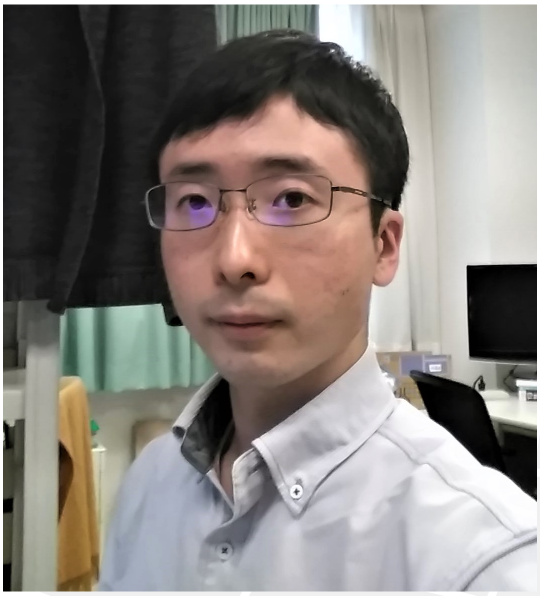
THE GEODYNAMICS SEMINAR №549



Nitrogen solubilities in the lower-mantle minerals: implications for the formation process of nitrogen reservoir in the deep Earth

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Venue: Zoom

A link will be sent @grc-all within 30 minutes before the beginning of the seminar.

Nitrogen is an important volatile element in geoscience such the origin of life and the biogeochemical cycle, but its geochemical behavior in the deep Earth remains controversial. Compared to other volatile elements, the abundance ratio of nitrogen normalized by chondrite composition in the bulk silicate Earth is one order of magnitude less (Marty et al., 2012). This constitutes the so-called "missing" nitrogen and remains an unsolved problem. One of the hypotheses explaining this "missing" nitrogen is the existence of a nitrogen reservoir in the deep Earth. To investigate the existence of nitrogen reservoir in the lower mantle, we experimentally examined how much nitrogen is incorporated into lower-mantle minerals such as bridgmanite and periclase including stishovite, using multi-anvil apparatus and secondary ion mass spectrometers. Experimental P-T conditions were 28 GPa and 1400 °C-1700 °C. A series of experimental results revealed that stishovite can incorporate more nitrogen (up to 404 ppm) than bridgmanite and periclase. Nitrogen solubilities in bridgmanite and periclase increased with increasing the FeO content. The nitrogen solubility in bridgmanite also increased with increasing temperature. We suggest that bridgmanite and ferropericlase can form a nitrogen reservoir in the lower mantle through the solidification of the magma ocean. Furthermore, the obtained results suggest that stishovite can transport nitrogen to the lower mantle via the subducting slab. This research suggests that nitrogen was supplied to the lower mantle via subduction approximately 4 billion years ago with the beginning of tectonic plate tectonics, forming a "hidden" nitrogen reservoir in the lower mantle.

Keywords:
1. "Missing" nitrogen, 2. Lower mantle, 3. Atmosphere and mantle co-evolution

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