Nickel isotope fractionation during smelting and refining: A new way to trace the sources of Ni in soils?

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Being able to trace the imprint of anthropogenically induced metal isotope signatures in natural environments represents a promising area in the research on metallic pollution [1, 2]. The present study aims to evaluate (1) the nickel isotope fractionation associated to the Ni-laterite ore smelting and refining in two metallurgical plants located in the Goiás State, Brazil (Barro Alto, Niquelândia), (2) the potential of Ni isotopes for tracing the natural *vs* anthropogenic Ni in soils, sediments and water. The Ni isotopic composition (δ^{60}Ni) ranges from -0.26 to 0.27 ‰ for the whole sample set. Nickel ores exhibit a large range of δ^{60}Ni values (0.02 to 0.20 ‰, n=7), which can be explained by the diversity of Ni-bearing phases [3]. Fly ash δ^{60}Ni values (n=10) are not significantly different from the Ni ore ones as well as the final FeNi produced (0.05‰, n=2). This latter positive value, close to the Ni ore one, is expected due to the very high production yield of the factories. However, reduction slags present the heaviest δ^{60}Ni values of all smelter samples, with δ^{60}Ni ranging from 0.11 to 0.27‰, n=8. The Ni isotopic composition of the topsoils developed on UM rocks collected in Barro Alto and Niquelândia ranges from -0.26 to -0.09‰ (n=20). On the contrary, the Ni isotopic composition of the non-UM topsoils, collected close to the Niquelândia metallurgical plant, exhibit a large variation of δ^{60}Ni, ranging from -0.17 up to 0.10 ‰, n=4). This enrichment in heavier isotopes highlight the potential impact of smelting activity in the surrounding area, as well as the potential of Ni isotopes for discerning anthropogenic samples (heavier δ^{60}Ni values) from natural ones (lighter δ^{60}Ni values). These results, coupled with geochemical and mineralogical investigations, would demonstrate the efficiency of Ni isotopes for tracing of environmental contamination.

[1] Bullen *et al* (2014), Treatise on Geochemistry (2nd Edition), 329-359. [2] Wiederhold *et al* (2015), *ES&T* **49**, 2606-2624. [3] Ratié *et al* (2015), *CG* **402**, 68-76.