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Fatally bitten ammonites from septarian concretions of the 'Marston Marble' (Lower Jurassic, Sinemurian), Somerset, UK, and their taphonomy

Chris Andrew, Paddy Howe, Chris Paul *

Lyme Regis Philpot Museum, Lyme Regis, Dorset DT7 3QA, United Kingdom

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ABSTRACT

A small polished slab of 'Marston Marble', Lower Jurassic, from Marston Magna, Somerset, UK, contains several ammonite specimens with pieces of shell missing from the body chamber immediately in front of the last suture. The damage is visible in sagittal sections, yet its position and extent are almost identical to damage reported from several Lower Jurassic ammonite genera from the Dorset coast and elsewhere, and attributed to the trace fossil *Bicrescomanducator rolli*. A second cut, but unpolished slab of 'Marston Marble' shows two more ventrally damaged ammonites, one in sagittal section. The damage is interpreted as the result of predation, by a teuthoid cephalopod and affected two prey species. This is the first time ventral bite marks have been reported from sectioned ammonites.

Some ammonites, but not bitten examples, have their body chambers largely filled with diagenetic calcite and were buried with the body inside. Often the calcite does not fill the full width of the body chamber, creating a false geopetal structure. As these are variously orientated with respect to bedding, the ammonites were possibly reworked before final burial. The polished slab derived from a septarian concretion. As the septarian cracks opened some ammonites were pulled apart. During shrinkage the sediment maintained a tight grip on fossils.

1. Introduction

Although it is generally accepted that ammonites were major predators in Mesozoic seas, much less has been recorded about ammonites as the victims of predation (see review in Mapes and Chaffin, 2003). Roll (1935) described specific damage to ammonite shells in which an irregular area was missing ventrally in the body chamber immediately in front of the last suture line. This type of damage was called 'ventral bite marks' by Klompmaker et al. (2009), to distinguish it from teeth marks laterally on ammonite shells as described, for example, by Kauffman and Kesling (1960) or apertural peeling by crabs as described by Monks (2000). Klompmaker et al. (2009, table 1, p. 246) also showed that such damage was widespread in ammonoids both taxonomically and stratigraphically, but its significance was usually overlooked. Independently, Andrew et al. (2010) described identical 'ventral bite marks' from at least eight genera of Lower Jurassic (Sinemurian) ammonites and one from the Eype Nodule Bed (Upper Pliensbachian) of the Dorset coast. Although this damage was well known to local collectors, it had not been reported in the scientific literature. Andrew et al. (2010) interpreted the damage as due to predation by teuthoid cephalopods and it was described as the trace fossil *Bicrescomanducator rolli* Donovan et al. (in Andrew et al., 2010). More recently, further occurrences of predation on ammonites have been reported from the Jurassic of Yorkshire (e.g., Wright et al., 2014; Maddra, in press).

A small slab of 'Marston Marble', measuring approximately 14 by 11 by a maximum of 6 cm thick and now in the Lyme Regis Philpot Museum, was found to contain several damaged ammonites in which sections of the venter of the body chamber immediately in front of the last suture are missing in shells that otherwise seem complete and well preserved. This damage is consistent with the ammonites having suffered 'ventral bite marks' (Klompmaker et al., 2009). At least two species of ammonites were preyed on and the slab reveals other aspects of the preservation history of these ammonites. However, some of the ammonites show other types of damage and at least one type is clearly post-depositional. It results from the formation of septarian cracks in the nodule. Thus, the preservational history of the ammonites in the slab needs to be understood thoroughly to eliminate other causes of damage and establish firmly the interpretation that some of the ammonites suffered predation. A second slab in the Lyme

* Corresponding author. Tel.: +44 1297 442956.
E-mail address: glcrcp@bris.ac.uk (C. Paul).

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Regis Museum differs in lacking any septarian cracks, but also preserves at least two more examples of bitten ammonites, one preserved in three dimensions, the other in a near sagittal section on a cut, but not polished surface.

As the source of the 'Marston Marble' is no longer worked, it is worth describing these slabs and the damaged ammonites in detail. As far as we are aware, no detailed description or interpretation of the 'Marston Marble' has previously been published. For example, Kellaway and Wilson (1941a, pp. 141–2, 1941b, p. 178) described it briefly as concretions, up to a metre across and crowded with ammonites. They also mentioned where the concretions cropped out west of Marston Magna and listed the ammonite fauna, but they did not mention the septarian cracks. Much the same information was repeated in a little more detail in Wilson et al. (1958, p. 33). In particular, we believe that this occurrence shows that ventral bite marks can be recognized in suitably orientated cross sections of ammonite shells. Finally, the interaction between the septarian cracks and the ammonites provides some additional evidence regarding the nature of both the sediment and ammonites within the concretion when the cracks formed. Thus, the aims of this paper are firstly to describe the bitten ammonites, then to interpret the preservation history of the ammonites in the slabs and, finally, to discuss the early septarian cracking of the polished nodule.

