Trace element diffusion in hydrous rhyolitic melt

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We conducted high pressure, high temperature experiments to determine the diffusivities of 17 trace elements (Y, Zr, Nb, La, Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Yb, Lu, Th, U) in rhyolitic composition silicate liquids. Synthesis experiments were run to create a trace element rich glass and a trace element poor glass. Diffusion couples were assembled by juxtaposing the two polished synthesis glasses against one another in a silver capsule. All diffusion experiments were executed in a piston cylinder apparatus at 1 GPa pressure and temperatures ranging from 740-940º C. Experiments at lower temperatures are currently underway.

Concentration gradients that developed in the glasses were characterized using a laser ablation inductively coupled plasma mass spectrometer (LA-ICP-MS). Diffusion coefficients were determined from concentration profiles. Diffusivities exhibit Arrhenian behavior within experimental error. Preliminary data suggest the highest activation energies are obtained for rare earth elements, with the largest activation energy acquired for Ce. Values for the pre-exponential factor, D_o, peak at Nd and are lowest for high field strength elements. Calculated diffusivities indicate the potential for fractionation of heavy rare earth elements from light rare earth elements. The database of diffusivities reported in this study are relevant to a variety of applications in igneous petrology.