Nickel: isotopes and olivine. What do they tell us about mantle source components?

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Nickel (Ni) stable isotopes have recently been applied to high temperature terrestrial samples. Primitive mantle δNi is estimated at 0.23±0.06‰[1] while δNi in ultramafic xenoliths ranges from +0.26‰ to -0.38‰ and correlates positively with $^{143}Nd/^{144}Nd$; leading to the suggestion that light Ni isotopes are associated with recycled pyroxenitic material[2]. Nickel and Mn contents of olivine in basalts have been used to quantify peridotite:pyroxenite proportions in their mantle source regions[3]. These two Ni approaches have the potential to characterise mantle source components and their lithologies.

We have therefore applied these techniques to lavas from Heard Island, an EMI hotspot located on the Kerguelen Plateau (Southern Indian Ocean). Heard Island lavas have extremely well correlated radiogenic isotopes inferred to result from simple binary mixing between two enriched mantle components: Big Ben and Laurens[4].

In conjuction with $^{87}Sr/^{86}Sr$, and x/Nb ratios the δNi data are indicative of two mixing trends involving three components. Both trends are anchored by an intermediate component with δNi = 0.049–0.085‰ and trend to heavier Ni (Big Ben: δNi = 0.054-0.148‰; Laurens: δNi = 0.121-0.252‰). Relative to this intermediate component, the Big Ben heavy Ni component has characteristics indicative of a sedimentary origin (e.g. higher $^{87}Sr/^{86}Sr$ and x/Nb ratios), while the Laurens heavy Ni component has characteristics likely to be eclogitic in origin (e.g. lower $^{87}Sr/^{86}Sr$ and x/Nb ratios). Mixing between the Big Ben and Laurens components is not seen.

Olivines in Heard Island lavas are consistent with highly variable source pyroxenite contents. The intermediate component has the narrowest range of pyroxenite content (50-90%), while with increasing δNi, within sample ranges in pyroxenite content decrease in Big Ben lavas and increase for Laurens lavas. This suggests that the Laurens component is more heterogeneous than the Big Ben component.

[1] Gall *et al.,* (2017) *GCA* 199 196-209; [2] Saunders *et al* submitted to *EPSL*; [3] Sobelev *et al.,* (2005) *Nature* 434 590-597; [4] Barling *et al.,* (1994) *J.Pet.* 35 1017-1053.