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# A new species of *Omphalocyclus* (Foraminiferida) from the Upper Cretaceous of Jamaica and its stratigraphical significance

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**ABSTRACT** – The orbitoidal larger foraminifer *Omphalocyclus maldonensis* n. sp. is described from the Maldon Inlier of northwestern Jamaica, being the first record of this genus from the island. The limestone in which it occurs contains the Upper Cretaceous (Upper Maastrichtian) *Titanosarcolites* rudist fauna, together with larger foraminiferal specimens identified as *Orbitoides megaloformis* Papp & Küpper. The new species differs from *Omphalocyclus macroporus,* the only other widely recognized species, in possessing a much smaller nucleus. At least some of the earlier records of *Omphalocyclus* from the Upper Cretaceous of Venezuela and Cuba should probably be referred to *O. maldonensis*. *J. Micropalaeontol.* **21**(2): 149–153, December 2002.

## INTRODUCTION

Larger foraminifera belonging to the Family Orbitoidae achieved circum-tropical distributions in the late Cretaceous (Dilley, 1973). Many of the species, particularly *Orbitoides* and *Omphalocyclus* have been used as biostratigraphic indicators in the platform limestone successions of the Mediteranean Tethys where ammonites and inoceramids are rare (e.g. Küpper, 1954; van Hinte, 1966; Dilley, 1973; Caus *et al*., 1996). *Omphalocyclus* has been widely recognized in Upper Cretaceous rocks in many parts of the Tethyan region, usually as *O. macroporus* (Lamarck) the type species (El-Asa'ad, 1989; Matsumaru, 1997). In most cases, the presence of *Omphalocyclus* has been used to indicate a Late Cretaceous, Maastrichtian, age for the rocks in which it occurs.

In the Caribbean, these foraminifera are also well known. *Orbitoides* is widespread (e.g. Renz, 1955; Seiglie & Ayala-Castañares, 1963; Jiang & Robinson, 1987), while *Omphalocyclus* has been reported from Cuba (Ellis, 1932; Rutten, 1935; Kupper, 1954; Seiglie & Ayala-Castañares, 1963) and northern Venezuela (Renz, 1955).

During the course of re-mapping the Upper Cretaceous rocks of the Maldon Inlier, northwest Jamaica (Chubb, 1958; Meyerhoff & Krieg, 1977; Fig. 1) two of us (GCG & SFM) sampled a layer containing numerous specimens of the larger foraminiferal genus *Omphalocyclus*. This is the first record of this genus from Jamaica. However, the specimens from the Maldon Inlier differ from typical *O. macroporus* and are described herein as *O. maldonensis*. We further discuss the biostratigraphical significance of the orbitoidal foraminifera in the Caribbean.

## GEOLOGICAL SETTING

Upper Cretaceous sedimentary rocks are well exposed in the Maldon Inlier in the Parish of St. James (western Jamaica: Fig. 1). The inlier has previously been mapped by Sawkins (1869), Bailey (Chubb, 1958) and Atkinson (1969). The succession, named informally by Chubb (1958), consists of two limestones, the Maldon Limestone and Vaughansfield Limestone, within a thick succession of volcaniclastic shales and sandstones (Fig. 2). These sediments were deposited in a shallow tropical sea, close to active volcanoes of a Cretaceous island-arc complex (Coates, 1977; Draper, 1987; Mitchell, in press). The limestones contain abundant rudist bivalves, including *Titanosarcolites giganteus* (Whitfield), *Biradiolites jamaicensis* Trechmann, *Chiapasella* sp., *Antillocaprina* spp., *Thyrastylon* spp., *Bournonia* spp. and *Plagioptychus* spp. (Chubb, 1971; Kauffman & Sohl, 1974). This is a typical assemblage of the *Titanosarcolites* fauna (Chubb, 1971) and is traditionally considered to indicate a Maastrichtian age (Chubb, 1971; Sohl & Kollman, 1985), although Jiang & Robinson (1987) suggested it may also be partly Late Campanian. New strontium isotopic dates indicate a late Maastrichtian age (Steuber *et al*., 2002). Corals, gastropods and ostracodes are also present (Coates, 1977; Sohl & Kollman, 1985; Hazel & Kamiya, 1993; Sohl, 1998). The intervening clastics yield gastropods, corals, ostracodes and the larger foraminifera *Kathina jamaicensis* (Cushman & Jarvis) and *Ayalaina rutteni* (Palmer) (Robinson, 1968; Atkinson, 1969; Hazel & Kamiya, 1993). Hazel & Kamiya (1993) erected three ostracode subzones in the Maldon Inlier. Zone 1a occurs in the Woodlands Shale, zone 1b in the Maldon Limestone and zone 1c in the upper Popkin Shale/lower Vaughansfield Limestone (Fig. 2).

