Report for the Joint Use/Research of the Institute for Planetary Materials, Okayama University for FY2024

05/24/2025

Category: ☑International Joint Research ☐General Joint Research ☐Joint Use of Facility ☐Workshop

Name of the research project: The mineralogy of subducted mid-ocean ridge basalt in Earth's lower mantle

Principal applicant: Jung-Fu Lin

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Collaborator

Name: Takashi Yoshino

Affiliated institution and department: Institute for Planetary Materials, Okayama University

Research report:

1) Please write the research report with free format, but include followings: research purpose, actually conducted research, and research outcomes. If necessary, you can add another page.
2) For the workshop, please write the report for the workshop. Also, attach the program, abstracts, and list of the participants etc.
3) Please add Collaborator's Name, Affiliated institution and department as needed.
4) Please answer the question on the next page.

Research purpose

The primary scientific objective of the proposed research is to investigate the thermodynamic relationships between bridgmanite and davemaoite under high-pressure and high-temperature (P-T) conditions, thereby advancing our understanding of the mineralogy of subducted mid-ocean ridge basalt and the structure of Earth's lower mantle. Subducted mid-ocean ridge basalt can be transported into the lower mantle by subducting slabs and has been associated with regions of low seismic velocity heterogeneities in the lower mantle. Under these conditions, subducted mid-ocean ridge basalt is composed of bridgmanite, davemaoite, stishovite, and a calcium ferrite-type aluminous phase.

However, recent discoveries of potential mixing between bridgmanite and davemaoite, as indicated by high P-T experiments and theoretical calculations, challenge current mineralogical models. Therefore, it is critical to determine whether such mixing can occur in mid-ocean ridge basalt, the extent of such mixing, and its impact on the physical properties of the subducted basalt. Currently, data derived from crystalline samples, which can minimize kinetic effects, are lacking. Thus, experimental data from crystalline samples are needed to better evaluate the mixing properties.

Research to conduct

We have synthesized starting samples using the Kawai apparatus for diamond cell experiments at GAECARS. We eventually used online laser-heated DAC coupled with synchrotron X-ray diffraction to check the synthesized phases. Quenched samples are analyzed by HRTEM.

Research outcomes

We have used the research results to understand the solubility of Ca in bridgmanite at high P-T conditions. We have applied thermodynamics to model the research results. We found that high P-T can enhance Ca solubility in bridgmanite. We are in the process of writing research results.