



Iron isotope study of recent laterites from Cameroon

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Lateritic soils cover about one third of the continents and half of the continental waters feeding the oceans drain these tropical soils. Iron is dominant in laterites and it is therefore essential to study the Fe isotope composition of such soils to gain a more accurate understanding of the iron cycling between continents and oceans. Yet only modern soils from temperate continental zones have been studied so far using this recent isotopic tool (e.g. Fantle and DePaolo, 2004; Emmanuel et al., 2005).

Two profiles located uphill and downhill, respectively, have been sampled over depths of up to 36m. They consist, from bottom to top, of a granodiorite bedrock, saprolite, mottled clay, nodular iron crust and loose clayey horizons (see Braun et al., 2005, for details). To obtain a more detailed characterization of the mineralogy of iron, Mössbauer spectroscopy was performed on bulk samples at 5K. These samples were also dissolved, iron was purified using ion chromatography and its isotopic composition was determined by plasma source mass spectrometry following the methods described in Poitrasson & Freyrier (2005). Iron isotope compositions are reported using the delta notation (in per mil) relative to the IRMM-14 isotopic international reference material.

Mössbauer measurements reveal that the iron mineralogy consists mostly of small amounts of phyllosilicates (<5%) and varying quantities of hematite (ca. 20 to 70 %) and goethite (ca. 30 to 80%). Hematite is the most abundant Fe-bearing mineral in the nodular fraction of ferruginous horizons whereas goethite is dominant in saprolite and

mottled clay horizons. Iron concentrations are also highly variable in the two profiles since Fe_2O_3 ranges from 1.6 wt% in a saprolite up to 50 wt% in the nodular fraction of ferruginous horizons. Despite these large variations in Fe concentrations and mineralogical abundances, Fe isotope compositions vary very little in the two profiles: the overall observed range is of 0.2 per mil in $\delta^{57}\text{Fe}$, and most samples are indistinguishable from the previously established baseline for igneous rocks (e.g., Beard and Johnson, 2006; Poitrasson, 2006).

There is no obvious relationship between bulk-rock $\delta^{57}\text{Fe}$ composition and the iron mineralogy determined by Mössbauer spectroscopy in the two profiles. At the cm-scale, however, iron nodules are isotopically heavier than coexisting clay matrix and mass balance calculations suggest that isotopic equilibrium may have been reached in the uphill profile.

Aside from iron nodules from ferruginous horizons, soft clayey samples from the downhill profile and a saprolite from the uphill profile display slightly heavier $\delta^{57}\text{Fe}$ values than the igneous baseline. This difference likely denote some iron transport associated with lateral fluid migration, in agreement with computed mass fraction transport functions. The lack of notable Fe isotope fractionation observed at the bulk-rock scale suggest that Fe^{2+} from the granodiorite parent rock was quantitatively oxidized during the lateritization process, thus leaving little opportunity for large isotopic fractionations requiring that at least some of the Fe occurs in the divalent state.

Overall, this lack of noticeable Fe isotopic variations in laterites suggest that most of the iron available to erosion and transport to the ocean from tropical zones will display an isotopic composition indistinguishable from the igneous rock baseline.

Our results are also in sharp contrast with the large Fe isotope fractionation found in an Paleoproterozoic laterite from Botswana (Yamaguchi et al., 2007). This disparity is certainly due to the larger amounts of Fe^{2+} occurring in Paleoproterozoic laterites compared to modern laterites, and confirms these authors' assertion that Fe isotopes can be a sensitive tracer to the variable amount of oxygen present in the atmosphere through geological times.