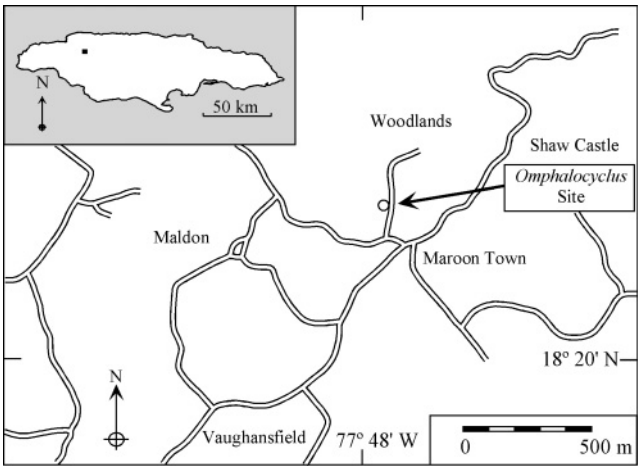



**Fig. 1.** Location of sample site in the Maldon Inlier (location in Jamaica inset).

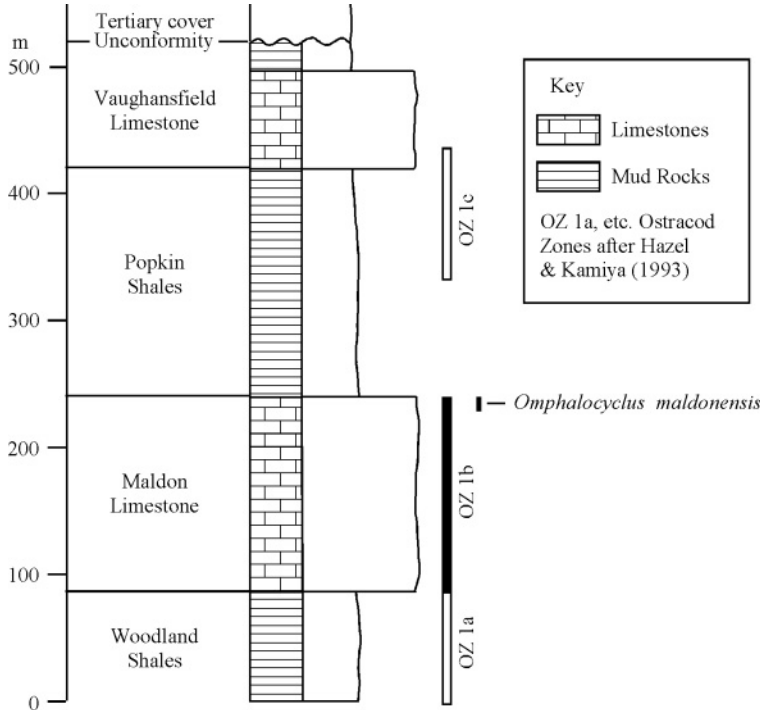



**Fig. 2.** Simplified geological succession in the Maldon Inlier.

## SYSTEMATIC PALAEONTOLOGY

Order **Foraminiferida** Eichwald, 1830
Suborder **Rotaliina** Delage & Herouard, 1896
Superfamily **Orbitoidacea** Schwager, 1876
Family **Orbitoididae** Schwager, 1876
Genus *Omphalocyclus* Bronn *in* Bronn & Roemer, 1852

*Omphalocyclus maldonensis* n. sp.
(Pl. 1, figs 1–6)

? 1955 *Omphalocyclus* cf. *macroporus* Lamarck; Renz: pl. 5, figs 1–3, 5–6, ?figs 4, 10.

