Utility of calcareous microfossil assemblages to date and provenance fossil marine reptile specimens in museum collections

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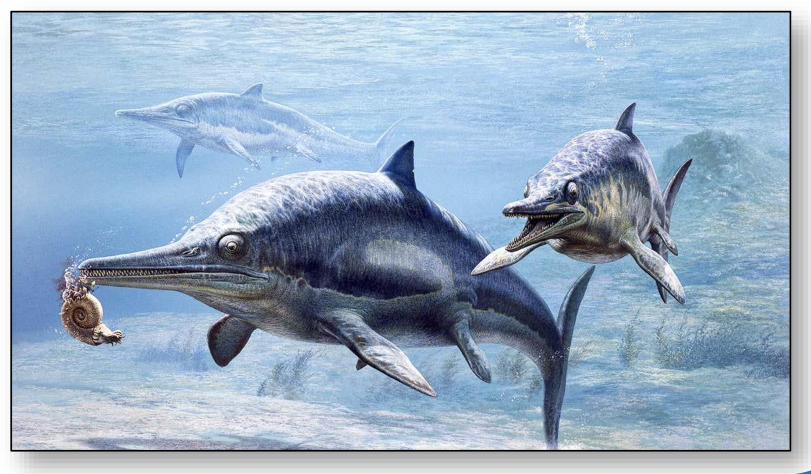
Abstract Many museums hold palaeontological specimens such as the large marine vertebrates of the Mesozoic (ichthyosaurs, plesiosaurs, pliosaurs, etc), but some of these lack details regarding their collection locality, level or age, this is especially the case for specimens collected in the 19th and early 20th centuries. Taking a forensic approach to this problem, and where fragments of matrix can be spared, micropalaeontology can fill-in some of the knowledge gaps, thus enhancing the scientific value of these specimens. Over the last few years, we have examined Early Jurassic specimens from British collections in an attempt to recover details regarding their stratigraphical provenance, geological age and possible geographical origin, based on the associated microfossils (ostracods and foraminifera). This approach is not always successful (especially in well-cemented limestone) but in some cases a few grams of mudstone matrix recovered from an inconspicuous part of the specimen (such as the underside) can provide a useful assemblage of calcareous microfossils. We provide examples to show how effective this approach can be and suggest that such collaborations could be instigated by micropalaeontologists around the world to help support scientific research in their local museums.

