On late Santonian ammonites from the Hofergraben Member (Gosau Group, Upper Cretaceous, Austria)

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Ammonites; Late Cretaceous; Northern Calcareous Alps; Gosau Group; Hofergraben Member; Austria

KEYWORDS: Ammonites; Late Cretaceous; Northern Calcareous Alps; Gosau Group; Hofergraben Member; Austria

Abstract

11 ammonite taxa are described from the upper Santonian of the Hofergraben site (Gosau Group; Upper Austria): Pachydiscidae gen. et sp. indet. juv., Placenticeras polyopsis (Dujardin, 1837), Placenticeras paraplanum Wiedmann, 1978, Placenticeras aff. maherndli Summesberger, 1979, Texanites quinquenodosus Redtenbacher, 1873, Eulophoceras jacobi Hourcq, 1949, Jouaniceras hispanicum Wiedmann, 1994, ? Jouaniceras sp., Eubostrychoceras acuticosatum (d’Orbigny, 1842), Glyptoxoceras crispatum (Moberg, 1885), Baculites fuchsi Redtenbacher, 1873. Jouaniceras hispanicum Wiedmann, 1994 and Eubostrychoceras acuticosatum (d’Orbigny, 1842) are recorded for the first time from the Gosau Group confirming the close connection with the Upper Cretaceous of the Corbières (France: Kennedy in Kennedy et al. 1995).

Figure 1: A. Schematic geological map of the Eastern Alps. Occurrences of Gosau Group sediments (black), brick symbol: Northern Calcareous Alps. After Summesberger et al. (2017a). B. Local sketch map of parts of the Gosau Basin, with modifications after Summesberger et al. (2017a) indicating the localities mentioned in the text.
their richness in macrofossils and for their contributions to Upper Cretaceous stratigraphy (e.g. Summesberger, 1985; Wagreich et al., 2009).

The late Santonian Sandkalkbank Member of the Hochmoos Formation is a distinct marker bed of about 20 metres thickness. It extends from the junction of the “elliptica” Graben (Gerrth, 1961, fig. 3) with the Neffgraben (Russbach, Salzburg), continues along the slope of the Schattau (Russbach, Salzburg) turns around the Bibereck where it appears in the “Finstergrabenwandl”. On the opposite side of the Gosau valley it loses its distinct character and terminates in the Hofergraben (Gosau, Upper Austria). The fauna of the Sandkalkbank Member was described by Wiedmann (1978: ammonites), Summesberger (1979, 1980: ammonites), Kollmann (1980: gastropods), Dhondt (1984: bivalves) and Summesberger et al. (2017c: ammonites).

The Hofergraben Member of the Hochmoos Formation, underlying the Sandkalkbank Member, is well-known for the excellent preservation of abundant bivalves (e.g. the type specimen of Cordiceramus muelleri (Petrascheck, 1906); fide Dhondt, 1987) and gastropods (Zekeli, 1852; Zittel, 1865–1866; Felix, 1908). In this paper cephalopods from the Hofergraben are described augmenting the previously described late Santonian cephalopod faunas noted above.

2. Geological Setting

The Hofergraben locality is situated in the Upper Austrian part of the Gosau Basin. The Gosau Basin exposes a sedimentary sequence, the Gosau Group, that ranges from Upper Turonian to Eocene. It begins with terrestrial conglomerates (the Kreuzgraben Formation) and coal bearing strata of the Neu-alm (Salzburg), where the ammonite Barroisiceras haberfellneri (Hauer, 1858) indicates a late Turonian age. The early Santonian Grabenbach and Hochmoos formations of the Lower Gosau Subgroup were deposited under shallow marine conditions. The highly fossiliferous Hofergraben Member and the Sandkalkbank Member of the Hochmoos Formation record the end of this shallow marine period, which was followed in the Campanian by increasing subsidence and the deep water deposits of the Upper Gosau Subgroup (Ressen Formation, Nierental Formation). The Maastrichtian to Eocene Zwieselalm Formation marks the end of marine sedimentation.

