
Ni mobility in a Brazilian lateritic regolith (Barro Alto, Goiás State) : what can we learn from Ni isotopes and quantitative solid speciation

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Abstract

Several studies have shown that terrestrial samples have different Ni isotopic signature, but only few studies have demonstrated their usefulness in environmental studies. In this study we have coupled Ni isotopes with qualitative and quantitative Ni speciation investigations in order to better understand the overall Ni cycle in tropical ultramafic (UM) context. Changes in Ni isotopic composition and in Ni speciation have been investigated along two core drilled through the lateritic regolith (52 samples up to a depth of 28m). Nickel solid speciation was determined by TEM-EDS and by XANES spectroscopy. Quantitative analysis of XANES spectra by linear combination-least squares fitting (LC-LSF) has been done in order to quantify the distribution of Ni among primary silicate minerals (olivine and serpentine), secondary phyllosilicates (serpentine and 2/1 clay minerals) and Fe-oxides (goethite).

Mineralogical and geochemical investigations allow us to distinguish a lateritic unit dominated by Fe-oxide and a saprolitic unit dominated by phyllosilicates. Electron microscopy and XANES show that Ni is mainly hosted by Ni-poor serpentine and 2/1 clay minerals such as smectite, chlorite and probably talc in the saprolitic unit, while it is mainly associated in the Fe oxide in the lateritic unit. The open-system mass transport functions have shown that Ni mobility in the profile is dependent of Mg and Fe contents.

Ni isotope values ($\delta^{60}\text{Ni}$) range from -0.04 to 1.43 , and show large variations throughout the profiles. Ni exchangeable fraction present $\delta^{60}\text{Ni}$ values systematically heavier than bulk sample. Ni isotope fractionation does not seem to be dependant of Ni solid speciation. These two profiles could be used to modelling the Ni behaviour/mobility at the weathering profile scale in UM complex of Barro Alto using Ni solid speciation and then Ni isotopic tool.

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