Nickel stable isotopes in oceanic basalts – a proxy for mantle recycling?

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Use of Ni isotopic compositions has accelerated in the last 5 years, with increased interest expressed in nearly 20 published papers in that time period. Gall et al. (1) presented early indications of Ni isotopic fractionation in the Earth's mantle in high temperature terrestrial systems. Recent work (2) has shown no significant Ni isotopic fractionation between mineral phases in the mantle, but that some ultramafic xenoliths, with metasomatic features or enriched lithologies, have isotopically lighter δ^{60}Ni (down to -0.38 ‰) than the values found for unmetasomatised peridotites (δ^{60}Ni = 0.20 ‰). This Ni isotopic heterogeneity is most extreme in pyroxenitic lithologies and appears to be related to recycling in the mantle (Saunders et al., submitted).

We present new Ni isotope data for terrestrial mafic rocks, measured using double spiking and MC-ICPMS (3). Previous work with Cameroon Line basaltic rocks (4) has shown that there is no Ni isotopic fractionation with different degrees of partial melting. The Ni isotopic compositions of 12 MORB glassses define a more restricted range than the 27 OIB and other intraplate mafic rocks (-0.04 to 0.19 ‰ relative to -0.16 to 0.23 ‰). No correlations are found with Ni concentration. However, the fresh axial MORB glasses display curvilinear trends that extend to light δ^{60}Ni associated with LREE enrichment, negative Eu anomalies, high Rb/Sr, and high K_2O/total alkalis. Ocean island basalts show a curvilinear trend with lighter δ^{60}Ni associated with less radiogenic $^{206}Pb/^{204}Pb$. One possible explanation is that this signal in MORB reflects components recycled by subduction, and is analogous to the processes inferred for ultramafic xenoliths.

References: (1) Gall L, et al. Geochim Cosmochim Acta. 2017; 199:196–209. (2) Saunders N., 2018, Thesis, Oxford. University (3) Gall L, et al. J Anal At Spectrom. 2012; 27(1):137. (4) Saunders N, et al. Goldschmidt abstracts, 2018