![Figure 2: Composite section of the Gosau Group in the Gosau area indicating the position of the Hofergraben Member (with revisions after Summesberger et al. 2017c).](image-url)
On late Santonian ammonites from the Hofergraben Member (Gosau Group, Upper Cretaceous, Austria)

(Wagreich and Decker, 2001).

3. Repositories of specimens

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<td>Natural History Museum, Vienna, Austria (Wagreich and Decker, 2001).</td>
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<td>Geologische Bundesanstalt (Geological Survey of Austria, former k. k. Geologische Reichsanstalt); Vienna, Austria (Wagreich and Decker, 2001).</td>
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<tr>
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<td>Dr. Peter Skoumal collection, Vienna, Austria (Wagreich and Decker, 2001).</td>
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<tr>
<td>GBT</td>
<td>Geologisch Paläontologisches Institut der Universität Tübingen</td>
<td>Geologisch Paläontologisches Institut der Universität Tübingen (Wagreich and Decker, 2001).</td>
</tr>
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</table>

4. Systematic Palaeontology

Class Cephalopoda Cuvier, 1797
Order Ammonoidea Zittel, 1884
Suborder Ammonitina Hyatt, 1889
Superfamily Desmoceratoidea Zittel, 1895
Family Placenticeratidae Hyatt, 1900
Genus Placenticeras Meek, 1876

Type species: Ammonites placenta DeKay, 1828, p. 278, pl. 5, fig. 2 by original designation of Meek, 1876, p. 442.

Placenticeras aff. maherndl Summesberger, 1979
Fig. 7/4, 5; Tab. 2

1979 Placenticeras maherndl Summesberger, p. 155, pl. 14, fig. 58-61; pl. 15, figs 62-66.

1995 Placenticeras maherndl Summesberger; Kennedy in Kennedy et al., p. 411, pl. 22, fig. 7.

Type: the holotype, by original designation, is MA 77/2, form A, the original of Summesberger, 1979 (pl. 14, fig. 58, 59).


Description: SK/HO/1995/7 (Fig. 7/4, 5), SK/HO/1989/6 and NHMW/2016/0191/0001 are fragments of internal moulds with large areas of the original shell preserved. NHMW/2016/0191/0001 is heavily crushed. SK/HO/1995/7 is the best preserved individual. All three specimens are deformed into an ellipse. Measurements (Tab. 2) are restored.

Table 1: Measurement of Placenticeras aff. maherndl Summesberger, 1979 from the Hofergraben site. Deformed dimensions are restored (rest).

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Table 2: Measurement of Placenticeras maherndl Summesberger, 1979 from the Hofergraben site. Deformed dimensions are restored (rest).

<table>
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<td>U</td>
<td>5</td>
<td>5</td>
<td>--</td>
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</table>

Discussion: Placenticeras aff. maherndl differs from Placenticeras maherndl Summesberger, 1979 in its fine lirate ribbing (see MA 1977/3: Summesberger, 1979, pl. 15, fig. 63).

Occurrence: Placenticeras aff. maherndl occurs in the upper Santonian Gosau Group of the Hofergraben only (Gosau, Upper Austria).

Placenticeras polyopsis (Dujardin, 1837), juv.
Fig. 6/6, 7

1837 Ammonites polyopsis Dujardin, p. 232, pl. 17, fig. 12.
1903 Placenticeras depressum Hyatt, p. 237.
1935 Placenticeras depressum; Brinkmann, p. 5.
1978 Stantonoceras depressum (Hyatt); Wiedmann, p. 665; pl. 1, figs 1, 2.
1979 Stantonoceras depressum (Hyatt); Summesberger, p. 145; pl. 10, figs 42, 43; pl. 11, figs 44-47; pl. 12, figs 48-52, text-figs...
31-37 (with synonymy).
1983 *Placenticeras polyposis* (Dujardin, 1837); Kennedy and Wright, p. 156, pls. 85, 86, text-figs 1-4 (with synonymy).
1995 *Placenticeras polyposis* (Dujardin, 1837); Kennedy in Kennedy et al. (p. 410, pl. 17, figs. 2-7, 9, 10; pl. 18, fig. 7.12; fig. 21. (with additional synonymy).
2017c *Placenticeras polyposis* (Dujardin, 1837); Summesberger et al., in press, pl. 10, figs 6a-b.

