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

2023 fiscal year first call / second call / others

10/18/2023

Category: International Joint Research

Name of the research project:

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Collaborator

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Research report:

Hydrous silicate melting of the upwelling mantle is considered to be responsible for the seismic low-velocity layer detected by seismology and high electric conductivity inferred by geoelectromagnetic studies, atop the 410-km discontinuity. Such melt should be able to gravitationally segregate from the upwelling/downwelling mantle and can significantly affect the electrical conductivity at that depth. The viscosity of the melt is a key parameter to constrain melt segregation and is related to the electrical conductivity of melt through the diffusivity of ions.

During this visit, we had 3 outcomes in measuring the viscosity of hydrous silicate melt, especially the water effect. Firstly, we developed the cell assembly, especially the design to protect the diamond capsule, for viscosity measurement of the SPring-8 beamtime. Secondly, we will prepare the cell assembly parts for the SPring-8 beamtime. Thirdly, we have done 9 experiments to determine the water effect on the viscosity of 410 melt composition at SPring-8. We used the in-situ falling sphere viscometry to measure the viscosity of 410 melt with various water content. The experiments were conducted using the SPEED1500 press in the front hutch. The falling path of spheres was captured with a frame rate of 1000 f/s. During the beamtime, we first tested several experiments to adjust the assembly for measuring the viscosity of hydrous melt. After improving the cell assembly (such as the set position of sphere), we succeeded in recording the falling path of spheres. Fig.1 shows an example distance-time diagram of Run S3641. The sphere reaches terminal velocity, which was then used to calculate the viscosity of melt based on Stoke's law.

After preliminary data analysis, we obtained the viscosity of 410 melt with ~5, 10, 14 wt%

water. Fig. 2 summarizes the preliminary results. The viscosity of 410 melt decreases with increasing water content. When the water content reaches 14 wt%, the melt viscosity is ~20 mPa.s, approaching the viscosity of liquid water.

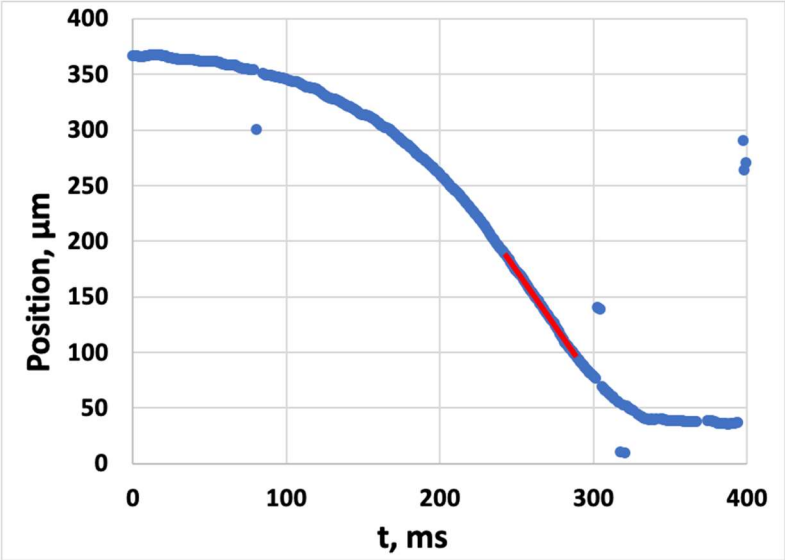

Fig. 1. an example distance-time diagram of Run S3641

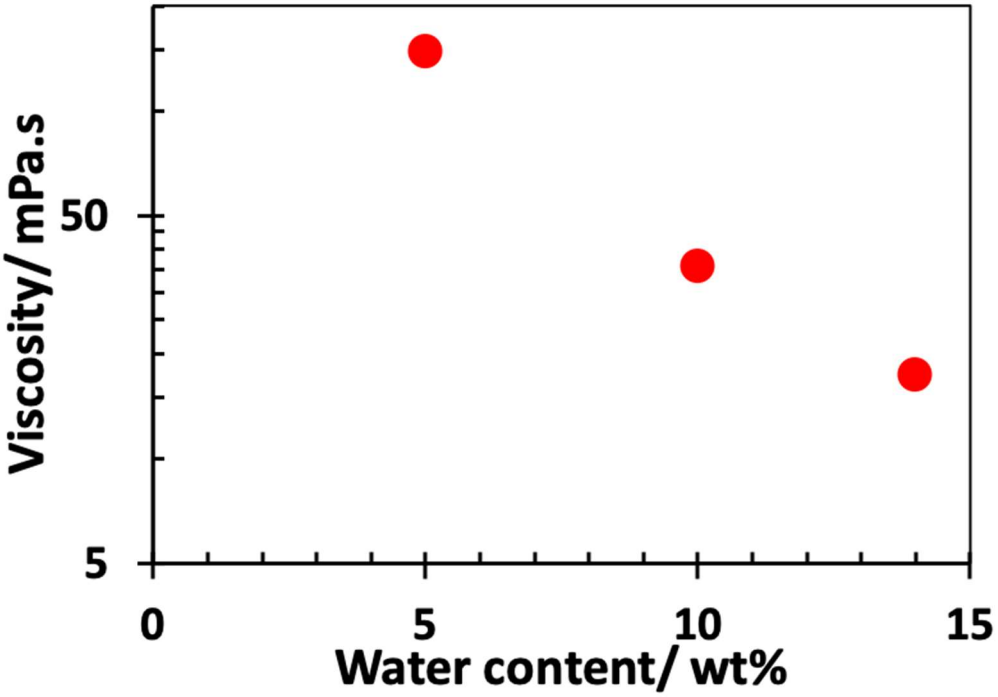

Fig. 2. Viscosity of 410 melt as a function of water content.