Periproctal plating in the echinoid *Coenholectypus larteti* (Cenomanian, Sultanate of Oman)

by John W.M. JAGT

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Abstract

A specimen of the holectypid echinoid *Coenholectypus larteti* (COTTEAU, 1869), from the 'Echinoid Marker Bed' of Member C (Natih Formation, uppermost Middle Cenomanian, Cretaceous) at Jebel Madamar (central Oman Mountains, Sultanate of Oman), preserves periproctal plating. This is only the second example of such plating in the genus *Coenholectypus*. Previous records of periproctal and/or peristomial plating in holectypoids and other irregular echinoids are listed and briefly discussed.

Key words: Echinoidea, Holectypoida, periproctal plating, Cenomanian, Oman.

Résumé

Un spécimen de l'échinoïde holectypidé *Coenholectypus larteti* (COTTEAU, 1869) provenant du "banc marqueur à échinoïdes" du Membre C (Formation de Natih, partie terminale du Cénomanien moyen) au Jebel Madamar (Montagnes de l'Oman central, Sultanat d'Oman) a conservé les plaques périproctales. C'est seulement le second exemple de telles plaques dans le genre *Coenholectypus*. Les mentions antérieures de plaques périproctales et/ou péristomales chez les holectypidés et autres échinoïdes irréguliers sont recensées et brièvement discutées.

Mots-clefs: Echinoidea, Holectypoida, plaques périproctales, Cénomanien, Sultanat d'Oman.

Introduction

An echinoid faunule collected in February 1998 from the so-called 'Echinoid Marker Bed' (SMITH *et al.*, 1990, p. 35) within Member C of the Natih Formation (uppermost Middle Cenomanian) at Jebel Madamar (central Oman Mountains) includes a specimen of the holectypid *Coenholectypus larteti* (COTTEAU, 1869) which preserves periproctal plating. Although retention of periproctal plating in other holectypids (e.g., species of the genera *Discoides* and *Camerogalerus*) is comparatively common, there is only one previous record of such plating in *Coenholectypus*, namely from the Upper Cenomanian of Sergipe, Brazil (SMITH & BENGTSON, 1991).

Retention of periproctal and/or peristomial plating is not at all common in irregular echinoids. Only under certain conditions, e.g. catastrophic (rapid) burial, successful predation, absence of *post-mortem* scavenging, bioturbation and/or current winnowing, are the flexible membranes covered by the buccal and/or anal plates kept in place. Normally, these would either be pushed out by decomposition gases, or would have collapsed into the test and, in both cases, become scattered in the process. Previous records of such plating are listed below and are briefly commented upon, with the emphasis on material collected recently from Upper Maastrichtian strata in southern Limburg (The Netherlands) and northeast Belgium.

The Jebel Madamar material described here is contained in the collections of the Natuurhistorisch Museum Maastricht (abbreviation NHMM). On foraminiferal evidence, SMITH *et al.* (1990, p. 38) assumed a latest Middle Cenomanian age for the lower part of Member C, within which the 'Echinoid Marker Bed' occurs. Ammonites from the upper part of Member C, as exposed at the nearby Jebel Salakh and Jebel Hinaydil, southwest of Jebel Madamar, indicate an early Late Cenomanian date, i.e. the equivalent of the *Calycoceras (Proeucalycoceras) guerangeri* Zone in NW Europe (KENNEDY & SIMMONS, 1991).

Description

Specimen NHMM 2001084 (Fig. 1) is a fairly large (test diameter 26.2 mm, height 13.3 mm) representative of *Coenholectypus larteti*, a species first recorded (COTTEAU, 1869, p. 537) from the Cenomanian of Syria. It closely matches specimens described and illustrated by SMITH *et al.* (1990, p. 57, figs 14d-f, 17, 18; with additional synonymy) from the 'Echinoid Marker Bed' at Jebel Madamar, where it is the commonest echinoid.

