Late Campanian echinoids and crinoids from the Gschliefgraben (Ultrahelvetic, Austria)

by

John W.M. Jagt


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Abstract

Eight species of echinoid and one crinoid are described from the Late Campanian of the Gschliefgraben near Gmunden (Upper Austria): rhabdocidarid(?) indet., Pseudoffaster caucasicus (DRU 1884), Echinocorys gr. conica (AGASSIZ 1847) ?, Echinocorys gr. subglobosa (GOLDFUSS 1829), Echinoconix sp., Cardiaster gr. cordiformis/granulosus, Micraster gr. Schroederi/glyphus, M. aturicus Hébert in Seunes 1891 and Austinoocrinus rothpletzii (Stolley 1892). Other species represented in the collections studied are of Turonian/Coniacian and Maastrichtian/Early Palaeogene age; these will be described elsewhere.

Zusammenfassung


Introduction

Echinoids and crinoids from the Gschliefgraben near Gmunden (Upper Austria), housed at the Naturhistorisches Museum Wien (NHMW; including the Hütter Collection) as well as contained in several private collections (Estermann [EST] and Skoumal [SK] collections), have been studied. In view of the fact that there is no measurable section at the Gschliefgraben, and that all specimens were collected from an active mudflow, the material is rather poorly documented stratigraphically (for a synthetic section see Kennedy & Summersberger 1984). A preliminary analysis suggests the age of these specimens to range from Turonian/Coniacian to Early Palaeogene. Species which have been shown to be of Late Campanian age elsewhere in Europe are here singled out for discussion and illustration. However, the ranges of some of these are known elsewhere to extend into the Maastrichtian, and this may apply to the Gschliefgraben as well.

Preservation varies considerably; most specimens have been crushed by sediment compaction but retain many details of test ornament, others are heavily abraded and fragmentary and appear almost smooth. Specimens from indurated strata have generally been mechanically prepared by the collectors and lack all surface ornament; still others are preserved as internal moulds (e.g. PL. 3, figs. 1–3, 6).

Specimens not discussed in the present paper will be described elsewhere; these include:

1 – ‘more primitive’ (judging from labral/plastronal and petal structure) microasterids of Turonian/Coniacian (and ?Santonian) age, comparable to material referred to previous authors to the prae­cursor/cortestudinarium group (Ernst et al. 1996; Wiese 1997; Kochler 1998) or the decipiens/nor­manniae group (David & FourAY 1984; Fouray 1985; Fouray & Pomerol 1985) from elsewhere in Europe. Most authors (e.g. Ernst & Schulz 1974; Stokes 1977; Drummond 1985, 1988; Kochler & Ernst 1989; Rose & Cross 1993) are in agreement over the morphological plasticity of representatives of this genus, and its tendency to develop local forms (ecomorphs) during the...
Late Cretaceous crinoids appear to be extremely rare thus of considerable interest. Turkmenia and Central Asian age in southern Germany in Austria. From the Early Maastrichtian of the Schweinbachgraben east of Gams (Styria), and Bourgueticrinid. Of these, Augustus (R. (DAMES 1884) co-occurrence of the last-named taxon with a new species of Microaster (M. gappi). This material also includes a small Stegasterid, which appears to be close to Maastrichtian (or ?Early Palaeogene) age.

Order Holasteroida Durham & Melville 1957 Family Stegasteridae Lambert 1917 Genus Pseudoffaster Lambert à Lambert & Thiéry 1924

Type species Offaster caucasicus DRU 1884, by original designation.

Pseudoffaster caucasicus (DRU 1884) (PI. 1, Figs. 12–15)

1884 Offaster caucasicus DRU: 514, pl. 26, figs. 5–10.
1997 Pseudoffaster caucasicus (DRU, 1884); JEFFERY: 698, pl. 8, figs. 4–7; text-fig. 14c–e.
in press Pseudoffaster caucasicus (DRU, 1884); JEFFERY, fig. 160 (with additional synonymy).

<table>
<thead>
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<th>Specimen</th>
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<tbody>
<tr>
<td>SK unreg.</td>
<td>21.6</td>
<td>20.5</td>
<td>16.6</td>
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Table 1. Measurements (in mm) of Pseudoffaster caucasicus from the Late Campanian of the Gschliefgraben near Gmunden.

Material: A single specimen (NHMW 1998z/98/2).

