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Mechanism of foam collapse near the surface: implications for the Vulcanian eruptions

Shizuka Otsuki[1*], Michihiko Nakamura[1]

[1]Dept. Earth Sci., Tohoku Univ.

In the eruption phase of vigorous Vulcanian explosions, lava domes or driblets repeatedly appear in the volcanic crater. It is believed that dense lavas are formed via compaction of melt foam, namely, density contrast between gas and melt matrix causes densification of permeable foam. However, the mechanism of lava formation is still unclear. The permeability of the lavas overlying the melt foam should decrease quickly enough to accumulate magma pressure in the conduit that is required from both geophysical observations and modeling of Vulcanian explosions. In this presentation, we propose that surface tension-driven foam collapse may produce dense andesitic lavas in addition to the compaction driven by gravity.

We have carried out heating experiments of andesitic pumices in the air and evacuated silica glass tubes with NNO buffer. We used the pumice clasts of the 1914 (Taisho) eruption of Sakurajima volcano. Its water content in the groundmass glass is ca. 0.5 wt%. The experimental temperature ranges from 400 to 1000 deg. C, and the run duration from 0.5 to 8 hours. With increasing run duration at 1000 deg. C, the vesicularity decreased in both atmospheric and evacuated runs. At 400 deg. C, however, no significant densification was observed. Since there was no excess confining pressure or shear strain, the only possible force to have caused the densification of melt foam is surface tension of the melt. The textural observations of the bubbles and cavities support this idea. The time scale of compaction and its relation to the interval of Vulcanian explosions will be discussed.