

Magmatic aggregate of basaltic ash particles

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Dynamics of volcanic cloud and jet at the vent is largely controlled by a grain size of pyroclast. The grain size is considered to be determined by primary fragmentation of magma, and subsequent breakup of pyroclasts due to their collisions in upper conduit (Dufek et al. 2012). However, whether the breakup occurs or not depends on viscoelastic response of magma (Dingwell and Webb, 1989).

In this study, we report aggregate of ash particles which is formed in magmatic temperature. We observed basaltic ash samples from Stromboli volcano, Italy, and Aso volcano, Japan. The “magmatic aggregate” shows texture that numerous small guest particles ($< 200 \mu\text{m}$) adhere or stick on a host particle ($> 1 \text{ mm}$). All the host particles are categorized to sideromelane having fluidal morphology. The guest particles are on fluidal surface of the host particle, and show fluidal and dense morphology. These characteristics found in the magmatic aggregate can be explained by collision and agglomeration of ash particles in high temperature condition. Here we model formation of the magmatic aggregates as passing of two frying particles bearing viscoelastic nature, by using viscosity of magma estimated (10^4 - 10^5 Pa s). When the relative velocity of the two particles falls the critical value, the two particles behave as viscous material, coalesce each other, and then form the magmatic aggregate. The result of calculation demonstrates that the critical relative velocity is approximately 10^{-2} m/s , and implies the magmatic aggregation is difficult to occur for silicic magma with highly viscosity. Thus we conclude that the collision can increase average grain size of pyroclast in basaltic system.

Keywords: Eruptive dynamics, Interaction of ash particles, Viscoelastic response of magma