

Viscosity of potassium titanate melt at high pressure

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Viscosity of silicate melt is a fundamental property, which controls volcanic processes, including rates of melt extraction, ascent, and magma mixing. Titanium oxide is contained less than 10 wt% in terrestrial magmatic liquids, however, some lunar magmas contains it over 10 wt%. The addition of titanium to silicate melt affects on the properties such as viscosity, density, and compressibility. Especially the pressure dependence of viscosity is of great interest, because magma is generated in the planetary interiors. The aim of this study is to measure the viscosity of $K_2TiSi_4O_{11}$ melt at high pressures to estimate the influence of the pressure-induced structural change of melt.

We performed in situ falling sphere viscometry in the pressure range from 1.3 to 7.4 GPa, by using the MAX-III high pressure apparatus at BL14C2 and NE7A beamlines at Photon Factory in KEK, Tsukuba, Japan. A falling platinum sphere in the melt was monitored by using an X-ray CCD camera with a YAG:Ce fluorescence screen. We observed that the viscosity of KTS4 melt decreased up to 3.3 GPa. In contrast, the pressure dependence in viscosity was not observed above 3.3 GPa. Based on XANES spectra of $K_2TiSi_4O_{11}$ glasses quenched under high pressure, Paris et al. (1994) showed that the coordination number of titanium increased with increasing pressure. The present study suggests that the melt becomes depolymerized by the coordination change of titanium under high pressure.

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