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New species of Mesozoic benthic foraminifera from the former British Petroleum micropalaeontology collection

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Abstract. This paper describes five new Mesozoic, deep-water benthic foraminifera from the former British Petroleum microfossil reference collections at the Natural History Museum, London. The focus is on selected calcareous and agglutinating taxa that are of stratigraphical and/or palaeoecological significance for academic and industrial related activities.

Ophthalmidium dracomaris (urn:lsid:zoobank.org:act:CCE951DF-0446-416B-AC2D-C5322CD335D2), *Trochammina fordonensis* (urn:lsid:zoobank.org:act:4F00A270-F9B2-46D4-8587-C7ADCC191D13), *Eobigenerina calloviensis* (urn:lsid:zoobank.org:act:B8443AA5-CFE4-44C0-A5A2-65EA97BF7EFA), *Arenoturrispirillina swiecickii* (urn:lsid:zoobank.org:act:06A35E03-5AA4-4363-B471-4E1A0091F62E) and *Ataxophragmium mariae* (urn:lsid:zoobank.org:act:B8443AA5-CFE4-44C0-A5A2-65EA97BF7EFA) are described with new illustrations. Their biostratigraphic and palaeoecological significance are briefly discussed.

1 Introduction

The North Sea Basin lies in between Scandinavia and north-western Europe and is bounded by the continental shelf edge, approximately comparable to the region covered by the current North Sea today. It is a topographical low and can be divided into several sub-basins of late Palaeozoic through Cenozoic age (Carr, 2004). The area has an active tectonic history and deposition has varied between the different basins. Benthic foraminifera have been used extensively in the oil and gas industry to date the sediments and investigate the impact of environmental and palaeobathymetric changes on these semi-enclosed basins (Gradstein et al., 1994; Jenkins and Murray, 1989; King and Hughes, 1983).

British Petroleum's exploration activities, especially in the UK sector, during the middle of the 20th century amassed a large volume of Mesozoic sample material and subsequently prepared micropalaeontological specimens, many of which are now housed at the Natural History Museum, London. The north-western European reference collection contains many of the specimens used in exploration activities and provides an almost unique collection of useful, yet in some instances formally un-described, foraminiferal taxa.

The taxonomy of the Cenozoic material from this collection has already been the focus of separate study (Fox et al., 2018). Presented here are five newly named species of Mesozoic benthic foraminifera which have academic and industrial value in their biostratigraphic and palaeoecological significance.

2 Materials

Light microscope images were taken using a Nikon SMZ25 stereoscopic zoom microscope and Nikon DS-Fi2 digital camera. SEM images were taken using uncoated specimens on a LEO 1455 VP scanning electron microscope.

3 Systematics

We present systematic data (descriptions, synonymies, biogeography and palaeoecologies) that were assembled from primary research, from the micropalaeontological literature, and also from consultation with specialists. Brief geological context is also provided, where available, for the well and/or outcrop where the type specimens were found. The taxonomic classification follows Loeblich and Tappan (1987)

with a few exceptions which mainly reflect taxonomic updates published subsequently (Kaminski, 2014).

Order **Miliolida** Delage & Hérouard, 1896

Superfamily **Nubecularioidea** Jones, 1875

Family **Ophthalmidiidae** Wiesner, 1920

Genus *Ophthalmidium* Kubler & Zwingli, 1870

Type species: *Oculina porosa* Kubler & Zwingli, 1866

Ophthalmidium dracomaris sp. nov.

Figs. 1.1–1.5

Synonyms

Ophthalmidium sp. A Coleman in Horton et al. 1974.

Ophthalmidium sp. A Medd in Richardson 1979.

Ophthalmidium sp. A Morris & Coleman 1981, 221. pl. 6.3.6, fig. 15.

Diagnosis: Compressed porcellaneous test, consisting of six to eight chambers, with a long tapering neck and simple circular aperture.

Dimensions: Diameter is $\sim 100\mu\text{m}$; height of test is $\sim 300\mu\text{m}$.

Description: Test compressed, elliptical in outline; porcellaneous wall texture, periphery acute and weakly keeled; chambers almost invisible externally, half-whorl in length, rounded at the base and tapering slightly towards the aperture, margins almost parallel, sutures very weakly depressed; aperture is simple, circular, at the end of a long tapering neck, lacking a tooth.

