

Hafnium-neodymium isotope evidence for enhanced weathering and tectonic-climate interactions during the Late Cretaceous

Pauline Corentin ^{*1}, Emmanuelle Pucéat ¹, Pierre Pellenard ¹, Michel Guiraud ¹, Justine Blondet ¹, Nicolas Freslon ^{1,2}, Germain Bayon ³, Thierry Adatte ⁴

¹Biogéosciences, UMR 6282 CNRS, Université Bourgogne Franche-Comté, France

² ISTO - Université d'Orléans, CNRS, BRGM, UMR 7327, France

³IFREMER, Unité de Recherche Géosciences Marines, France

⁴Institute of Earth Sciences, Géopolis, University of Lausanne, Switzerland

Over million-year timescale the carbon cycle, central for atmospheric CO₂ evolution, is driven by mantle CO₂ degassing (source) and by continental weathering that drawdown CO₂ through silicate weathering reactions (sink).

Based on a novel geochemical proxy of the chemical weathering intensity (the combined Lu-Hf and Sm-Nd isotope systems in clays), associated to clay mineralogy, we discuss the links between tectonic, continental weathering and climate evolution during the late Cretaceous. That period records the very first step of the last greenhouse-to-icehouse transition and is concomitant to major uplift phases affecting the margins of both Africa and South-America.

Three sites along the South American and the African atlantics margins (IODP 356, 959 and 1259) were targeted based on their relatively complete record of upper Cretaceous sediments and on their location on both margins.

Our new results for the site 356 point to the occurrence of enhanced chemical weathering during the Campanian following the uplift of the Southeastern Brazilian margin that promoted the establishment of more hydrolysing conditions. At Demerara Rise (Site 1259), our data suggest a decoupling between physical erosion and chemical weathering, that may be explained in this area by a weaker tectonic pulse within a continuing hydrolysing climate. Chemical weathering intensity at this site rather appears to follow the evolution of global temperature. By contrast, at site 959 on the African margin, our data point to an increase in chemical weathering of the margin during the Santonian and Campanian with more pronounced fluctuations than the other sites, suggesting a combined control of both tectonic and climate.

New data from these 3 regions that encountered different climatic, geologic and tectonic conditions suggest that chemical weathering markedly intensified at all sites during the late Cretaceous and likely point to a major role of tectonic uplift in the late Cretaceous global cooling.

Key Words: late Cretaceous – paleoclimate – weathering – uplift - clay mineralogy – Hf-Nd isotope