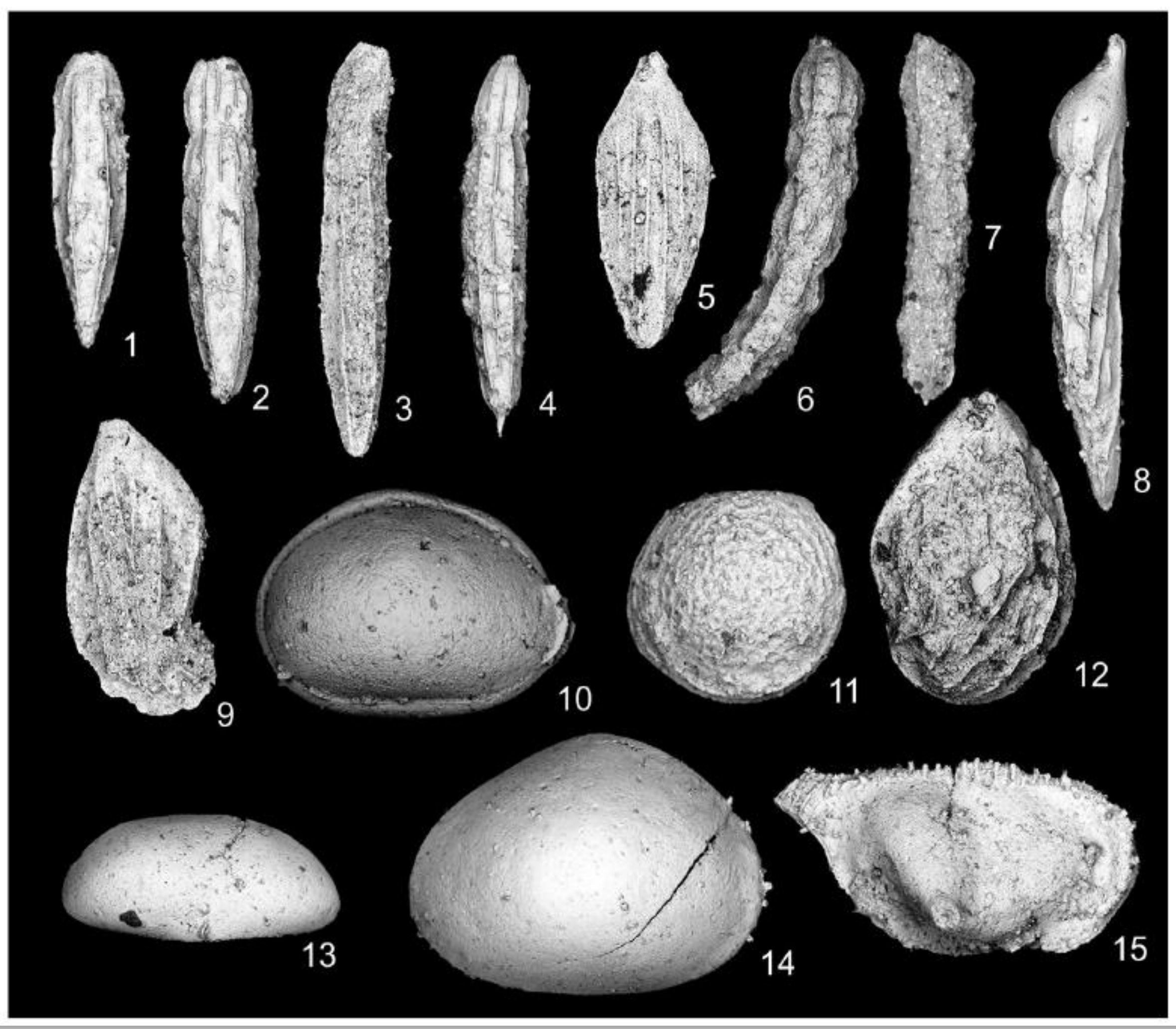
Ichthyosaurs were marine reptiles (250-90 Ma, Triassic-Early Cretaceous), they were active predators with similarities to modern dolphins. Ichthyosaurs possessed large eyes and large vertical tails, they were air-breathing, warm-blooded & viviparous. We have examined microfossil samples from a number of ichthyosaurs from British museums to help determine their age, environment of deposition and possible geographical origin (Lomax *et al*. 2016, *Hist. Biol*., **31**, 600-609; Lomax *et al*., *Geol. J*., **54**, 83-90).



Case Study 1: Lapworth Museum of Geology, University of Birmingham

Study of a neonate *Ichthyosaurus communis* (BU 5289). With a sample of about 8-10 g we recovered a good calc-micro assemblage.

Dean Lomax with BU 5289



1–3. *Paralingulina tenera tenera*, 4. *Nodosaria mitis*, 5. *Ichthyolaria terquemi*, 6. *Marginulina prima insignis*, 7. *Marginulina prima incisa*, 8. *Mesodentlina matutina*, 9. *Planularia inaequistriata*, 10. *Ogmoconchella nasuta*, 11. *Polycope pumicosa*, 12. *Astacolus speciosus*, 13. *Paracypris* sp., 14. *Ogmoconcha hagenowi*, 15. *Monoceratina frentzeni*.

