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Application of late Mesozoic non-marine ostracods: *Quo vadis*?

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Cretaceous biostratigraphy as based on non-marine ostracods has a long tradition, particularly with respect to the so-called "Purbeck-Wealden interval" (uppermost Tithonian to Barremian/lowermost Aptian) in Europe, but has, at the same time, always been affiliated with considerable problems and limitations. Over seven decades, the accumulation of multitudinous studies of these ostracods in different parts of the world has produced a literature that is rich yet littered with contradictions and confusion with regard to not only the taxonomic identities of the fossils but also their interpretation in terms of palaeoenvironments and phylogeny. While biostratigraphy with Late Mesozoic non-marine ostracods for intra-basinal correlations has produced good results and, locally, has potential for high-resolution correlations, their utility for supraregional, i.e., inter-basinal to global, correlations has widely been doubted.

Crucial to a broader, supraregional approach to (Late Jurassic and) Cretaceous non-marine ostracod biostratigraphy is an appreciation of the fact that certain groups are not restricted to individual waterbodies or smaller geographic regions in their distribution and dispersal. Today, whole living specimens or their eggs can be transported passively by larger animals or wind over long distances, crossing migration barriers – and non-marine ostracods are considered to have been already able to do so by the Late Jurassic. In the light of this knowledge, and adopting a uniformitarian, palaeobiological approach, the attempts to revise and rejuvenate the biostratigraphical and palaeoenvironmental applications of late Mesozoic non-marine ostracods have been made by various authors over the past two decades (e.g., Horne 1995, 2002; Schudack 1996, 1999; Horne & Martens 1998; Schudack et al. 1998; Sames 2010; Sames et al. 2010a, b).

Attempts at supraregional correlation furthermore have to deal with two major issues: the application of taxonomy and the palaeoenvironmental context. The absence of a stable, consistent taxonomic scheme, applicable on regional to global scales, is one of the major impediments to the successful biostratigraphical application of the respective ostracods to inter-basinal correlations. Contributing factors include the plethora of published names for taxa, assumptions of endemicity of faunas, confusion of taxonomically and ecophenotypically relevant carapace features, and a lack of agreement about how much morphological variation to allow in a species, leading to both over- and under-estimations of diversity. The complex stratigraphical records of Cretaceous non-ma-

rine ostracods result from the varying influences of local environmental factors and regional to global climatic factors, dispersal events and the evolution and extinction of taxa. A more conservative taxonomic concept, i.e., fewer taxa with strong true variation including a high proportion of ecophenotypy, also enables correlations between different palaeoenvironments. Significant efforts to establish correlations using environmentally-influenced, cyclic changes in ostracod assemblages remain the subject of debate (e.g., Anderson 1985; Horne 1995, 2002; Anderson 2004).

For the purpose of biostratigraphic application, there are different ways of handling the morphological variability exhibited by Cretaceous cytheroidean and particularly cypridoidean taxa, namely those of the genus *Cypridea* and its close relatives. As the example of *C. clavata* (Fig. 1) demonstrates, caution is advisable when interpreting morphological variation within species (i.e., true variation, as opposed to the polymorphism implied by naming discrete forms). Eight taxa (*C. bogdenensis* and seven subspecies of *C. clavata*) were shown by Anderson (1985) as having discrete ranges implying precise biostratigraphical value, but this is called into question by a more conservative taxonomic approach that regards them as ecophenotypic variants (Nye et al. 2008).

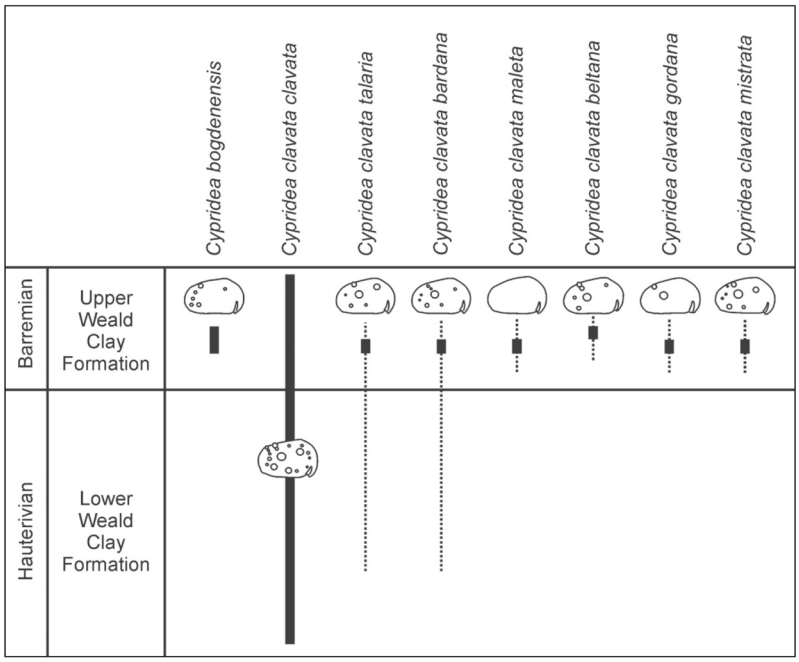

Fig. 1: Stratigraphical ranges of *Cypridea clavata* subspecies and *Cypridea bogdenensis* in the Weald Sub-basin of England. Solid lines indicate maximum occurrence ranges as illustrated by Anderson (1985; fig. 5), dotted lines indicate probable full ranges of occurrence.

Greater precision does not necessarily mean greater accuracy; indeed, the apparent precision afforded by relatively arbitrary distinctions of subspecies may be largely an illusion. On the other hand, the more conservative approach facilitates long-range interbasinal correlation. In the light of what we now know about the dispersal mechanisms of non-marine ostracods and taking a broader taxonomic view, we can suggest, for example, that the North American *C. inornata* is a synonym of the European *C. setina* and correlate deposits of the Lower Cretaceous North American Western Interior Basin to the English Purbeck-Wealden (Sames et al. 2010a).

Heading towards a global biostratigraphical approach, the goal of global taxonomic stability may be achievable but will not be reached quickly; nevertheless new data and modern insights into ostracod palaeobiology and palaeobiogeography can assist the process of revision. Even though there are still gaps in our knowledge on the Mesozoic evolution of non-marine ostracods, we can presently translate many recent facts into the Upper Jurassic and Cretaceous, with, however, different degrees of certainty dependent on the respective group of non-marine ostracods. Based thereupon, it is not the question anymore whether inter-basinal to inter-continental correlations are possible or not (Sames 2010). The guiding principle concerning the present and near future of late Mesozoic non-marine ostracod biostratigraphy is rather to take these facts for granted and develop a network of supraregional correlations (i.e., stratigraphic ties) at the interim cost of lesser accuracy, then followed by the integration of these with other chronostratigraphical and geochronologic methods on regional to global scale to improve the resolution. In summary, we are approaching a new period of the fundamental reinterpretation of the basics of Cretaceous non-marine ostracod biostratigraphy and its practical implementation. Recent progress has shown that we are still some way from using the full potential of non-marine Late Jurassic to Cretaceous ostracods, be it for regional or supraregional biostratigraphy or in terms of other applications.

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