**Lectotype:** the original of Dujardin (1837: pl. 17, fig. 12a) designated by Kennedy and Wright (1983: p. 856).

**Material:** SK/HO/1989/4 a single juvenile individual.

**Description:** The single specimen SK/HO/1989/4 (Fig. 6/6, 7) is a well preserved juvenile of about 30 mm diameter. The umbilicus measures 4.4 mm. The whorl height is about 10 mm. There are 10 prorsiradiate umbilical bullae. They efface on the outer third of the flank, and may or may not link to the strong ventrolateral clavi. The flanks are irregular and very flat; there are narrow ventrolateral ridges, the venter is flat. The sutures are not visible. The aperture is not preserved.

**Occurrence:** *Placenticeras polyposis* (Dujardin, 1837) is common in the upper Santonian of the Finstergarbenwandl Member (Summesberger, 1979, Summesberger et al., 2017c. In the Corbières it ranges through the whole Santonian (Grossouvre, 1894; Kennedy in Kennedy et al., 1995). It seems to be limited to the upper Santonian in the Gosau Group.

**Family and Subgenus**

**Subfamily Texanitinae** Collignon, 1948

**Genus** *Texanites* Spash, 1932

**Type species:** *Texanites texanus* F. Roemer, 1852 by original designation of Spath, 1932

*Texanites (Texanites) quinquenodosus* (Redtenbacher, 1873) not figured

1854 *Ammonites texanus* ?; Reuss, p. 24, 41.
1858 *Ammonites texanus* von Hauer (non Römer, 1852); p. 10, pl. 2, fig. 4–6.
1873 *Ammonites quinquenodosus* Redtenbacher; p. 108; pl. 24, fig. 3.
1948 *Texanites quinquenodosus* (Redtenbacher); Collignon, p. 69.
1981 *Texanites quinquenodosus* (Redtenbacher); Kennedy, Klinger and Summesberger, p. 126, fig. 8–16 (with synonymy).
2012 *Texanites quinquenodosus* (Redtenbacher, 1873); Summesberger and Zorn, pp. 6, 7; pl. 15, fig. 1; pl. 16, fig. 1.
2017a *Texanites (Texanites) quinquenodosus* (Redtenbacher, 1873); Summesberger et al., in press, pl. 19, figs. 3-7 (with synonymy).

**Lectotype:** is GBA 1873/01/13, the original of Redtenbacher (1873, pl. 24, Fig. 3a, b) from the Santonian Gosau Group of St. Wolfgang, refugirued by Kennedy et al. (1981: p. 128, fig. 8).

**Material:** NHMW 1864/0001/0730, a single specimen from the collection of the Natural History Museum Vienna.

**Description and Discussion:** NHMW 1864/0001/0730 is a large fragment of originally about 120 mm in diameter, broken into pieces but nevertheless identifiable by the preserved characteristics. A larger part of the fragment was figured by Kennedy et al. (1981, Fig. 9 C).

**Occurrence:** *Texanites quinquenodosus* Redtenbacher, 1873 is one of the more common ammonites occurring in the Gosau Group. Its stratigraphic range extends from basal Santonian through lower and middle Santonian. Stratigraphically lowest occurrences are at the Randobach of Russbach (Salzburg), the Stöcklwaldgraben (a side creek of the Randobach), at the Schneiderwirtsbrücke, often co-occurring with *Cladoceras undulatoplicatus*. Its stratigraphically highest position is below the Sandkalkbank Member in the Neffgraben (Russbach, Salzburg). Its occurrence at the Hofergraben is therefore older than the recently collected upper Santonian fauna described herein.