Test outline is subpentagonal (Fig. 1A, B), with a low conical profile (Fig. 1C) and a well-rounded ambitus, a deeply invaginated peristome (Fig. 1B), and a small, longitudinally elongate periproct, narrowly rounded ado-

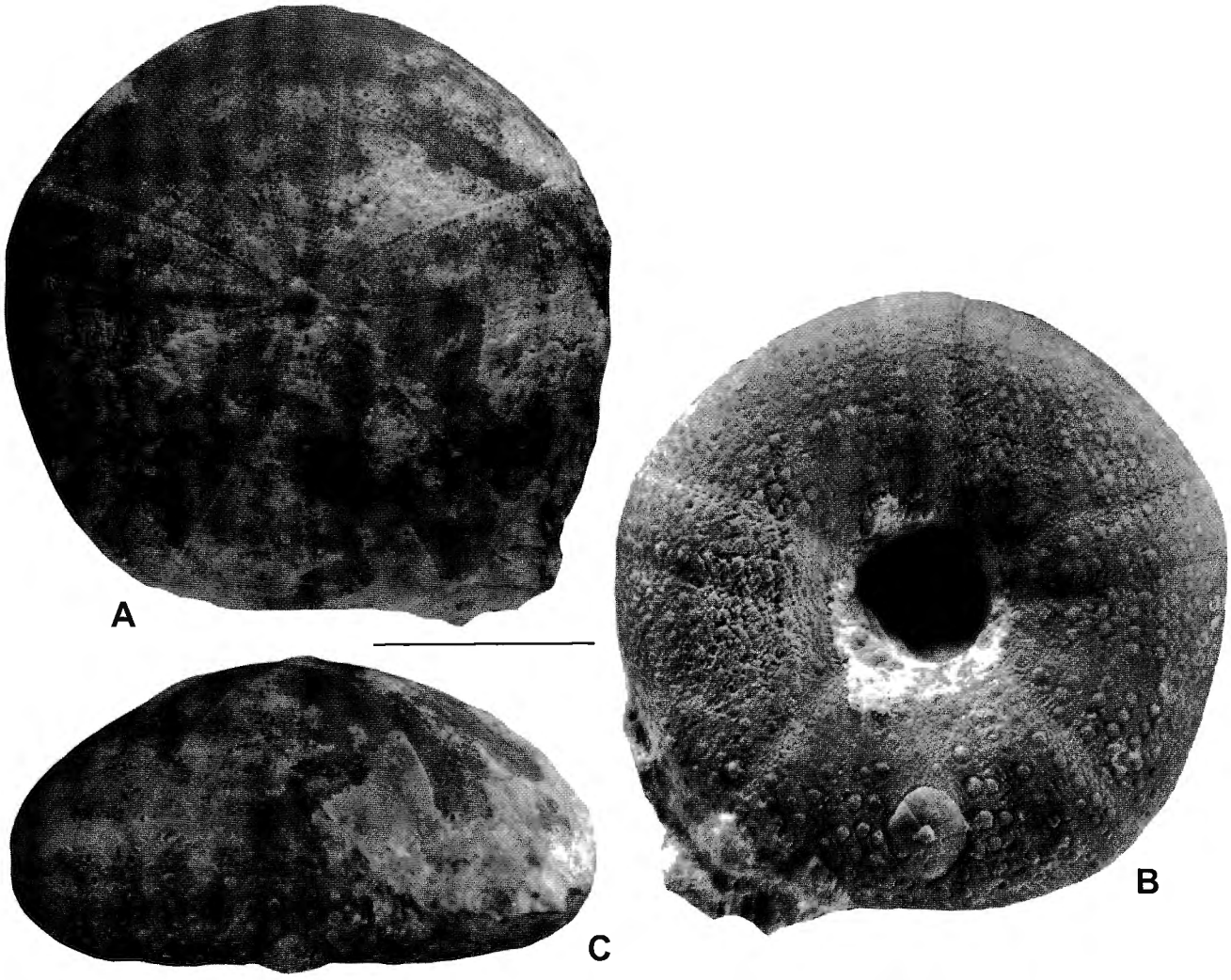

Fig. 1 – *Coenholectypus larteti* (COTTEAU, 1869), NHMM 2001084, 'Echinoid Marker Bed', lower part of Member C (Natih Formation, uppermost Middle Cenomanian), Jebel Madamar, central Oman Mountains. Scale bar equals 10 mm.

rally and pointed adapically (Figs 1B, 2). Periproct width is 3.4 mm, its length 4.6 mm. Remarkably, all periproctal plates, 10 in number (as preserved) are retained; these are arranged in a single circlet, with two smaller, tongue-shaped plates in the central part. The largest plate occupies the adambital part of the periproctal opening; all other plates are smaller and of variable size and outline. In side view (Fig. 1C), these plates form a low dome; the plates themselves are more or less swollen medially, with bevelled margins, with the exception of the two adambital ones; sutures are deep, except adambitally. Tubercles occur on some plates (in particular on adambital ones), otherwise carrying scattered granules. The anal opening itself is matrix filled, but appears to have been relatively small, and longitudinally elongate.

