

SVC062-15

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Petrological viscosity scale for preeruptive magmas as a tool to assess magma eruptability

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Magma eruptability is an important concept in assessment for long-term volcanism at active and hazardous volcanoes. The magma eruptability is dominantly controlled by magma viscosity, because timescale of magma transport is controlled in the balance between viscous resistance of magma and driving forces. Magma viscosity at chamber conditions can be estimated by the petrological analysis of erupted materials. There are, however, a few petrological viscosity estimates, because petrological precise data required for magma viscosity estimate (melt composition, melt water content, temperature and phenocryst content) are not easy to be acquired. In order to develop a simple method to approximate preeruptive magma viscosity, petrological data satisfying data requirement for viscosity estimate were compiled from previous studies of hydrothermal experiments simulating chamber conditions, and the correlations among petrological data under phase equilibrium conditions and preeruptive magma viscosity were examined. Melt SiO₂ contents show a good linear correlation with melt viscosities. Based on this correlation, an empirical equation to approximate melt viscosity at chamber conditions can be obtained as a function of melt SiO₂ content. Another empirical equation to approximate melt SiO₂ content can be also obtained as a function of bulk SiO₂ and phenocryst contents from the experimental data. This approximation is useful to estimate melt SiO₂ content because melt SiO₂ content (SiO₂ content of total groundmass) is not always easy to be analyzed due to complicated groundmass texture. Using the above two approximations, we can estimate magma viscosity at chamber conditions based only on bulk SiO₂ and phenocryst contents. Bulk SiO₂ content, which is often used as a qualitative measure of preeruptive magma viscosity, is not well correlated with magma viscosity (Takeuchi, 2009, Fall Meeting, VSJ). Alternatively, the new approximation based on bulk SiO₂ and phenocryst contents is a quantitative measure to estimate preeruptive magma viscosity. Although this method is rough approximation of magma viscosity, it has great applicability for a large numbers of magmas erupted in past activities to evaluate long-term eruptive patterns of volcanoes from the standpoint of magma eruptability.

Keywords: magma viscosity, eruptability, magma chamber, volcanic rock, petrological analysis