THE GEODYNAMICS SEMINAR №616

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Venue: Meeting Room #486

Science Research Bldg. 1, 4th floor.
Ehime Univ.

Keywords:

1. Sub chondritic N/C and N/Ar ratios of achondrites
2. Nitrogen solubility
3. Magma ocean
4. A rapid-quenching technique for multi-anvil press

The development of a rapid-quench cell for high-pressure experiments on nitrogen solubility in mafic magmas

Carbonaceous chondrites (CCs) are thought to be the major building blocks of terrestrial planets. Previous geochemical studies have reported that achondrites, meteorites from a differentiated body, are more depleted in nitrogen than carbon and argon compared to primitive CCs (e.g., Marty et al., 2020). As a possible cause of this nitrogen depletion, the selective loss of nitrogen to the space by magma degassing during the chemical differentiation of the parent body of achondrites has been considered (e.g., Marty et al., 2020; Grewal et al., 2021). Previous experimental studies have shown that nitrogen solubility in silicate melts from andesitic to basaltic compositions is mainly controlled by pressure and oxygen fugacity (e.g., Dasgupta et al., 2022). However, the effect of silicate melt composition on the nitrogen solubility is not well understood. In particular, nitrogen solubility experiments using mafic compositions more than basalt have not yet been reported due to experimental difficulties. If nitrogen solubility in silicate melt is also controlled by melt composition, the nitrogen solubility in mafic magmas is needed to constrain the origin of sub-chondritic N/C and N/Ar ratios of achondrites. This is because the silicate part of CCs and differentiated planetesimals is more mafic compositions than basalts. To experimentally investigate nitrogen solubility in silicate melt, melt is needed to be recovered as a glass by quenching for chemical analysis, and cooling rate is critical to the synthesis of a mafic silicate glass (e.g., Kohara et al., 2011, Bonder et al., 2020).

In this study, we try to improve the rapid-quench cell for a multi-anvil press based on Bonder et al. (2020) to synthesize mafic-silicate glass in order to clarify the nitrogen solubility in mafic silicate melts. Starting material was prepared from a mixture of oxides with enstatite chondritic mantle composition (Javoy et al., 2010). 5 wt% NH4NO3 was added to the oxide mixture as a nitrogen source. High-pressure experiments were conducted at 2 GPa and 1600℃. The recovered sample shows quench crystals surrounded by quenched glass. EDS analysis shows that the composition of the glass is similar to enstatite chondritic mantle though most of iron was absorbed in the Pt capsule. In this seminar, I will summarize the result of preliminary experiments and discuss the future plan.

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