



Contribution ID: 70

Type: Oral

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

Wednesday, 24 November 2021 16:50 (15 minutes)

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.

Presenter Gender

Man

Do you wish to take part in the Student Poster Slam

Condition of submission

Yes

Students Only - Are you interested in AINSE student funding

Level of Expertise

Early Career <5 Years

Pronouns

Which facility did you use for your research

Australian Synchrotron

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Session Classification: Earth, Environment & Cultural Heritage

Track Classification: Earth, Environment & Cultural Heritage