK/RA/1982/73a	22.3	5.9	13.1	0.45	2	8.9
SK/RA/1982/73b	22.9	5.2	13.6	0.38	2.1	9.1
SK/RA/1982/73c	19.4	4.2	8.1	0.51	2.1	10.8
SK/RA/1982/74a	21.6	4	12.5	0.32	2	9.2
SK/RA/1982/74b	24.7	--	15.1	--	1.9	7.7
SK/RA/1982/74c	20_{est}	5.9	13_{est}	0.45_{est}	1.7	8.5
SK/RA/1982/76	34.9	4	20	0.2	2.3	6.6
SK/RA/1984/103	29.9	3.6	16.4	0.22	2	6.7
SK/RA/2000/143b	31.9	4.6	13.8	0.33	2.8	8.8
SK/EB/1985/3	22.5	5.6	15.6	0.36	2	8.9
SK/EB/1985/4a	27	3.4	16.1	0.21	1.6	5.9
SK/EB/1985/4b	15.9	2.5_{est}	9	0.28	1.3	8.2
SK/EB/1985/6	25.5	--	15.9	--	1.8	7
SK/EB/2000/23	35.4	5.7	19.7	0.29	1.6	5.9
SK/EB/2000/24	30	--	18.2	--	2.2	7.3
SK/EB/2003/28	37.5	--	23.2	--	2.5	6.7
SK/EB/2003/29	16.2	3.4	9.4	0.36	1.2	7.4
SK/EB/2009/46	26.2	--	14.2	--	1.8	6.8
SK/EB/2011/53	31.5	5.8	18.8	0.31	1.8	5.7
SK/EB/2012/55	29.6	--	17.1	--	2	8.8
SK/EB/2012/56	21.9	3.4	11.5	0.29	1.3	5.9
SK/EB/2013/57	27.8	6.5	15.5	0.41	1.3	4.6
SK/EB/2013/63	38.2	--	20.3	--	2.2	5.7
SK/EB/2013/70	24.2	5.3	13.1	0.4	1.3	5.4
SK/EB/2013/74	50.2	3.4	21	0.16	3.8	7.6
NHMW 1982/0032/0001	27.0_{est}	--	16.0_{est}	--	2.2	8.1
NHMW 1982/0036/0001	26.7	4.1	15.3	0.26	2	7.5
NHMW 1983/0034/0002	25.7	4.1	16.6	0.24	2	7.8

NHMW 1983/0035/0001	31.6	3.7	--	--	--	--
NHMW 2010/0355/0030	26.2	--	14.8	--	2.2	8.4
NHMW 2014/0138/0001	45	6.3	25.5	0.24	2.8	6.2
NHMW 2014/0138/0002	26.9	--	15	--	2.4	8.9
NHMW 2010/0300/0030	25.1	--	15.1	--	2.3	9.1

Tab. 16.
Eulophoceras natalense HYATT, 1903. U % of D. Microconchs.

the Randobach site (SK/RA/1982/73a–d: Pl. 23, Fig. 14) are pyritised. Parts of the sutures are frequently exposed. Specimens from Lower Austria (Markt Piesting, Thalgasse) are preserved with brittle yellowish or rusty shell without sutures in shaly sandstone (there are no macroconchs from Piesting).

Microconchs and juvenile macroconchs of *Eulophoceras natalense* generally measure between 20 and 30 mm (see Table 16) in diameter and are coarsely ornamented. The general outline is discoidal, compressed or highly compressed. The venter is fastigiate with an entire sharp keel which continues to the aperture. The whorls overlap almost completely leaving a very small umbilicus which decreases in diameter through ontogeny. The steep umbilical wall passes without a distinct umbilical edge into the flank. The flanks are gently convex with the greatest breadth at mid-flank. The ventrolateral margin is markedly accentuated by the ornament. Body chambers are preserved in many cases. The sculpture of the adult microconchs weakens or is lost on the adult body chamber. Despite minor *post mortem* deformation measurements (Tabs. 14–16) are still valid.

Microconch ("*Hemitissotia randoi"* type) ornament is variable and dominated by approximately 16 or more strongly biconvex ribs per whorl. They arise at the umbilical shoulder singly or in pairs with or without an incipient bulla. They strengthen progressively across the flanks, are feebly concave and prorsiradiate on inner flanks, flexing back in a 90° geniculation at mid-flank and are markedly concave on the outer flank, projecting forwards and strengthening on the outermost flank and linking to a low, flat, more-or-less triangular ventrolateral tubercle. Ribbing weakens and is lost in most individuals at a diameter of 27–30 mm. Some juvenile individuals appear to have smooth or near smooth flanks, anticipating the adult ornament.

Change of ornament during ontogeny

Change of ornament from "*Hemitissotia randoi*" type to *Eulophoceras natalense* type during the ontogeny of single individuals can be observed in a number of specimens: SK/RA/1983/86 (Pl. 22, Figs. 1, 2), or SK/RA/1981/31 (Pl. 22, Fig. 4) and NHMW 1983/0034/0002 (Pl. 22, Fig. 5) at a diameter of approximately 27–30 mm (Pl. 21, Figs. 3, 11); others are poorly ornamented throughout ontogeny (Pl. 23, Fig. 12).

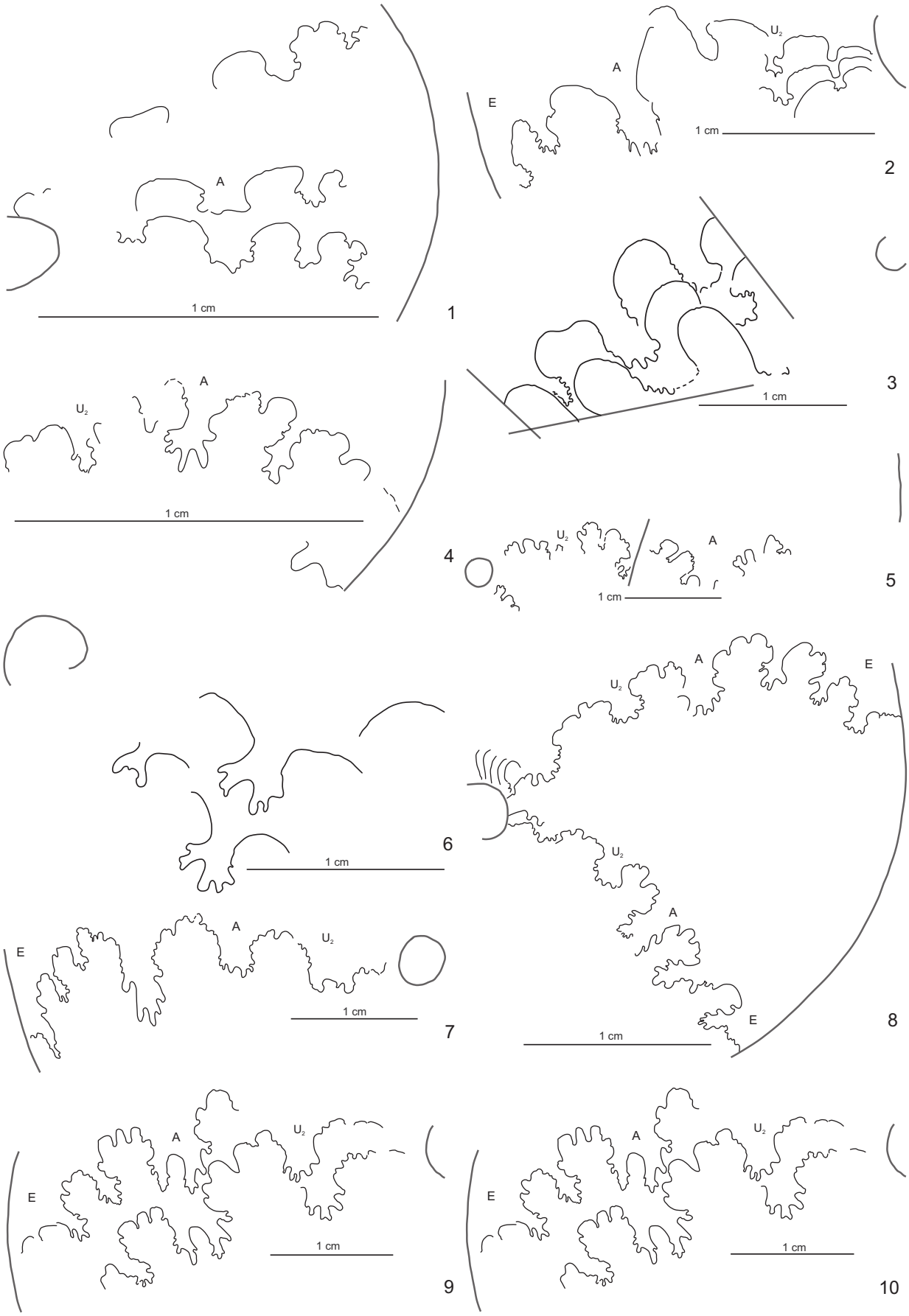
The external sutures are characterised by a wide E/A and elongate folioles (for the sutures see Text-Figures 13a, b).

Discussion: *Hemitissotia randoi* (microconch) and *Eulophoceras natalense* (macroconch) is thus a dimorphic pair. Their specific identity based upon morphological details is supported by the co-occurrence of macroconchs, microconchs and subadult macroconchs at several localities. All of the South African representatives of *Eulophoceras* described to date are macroconchs, in marked contrast to the Austrian occurrences. They were discussed recently by KENNEDY & KLINGER (2012a). As they noted, *Eulophoceras* species have been differentiated chiefly on the basis of minute differences in the sutures. SPATH (1922: 145) expressed his doubts concerning VAN HOEPEN's 'species' of *Pelecodiscus* (= *Eulophoceras*); in spite of this, he went on to introduce several new species of *Sphenodiscoceras* (= *Eulophoceras*), based on a manuscript by the late G.C. Crick. YOUNG (1963: 126) noted the variability of sutures (see Text-Figures 13a, b) within species or even within individuals (see Text-Figures 13a, b). COOPER (1988: 209–210) placed all of the South African 'species' in the synonymy of *Eulophoceras natalense*, as did KENNEDY in KENNEDY et al. (1995: 426) and KENNEDY & KLINGER (2012a: 33, Figs. 5–11, 12A–C). Differences between *E. natalense, E. jacobi* HOURCQ, 1949, *E. bererense* HOURCQ, 1949, *E. vautrini* BASSE 1954, *E. wollmanae* YOUNG 1963, and *E. losaense* SANTAMARIA ZABALA, 1995, are discussed in detail by KENNEDY & KLINGER (2012a: 35). *E. natalense* from the Lower Santonian of Brandenberg (BSP 1981 I 109: IMMEL et al., 1982: Pl. 8, Fig. 5) can best be compared with the specimens from Windischgarsten (Austria; Pl. 19, Fig. 3) and the Gosau Basin (Pl. 19, Fig. 4).

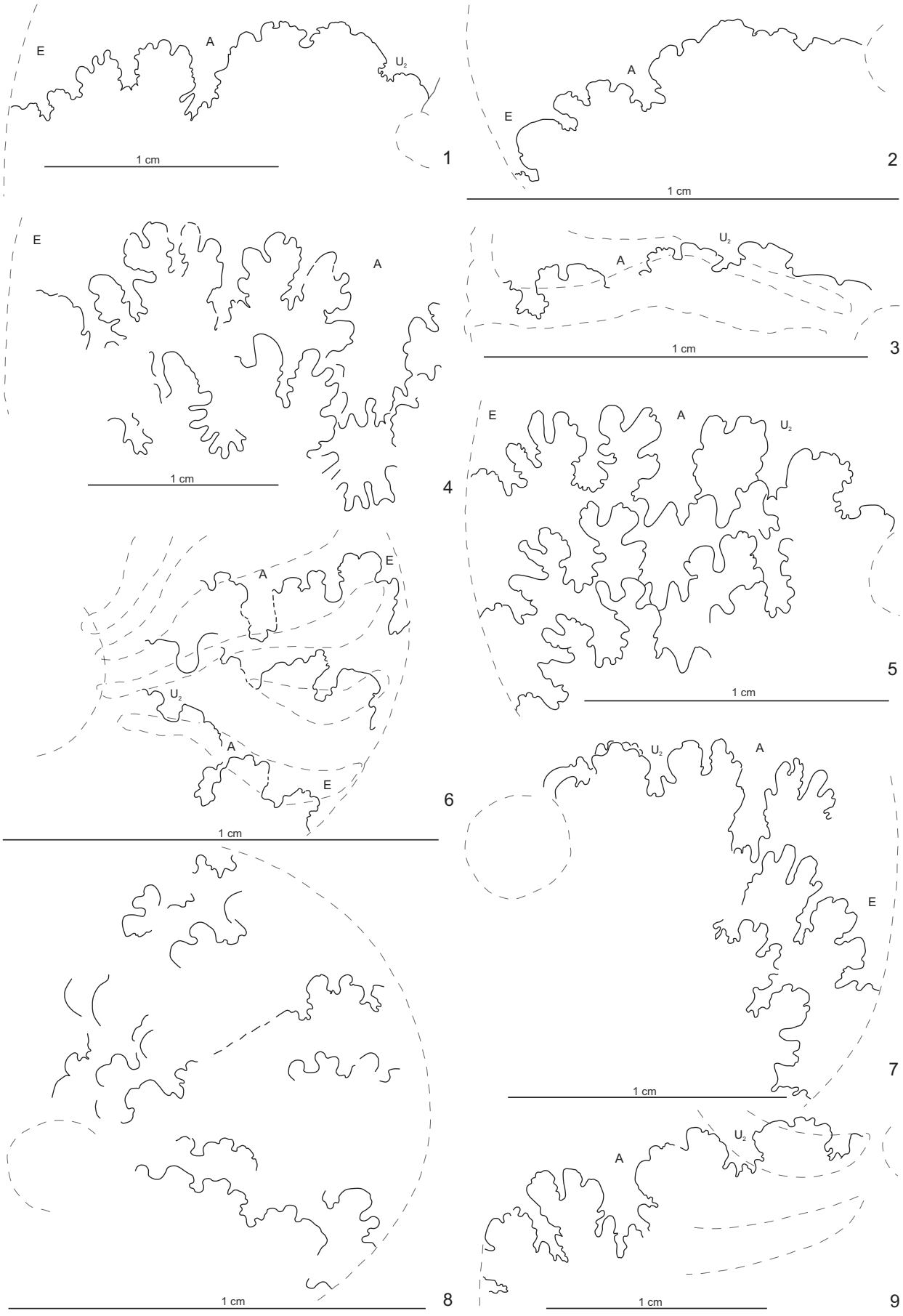
The late Santonian *Diaziceras austriacum* (SUMMESBERGER, 1979) (= *Skoumalia austriaca*, form A of SUMMESBERGER, 1979), (see KENNEDY & KLINGER (2012b) differs from *Eulophoceras natalense* in its wider umbilicus and the presence of small, widely separated bullae on the ventrolateral shoulders, whereas co-occurring *Eulophoceras jacobi* HOURCQ, 1949) (= *Skoumalia*) *austriaca* SUMMESBERGER, 1979, form B), also of late Santonian age and originally thought to be the dimorphic partner of *Diaziceras austriacum* differs from *E. natalense* in its tiny and prorsiradiate ventrolateral bullae.

