Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.12443

Probing the lower mantle with high-precision Si and Mg isotope data

XIAONING LIU[1], REMCO C. HIN[2], MARTIJN KLAVER[3], CHRISTOPHER D. COATH[1] AND TIM ELLIOTT[1]

[1]University of Bristol

[2]Bayerisches Geoinstitut

[3]Cardiff University

Presenting Author: xl17349@bristol.ac.uk

The high precision isotope analysis of major, rock-forming elements can provide novel constraints on the composition of the lower mantle[1]. Although multi-collector inductively coupled mass-spectrometry (MCICPMS) has enabled a significant improvement in the precision of isotope measurements, the sample-standard bracketing approach typically used in conjunction with MC-ICPMS relies on external normalisation and any differences in the matrices between sample and reference standard can undermine data reproducibility. Double spiking provides a more robust approach but is classically applicable only to elements with 4 or more isotopes and so excludes the major elements Mg and Si. Here, we use a critical mixture double spiking approach to circumvent this problem [2]. This procedure has previously been used for Mg [3] but here we extend its application to Si isotope ratio analysis. This work follows on from work documented in a preliminary report [4]. Si isotope composition of several international rock standards (e.g., BHVO-2, BIR-1&JP-1) were analysed. These data are in agreement with the literature sample-standard bracketing data but we were able to obtain higher reproducibility (±0.025‰ 2sd, on δ^{30}Si). Our initial work on some ocean island basalts samples from Samoa show they have anomalously light Mg isotope compositions. Theoretical calculations predict significant Mg isotope fractionation between different olivine polymorphs and with Bridgmanite[5]. A similar prediction has been made for the Si isotope ratios[6]. Thus solidification of a global magma ocean should simultaneously fractionate Si and Mg isotope ratios and this signature may be preserved in the composition of deep mantle plumes . To further investigate if the Samoan Mg isotope anomaly is linked to the Bridgmanite fractionation, we are using our critical double spiking approach to make high-precision Si isotope measurement on the same samples.

[1] Williams et al. (2021) *Science Adv.* **7,** eabc7394. [2] Coath et al. (2017) *Chem. Geol.* **451,** 78-89. [3] Hin et al. (2017) Nature **549**, 511-515. [4] Klaver et al. (2018) *Goldschmidt abstract 2017003420*. [5] Wu et al. (2014) *Earth Planet. Sci Lett.* **409,** 339-347. [6] Huang et al. (2013) *Geochimi. Cosmochim. Acta* **140**, 509-520.