**Type species:** *Eulophoceras natalense* Hyatt, 1903, p. 86, pl. 11, figs 2-6, by original designation.

*Eulophoceras jacobi* Hourcq, 1949

Fig. 4/1-8; Tab. 3

1949 *Eulophoceras Jacobi* Hourcq; p. 95, pl. 1, fig. 2.
1969 *Eulophoceras Jacobi* Hourcq; Collignon, p. 204, pl. 600, fig. 2253.
1979 *Skoumalia austriaca* Summesberger 1979, form B; p. 143, pl. 9, fig. 39-41, text-fig. 29, 30.
non 1979 *Skoumalia austriaca* Summesberger, form A, p. 141, pl. 9, fig. 37-38, text-fig. 26, 27, 28 (= *Diaziceras austrium* (Summesberger, 1979)).
1980 *Skoumalia austriaca* Summesberger, form B; Summesberger, p. 280, pl. 2, fig. 5–6; pl. 3, fig. 7-8; text-fig. 5, 6. 1982 *Skoumalia austriaca* Summesberger; Kollmann and Summesberger, p. 49, partim.
1985 *Eulophoceras austricum,* “forme B” (Summesberger); Amédro and Hancock, p. 23–24; fig. 11 d, e.
1987 *Eulophoceras austrium* (Summesberger 1979); Immel, p. 113, partim.
1987 *Eulophoceras austrium* (Summesberger, 1979); Kennedy, p. 776, pl. 82, fig. 1–3.
1995 *Eulophoceras austrium* (Summesberger, 1979); Kennedy in Kennedy et al., p. 426; pl. 26, fig. 8; text-fig. 33.
non 1995 *Eulophoceras austrium* (Summesberger, 1979); Kennedy in Kennedy et al., Pl. 25, Fig 3–5; text-fig. 34 (= *Dia-
**Eulophoceras austriacum** (Summesberger, 1979).

Non 1995 *Eulophoceras austriacum* (Summesberger, 1979); Lomzerheim, p. 61, Pl. 5, Fig. 2.

2000 *Eulophoceras austriacum* (Summesberger, 1979); Summesberger in: Egger et al., p. 26, partim.

2012a *Eulophoceras jacobi* Hourcq; Kennedy and Klinger, p. 32, 35; fig. 4, 12 A-C.

2017c *Eulophoceras jacobi* Hourcq, 1949; Summesberger et al., in press, pl. 10, Figs. 2-5, Text-fig. 17.

**Lectotype:** is the original of Hourcq (1949: pl. 11, fig. 2, text-fig. 7) subsequently designated and refigured by Kennedy and Klinger (2012a, p. 35; text-fig. 12 A-C).

**Material:** 11 specimens: SK 1979/3; SK/HO/1989/5a, b; SK/HO/2003/9, 10, 11, 12; SK/HO/2004/14, 15, 16, 20; (+ 9 specimens from Hofergraben, collection Skoumal).

**Discussion:** Hourcq (1949: pl. 11, fig. 2, text-fig. 7) subsequently designated and refigured by Kennedy and Klinger (2012a, p. 35; text-fig. 12 A-C).

**Occurrence:** *Eulophoceras jacobi* Hourcq, 1949 occurs in the upper Santonian of the Hofergraben Member of the Upper Gosau Subgroup of the Hofergraben (Gosau, Upper Austria) and in the stratigraphically very close Finstergrabenwandl. It was described originally by Hourcq, 1949 from the top Santonian of Madagascar. It was furthermore described under *Eulophoceras austriacum* (Summesberger) “forme B” by Amédro and Hancock 1985 (p. 23, 25; figs 11 d, e) form B fell into synonymy of *Eulophoceras austriacum* (Summesberger).

**Type species:** *Heteroceras ? sicardi* DE GROSSOUVRE, 1894, pl...
Jouaniceras hispanicum  Wiedmann, 1994
Fig. 5/1-6, 8, 9, 11, 12; Tab. 4

Grossouvre (1894) established Heteroceras Sicardi already in a footnote (p. 224) contradicting his own assignment (p. 223) of “Lytoceras Sicardi n.sp.” for reasons of an early developmental stage with different orientation of the whorls. Basse (1939, p. 43, pl. 3, fig. 3-7, p. 42, text-fig. 1) and Kennedy in Kennedy et al. (1995, p. 429, pl. 28, fig. 1-8) followed this argument and figured the early helical stage. A further difference is the lack of uncoiling of the body chamber in J. sicardi. The different ribbing of holotype and paratype of Jouaniceras hispanicum should be mentioned, the holotype (GPII 1755/1; pl. 43, fig. 2) has narrow ribs (rib index 5) and distinct uncoiling, whereas the paratype IGD Ce 0121 (pl. 43, fig.1) has widely separated straight ribs (rib index 3). In both specimens of J. hispanicum figured and described by Wiedmann (1994) the early growth stage is not preserved. Jouaniceras ? sp. described by Klinger et al. (2007) differs in its larger size and in its flared main ribs, with much finer secondary ribs between.