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The first known neonate *Ichthyosaurus communis* skeleton: a rediscovered specimen from the Lower Jurassic, UK

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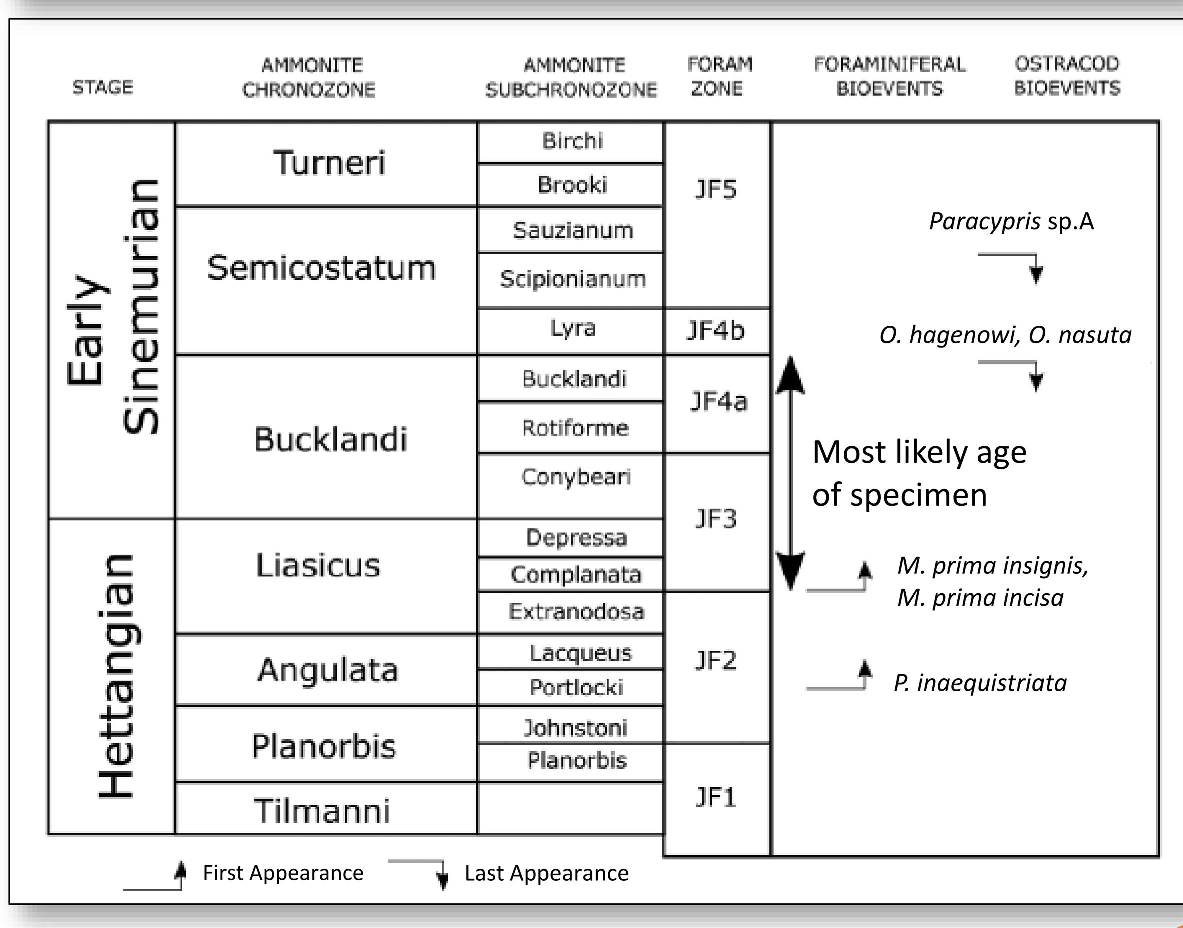
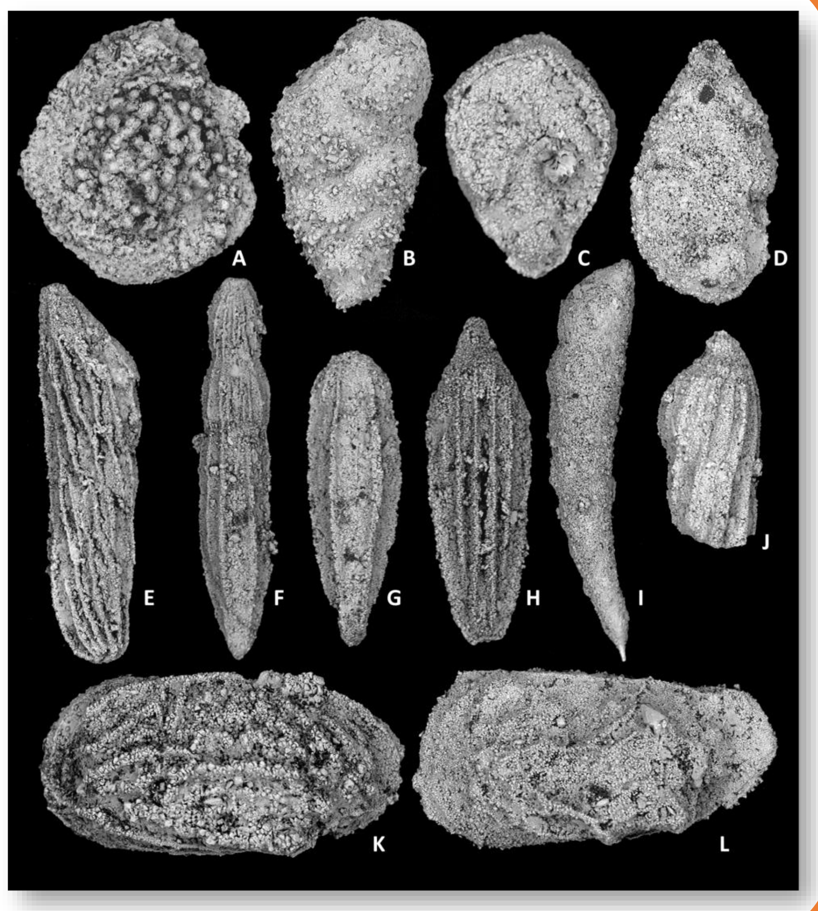