Discussion

In overall structure, the periproct plating of NHMM 2001084 resembles that of *Coenholectypus* sp. from the Upper Cenomanian of Cruzes (Sergipe, Brazil), illustrated by SMITH & BENGTSON (1991, p. 36, fig. 28b), but differs in details. Although incompletely preserved, the Brazilian specimen also appears to have had plates arranged in two circlets, with a couple of similar-sized plates centrally.

In other holectypids, retention of periproctal plating seems to be comparatively common. In the literature, examples have been described and illustrated for (see also HAWKINS, 1912a):

* the Aptian *Discoides decorata* (DESOR, 1842) (see SMITH & WRIGHT, 1999, p. 348, fig. 128d);
* the Albian-Cenomanian *D. subuculus* (LESKE, 1778) (see SMITH *in* SMITH *et al.*, 1988, fig. 37d; SMITH & WRIGHT, 1999, fig. 135a, b);
* the Cenomanian-Coniacian *Camerogalerus minimus* (DESOR, 1842) (see COTTEAU, 1861, pl. 1012, fig. 6; LÖSCHER, 1910, p. 291, fig. 8; HOLMES, 1935, p. 471, figs A, C-D, F, as *Discoidea dixoni*, G, I; MĄCZYŃSKA, 1958, p. 96, fig. 25, pl. 9, fig. 15; SMITH & WRIGHT, 1999, fig. 135c, d, pl. 116, fig. 16);

* the Cenomanian *Camerogalerus cylindricus* (LAMARCK, 1816) (see NORTH, 1915, p. 500, figs B-D; HOLMES, 1935, p. 476, fig. K; MĄCZYŃSKA, 1958, p. 87, fig. 6, pl. 1, figs 3, 4).

Although details of periproctal plating differ considerably in all these examples, it appears that the type of plating in *Coenholectypus larteti* is closer to that in *Camerogalerus* than that seen in *Discoides*, in showing a distinct outer circlet of plates, and a less well-developed inner circlet. However, adoral plates generally are smaller in *Camerogalerus* than in NHMM 2001084, and the anal opening is closer to the adoral margin. Unfortunately, the latter does not show any diminutive platelets directly encircling the anal opening. However, these may originally have been present, having probably been pushed out by the matrix plug.

Previous records

Records of periproctal and/or peristomial plating in other irregular echinoids are scattered throughout the literature. Although the list below is probably not complete, these records are here briefly commented upon.

KIER (1972, pl. 47, figs 1-5) illustrated a few periproctal plates collapsed into the periproct opening, in the Early Cretaceous pygurid *Pygurus yamamaensis* KIER, 1972. In another specimen of the same species, KIER (pl. 47, fig. 2) noted the retention of buccal spines, which is highly unusual.

Of the Cenomanian anorthopygid *Anorthopygus orbicularis* (de GRATELOUP, 1836), SMITH & WRIGHT (1999, p. 362, fig. 136a, e; pl. 115, figs 3, 5, 6) described a specimen (internal mould) preserving periproctal plating, forming 'a tesselate pavement aborally', and consisting of at least 17 polygonal plates of varying sizes.

Amongst conulids, preservation of periproctal plating appears to be extremely rare, with only a single specimen of the Campanian-Maastrichtian *Globator bleicheri* (GAUTHIER, 1889) known (SMITH, 1995, fig. 47). This type recalls that seen in some small holasteroids (e.g., *Offaster*, *Galeola*).

D'ORBIGNY (1853, pl. 822, fig. 9) illustrated the periproctal plating of *Holaster senonensis*, now referred to the genus *Galeola* (see ERNST, 1971), which is characterised by a central anal opening, and up to three circlets of plates and platelets, of decreasing size. Note that MELVILLE & DURHAM (1966, fig. 186/1) copied this illustration, but referred to it as belonging to the genus *Offaster*. The type of periproctal plating that GAUTHIER (1891, p. 12, pl. 1, fig. 11) described for *Offaster* from the Sens area (France) differs considerably from the example given by d'ORBIGNY.

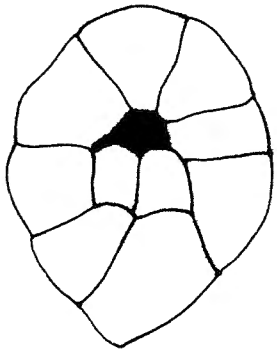

Fig. 2 – Camera lucida drawing of periproctal plating of NHMM 2001084 (compare Fig. 1), x 10.

