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Comparative sedimentology of Late Jurassic, lacustrine, microbial mounds (Purbeck Limestone Gp, Wessex Basin, UK

Dan Bosence (1) and Arnaud Gallois (1,2)

(1) Department Earth Sciences, University of London Royal Holloway College, United Kingdom (d.bosence@es.rhul.ac.uk),
(2) Institute of Earth Sciences Jaume Almera (ICTJA-CSIC), Barcelona, Spain (agallois@ictja.csic.es)

A central tenet of Ginsburg's concept of comparative sedimentology was the use of modern analogues in understanding ancient sedimentary features of limestones; "The vitality of the comparative approach is attributed to the continuing comparisons of recent and fossil examples." This presentation explores the benefits, and also the pitfalls, of this approach through new research on the environment of deposition of microbial mounds in the non-marine Purbeck Limestone Group from its type locality in the Wessex Basin, UK.

Mound-forming, porous limestones have been described from the lowermost Purbeck limestones since the early nineteenth century and variously interpreted as fresh water spring tufa deposits or hypersaline lagoon stromatolites. Current research establishes these accumulations as in-situ microbialite mounds (up to 4m high and 20m across) that occur within bedded inter-mound peloidal packstones-grainstones. The microbialite mounds are located in three lacustrine sequences separated by three paleosols. The microbialite mounds reveal complex and irregular shapes in part due to their association with tree remains. They are constructed by a Microbialite facies (Stromatolite, and Thrombolite sub-facies) and Burrowed Boundstone facies. Commonly, mounds initiated around trees and branches during flooding of lake waters over a vegetated landscape. The Burrowed Boundstone facies initially forms a microbially-bound casing around trees when the trees were still upright. Contemporaneously, the Stromatolite sub-facies was deposited on the lake floor. Subsequently, the Thrombolite sub-facies forms the main framework for the mounds. Inter-mound facies onlap and interfinger with the mounds indicating that deposition occurred during the development of the thrombolite framework. A sharp transition is then recorded above these three sequences to evaporite bearing strata that form the (non-mounded) overlying beds of the Purbeck limestones.

The mounds are comparable in structure and microfacies with several different present-day examples of mounds from lacustrine settings (fresh-water, brackish-water, hypersaline) as well as hypersaline marine settings. This re-affirms the view that thrombolite fabrics are not diagnostic of depositional environment. However, the associated molluscan and ostracod faunas are indicative of fresh to brackish waters, and the absence of charophytic algae and in-situ evaporites indicates a brackish-water setting for these mounds. This is supported by preliminary C and O stable isotope data from adjacent intermound sediments. No exact modern-day analogue is known for the Purbeck mounds but they have many similarities in their sedimentological development with microbialite mounds from the fresh-water Laguna Bacalar, Mexico.

Regional geology, local seismic data and mapping of mounds indicate they occur in an extensional sub-basin within the Wessex Basin and that the mounds preferentially occurred in shallow, fault-controlled marginal sites including a relay ramp.

So what?

Thrombolitic mounds, in general, are not indicative of any specific depositional environment.

Petrographic, palaeontological and isotope data indicate that the microbial mounds in the Purbeck limestones accumulated in a brackish-water setting.

Local extensional tectonic structures control the occurrence of the Purbeck mounds to shallow lake margins.

In lacustrine successions sharp vertical facies transitions can occur between brackish and hypersaline lake strata.