The melt-deformation for the difference from Reynolds number.

Munetoshi Sakai[1]; Mie Ichihara[2]; Takumi Kato[3]; Kozo Kobayashi[4]; takuma hayakawa[5]

[1] Ins. of geoscience, Tsukuba Univ; [2] ERI, U. Tokyo; [3] Kyushu Univ.; [4] School of Medicine, Univ of Tsukuba; [5] Life&Environmental Sci,Tsukuba Univ

1. Introduction

During explosive volcanic eruptions, the volcanic ashes are generated by the interaction of multi-phase flow of magma with high-pressure volcanic gas. The particle size distribution is controlled by vent configuration, volcanic gas pressure and physical properties of the magma. In order to understand the physical condition of a volcanic eruption it is necessary to know the mechanism for the melt fragmentation and its relevance to the size distribution of the volcanic ash. An analogous experiment using the melted sample was performed to investigate the effect of melt viscosity, gas pressure, flow rate and vent configuration on the particle size distribution. For the sake of simplification, we assumed that the magma fragmental process happened only according to the external factor by gas phase, and fragmented the fluid experiment to which it can be similar in the pressure of the gas at the time of crush, and form change of flux control and vent. The spread of size distribution has a quantitative relation to the Reynolds number. However, the ranges of test section diameter and dynamic viscosity were narrow, because the experiment system under high temperature environment restricted them. In room temperature environment, it is easy to vary the dynamic viscosity and the test section diameter. In order to clarify the relationship between a liquid phase deformation and Reynolds number, the experiments, which concentrated to the observation of the liquid deformation process by the gas phase, are reported.

2. Experimental setup and procedure

Water and silicon oil were used as test samples, and the dynamic viscosity was known. Test section of an acrylic pipe had aspheric surface and inside diameter, R, 25 mm. The another acrylic pipes, inner diameter, R, 16 mm or 8 mm, are inserted to the acrylic pipe with aspheric surface to change the inside diameter of test section. Test sample of water or silicon oil was set into the test section with the height of 3, 7 or 11 cm. N_2 gas with flow rate 25 to 40 L/min and gas pressure of 0.2 MPa is added to test section. The deformation was observed by high-speed camera, 2000 fl/s.

3. Experimental conditions and main characteristics of multiphase flow

When one experimental condition was varied and other three experiment conditions were fixed, the following features were observed.

Flow velocity: The plume as an annular flow grew up more effectively, when the flow velocity was larger.

Dynamic viscosity: Jet was generated in the initial stage of injecting N_2 gas, when the dynamic viscosity was high.

Inner diameter: The situation of inhomogeneous multiphase tended to occur as the inner diameter got larger.

Inlet diameter: The gas phase and the liquid phase became more inhomogeneous, when the ratio of inner diameter and inlet diameter was larger. The plume elevation was dependent on the inlet diameter r, too.

4. Reynolds number and the gas-phase elevation

The melt deformation is controlled by dynamic viscosity, flow velocity, inner radius and inlet radius. The deformation process was classified into three categories, i.e., the plume elevation, the plume elevation with inhomogeneous stage, and the inhomogeneous multiphase flow. The threshold to elevate plume is understood, when the Reynolds number is calculated. It is easy to elevate plume, because Reynolds number is large.