

Controlling mechanism of air shock intensity in vulcanian eruptions at Sakurajima volcano, Japan

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BL-Swarms is the phenomenon of numerous BL-type earthquakes occurring within a few days, prior to an explosive event. In vulcanian eruptions of Sakurajima volcano, textural characteristics of volcanic ash are correlated with air shock intensity. S-particle (volcanic glassy particles which bear gloss and smooth surface) is divided into V-type particles (those including vesicles) and NV-type particles (those without vesicles). The number ratio of NV-type particles to V-type particles (the N/V number ratio) has a negative correlation with amplitude of air shock. Vesicularity of V-type particle also increases with the amplitude of air shock for eruption with BL-Swarms. These facts indicate that when the amount of gas phase in shallow conduit is large, the amplitude of air shock becomes high in an explosion with BL-Swarms. In order to explain such correlations we propose a controlling mechanism of air shock intensity in vulcanian eruptions with BL-Swarms at Sakurajima volcano on the basis of the shock tube model on vapor-liquid two phases. Assuming no relative motion between gas and liquid, the front velocity of the gas and ash mixtures is written as follows:

$$v = (nRT)^{1/2} \ln(p_i/p_{us})$$

where n is the mass fraction of gas phase, R is the gas constant, T is the temperature, p_i is the initial pressure and p_{us} is the pressure in the upper reaches of shock wave. Large mass fraction of gas phase makes expansion rate and front velocity higher. High eject velocity may generate large pressurization of adjacent air, and high amplitude of air shock. Therefore, large amount of gas phase in shallow conduit results in large air shock intensity. This model can successfully explain the correlation between volcanic ash texture and air shock intensity. Vulcanian eruptions are often modeled as shock tube problem (e.g. Turcotte et al., 1990), but the validity of the model has not been confirmed by evidences from volcanic product. The relation among N/V number ratio, vesicularity of V-type particle and the amplitude of air shock may be possible evidence showing that a vulcanian eruption (with BL-Swarms) resembles the situation of shock tube experiments.