Eulophoceras wollmanae YOUNG, 1963 (Pl. 72, Fig. 5, Pl. 74, Figs. 1, 3–6) differs in its greater whorl breadth and occluded umbilicus.

Occurrence: All Austrian Gosau Group occurrences of *Eulophoceras natalense* HYATT, 1903 are of early Santonian date: Brandenberg (Tyrol; IMMEL et al., 1982), Windischgarsten (Upper Austria), Edlbachgraben (Gosau, Upper Austria) and Grabenbach (Gosau, Upper Austria). Randobach 3, the type area of "*Hemitissotia randoi*" GERTH, 1961 and the Stöcklwaldgraben, a tributary of the Randobach (TRÖGER & SUMMESBERGER, 1994), are located in Rußbach (Salzburg). The occurrence of Markt Piesting (Lower Austria) is equally of early Santonian age. Elsewhere in Europe *E. natalense*



Text-Fig. 13a.
External sutures of *Eulophoceras natalense* HYATT, 1903. Fig. 1: NHMW 1982/0032/0001, Fig. 2: NHMW 2014/0105/0001, Fig. 3: NHMW 2014/0139/0001, Fig. 4: SK/EB/1985/1, Fig. 5: NHMW 2014/0139/0002, Fig. 6: NHMW 2014/0139/0003, Fig. 7: SK/EB/1987/13a, Fig. 8: SK/EB/2000/13b, Fig. 9: SK/EB/2000/18, Fig. 10: SK/EB/2000/19.



Text-Fig. 13b.
External sutures of *Eulophoceras natalense* HYATT, 1903: Fig. 1: SK/EB/2000/22, Fig. 2: SK/RA/1981/1c, Fig. 3: SK/RA/1981/1e, Fig. 4: SK/RA/1981/29, Fig. 5: SK/RA/1982/73a, Fig. 6: SK/RA/1981/31, Fig. 7: SK/RA/1983/86, Fig. 8: SK/RA/1982/74a, Fig. 9: SK/SG/2000/31a.

is described from the Santonian of the Corbières in southern France (KENNEDY in KENNEDY et al., 1995). In Africa *E. natalense* occurs in the late Santonian to early Campanian Mzamba Formation of the Mzamba Estuary in Eastern Cape Province and northern KwaZulu-Natal in South Africa and in the early Campanian of Angola (COOPER, 1988). The stratigraphic range of *Eulophoceras natalense* is thus from the early Santonian through early Campanian, with an acme in the Santonian.

Biostratigraphical subdivision of the Santonian Gosau Group

The Santonian part of the Gosau Group corresponds to the *Placenticeras polyopsis* Zone. It can be divided into three subzones as follows:

1) *Eulophoceras natalense* Subzone (early Santonian).

Eulophoceras natalense HYATT, 1903 appears together with *Nowakites savini* DE GROSSOUVRE, 1894, *Texanites quinquenodosus* (REDTENBACHER, 1873) and *Cladoceramus undulatoplicatus* (ROEMER, 1852).

Texanites quinquenodosus appears at the base of the Santonian and extends, together with *M. gosauicum*, from Randobach 2 to about 20 m below the base of the Sandkalkbank Member in the Neffgraben. The highest specimen was found above the confluence of the „*Elliptica*" Graben with the Neffgraben (GERTH, 1961: Figs. 3, 4). *Texanites quinquenodosus* does not occur in the Sandkalkbank Member. Texanitids are represented in the Sandkalkbank Member by *Reginaites gappi* WIEDMANN, 1978. The absence of Campanian members of the family (e.g. *Submortoniceras*) in the Gosau Group may be a reflection of facies changes (see WAGREICH & MARSCHALKO, 1995).

2) *Muniericeras gosauicum* Subzone (middle Santonian).

Muniericeras gosauicum (HAUER, 1852) occurs abundantly together with *Texanites quinquenodosus* (REDTENBACHER, 1873), *Parapuzosia corbarica* (DE GROSSOUVRE, 1894) and *Baculites* sp. at the Randobach 2 site and extends through the Grabenbach Formation (Neffgraben/Rußbach) together with *Texanites quinquenodosus.*

3) *Placenticeras paraplanum* Subzone (late Santonian).

Placenticeras paraplanum (WIEDMANN, 1978) occurs together with abundant *Placenticeras polyopsis* (DUJARDIN, 1837), *Boehmoceras krekeler*i (WEGNER, 1905) and *Boehmoceras arculus* (MORTON, 1834) (see SUMMESBERGER, 1979, 1980).

Systematic conclusions

Hauericeras (*Gardeniceras*) aff. *gardeni* is described and is a close relative of *Hauericeras* (*G.*) *gardeni* (BAILY, 1855). We follow KENNEDY (1986) and KENNEDY & KLINGER (2006) in the interpretation of *Pseudomenuites katschthaleri* IMMEL et al. (1982) from the early Santonian of Brandenberg (Tyrol) as the microconch of *Eupachydiscus isculensis* (REDTENBACHER, 1873). An additional microconch individual from the middle Santonian of Schneiderwirtsbrücke (Pl. 10, Fig. 3) confirms this interpretation. The dominating faunal element *Muniericeras gosauicum* (HAUER, 1858) is redescribed and shown to be a highly variable dimorphic species. "*Hemitissotia randoi*" GERTH, 1961 is shown to be based on the microconch of *Eulophoceras natalense* HYATT, 1903.

Revised list of Nautiloids and non-heteromorph Ammonites described by IMMEL et al. (1982) and IMMEL (1987) from the early Santonian of Mühlbach/Brandenberg (Tyrol)

? *Cimomia* cf. *gosavica* (REDTENBACHER, 1873)
Cymatoceras sp.
Hyporbuilites woodsi (VAN HOEPEN, 1921)
Gaudryceras mite (REDTENBACHER, 1873)
Gaudryceras ex gr. *denseplicatum* JIMBO, 1894
Gaudryceras sp. indet.
Anagaudryceras redtenbacheri (IMMEL et al., 1982), juv.
? *Anagaudryceras* cf. *subtililineatum* (KOSSMAT, 1895)
Saghalinites nuperus (VAN HOEPEN, 1921)
Parapuzosia (*Parapuzosia*) *daubreei* (DE GROSSOUVRE, 1894)
Parapuzosia (*Parapuzosia*) *corbarica* (DE GROSSOUVRE, 1894)
Parapuzosia sp. indet.
Damesites sugata (FORBES, 1846)
Hauericeras (*Hauericeras*) *pseudogardeni* (SCHLÜTER, 1872)
Hauericeras (*Gardeniceras*) aff. *gardeni* BAILY, 1855
Kossmaticeras (*Kossmaticeras*) cf. *sparsicostatum* (KOSSMAT, 1897)
Nowakites carezi (DE GROSSOUVRE, 1894)
Nowakites carezi (DE GROSSOUVRE, 1894), juv. (REDTENBACHER, 1873)
Patagiosites stobaei (NILSSON, 1827)
Eupachydiscus isculensis (REDTENBACHER, 1873), microconch
Texanites (*Texanites*) *quinquenodosus* (REDTENBACHER, 1873)
Paratexanites serratomarginatus (REDTENBACHER, 1873)
Eulophoceras natalense HYATT, 1903

Revised plate explanations for IMMEL et al. (1982: Pls. 1–11), excluding the heteromorphs

Plate 1

Figs. 1, 2: *Cymatoceras sharpei* (SCHLÜTER) → *Cymatoceras* sp.

Figs. 3, 4: *Phylloceras* (*Hypophylloceras*) *velledaeforme* (SCHLÜTER) → *Hyporbulites woodsi* (VAN HOEPEN, 1921).

Fig. 5: *Gaudryceras* ex gr. *denseplicatum* (YABE) → recte: *Gaudryceras* ex gr. *denseplicatum* JIMBO, 1894.

Fig. 6: *Gaudryceras* sp. → *Gaudryceras* sp. indet.

Fig. 7: *Anagaudryceras* cf. *subtililineatum* (KOSSMAT) → ? *Anagaudryceras* cf. *subtililineatum* (KOSSMAT, 1895).

Plate 2

Figs. 1, 2: *Saghalinites* aff. *wrighti* BIRKELUND → *Saghalinites nuperus* (VAN HOEPEN, 1921).

Figs. 3a, b, 4a, b: *Pseudophyllites latus* (MARSHALL) → *Saghalinites nuperus* (VAN HOEPEN, 1921).

Fig. 5: *Kitchinites stenomphalus* SUMMESBERGER → *Nowakites carezi* (DE GROSSOUVRE, 1894).

Fig. 6: *Damesites* cf. *compactus* (VAN HOEPEN) → *Damesites sugata* (FORBES, 1846).

Fig. 7: *Damesites* sp. → *Damesites sugata* (FORBES, 1846).

Fig. 8: ?*Mesopuzosia* sp. indet. → *Parapuzosia* sp. indet.

Fig. 9: *Parapuzosia daubreei* (DE GROSSOUVRE) → *Parapuzosia* (*P.*) *daubreei* (DE GROSSOUVRE, 1894).

Fig. 10: *Parapuzosia daubreei* (DE GROSSOUVRE) → *Parapuzosia* (*P.*) *corbarica* (DE GROSSOUVRE, 1894).

Plate 3

Figs. 1, 2: *Parapuzosia daubreei* (DE GROSSOUVRE) → *Parapuzosia* (*P.*) *daubreei* (DE GROSSOUVRE, 1894).

Fig. 3: *Parapuzosia corbarica* (DE GROSSOUVRE) → *Parapuzosia* (*P.*) *corbarica* (DE GROSSOUVRE, 1894).

Plate 4

Fig. 1: *Parapuzosia corbarica* (DE GROSSOUVRE) → *Parapuzosia* (*P.*) *corbarica* (DE GROSSOUVRE, 1894).

Fig. 2: *Parapuzosia daubreei* (DE GROSSOUVRE) → *Parapuzosia* (*P.*) *daubreei* (DE GROSSOUVRE, 1894).

Fig. 3: ?*Mesopuzosia yubarensis* (JIMBO) → *Parapuzosia* (*P.*) *daubreei* (DE GROSSOUVRE, 1894).

Fig. 4: *Desmophyllites* cf. *larteti* (SEUNES) → *Hauericeras* (*H.*) *pseudogardeni* (SCHLÜTER, 1872).

Plate 5

Figs. 1–4: *Hauericeras gardeni* (BAILY) → *Hauericeras* (*Gardeniceras*) aff. *gardeni* (BAILY, 1855).

Fig. 5: *Kossmaticeras* (*Kossmaticeras*) cf. *sparsicostatum* (KOSSMAT) → *Kossmaticeras* (*Kossmaticeras*) cf. *sparsicostatum* (KOSSMAT, 1897).

Fig. 6: *Patagiosites patagiosus* (SCHLÜTER) → *Patagiosites* sp.

Fig. 7: *Patagiosites redtenbacheri* n. sp. → *Anagaudryceras redtenbacheri* (IMMEL et al., 1982), juv.

Plate 6

Fig. 1: *Hauericeras gardeni* (BAILY) → *Hauericeras* (*Gardeniceras*) aff. *gardeni* (BAILY, 1855).

Figs. 2–4: *Hauericeras gardeni* (BAILY) → *Hauericeras* (*Gardeniceras*) aff. *gardeni* (BAILY, 1855).

Figs. 5–7: *Patagiosites redtenbacheri* n. sp. → *Anagaudryceras redtenbacheri* (IMMEL et al., 1982).

Plate 7

Fig. 1: *Patagiosites redtenbacheri* n. sp. → *Anagaudryceras redtenbacheri* (IMMEL et al., 1982).

Figs. 2–5: *Pseudomenuites katschthaleri* n. sp. → *Eupachydiscus isculensis* (REDTENBACHER, 1873), microconch.

