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Simplified estimation of preeruptive magma viscosity for the 2011 eruption at Shinmoedake, Kirishima volcano

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Magma viscosity is one of the most important physical properties to model eruption processes, because it controls timescale of magma movement. Although preeruptive magma viscosity can be estimated from petrological analysis of erupted materials, it is time-consuming to acquire petrological data required for magma viscosity estimate (melt composition, melt water content, temperature and phenocryst content). Takeuchi (2010, JPGU) has proposed a simplified method to estimate preeruptive magma viscosity by using only melt SiO_2 and phenocryst content data. In this study, the simplified method was applied for the magma erupted in 26-27 Jan, 2011, at Shinmoedake, Kirishima volcano, Japan.

Analyzed sample was a gray, pumicious lapilli sampled on 28 Jan at 9 km SE from the Shinmoedake crater. The resin-impregnated pumice sample was polished and analyzed by electron probe micro analyzer. The porosity and phenocryst modal composition were obtained from image analysis of back scattered electron images. Elemental mapping images for Mg, Ca and Fe were used for discrimination of phenocryst phases. The analyzed area was ca. 1.0 cm x 1.1 cm with 2 micron meter in spatial resolution. Broad beam with 20 micron meter in diameter was used for obtaining melt SiO_2 content of microlite-rich groundmass. As a result, the porosity, the phenocryst and melt SiO_2 contents were ca. 64 vol%, ca. 40 vol% and 63 wt%, respectively. Applying the simplified method for this melt SiO_2 content, preeruptive melt viscosity were estimated to be ca 10^3 Pas. Preeruptive magma viscosity of phenocryst-bearing magma was estimated to be ca 10^4 Pas, based on Einstein-Roscoe equation. This characteristic of preeruptive melt and magma viscosity is similar to the magmas of Sakurajima vulucanian activity, Asama 2004 eruption, precursory eruption of Hokkaido Komagatake 1929 and Pinatubo 1991.

Keywords: Kirishima volcano, Shinmoedake, 2011 eruption, preeruptive magma viscosity