Early Jurassic palaeoclimate and time: integrated astrochronology for the Sinemurian (Lower Jurassic) from UK outcrop and core

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Climate research in the Jurassic has historically focused on geologically short, large-scale events such as the Triassic-Jurassic boundary mass extinction and the Toarcian Oceanic Anoxic Event. However, the climate system in the remaining 17 Myr of the Early Jurassic is significantly under studied, this despite the identification of several smaller magnitude and less well understood carbon-cycle perturbations such as the 'Liasidium Event' (*obtusum-oxynotum* zones, Sinemurian) and the Sinemurian-Pliensbachian boundary event. The paucity of long, multi-proxy integrated astrochronological studies across this interval has restricted understanding of the temporal relationships and driving factors associated with these events. In addition, there are stages of the early Jurassic with either no robust (Sinemurian) or contentious, astrochronology (Hettangian, Toarcian). As part of the multi-faceted Early Jurassic Timescale and Earth System project (JET), we provide new, high-resolution, multi-proxy datasets for the Sinemurian and Early Pliensbachian stages from shallow marine strata exposed in outcrop (Robin Hoods Bay, Yorkshire) and British Geological Survey stratigraphic boreholes (Mochras, Cardigan Bay and Burton Row, Somerset, UK). Carbon-isotope stratigraphy ($\partial^{13}C_{org}$) is complemented with elemental analysis (portable XRF), Rock Eval, and Mercury datasets to understand the long-term carbon cycle and environmental evolution. The study aims to contextualise climatic changes in the Sinemurian and provide an astronomical framework in which to interpret these events. Results show two large, negative CIE's in the mid Sinemurian, *obtusum* Zone (4‰ –ve CIE) and, second, the broader CIE in the *jamesoni* Zone, early Pliensbachian (3‰ –ve CIE). Both CIE's are associated with significant organic matter enrichment with anoxic to dysoxic conditions, however the severity of anoxia appears to be spatially inconsistent between study sections. Time series analysis confirms the presence of Milankovitch cyclicity and is used to estimate the duration of the Sinemurian stage and the climatic perturbations within. Integrating cyclostratigraphy and sequence stratigraphy from several study sections, addresses the problem of cryptic sub-biostratigraphic hiatuses.

Keywords: Astrochronology, Jurassic, Time, Climate, Stratigraphy, JET

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