Heteroceras (?) cfr. Sicardi de Grossouvre described from the Upper Cretaceous of Florence, Italy (Desio, 1920, p. 233, pl. 5, fig. 3) was noted by Wiedmann (1994, p. 232) as “quite different to both species (‘sicardi’ and ‘hispanicum’) and may represent a third one”. Kennedy in Kennedy et al. (1995, p. 429) quoted Heteroceras (?) cfr. Sicardi de Grossouvre, Desio, 1920 with a question mark in the synonymy. Given its rapidly increasing whorl height (Desio, 1920, pl. 5, fig. 3) and accompanying Coniacian ammonites (e.g. Peroniceras sp.) it seems even questionable that the specimen is a Jouaniceras. ? Jouaniceras sp. described below differs in its straight shafts with an indication of a curved continuation.


Table 4: Measurements of Jouaniceras hispanicum from the upper Santonian of the Hofergraben (Gosau, Upper Austria). Intercost. = intercostal

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<th>Wb</th>
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<td>5.9</td>
<td>5.1</td>
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<td>28.3</td>
<td>6.8</td>
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<td>8.8</td>
<td>6</td>
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<td>25</td>
<td>4.9</td>
<td>4.3</td>
<td>3.0</td>
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<tr>
<td>SK/HO/1989/2c</td>
<td>26.5</td>
<td>8.7</td>
<td>4.5</td>
<td>--</td>
</tr>
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<td>SK/HO/1989/2d</td>
<td>20.3</td>
<td>4.8</td>
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<td>--</td>
</tr>
<tr>
<td>SK/HO/1989/2e</td>
<td>21.0</td>
<td>6.5</td>
<td>6.5</td>
<td>3.3</td>
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</tbody>
</table>

Material: two specimens, SK/HO/1989/1e, SK/HO/1989/1f

Description: Both specimens are straight shafts (33 mm, 47.5 mm length) with a suggestion of a curved continuation. The whorl section is circular, the diameter is about 4.5 mm. SK/HO/1989/1f (fig. 5/7) has even, regular, oblique rursiradiate ribs that encircle the whorl. The ribs are narrow and sharp, the interspaces narrow. There are no flared ribs, bifurcations, nor tubercles. SK/ HO/1989/1e (fig. 5/10) is partially embedded in matrix. This specimen is curved at one of the ends (?) adapertural. Ribbing is similar to, but somewhat wider spaced than in SK/HO/1989/1f.

Discussion: Jouaniceras sicardi (de Grossouvre, 1894) differs from J. hispanicum in its helical early whorls (see Kennedy in Kennedy et al. 1995, pl. 28, fig. 2-7; Basse 1939, pl. 3, fig. 4-6) which are perpendicular to the succeeding planispiral whors.

1994 Jouaniceras hispanicum n. sp., Wiedmann, p. 232, pl. 43, fig. 1, 2; text-fig. 16 a.
1995 Jouaniceras hispanicum, Wiedmann; Kennedy in Kennedy et al., p. 429.

Type: The holotype by original designation of Wiedmann (1994, p. 232, pl. 43, fig. 2; text-fig. 16 a) is GPII 1755/1 from the middle Santonian of Puerto de Vitoria (Alava), paratype is IGD Ce0121 (Wiedmann, 1994, p. 232, pl. 43, fig. 1).

Material: SK/HO/1989/1a, b, c, d, e, f; SK/HO/1989/2a, b, c, d; NHMW 2017/0050/0001, 2.

