Si isotopes in zircon from experiments, granites, and mantle-derived samples

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The application of silicon isotopes to understanding and quantifying geochemical sources and cycles has increased in recent years due to the ability to conduct high precision isotope measurements [1-3]. For instance, chemical weathering results in an enrichment in the lighter Si isotopes in neo-formed clay minerals when compared to the starting rock [1]. In agreement with this observation, the Si isotopic composition of granitoids derived from sedimentary lithologies are, on average, enriched in the lighter Si isotopes when compared to igneous-derived sources [3].

Here we focus on the Si isotope composition of zircon. Zircons are the only known samples available on Earth that allow us to directly study the Hadean (e.g., [4]); understanding the Si isotope systematics of zircons offers the potential to investigate ancient mantle composition and, also, the possibility of low-temperature fluid-induced chemical weathering during our planet's earliest history. Preliminary observations indicate that mantle-derived zircon yield Si isotopic compositions resolvable from those of continental (I-type) granitoids, however, this difference could be due to differentiation and/or the presence of varying mineral assemblages during crystal growth [2], rather than differences in source composition.

Therefore, we have experimentally investigated the magnitude of Si isotope fractionation between zircon and quartz. A series of experiments were conducted, based on the 3 isotope exchange method [5], in which zircon and quartz progressively approached their equilibrium isotopic composition. Initial results yield calculated fractionations that are broadly consistent with those measured between zircon-quartz pairs in natural samples, and reveal the potential that zircons hold to understanding the silicon cycle throughout Earth's history.

[1] Ziegler et al. (2005) *Geology* **33**, 817–820. [2] Savage et al. (2011) *GCA*, **75**, 6124-6139. [3] Savage et al. (2012) *GCA* **92**, 184-202. [4] Trail et al. (2011) *Nature* **480**, 79-82. [5] Shahar et al. (2011) *GCA* **75**, 7688–7697.