

Radio-astrochronology of the Agrio Formation (Neuquén Basin, Argentina) to reduce the uncertainties of the geological time scale in Early Cretaceous times

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Important discrepancies between the numerical ages stated by the Geological Time Scale 2016 and radio-astrochronological works have been reported in the last years (Aguirre-Urreta et al., 2015; Martinez et al., 2015; Ogg et al., 2016). Large uncertainties notably exist for the Valanginian-Hauterivian stages for which the recently provided timescales are still debated. Here, we present an astronomical calibration for the Agrio Formation (Neuquén Basin, Argentina) to better constraint the durations of the Valanginian and the Hauterivian stages. The formation is divided into a lower and an upper member (called Pilmatué and Agua de la Mula members, respectively) composed of marl-limestone alternations deposited in a semi-pelagic to outer ramp environment and related to an orbital forcing (Sagasti, 2005). A rapidly (<0.5 myr) deposited member of continental sandstone, separates these two members. A total of 2130 bulk-rock samples have been collected each 25 cm and their mass-corrected magnetic susceptibility has been measured to detect lithological cycles. Spectral analyses were performed using the multi-taper method and the time-frequency weighted fast Fourier transform. In the lower part of the Pilmatué Member (Lower Agrio), the record of the 405-kyr eccentricity cycle is obvious but its amplitude promptly decreases at younger intervals. However, the orbital cycles of precession, obliquity and 100-kyr eccentricity are recorded, allowing the duration of the Pilmatué Member to be assessed at 4.70 myr. Anchoring this duration to the CA-ID-TIMS age of 130.39 ± 0.16 Ma provided in the Pilmatué Member, the age of this member ranges from 133.76 to 129.07 ± 0.16 Ma. The age of the top of the Lower Agrio slightly overlaps the age of the base of the Upper Agrio (129.09 ± 0.16 Ma). Such an overlap falls in the range of the uncertainties in the CA-ID-TIMS ages. First correlations to the Tethyan area suggest that the early Hauterivian has a duration of 2.1 myr, falling in the range of uncertainty mentioned by Martinez et al. (2015) (2.5 ± 0.4 myr), but being much longer than the duration of 1.21 myr proposed in the geological time scale 2016 (Ogg et al., 2016), suggesting the duration of the Hauterivian stage has to be increased by, at least, 0.9 myr for the next compilation.

References:

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