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Silicon isotopes as tracers of laterite formation processes through time and space

Damien Guinoiseau[1], Julien Bouchez[1], Zuzana Fekiacova[2], Thierry Allard[3], Claire Ansart[4], and Cecile Quantin[4]

[1]Institut de Physique du Globe de Paris, Université de Paris, Paris, France (guinoiseau@ipgp.fr)
[2]CEREGE, Université Aix-Marseille, Aix-en-Provence, France (zuzana.fekiacova@inra.fr)
[3]Institut de Minéralogie, de Physique des Matériaux et de Cosmochimie, Sorbonne Université, Paris, France (thierry.allard@upmc.fr)
[4]GEOPS, Université Paris-Saclay, Orsay, France (cecile.quantin@u-psud.fr)

Lateritic soils are deep weathering profiles, developed in tectonically quiescent areas under tropical conditions and over long timescales. Laterites are key components in the regulation of element cycle in the Earth's history but, the timing between climatic changes and lateritic weathering episodes remains unconstrained. The combination of chronometric and weathering proxies is one way to build a comprehensive story of laterite formation.

In this study, two lateritic vertical profiles were targeted on the outer part of the Guyana Shield in the Amazon Basin. This region is tectonically stable and subjected to a rainy tropical climate since the Cretaceous. The first soil profile, located in the Brownsberg Mountains, Suriname, is developed on Proterozoic Greenstone [1]. The second lateritic cover, already studied and dated using EPR technique [2], is developed over the Cretaceous sedimentary Alter do Chao formation, Brazil. Both lateritic profiles are characterized by 1/ a total depletion of soluble elements and weathering of primary minerals at the base of the profile and 2/ a desilication followed by the formation of Fe and Al duricrusts on top. Here, traditional geochemical budgets are seconded by measurements of Si isotopes in both soils (bulk and/or clay fractions) and laterite draining streams. Silicon isotopes ($\delta^{30}Si$) are known to be an excellent weathering proxy, fractionated during clay mineral formation [3].

In Suriname bulk soils, heavier $\delta^{30}Si$ is associated with lateritization due to the "buffering" quartz exerts on bulk $\delta^{30}Si$. However, if clay fractions are isolated, the observed strong enrichment in light Si ($\Delta\delta^{30}Si_{\text{clay fraction-bedrock}}$ up to -0.9‰) is in line with the weathering of primary minerals and the formation of kaolinite. The dating of this intense weathering episode is c.a. 2-9 Ma based on preliminary EPR dating of kaolinites.

Regarding the Brazilian laterite, the material forming the Alter do Chao formation already suffered weathering episodes before deposition. The combination of EPR dating [2] and $\delta^{30}Si$ measurements on the clay fraction reveals two distinct formation phases. First, chemical weathering is limited to the 37-22 Ma period. Second, the progressive depletion of $\delta^{30}Si$ from the

bottom to the top of the lateritic profile highlights a replacement of a first kaolinite generation by a second population through dissolution-reprecipitation around 6 Ma, as previously inferred by EPR dating [2].

These results, in combination with elemental mass budgets, give us better constraints to estimate the intensity and the timing of element mass transfers during laterite formation.

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