Remarks: Specimens were originally described by Coleman (1974; in Horton et al., 1974) from the area around Milton Keynes, Buckinghamshire, and these have been described in some detail by Morris and Coleman (1989). *Ophthalmidium dracomaris* sp. nov. differs from *O. compressum* (Barnard, Cordey & Shipp, 1981) by possessing fewer chambers. *O. maredraco* bears a resemblance to *O. michalskii* illustrated in Plate 1, Figs. 1, 6 and 7, but differs by having a more flattened, less rounded test and a longer, narrower neck.

Type level: Middle Jurassic. Late Callovian, athleta–lamberti ammonite zones.

Type locality: Well: Tetney Lock-1, Lincolnshire, UK. Depth: 1652 ft (503.5 m).

Distribution: Late Callovian of England.

Etymology: This species was named based upon its resemblance to the head of a sea dragon.

Holotype: NHMUK PM PF 74496.

Paratypes: NHMUK PM PF 74497–74500.

Order **Lituolida** Lankester, 1885

Superfamily **Trochamminoidea** Schwager, 1877

Family **Trochamminidae** Schwager, 1877

Genus *Trochammina* Parker & Jones, 1859

Type species: *Rotalia (Trochammina) inflata* (Montagu) = *Nautilus inflatus* Montagu, 1808

Trochammina fordonensis sp. nov.

Figs. 1.10–1.12

Synonyms

Trochammina sp. 68 Internal British Petroleum report.

Diagnosis: Small, low spired, finely agglutinated, trochoid test with eight to nine chambers in the final whorl, umbilical to extra-umbilical aperture with a lip.

Dimensions: Diameter is $150\text{--}200\mu\text{m}$; height of test is $\sim 200\mu\text{m}$.

Description: Test small, trochoid, flattened, very low spired, rounded in outline; consists of two whorls with eight to nine chambers in the final whorl, increasing gradually in size, flat on umbilical surface, convex on spiral side. Periphery acute, slightly lobate on margin. On the umbilical side only the final whorl is visible. Sutures are radial on umbilical side and slightly curved on the spiral side. Wall finely agglutinated with much cement; umbilical to extra-umbilical aperture with a lip, opening into umbilicus commonly obscured due to preservation.

Remarks: *Trochammina fordonensis* sp. nov. is similar to *Trochammina aquilonaris* Hedinger, 1993 in general morphology and size, but differs in having a flattened dorsal side and radial sutures on the umbilical side.

Type level: Early Aptian.

Type locality: Well: Fordon-1 (BGS Borehole TA07NE24), Yorkshire, UK. Depth: 750 ft (228.6 m).

Distribution: Speeton Clay Formation, UK.

Etymology: This taxon is named after the type locality.