Figs. 6, 7: *Menuites sturi* (REDTENBACHER) → *Patagiosites stobaei* (NILSSON, 1827).

Fig. 8: *Eupachydiscus isculensis* (REDTENBACHER) → *Nowakites carezi* (DE GROSSOUVRE, 1894), juv.

Figs. 9–11: *Eupachydiscus isculensis* (REDTENBACHER) → *Eupachydiscus isculensis* (REDTENBACHER, 1873).

Plate 8

Figs. 1–4: *Eupachydiscus isculensis* (REDTENBACHER) → *Eupachydiscus isculensis* (REDTENBACHER, 1873), macroconch.

Fig. 5: *Eulophoceras natalense* HYATT → *Eulophoceras natalense* HYATT, 1903.

Fig. 6: *Paratexanites serratomarginatus* (REDTENBACHER) → *Paratexanites serratomarginatus* (REDTENBACHER, 1873).

Plate 9

Fig. 1: *Texanites quinquenodosus* (REDTENBACHER) → *Texanites* (*T.*) *quinquenodosus* (REDTENBACHER, 1873).

Fig. 2: *Neocrioceras* (*Neocrioceras*) *maderi* n. sp.; not revised.

Fig. 3: *Neocrioceras* (*Schlueterella*) *compressum* KLINGER; not revised.

Figs. 4, 5: *Diplomoceras* (*Glyptoxoceras*) *subcompressum* (FORBES); not revised.

Plate 10

Figs. 1–4: *Neocrioceras* (*Schlueterella*) *compressum* KLINGER; not revised.

Figs. 5, 6: *Diplomoceras* (*Glyptoxoceras*) *indicum* (FORBES) → *Glyptoxoceras crispatum* (MOBERG, 1885).

Fig. 7: *Diplomoceras* (*Glyptoxoceras*) *subcompressum* (FORBES); not revised.

Plate 11

Figs. 1, 2: *Neocrioceras* (*Neocrioceras*) *maderi* n. sp. → not revised.

Fig. 3: *Neocrioceras* (*Neocrioceras*) *compressum* KLINGER; not revised.

Fig. 4: *Diplomoceras* (*Glyptoxoceras*) *subcompressum* (FORBES); not revised.

Figs. 5–7: *Baculites incurvatus* DUJARDIN; not revised.

Fig. 8: *Baculites fuchsi* REDTENBACHER; not revised.

List of early and middle Santonian Nautiloids and non-heteromorph Ammonoids from the Austrian Gosau Group

Angulithes westphalicus (SCHLÜTER, 1876)	10	Pl. 1, Figs. 1–3, Pl. 2, Figs. 1–3, Pl. 3, Figs. 4–5, Pl. 4, Figs. 1–3, Tab. 1
Cymatoceras sp.	11	Pl. 4, Figs. 4–6
Cymatoceras cf. *huxleyanum* (BLANFORD, 1861)	12	Pl. 3, Figs. 1–3
? *Cimomia* cf. *gosavica* (REDTENBACHER, 1873)	12	not figured
Nautilidae, gen. et sp. indet, juv.	13	Pl. 4, Figs. 7, 8
Hyporbulites woodsi (VAN HOEPEN, 1921)	13	Pl. 5, Fig. 1
Anagaudryceras redtenbacheri (IMMEL et al., 1982)	14	not figured
Anagaudryceras sp.	14	Pl. 5, Fig. 2, Tab. 2
? *Anagaudryceras* cf. *subtililineatum* (KOSSMAT, 1895)	14	not figured
Gaudryceras mite (HAUER, 1866)	15	not figured
Gaudryceras sp. indet. 1	16	not figured
Gaudryceras sp. indet. 2	16	not figured
Saghalinites nuperus (VAN HOEPEN, 1921)	16	Pl. 5, Figs. 3–10
Jimboiceras cf. *reyi* COLLIGNON, 1983	17	Pl. 6, Figs. 1–4, 6, 7, Text-Fig. 4, Tab. 3
Parapuzosia (*Parapuzosia*) *daubreei* (DE GROSSOUVRE, 1894)	18	not figured
Parapuzosia (*Parapuzosia*) *corbarica* (DE GROSSOUVRE, 1894)	18	Pl. 6, Fig. 9, Pl. 9, Fig. 9
Parapuzosia sp. indet.	19	not figured
Haeuericeras (*Haeuericeras*) *pseudogardeni* (SCHLÜTER, 1872)	19	Pl. 6, Fig. 8
Haeuericeras (*Gardeniceras*) aff. *gardeni* (BAILY, 1855)	20	Pl. 6, Fig. 5, Pl. 7, Figs. 1–3, 6–8, Tab. 4
Haeuericeras (*Gardeniceras*) *lagarum* (REDTENBACHER, 1873)	21	Text-Fig. 5
Haeuericeras (*Gardeniceras*) sp. indet.	21	Pl. 7, Figs. 4, 5
Damesites sugata (FORBES, 1846)	22	Pl. 8, Figs. 1, 2, 4, 5, Text-Fig. 6, Tab. 5
Damesites sp. indet.	23	not figured
Kossmaticeras (*Kossmaticeras*) cf. *sparsicostatum* (KOSSMAT, 1897)	24	not figured
Nowakites carezi (DE GROSSOUVRE, 1894)	24	Pl. 8, Figs. 3, 6, 7, Pl. 9, Figs. 3–5, Tab. 6
Nowakites draschei (REDTENBACHER, 1873)	25	Pl. 8, Figs. 8–12, Text-Fig. 7
Nowakites savini (DE GROSSOUVRE, 1894)	25	Pl. 9, Figs. 1, 2, Pl. 10, Fig. 1, Tab. 7
Patagiosites? sp.	26	not figured
Eupachydiscus isculensis (REDTENBACHER, 1873)	27	Pl. 9, Figs. 6–8, Pl. 10, Fig. 3
Tragodesmoceras aff. *clypeale* (SCHLÜTER, 1872)	28	Pl. 10, Figs. 2, 5, Text-Fig. 8, Tab. 8
Muniericeras gosauicum (HAUER, 1858)	29	Pl. 11, Figs. 1–13, Pl. 12, Figs. 1–11, Pl. 13, Figs. 1–8, Pl. 14, Figs. 1–3, Pl. 15, Figs. 1–8, Pl. 16, Figs. 1–7, Pl. 17, Figs. 1, 3–9, Text-Figs 9–11, Tab. 9, 10
Texasia cricki (SPATH, 1921)	34	Pl. 18, Fig. 2, Tab. 11
Pseudoschloenbachia (*Pseudoschloenbachia*) sp.	35	Pl. 18, Fig. 1
Placenticeras paraplanum WIEDMANN, 1978	35	Pl. 10, Fig. 4, Tab. 12
Placenticeras sp. indet.	36	not figured
Texanites (*Texanites*) *quinquenodosus* (REDTENBACHER, 1873)	36	Pl. 18, Figs. 3–7, Text-Fig. 12, Tab. 13
Eulophoceras natalense HYATT, 1903	37	Pl. 17, Fig. 2, Pl. 19, Figs. 1–5, Pl. 20, Figs. 1–8, Pl. 21, Figs. 1–11, Pl. 22, Figs. 1–6, Pl. 23, Figs. 1–19, Text-Fig. 13, Tab. 14–16

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Plates

Plate 1

Figs. 1–3: *Angulithes westphalicus* (SCHLÜTER, 1876); SIM 1996/1; Randobach, Rußbach, Salzburg. x 0.9

Specimen coated with ammonium chloride.

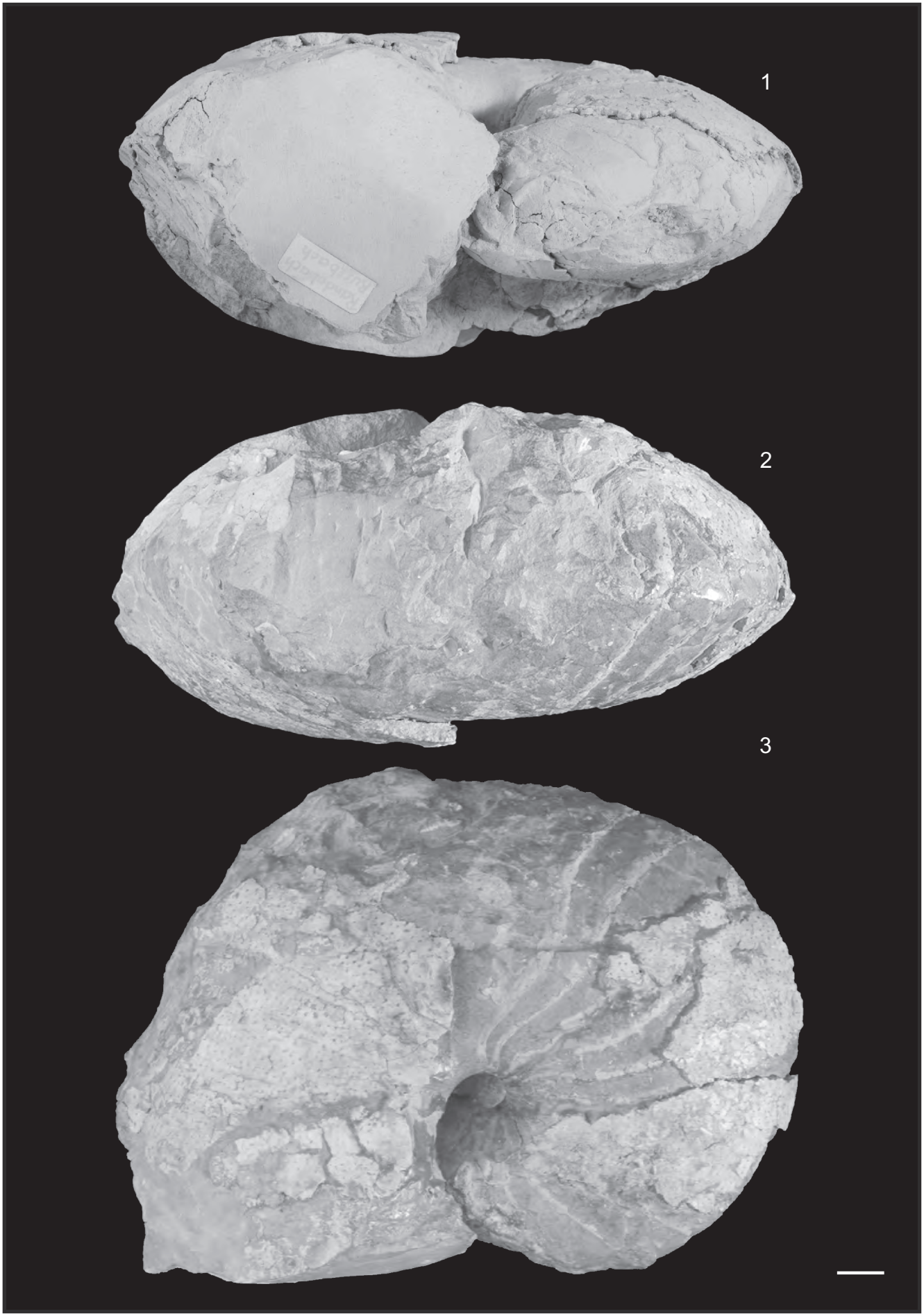
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Plate 2

Figs. 1–3: *Angulithes westphalicus* (SCHLÜTER, 1876); SCH 2012/1; Randobach, Rußbach, Salzburg. x 0.9

Specimen coated with ammonium chloride.


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Plate 3

Figs. 1–3: *Cymatoceras* cf. *huxleyanum* (BLANFORD, 1861); SK/GR/1983/30; Grabenbach, Gosau, Upper Austria. x 2

Figs. 4, 5: *Angulithes westphalicus* (SCHLÜTER, 1876); NHMW 2012/0182/0001; Edlbach, Gosau, Upper Austria. x 0.9

All specimens coated with ammonium chloride.


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Plate 4

Figs. 1–3: *Angulithes westphalicus* (SCHLÜTER, 1876); SK/EB/1985/10; Edlbach, Gosau, Upper Austria. x 0.9

Figs. 4–6: *Cymatoceras* sp.; SK/RA/1982/54; Randobach, Rußbach, Salzburg. x 1

Figs. 7, 8: Nautilidae, gen. et sp. indet., juv.; SK/1983/15; Grabenbach, Tauerngraben, Upper Austria. x 2

All specimens coated with ammonium chloride.

