Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.11322

Iron isotopes in mantle and cumulate xenoliths from Adak Island, Central Aleutians

EMMA SOFIA SOSA[1], CLAIRE E BUCHOLZ[1], JUAN DAVID HERNÁNDEZ-MONTENEGRO[1], FRANÇOIS L.H. TISSOT[2], MICHAEL A. KIPP[1], SUZANNE M KAY[3] AND ROBERT KAY[3]

[1]California Institute of Technology

[2]Caltech

[3]Cornell University

Presenting Author: esosa@caltech.edu

While mid-ocean ridge basalts exhibit a limited range of iron isotope compositions ($\delta^{56}Fe = 0.105 \pm 0.006$‰ [1]), arc magmas are more variable (e.g., -0.15 to +0.20‰; [2,3]). The extent to which prior source depletion [2], oxygen fugacity [4], fluid flux from the subducted slab [5], and crustal differentiation [3,6] drive iron isotope variations in arcs is debated. Existing studies of iron isotopes in arc systems have predominantly analyzed lavas. We provide a complementary iron isotope record of lower crustal cumulate xenoliths. Our data represent the second measurements of iron isotopes in cumulate island arc xenoliths [6] and extend to more primitive lithologies than previous studies have measured. We analyzed minerals (spinel, clinopyroxene, olivine) and whole-rock iron isotope ratios from cumulate xenoliths (and one mantle xenolith) from Adak Island, Central Aleutians. Adak xenolith lithologies include a mantle lherzolite, primitive cumulate dunites and clinopyroxenites, and more evolved amphibole gabbros and hornblendites (analyses of the latter two are underway). Adak cumulates broadly fall into two groups based on their bulk-rock $\delta^{56}Fe$ and clinopyroxene trace element characteristics. Group 1 are isotopically light (bulk-rock $\delta^{56}Fe$ -0.073 to +0.008‰) and have low trace element abundances, whereas Group 2 are isotopically heavier (bulk-rock $\delta^{56}Fe$ +0.040 to +0.086‰) with higher trace element abundances, suggesting that prior mantle source depletion or contribution from a slab-derived fluid influenced the $\delta^{56}Fe$ of their parental melts. Calculated $\delta^{56}Fe$ of melts in equilibrium with the cumulates varies from 0.08-0.11‰ for Group 1 and 0.13-0.24‰ for Group 2 and appear to be negatively correlated with Mg# in both groups. Fractional crystallization modeling demonstrates that within both groups, increases in equilibrium melt $\delta^{56}Fe$ from more primitive to more evolved samples can largely be explained through closed system fractionation.

[1] F. Z. Teng *et al.*, GCA 107, 12 (2013).

[2] J. Foden *et al.*, EPSL 494, 190 (2015).

[3] D. H. Du *et al.*, Geology (2022).

[4] N. Dauphas *et al.*, EPSL 288, 255 (2009).

[5] S. Turner *et al.*, Geology 46, 947 (2018).

[6] G. F. Cooper and E. C. Inglis, Frontiers in Earth Science 9, (2022).