Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.22282

Multi-pathway diffusion of lithium in feldspar

BRENDAN GARVEY, GABE LAROUCHE AND MEGAN HOLYCROSS

Cornell University

Presenting Author: bmg86@cornell.edu

Lithium is a relatively fast diffusing, moderately volatile element and therefore has the potential to quantify the timescales of processes such as magma recharge, degassing, and decompression occurring minutes to days before an eruption. The experimental calibration of Li diffusion in feldspar provides a method to quantify these rapid timescales in a ubiquitous mineral phase and ultimately aid in eruption forecasting. We ran Li-in-feldspar diffusion experiments with multiple feldspar compositions using powdered spodumene mixed with quartz as our Li source. In contrast to previous results[1], our experiments show both simple error function-like profiles and complex diffusion profiles, and a compositional dependence in plagioclase feldspars. Complex diffusion profiles require a multi-path diffusion finite difference model to obtain relevant diffusivities for Li. Preliminary results show that multi-pathway Li diffusion in feldspar occurs via a slow vacancy mechanism and a fast interstitial mechanism in feldspars with intermediate anorthite contents. Multi-path diffusion is governed by the reaction $Li_{Interstitial}$ + Vacancy = Li_{Metal}, similar to Li diffusion mechanisms recognized in other minerals (e.g., olivine[2]). Our Li diffusion coefficients for pure albite conform to error function solutions and align with prior results[1], while experiments with An_{60} plagioclase are slower by 1-3 orders of magnitude at the same temperature. We hypothesize that this compositional dependence is due to a transition of plagioclase lattice bonding lengths and/or due to varying Fe content in the feldspar. Our new data indicate eruption timescales constrained by Li-in-feldspar diffusion chronometry in intermediate plagioclase compositions may be longer than suggested by previous experimental diffusion coefficients[1].

[1]Giletti, B.J., Shanahan, T.M. (1997) *Chem Geol* 139, 3-20.

[2]Dohmen et al. (2010) *Geochim Cosmochim Acta* 74, 274-292.