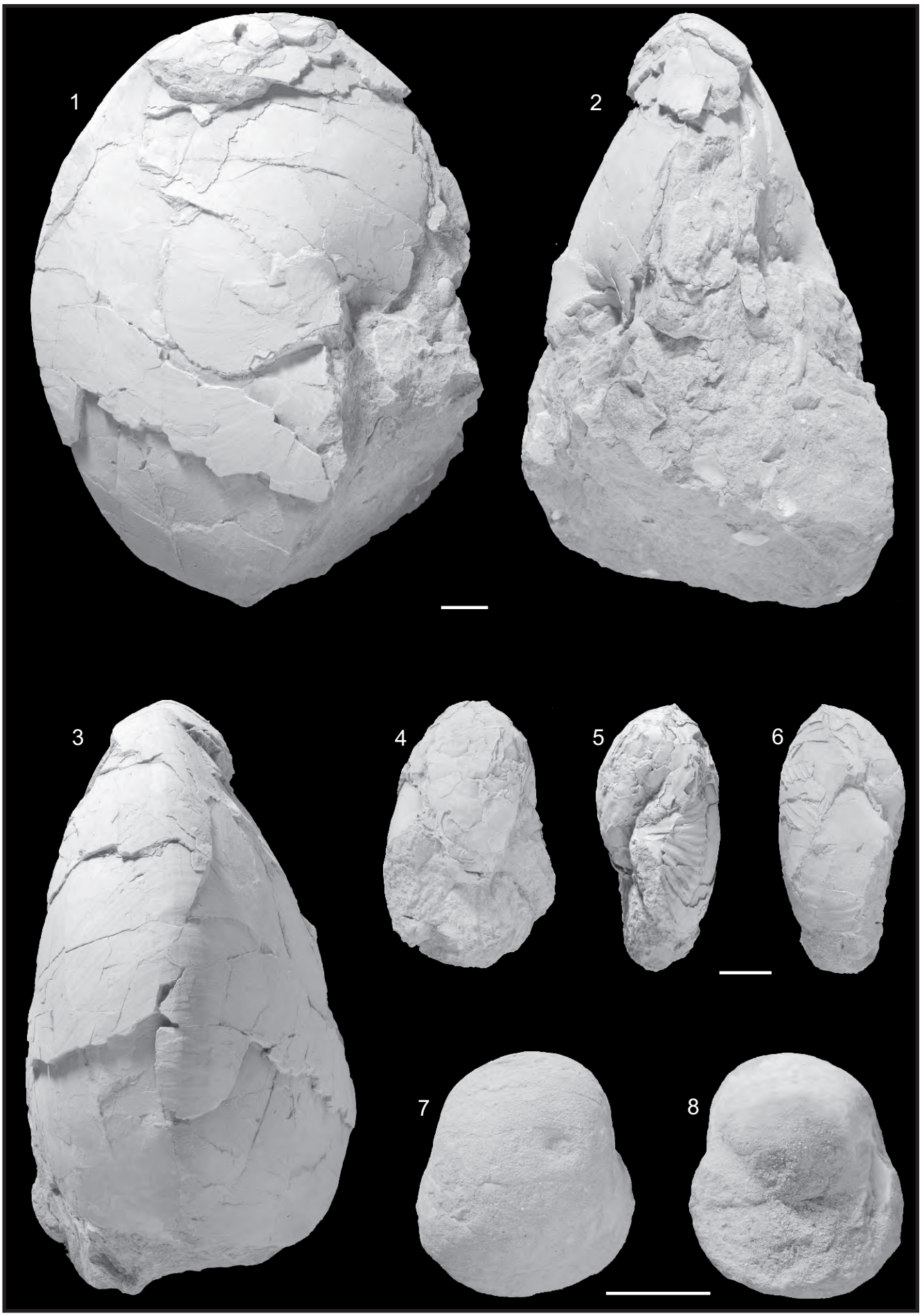
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Plate 5

Fig. 1: *Hyporbulites woodsi* (VAN HOEPEN, 1921); SK/RA/1999/142; Randobach, Rußbach, Salzburg. x 1

Fig. 2: *Anagaudryceras* sp.; OÖLM 2014/10; Gosau Group; no locality details. x 1

Figs. 3, 4: *Saghalinites nuperus* (VAN HOEPEN, 1921); NHMW 2013/0015/0005; Weißwasser, Unterlaussa, Upper Austria. x 1

Figs. 5, 6: *Saghalinites nuperus* (VAN HOEPEN, 1921); NHMW 2013/0015/0004; Weißwasser, Unterlaussa, Upper Austria. x 1

Figs. 7, 10: *Saghalinites nuperus* (VAN HOEPEN, 1921); NHMW 2012/0186/0010; Randobach, Rußbach, Salzburg. x 1

Figs. 8, 9: *Saghalinites nuperus* (VAN HOEPEN, 1921); NHMW 1982/0035/0001; Edlbach, Gosau, Upper Austria. x 2

All specimens coated with ammonium chloride.


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Plate 6

Figs. 1, 2: *Jimboiceras* cf. *reyi* COLLIGNON, 1983; NHMW 2013/0015/0002; Blahberg, Unterlaussa, Upper Austria. x 1

Figs. 3, 4: *Jimboiceras* cf. *reyi* COLLIGNON, 1983; NHMW 2013/0016/0001; Glanegg castle, Grödig, Salzburg; late Coniacian. x 1

Fig. 5: *Hauericeras* (*Gardeniceras*) aff. *gardeni* (BAILY, 1855); SK/EB/2010/48; Edlbachgraben, Gosau, Upper Austria. x 2

Figs. 6, 7: *Jimboiceras* cf. *reyi* COLLIGNON, 1983; NHMW 2013/0015/0001; Breitenberg, Unterlaussa, Upper Austria. x 1

Fig. 8: *Hauericeras* (*Hauericeras*) *pseudogardeni* (SCHLÜTER, 1872); NHMW 2013/0017/0001; Broitzem, Germany; early Campanian. x 1

Fig. 9: *Parapuzosia* (*Parapuzosia*) *corbarica* (DE GROSSOUVRE, 1894); SK/RA/2015/165; Randobach 2, Rußbach, Salzburg; middle Santonian. x 1

All specimens coated with ammonium chloride.

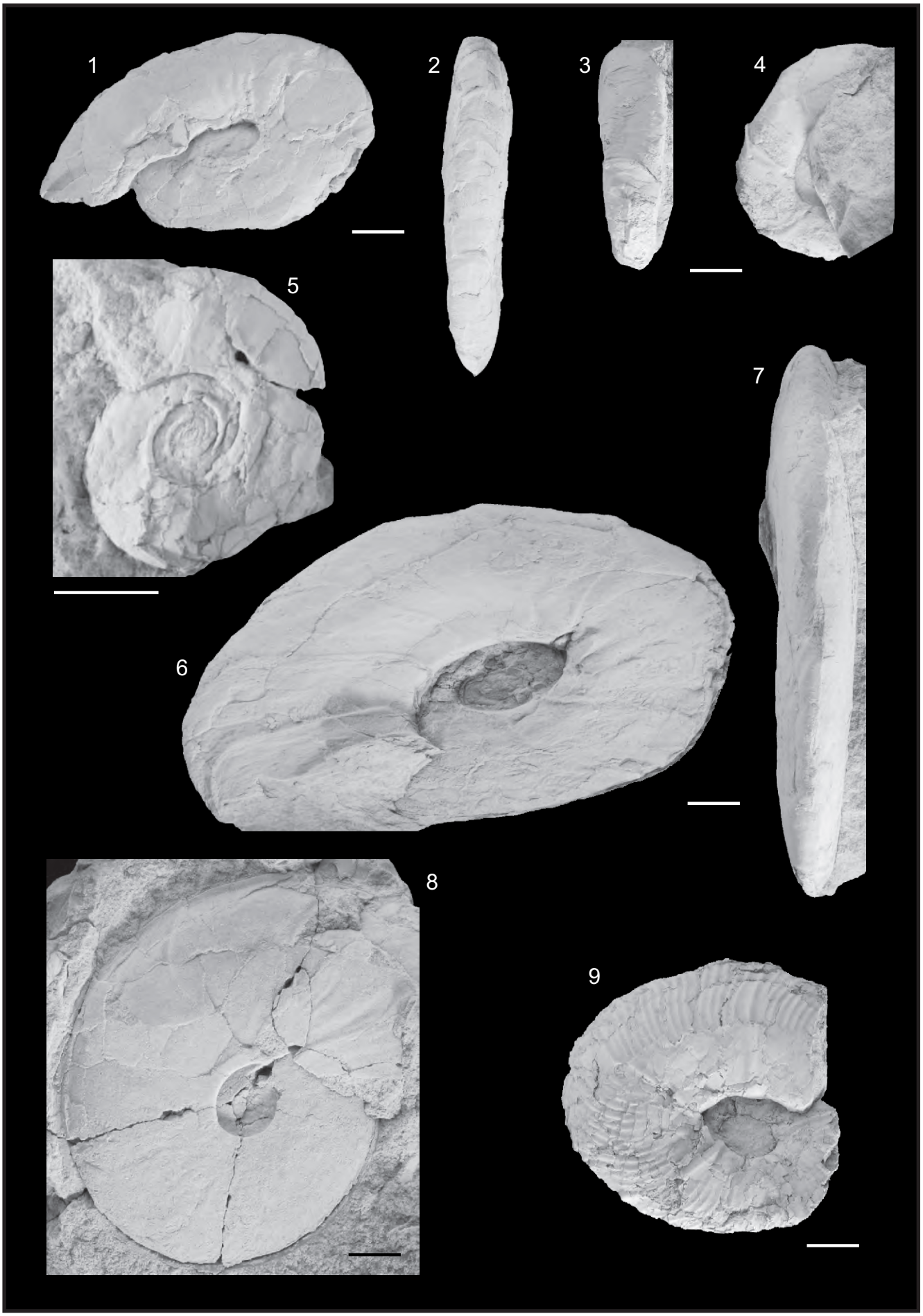
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Plate 7

Fig. 1: *Hauericeras* (*Gardeniceras*) aff. *gardeni* (BAILY, 1855); NHMW 2010/0355/0027; Parking area, Hornspitz cable car, Rußbach, Salzburg. x 1

Fig. 2: *Hauericeras* (*Gardeniceras*) aff. *gardeni* (BAILY, 1855); SK/EB/2010/50; Edlbachgraben, Gosau, Upper Austria. x 1

Fig. 3: *Hauericeras* (*Gardeniceras*) aff. *gardeni* (BAILY, 1855); SK/EB/2010/49; Edlbachgraben, Gosau, Upper Austria. x 1

Fig. 4: *Hauericeras* (*Gardeniceras*) sp. indet.; NHMW 2013/0015/0003; Weißwasser, Unterlaussa, Upper Austria; Gosau Group, early Santonian. x 1

Fig. 5: *Hauericeras* (*Gardeniceras*) sp. indet.; NHMW 2013/0015/0003; Weißwasser, Unterlaussa, Upper Austria; Gosau Group, early Santonian. x 2

Fig. 6: *Hauericeras* (*Gardeniceras*) aff. *gardeni* (BAILY, 1855); SK/EB/2001/26; Edlbachgraben, Gosau, Upper Austria. x 1

Fig. 7: *Hauericeras* (*Gardeniceras*) aff. *gardeni* (BAILY, 1855); SK/EB/2001/27; Edlbachgraben, Gosau, Upper Austria. x 1

Fig. 8: *Hauericeras* (*Gardeniceras*) aff. *gardeni* (BAILY, 1855); SK/GR/1983/35; Grabenbach, Gosau, Upper Austria. x 1

All specimens coated with ammonium chloride.

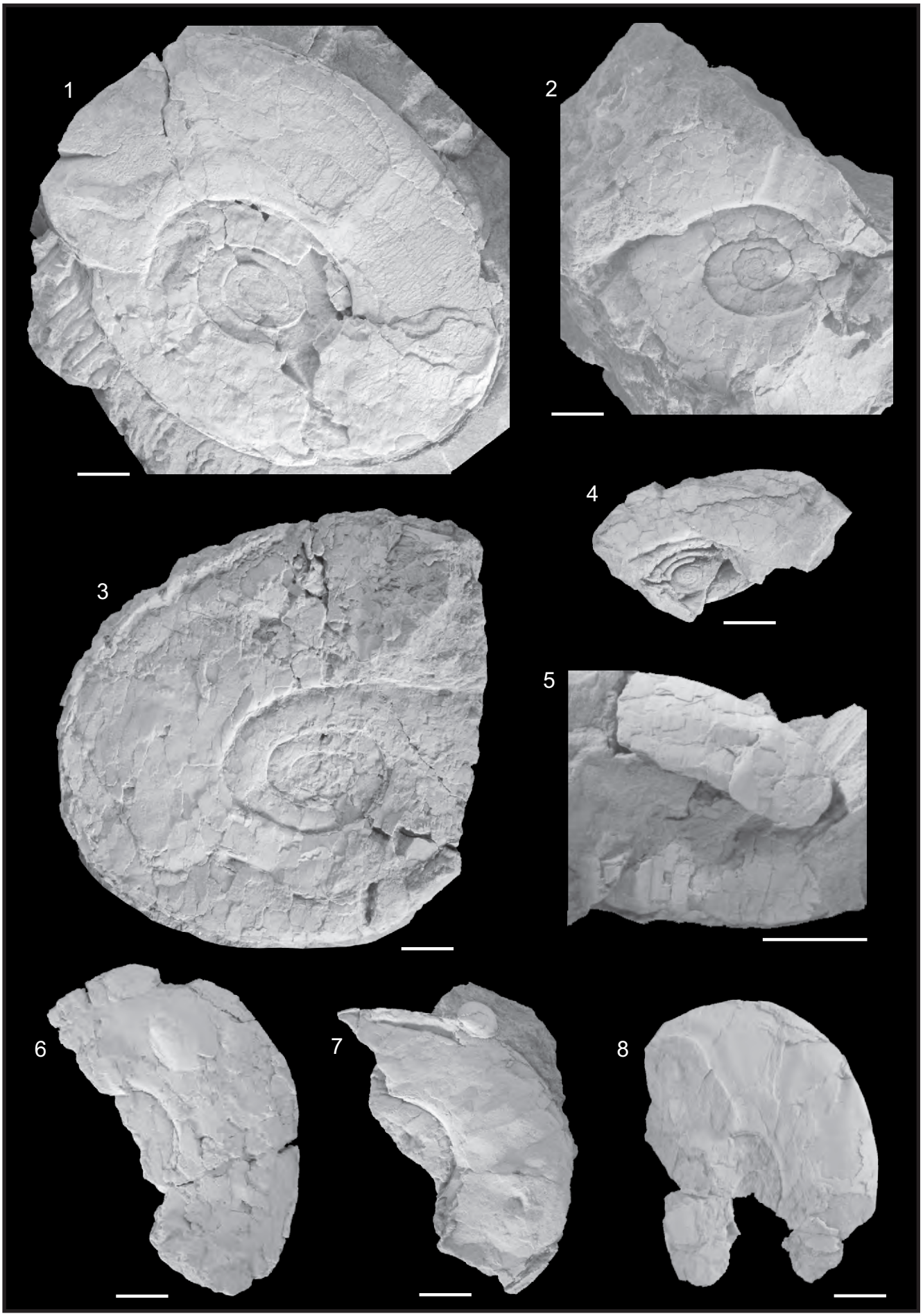
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Plate 8

Figs. 1, 2: *Damesites sugat*a (FORBES, 1846); NHMW 2013/0466/0001; Neffgraben, Rußbach, Salzburg; middle Santonian. x 1

Fig. 3: *Nowakites carezi* (DE GROSSOUVRE, 1894), juv.; NHMW 2013/0466/0002; Neffgraben, Rußbach, Salzburg; middle Santonian. x 1

Figs. 4, 5: *Damesites sugata* (FORBES, 1846); SK/NE/1991/15; Neffgraben, Rußbach, Salzburg; middle Santonian. x 2

Figs. 6, 7: *Nowakites carezi* (DE GROSSOUVRE, 1894); NHMW 1861/0001/0192; Randobach, Rußbach, Salzburg. x 1

Figs. 8, 9: *Nowakites draschei* (REDTENBACHER, 1873); NHMW 2013/0467/0001; Finstergrabenwandl, Gosau, Upper Austria; Hochmoos Formation, late Santonian. x 1

Figs. 10–12: *Nowakites draschei* (REDTENBACHER, 1873); holotype; OÖLM 1938/30; Neffgraben, Rußbach, Salzburg; middle Santonian. x 1

All specimens coated with ammonium chloride.

