

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

May 28, 2025

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

Name of the research project: Constraining the conditions and timing of high pressure metamorphism in the orogenic lower crust from western Grenville Province, Canada

Principal applicant: Wentao Cao

Affiliated institution and department: State University of New York at Fredonia, Department of Geology and Environmental Sciences.

Collaborator

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

Research report:

The project aims to constrain the conditions and timing of high-pressure metamorphism in the orogenic lower crust of western Grenville Province. Specifically, the project will provide new constraints on metamorphic pressure-temperature conditions using phase equilibrium modeling and mineral chemistry. We proposed determining the timing of high-pressure metamorphism using garnet Lu-Hf and Sm-Nd geochronology and in situ U-Pb rutile and titanite geochronology, but decided to proceed with solution based garnet geochronology due to the unavailability of the laser ablation instrument. The ultimate goal of the project is to further test the tectonic processes operating in the Proterozoic orogen, in a large hot collisional model (Rivers et al., 2008) vs. in the far-travelled allochthonous model (Gervais et al., 2023).

During my visit to the Institute, we have determined the major element geochemistry using electron microprobe and the elemental compositions of garnet fractions of three specimens. IPM faculty helped prepared the samples into sample mounts suitable for microprobe analyses. Dr. Ota and I selected suitable garnet for microprobe analyses and suitable elements for garnet analyses – the garnet grains of the samples show slight compositional zoning that is characteristic of granulite-facies metamorphism. Phase equilibrium modeling was conducted to model metamorphic pressure-temperature conditions. For the geochronological constraints, we hand-picked garnet grains, along with magnetic separation after traditional density separation. A total of 12 garnet

fractions of three specimens were analyzed using the ICP-MS, after crushing and sample digestion in the clean lab. More garnet hand-picking was conducted at SUNY Fredonia again to prepare for further isotopic analysis of garnet grains.

We plan to continue the collaboration in FY2025 to finish constraining the P-T conditions and timing of metamorphism using garnet geochronology. We will obtain more info on the chemistry of other minerals using electron microprobe and determine the isotopic composition of garnet Sm-Nd and Lu-Hf and bulk rock for age constraints, which will be integrated to evaluate the tectonic processes in the Proterozoic Grenville Province. We anticipate this project will be finished and results presented at an international conference and published as a peer-reviewed journal.