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Relationship between mode of eruption and plagioclase in the basaltic eruption products of Fuji volcano

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In this work, we analyzed some of the textural features of basaltic eruption products of Fuji volcano to identify the key processes determining the mode of eruptions. Fuji volcano mostly consists of mildly evolved basalt, although its mode of eruption varies from explosive sub-Plinian type to effusive lava flow emplacement. Previous studies suggested that degassing of magmas during ascent mainly determines the mode of eruptions. Jaupart and Allegre(1991) suggested that variation of initial ascent rate of magmas eventually bifurcates the ascent rate by vesiculation and degassing at shallow depth, whereas Woods and Koyaguchi(1994) presented a model that accounts for the two numerical solutions for explosive and effusive eruptions caused by the variation of mass eruption rate. Degassing of water from magmas raises the liquidus temperature of the magma, thus causing degassing-induced crystallization. Because Ca/(Ca+Na) ratio of plagioclase is strongly affected by water content of magmas, we examined the zoning profiles of plagioclase in the basaltic ejecta of Fuji volcano to find water content of magmas where plagioclase crystallized. We examined the effusive samples of the Aokigahara, Kennomarubi, Takamarubi, Hinokimarubi, Kansuyama lava flows and explosive Hoei, Yufune-2, Zunazawa, S-18, S-12, and explosive to effusive eruption products of Omuroyama parasitic cone. The core composition of plagioclase in explosive eruption products generally have high Ca/(Ca+Na) ratio (0.80-0.92), whereas those in effusive eruption products tends to have lower Ca/(Ca+Na) ratio of 0.6-0.75 in Aokigahara and Kenmarubi lava flows, and of 0.75-0.88 in Takamarubi and Hinokimarubi lava flows. Previous experimental studies suggest that equilibrium liquidus plagioclase have high Ca/(Ca+Na) ratio at high water contents, and the core composition of plagioclase suggests that effusive magmas tends to have lower water contents just before the eruption compared with the explosive magmas. It is suggested that magma chamber of Fuji volcano is located at ca. 15km depth, and magma is halted at some depth (1-5km) before eruption where some degassing may induce crystallization of phenocrysts, and successive intrusion/mixing of magmas may eventually cause the final outbreak of vent to form either explosive or effusive eruptions depending on the water contents of magma, mostly determined by the depth of the magma pocket.

Keywords: Fuji volcano, mode of eruption, plagioclase composition, water content of magmas, degassing of magmas