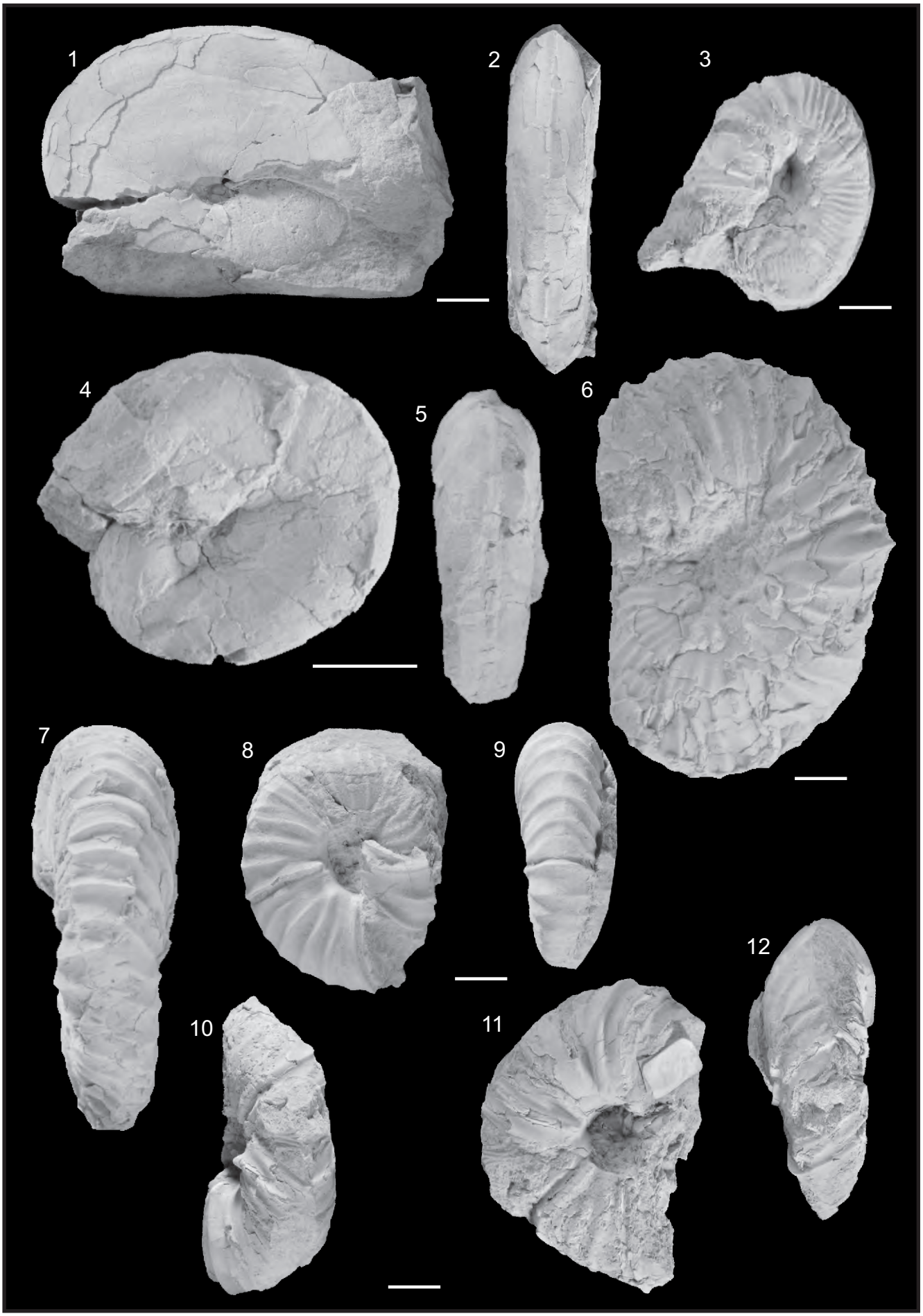
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Plate 9

Figs. 1, 2: *Nowakites savini* (DE GROSSOUVRE, 1894); NHMW 2010/0082/0001; Edlbachgraben, Gosau, Upper Austria; early Santonian. x 1

Figs. 3, 4: *Nowakites carezi* (DE GROSSOUVRE, 1894); SK/RA/2002/144; Randobach 3, Rußbach, Salzburg; early Santonian. x 1

Fig. 5: *Nowakites carezi,* juv. (DE GROSSOUVRE, 1894); SK/GR/1993/45; Tauernbach, Gosau, Upper Austria; Santonian. x 2

Figs. 6–8: *Eupachydiscus isculensis* (REDTENBACHER, 1873); SK/RA/1983/84; Randobach 2, Rußbach, Salzburg; middle Santonian. x 1

Fig. 9: *Parapuzosia* (*Parapuzosia*) *corbarica* (DE GROSSOUVRE, 1894); SK/RA/1982/78; Randobach 2, Rußbach, Salzburg; middle Santonian. x 2

All specimens coated with ammonium chloride.

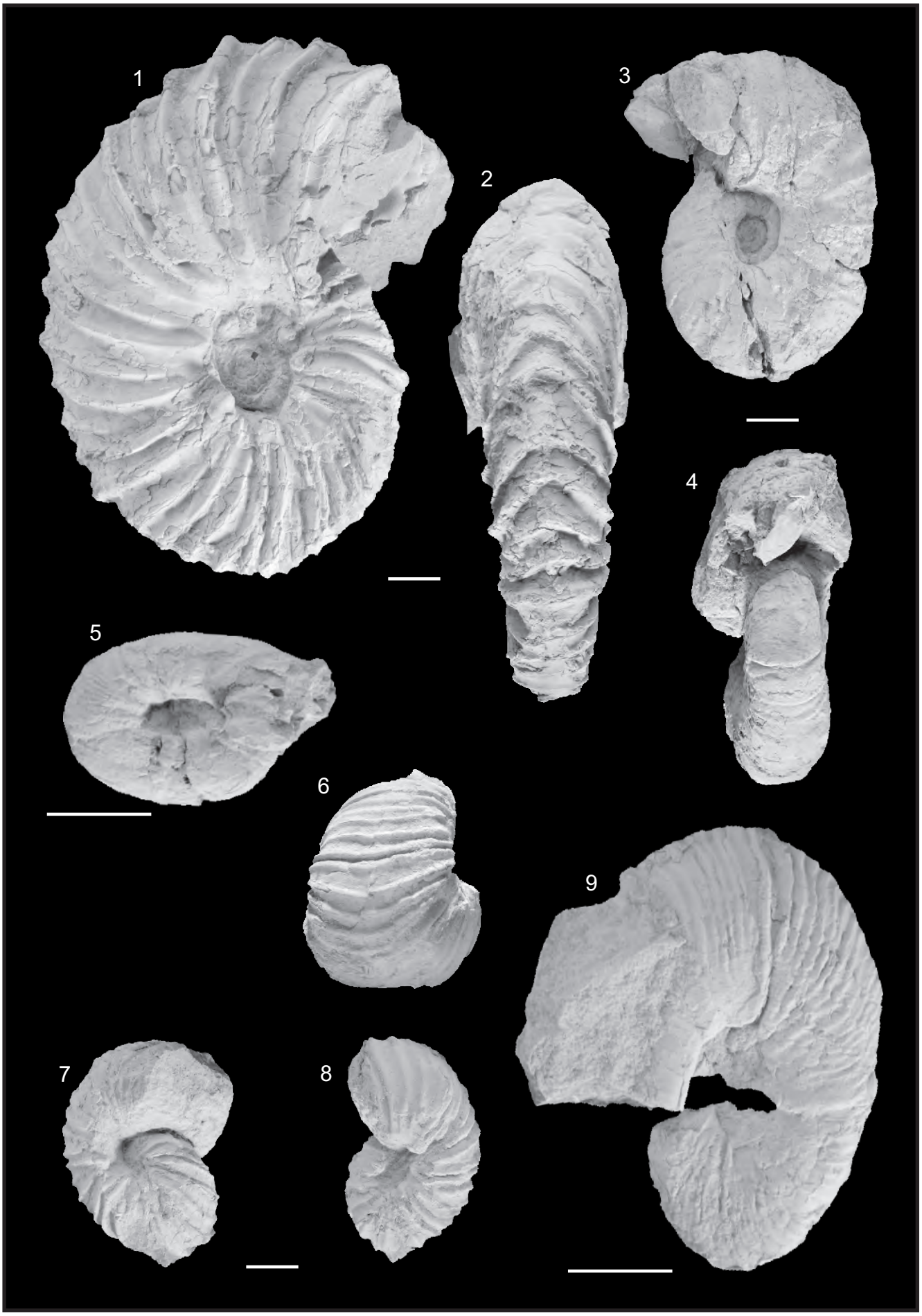
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Plate 10

Fig. 1: *Nowakites savini* (DE GROSSOUVRE, 1894); SK/RA/2014/164; Randobach 3, Rußbach, Salzburg; basal Santonian. x 1

Fig. 2: *Tragodesmoceras* aff. *clypeale* (SCHLÜTER, 1872); SK/SB/1989/4; Schneiderwirtsbrücke, Nussenseebach, Salzburg; middle Santonian. x 1

Fig. 3: *Eupachydiscus isculensis* (REDTENBACHER, 1873); microconch; SK/SB/1989/6; Schneiderwirtsbrücke, Nussenseebach, Salzburg; middle Santonian. x 2

Fig. 4: *Placenticeras paraplanum* WIEDMANN, 1978; NHMW 2014/0090/0001; Neffgraben, Rußbach, Salzburg; late Santonian, *Paraplanum* Zone. x 1

Fig. 5: *Tragodesmoceras* aff. *clypeale* (SCHLÜTER, 1872); SK/RA/1999/140; Randobach 1, Rußbach, Salzburg; middle Santonian. x 1

All specimens coated with ammonium chloride.


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Plate 11

Microconchs of *Muniericeras gosauicum* (HAUER, 1858)

Figs. 1–3: *Muniericeras gosauicum* (HAUER, 1858); neotype; NHMW 2013/0581/0001; ex Coll. Skoumal; Randobach 2, Rußbach, Salzburg; middle Santonian. x 1

Figs. 4, 7, 8: GIUW not registered; Stöckl (Grabenbach 2), Rußbach, Salzburg. x 1

Figs. 5, 6: PIUW not registered; Gosau (possibly Randobach 2), Rußbach, Salzburg; Santonian. x 2

Figs. 9, 11, 12: MA/1977/1; Randobach 2, Rußbach, Salzburg. x 1

Fig. 10: NHMW 2013/0472/0002; Neffgraben, Rußbach, Salzburg. x 1

Fig. 13: SK/GR/1981/15; Grabenbach, Gosau, Upper Austria; middle Santonian. x 1

Figs. 1–3 are uncoated, Figs. 4–13 are coated with ammonium chloride.