Description: SK/HO/1989/2a is a slightly deformed internal mould with adherent shell fragments. Three inner whorls of the individual are coiled in a plane. The body chamber uncoils from the last quarter of the fourth whorl. The three inner whorls measure 25 mm (restored) in diameter. Including the uncoiled body chamber the diameter would be (restored) about 45 mm. Whorl height increases from 2 mm on the innermost whorl to 7 mm, and up to 8 mm close to the aperture. The very shallow umbilicus measures 3 mm in diameter. The whorl section is rounded, with a dorsal depression that housed the dorsum of the previous whorl (Wiedmann, 1994, fig. 16 A). Approximately 35 sharp and narrow ribs per whorl are straight, single and encircle the whorl. The interspaces are much wider than the ribs. Rib density increases markedly towards the aperture (Fig. 5/5). SK/HO/1989/1c (Fig. 5/12) is a crushed fragment. It also shows the uncoiled body chamber and the increase in rib density at the aperture. All specimens available have neither constrictions nor tubercles nor flared ribs. The sutures are not exposed. Uncoiling of the body chamber of Jouaniceras hispanicum Wiedmann, 1994 (pl. 43, fig. 2) can be observed in Fig. 5/5.

37, fig. 6, 11), by original designation by Basse, 1939.

Jouaniceras hispanicum Wiedmann, 1994
Fig. 5/1-6, 8, 9, 11, 12; Tab. 4
**Occurrence:** The occurrence of Jouaniceras sp. at the Hofergraben site is the only record so far from the Austrian Gosau Group.

**Genus Eubostrychoceras** Matsumoto, 1967

**Type species:** Eubostrychoceras indopacificum Matsumoto, 1967, p. 33, pl. 18, fig. 1, by original designation.

*Eubostrychoceras acuticostatum* (d’Orbigny, 1842) is closely related to Jouaniceras.

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<td>5.0&lt;sub&gt;rest&lt;/sub&gt;</td>
<td>5.0&lt;sub&gt;rest&lt;/sub&gt;</td>
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Table 5: Measurements of questionable fragments of body chambers of Jouaniceras sp. from the upper Santonian of the Hofergraben (Gosau, Upper Austria); <sub>adap</sub> = adapical; <sub>adap</sub> = adoral; <sub>rest</sub> = restored; L = length.

**Discussion:** Co-occurrence and similar ribbing leads to the assumption that both specimens are related to Jouaniceras.

**Family Diplomoceratidae** Spath, 1926

**Subfamily Diplomoceratinae** Spath, 1926

**Genus Glyptoxoceras** Spath, 1925

**Type species:** Glyptoxoceras crispatum (Moberg, 1885) Fig. 6/1, 2, 3, 4

1885 *Anisoceras* (Hamites ?) *crispatum* Moberg, p. 32; pl. 3, figs 12, 13.
1979 ? *Diplomoceras* (Subgenus ?) *tenuisulcatum* (Forbes); Summesberger, p. 124, pl. 3, fig. 21.
1982 *Diplomoceras* (Glyptoxoceras) *indicum* (Forbes, 1846); Immel et al., p. 26; pl. 10, fig. 5, 6.
1982 *Diplomoceras* (Glyptoxoceras) *subcompressum* (Forbes, 1846); Immel et al., p. 26; pl. 10, fig. 7.
1987 *Diplomoceras* (Glyptoxoceras) *subcompressum* (Forbes, 1846); Immel, p. 136, partim.
1995 *Glyptoxoceras crispatum* (Moberg, 1885), Kennedy in: Kennedy et al., p. 430, pl. 27, figs 16, 24; pl. 29, figs 1, 8, 11, 19, 20 (with synonymy).
2000 *Glyptoxoceras crispatum* (Moberg, 1885); Kennedy and Kaplan, p. 96; pl. 34, fig. 2.
2010 *Glyptoxoceras crispatum* (Moberg, 1885); Wagreich et al. p. 185.
2017b *Glyptoxoceras crispatum* (Moberg, 1885); Summesberger et al., pl. 1, figs 11, 12, 13.
2017c *Glyptoxoceras crispatum* (Moberg, 1885); Summesberger et al., pl. 12, figs 6-13.

**Types:** The lectotype, by the subsequent designation of Kennedy and Christensen (1997, p. 107), is no. 3877 in the collections of the Sveriges geologiska Untersöknings, Uppsala, Sweden, the original of Moberg (1885, p. 32, pl. 3, figs 12-13). The paralectotype is no. 3876 in the same collection. Both are from the Santonian of Eriksdal, Sweden.

