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Hf-Nd isotope evidence for enhanced chemical weathering on the West African craton during the late Cretaceous

PAULINE CORENTIN[1], EMMANUELLE PUCÉAT[2], PIERRE PELLENARD[2], MICHEL GUIRAUD[3], JUSTINE BLONDET[4], THIERRY ADATTE[5] AND GERMAIN BAYON[6]

[1]Géosciences Montpellier
[2]Université Bourgogne
[3]Université Bourgogne Franche-Comté
[4]Université de Bourgogne
[5]ISTE, bâtiment GEOPOLIS
[6]IFREMER

Presenting Author: pauline.corentin@umontpellier.fr

The carbon cycle, which plays a major role in the evolution of atmospheric CO_2, is controlled over the long term (> 1Ma) by the degassing of mantle CO_2 (source) and by continental weathering which consumes CO_2 through silicate weathering reactions (sink).

In this study, we aim to discuss the links between tectonic, long-term evolution of silicate chemical weathering intensity and climatic changes during the late Cretaceous, which is marked by a major global cooling representing the initiation of the last greenhouse-icehouse transition, by using a new geochemical proxy ($\Delta\varepsilon_{Hf}$ based on the coupled Lu-Hf and Sm-Nd isotope systems in clays; Bayon et al., 2016; Corentin et al., 2022; 2023). This proxy is applied here on sediments from DSDP Site 959 on the Ivory Coast-Ghana margin. Mineralogical proxies are also used in association to the $\Delta\varepsilon_{Hf}$ to assess the mechanical erosion and hydrolysing conditions.

Results show that the clay mineral assemblages display a large dominance of smectites pointing to a relatively hydrolyzing climate with contrasted seasons associated to a low relief throughout the late Cretaceous, while the evolution of the $\Delta\varepsilon_{Hf(t)clay}$ shows enhanced chemical weathering on the West African craton from the Santonian to the middle Campanian. At the same time a pulse of mechanical erosion is recorded highlighted by the ratio Quartz/Clays and Feldspar/Clays, suggesting a coupling between mechanical erosion and chemical weathering on the margin. Moreover, the $\varepsilon_{Nd(t)}$ displays no major change of sources at Site 959 during the late Cretaceous.

These new data obtained at Site 959 are consistent with those combined with sites 1259 (Corentin et al., 2023) and 356 (Corentin et al., 2022) on the eastern margin of South America, affected by different climatic, geological and tectonic conditions, suggesting that chemical weathering markedly intensified at each site during the late Cretaceous. Hence, we propose a potentially major role of tectonic uplifts affecting the southern Atlantic margins of Africa and South America in the global cooling of the Upper Cretaceous.

Bayon et al. (2016) EPSL 438, 25-36.

Corentin et al. (2022) Chemical Geology 591, 12074.

Corentin et al. (2022) Marine Geology 455, 106968