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First bryozoan fauna from a tropical Cretaceous carbonate: Simsima Formation, United Arab Emirates–Oman border region

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ABSTRACT

Twenty species of bryozoans are described from the Simsima Formation (Late Campanian–Maastrichtian) at six sites in the United Arab Emirates–Oman border region, extending from Jebel Huwayyah in the south to Jebel Faiyah in the north. Most encrust rudists and algal rhodoliths. Although surface preservation is poor to moderate, sufficient material is available to warrant the description of four new species: *Conopeum wilsoni* sp. nov., *Wilbertopora cheethami* sp. nov., *Tyloporella smithi* sp. nov., and *Monoceratopora whybrowi* sp. nov. A survey of latest Cretaceous bryozoan faunas shows the Simsima bryozoan fauna to be unusual in coming from a tropical palaeolatitude. Indeed, the only other described Campanian–Maastrichtian bryozoan fauna from the Cretaceous tropics comes from the underlying Qahlah Formation. Compared with contemporaneous bryozoan faunas at higher latitudes in the northern and southern hemispheres, the Simsima fauna contains few erect taxa but the genera present are all found in these higher latitudes; there is no indication of tropical endemic genera, or of early appearances of genera that later spread beyond the tropics.

1. Introduction

The fossil record of bryozoans in tropical latitudes of the Cretaceous is extremely sparse. There are several possible explanations for the deficiency of bryozoans around the Cretaceous palaeoequator. For instance, bryozoans in sediment-forming quantities are rare in the post-Palaeozoic tropics, contrasting with their abundance at low latitudes in the Palaeozoic tropics (Taylor and Allison, 1998). Typically erect, sediment-forming bryozoans appear to be rarer in the post-Palaeozoic tropics, the majority of species being relatively inconspicuous encrusters. These encrusting bryozoans frequently go unnoticed, especially in well-lithified rocks where pristine surfaces of bryozoan-encrusted substrates may not be available for examination. Furthermore, encrusting bryozoans are difficult to study in section because they are thin and taxonomically diagnostic surface features are seldom visible.

The bryozoan fauna from the Campanian–Maastrichtian Qahlah Formation of the Hajar Mountains at the border of Oman and the United Arab Emirates was described by Taylor (1995; see also Wilson and Taylor, 2001). This nearshore clastic formation is notable in having been deposited at an equatorial palaeolatitude, unlike almost all other faunas documented in the Cretaceous bryozoan literature. Overlying the Qahlah Fm. are carbonates of the Simsima Fm. The main objective of the current paper is to record the presence of bryozoans from the Simsima Fm and to introduce several new species. This fauna is important in representing the first diverse bryozoan assemblage reported from a tropical carbonate of Late Cretaceous age, offering a unique opportunity to make comparisons with coeval temperate carbonates that contain abundant bryozoans, such as the chalks of northern Europe.

2. Geological setting

The Simsima Formation is a highly fossiliferous, shelf margin carbonate deposit resting conformably on the transgressive siliciclastics sediments of the Qahlah Formation across the western flank of the Oman Mountains. Unconformably overlying the Simsima are open marine argillaceous limestones of the Muthaymimah Formation of Paleocene to ?Middle Eocene age (Abdelghany, 2003). The Simsima consists primarily of bioclastic and dolomitic limestones, and contains a rich biota dominated by echinoids (Smith, 1995; Boukhary et al., 1999), molluscs (e.g. Kennedy, 1995; Morris, 1995a, b; Morris and Skelton, 1995; Mustafa and Hamdan, 1997), corals (e.g. Metwally, 1996; Baron-Szabo, 2000; Gameil, 2005), larger benthic foraminifera (Abdelghany, 2003), rhodoliths, sponges and rare brachiopods (Owen, 1995). It rims the Oman foredeep and extends northward in a narrow belt from Jebel Hafit (eastern Abu Dhabi) into the northern United Arab Emirates

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(Alsharhan and Nairn, 1993), reaching 100 m in thickness along the western margins of the North Oman Mountains (Smith et al., 1995a). Abdelghany (2003) suggested an overlap in the ages of the Qahlah and the lower Simsima, interpreting an interfingering relationship between them as probably due to subsidence. Based on the occurrence of planktonic and larger benthic foraminifera the Simsima has been assigned to the Late Campanian–Maastrichtian (Abdelghany, 2003, 2006). Earlier works (e.g. Hamdan, 1990) gave only a Middle Maastrichtian date.

Palaeoenvironmental interpretations of the Simsima Formation vary somewhat. Using faunal and lithological associations, Skelton et al. (1990) recognized beach, tidal channels and inshore shelf facies in a progressively deepening succession, with the highly fossiliferous lower beds interpreted as deposits formed in a tidal channel-point bar setting. Smith et al. (1995a) disagreed with this interpretation as the diverse echinoid fauna is at variance with a tidal environment. Based on the petrography of the sediments and faunal assemblages, they inferred that deposition occurred below wave-base (see also Hooker et al., 2000), carbonate production keeping pace with shelf subsidence. However, according to Searle and Ali (2009), the Simsima Formation represents a deepening-upwards succession passing from an inshore rudist-rich facies to an open-shelf orbitoid foraminiferal facies.