Discussion: This specimen is comparatively well preserved, being only slightly laterally compressed. It preserves sufficient details of tuberculation and plat­ing to allow it to be assigned to P. caucasicus beyond doubt. JEFFERY (1997) and SMITH & JEFFERY (in press) showed Pseudoffaster renngarteni SCHMIDT 1938 and P. Schmidt POSLOVSKAYA & MOSKVIN 1959 to be junior synonyms of the present species. The former had been recorded exclusively from strata of Maastrichtian age, the latter also from the Campanian of the former Soviet Union.

The present specimen may also be of Maastrichtian age, and is here referred to the Late Campanian with a query.

Systematic palaeontology

Order Cidaroida CLAUS 1880
Family Rhabdocidaridae LAMBERT 1900?

rhabdocidarid (?) indet.

(Pl. 1, Fig. 11)

Material: A single primary spine (NHMW 1998z/98/2).

Discussion: Cidarid spines are notoriously difficult to assign to genera and species. In being more or less cylindrical, long and ornamented with thin striae and well-spaced large thorns in irregular rows, the present material appears to be close to rhabdocidarids. However, test plates are needed to confirm such an assignment (see SMITH & WRIGHT 1989; SMITH 1995). There are but few records of Late Cretaceous rhabdocidarids; the present material may also be of Maastrichtian (or ?Early Palaeogene) age.

Order Holasteroida DURHAM & MELVILLE 1957 Family Stegasteridae LAMBERT 1917 Genus Pseudoffaster LAMBERT & THIÉRY 1924

Type species Offaster caucasicus DRU 1884, by original designation.

Pseudoffaster caucasicus (DRU 1884) (Pl. 1, Figs. 12–15)

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1997 Pseudoffaster caucasicus (DRU, 1884); JEFFERY: 698, pl. 8, figs. 4–7; text-fig. 14c–e.
in press Pseudoffaster caucasicus (DRU, 1884); SMITH & JEFFERY, fig. 160 (with additional synonymy).

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Material: A single specimen, SK unregistered.

Discussion: This specimen is comparatively well preserved, being only slightly laterally compressed. It preserves sufficient details of tuberculation and plat­ing to allow it to be assigned to P. caucasicus beyond doubt. JEFFERY (1997) and SMITH & JEFFERY (in press) showed Pseudoffaster renngarteni SCHMIDT 1938 and P. Schmidt POSLOVSKAYA & MOSKVIN 1959 to be junior synonyms of the present species. The former had been recorded exclusively from strata of Maastrichtian age, the latter also from the Campanian of the former Soviet Union.

The present specimen may also be of Maastrichtian age, and is here referred to the Late Campanian with a query.
Present records of *P. caucasicus* include the Maastrichtian of the northern Caucasus and Kazakhstan, Kopet Dagh, Georgia and northern Spain.

Family Echinocoridae **LAMBERT** 1917

**Genus Echinocorys** **LESKE** 1778

**Type species** *Echinocorytes scutatus* **LESKE** 1778, by monotypy.

**Remarks:** Rather than lumping all 'species' into a single taxon, *E. scutata* (Leske 1778), as advocated by a number of authors, treatment as morphotypes or definitely of stratigraphical value.

**Echinocorys** *gr. conica* (Agassiz 1847)?

(Pl. 1, Figs. 9, 10)

**Compare:**

1847 *Ananchytes conica* Agassiz: 136.

1903 *Echinocorys conicus*, Agassiz (*Ananchytes*), 1847; **LAMBERT**: 66, pl. 4, figs. 1, 2; pl. 5, fig. 6.

1935 *Echinocorys lamberti* **SMISER**: 32, pl. 2, figs. 3, 4; text–fig. 14.

1935 *Echinocorys conicus* Agassiz (*Ananchytes*); **SMISER**: 33, text–fig. 15.

1972 *Echinocorys conica* (Agassiz); **ERNST**: pl. 7, fig. 1.

**Material** A single specimen, SK unregistered.

**Discussion:** The present specimen appears to be a comparatively large representative of a group of 'species'.

Table 2. Measurements (in mm) of *Echinocorys gr. conica* (?) from the Late Campanian of the Gschliefgraben near Gumunden.

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<td>SK unreg.</td>
<td>63.8</td>
<td>54.2</td>
<td>50.1</td>
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that is best known from the late Early Campanian and early Late Campanian (*conica/piliplosa to conica/mucronata zones sensu germanico*; see e.g. **ERNST** 1972, 1975; **ERNST** et al. 1979, 1997).