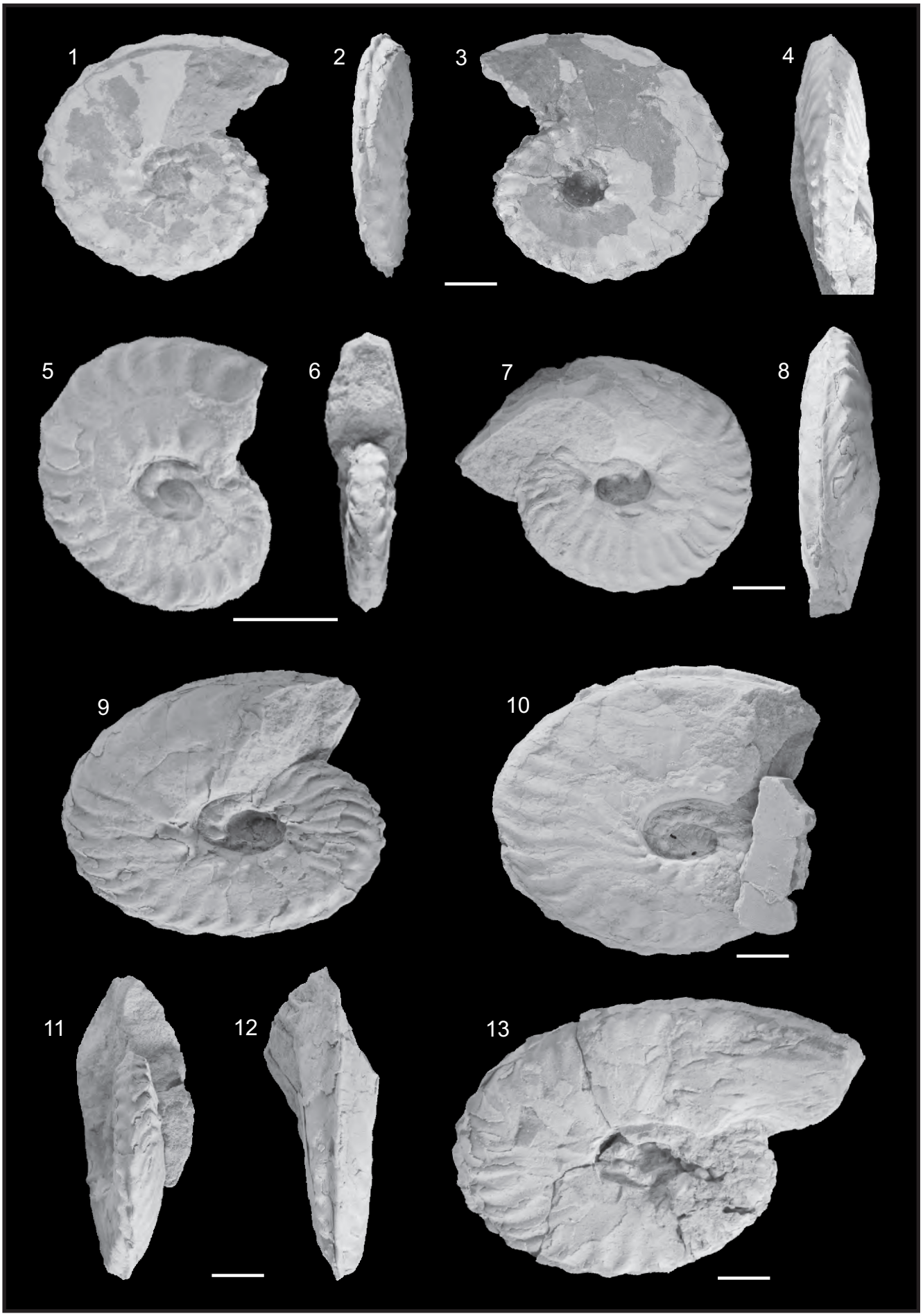
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Plate 12

Microconchs of *Muniericeras gosauicum* (HAUER, 1858)

Figs. 1, 2: NHMW 2013/0472/0001; Neffgraben, Rußbach, Salzburg; middle Santonian. x 2

Figs. 3, 6: SK/RA/1981/5; Randobach 2, Rußbach, Salzburg; middle Santonian. x 2

Figs. 4, 5: SK/RA/1981/4; Randobach 2, Rußbach, Salzburg; middle Santonian. x 2

Fig. 7: SK/RA/1981/22; Randobach 1, Rußbach, Salzburg; middle Santonian. x 1

Fig. 8: SK/RA/1982/57; Randobach 2, Rußbach, Salzburg; middle Santonian. x 2

Figs. 9, 10: NHMW/ 2012/0186/0004; Randobach 2; Rußbach, Salzburg; middle Santonian. x 2

Fig. 11: SK/GR/1981/16; Tiefengraben, Gosau, Upper Austria; middle Santonian. x 1

All specimens coated with ammonium chloride.

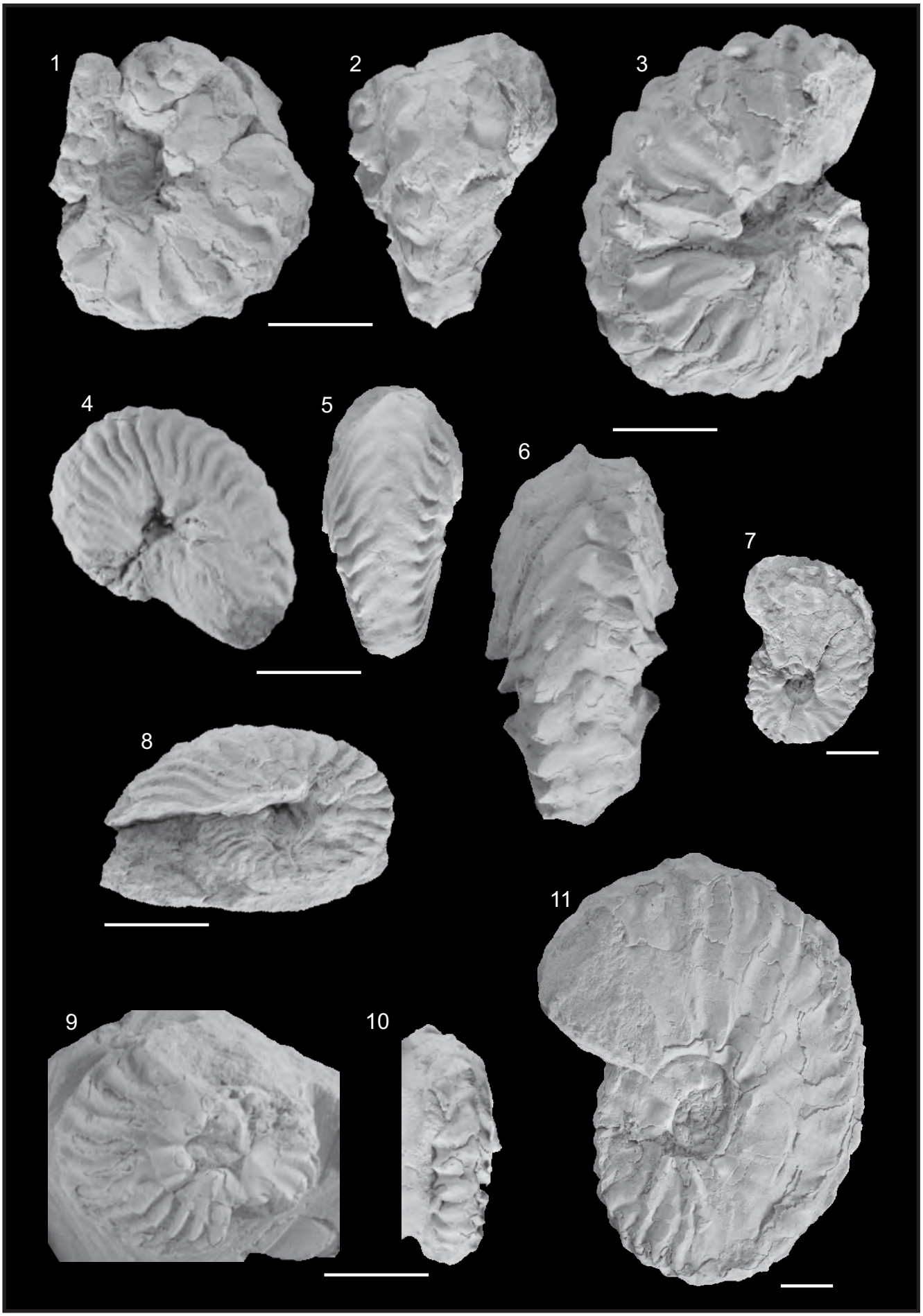
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Plate 13

Microconchs of *Muniericeras gosauicum* (HAUER, 1858)

Fig. 1: SK/NE/1989/9; Neffgraben, 20 m below "*elliptica*" Graben, Rußbach, Salzburg. x 2

Figs. 2, 3: SK/RA/1997/132; Randobach 1, Rußbach, Salzburg. x 1

Figs. 4, 5: SK/RA/1999/142; Randobach 1, Rußbach, Salzburg. x 1

Fig. 6: SK/RA/2003/147; Randobach 2, Rußbach, Salzburg. x 1

Fig. 7: SK/RA/1982/48; Randobach 2, Rußbach, Salzburg. x 1

Fig. 8: SK/RA/1990/121; Randobach 1, Rußbach, Salzburg. x 1

All specimens are from the middle Santonian and coated with ammonium chloride.

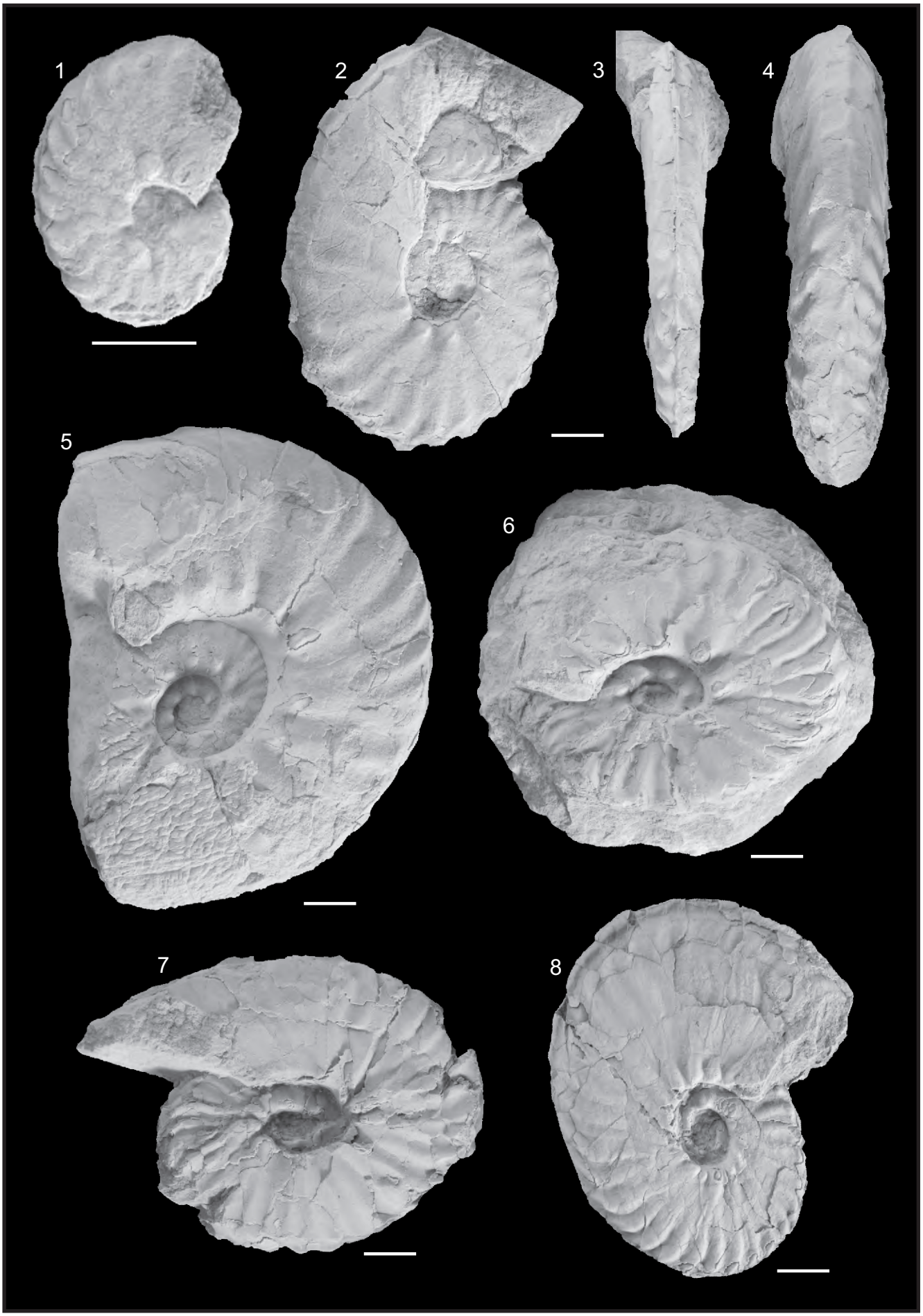
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Plate 14

Macroconchs of *Muniericeras gosauicum* (HAUER, 1858)

Fig. 1: SK/RA/1981/11; lateral view, coated with ammonium chloride.

Fig. 2: SK/RA/1981/11; lateral view, last whorl partially removed, uncoated to show sutures and change of keel ornament.

Fig. 3: SK/RA/1981/11; ventral view, coated with ammonium chloride.

All specimens are from middle Santonian, from the Randobach 1 site and figured x 0.9.


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Plate 15

Macroconchs of *Muniericeras gosauicum* (HAUER, 1858)

Fig. 1: SK/RA/1982/51; Randobach 1, Rußbach, Salzburg.

Fig. 2: SK/RA/1982/56; Randobach 2, Rußbach, Salzburg.

Fig. 3: SK/RA/1982/50; Randobach 1, Rußbach, Salzburg.

Fig. 4: SK/RA/1981/34; Randobach 1, Rußbach, Salzburg.

Fig. 5: SK/RA/1981/34; Randobach 1, Rußbach, Salzburg.

