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Early Cretaceous precise radioisotopic ages, ammonite biostratigraphy and calcareous nannofossil bioevents from the Neuquén Basin, Argentine Andes

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Up to now, the global 'standard' Early Cretaceous stages are based on stratigraphic sections in the Mediterranean Province of the Tethys, and are mostly defined by ammonite biostratigraphy and calcareous nannofossil bioevents that have been calibrated with the M sequence of magnetic polarity chrons. The lack of precise radiometric ages has hindered the construction of an accurate geological time scale [1], despite the efforts of the International Commission on Stratigraphy [2].

The Neuquén Basin is a retro-arc basin developed in a normal subduction segment at the foothills of the Andes. Laterally continuous outcrops and an abundant fossil record, combined with tuffaceous layers interbedded in thick sedimentary successions make the basin an excellent site for stratigraphical, paleontological, and radioisotopic studies. The infill of the basin during the Late Jurassic-Early Cretaceous is represented by both marine and continental deposits that are assembled in the Mendoza Group (from base to top, Tordillo, Vaca Muerta, Mulichinco and Agrio Formations).

Vennari et al. [3] presented a CA-ID TIMS U-Pb age of 139.55 ± 0.18 Ma from a tuff near the base of the Berriasian. The Tithonian-Berriasian transition was recognized in the Vaca Muerta Formation on the basis of ammonite zones and calcareous nannofossil bioevents which allow correlation with well-established Tethyan floras and faunas. Although the formal definition of the base of the Berriasian is still under consideration, those authors proposed that the J-K boundary should be close to 140 Ma.

More recently, Aguirre-Urreta et al. [4] provided two CA-ID TIMS U-Pb ages of 129.09 ± 0.16 Ma and 127.42 ± 0.15 Ma from two distinct tuffs interbedded within the marine sediments of the Upper Agrio Formation. Both horizons are well constrained biostratigraphically by ammonites and calcareous nannofossils which correlate with the 'standard' sequence of the Tethyan Realm. The lower horizon is very close to the base of the Upper Hauterivian and the upper horizon to the Hauterivian-Barremian boundary, indicating that the former lies at *c*. 129.5 Ma and the latter at *c*. 127 Ma. Martinez et al. [5] anchored their astrochronology data from two classic Mediterranean basins with our U-Pb data base which reinforce our differences with the current IUGS geological time scale. They dated the base of the Valanginian at 137.05 ± 1.0 Ma, the base of the Hauterivian at 131.96 ± 1.0 Ma, and the base of the Barremian at 126.02 ± 1.0 Ma.

We present here a new CA-ID TIMS U-Pb age of 130.39 ± 0.16 Ma for the Lower Agrio Formation of Early Hauterivian age. These new radioisotopic ages are beginning to fill a gap of over 14 million years in the numerical calibration of the current global Early Cretaceous geological time scale [2].

Research projects in progress in the Neuquén Basin on magnetostratigraphy, astrochronology and CA-ID-TIMS U–Pb zircon dating will certainly improve the Early Cretaceous chronology presented here and will contribute to the construction of a more precise and stable geological time scale.

References:

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