However, there is also a certain resemblance to some tests usually assigned to the *pyramidata* group (non *pyramidalis* **SMISER** 1935, lapsus). This group comprises tests which are typically almost symmetrically conical and which characterise the Late (latest) Campanian and Early (earliest) Maastrichtian in NW Europe.

**Discussion:** Specimens grouped under this heading are characterised by conspicuous test plating (well-developed sutures and more or less convex plates) and a curious test shape. The apical system is positioned in the posterior half of the test, which appears 'pushed over backwards'. That this is not a preservational matter, i.e. a function of deformation by sediment compaction, is clearly seen in the specimen illustrated in Pl. 3, fig. 4. At the ambitus, test plates are splayed out, but only slightly so. The remainder of the test is undamaged. Specimens vary in total test length between 69.0 and 88 mm.

In view of the fact that nothing comparable has been found in the literature, this form cannot be assigned to species, nor to stratigraphical level. Its inclusion here

1935 *Echinocorys subglobosus* **GOLDFUSS** (*Ananchytes*); **SMISER**: 15, text–fig. 3.

1999 *Echinocorys gr. subglobosa* **GOLDFUSS** 1829; **SUMMERS-BERGER** et al.: pl. 11, fig. 5.

**Material** EST 73, EST 125, EST 126, EST 130, EST 131, EST 139, EST 162, EST 163, EST 171, EST 180, EST 188, **NHMW** 1997/2076/17 and 1998z/98/6–8).

**Discussion** This group is well represented in the collections studied, with most specimens comparing well with material known from the early Late Campanian (*conica/mucronata and basiplana/spiniger zones*) of northeast Belgium (Liège) and from the *stobaei/basiplana (= basiplana/spiniger)* Zone of NW Germany. **ERNST** (1975) and **ERNST** et al. (1997) showed the *subglobosa* group to range from the lower *piliplosa* Zone (Early Campanian) into the *vulgaris/basiplana (= roemeri)* Zone, with a distinct maximum in the *stobaei/basiplana* Zone (Late Campanian).

A few specimens (e.g. EST 129, EST 177) appear to be closer to the *'E. pyramidalis'* of German authors (e.g. **ERNST** 1975; **NIEBUHR** et al. 1997), which in sections in the Hannover area characterises the *minor/polyplucus and bipunctatum/roemeri* zones. **KÜHN** (1925:180) record of *Echinocorys ovatus* **LESKE** var. *pyramidatus* (*PORTLOCK*) may refer to this type. Typical *pyramidata* (*sensu PORTLOCK* 1843: 355) morphologies are not represented in the collections studied.

Still others (e.g. EST 124) are reminiscent of what **LAMBERT** (1903) and **SMISER** (1935) referred to as *E. conoidea* (*GOLDFUSS* 1829), which these authors recorded also from the Late Campanian. However, I prefer to interpret this form on the basis of the type material in the collections of the Rheinische Friedrich-Wilhelms-Universität Bonn. Test specimen 343a in the Goldfuss Collection clearly shows this to be from the Late Maastrichtian Lixe 1 Member (Gulpen Formation) of the Haccourt-Lixe area (Liège, NE Belgium).

**Echinocorys** *sp.*

(Pl. 3, Fig. 4)

**Material** EST 122, EST 128 and **NHMW** 1998z/98/9–10); EST 133 may also belong here.

**Discussion:** Specimens grouped under this heading are characterised by conspicuous test plating (well-developed sutures and more or less convex plates) and a curious test shape. The apical system is positioned in the posterior half of the test, which appears 'pushed over backwards'. That this is not a preservational matter, i.e. a function of deformation by sediment compaction, is clearly seen in the specimen illustrated in Pl. 3, fig. 4. At the ambitus, test plates are splayed out, but only slightly so. The remainder of the test is undamaged. Specimens vary in total test length between 69.0 and 88 mm.
is based solely on similarity of adhering sediment to that of certain specimens of *E. gr. subglobosa.* The *Estermann* Collection includes two specimens (EST 135, EST 141) of very large size (length c. 101 and 133 mm, respectively) and with thick tests, but unfortunately these are poorly preserved and cannot be identified to species or group. Comparable sizes normally are only encountered in *E. gr. belgica* Lambert 1898, which appears to be typical of the Early Maastrichtian.

Family Cardiasteridae Lambert 1917
Genus *Cardiaster* Forbes 1850

*Type species:* *Spatangus granulosus* Goldfuss 1829, by original designation.

