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Probable remains of jellyfish (Cnidaria, Scyphozoa) from the lower Middle Triassic (Anisian) of Winterswijk, eastern Netherlands

H.W. Oosterink[1,*] & H. Winkelhorst[2]

1 Hortensialaan 64, NL-7101 XH Winterswijk, the Netherlands
2 Molenstraat 14, NL-7122 ZW Aalten, the Netherlands
* Corresponding author. Email: hw.oosterink@hetnet.nl

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Abstract

During recent years, regular round structures have been collected from the top of Bed 12 of the Vossenveld Formation (Lower Muschelkalk, lower Middle Triassic, Anisian) in the Winterswijk area, eastern Netherlands. These are here illustrated and described as probable remains of jellyfish.

Keywords: Cnidaria, Medusae, Muschelkalk, the Netherlands

Introduction

Stratigraphically, the Muschelkalk sequence in the Winterswijk area (Fig. 1) belongs to the Bithynian Substage of the Anisian Stage (lower Middle Triassic). In 2010, the German Stratigraphic Subcommission on the Permian/Triassic (DSK) established a new lithostratigraphic unit, the Vossenveld Formation, for the sequence exposed at working quarries in the hamlet of Vossenveld, close to the Netherlands/Germany border. This formation is characterised by a unique combination of fine-grained, marly coastal deposits documenting sabkha tidal settings with algal laminates (mudflats) and shallow-marine

Fig. 1. The quarry complex in the hamlet of Vossenveld, east of Winterswijk, the Netherlands.

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faunas (Hagdorn & Simon, 2010). Strata comprise grey dolomite and thin-layered limestone with, at certain levels, ripple marks and mud cracks caused by shrinkage during deposition (Borkhataria et al., 2006). The deepest portions of the quarry complex expose reddish brown clays and marls (Hagdorn & Simon, 2010); the Röt/Muschelkalk boundary presumably lies about 40 metres below the present floor (Borkhataria, 2004).

The level (Fig. 2) that has yielded the probable jellyfish remains is the top of Bed 12, which is 1.80 m above a thin red bed (Bed 11) and 0.2 m below Dolomite II (= Bed 13) in Oosterink's (1986) terminology. The top of Bed 12 reveals mud cracks in a clayey marl; this level yields numerous tetrapod ichnotaxa *Rhynchosauroides peabodyi* and *Procolophonichnium haarmuelensis* (= *P. winterswijkense*) as well as the probable jellyfish remains described here (Figs 3, 4).

