

Elevated Fe-isotopes reflect wedge oxidation driven by sediment subduction?

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We present new Fe-isotope data on > 100 basaltic samples from the Pacific and Indian Ocean arc systems arcs. This data was collected to investigate whether there is systematic variation in Fe isotopic compositions that may reflect differing oxidation and water content of different arc's mantle wedges, in turn reflecting tectonic factors such as the rate of subduction and the age of the subducting plate (the slab thermal parameter (ϕ) [1]). Subduction arc systems have significantly more water than other tectonic settings and have elevated $\text{Fe}^{3+}/\Sigma\text{Fe}$ values in the range >0.1 to 0.5 (our data has a mean of ~ 0.35), compared to MORB = 0.1-0.2 [3]. Although peridotites from sub-arc mantle wedges have elevated oxidation the site of the oxidation of arc magmas remains controversial. Arguments using redox-sensitive element ratios (V/Sc or Zn/Fe_T) imply that oxidation of arc magmas is associated with degassing after the melts have left the mantle wedge source and that the mantle wedge has $f\text{O}_2$ values as reduced as the source of MORB [2].

Our $\delta^{57}\text{Fe}$ data span a range from -0.2 to +0.2 (± 0.04), with a mean around +0.05. This is significantly lighter than the mean for MORB and BABBs ($\sim +0.10$) [3]. This suggests that sub-arc wedge peridotite is more refractory than MORB-source. The data set shows positive correlation between $\delta^{57}\text{Fe}$ and Pb- or Sr-isotope ratios and $\text{Fe}^{3+}/\Sigma\text{Fe}$, negative correlation between $\delta^{57}\text{Fe}$ and Ba/La. Interestingly there is a strong negative correlation between $\delta^{57}\text{Fe}$ and ϕ . As the high ϕ arcs see more efficient water subduction to depth, our important conclusion is that if elevated $\delta^{57}\text{Fe}$ values are indeed reflective of melting of more oxidised mantle [4], then this is not a direct result of water introduction to the mantle wedge alone. The positive correlations with Pb-and Sr- isotopes and negative with Ba/La tend to suggest heavier iron isotope signatures are a response to sediment subduction, perhaps transporting oxidised sulfur?

[1] Van Keken , *et al.* (2011) *J. Geophys Res.* **116**, BO1401.

[2] C-T. Lee *et al.*, (2010) *Nature* **468**, 681-685. [3] Teng *et al.*, *Geochimica et Cosmochimica Acta*, 107, 12-26. [4] Dauphas *et al.* (2009) *Earth & Planetary Sci Let* **288**, 255-267.