*Cardiaster gr. cordiformis/granulosus*  
(Pl. 3, Figs. 1–3)

1829 *Spatangus granulosus* Goldfuss: 148, pl. 45, fig. 3.
1833 *Spatangus cordiformis* Woodward: 50.
1972 *Cardiaster aff. granulosus* (Goldfuss); Ernst: 117, fig. 20.
1997 *Cardiaster cordiformis* (Woodward, 1833); Niebuhr et al.: 220, pl. 5, fig. 1.

*MATERIAL* A single specimen, EST 195a, in internal mould preservation.

*DISCUSSION* Although lacking test material, the present specimen is fairly well preserved. However, details of plastron plating cannot be made out.

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<td>50.0</td>
<td>52.0</td>
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</table>

**Table 3.** Measurements (in mm) of *Cardiaster gr. cordiformis/granulosus* from the Late Campanian of the Gschliefgraben near Gmunden.

*Cardiaster cordiformis*, which appears to be the (late) Late Campanian precursor of *C. granulosus*, a widely distributed species of Maastrichtian age, differs from the latter only in plastronal structure. On the basis of what may be seen of the structure in the present specimen, this appears to be closer to *C. granulosus* than to *C. cordiformis*. In the Hannover area, the latter species first appears in the middle minor/polyplocum Zone, and is fairly common in the *bipunctatum/roemerii* Zone (Niebuhr et al. 1997). In Norfolk (SE England) it is known from coeval strata (Beeston Chalk and lower Paramoudra Chalk; see Wood 1988).

Order *Spatangoidea* Claus 1876
Suborder *Micrasterina* Fischer [in:] Moore 1966
Family *Micrasteridae* Lambert 1920
Genus *Micraster* Agassiz 1836

*Type species* *Spatangus Cor Anguinum* var. a *Anglicum* Leske 1778, by subsequent designation of Pome 1883:42.

*Micraster gr. Schroederi/glyphus*  
(Pl. 2, Figs. 1–3, 7, 8)

1869 *Micraster glyphus* Schlüter: 235, pl. 1, fig. 2.
1892 *Micraster Schroederi* Stolley: 259, pl. 8, fig. 5; pl. 9, fig. 1.
1970 *Micraster (Micraster) glyphus* Schlüter, 1869; Ernst: pl. 17, fig. 4.
1972 *Micraster m. Schroederi/glyphus*; Ernst, pl. 5, fig. 3.
1975 *Micraster glyphus* Schlüter 1869; Stokes: 70, fig. 291 (with additional synonymy).
1975 *Micraster Schroederi* Stolley 1891; Stokes: 78, pl. 9, figs. 5–7; pl. 10, figs. 1, 2; text-fig. 30c (with additional synonymy).
1999 *Micraster glyphus* Schlüter 1869; Summesberger et al.: pl. 12, figs. 1, 3, 5.

*MATERIAL* NHMW 1998z/98/3 and 1998z/98/5; EST 76 and NHMW 1998z/98/4,11–33 may also belong here.

*DISCUSSION* This group comprises all ‘depressed’ *micrasterids* with well-developed subanal fasciole occurring in the Early and early Late Campanian (see Stokes 1976). *Micraster Schroederi* appears to be the precursor of *M. glyphus*, and ‘typical’ specimens of these two taxa are easily distinguished. However, populations normally contain many intermediates, which is why these are here referred to as a group (see Jagt 1999b).

A few comparatively small (? subadult; test length between 34.4 and 46.3 mm) specimens from the Gschliefgraben belong here. On details of petal and plastral/labral structure these are easily spotted amongst the many *micrasterids* in the collections studied. Most of these, however, appear to be of the ‘more primitive’ morphologies (see above).

A single specimen (Pl. 2, figs. 4–6) may either belong here or with *M. aturicus*. The shape of labrum (Pl. 3, fig. 4) would favour an assignment to the latter.

There is also a good match between the species illustrated in Pl. 2, figs. 1–3 and Stokes’s (1975: 3, figs. 6–8) figure of the neotype of *Micraster corculumbarium* Desor 1858, which according to Stokes is confined to the Late Campanian of the Pyrenean Province (SW France, Spain). Hancock et al. (1993) recorded this species from unit H at Tercis (Dax, France). Of note is that Stokes (1975: 47) pointed out that, ‘Un grand échantillon de cette espèce (= *M. corculumbarium*) (Coll. Lambert) peut à peine être distingué d’un petit *M. glyphus* et donc nous supposons que *M. corculumbarium* est un descendant néoténique de *M. glyphus*.’
in press *Micraster aturicus* Seunes, 1891; Smith & Jeffery: fig. 171.

