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Integrated orbital time scale of the Valanginian-Hauterivian (Early Cretaceous): Chronological relationships between Paraná-Etendeka LIP, Weissert and Faraoni events

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During the Valanginian and the Hauterivian stages, the Weissert and Faraoni Events recorded global perturbations of the carbon cycle, marine organic matter deposits and rapid ecosystem changes. Both events were successively attributed to the activity of the Paraná-Etendeka Large Igneous Province (LIP). However, due to the scarcity of the radiometric ages available for this time interval, the chronological relationships between these events and the activity of the Paraná-Etendeka LIP remain unclear.

Recently, the duration of the Valanginian Stage was calculated using a cyclostratigraphic approach on GSSP candidates and stratotypes (Martinez et al., 2013), but could not be anchored on a radiometric age. Here, we propose a duration assessment of the Hauterivian Stage using a similar cyclostratigraphic approach on the hemipelagic marl-limestone alternations from the La Charce section (Hauterivian GSSP candidate; SE France) and the Río Argos section (Barremian GSSP candidate; SE Spain). This duration could be anchored on an U/Pb age from a tuff level precisely dated using calcareous nannofossils and chemostratigraphy, to provide a refined geological time scale for the Valanginian and the Hauterivian stages.

A total of 2000 spectral gamma-ray measurements were performed with a constant 0.20-m sample step. Spectral analyses were performed on the gamma-ray series to detect any sedimentary cycle. The precession, obliquity, 100-kyr and 405-kyr eccentricity cycles were identified by comparing sedimentary to orbital period ratios. The duration of the Hauterivian Stage could be assessed at 5.9 myr, using the 405-kyr eccentricity cycle as a reference. By anchoring the U/Pb age of Aguirre-Urreta et al. (2008) on the orbital time scale provided for the Valanginian-Hauterivian stages, the base of the Valanginian Stage could be dated at -140.2 $\pm$ 1.5 Ma, the base of the Hauterivian at -135.1 $\pm$ 1.5 Ma and the base of the Barremian at -129.2 $\pm$ 1.5 Ma. In addition, the Weissert Event started at -138.3 $\pm$ 1.5 Ma and lasted for 5.8 myr. The Faraoni Event started at -129.8 $\pm$ 1.5 Ma and lasted for 0.1 myr. The activity of the Paraná-Etendeka LIP activity started at -134.6 $\pm$ 0.6 Ma, and lasted for 1 myr (Thiede and Vasconcelos, 2010). Thus, the Paraná-Etendeka LIP activity could not be responsible for the onset of the Weissert and the Faraoni events. The Paraná-Etendeka activity only coincides with the smooth decreasing trend of the δ13C values and with the end of the cooling phase observed at the end of the Valanginian Stage.

References:

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