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Comptoniaster adamsi nov. sp. (Echinodermata, Asteroidea) from the middle Cretaceous of Texas and its phylogenetic position☆

Comptoniaster adamsi *nov. sp. (Asteroidea) du Crétacé moyen du Texas et sa position phylogénétique*

Daniel B. Blake

Department of Geology, University of Illinois, Urbana, Illinois 61801, USA

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Abstract

Comptoniaster adamsi nov. sp. (Asteroidea, Valvatida, Goniasteridae) is described from the middle Cretaceous (Cenomanian-Turonian) Britton Formation of northcentral Texas, USA. The new species provides the focus for an exploratory cladistic analysis of Mesozoic asteroids of the *Comptoniaster-Tylasteria* Group *sensu* G. Breton. The systematics of Mesozoic goniasterids has relied heavily on the morphology of marginal ossicles, which generally are the best-preserved elements of the skeleton. Unfortunately, marginal ossicular data are scanty for most species because ossicles tend to be morphologically simple yet varied even within individuals, and few even partially articulated specimens are available to provide more comprehensive information. Further, both plesiomorphy and homeomorphy have been important. Because of limited available data, phylogenetic reconstruction here is preliminary. Nevertheless, a number of taxon groupings recognized in the literature are recovered, and stratigraphic distribution provides some support for results. Data unfortunately are particularly incomplete for species of *Comptoniaster*, the focus of the study. *Comptoniaster adamsi* nov. sp. clustered with three other species assigned to the genus, including the type, all Cretaceous in age. Jurassic species of *Comptoniaster* are more widely distributed in the analysis, perhaps reflecting an early stage in diversification or perhaps suggesting the need for species assignment reassessment, but also reflecting the limited available data.

Keywords: Echinodermata; Asteroidea; Phylogeny; Cretaceous; Texas

Résumé

Comptoniaster adamsi nov. sp. (Asteroidea, Valvatida, Goniasteridae) est décrit du Crétacé moyen (Cénomanien-Turonien ; Formation Britton) du Texas nord-central (États-Unis). À partir de cette nouvelle espèce, une analyse cladistique exploratoire des astéroïdes mésozoïques du groupe des *Comptoniaster-Tylasteria* (*sensu* G. Breton) est réalisée. La systématique des goniastéridés mésozoïques est fondée sur la morphologie des ossicules marginaux, qui sont généralement les éléments du squelette les mieux préservés. Malheureusement, ces données sont rares pour la plupart des espèces, les ossicules tendant à être morphologiquement simples mais variables, y compris pour un même individu, alors que peu de spécimens, même partiellement articulés, fournissent des informations sur cette variation. De plus, plésiomorphies et homéomorphies sont abondantes. En raison de la limitation des données disponibles, les résultats de l'analyse phylogénétique présentés ici sont donc préliminaires. Néanmoins, un certain nombre de groupements de taxons reconnus dans la littérature sont identifiés, et la distribution stratigraphique supporte certains d'entre eux. Les données sont malheureusement particulièrement incomplètes pour les espèces de *Comptoniaster*, objet de cette étude. *Comptoniaster adamsi* nov. sp. se regroupe avec trois autres espèces attribuées au même genre, dont l'espèce-type, toutes d'âge crétacé. Les espèces jurassiques de *Comptoniaster* sont plus largement distribuées au sein du cladogramme, ce qui, tout en soulignant les limites des données disponibles, pourrait être le reflet d'une phase précoce de diversification de ce genre, ou bien suggérer la nécessité de réexaminer certaines attributions spécifiques.

Mots clés : Echinodermata ; Asteroidea ; Phylogénie ; Crétacé ; Texas

☆ Corresponding editor: Gilles Escarguel.

E-mail address: dblake@illinois.edu.

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1. Introduction

Asteroids are common marine invertebrates today, and they contribute significantly to many benthic communities. The class appears to have been ecologically important since its emergence early in the Paleozoic (Blake and Rozhnov, 2007), and in spite of apparent widespread extinction during the Permian-Triassic transition (as documented by taxon ranges, e.g., Spencer and Wright, 1966), asteroids rediversified and their significance reemerged during the Mesozoic (Aberhan et al., 2006). Asteroid history can provide useful insights into the evolution of certain marine ecosystems, and study of asteroid phylogeny helps in understanding ecosystem changes through time.