**Material** EST 120, EST 152, SK 75 and SK unreg. EST 117 may also belong here.

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<td>EST 152</td>
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<td>SK 75</td>
<td>c. 57.5</td>
<td>54.4</td>
<td>26.0*</td>
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<tr>
<td>SK unreg.</td>
<td>49.1</td>
<td>49.4</td>
<td>35.0</td>
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*Table 4. Measurements (in mm) of *Micraster gr. aturicus* from the Late Campanian of the Gschliefgraben near Gmunden.*

*distorted

**Discussion** The present species was first recorded by Seunes (1891) from the *polyplocum* Zone (assisé à *Heteroceras polyplocum*) of Tercis, Angoumé and Heugas (Landes, France). Specimens from the Gschiefgraben correspond closely with material illustrated by Seunes (1891) and Stokes (1975). The latter author considered this species to be confined to his ‘Province Pyrénénène,’ and noted that it first appears during the latest Early Campanian (where intermediates to *M. antiquus* Cotteau 1887 occur), but that ‘la grande forme typique’ was restricted to the Late Campanian. He went on (p. 47) to note that at Tercis, ‘...le grand *M. aturicus* typique ne semble se trouver que dans les calcaires marneux gris-vert-bléuté du Campanien supérieur.’ In addition to French localities, cited as localities Montesquiu (Arce, Spain).

Smith & Jeffery (in press) remarked that *M. aturicus* differed from *M. Schroederi* only in having a concave lateral profile of the anterior part of the test, and recorded it from the Campanian of the French Pyrenees and the Maastrichtian of Alicante (Spain) and Georgia.

Order Crinoidea Miller 1821

Family Isocrinidae Gislen 1924

Genus *Austinocrinus* De Lorient 1889

**Type species** *Austinocrinus komaroffi* De Lorient 1889, by monotypy (= *Pentacrinus erckerti Dames 1885*).

*Austinocrinus rothpletzi* Stolley 1892

(Pl. 1, Figs. 1–8)

1892 *Austinocrinus rothpletzi* Stolley: 252, pl. 10, figs. 7–10. 14.
1961 *Austinocrinus rothpletzi* Stolley: 1892; Rasmussen: 38, pl. 2, figs. 1–9 (with additional synonymy).
1992 *Austinocrinus rothpletzi* Stolley, 1892; Klikushin: 120, text-fig. 123, pl. 15, figs. 1–10.

**Material** NMNH 1998/2/0034/0015 (Hütter Colln); some thirty (pluri)columnals and ten cirrals.

**Discussion** State of preservation as well as columnal diameter vary: between 5.3 and 15.5 mm. The sample contains a series of ten pluricolumnals (consisting of between 2 and 5 columnals each), whose diameter varies between 8.7 and 8.9 mm. These may all be from the same individual. The same goes for some smaller internodals with diameters between 5.3 and 5.7 mm. A single pluricolumnal preserves two proximal cirrals. Details of articular facets also vary considerably; many specimens appear water worn, with petals excavated. The best preserved specimens (Pl. 1, figs. 1, 3–5, 8) illustrate the variation in articular facet structure. Columnal latera are smooth (Pl. 1, figs. 1, 7).

**Discussion** Of the various Campanian-Maastrichtian species of this genus described in the literature (Sieverts-Doreck 1953; Klikushin 1973, 1975, 1982, 1992; Jagt 1999a), the present specimens have most features in common with *A. rothpletzi*, which ranges from the Late Santonian to the Late Campanian. However, the exact stratigraphic ranges of the various taxa are still rather poorly known, which may in part be explained by the range of variation seen in columnal articular facets and lateral surfaces. Intermediates between *A. rothpletzi* and *A. bicornatus* have been recorded from the late Late Campanian/Early Maastrichtian of Norfolk, England (Wood 1988). That author (p. 68) referred to ‘early forms of *Austinocrinus bicornatus*’ from the so-called *Austinocrinus* Bed in the ‘micronata Zone’ Beeston Chalk at Caistor St Edmunds (Norfolk), and from the top of the Beeston Chalk and (possibly) the lower part of the Paramoudra Chalk of the St James Pit in the same area. He also noted (p. 72) that, ‘The *Austinocrinus* are probably transitional between *A. rothpletzi* Stolley and the later *A. bicornatus*.’ Johansen & Surlaky (1990) showed the ‘Beeston Chalk Member’ to be roughly equivalent to the NW German *polyplocum* and *langei* zones (sensu Schulz 1985) and the ‘Paramoudra Chalk Member’ to correspond to the *grimmensis/granulosus* Zone and possibly earliest Maastrichtian *lanceolata* Zone. Christensen (1995), on the basis of coleoid cephalopods, showed the Beeston Chalk Member and the lower part of the Paramoudra Chalk Member to correlate with the *polyplocum* and lower *langei* zones, while the remainder of that member was equated with the upper *langei* and *grimmensis* zones.

