Silicon isotopes as paleoweathering proxies: Application to Paleogene Central African environments

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While pristine silicate rocks display uniform Si isotopic compositions on continents (δ^{30}Si ~ -0.3 ± 0.2 ‰; 1), their alteration leads to weathering products having very distinctive Si isotopic ratios: a dissolved pool characterized by positive δ^{30}Si values (up to ~ +3.0 ‰), and residual clays with negative values (down to δ^{30}Si ~ -3.0 ‰; 2). This mass-dependent isotopic fractionation results from the preferential incorporation of the light ^{28}Si isotope released during silicate weathering into secondary clays and iron oxides. Relationships have been reported between the degree of Si isotopic fractionation in soils, clay mineralogy, and weathering indices (2), thereby suggesting that the δ^{30}Si composition of clays is controlled to some extent by weathering conditions.

To further constrain the factors controlling the Si isotopic distribution in clays, we have analysed a large number of modern sediments collected near the mouth of rivers worldwide, including some the world largest rivers (e.g. Amazon, Niger, Congo, Mississipi, Yangtze, MacKenzie). These new data demonstrate a clear link between river clays δ^{30}Si, the degree of chemical weathering, and climatic parameters (T°C, rainfall) in corresponding drainage basins. While the distribution of Si isotopes in river sediments also appears to be influenced by the lithology of rocks in the catchment area, our results pave the way for their use as proxies for past silicate weathering in sedimentary records. Here, as a first case study, we present a Paleogene $\delta^{30}Si_{clay}$ record for samples collected at the Landana cliff section (Cabinda, Angola). Taken together with other weathering proxies (CIA, Nd-Hf isotopes), these data provide additional constraints on the Paleocene/Eocene paleoenvironmental transition in Central Africa, a period marked by a climatic optimum known as the 'Paleocene-Eocene Thermal Maximum' (PETM). .

[1] Savage *et al.* (2013), GCA 109, 384-399.
[2] Frings *et al.* (2016), Chem. Geol. 425, 12-36.