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# Laterites as paleoenvironmental archives: when isotopes meet ages

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## Résumé

Laterite formations are nutrient-depleted weathering profiles ubiquitously found in tropical areas. Recent advances in kaolinite and iron oxide dating techniques have shown that Amazonian laterites and their mineral assemblages are not contemporaneously formed but constitute multi-million year archives that record the climatic and environmental conditions prevailing during their weathering history.

In this study, we document how the stable isotope compositions (silicon, oxygen, hydrogen) and kaolinite and iron oxide ages can be combined to highlight the main weathering episodes that shaped a lateritic profile developed on the Alter do Chão formation (Cretaceous – Early Paleogene sediments of the Central Amazon basin). The duration and intensity of these events are further linked to local hydrological control as well as to major geodynamic and climatic shifts during the Cenozoic.

Two main weathering episodes correspond to previously reported events showing their consistency on a regional scale. The first post-deposition weathering episode, in the Late Eocene – Early Miocene, is consistent with a long ( $> 10$  Myr) but moderately intense in situ chemical reworking of the minerals initially present in the sediments of Alter do Chão Formation. In the upper part of the profile, the radical change in the degree of crystalline disorder and Si isotope signatures of the kaolinites indicates a downward replacement of the first generation of kaolinites during a high-intensity but short-lived ( $< 5$  Myr) weathering episode dated to the Late Miocene – Pliocene. This episode is consistent with the onset of the Amazonian transcontinental route in a general context of sea level drop, accentuating the intensity of continental drainage and weathering. Besides, the  $\delta^{18}\text{O} - \delta\text{D}$  signature of this kaolinite generation suggests the onset of a "monsoon-like" climate. In addition, the presence of an uncommon ferruginous lateritic duricrust at 9 m depth affects this profile's hydrological structure. Dated at  $16 \pm 3$  Ma and suggesting a rise of groundwater levels in the Central Amazon basin, this duricrust slows down the progression of the weathering front. It acts as a hydrological barrier that allows for a more recent (Quaternary to present) weathering episode at the top of this physical boundary.

**Mots-Clés:** Stable isotope geochemistry, Tropical weathering, Laterite, Kaolinite and Fe, oxide dating

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