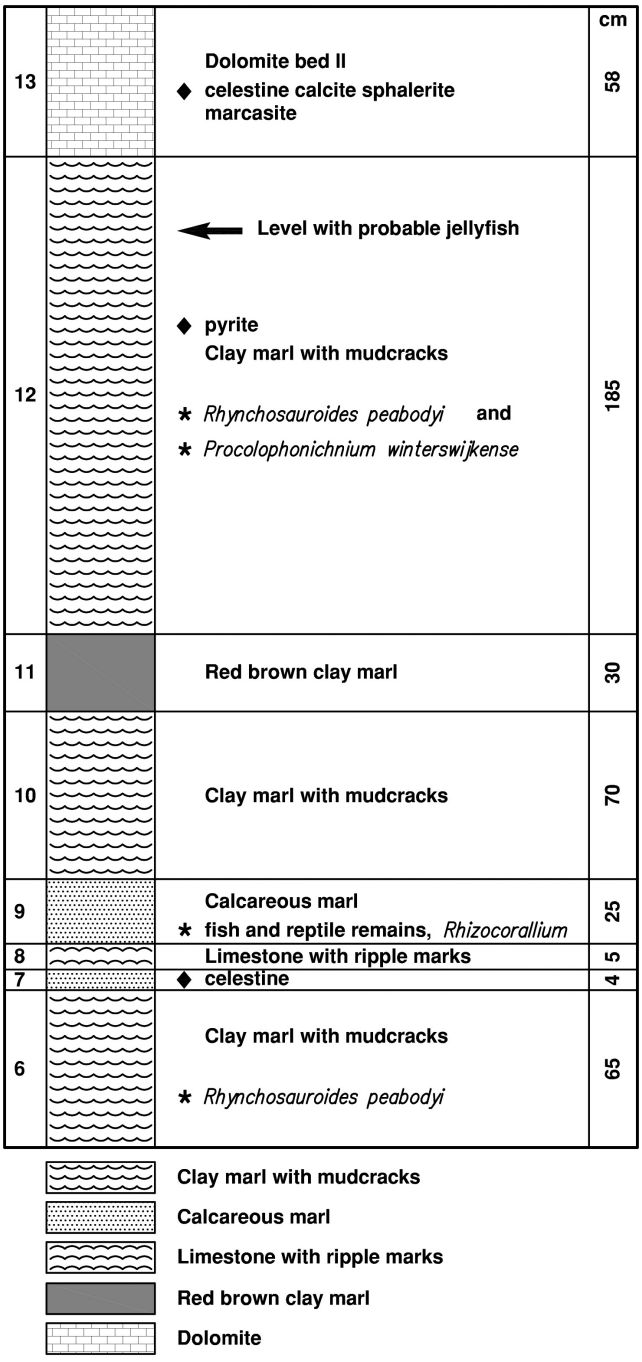

Fig. 2. Part of the log of strata exposed at the Winterswijk quarry complex, showing beds 6 to 13. The arrow denotes the level of provenance of the probable jellyfish remains.

Palaeontology

Ever since the start in 1986 of detailed faunal and stratigraphic studies in the Winterswijk Muschelkalk sequence, these levels (6-13; see Fig. 2) have yielded a wide range of vertebrate and invertebrate taxa (Table 1). Vertebrates comprise aquatic reptiles (skeletons, isolated bones and skulls) as well as cartilaginous and bony fish. Marine molluscs include numerous bivalves in external and internal mould preservation, the predominant species being *Myophoria vulgaris*, and rare cephalopods and gastropods. Of brachiopods, only a single lingulid taxon is known to date, while arthropods include lobsters and limulids.

Footprints and tracks document the presence of reptiles which roamed the coastal area in search of food; a total of five ichnotaxa have been described. In addition, a great number of invertebrate trace types illustrate feeding, hiding, foraging, dwelling and moving in and across the shallow-water, coastal setting represented by the Vossenveld Formation sequence. To this impressive list, probable jellyfish remains may now be added.

Material and description

In total, the collection of probable jellyfish comprises some 50 specimens; for most of these, slab and counter slab are available. Specimens illustrated in Figs 5-12 are the collection of Museum Freriks Winterswijk (MFW), bearing registration numbers 0242-21367 to 0242-21374. All individuals are of medium size, measuring between 40 and 50 mm across. The outer rim of these circular structures is ca 3.5 mm in width, while the centre of the 'disc' shows some irregular elevations. These do reveal a certain uniformity. Although there are no regular distinctive features, the resemblance to certain scyphozoans (Medusae) is such that most workers whom we consulted, agree that they do represent jellyfish remains. However, others noted that they might actually constitute gas bubbles which subsequently cracked (Hagadorn, pers. comm., 2011). In contrast, Professor Steve Hasiotis expressed the opinion (pers. comm., 2012) that these impressions do constitute jellyfish remains, based on their diagnostic shape and internal patterns. In addition, colleagues at Bonn University have recently prepared thin slices of some small laminae of the probable jellyfish which included the sediment layers directly below and above the imprints. Microscopic analysis did not reveal any sign of disturbance of the laminae, which contradicts the gas bubble interpretation.

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Fig. 3. Photograph (June 2011) of the section shown in Fig. 2, with a red line denoting the level which yielded the probable jellyfish remains.

