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Assessing orbital vs. volcanic control on carbon cycle during the Early Cretaceous

Mathieu Martinez¹, Beatriz Aguirre-Urreta², Marina Lescano², Guillaume Dera³, Julieta Omarini^{4,5}, Maisa Tunik⁴, Tomas Frederichs⁶, Heiko Pälike⁶, Luis O'Dogherty⁷, Roque Aguado⁸, Miguel Company⁹, and Jose Sandoval⁹

¹Univ. Rennes, Géosciences Rennes, Vandoeuvre-les-Nancy, France (mathieu.martinez@univ-rennes1.fr)

²Instituto de Estudios Andinos Don Pablo Groeber, CONICET & Universidad de Buenos Aires, Ciudad Universitaria, pabellón 2, 1428 Buenos Aires, Argentina

³Géosciences Environnement Toulouse (GET), Université Paul Sabatier Toulouse 3, CNRS UMR 5563, IRD, Toulouse, France

⁴Instituto de Investigación en Paleobiología y Geología, CONICET & Universidad de Río Negro, Sede Alto Valle, 8332 General Roca, Río Negro, Argentina

⁵IIPG, CONICET. Av. J. A. Roca 1242, General Roca, Río Negro, Argentina

⁶MARUM: Center for marine Environmental Sciences, Leobener Strasse 8, Universität Bremen, 28359 Bremen, Germany

⁷Departamento Ciencias de la Tierra, Universidad de Cádiz, CASEM, 11510 Puerto Real, Spain

⁸Departamento de Geología y CEAETEMA, Universidad de Jaén, Campus Científico-Tecnológico de Linares, 23700 Linares, Spain

⁹Departamento de Estratigrafía y Paleontología, Universidad de Granada, 18002 Granada, Spain

The interval from the Valanginian to the Barremian stages (137–121 Ma; Early Cretaceous) is punctuated by several episodes of environmental changes, accompanied by shifts in weathering intensity on the continents and changes in the Tethyan neritic carbonate production. We synthesize here the astrochronology of two recent studies performed in the Neuquén basin, Vocontian Basin and Subbetic Domain (Aguirre-Urreta et al., 2019; Martinez et al., 2020), anchored to CA-ID-TIMS U-Pb ages, which conclusions have been included in the Geologic Time Scale 2020 (Gale et al, in press). We applied this time scale to a compilation of carbon-isotope ratio from belemnites and proxies of detrital supply in the Tethyan area (Vocontian Basin and Subbetic Domain). From this compilation, we show that the episodes of environmental changes are paced by a 2.4-Myr cycle and, with a lower amplitude, a 1.2-Myr cycle. In addition, the new time scale shows the synchronicity between the Weissert Event and the Parana-Etendeka Large Igneous Province. In the series of carbon-isotope ratios measured on belemnite rostra, the amplitude of the 2.4-Myr cycle is twice higher during the Valanginian than in the Late Barremian and three times higher than in the Hauterivian and Early Barremian, suggesting that the activity of the Parana-Etendeka Large Igneous Province amplified the initial orbital forcing to trigger the environmental changes observed during the Mid-Valanginian.

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