2. Materials and methods

The 'Marston Marble' or 'Ammonite Marble' is a very local concretionary horizon within the Charmouth Mudstone Formation, formerly exposed and worked near Marston Magna, about 7 km NE of Yeovil, Somerset, UK (Arkell, 1933, p. 123; Kellaway and Wilson, 1941b, p. 178). The concretions are crowded with small ammonites in which the shells are white and contrast well with the dark grey claystone that forms the bulk of the concretion. The concretions take a good polish and are still occasionally sold. The ammonites are superbly preserved and of a wide range of sizes. Currie (1942) used the 'Marston Marble' as the basis of her study of ammonite growth in '*Promicroceras marstonense* Spath, 1925', as did Palframan (1967). Trueman (1941) also used this species, among others, in his calculations of buoyancy and ammonite life orientation. According to Page (2009, pp. 23–24), the 'Marston Marble' correlates with the *blakei* biohorizon (sn41) in the Stellare Subzone of the Obtusum Chronozone. In addition, Page (2009, p. 24) stated that the type specimen of *Ammonites planicosta* J. Sowerby, 1812, the type species of *Promicroceras* Spath, 1925, also came from the 'Marston Marble' and so is a senior synonym of *Promicroceras marstonense*.

The polished slab of 'Marston Marble' in the Lyme Regis Museum (Fig. 1, registration number LYMPH 2014/36) is clearly septarian, with cracks reaching up to 6 mm across and filled with at least three stages of diagenetic calcite fill. The slab has a main polished surface, parallel to bedding (Fig. 1A), and three other polished sides (e.g., Fig. 1B). The original way up of the slab cannot be determined. Although some ammonites appear to have geopetal fillings in the body chamber (e.g., Fig. 2), the origin of these structures is open to interpretation and they are preserved in a wide range of orientations indicating that the ammonites may have been disturbed and redeposited since the apparent geopetal fillings formed. In addition, to facilitate measurement of the orientation of vertically preserved ammonites, an arbitrary 'north' direction was selected (Fig. 1). Polished sides indicate several pairs of imbricate ammonites, probably orientated by currents coming from the arbitrary south (e.g., Fig. 1B). Another, but unpolished, slab of Marston Marble in the Lyme Regis Museum (Reg. No. LYMPH 2000/36) was also examined to confirm features seen in polished sections.

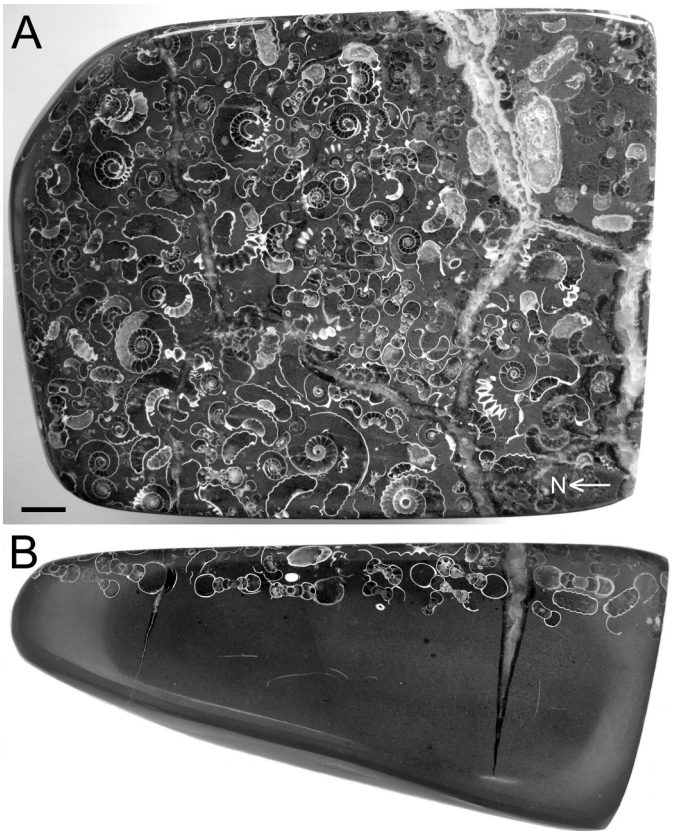

Fig. 1. (A) General view of the main polished surface of the block of 'Marston Marble'. LYMPH 2014/36. Note the septarian cracks filled with calcite and the abundant ammonites. (B) Lateral view to show ammonites crowded in a thin layer. Note the septarian cracks increase in thickness upwards and several pairs of imbricate ammonites sloping down towards the arbitrary south (arrow). Scale bar = 10 mm.

In the polished slab the ammonites are all small, the largest measurable reaching 21 mm diameter, and they are preserved in seemingly random orientations. The ammonites are crowded into a layer that, as now preserved in the cut and polished slab, reaches a maximum of 20 mm thick, but its original thickness is unknown. Nevertheless, at its thickest the slab is 60 mm thick, so it is clear the ammonites occupied a small portion of the original thickness of the concretion (Fig. 1B). A single ammonite, probably *Promicroceras*, occurs on the unpolished back of the slab. As the septarian cracks decline in thickness towards the back of the slab, we conclude that the ammonite-rich horizon was towards the centre of the original concretion. In addition, the widest cracks are all near the thickest part of the concretion (the arbitrary south end), suggesting there was at least as much of the concretion missing in this direction. It seems likely that the preserved slab represents less than a quarter of the original concretion.

While examining the slab to measure shell and septal thickness as part of a project to calculate buoyancy in *Promicroceras*, several damaged examples were noticed (Fig. 3). A few clearly had a short section of the body chamber missing ventrally, but were otherwise undamaged. In a small number of other examples damage was less clearly defined. Nevertheless, in some examples the damage agreed so well with the pattern described by Roll (1935), Klompmaker et al. (2009) and Andrew et al. (2010) as to suggest an identical origin. The damage can most easily be recognized in approximately sagittal sections of the ammonites. A record was kept of all ammonites sectioned in this orientation, whether damaged or not, to estimate the approximate frequency of damage. The same basic measurements were taken as in