**Type species.** *Orbulites macropora* Lamarck, 1816.

**Derivation.** After the Maldon Inlier, where the species occurs.

**Diagnosis.** A species of *Omphalocyclus* with a quadrilocular nucleus with a diameter of 0.16 mm to 0.30 mm, and a significant periembryonic zone of uniserial orbitoidal chambers.

**Holotype.** UWIGM RG2001.248.

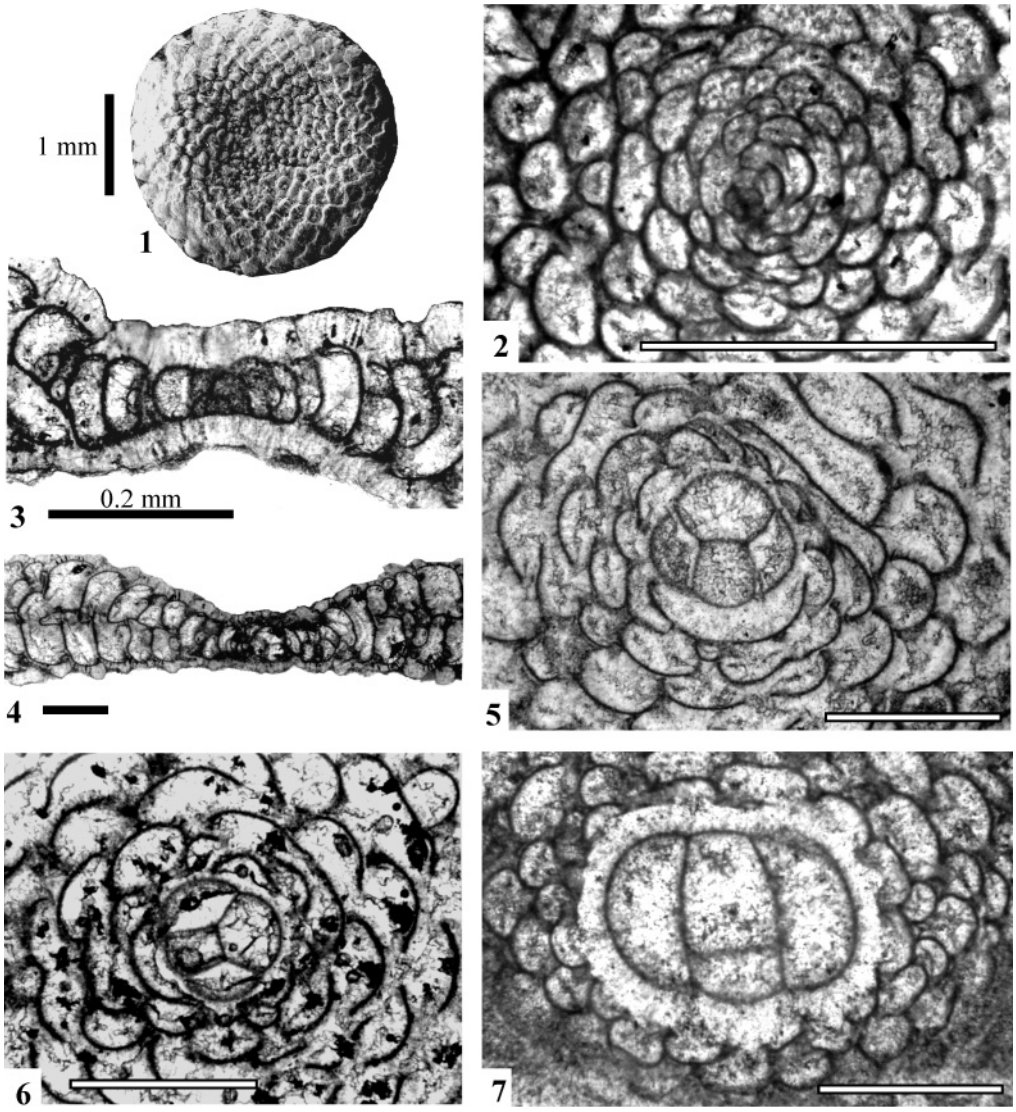
**Paratypes.** UWIGM1999.48–52.

