

Geo(Im)pulse

A late Miocene astropectinid (Echinodermata, Asteroidea) and associated ichnofossils from Liessel, province of Noord-Brabant, the Netherlands

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Abstract

A fragmentary and partially dissociated arm of an astropectinid starfish, assigned to the genus *Astropecten* Gray, 1840, is recorded from decalcified and limonitised, fine-grained sandstone concretions and slabs of late Miocene (Tortonian) age, collected from the former gravel and sand pit 'de Hoogdonk' near Liessel, province of Noord-Brabant. Added are two examples of the ichnofossil *Asteriacites lumbricalis* von Schlotheim, 1820, both preserved in convex hyporelief and co-occurring with other, indeterminate traces. Although astropectinids have been recorded previously from Miocene and Pliocene deposits in the Netherlands, the present is the first record of fossilised traces of starfish.

Keywords: Echinodermata, Asteroidea, Astropectinidae, ichnofossil, Miocene, the Netherlands

Introduction

Until recently, highly diverse late Miocene (early to middle Tortonian) and late Pliocene (Gelasian) faunal and floral assemblages were collected during dredging at a sandpit near Liessel, exploited by the 'Kalkzandsteenfabriek Hoogdonk BV'. In general, marine biota recognised are of late Miocene age, as are decalcified and limonitised levels of sandstone concretions and slabs with a molluscan fauna preserved as internal and external moulds. Bivalve and gastropod taxa recorded allow the environment to be characterised as sandy sublittoral (Peters, 2009). Such limonitised sandstone concretions and slabs have now also yielded a partial astropectinid arm and traces left by feeding/resting starfish, possibly juvenile astropectinids or goniasterids. Both are here briefly described and illustrated. Specimens are contained in the collections of the Oertijdmuseum De Groene Poort, Boxtel (abbreviation: MAB).

Systematic palaeontology and ichnology

Family Astropectinidae Gray, 1840

Genus *Astropecten* Gray, 1840

Astropecten sp.

Fig. 1.

Material

MAB 1069, an external mould of a fragmentary, partially disarticulated arm in decalcified, limonitised sandstone matrix. A silicone rubber cast was produced of this specimen to allow ossicle structure to be described.

Description

The arm fragment exposes the oral (actinal) surface; over a length of c. 27 mm (greatest width c. 9 mm), inferomarginal plates are preserved for a large part in anatomical connection, but both towards the disc and terminal arm plates, ossicles are



Fig. 1. Late Miocene (Tortonian) *Astropecten* sp. (MAB 1069) from sand pit 'de Hoogdonk' near Liessel (province of Noord-Brabant, the Netherlands); silicone rubber cast of arm fragment, in oral (actinal) view.

displaced and unordered; the ambulacral groove was taphonomically (post mortem) shortened, precluding observation of ambulacral and adambulacral ossicles; inferomarginal ossicles are relatively wide (width between 4.0 and 5.6 mm, depending of position along arm), their length being more or less constant (c. 1 mm); the outer surface is flat to weakly convex; ornament is poorly preserved; granules occur over the entire surface; no enlarged, horseshoe-shaped spine bases are visible (undoubtedly on account of poor preservation); lateral aspect of inferomarginal ossicles shows a clear, broadly rounded articulation process, and it is weakly concave and with a comparatively wide fasciolar surface. Towards the disc, several ossicles are visible which cannot be identified beyond doubt; superomarginal ossicles and paxillae are not seen.

Discussion

Comparison with extant Astropectinidae (*Astropecten irregularis* (Pennant, 1777); see Mortensen, 1977, fig. 32) suggests that MAB 1069 represents an individual with an estimated disc diameter (= r) of c. 12 mm and an arm length, measured from the centre of the disc (= R), of c. 36 mm.