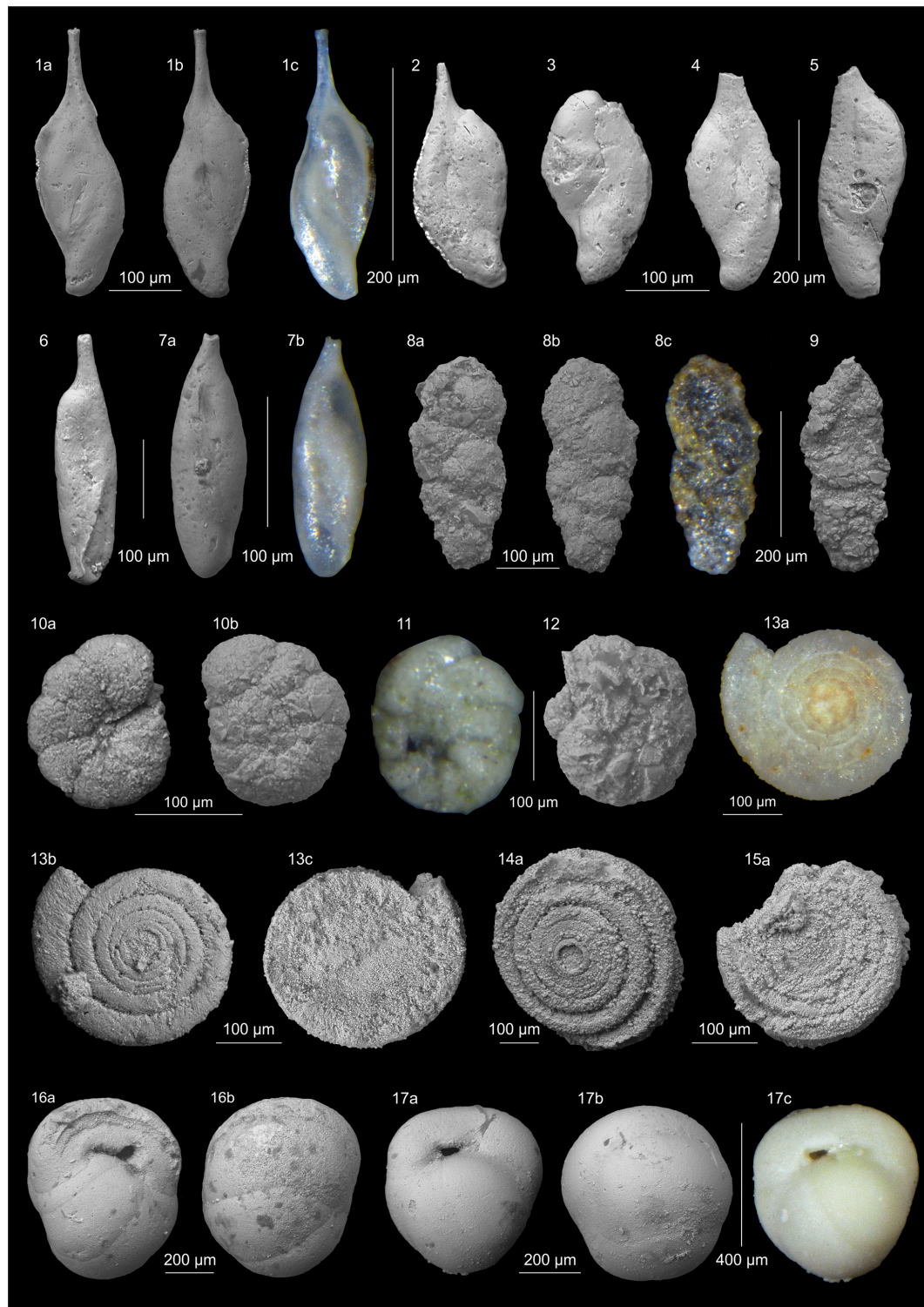


Plate 1. (1–5) *Ophthalmidium dracomaris* n. sp.: (1) holotype (NHMUK PM PF 74496); (2–5) paratypes (NHMUK PM PF 74497–74500). (8–9) *Eobigenerina calloviensis* n. sp.: (8) holotype (NHMUK PM PF 74504); (9) paratype (NHMUK PM PF 74505). (10–12) *Trochammina fordonensis* n. sp.: (10) holotype (NHMUK PM PF 74501); (11–12) paratype (NHMUK PM PF 74502–74503). (13–15) *Arenoturrispirillina swiecickii* n. sp.: (13) holotype (NHMUK PM PF 74506); (14–15) paratype (NHMUK PM PF 74507 + NHMUK PM PF 74552). (16–17) *Ataxophragmium mariae* n. sp.: (16) holotype (NHMUK PM PF 74553); (17) paratype (NHMUK PM PF 74554).

Holotype: NHMUK PM PF 74501.

Paratypes: NHMUK PM PF 74502–74503.

Order **Textulariida** Delage & Hérouard, 1896

Suborder **Verneulinina** Mikhalevich & Kaminski, 2004.

Superfamily **Verneulinioidea** Cushman, 1911.

Family **Prolixoplectidae** Loeblich & Tappan, 1985.

Genus *Eobigenerina* Cetean, Setoyama, Kaminski, Neagu, Bubík, Filipescu & Tyszká, 2008

Type species: *Bigenerina variabilis* Vašíček, 1947

Eobigenerina calloviensis sp. nov.

Figs. 1.8–1.9

Synonyms

Bigenerina sp. 24 Internal British Petroleum report.