**Material.** About 200 complete tests from the Maldon Limestone, Maldon Inlier Jamaica (UWIGM 1999.45 & UWIGM 1999.46). The tests are well preserved with good surface ornamentation.

**Type locality and horizon.** The specimens were collected *c.* 9 m below the top of the Maldon Limestone (Fig. 2), alongside a minor road *c.* 78 m north of the junction at Maroon Town, Parish of St James (Fig. 1). *Omphalocyclus maldonensis* occurs associated with the foraminifera *Orbitoides megaloformis* Papp & Küpper (Pl. 1, fig. 7) and *Kathina jamaicensis* (Cushman & Jarvis). Hazel & Kamiya (1993) placed the Maldon Limestone within subzone 1b of their informal ostracode zonation for the *Titanosarcolites*-bearing limestones and related sequences of Jamaica. Upper Maastrichtian (see discussion below).

**Description.** Externally the test is disk shaped, bilaterally depressed in the centre, more or less circular in outline. Many tests are asymmetrical, one side being flat to slightly depressed in the centre, the opposite side with a markedly depressed centre. Surface ornamented with a cellular pattern of low ridges mimicking the internal pattern of septa separating the chambers; periphery bluntly rounded, with two to three rows of coarse pores; smaller specimens with two rows of pores, frequently separated by a more or less prominent keel. Diameters of 176 measured specimens range from 1.2 mm to 6.6 mm and maximum thicknesses (at or near the periphery) from 0.24 mm to 0.98 mm (Fig. 3). Equatorial sections of well preserved megalospheric individuals exhibit a quadrilocular nucleus, similar in pattern to that of *Orbitoides* (e.g. Caus *et al.*, 1996), surrounded by a thickened wall. Internal nuclear diameters of 11 sectioned individuals range from 0.16 mm to 0.30 mm. Adauxiliary chambers (*sensu* Caus *et al.*, 1996, p. 128) are generally 8 to 9 (observed range 6 to 10) in number, surrounded by about 7 or 8 cycles of orbitoidal chambers. In the outer part of the test, the equatorial layer consists of chambers with a more or less square cross-section (chessboard pattern of Höttinger, 1981).

In axial section, the nucleus is succeeded variably by 2 to 4 cycles of normal uniserial orbitoidal chambers, then by 5 to




**Explanation of Plate 1. figs 1–6.** *Omphalocyclus maldonensis* sp. nov.: **1**, holotype (UWIGM RG2001.248), scale bar 1 mm; **2**, equatorial section of microspheric form (UWIGM1999.48); **3–4**, transverse sections (UWIGM 1999.49–50); **5–6**, equatorial section of macrospheric form (UWIGM1999.51–52). Scale bar for 2–6 is 0.2 mm. **fig. 7.** *Orbitoides megaloformis* Papp & Küpper. Equatorial section of macrospheric form (UWIGM1999.53), scale bar 0.2 mm. All specimens from upper part of Maldon Limestone.

10 cycles of biserial orbitoidal chambers of the type illustrated by Höttinger (1981, fig. 7); a third, somewhat irregular layer of equatorial chambers is inserted between the last 3 to 6 cycles of orbitoidal chambers in the peripheral region. These are of the kind described by Höttinger (1981, figs 5 & 6). The more numerous triserial cycles are seen preferentially in microspheric specimens. No lateral chambers of the orbitoidal kind are present.

Equatorial sections of the microspheric generation show a tiny, apparently biserial embryonic stage, surrounded by a low trochospiral coil of about 6 to 8 chambers. These are succeeded in turn by from five to as many as 12 or more cycles of orbitoidal equatorial chambers, similar to those of the megalospheric generation. These may be followed, in the distal part of the test, by several cycles of chambers of the chessboard pattern of Höttinger (1981).

