Iron isotope contraints on mantle lithological heterogeneity beneath the Azores

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Lithological variations in the Earth's mantle have important implications for mantle dynamics and melting [1-2] but linking geochemical and mineralogical variation is difficult [3]. However the Fe isotope compositions (δ^{57}Fe) of mafic rocks reflect mineral-specific partitioning [4-6]. A rececent study of Salt Lake Crater (Hawaii) peridotite and pyroxenite xenoliths [9] revealed that pyroxenites are enriched in isotopically heavy Fe whereas peridotites display light δ^{57}Fe values that correlate with indicators of melt extraction. Melts derived from pyroxene-dominated sources should thus display heavy δ^{57}Fe relative to melts derived from depleted peridotitic lithologies. The Azores are a suitable area to test this hypothesis because of the short-wavelength variation in source geochemistry documented in radiogenic isotopes and trace elements [7-11]. We have analysed samples from São Jorge, São Miguel, Pico, Faial and Terceira and can demonstrate island-specific Fe isotope systematics. In São Miguel correlations between δ^{57}Fe and Sr and Nd isotopes can be interpreted in terms of mixing between a a radiogenic Sr/unradiogenic Nd component with a light, "peridotitic" δ^{57}Fe value and a component with heavier δ^{57}Fe and yet less enriched radiogenic isotope signatures. This indicates decoupling between δ^{57}Fe and radiogenic isotopes, as components with "enriched" radiogenic isotopes signatures are usually considered to reflect pyroxenite lithologies. São Jorge samples display extremely heavy δ^{57}Fe values that correlate with Pb isotopes as well as fractionation-corrected major element ratios indicative of pyroxenite lithologies.

[1] Hirschmann et al., CMP 1996; [2] Dasgupta et al., EPSL 2010; [3] Workmann et al., G^3 2004; [4] Weyer and Ionov, EPSL 2007; [5] Williams et al., ESPL 2005; [6] Williams and Bizimis, EPSL 2015; [7] Turner et al., Chem Geol. 1997; [8] Widom et al., Chem Geol. 1997; [9] Elliott et al., GCA 2007; [10] Beier et al., EPSL 2007; [11] Millet et al., Chem Geol. 2009.