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Pressure-dependent changes in Zr coordination in silicate liquid: in vs. ex situ measurements

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Changes in the coordination of elements in silicate melts as a function of pressure impact their geochemical behaviour and are key to understanding processes such as planetary differentiation. Questions persist as to the extent to which the coordination environment of elements in silicate melts at high pressure and temperature can be preserved in glasses recovered to ambient conditions.

The only method to unambiguously measure the coordination environment of trace elements in a silicate liquid at high pressure is via *in situ* measurements such as x-ray absorption spectroscopy, preferably in large volume apparatus that can simulate the environment of the upper mantle such as the Macquarie D-DIA apparatus. These measurements are difficult and only possible at a handful of facilities worldwide, so most experimental data are derived from *ex situ* measurements of recovered glasses.

We made Zr K-edge XANES measurements *in situ* at conditions simulating the mantle, showing a pressure-dependent change consistent with an earlier *ex situ* study on samples recovered from piston-cylinder experiments in which glasses were annealed close to their glass transition temperature (Burnham et al. 2019). We plan further XAS experiments measuring samples recovered from our *in situ* experiments to determine the differences between quenched glasses, annealed glasses, and *in situ* measurements.

We propose that changes in Zr XANES correspond to an increase in the coordination number of Zr with pressure. This could explain previously observed changes in Zr solubility at high pressure not predicted by current models, and changes in Zr olivine/melt partition coefficients at mantle pressures.

Level of Expertise

Early Career <5 Years

Presenter Gender

Man

Pronouns

Which facility did you use for your research

Australian Synchrotron

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Condition of submission

Yes

Primary author(s) : FARMER, Nicholas (Macquarie University); Prof. RUSHMER, Tracy (Macquarie University); WYKES, Jeremy (Australian Synchrotron); Dr MALLMANN, Guilherme (Australian National University)

Presenter(s) : FARMER, Nicholas (Macquarie University)

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