# Mg Diffusion in Alkali Feldspar; Applications for Diffusion Chronometry in Magmatic Systems

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The diffusion of elements in crystals is now recognized as a powerful chronometer that enables the determination of rates of magmatic processes or thermal histories of meteorites, for example. Feldspar is a ubiquitous phase in magmatic environments and thus, particularly useful as a chronometer. Mg diffusion in Na- and Ca-rich feldspar ($D = 10^{-15}$ to $10^{-19}$ $m^2$ $s^{-1}$) [1, 2] has been shown to diffuse relatively fast compared to Ba and Sr ($D = 10^{-17}$ to $10^{-22}$ $m^2$ $s^{-1}$) [3], such that Mg diffusion in plagioclase can record processes that occur over timescales as short as years to days at magmatic temperatures. Chemical zoning of Ba and Sr in plagioclase feldspar has been shown to change as a function of major element composition, and therefore motivates the determination of Mg diffusivity in K-bearing feldspar, which is poorly constrained. Here we present the results of a series of 1 atm experiments in order to determine Mg diffusivity in Eifel sanidine ($Or_{83}$) [4]. Polished sections of sanidine were surrounded by source powder of MgO, $SiO_2$, $Al_2O_3$ mixed with ground sanidine of the same composition in Pt capsules and annealed in air. Experiments were conducted at 800–1150 °C (in increments of 50 ºC) for times ranging from 30 min to 10 days and analyzed via depth profiling on the Secondary Ion Mass Spectrometry (SIMS) at Arizona State University. Preliminary results suggest temperature-dependent diffusivities ranging from $10^{-20}$ to $10^{-18}$ $m^2$ $s^{-1}$ at temperatures of 850–1150 ºC. Mg diffusion in sanidine was examined along two different crystallographic axes (b and c) to investigate isotropy and we find similar diffusivities along both the b and c axis. The observed Mg diffusivities in K-bearing feldspar are one to two orders of magnitude slower than those observed in Na- and Ca-bearing feldspar at the same temperatures [2], and suggest Mg in K-bearing feldspar may record longer timescales relative to Mg in plagioclase feldspar. Future experiments will examine Mg diffusivity in lower orthoclase content K-feldspar.

[1] La Tourrette & Wasserburg (1998), EPSL 158, 91–105.
[2] Van Orman et al. (2014), EPSL 385, 79–88.
[3] Cherniak (2010), RMG 72, 691–733.
[4] Hodson (1998), GCA 62, 3429–3435.