Fig. 4. Photograph (June 2011) of the section shown in Figs 2 and 3, with the top end of the measuring tape marking the level which yielded the probable jellyfish remains.

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Table 1. List of body fossil and ichnofossil taxa recorded to date from the Vossenveld Formation of the Winterswijk area (data from Demathieu & Oosterink, 1983, 1988; Oosterink, 1986, 2001, 2009, 2010; Hagdorn & Rieppel, 1998; Diedrich, 2001; Albers & Rieppel, 2003; Oosterink et al., 2003; Sander & Klein, 2006; Hauschke et al., 2009; Klein, 2009; Klein & Albers, 2009; Klompmaker & Fraaije, 2011; Klein, 2012).

Reptiles
Anarosaurus heterodontus Rieppel & Lin
Nothosaurus winterswijkensis Albers & Rieppel
Nothosaurus winkelhorsti Klein & Albers
Nothosaurus marchicus Koken
Nothosaurus sp.
Cymatosaurus sp.
Placodus gigas Agassiz
Dactylosaurus sp.
Saurosphargis sp.
Paratosuchus sp.
Amotosaurus sp. (= *Tanystropheus antiquus* of previous records)
Cartilaginous and bony fish
Acrodus lateralis Agassiz
Paleobates angustissimus Agassiz
Eosemionotus vogeli (Fritsch)
Saurichthys sp.
Gyrolepis sp.
Birgeria sp.
Pholidophorus sp.
Colobodus sp.
'*Coelacanthus*' sp.
Bivalves
Species of the genera *Gervillia, Hoernesia, Myophoria, Homomya, Pleuromya* and *Modiolus*
Cephalopods
Beneckeia buchi (von Alberti)
Gastropods
Loxonema sp.
Brachiopods
Lingularia sp.
Arthropods
Clytiopsis argentoratensis Bill
Pseudoglyphea cf. *spinosa* (Assmann)
Oosterinkia neerlandica Klompmaker & Fraaije
Limulitella sp.
Ichnofossils
Rhynchosauroides peabodyi (Faber)
Procolophonichnium haarmuelensis (Holst, Smit & Veenstra) (= *P. winterswijkense* Demathieu & Oosterink)
Phenacopus faberi Demathieu & Oosterink
Coelurosaurichnus ratumensis Demathieu & Oosterink
Synaptichnium ('*Brachychirotherium*') *paraparvum* (Demathieu & Oosterink)
Species of the ichnogenera *Rhizocorallium, Diplocraterion, Skolithos, Teichichnus, Gyrophyllites, Kouphichnium, Planolites, Radulichnus, Pholeus, Thalassinoides* and *Undichna*

Bed 37 has recently yielded another probable jellyfish find (Fig. 12). This disc-shaped specimen, measuring ca 40 mm across, rests on a wave-formed, ripple deposit and is associated with bivalves which occur even in the centre of the disc. The disc print consists of about seven, more or less clearly developed, rings.

Discussion

The majority of jellyfish records are of early Palaeozoic age (e.g., Cambrian); records of Mesozoic age are fewer. Comparison of the present material with Triassic records elsewhere are hampered by the fact that only few jellyfish of that age are on record. In addition, not all round structures ultimately turn out to be jellyfish. For instance, finds of Medusae in the Cambrian King Square Formation of New Brunswick (Canada) have since proved to be sedimentary structures which have been referred to as 'Astropolithon' (Hagadorn & Miller, 2011). Hagadorn et al. (2002) supplied us with an image of Late Cambrian Scyphozoa on a shoreline with ripple marks of the Mt. Simon-Wonewoc Sandstone in central Wisconsin. Their size is 4 to 9 times that of the Winterswijk findings. Interestingly, the latter findings have also been made in beds with ripple marks.

