Viscosity of basaltic magma at high pressure

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Viscosity and density control the mobility of magma. Sakamaki et al. (2013) measured the viscosity of basaltic magma at high pressure and reported the viscosity minimum around 4 GPa. They also measured the density of magma and found a quick elevation of the density around the pressure. On the basis of the results they proposed a model of stagnation of magma around the lithosphere-asthenosphere boundary (melt pond model). However, the pressure range of their measurement was limited to 7 GPa. Reid et al. (2003) carried out viscosity measurement of diopside melt to 13 GPa and reported the viscosity maximum around 10 GPa. They suggested that the decrease in viscosity above 10 GPa was caused by the structural change of melt. Therefore, the change in viscosity is also expected in basaltic magma. Here, we report the result of viscosity measurement of basaltic magma above 10 GPa. We adopted the falling sphere method using the X-ray radiography. Experiments were carried out at the beamline BL-04B1 in SPring-8. We found the decrease in viscosity between 7 and 10 GPa. Above 10 GPa the viscosity increased to 13 GPa. On the basis of the observation of seismic wave, the existence of melt around the base of the upper mantle (e.g., Revenaugh and Sipkin, 1994). We suggest the stagnation of melt by the change in viscosity.

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