**Dimensions.** Measurements of the nucleus of specimens of *Omphalocyclus* from Jamaica and The Netherlands (early late Maastrichtian, ENCI quarry) is given below. The terminology, Li and li, follows that used by van Hinte (1966) for the nucleus of *Orbitoides* and is illustrated with reference to Figure 4. Measurements in mm.

| Locality | *n* | Li | | | | li | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | SD | Min | Max | Mean | SD | Min | Max |
| Jamaica | 11 | 0.23 | 0.04 | 0.30 | 0.16 | 0.23 | 0.03 | 0.28 | 0.19 |
| ENCI | 9 | 0.42 | 0.08 | 0.49 | 0.27 | 0.43 | 0.08 | 0.54 | 0.30 |

**Remarks.** *Omphalocyclus maldonensis* differs from typical *O. macroporus* in possessing a smaller nucleus, in exhibiting a

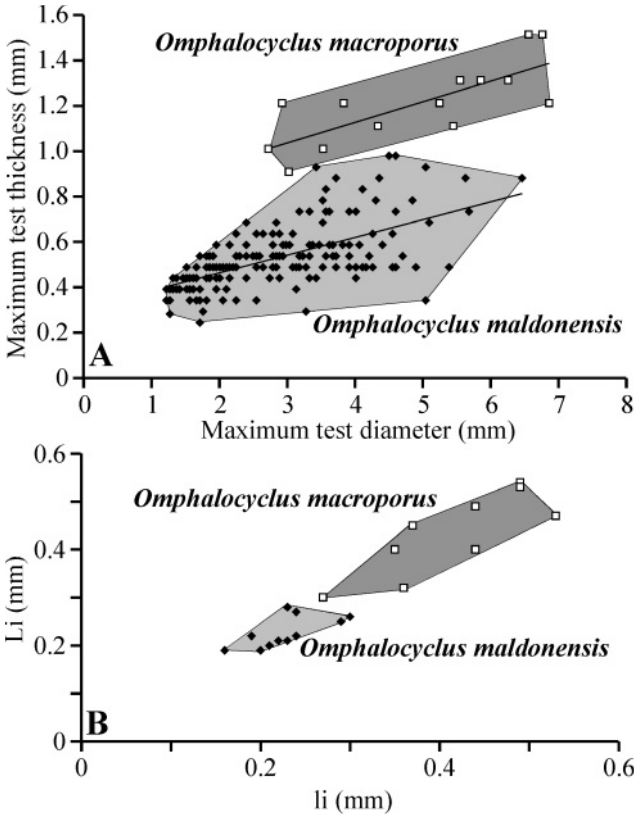



**Fig. 3.** Scatter plots of maximum test thickness versus maximum test diameter and Li versus li for *Omphalocyclus macroporus* and *O. maldonensis*.

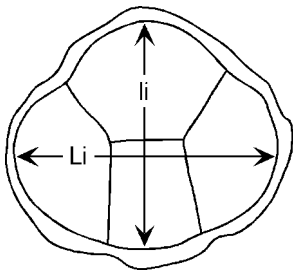



**Fig. 4.** Details of measurements (Li & li) of nuclear dimensions in *Omphalocyclus*.

significant periembryonic zone of uniserial orbitoidal chambers, and in having a less pronounced surface ornamentation. It differs from *O. schlumbergeri* (Silvestri) in possessing a quadrilocular nucleus. It is distinguished from *Pseudomphalocyclus blumenthali* Meric by the lack of lateral chambers of the orbitoidal (or any other) type. Renz (1955) described specimens of *O.* cf. *macroporus* (Lamarck) from Venezuela that included a range of 0.25 mm to 0.3 mm for the nuclear diameter and the presence of uniserial chamber layers surrounding the nucleus, suggesting a close relationship with *O. maldonensis*. Lamarck (1816) did not state a type locality for *O. macroporus*. However, since Defrance (1825) it has generally been regarded as 'Pietersberg', near Maastricht, The Netherlands (Van Gorsel, 1978). Sample ER1598, collected by one of us (ER) from near the base of unit Md of the Maastrichtian section at the ENCI quarry at Pietersberg, yielded megalospheric specimens of *O. macroporus* with nuclear dimensions ranging from about 0.3 mm (one specimen only) to 0.55 mm, roughly twice the size of *O. maldonensis* (Fig. 4). In this study, the maximum diameter (at or near the periphery) and maximum thickness of 176 specimens of *O. maldonensis* were measured. For comparison, the same dimensions of 14 specimens from sample ER1598 were also measured. Both populations are clearly distinct (Fig. 3).