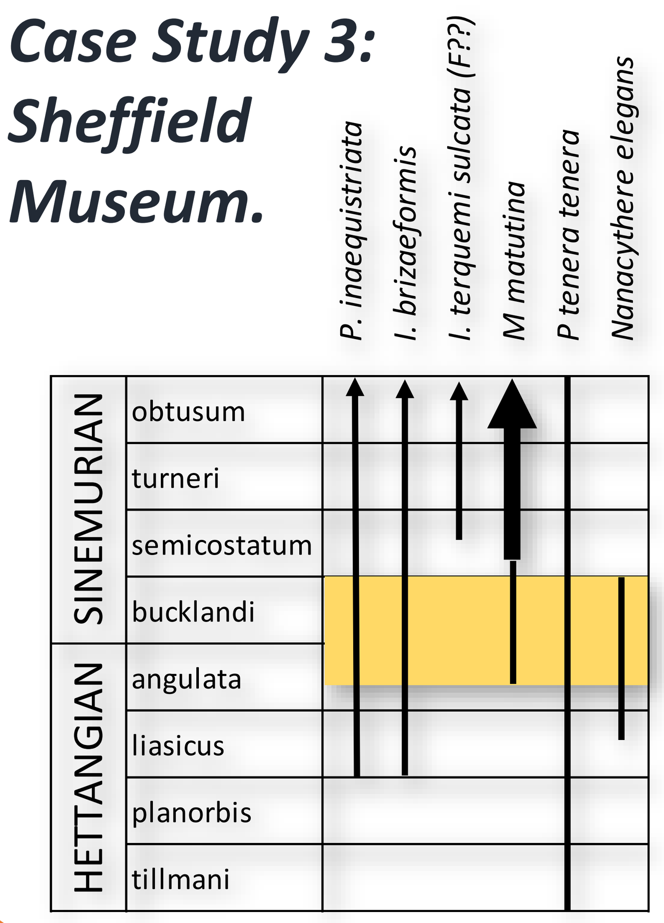
Case Study 2: Birmingham Science Museum.

