Density measurement of silicate glass and melt at high-pressures and temperatures by in-situ x-ray absorption method

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Density is important physical property to understand high-pressure behaviors of silicate glass and melt. We applied the x-ray absorption technique to measure the density of silicate glass at high-pressure using large-volume multi-anvile device combined with synchrotron radiation. We examined the density of Fe-bearing Na-disilicate glass and melt up to 5 GPa.

High-pressure x-ray absorption experiments were conducted at BL22XU in SPring-8, where the cubic-type press (SMAP180) is installed. In order to enhance the absorption contrast between silicate and surrounding materials, we used a single crystal diamond ring as a sample container and a boron-epoxy resin as a pressure-transmitting medium. Intensities of incident (I0) and transmitted (I) monochromatic x-rays were measured by ion chambers.

We can evaluate density from the x-ray absorption profile along a radial direction of a cylindrical sample using equation of $I = I0\exp(-mu.rho.t)$, where mu is mass absorption coefficient and rho is density, and t is sample thicness. We obtained the density of Fe-bearing Na-disilicate glass up to 5 GPa and 600 K to derive bulk modulus of to be 14 GPa at 300 K. Density increase associated with structural relaxation of glass was also observed with increasing temperature at 5 GPa. Recently we measured the x-ray absorption profiles of Fe-bearing Na-disilicate melt at 3 GPa and 1550K, and the results will be reported.