**Material:** SK/HO/1989/6 a, b, two fragments.

**Description:** SK/HO/1989/6 a, b are two fragments of internal moulds of a crushed loosely coiled spire possibly from the same individual. The whitish shell is partially preserved. The estimated diameter of the spire is about 36 mm, the umbilicus approximately 18 mm. The originally apparently circular diameter of the whorl must have been about 10 mm, now deformed by crushing. The surface is ornamented by about 45 S-shaped and sharp-crested ribs per whorl, separated by wider interspaces. The rib index is about 4. There are no constrictions, no flared ribs, no bifurcations and no tubercles. The sutures are not exposed.

**Discussion:** In our opinion *Eubostrychoceras acuticostatum* (d’Orbigny, 1842) is closely related to *Eubostrychoceras otsukai* (Yabe, 1904).

**Occurrence:** In Europe *Eubostrychoceras acuticostatum* (d’Orbigny, 1842) is a rare species occurring in the middle Santonian of the Corbières (France). It is recorded for the first time from the upper Santonian of the Gosau Group.
HO/2004/18 are straight parts. The surface is ornamented by narrow, sharp, straight to rursiradiate ribs.

**Discussion:** *Glyptoceras crispatum* (Moberg, 1885) was discussed by Kennedy and Christensen (1991), Kennedy in Kennedy et al. (1995), Kennedy and Kaplan (2000), and Summesberger et al. (2017 b, c). The straight fragments from the Sandkalkbank Member were misidentified by Summesberger (1979, p. 124, pl. 3, fig. 21) as ? *Diplomoceras* (Subgenus ?) tenusulcatum (Forbes).

**Occurrence:** *Glyptoceras crispatum* (Moberg, 1885) occurs in the lower and middle Santonian of the Corbières and Sweden, in the middle Santonian of the Münster Basin (Germany). In the Gosau Group it occurs in the lower Santonian (Brandenberg, Tyrol) and the lower to upper Santonian in the Gosau Group of Upper Austria and Salzburg.

Family Baculitidae Gill, 1871
Genus *Baculites* Lamarck, 1799

**Type species:** *Baculites vertebralis* Lamarck, 1801 by subsequent designation of Meek, 1876.

*Baculites fuchsi* Redtenbacher, 1873
Fig. 7/2, 3

2017b *Baculites fuchsi* Redtenbacher, 1873, Summesberger et al., p. 121, pl. 10, figs. 1-15, text-fig. 6.
2017c *Baculites fuchsi* Redtenbacher, 1873, Summesberger et al., in press, pl. 15, fig. 4a-c.

**Description:** GBA 1935/001/0026 is a laterally flattened individual of 111 mm length and (exaggerated) 15 mm width. The asymmetrically U-shaped aperture is preserved.

**Discussion:** Brinkmann (1937, p. 4) was the first to describe the specimen GBA 1935/001/0026 from the Hofergraben. His identification “*Baculites cf. vertebralis* Lamarck” is limited to the Maastrichtian. In our opinion *Baculites fuchsi* Redtenbacher, 1873 is today the adequate interpretation. It differs from *Baculites incurvatus* DUJARDIN, 1837 and *Baculites brevicosta* SCHLÜTER, 1876 by its smooth surface without ornamentation.

**Occurrence:** *Baculites fuchsi* Redtenbacher, 1873 is common in the Santonian (Summesberger et al., 2017b, c). The holotype is from the Tiefengraben (= Grabenbach, Gosau; Upper Austria). This and the majority of recently collected specimens are from the lower and middle Santonian. The Brandenberg specimen is from the lower Santonian. The specimens described by Summesberger (1979) are from the upper Santonian. *Baculites fuchsi* Redtenbacher, 1873 is a typical Santonian species, occurring in the limited area of the Gosau Group. Unfortunately it cannot be localised exactly within the Hofergraben. It is also described under *Baculites cf. fuchsi* Redtenbacher, 1873 from the Coniacian/Santonian of Denmark (Kennedy and Christensen, 1991: 217) and Spain (Santamaria, 1991; Santamaria Zabala, 1992).

