Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.32271

Exploring triple-silicon isotope behaviour during amorphous silica precipitation and mass-spectrometry

DR. PATRICK J. FRINGS[1], FRANZISKA M. STAMM[2], MICHAEL TATZEL[3] AND MARCUS OELZE[4]

[1]GFZ German Research Centre for Geosciences
[2]Institute of Applied Geosciences, Graz University of Technology
[3]University of Göttingen
[4]Bundesanstalt für Materialforschung und -prüfung (BAM)

Kinetic and equilibrium isotope effects make subtly different predictions about the mass-dependent scaling between the silicon (Si) isotope ratios $^{30}Si/^{28}Si$ and $^{29}Si/^{28}Si$. The mass-dependencies of kinetic vs. equilibrium fractionations are typically not resolvably different during analysis, but recent work [1,2] demonstrates that with high-precision and high-resolution analyses, deviations from a fractionation line are in fact quantifiable. This opens up a new analytical frontier of 'triple silicon isotopes' that can build on frameworks developed for e.g. the oxygen and sulfur isotope systems, to provide a new constraint on Si sources and processing. Elsewhere, others have suggested that instrumental mass-bias in plasma-source instruments is not mass dependent for Si isotopes [3], though subtle hydride or doubly-charged interferences may explain some of these observations. It is not clear the extent to which mass-independent instrumental mass bias and/or interferences might confound measurement and interpretation of triple silicon isotopes.

Here we present the results of preliminary experiments designed to capture a transition from kinetic to equilibrium fractionation during amorphous silica precipitation. Using educt-product (rather than standard-sample) bracketing on a Neptune HR-MC-ICP-MS, we investigate optimal measurement strategies for improved precision of triple silicon isotopes. We also present the results of tests to isolate any potential mass-independent silicon isotope fractionation during MC-ICP-MS analyses.

1. Sun et al. 2023, EPSL **607** https://doi.org/10.1016/j.epsl.2023.118069
2. Pack et al. 2023, GGG **24** https://doi.org/10.1029/2023GC011243
3. Yang et al. 2018 JAAS **33** https://doi.org/10.1039/c8ja00210j