# Si isotope fractionation in quartz, feldspar, and fayalite

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Measurements of mineral pairs in igneous rocks reveal resolvable Si isotope fractionations [1], and whole rock data show strong evidence for predictable Si isotope fractionation during igneous differentiation [2,3]. Here we present a progress report of experimental studies whose goal is to characterize Si isotope fractionations between igneous phases.

We report results from two types of experiments. The first involves direct synthesis of mineral pairs. The second utilizes the "3-isotope method", where one phase is isotopically doped to lie off the terrestrial mass fractionation line, and time series experiments characterize the approach to equilibrium to a secondary mass fractionation line. All experiements were performed in a piston cylinder device under hydrous conditions; the Si isotope composition of each phase was measured by MC-ICP-MS.

Preliminary results show that quartz–fayalite fractionations (800-900 °C at 1 GPa), are comparable to those determined for quartz–zircon [4]. This agrees with the expectation that orthosilicates (i.e., zircon and olivine) should have broadly comparable β values. Quartz–fayalite fractionations have particular relevance to magmatic differentiation: olivine is often the earliest phase to crystalize during fractional crystallization, and quartz the last; thus, the fractionation between these two major rock-forming phases broadly constrains the maximum possible Si isotope fractionation from mafic→felsic evolution in a closed system.

Experiments have also been performed to characterize quartz–K-feldspar Si isotope fractionations. These results have implications for the composition and transport of Si isotopes in the near surface environment as the rates of chemical weathering of igneous phases are demonstrably different. We also report preliminary quartz–fluid fractionations directly relevant to fluid-rock interactions during metamorphism. At 900 °C and 1 GPa, we observe no resolvable fractionation between quartz and fluid. Future experiments will explore whether this is also the case at lower temperatures.

[1] Savage, P.S., et al. (2012) GCA 92, 184-202. [2] Savage, P.S., et al. (2011) GCA 75, 6124-6139. [3] Poitrasson, F. and Zambardi, T. (2015) GCA 167, 301-312. [4] Trail D., et al. (under review).