Diagnosis: Small biserial to uniserial agglutinating test with six to seven slowly enlarging chambers.

Dimensions: Diameter is $\sim 150\ \mu\text{m}$; height of test is $\sim 300\ \mu\text{m}$.

Description: Test free, small, elongate in lateral outline and compressed; tapered at the base and rounded at the apertural end. Consists of two sections; initially biserial with six to seven slowly enlarging chambers; final two chambers are loosely biserial to lax-uniserial, not symmetrical, forming an uneven row with oblique sutures. Chambers in the uniserial part increase very little in size as added. Sutures are thin and depressed. Aperture terminal, in the form of a rounded opening on the slightly upwardly prolonged end of the last chamber. Wall finely agglutinated with grains less than $20\ \mu\text{m}$ in size.

Remarks: The genus *Eobigenerina* differs from *Bigenerina* in possessing organic cement that is silicified in fossil specimens. The Cenozoic genus *Bigenerina* possesses calcareous cement with pseudopores. Many of the late Paleozoic to Mesozoic species that were originally described as *Bigenerina* likely belong in *Eobigenerina* (Cetean et al., 2011). The chamber arrangement in the new species is initially biserial, becoming loosely biserial to lax-uniserial (sensu Kaminski et al., 2011) in the final chambers. This species differs from *Bigenerina elongata* (Gauger, 1953) and *B. ciscoensis* (Cushman and Waters, 1928) in possessing a shorter uniserial part and smaller test.

Type level: Early Jurassic; late Callovian, athleta–lamberti ammonite zones.

Type locality: Well: Tetney Lock-1 (BGS Borehole: TA30SW93), Lincolnshire, UK. Depth 1751 ft (533.7 m).

Distribution: Currently restricted to the immediate area around the type locality.

Etymology: This simple agglutinating form is named for the type level at which it is found.

Holotype: NHMUK PM PF 74504.

Paratypes: NHMUK PM PF 74505.

Order **Spirillinida** Hohenegger & Piller, 1975

Superfamily **Ammodiscoidea** Reuss, 1862

Family **Ammodiscidae** Reuss, 1862

Genus *Arenoturrspirillina* Tairov, 1956

Type species: *Spirillina limbata* Brady, 1879

Arenoturrspirillina swiecickii sp. nov.

Figs. 1.13–1.15

Synonyms

Arenoturrspirillina sp. A Swiecicki, 1980; pl. 1, figs. 3, 4.

Diagnosis: Single sub-rectangular to rectangular tubular chamber, coiling in a regular trochospire, with a circular outline.

Dimensions: Diameter is $\sim 600\ \mu\text{m}$.

Description: Test free, large; low conical spire, consisting of proloculus followed by single tubular chamber coiling in a low regular trochospire, outline circular, peripheral margin sub-rectangular to rectangular, occasionally developing angular keels; chamber size increasing gradually and uniformly, forming five to six whorls; spiral suture distinct and depressed; aperture arcuate opening at end of chamber; wall finely agglutinated, organic cement; surface finely roughened.

Remarks: This species was referred to as *Spirillina limbata* Brady by Heron-Allen and Earland (1910). However, examination of their hypotypes by Barr (1962) revealed the present species to be distinct, bearing only a superficial resemblance to the Recent *S. limbata*. Barr (1962) described this form as “*Ammodiscoides heronalleni*”, but this name has never been published. This species was illustrated and described in Swiecicki’s 1980 doctoral thesis in which it was removed from the genus *Ammodiscoides* Cushman (1909) as “it does not show the change from trochospiral to planispiral growth, characteristic of this genus” and was

instead placed in *Arenoturrispirillina* Tairov (1956) on the basis of its “low, regular trochospiral coil”. There have been several references (e.g. Cushman, 1946; Hofker, 1959) to Cretaceous occurrences of *Ammodiscoides turbinatus* (Cushman, 1909) originally described from the Holocene, Gulf of Mexico. This latter species, the genotype of *Ammodiscoides*, “lacks the regular trochospiral form” of the present species and therefore further investigation is required on these Cretaceous references (Sweicicki, 1980).

Type level: Campanian, benthic foraminifera biozones B1ii–B5i.

