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Viscosity of CaMgSi₂O₆ liquid at high pressure revisited

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The knowledge of the viscosity of silicate melts under high pressure is of importance to understand magmatic processes in the Earth's interior. It is known that the pressure dependence of viscosity is strongly related to the structure of melt. The diopside (CaMgSi₂O₆) composition melt is characterized as a depolymerized melt, and a positive pressure dependence of viscosity has been reported. However, there is a discrepancy in a curvature in previous studies. Scarfe et al. (1979) and Brearley et al. (1986) reported three times increase from 1 atm to 1.5 GPa. In contrast, Taniguchi (1992) showed that the positive pressure dependence was half of the previous studies. The viscosity of CaMgSi₂O₆ liquid was measured by Reid, Suzuki et al. (2003) up to 13 GPa. However, the data at the low-pressure range between 3.5 and 7.0 GPa were scarce. In the present study, high-pressure viscosities of the diopside (CaMgSi₂O₆) composition melt were measured between 1 and 4 GPa. X-ray radiography technique was used to observe falling spheres in situ. We conducted experiments using the Kawai type multianvil apparatus loaded in the MAX-III press on the PF-AR NE7A station at the High Energy Acceleration Research Organization (KEK). The measured viscosities between 1 and 2 GPa were consistent with Taniguchi (1992) and inconsistent with Scarfe et al. (1979) and Brearley et al. (1986). A positive correlation to pressure was observed up to 4 GPa.

Keywords: viscosity, magma, mantle, high pressure, X-ray radiography