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Unusually high-temperature andesitic magma erupted shortly before the Aso-2 pyroclastic flow from Aso caldera, Japan

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Aso Volcano, which is located in central Kyushu, southwestern Japan, is one of the largest caldera volcanoes in the world. The caldera (25 km north-south and 18 km east-west) was formed by four large pyroclastic flow eruptions: Aso-1 (270 ka), Aso-2 (14 ka), Aso-3 (12 ka) and Aso-4 (89 ka). Each pyroclastic flow deposit is divided into several flow units. In particular, the stratigraphy of Aso-2 eruption deposit is very complicated and the chemical compositions remarkably vary between subunits in the eruption cycle. Andesitic lava flows were generated shortly before the main Aso-2 eruption. Tamaraigawa lava distributed east of Aso caldera and Iwato, Akita and Togawa lavas distributed west. These lavas are nearly aphyric and display textural characteristics similar to pahoehoe lava flows.

Lava compositions, temperatures and viscosities have been investigated. All lavas are phenocryst-poor, consist of two pyroxene andesite and have 61 wt.% SiO2 except for Togawa lava (58 wt.% SiO2; Matsumoto, 1974). The magma temperatures were estimated using the two-pyroxene thermometer of Anderson et al. (1983). Five to seven coexisting pairs of pyroxenes were analyzed for each lava. The calculated magma temperatures are 1123+/-23 oC (Tamaraigawa lava), 1081+/-17 oC (Iwato lava), 1061+/-18 oC (Akita lava) and 1045+/-24 oC (Togawa lavas). We calculated the melt viscosity of the Tamaraigawa lava at 1123 oC (two-pyroxene temperature) using the model of Giordano et al. (2008). The results show that the Tamaraigawa lava has a viscosity lower than 10^4.5 Pa s (dry case). Dissolution with water further decreases the melt viscosity to 10^2.7 Pa s at 2 wt.% H2O.

In general, andesitic magmas have eruption temperatures of 900?1000 oC and viscosities around 10^8~9 Pa s. The andesitic lavas in this study, therefore, had unusually high temperature and low viscosity conditions similar to basaltic lavas. The data are consistent with the textural characteristics of pahoehoe lava flow.

Keywords: Aso caldera, presursory event, high-temperature andesitic magma, paahoehoe lava