In Neogene strata in the North Sea Basin, more or less well-preserved asteroids are extremely rare. Only those forms with relatively sturdy marginal ossicles, such as Astropectinidae and Goniasteridae, are well represented, albeit often as dissociated remains of arm and disc. Of other families, for example Luidiidae, material has been described previously, but fossil material of a highly characteristic and common form such as the extant *Asterias rubens* Linnaeus, 1758 (Asteriidae) is completely unknown. To date, only Janssen (1972) and Jagt (1991) have recorded a number of early and middle Miocene species, often in open nomenclature, to which Herman & Marquet (2007) added well-preserved and fairly rich 'populations' of goniasterids from the upper Miocene in the Kallo area, province of Antwerpen (Belgium).

Elsewhere in Europe there is a far superior record of asteroids. Near-complete skeletons of Astropectinidae (genus *Astropecten*), Goniasteridae (genus *Ceramaster* Verrill, 1899) and Luidiidae (genus *Luidia* Forbes, 1839) are known from the middle Miocene (Langhian/Serravallian) of the Paratethys (e.g., southeast Poland, Ukraine, Austria and Romania). Reference is made to papers by Nosowska (1997), Radwański & Wysocka (2001, 2004), Binder (2002), Kroh (2007) and Jagt & Codrea (in press) for details. Dissociated marginal ossicles assigned to *Ceramaster* are also known from the Oligocene of Denmark and northern Germany (Wienberg Rasmussen, 1951; Kutscher, 1980, 1985) as well as from the middle Miocene of Winterswijk-Miste (Jagt, 1991).

Without doubt, MAB 1069 is the best-preserved Neogene astropectinid from the North Sea Basin recorded so far. Unfortunately, the material cannot be identified specifically, because superomarginal ossicles cannot be observed and tubercles/arm spines are not preserved or cannot be made out precisely. In view of the width of the inferomarginal ossicles it certainly cannot be assigned to the Recent taxon *Astropecten irregularis*, nor to Miocene material described and illustrated by Janssen (1972) and Jagt (1991). A comparison with well-preserved specimens from Poland and the Ukraine, in particular with *Astropecten navodicensis* Nosowska, 1997, and *A. forbesi* Heller, 1858, shows that those are different species, with longer and more slender arms (see also Radwański & Wysocka, 2001, 2004).

Neogene astropectinids are widely distributed throughout Europe and North America (Blake, 1973), but since generally only dissociated skeletal elements are available, identification to species will rarely be feasible (Kaczmarek, 1987; Kroh, 2007). Astropectinids are typical carnivores which feed on sponges, molluscs, crabs, corals, worms and other echinoderms (Blake, 1989, 1990).

Ichnogenus *Asteriacites* von Schlotheim, 1820

Asteriacites lumbricalis von Schlotheim, 1820

Fig. 2.

Material

MAB 1068, two specimens on a dark brown/blackish, fine-grained, decalcified and limonitised sandstone slab (size c. 130 × 95 mm), associated with other indeterminate traces, all preserved in convex hyporelief.

Description

The slightly concave slab represents an infill of the original sea floor and shows a large, loop-shaped burrow (width c. 10 mm) which cannot be ascribed to any particular producer, but probably was not made by an echinoid, since the peculiar structure of such traces is not visible (compare Smith & Crimes, 1983; Radwański & Wysocka, 2001). In addition, there is a smaller, yet comparable burrow perpendicular to it. Close to the latter are two star-shaped trace fossils, also preserved in convex hyporelief and one smaller than the other (measured from arm tip to arm tip, 13 and 9 mm, respectively). Both examples show five tapering arms which, however, are not of equal width throughout and are partially disturbed or incomplete. In view of size difference, it can be ruled out that the same individual created both traces. Overall form and shape suggests an asteroid, rather than an ophiuroid, and quite possibly, juvenile astropectinids (see above) or, alternatively, goniasterids can be evoked as producer of these traces.

Discussion

On the basis of often small differences, some authors have suggested to introduce various ichnotaxa for star-shaped traces of this kind (see, e.g. Chamberlain, 1971; Rioult & Bulow, 1988), but, in the interest of nomenclatural stability and a proper understanding of ichnofossil taxa (Pickerill, 1994; Bertling et al., 2006), it is preferable to incorporate such traces into a single ichnotaxon, irrespective of the fact whether they were produced by asteroids or ophiuroids.