Ichthyosaur, from Shipston-on Stour, Warwickshire.

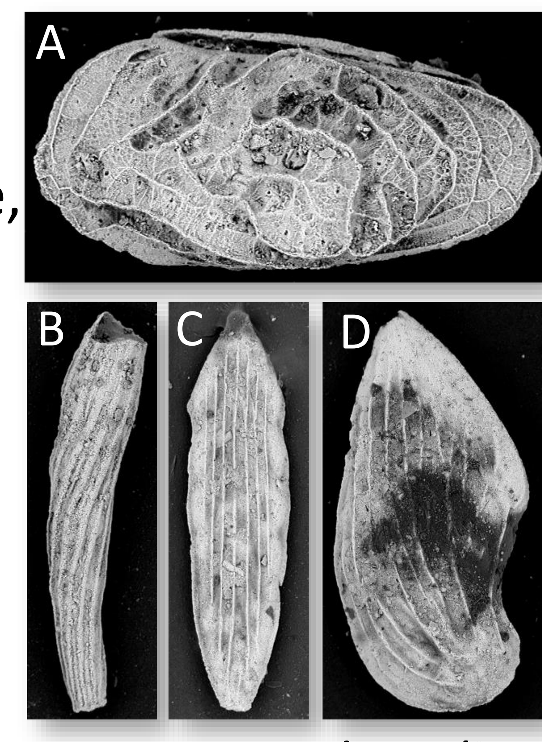
Diverse assemblage of foraminifera but relatively few ostracods. These indicate latest Angulata to Bucklandi chronozones (late Hettangian to early Sinemurian).



Case Study 3: Sheffield Museum.



Only 1 ostracod, but it was crucial to refining the age, Angulata to Bucklandi Chronozone (late Hettangian-early Sinemurian).