In the literature, there are comparatively many records of peristomial plating in the Late Cretaceous-Early Paleogene holasteroid genus *Echinocorys*, but instances of periproctal plating are so far unknown. Although varying in details, the type of peristomial plating is surprisingly uniform in this genus, as a comparison of illustrations in LAMBERT (1903, fig. 4), HAWKINS (1912b, fig. 1), MOSKVIN & SHIMANSKAIA (1993, figs 2, 4/5), and JAGT (2000, pl. 21, fig. 11) reveals.

A comparable type, but with associated elongate, bar-like plates close to the adoral rim of the peristomial opening, occurs in the Late Maastrichtian *Hemipneustes striatoradiatus* (LESKE, 1778) (see DORTANGS, 1990, p. 42; JAGT, 2000, pl. 24, figs 8, 9). Numerous examples are now known from the Maastrichtian type area, from both the Nekum and Meerssen members (Maastricht Formation), also in flint preservation. In some instances, 'populations' comprising a dozen or more specimens have been collected, all with peristomial and/or periproctal plating preserved, pink or light purple in colour, as well as portions of the spine canopy. This allows the range of variation to be determined in this species (JAGT *et al.*, in prep.). It appears that variation in number of plates is limited though, with 19-21 peristomial plates and numerous (up to 70-75) plates/platelets covering the periproct, and more or less regularly arranged in up to five circlets, with a subcentral anal opening.

The only example of peristomial and periproctal plating in the Late Maastrichtian *H. oculatus* COTTEAU, 1890 (see JAGT, 2000, p. 280) is closely comparable, although details cannot be made out due to the fact that in both openings plating has partially collapsed into the test.

Despite the fact that representatives of the Late Maastrichtian holasteroid *Cardiaster granulosus* (GOLDFUSS, 1829) are generally considered to have burrowed fairly deeply, and numerous specimens have been collected over the years, the number of specimens preserving either peristomial or periproctal plating is extremely low. The elongate, bar-like plates close to the adoral peristome rim also occur in this species, as a specimen illustrated by JAGT (2000, pl. 22, figs 3, 4) shows. A comparable arrangement of broadly triangular, larger plates and an associated, less regularly arranged series of much smaller, wedge- or lozenge-shaped plates is evident.

In spatangoids, it appears that the type of peristomial plating is closely comparable to that seen in the various holasteroids (see above), as is shown by the Eocene brissid *Eupatagus (E.) excentricus* (GREGORY, 1891) (see LEWIS, 1989, text-fig. 10, pl. 6, fig. 1b, f). Of the Campanian-Maastrichtian *Hemiaster* gr. *aquisgranensis* SCHLÜTER,

1899 (see JAGT, 2000, pl. 28, fig. 4), synonymised with *Hemiaster stella* (MORTON, 1830) by SMITH & JEFFERY (2000, p. 323), just a single specimen preserves some of the thin peristomial plates. DORTANGS (1990, p. 42) noted that plating was also known in the Late Maastrichtian *Leymeriaster maestrichtensis* (SCHLÜTER, 1897); however, whether this pertained to the peristome or periproct (or both) is not indicated. Without having seen the actual specimen(s), I cannot comment on this record.

The type of periproctal and peristomial plating occurring in the small, paedomorphic hemiasterids is different and appears to be characterised by just four peristomial plates, two large but equal-sized plates, occupying most of the opening, and two much smaller ones tucked away in both corners. Examples of this can be found in DORTANGS (1989, p. 43) for the Late Maastrichtian *Hemiaster prunella* (LAMARCK, 1816) and in COTTEAU (1883, p. 214, pl. 11, figs 9, 10) for the Turonian-?Campanian *H. nasutulus* SORIGNET, 1850. Periproctal plating seems to be more variable, but in all recorded instances shows numerous small, densely granulate platelets, arranged in more or less regular circlets.

Work under way (JAGT *et al.*, in prep.) will provide details of peristomial and/or periproctal plating in Late Cretaceous holasteroids and spatangoids from the Maastrichtian type area, provide comparisons with extant taxa wherever possible, and offer explanations for this special type of preservation.

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John W.M. JAGT
Natuurhistorisch Museum Maastricht
P.O. Box 882, NL-6200 AW Maastricht
The Netherlands
E-mail: mail@nhmmaastricht.nl

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