

Sound velocity measurements of SiO_2 - Al_2O_3 glass under high-pressure

OHIRA, Itaru^{1*}, MURAKAMI, Motohiko¹, OHTANI, Eiji¹

¹Department of Earth and Planetary Materials Science, Graduate School of Science, Tohoku University

Determination of the structure and physical properties of silicate melt under high pressure and high temperature is an important key to understand the Earth's evolution and the gravitational stability of melts in Earth's deep interior. Natural silicate melts mainly consist of SiO_2 with various chemical components. Aluminum is one of the most abundant elements in the natural silicate melts, and the Al_2O_3 contents can be as high as 12 mol.% in magmas. To understand the effect of Al_2O_3 on the compression behavior of silicate melts is therefore essentially important. There have so far been a number of experimental studies of glasses, as the analogue of melts, in the binary system of SiO_2 - Al_2O_3 with various experimental techniques. Previous experimental results obtained by NMR, IR, Raman and X-ray diffraction spectroscopies showed that SiO_2 - Al_2O_3 glasses with 0.4 to up to 12.0 wt.% Al_2O_3 contain high coordinated (5-, and 6-fold coordinated) Al sites (e.g., Sen and Yaungman, 2004, Okuno et al., 2005), which significantly affects the density of SiO_2 - Al_2O_3 glasses (Okuno et al., 2005; Linh and Hoaug, 2007). However, there are few experimental studies about the structures and physical properties of SiO_2 - Al_2O_3 glasses under high pressure toward an implication for the Earth's evolution and geophysical phenomenon in Earth's deep interior due to experimental difficulties.

To understand the effect of Al_2O_3 on the compression behavior of SiO_2 - Al_2O_3 glasses under high pressure, *in-situ* high pressure Brillouin scattering measurements of acoustic wave velocities were carried out at room temperature in a symmetric diamond anvil cell. Brillouin scattering is highly sensitive to the structural change regardless of the state of the sample (glass, liquid and crystal) and its result of silicate glasses can provide us with the information leading to the changes of structure and density in silicate melts in the temperature and pressure range corresponding to the Earth's mantle. We synthesized SiO_2 - Al_2O_3 glasses with several compositions by levitation method using CO_2 laser and performed structure analysis of them by X-ray diffraction at BL04B2, SPring-8. Brillouin scattering measurements of acoustic wave velocity were carried out up to 60 GPa.

Our results showed that the velocity-pressure curve of the sample with lower alumina contents has very similar trend to that of SiO_2 glass. In contrast, we observed the anomalous sound velocity evolution for the samples with higher alumina contents, which strongly suggests the drastic change of compression behavior of SiO_2 - Al_2O_3 glass.

In this presentation, we will present those new experimental results on the compressional behavior of SiO_2 - Al_2O_3 glasses including the results obtained by synchrotron X-ray diffraction measurements, and discuss about the possible implications for the magmas in deep Earth's interior.

Keywords: Structure of silicate glass and melt, Brillouin scattering, Acoustic wave velocity measurement