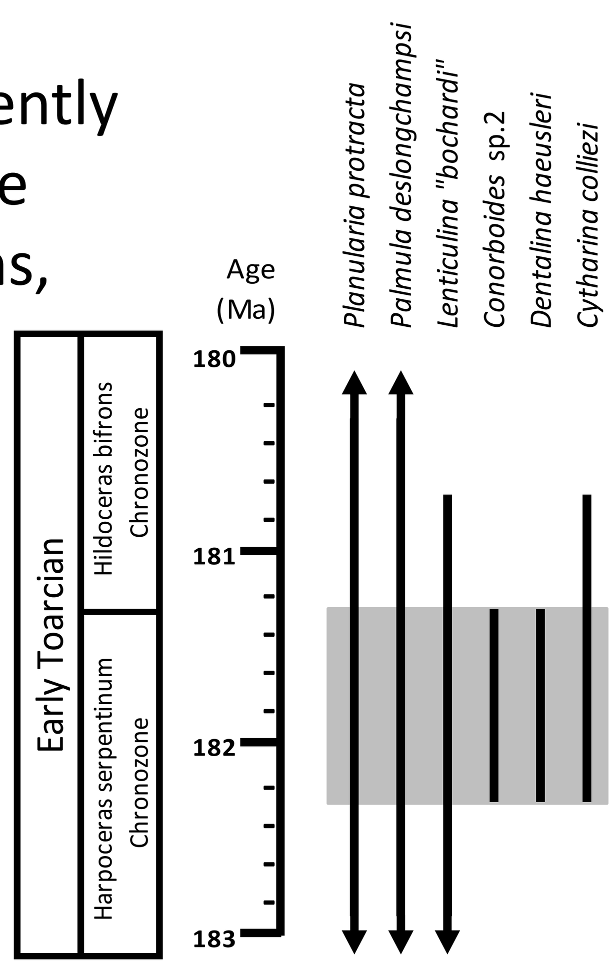


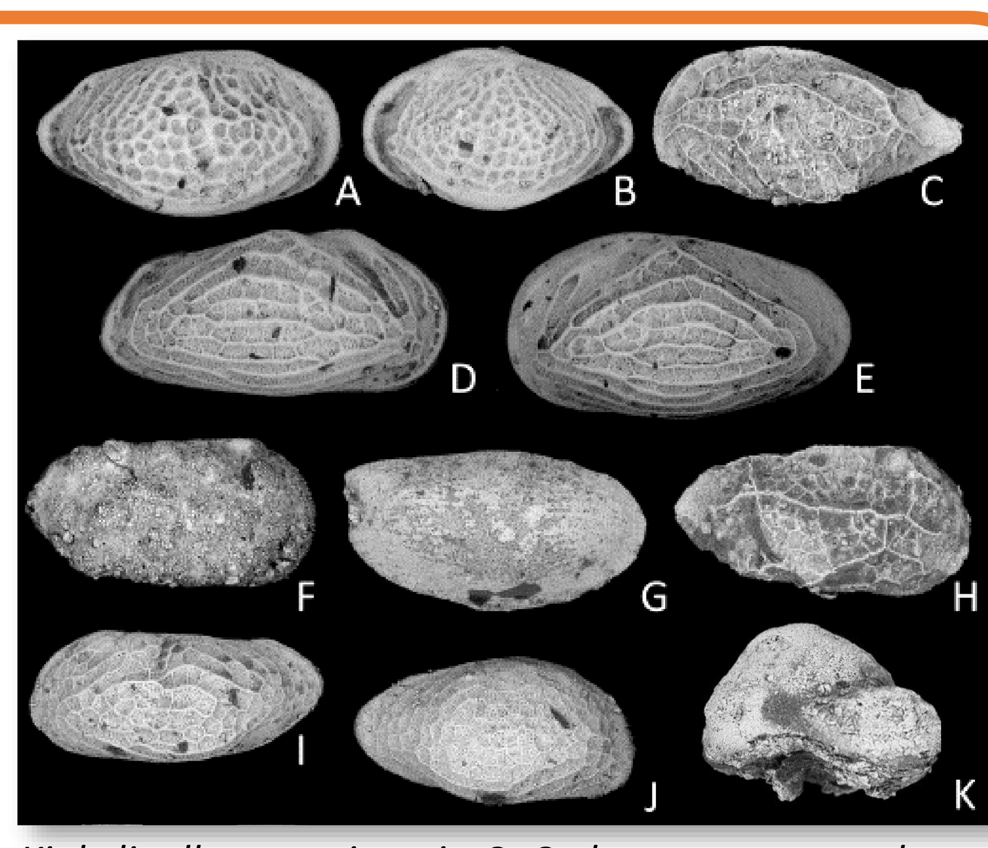
A. *Nanacythere elegans*, B. *Mesodentalina matutina*, C. *Ichthyolaria terquemi*, D. *Planularia inaequistriata*.

Case Study 4: Rutland Water.

The 'Rutland Sea Dragon' (*Temnodontosaurus* cf. *trigonodon*), eastern England. Only recently discovered, it has poor ammonite control. Microfossils, indicate early-Toarcian age, while fragments of diverse, larger organisms, provide details of the palaeoenvironment, e.g. fish, shark,…

…echinoid, ophiuroid, crinoid, bivalve, brachiopod, gastropod, etc., etc.





A-B. *Kinkelinella sermoisensis*, C. *Cytheropteron gwashense*, D-E. *Ektyphocythere intrepida*, F. *Trachycythere* sp., G. *Tanycythere* sp., H. *Eucytherura transversiplicata*, I-J. *Procytherura mediocostata*, K. *Conorboides* sp.