Type locality: On shore, Ignaberga, Sweden.

Distribution: Rare specimens have been found in the Campanian of the Isle of Wight. A single specimen was also found in the lower Maastrichtian of Norfolk (Sweicicki, 1980).

Etymology: This species is named for Anthony Swiecicki, who first described this taxon in his doctoral thesis on the biostratigraphy of the Campanian and Maastrichtian chalks of the United Kingdom (1980).

Holotype: NHMUK PM PF 74506.

Paratypes: NHMUK PM PF 74507 + NHMUK PM PF 74552.

Order **Loftusiida** Kaminski & Mikhalevich, 2003

Superfamily **Ataxophragmioidea** Schwager, 1877

Family **Ataxophragmiidae** Schwager, 1877

Genus *Ataxophragmium* Reuss, 1860

Type species: *Bulimina variabilis* d’Orbigny, 1840

Ataxophragmium mariae sp. nov.

Figs. 1.16–1.17

Synonyms

1941 *Ataxogyroidina globosa* (von Hagenow); Marie, p. 59, pl. 5, figs. 50–7.

1966 *Ataxophragmium globosum* (von Hagenow); Hofker, p. 33, pl. 4, fig. 9.

1977 *Ataxophragmium globosum* (von Hagenow); Villain, p. 43, pl. 4, figs. 2, 3.

Diagnosis: A species of *Ataxophragmium* with a regular, low trochospiral chamber arrangement, tendency to planoconvex form, sub-rectangular, interiomarginal aperture and smooth surface.

Dimensions: Height of test: 700 µm; diameter: 650 µm.

Description: Test free; an asymmetrical low trochospiral coil with a tendency to planoconvexity, outline sub-spherical; two, occasionally three, whorls embracing, overlapping, evolute; chambers indistinct, moderately and uniformly increasing in size, may be slightly inflated, six per whorl several times higher than broad; last chamber often overlaps previous whorl both dorsally and ventrally; sutures distinct, flush; apertural face flat, making angle of approximately 65° with previous whorl; aperture a deep, elongate, sub-rectangular slit along interiomarginal suture of last chamber, may show partial development of central lobe; interior most often simple, occasional forms show development of sutural buttresses; wall finely agglutinated, with calcareous cement; surface smooth.

Remarks: Marie (1941) originally described this rather distinctive species of *Ataxophragmium*, noting in particular its characteristic form and aperture. However, he referred to it as *Nonionina globosa* von Hagenow (1842), a form described, though never figured, from the Upper Cretaceous. Later workers, including Reuss (1862), Marsson (1878), Franke (1925, 1927), Cushman (1931), Schijfsma (1946) and Visser (1951), have all considered *N. globosa* to be calcareous and perforate, and it is herein considered to belong to the genus *Gyroidinoides*. The present form *A. mariae* is broadly similar in shape, but its wall character and aperture serve clearly to distinguish it. Schijfsma (1946) noted the above situation and erected *Ataxogyroidina pseudoglobosa* and included forms referred to by Marie as *A. globosa* in its synonymy. From his figures and descriptions, however, it is clear that *A. pseudoglobosa* (Schijfsma, 1946) is not conspecific with Marie’s species nor with the (Tairov, 1959) forms herein described, lacking as it does the characteristic form, aperture and smooth surface.

Type level: Upper Campanian.

Type locality: German Jura.

Distribution: This species is moderately common in the upper Campanian on the Isle of Wight and Norfolk, UK.

Etymology: Named in honour of Pierre Marie who first described this taxon.

Holotype: NHMUK PM PF 74553.

Paratypes: NHMUK PM PF 74554.

4 Summary

Five new species of deep-water benthic foraminifera from the Mesozoic of north-western Europe are described from the ex-

tensive reference collections at the Natural History Museum, London. These benthic foraminifera are important for their biostratigraphic and palaeoenvironmental value, hence their overdue formalized taxonomic descriptions. This study highlights the importance of both museum and industrial collections for their vast potential for new, publishable data, including new taxa and material from restricted and no-longer accessible locations.

Data availability. Type and figured material is deposited at the Natural History Museum, London, where it is available for inspection upon request.

Competing interests. The authors declare that they have no conflict of interest.

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