## SIGNIFICANCE OF *OMPHALOCYCLUS MALDONENSIS*

In the upper part of the Maldon Limestone, *O. maldonensis* occurs with rare specimens of *Orbitoides*. Equatorial thin sections of these *Orbitoides* (Pl. 1, fig. 7) are comparable with examples of *Orbitoides megaloformis* collected from the Guinea Corn Formation at Logie Green (e.g. Krijnen *et al*., 1993, figs 22-6,7) in the Central Inlier (central Jamaica: Fig. 1). Van Hinte (1966) demonstrated that within the *Orbitoides* lineage there is an increase in the size of the nucleus and number of epi-auxillary chamberlets as one passes from more primitive to more advanced species through the late Cretaceous. Based on the nuclear characteristics, Jiang & Robinson (1987, fig. 8) suggested that the Logie Green *Orbitoides* might indicate a stratigraphic position near the Campanian–Maastrichtian boundary. Krijnen *et al.* (1993) noted that the specimens of *O. megaloformis* from the Central Inlier partly fit the limits set by Van Hinte (1966) for that taxon and suggested that the fauna might be slightly more advanced and, therefore, represented the very Early Maastrichtian. Caus *et al.* (1996), in a review of the biostratigraphic value of species of the genus *Orbitoides*, proposed that *Orbitoides megaloformis* Papp & Küpper characterized the latest Campanian of Europe. Independent age dating of the Logie Green site comes from nannofossils (Robinson, 1988, p. 59). The site has yielded a flora that includes *Lithraphidites praequadratus* Roth, but lacks *L. quadratus* Bramlette & Martini, *Quadrum trifidum* (Stradner) and *Reinhardtites levis* Prins & Sissingh. This indicates zone CC25A (Sissingh, 1977), which Hardenbol *et al*. (1998) suggest is of latest Early to early Late Maastrichtian age in the Tethys. New strontium isotopic dates derived from well-preserved skeletal calcite of rudist shells from the Maldon Limestone indicate a latest Maastrichtian age (65 to 65.83 Ma: Steuber *et al*., 2002).

Renz (1955, pp. 59–60) reported *O*. cf. *macroporus* and *Orbitoides palmeri* Gravel from Venezuela. The nuclear dimensions and presence of uniserial chamber layers surrounding the nucleus in *O*. cf. *macroporus* suggest it may represent *O. maldonensis*. The quoted dimensions of the nucleus for *O. palmeri* (508 μm × 381 μm) and its distinctly quadrilocular nucleus (Renz, 1955, pl. 6, fig. 3) suggest that this designation may be a synonym of *O. megaloformis*. Examination of the specimens, however, would be required to confirm these interpretations. It is, therefore, possible that this Venezuelan fauna contains the same assemblage of orbitoid foraminifera as the upper Maldon Limestone. Renz (1955) considered that his unit bearing *O*. cf. *macroporus* and *O. palmeri* was Maastrichtian, based on the presence of *Vaughanina* Palmer, *Omphalocyclus* Bronn and *Sulcoperculina* Thalmann.

In the type Maastrichtian in The Netherlands, *O. macroporus* is associated with *O. apiculata* Schlumberger (Hardenbol *et al*., 1998). This association has also been reported from elsewhere,

including Saudi Arabia (El-Asa'ad, 1989), Turkey (Matsumaru, 1997) and, significantly, Cuba (Seiglie & Ayala-Castañares, 1963). Hardenbol *et al.* (1998) indicated that *O. macroporus* appeared in the upper Lower Maastrichtian.

In the Caribbean, therefore, there appear to be two orbitoid faunas, a fauna with *O. megaloformis* and *O. maldonensis* (Jamaica and possibly northern Venezuela); and a fauna with *O. apiculata* and *O. macropora* (Cuba).

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