**5. Conclusions**

The sequence exposed in the Hofergraben belongs to the Hofergraben Member, which is very close stratigraphically to the Finstergrabenwandl (Sandkalkbank Member) and to the Bibereck Formation of the Schattau section (Summesberger et al., 2017c). The cephalopod fauna of the Hofergraben site differs in several aspects: The most conspicuous difference is the occurrence of *Jouaniceras hispanicum* Wiedmann 1979 in a remarkable sample (Fig. 6). Also present is *Eulophoceras ja-coi* Hourcq, 1949, whereas *Diaziceras austricum*, co-occurring in the neighbouring Finstergrabenwandl, is absent. Also of note is the absence of several other taxa, including Nautiloidea, and the ammonites *Hauericeras* and *Boehmoceras*.

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**References**


On late Santonian ammonites from the Hofergraben Member (Gosau Group, Upper Cretaceous, Austria)

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Figure 4: *Eulophoceras jacobi* Hourcq, 1949
Fig. 4/1, 4: SK/HO/2004/15
Fig. 4/2: SK/HO/2003/9
Fig. 4/3: SK/HO/2003/10
Fig. 4/5: SK/HO/2004/19
Fig. 4/6: SK/HO/2004/16
Fig. 4/7: SK/HO/2003/12
Fig. 4/8: SK/HO/2004/20
All are late Santonian. All are coated with ammonium chloride. All are from the Hofergraben site. Figs. 1, 4, 6, 7 are × 2, Figs. 2, 3, 5, 8 are × 1.
On late Santonian ammonites from the Hofergraben Member (Gosau Group, Upper Cretaceous, Austria)

Figure 5:
Fig. 5/1: SK/HO/1989/2d
Fig. 5/2: SK/HO/1989/2c
Fig. 5/3: NHMW 2017/0050/0002
Fig. 5/4: NHMW 2017/0050/0001
Fig. 5/5: SK/HO/1989/2a
Fig. 5/6: SK/HO/1989/2b
Fig. 5/7: SK/HO/1989/1f
Fig. 5/8: SK/HO/1989/1d
Fig. 5/9: SK/HO/1989/1a
Fig. 5/10: SK/HO/1989/1e
Fig. 5/11: SK/HO/1989/1b
Fig. 5/12: SK/HO/1989/1c

All are *Jouaniceras*, 1-6, 8, 9, 11, 12, are *J. hispanicum* Wiedmann, 1994, 7, 10 are *Jouaniceras* sp. All are coated with ammonium chloride. All are from the Hofergraben site. 1, 3, 4, 5, 6, 10, 11, 12 are x 1.5; 2, 7, 8, 9 are x 2.
Figure 6:
Fig. 6/1, 2, 3, 4: Glyptoxoceras crispatum (Moberg, 1885), Fig. 6/1: SK/HO/1989/3a
Fig. 6/2: SK/HO/1989/3d
Fig. 6/3: SK/HO/2004/17
Fig. 6/4: SK/HO/2004/18
Fig. 6/5: Pachydiscus sp., SK/HO/1996/8
Fig. 6/6, 7: Placenticeras polyopsis (Dujardin, 1837); SK/HO/1989/4
Fig. 6/8, 9, 10, 11: Eubostrychoceras acuticostatum (d’Orbigny)
Fig. 6/8, 9: SK/HO/1989/6a
Fig. 6/10, 11: SK/HO/1989/6b
All are coated with ammonium chloride. All are from the Hofergraben site. 1, 2, 3, 5, 8, 9, 10, 11 are x 2; 4, 6, 7, are x 1.5
Figure 7:
Fig. 7/1: *Placenticeras paraplanum* Wiedmann, 1978; NHMW 1884 D 2522
Fig. 7/2, 3: *Baculites fuchsi* Redtenbacher 1873; GBA 1935/001/0026
Fig. 7/4, 5: *Placenticeras* aff. *maherndi* Summesberger, 1979; SK/HO/1995/7

All are coated with ammonium chloride. 1, 2, 3 are from a historic site in the Hofergraben. 4, 5 are from the same site in the Hofergraben as all the others on the preceding figures. 2, 3 are x1; 1, 4, 5 are x 1.5.
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