3. Material and methods

Material for this study was collected from the Simsima Formation (Late Campanian–Maastrichtian) at six localities extending from Jebel Huwayyah in the south to Jebel Faiyah in the north (Fig. 1; see also Smith et al., 1995b). Collections were made during three visits to the Oman Mountains (1992, 1995, and 1999) by parties of palaeontologists from the Natural History Museum, London (NHML). A total of twenty bryozoan taxa can be recognized; four of these are described as new species, the remainder being identified only to genus level. Most are encrusting species found on the surfaces of mollusc shells, especially rudists but also oysters and gastropods, or on sponges and rhodoliths. All of the specimens are registered in the palaeontological collections of NHML.

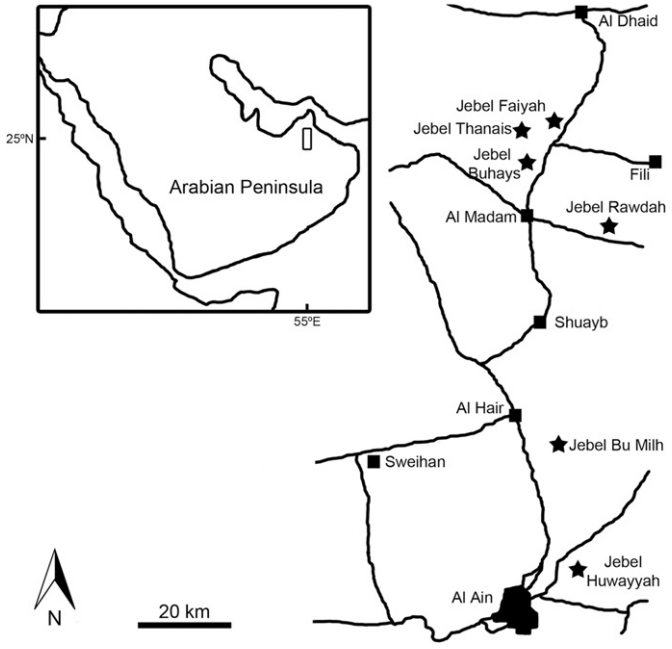

Fig. 1. Map of the Arabian Peninsula showing the area of sampling at the United Arab Emirates–Oman border region and the location of the six outcrops where the bryozoan material was collected (modified from Wilson and Taylor, 2001).

Scanning electron microscopy (SEM) was undertaken on uncoated specimens with a low-vacuum scanning electron microscope (LEO VP-1455) at the NHML, using a back-scattered electron detector. Zooidal measurements were made from SEM images using the image-processing program ImageJ. Cheilostome bryozoan classification used here follows D. P. Gordon's provisional listing of genera for the *Treatise on Invertebrate Paleontology* (http://www.bryozoa.net/treat_family_2011.pdf).

4. Systematic palaeontology

Order: Cyclostomata Busk, 1852
Suborder: Tubuliporina Milne Edwards, 1838
Family: Stomatoporidae Pergens and Meunier, 1886
Genus *Stomatopora* Bronn, 1825
Type species. *Alecto dichotoma* Lamouroux, 1821, Bathonian, France.
Range. Triassic (Carnian)–Recent.

'*Stomatopora*' sp.
Fig. 2A, B.
Material. NHML BZ 5861, Jebel Buhays, north of Al Madam, United Arab Emirates.
Description. Colony encrusting, uniserial, new branches forming by dichotomous bifurcations at an angle of about 75°; number of autozooids per branch internode uncertain, apparently 5–6. Branch width approximately 150 μm. Ancestrula and zone of astogenetic change not recognized. Autozooids with quite convex walls containing abundant circular pseudopores.
Remarks. Two colonies of the runner-like cyclostome '*Stomatopora*' sp. encrust fragments of rhodoliths. The poor preservation of the specimens does not allow the description of autozooidal characters. *Stomatopora* differs from the related genus *Voigtopora* principally in the lack of lateral branching (see Illies, 1976).

Unfortunately, not only is the correct identity of the type species of *Stomatopora* in doubt (e.g. Pitt and Taylor, 1990), but species assigned to this genus suffer from a paucity of morphological characters making their taxonomy difficult even when well preserved material is available for study.

Genus *Voigtopora* Bassler, 1952
Type species. *Alecto calypso* d'Orbigny, 1850, Senonian of Saintes, Charente-Maritime, France.
Range. Cretaceous (Late Hauterivian)–Eocene (Lutetian), ?Recent. The Recent genus *Jullienipora* Reverter-Gil & Fernández-Pulpeiro, 2005 seems to be closely related to, if not congeneric with, *Voigtopora*.

Voigtopora sp.
Fig. 2C, D.
Material. NHML BZ 5862, Jebel Buhays, north of Al Madam, United Arab Emirates.
Description. Colony encrusting, uniserial, branches originating exclusively by lateral budding at angles of nearly 90° to the parent branch. Ancestrula and zone of astogenetic change not observed. Autozooids elongate (mean L = 620 μm) and narrow (mean W = 250 μm), with peristomes (L = 170 μm) terminating in a small circular aperture (D = 100 μm). Autozooidal walls convex, containing abundant and evenly distributed circular or drop-shaped pseudopores.
Remarks. Five colonies of the runner-like cyclostome *Voigtopora* sp. encrust gastropod shells or their moulds. This genus is