Unfortunately, fossil asteroids are almost invariably rare even in otherwise fossiliferous settings. A single new specimen from the middle Cretaceous (Cenomanian and Turonian) Britton Shale (Eagle Ford Formation) of Texas (USA) is both incomplete and incompletely exposed, but details are well enough preserved to allow recognition of a new species, *Comptoniaster adamsi*, which is assigned to the *Comptoniaster-Tylasteria* Group *sensu* Breton (1992). *Comptoniaster* is hitherto unknown from beyond Europe; however the new species does not extend the previously documented stratigraphic range. Results of a cladistic analysis of the *Comptoniaster-Tylasteria* Group and select similar taxa reflect the limitations of data currently available.

2. Terminology

Terminology follows Spencer and Wright (1966) and Blake and Portell (2009).

3. Material and occurrence

3.1. Material

A single incomplete specimen, Texas Memorial Museum Non-Vertebrate Paleontology Laboratory (NPL 31736), is available. The specimen is exposed in dorsal aspect. The arm radius as preserved is 73 mm whereas radius in life based on taper of an apparently little-distorted incomplete arm probably was less than 5 mm greater. The disk is collapsed and twisted but form does not appear seriously distorted; disk radius now is 44 mm. The specimen includes most of the disk and two interbrachial arcs as well as most of one arm reaching nearly to the tip. The dorsal surface is collapsed and ossicles are disrupted, displaced, and some are inverted. Ambulacrals are exposed, and limited data are available for the adambulacrals and parts of the jaw frame. Preservation of surface detail is excellent.

3.2. Occurrence

The collecting locality was a temporary exposure at a landsite development within the town limits of Coppell, Dallas County, Texas; Coppell is about midway between the cities of Denton and Dallas. The locality is about 1.6 km (1.2 miles) west of Interstate-35E and about 0.5 km (0.3 miles) south of Sandy Fork Road, on the east side of McInnish Park; the park lies on the east side of the Elm Fork of the Trinity River. Locality coordinates are 96° 56' 05'' W and 32° 57' 50'' N.

The specimen is preserved on a siderite slab collected from the Britton Shale of the Eagle Ford Formation (or ''Group'' in different usages). Biostratigraphy and stratigraphy of the Eagle Ford have been treated by Brown and Pierce (1962) and more recently by Jacobs et al. (2005a, 2005b); information here was taken from these sources. The early Late Cretaceous (Cenomanian and Turonian) Britton has a total thickness of about 100 m; it encompasses the *Sciponoceras gracile* Zone of Kennedy (1988) and Kennedy and Cobban (1990), which is correlative with the *Metoicoceras geslinianum* Zone of Europe. The Britton Shale is interpreted as having been deposited in a shallow-water environment under normal marine conditions within the photic zone but below wave base. Bioturbated, irregular, fossiliferous siderite concretionary layers are present within the Britton Shale along with localized sandstone and limestone stringers composed of *Inoceramus* prisms. Most fossils are clasts and are thought to have been transported from higher-energy settings into the lower-energy Britton setting. Specifically, however, it is unknown whether the type specimen of *C. adamsi* was transported from its life habitat, or if it was moved, whether transport occurred before or after partial decay and dissociation. Specimen completeness and absence of ossicular abrasion suggest limited transport at most.

4. Cladistic analysis

4.1. Background

For many years, paleontologists sought to identify the closest affinities of fossil asteroids of all ages from within the living fauna. This approach was summarized by Spencer and Wright (1966), in which all asteroid ordinal groups and their putative somasteroid ancestors were posited as ranging from the Ordovician to the Holocene. Cited stratigraphic ranges, and especially those at the family level and below, however, show that these authors were well aware of important changes during the Paleozoic-Mesozoic transition. Since Spencer and Wright (1966), authors have stressed the significance of this interval both for the somasteroids and their putative immediate descendants (e.g., Madsen, 1966; Blake, 1982) as well as for the other higher taxa (Kesling, 1969; McKnight, 1975; Blake, 1987; Gale, 1987; Breton, 1992).

Probably because of a sketchy fossil record, crown-group fossil asteroids have received only limited cladistic treatment. Villier et al. (2004a) developed a phylogeny for numerous extant species of the Pterasteridae, then assigned isolated fossil ossicles to the living genera, further arguing that isolates can be sufficient for generic recognition (rather than requiring more complete specimens). Villier et al. (2004b) used cladistic analysis in a study that combined description of a new genus of the extinct family Stauranderasteridae with revision of generic diagnoses and reassessment of species assignments for the