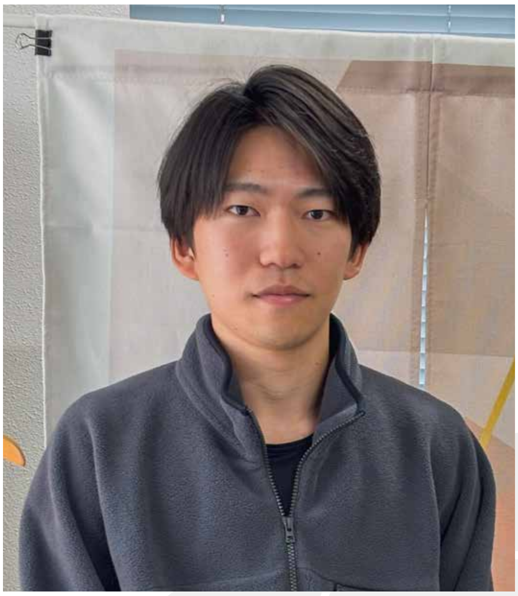
THE GEODYNAMICS SEMINAR

Nº 641



An experimental study on nitrogen solubility in oxidized planetesimal magmas

Nitrogen is a key volatile element for planetary atmospheres and life on Earth. Thus, elucidating how terrestrial planets acquired nitrogen is crucial for understanding their habitability. Although carbonaceous chondrites (CCs) have been considered important contributors of terrestrial volatiles, nitrogen in achondrites derived from differentiated bodies is much more depleted than carbon and argon. Under the oxygen fugacity of CCs (i.e., $fO_2 > \Delta IW+1$), nitrogen is stable as N_2 and is poorly soluble in magmas at surface pressures, suggesting an extensive loss of nitrogen from fully molten planetesimals composed of CCs. Therefore, to retain nitrogen in terrestrial planets, either rapid accretion faster than differentiation timescale or the late accretion of primitive CCs has been proposed.

Here we focus on a partially molten planetesimal because volatile-bearing melts may be trapped along grain boundaries at low melt fractions (i.e., ~40%). Given that partial melt compositions of CCs change with melt fraction, the effect of melt composition on N_2 solubility might be important, but remains poorly constrained. We experimentally investigated the effect of melt composition on N_2 solubility (2–5 GPa, 1500–1600 °C) and discuss the nitrogen retention capacity of partially molten planetesimals. We find N_2 solubility can be described as a function of melt ionic porosity (IP) and N_2 partial pressure. Using the newly obtained scaling law for N_2 solubility, we show that partially molten planetesimals may have retained 1–10% of their initial nitrogen. We propose that partially molten planetesimals could have been important contributors of terrestrial nitrogen.

Mr. Takuto Akimoto

Master student (M2)

Geodynamics Research Center

2025.11.14 (Fri.) 16:30 ~

Venue: Meeting Room #486

Science Research Bldg. 1, 4th floor.

Ehime Univ.

Keywords

1. Nitrogen solubility
2. Melt ionic porosity
3. Planetesimal differentiation

Contact: Steeve Gréaux, PhD. (e-mail: greaux.steeve_georgi.me@ehime-u.ac.jp)