Comparing our material to other published Triassic findings is not unequivocal. Adam (1950) recorded an example of *Medusina eisfeldensis* from the Triassic of Eisfeld (Thüringen, eastern Germany), which is comparable in overall dimensions with the Winterswijk material, but is less flat and does not have a perfectly round shape. In addition, the Eisfeld specimen has a differently shaped umbrella. In the appendix of Adam's 1950 paper, there is mention of a second find. This specimen is not comparable with the Winterswijk finds either.

Romero et al. (2011) described Medusae from the Middle Triassic (Ladinian) of Montral-Alcover in northeast Spain. On average, *Tarracodiscus vial*, *T. villaltai* and *Heliobranchia catalaunica* match the Winterswijk specimens in size, but there the similarity ends. Grauvogel & Gall (1962) and Gall (1971, 1990) mentioned Medusae with tentacles, *Progonionemus vogesiacus*, from the Lower Triassic (Anisian) Grès à Voltzia Formation of northeast France. These specimens, assigned to the Hydrozoa, are very small (6 mm in diameter; see also Young & Hagadorn, 2010). Those authors further presented a general overview of occurrences of cnidarian Medusae from the Middle Cambrian to the Upper Jurassic in North America (Canada, USA) and Europe.

Hagdorn (pers. comm., July 2010) informed us that a great number of Medusae had recently come to light in the Upper Triassic Lettenkeuper at Hohenloh in southern Germany. This material, of overall dimensions between 10 and 70 mm, has not yet been published; preliminary comparisons show them to be entirely different from the Winterswijk specimens.

The only jellyfish which match the Winterswijk material in shape and overall dimensions are specimens from the Upper Jurassic lithographic limestone of Cerin (France), described as *Paraurelia cerinensis* (Gaillard et al., 2006). Here the discoidal

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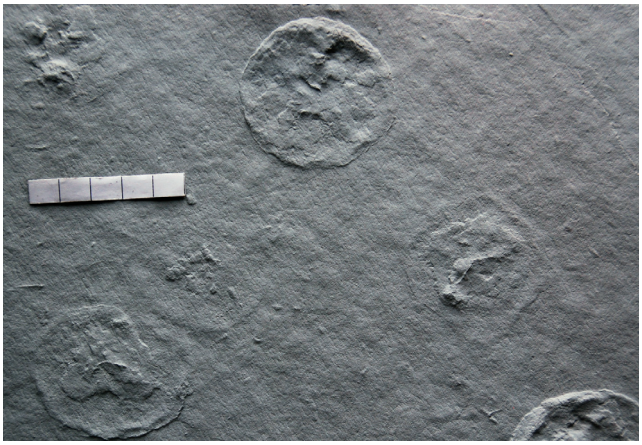

Fig. 5.

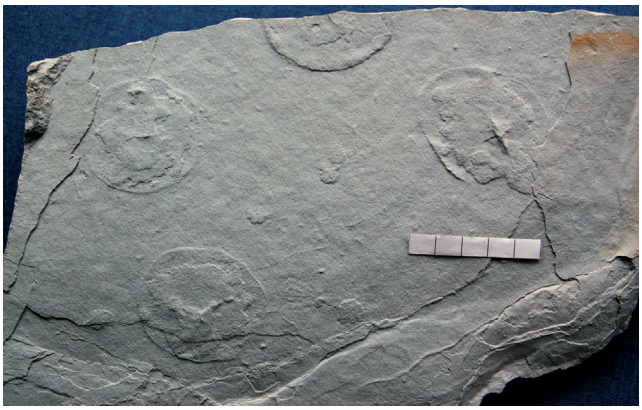

Fig. 6.

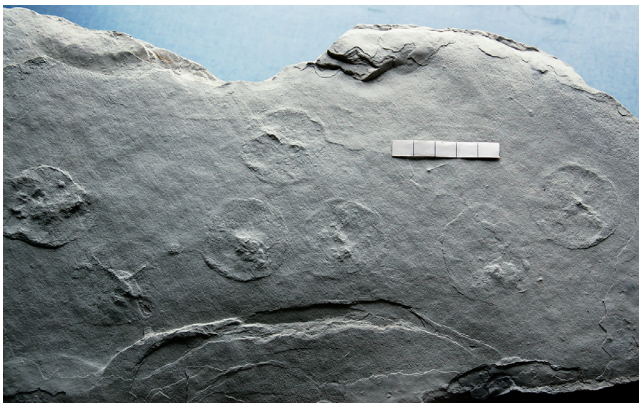

Fig. 7.

