Ni isotope fractionation during lateritization of serpentinites

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No fractionation of Ni isotopes which sufficiently exceeded analytical errors is mentioned in recent compilations. However, a presupposition existed that Ni isotope fractionation could be observed in such low-temperature formations as laterites rather than in magmatic or other high-temperature rocks. Our study was aimed at searching possible variations in Ni isotope composition in a system "ultrabasic rock – laterite".

Subject for study were Proterozoic serpentinite from the Wind Belt (Baltic Shield) and Lower Carboniferous lateritic profile formed at the expense of it. The profile is well-zoned and reaches 40 m thick. The main Ni-bearing minerals are montmorillonite and goethite; bulk Ni content usually does not exceed 1 wt. %. Another set of samples was Early Paleozoic serpentinite from the Ufaley Region, Central Urals, and its alteration products from the Ufaley Ni deposit aged Lower Cretaceous. The deposit belongs to the contact-karst type; laterite is partly preserved on serpentinites and partly redeposited in karstic caves along the contact of serpentinites with the nearest marbles. The content of Ni varies from 0.6 – 0.7 wt. % in leached serpentinites to 9 wt. % in garnierite stockwork.. The other lateritic profile (Serov deposit) occurs in the Northern Urals. It was formed in Late Triassic over Paleozoic serpentinized harzburgites and covered by Early Jurassic sediments. Weathered products are characterized by low Ni content (usually 1 wt. % and less). All of samples had undergone preliminary total acid dissolution; Ni separation was made consequently on chromatographic columns using BioRad AG MP-1 and Eichrom Ni resins. Ni isotope analyses were carried out on the MC-ICP-MS Neptune (Thermo Finnigan). Correction for instrument mass bias was made using exponential mass fractionation law ($^{65}Cu/^{63}Cu=0.44625$). For this, in-house Cu standard was added to the sample solution before measurements. The method of bracketing was used for the analyses performance as well. This provided double control over the results obtained. The long-term reproducibility of our analytical work was ±0.03‰ for $\delta^{60}Ni$ and ±0.01‰ for $\delta^{62}Ni$.

With respect to Ni isotope composition of parent serpentinites, samples of garnierite ore of infiltration genesis show more heavy composition, while oxidised laterite samples have more easy composition. Dependance of isotope effect on the intensity of weathering is observed. Thus, the smallest Ni isotope fractionation is observed for the samples from the Serov deposit which formed during least productive Triassic epoch. Maximum isotope effect is found for samples from the Ufaley deposit formed during most productive Cretaceous weathering epoch.