Bell (2004) recorded a related, albeit clearly different, trace under the name of *Ophioichnus aysenensis*, an ichnotaxon accommodating the 'walking by arms' of ophiuroids, and thus utterly different from the 'resting traces' referred to as *Asteriacites lumbricalis*. The latter ichnospecies has been recorded from various types of deposits, of widely divergent ages and often occurring in huge numbers (Lewarne, 1964; Ensom, 1984; Dam, 1990; Breton et al., 2001; de Gibert & Ekdale, 2002; Bell, 2004; Mángano & Buatois, 2004; Larsen, 2005; Savrda, 2007). It represents genuine cubichnia (sensu Seilacher, 1953): resting traces documenting temporary immobility (de Gibert et al., 2004). Ekdale et al. (1984, fig. 15-2) assigned *Asteriacites* to the *Cruziana* (softground) Ichnofacies, typical of sublittoral settings. Finally, Bromley (1996) noted about cubichnia that

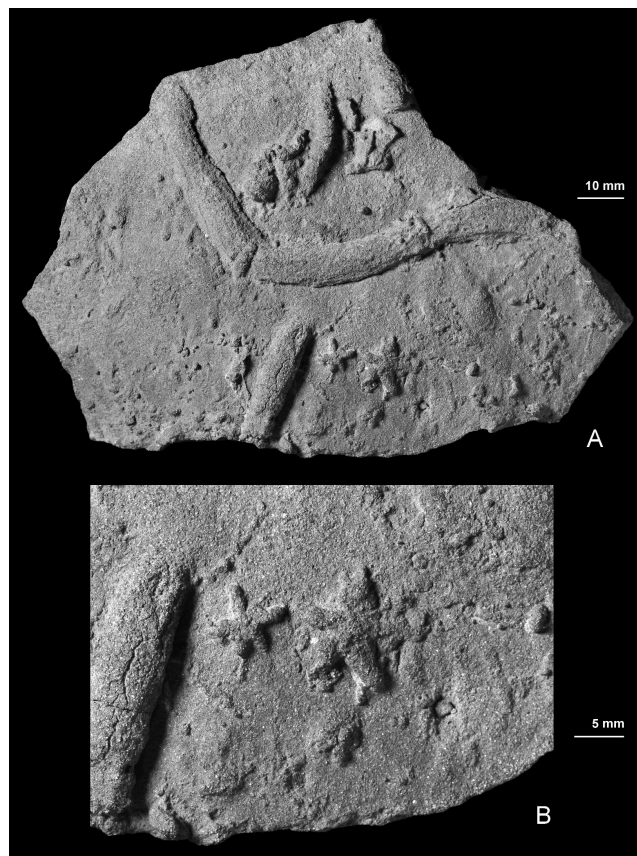


Fig. 2. Late Miocene (Tortonian) examples of *Asteriacites lumbricalis* von Schlotheim, 1820 (MAB 1068), preserved in convex hyporelief on a decalcified and limonitised sandstone slab from sand pit 'de Hoogdonk' near Liessel (province of Noord-Brabant, the Netherlands); A – general overview of slab; B – detail, showing both specimens of the asteroid trace fossil.

these were structures produced by vagile (= free-moving, rather than sessile) bottom-living animals which temporarily burrow into the sea floor, and after some time, leave this site by the same way. Some predators, such as asteroids, display such behaviour when trying to catch infaunal prey.

Conclusion

Not only does this small faunule comprise the first articulated remains of astropectinid starfish to be recorded from the Miocene of the North Sea Basin, it also yields an example of traces left by asteroids on the seafloor. It comes as no surprise that such traces are extremely rare in the generally unconsolidated sandy, or sandy-clayey, deposits which are typical of the Miocene in this basin. As such, the Liessel material is unique in offering a rare glimpse of echinoderm palaeoecology.

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