Fig. 6: SK/RA/1986/107; Randobach 1, Rußbach, Salzburg.

Fig. 7: SK/GR/2002/47; Grabenbach, Gosau, Upper Austria.

Fig. 8: SK/GR/1981/19; Grabenbach, Gosau, Upper Austria.

All specimens are from the middle Santonian, coated with ammonium chloride and figured x 1.


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Plate 16

Macroconchs of *Muniericeras gosauicum* (HAUER, 1858)

Figs. 1, 2: SK/RA/1983/81; Randobach 2, Rußbach, Salzburg.

Figs. 3, 6: SK/RA/1982/77; Randobach 2, Rußbach, Salzburg.

Figs. 4, 7: SK/RA/1982/53; Randobach 2, Rußbach, Salzburg.

Fig. 5: SK/RA/1997/131; Randobach 2, Rußbach, Salzburg.

All specimens are from the middle Santonian, are coated with ammonium chloride and figured x 1.


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Plate 17

Fig. 1: SK/NE/1989/5; Neffgraben, Rußbach, Salzburg. x 1

Fig. 2: NHMW 2010/0300/0030; parking site, Rußbach, Salzburg. x 2

Figs. 3, 4, 6: SK/RA/1984/109; Randobach 2, Rußbach, Salzburg. x 1

Fig. 5: SK/RA/1982/80; Randobach 2, Rußbach, Salzburg. x 1

Fig. 7: SK/RA/1982/46; Randobach 2, Rußbach, Salzburg. x 1

Fig. 8: SK/RA/1988/115; Randobach 1, Rußbach, Salzburg. x 1

Fig. 9: SK/RA/1981/10; Randobach 1, Rußbach, Salzburg. x 1

Figs. 1, 3–9 are macroconchs of *Muniericeras gosauicum* (HAUER, 1858), Fig. 2 is a juvenile of *Eulophoceras natalense* HYATT, 1903.
All specimens are coated with ammonium chloride.


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Plate 18

Fig. 1: *Pseudschloenbachia* (*Pseudschloenbachia*) sp. NHMW 1982/0031/0001; Randobach 2, Rußbach, Salzburg. x 1

Fig. 2: *Texasia cricki* (SPATH,1921); SEIDL/CE 00002; Randobach 3, Rußbach, Salzburg; early Santonian. x 1

Figs. 3–5: *Texanites quinquenodosus* (REDTENBACHER, 1873); SK/NE/1990/14; Neffgraben, Rußbach, Salzburg; middle Santonian. x 1

Fig. 6: *Texanites* (*T.*) *quinquenodosus* (REDTENBACHER, 1873), juv.; SK/RA/1981/19; Randobach 1, Rußbach; middle Santonian. x 1.5

Fig. 7: *Texanites* (*T.*) *quinquenodosus* (REDTENBACHER, 1873); NHMW 2015/0031/0001; Neffgraben, Rußbach, Salzburg; middle Santonian. x 1

All specimens are coated with ammonium chloride.

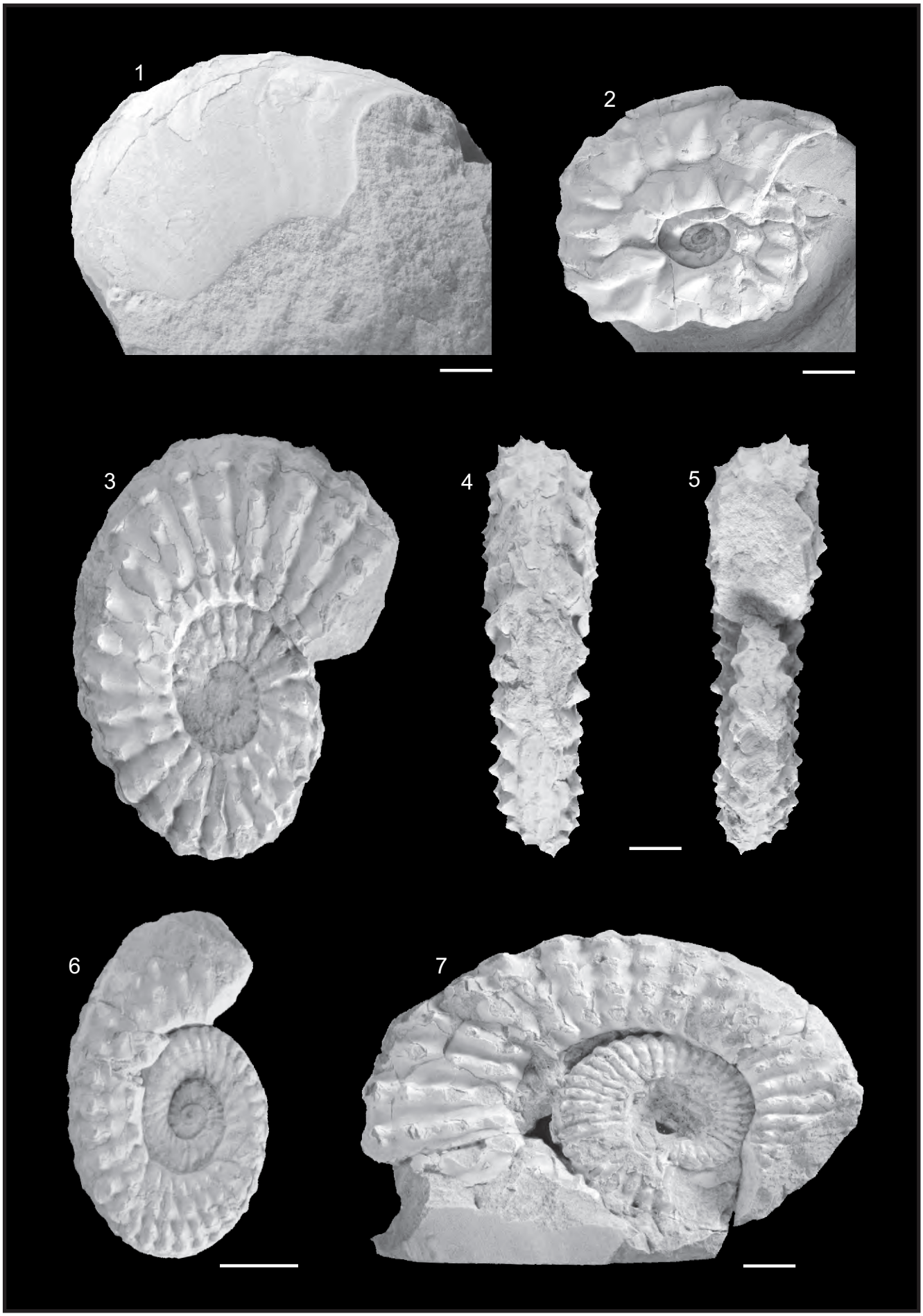
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Plate 19

Eulophoceras natalense HYATT, 1903

Fig. 1: SK/EB/1987/13b; Edlbachgraben, Gosau, Upper Austria. x 1

Fig. 2: SK/RA/1981/31; Randobach, Rußbach, Salzburg. x 2

Fig. 3: NHMW 2014/0139/0001; Windischgarsten, Upper Austria. x 1

Fig. 4: SK/EB/2011/51; Edlbachgraben, Gosau, Upper Austria. x 1

Fig. 5: SK/EB/2013/70; Edlbachgraben, Gosau, Upper Austria. x 2

All specimens are early Santonian. Figs. 1 and 2 are uncoated, Figs. 3–5 are coated with ammonium chloride.


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Plate 20

Eulophoceras natalense HYATT, 1903

Fig. 1: SK/EB/2004/35; Edlbachgraben, Gosau, Upper Austria.

Fig. 2: MA/1975/1; Edlbachgraben, Gosau, Upper Austria.

Figs. 3, 4: SK/EB/1987/13a; Edlbachgraben, Gosau, Upper Austria.

Fig. 5: NHMW 1983/0034/0002; Randobach, Rußbach, Salzburg.

Fig. 6: SK/EB/2000/21; Edlbachgraben, Gosau, Upper Austria.

Figs. 7, 8: SK/EB/1992/14; Edlbachgraben, Gosau, Upper Austria.

All specimens are early Santonian, are coated with ammonium chloride and figured x 1.

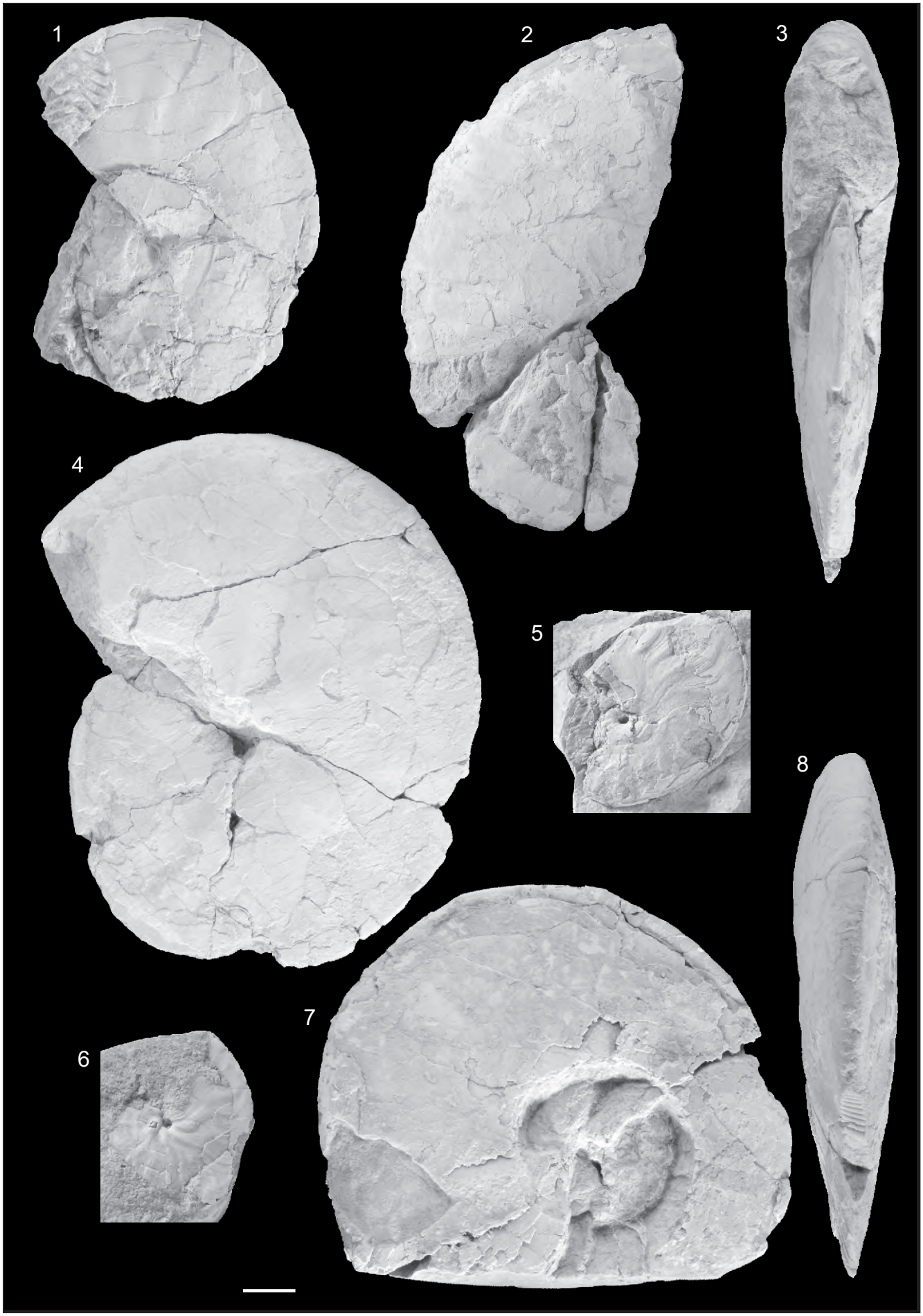
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Plate 21

Eulophoceras natalense HYATT, 1903

Figs. 1, 5: SK/EB/2013/63; Edlbachgraben, Gosau, Upper Austria. x 1

Fig. 2: SK/EB/2000/24; Edlbachgraben, Gosau, Upper Austria. x 2

Fig. 3: SK/EB/2012/55; Edlbachgraben, Gosau, Upper Austria. x 2

Fig. 4: SK/RA/1982/76; Randobach, Rußbach, Salzburg. x 2

Fig. 6: SK/RA/1981/29; Randobach, Rußbach, Salzburg. x 1

Fig. 7: SK/EB/2009/46; Edlbachgraben, Gosau, Upper Austria. x 2

Fig. 8: SK/EB/2012/55; Edlbachgraben, Gosau, Upper Austria. x 2

Fig. 9: SK/EB/1985/2; Edlbachgraben, Gosau, Upper Austria. x 2

Fig. 10: SK/EB/2003/29; Edlbachgraben, Gosau, Upper Austria. x 2

Fig. 11: SK/RA/2000/143b; Randobach, Rußbach, Salzburg. x 2

All specimens are early Santonian and are coated with ammonium chloride.