Specimens (Jagt Colln) similar to the ones from the Gschiefgraben are also known from the *vulgaris/stolleyi Zone* of the Teutonia quarry (Hanover area; see Ernst et al. 1997; Niebuhr et al. 1997).

In a brief survey of previous crinoid records from Austria, Kristan-Tollmann (1987) noted that Sieverts-Doreck (1953: 115) mentioned an ‘*Austinocr.* sp., Flysch of the Ostalpen?’ Unfortunately, of this record no geographic and stratigraphic data were supplied, so that it cannot be determined which species was involved.
<table>
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<th>Chronostratigraphy</th>
<th>Biostratigraphy NW Germany</th>
<th>Inoceramid assemblage zones</th>
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<td>Sph. - Sphaeroceramus</td>
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<td>Cat. - Caturceramus</td>
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</table>


Inoceramid zones after WALASZCZYK (1997), IZ Inoceramid zones after TROGER (1989), TROGER et al. (this volume).

Table 5. Stratigraphic range of echinoids and crinoids from the Campanian of the Gschliefgraben.
Conclusions

Despite the fact that the collections studied were made from an active mudflow and thus lack accurate stratigraphic data, sufficient data have been gathered to confirm the Late Campanian age of a certain portion of this material. Moreover, the Gschliefgraben fauna is shown to contain elements both of the Tethyan and North Temperate realms. In this respect, it recalls Early Maastrichtian faunas from southern Germany (SCHULZ 1983). The occurrence of Micraster aturicus and possibly of M. corculumbarium (tentatively referred to M. gr. Schroederi/glyphus above) allows a correlation with the French/Spanish Pyrenees, and the Tercis section in particular (see ODIN 1996). Pseudoffaster caucasicus, which however may be Maastrichtian in age, is another typically Tethyan representative. Austinocrinus rothpletzi links both realms, and the holasteroid echinoids amongst the Gschliefgraben assemblages appear to substantiate the early to late Late Campanian age assignment.

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Plate 1

Figs. 1–8:  *Austinocrinus rothpletzi* Stolley; 1998z/0034/0015; (pluri)columnals (internodals as well as nodal and cirrals; articular facets and lateral aspects, all x 2.

Figs. 9, 10:  *Echinocorys* gr. *conica* (Agassiz) ?; SK unregistered, x 1.

Fig. 11:  Rhabdocidarid(?) indet., primary spine (three fragments of same specimen); NHMW 1998z/98/2, x 2.

Figs. 12–15:  *Pseudoffaster caucasicus* (Dru); SK unregistered, x 2.

Figs. 16–18:  *Micraster aturicus* Hebert in Seunes; 16, 17 are SK unregistered; 18 is SK 75; x 1.

All specimens are from the Late Campanian of the Gschliefgraben near Gmunden.
**Plate 2**

Figs. 1–3, 7, 8: *Micraster gr. Schroederi/glyphus*; 1–3 are NHMW 1998z/98/3; 7, 8 are NHMW 1998z/98/5.


Figs. 9–14: *Micraster aturicus* Hébert *in Seunes*; 9, 10 are EST 152; 11–14 are EST 120.

All specimens are from the Late Campanian of the Gschliefgraben near Gmunden. All are x 1, except 12–14 which are x 0.85.
PLATE 2

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Plate 3

Figs. 1–3: Cardiaster gr. cordiformis/granulosus; EST 195a.

Fig. 4: Echinocorys sp.; EST 128.

Figs. 5–7: Echinocorys gr. subglobosa (Goldfuss); 5 is NHMW 1998z/98/6; 6 is EST 180; 7 is NHMW 1998z/98/7.

All specimens are from the Late Campanian of the Gschliefgraben near Gmunden; all are x 1.
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