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Development of a method for simultaneous Fo#, Fe and Mg isotope analyses in olivine

SILVIA C. CASTILLA, CORLISS KIN I SIO AND DUANE SMYTHE

University of Toronto

Diffusion of Fe and Mg in olivine produces compositional (Fo#) zoning that can be used to constrain the temporal evolution of magmas, including magma residence times and ascent rates. Isotope profiles of Fe and Mg in these crystals can further constrain the relative contributions of chemical diffusion versus crystal growth in generating zoning[1]. Essentially, these isotope profiles inform about the initial and boundary conditions under which diffusion may have occurred, thereby improving the accuracy of the estimated timescales and rates. A challenge of this method is the limited crystal area available for spatially resolved analyses. In addition, Fe isotopes, Mg isotopes, and Fo# are all currently measured at different locations in a crystal[2], which can make it challenging to robustly correlate data in compositionally zoned crystals.

We are developing a methodology for simultaneous determination of Fo#, Fe and Mg isotope compositions in olivine crystals. This method utilizes a suite of well-characterized olivine standards and fs-LA-MC-ICPMS (a NWRfemto coupled to a Neoma system) at the University of Toronto. Preliminary results show that sufficient precision on Fe and Mg isotope analyses can be achieved via peak jumping. Tests are being carried out to assess matrix effects and tolerance for concentration mismatch between samples and the bracketing standard. This method has the potential to reduce data acquisition time while minimizing uncertainty in pairing analyses conducted on different regions of a sample.

[1]Sio and Dauphas (2017) *Geology*, 45(1), 67-70.

[2]Oeser et al., (2015), *GCA*, 154, 130-150.