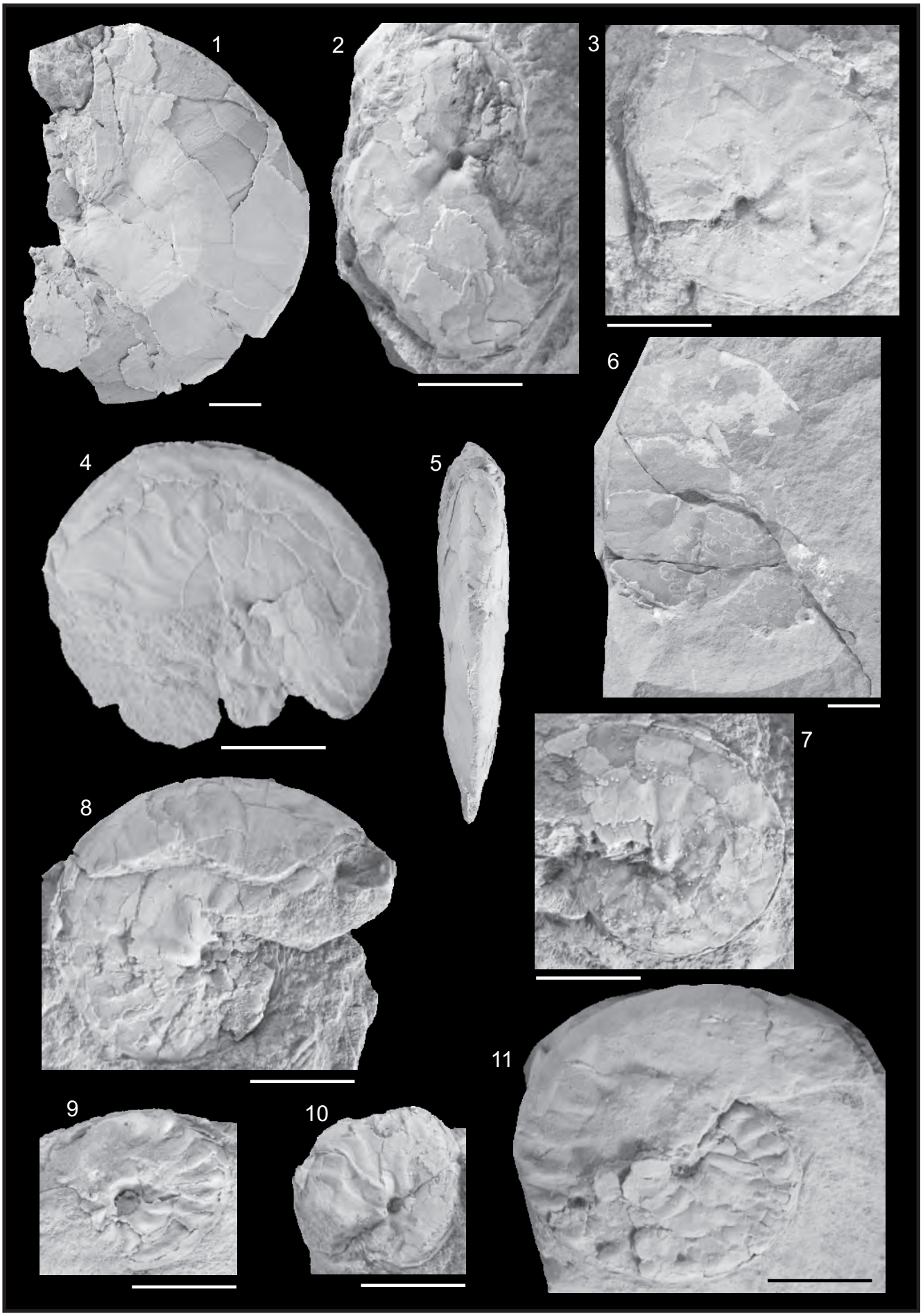
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Plate 22

Eulophoceras natalense HYATT, 1903

Figs. 1, 2: SK/RA/1983/86; Randobach, Rußbach, Salzburg.

Fig. 3: SK/EB/2003/28; Edlbachgraben, Gosau, Upper Austria.

Fig. 4: SK/RA/1981/31; Randobach, Rußbach, Salzburg.

Fig. 5: NHMW 1983/0034/0002; Randobach, Rußbach, Salzburg.

Fig. 6: NHMW 2014/0138/0002; Markt Piesting, Lower Austria.

All specimens are early Santonian, coated with ammonium chloride and figured x 2.

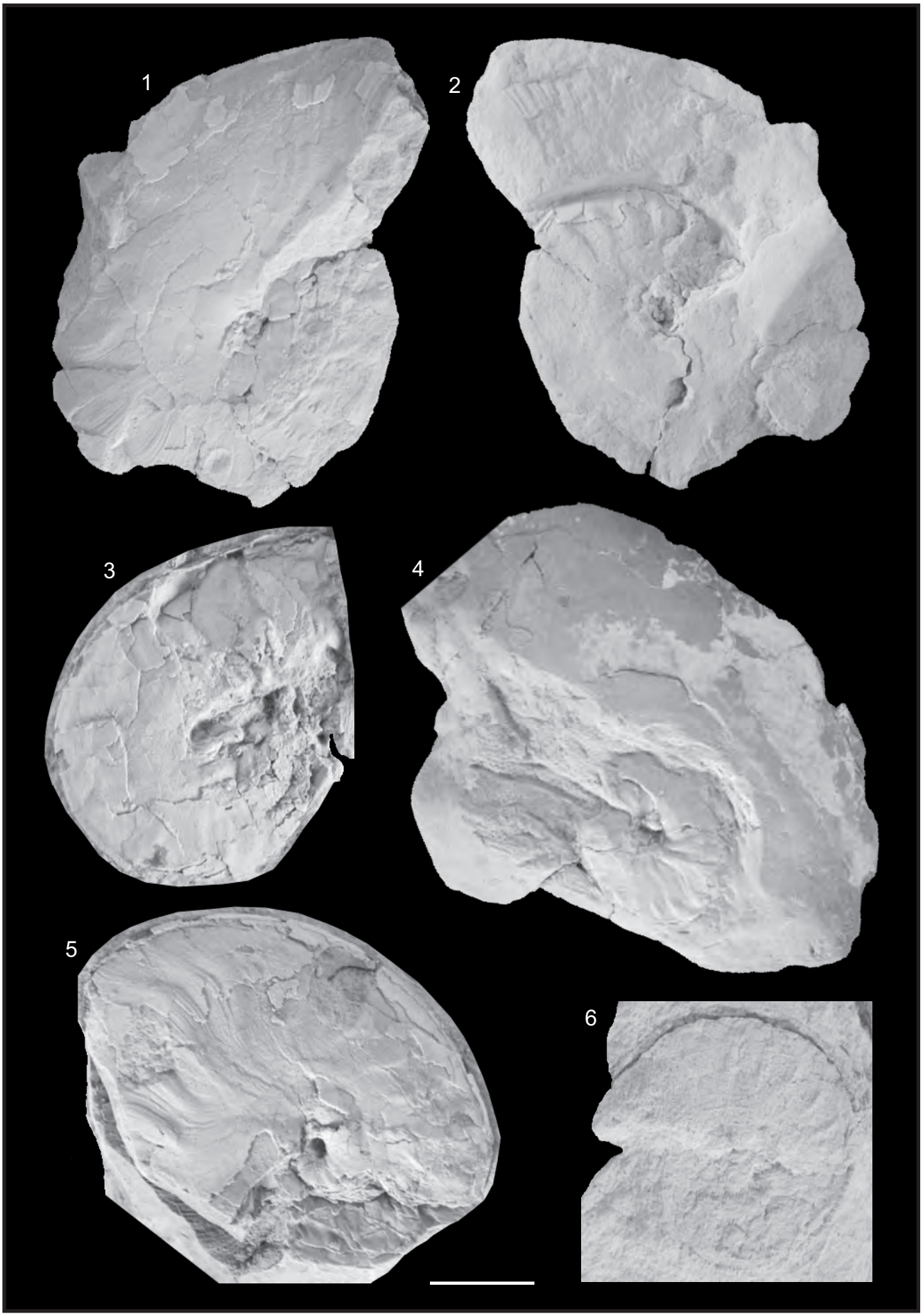
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Plate 23

Eulophoceras natalense HYATT, 1903

Figs. 1, 2: SK/RA/1984/103; Randobach 3, Rußbach, Salzburg. x 2

Figs. 3, 7: SK/RA/1982/74a; Randobach 3, Rußbach, Salzburg. x 2

Fig. 4: NHMW 2014/0138/0001; Markt Piesting, Lower Austria. x 1

Fig. 5: NHMW 2014/0137/0001a; Unterlaussa, Upper Austria. x 2

Fig. 6: NHMW 1982/0036/0001; Stöcklwaldgraben, Randobach, Rußbach, Salzburg. x 1

Fig. 8: SK/RA/1981/28; Randobach 3, Rußbach, Salzburg. x 2

Fig. 9: SK/EB/1985/3; Edlbachgraben, Gosau, Upper Austria. x 2

Fig. 10: SK/RA/1981/1b; Randobach 3, Rußbach, Salzburg. x 2

Fig. 11: SK/RA/1981/1g; Randobach 3, Rußbach, Salzburg. x 2

Fig. 12: NHMW 1983/0034/0001; Randobach 3, Rußbach, Salzburg. x 1

Fig. 13: SK/RA/1981/1c; Randobach 3, Rußbach, Salzburg. x 2

Fig. 14: SK/RA/1982/73; Randobach 3, Rußbach, Salzburg. x 2

Fig. 15: SK/RA/1981/1e; Randobach 3, Rußbach, Salzburg. x 2

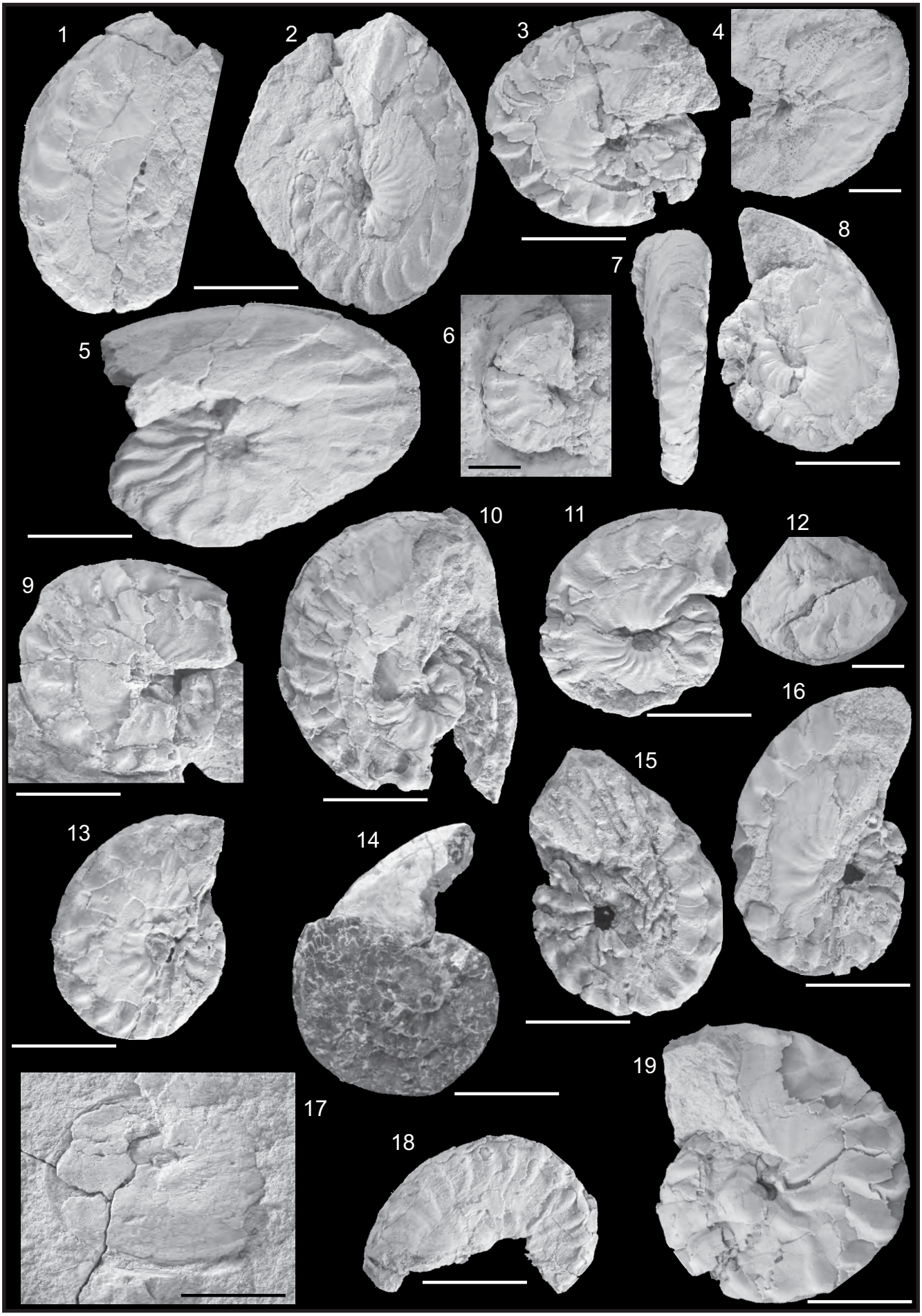
Fig. 16: SK/RA/1981/1d; Randobach 3, Rußbach, Salzburg. x 1

Fig. 17: NHMW 1982/0032/0001; Grabenbach, Gosau, Upper Austria. x 2

Fig. 18: SK/RA/1981/1h; Randobach 3, Rußbach, Salzburg. x 2

Fig. 19: SK/RA/1981/44; Randobach 3, Rußbach, Salzburg. x 2

All specimens are microconchs and are early Santonian; all but Fig. 14 are coated with ammonium chloride.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