Melt fragmentation Process of Multiphase Flow; Deformation of liquid and determining factor of size distribution of melt fragments

Munetoshi Sakai[1], Takumi Kato[2], Kozo Kobayashi[3], Hidenori Terasaki[4]

[1] Ins. of geoscience, Tsukuba Univ, [2] Inst. Geoscience, Univ. Tsukuba, [3] School of Medicine, Univ of Tsukuba, [4] Geosci., Univ. of Tsukuba

Introduction:

Magma fragments is generated by the interaction between the volcanic gas, which had high pressure within vent, and magma in an explosive volcanic eruption. It is thought that a grain size distribution of a magma fragmentation is controlled by the physical properties of magma and generation conditions; volcanic gas pressure, form of vent and contact style. Sakai and Kato (1998) conducted the experiment of melt fragmentation in the air, and reported that viscosity had influenced the grain size distribution of the melt fragmentation. However, there were the following three problems by the experiment method. First, since it was a fragmentation experiment of a simple drop, difficulty was in comparison with the magma fragmentation process in vent. And, since the pressure change range in the experiment of drop fragmentation was narrow, relation between grain size and gas pressure was not able to be considered. Finally, the flux of the gas in contact with drop was immeasurable. In order to reflect vent form, the pressure and flux of volcanic gas which is the generation conditions of the magma fragmentation, the analog experimenting method for having taken into consideration for vent form, the gas pressure and flux at the time of melt fragmentation is reported.

The experiment method:

In order to observe multiphase flow of the magma and volcanic gas in vent there is the experiment method 1. And the experiment method 2 to explore the factor which determines grain size distribution is reported.

The experiment method 1; multiphase flow observation in room temperature.

Sucrose solution, which is Sucrose content 100%-60% for the solubility of 25 degrees C, was put into the glass pipe ,12mm of diameters of inner. N2 gas was sent in from bottom or the side by the pressure from 0.01MPa s to 0.5MPa s, and the flux from 1 L/min to 20 L/min, and multiphase flow was generated. At this time, a sample part is recorded on videotape with a digital camera, and a rate of a bond was measured from the picture analysis of multiphase flow. The destructive intensity of bubbles was calculated, because the amplitude and the pitch of vibration by bubble burst were measured by AE sensor.

Experiment method 2; hot melt experiment.

The sample, NaCl, was put to the alumina pipe, the diameter 8 mm, 10 mm and 12mm of inner, in an electric furnace, and it heated to 850 degrees C. After sample dissolution, N2 gas was sent from bottom or the side of an alumina pipe by the pressure from 0.01MPa s to 0.5MPa s, and the flux from 1 L/min to 20 L/min, multiphase flow was generated immediately, and was fragmented. The sudden cold of melt fragments was carried out in air, and they fell in the container around the alumina pipe. Picture analysis of the solid sample was performed, and the diameter of a particle was measured.

Result:

The experiment method 1. The multiphase flow occurred from bottom of glass pipe. The continuous phase is liquid, and the feature was similar in the style of slag.The experiment method 2. The sample was crushed by N2 gas enclosed in the alumina pipe. The function system of the cumulative grain size distribution becomes exponential. That is, let x be the diameter of an experimental fragments by letting N into cumulative number.

$$N(x) = A \exp(B x)$$

It is set to (1). However, both A more than 0 and B lower than 0 are constants, B expresses the degree of attenuation of N (x) and it is shown that a spread of the size of a particle is so large that it is close to 0.