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The "Ultimate basis of Chronology": Cyclostratigraphic calibration of high-resolution ammonite-correlated 'events' in the Lower Jurassic

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The great potential of ammonites for developing reliable high-resolution biochronologies for the Jurassic System was first realised by S.S. Buckman in the late 19th Century [1]. Remarkably, however, there was little further progress until the later 1970s and into the 1980s as the concept of 'Horizons' and 'Biohorizons' developed. The latter, in particular, can be considered to be equivalent to biochronological 'events', representing stages in the evolution of a characteristic 'index' fauna, preserved periodically through of combination of depositional and diagenetic factors. Crucially, the apparently strong influence of non-biological factors on the recognition and distribution of biohorizons, means that many can be recognized over considerable distances and, therefore, represent ideal and effectively isochronous surfaces for correlation purposes. Indeed, the rapidity of distribution of marine organisms with a planktonic larval stage, such as ammonites, by oceanic currents could conceivably move could conceivably allow a circumglobal distribution, equatorially, in just over 30 months (2.56 years) assuming no continental barriers existed [2]. Virtually only major extraterrestrial impacts and "super-volcano" eruptions can have a more geological 'instantaneous' global effect, of a few weeks for materials to settle, but such events are rather rare. But when compared with the 10,000 years or so necessary for a full magnetic reversal to take place, the 2000 years for global, oceanic mixing of stable isotopes and an around 50,000 resolution for Sr isotope age calibration, the much high resolution available through using biochronological markers becomes very apparent [1]

In addition, a sequence of biohorizons can offer a higher level of resolution than almost any other correlative tool and new results from the basal Jurassic, Hettangian Stage indicate that the average interval between biohorizons may be under 40,000 years. In addition, as this Hettangian succession of 55 biohorizons is recorded in a cyclical sequence of mudrock-limestone alternations in south-west England with a clear Milankovitch signature [3], it is now also possible to calibrated the duration of each biohorizon-biohorizon interval. The result is a calibrated high resolution chronology for the stage, within which every component subdivision has a defined duration – from biohorizon to horizon to subzone to zone. This is the may be first, fully calibrated biostratigrapical framework for a stage in the Jurassic System and maybe one of the first in the geological record.

Crucially, however, if this is all possible with ammonites, it should also be possible with other fossil groups with planktonic or nektonic life stages. Adopting a calibrated biohorizonal approach elsewhere in the geological time scale, could actually help develop a reliable dating framework – one that can actually be correlated using the high resolution of biostratigraphical markers.

References:

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