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Astrochronology of the Barremian Stage: implications for the dynamics of the anoxic events in the Early Cretaceous

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Large uncertainties exist on the numerical ages of the stages in the Early Cretaceous which hamper from an accurate reconstruction of the past climate. Recent radio-astrochronologic data suggest to move the ages of the Tithonian to the Hauterivian stages by 3 to 5 Myr toward younger ages (Lena et al., 2019; Aguirre-Urreta et al., 2019). As the numerical ages in the Cenomanian are constrained with radio-astrochronology, this means that the duration of the Barremian to the Albian stages is overestimated. The duration of the Barremian Stage was estimated by bed counting on the assumption of a control by precession and eccentricity cycles (e.g., Bodin et al., 2006). The alternations and bundling can vanish leading to uncertainties in the duration estimates. Here, we provide an astrochronology from the eccentricity cycles based on spectral analyses performed on both magnetic susceptibility and calcium carbonate content series. Two sections are studied here in the Subbetic Domain (SE Spain). They are composed of marl-limestone alternations which reflect humid-arid cycles orbitally-driven. Detailed ammonite and calcareous nannofossil controls allow correlations with other sections in the basin and in the Tethyan Realm. The short and long-eccentricity cycles are identified throughout the Late Hauterivian to the earliest Aptian. The interval around the Hauterivian-Barremian boundary was recovered in a section previously studied for astrochronology and shows that the eccentricity cycles can be correlated to the sections studied here, validating the interpretations. From the record of the 405-kyr eccentricity cycle, the duration of the Barremian Stage is proposed at 4.25 ± 0.13 Myr. Anchoring this duration on previously obtained radio-astrochronology at the end of the Hauterivian, the Barremian Stage started at 125.91 ± 0.06 Ma and ended at 121.67 ± 0.11 Ma. The age of the latest Barremian agrees well with the age of the base of magnetochron M0r calculated from a synthesis of radiometric ages (Olierook et al., 2019). The Faraoni, Mid-Barremian and Taxy episodes show a pacing of 2.34 Myr, suggesting a strong orbital control on the expansion of oceanic anoxic conditions in the Tethys.

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