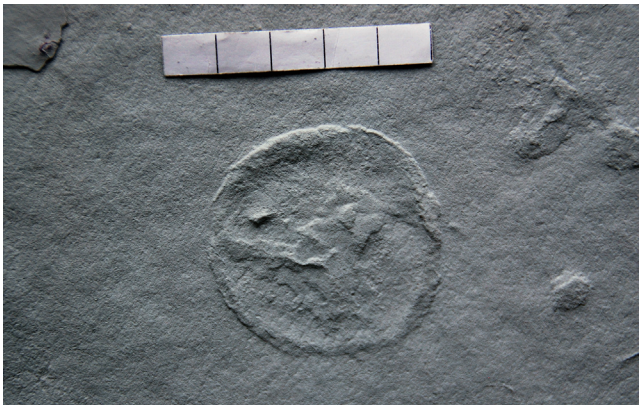

Fig. 8.

Fig. 9.

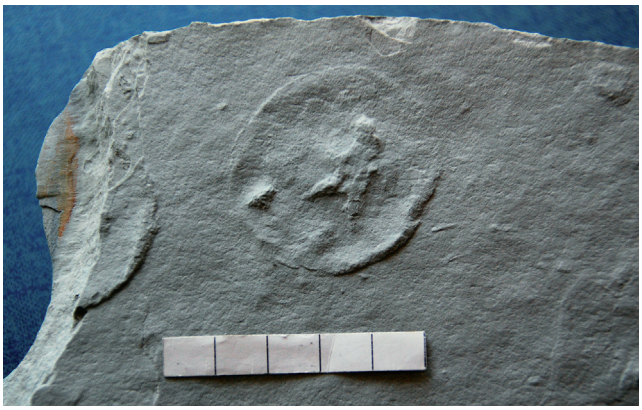

Fig. 10.

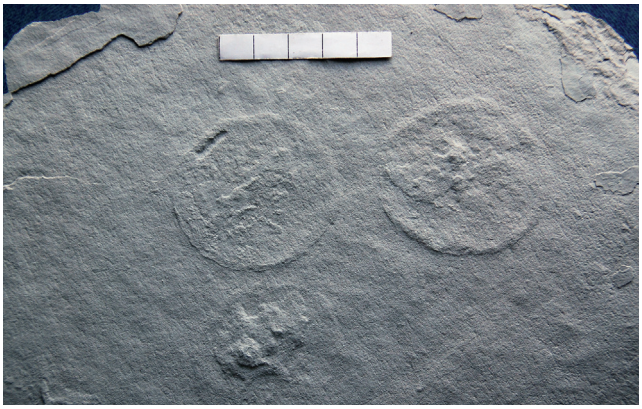

Fig. 11.

Figs 5-11. Examples of probable jellyfish remains from the Vossenveld Formation of the Winterswijk area. Sample numbers MFW 0242-21367 to 0242-21373. All scale bars equal 50 mm.

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Fig. 12. Probable jellyfish from bed 37, in ripple mark bed. MFW 0242-21374.

umbrella has a markedly thickened border, as in the Winterswijk material. However, our specimens lack the four marked central organs of *P. cerinensis* and show only irregular central structures.

In summary, in the absence of an alternative explanation, we conclude that our material represents the imprints of fossil jellyfish. The occurrence of such fossils in Winterswijk could be expected in these depositional environments of extensive muddy tidal flats with microbiological (algal) activity, which are conducive to the preservation of such biota.

Acknowledgements

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