Magma volume budget of the 1986 Izu-Oshima summit eruption

*Shin'ya Onizawa[1]

1. Volcanology Research Department, Meteorological Research Institute, JMA

Introduction

Mismatches between DRE volume of erupted lava and deflation volume of magma chamber inferred by ground deformation data are widely recognized. Such mismatch of the volume budget is recognized for the 1986 Izu-Oshima summit eruption. One possible reason for the mismatch is due to magma compressibility. Further, from the estimation of the compressibility, there is a possibility to extract information about physical properties and gas content in a magma chamber of Izu-Oshima volcano.

Extrusive and deflation volumes of 1986 summit eruption

Temporal sequence and a total DRE volume of extruded lava of the 1986 summit eruption were reported by e.g. Endo et al. (1988). The estimated total amount of lava is $1.4*10^7$ m^3. Further, ground deformation suggesting subsurface deflation by volumetric strain and tilt meters, as to synchronize with the lava extrusion. Yamaoka inferred the deflation source parameters to be 5 km-depth and deflation volume of $5*10^6$ m^3 by introducing a spherical pressure source. Based on these researches, volume ratio of erupted material to deflation becomes about 2.7.

Magma effective properties

Magma is composed of solid (crystal), liquid (melt) and gas phases. Therefore, to calculate effective properties such as density and bulk modulus, it is needed to be known properties and fraction of each phase. As for solid phase, Fujii et al. (1988) and Nakano et al. (1988) reported that phenocryst content is 5- 10 wt. % and most of phenocrysts are plagioclase for the 1986 summit eruption. Melt compositions are measured for plagioclase-hosted melt inclusions of the 1986 summit eruption by Hamada et al. (2007). Dissolved H_2O contents are 0.2 –1.4 wt.%. Bulk modulus is calculated to be about 16 GPa by using the measured composition and equation of state for melt (e.g., Spera, 2015). Bulk modulus of gas phase equals to pressure as long that ideal gas is to be assumed. For lithostatic pressure at the depth of 5 km inferred by Yamaoka (1994), the bulk modulus of gas becomes to be about 0.13 GPa. Finally, large uncertainty of fractions for liquid and gas phases remains to predict the bulk properties of magma.

Volume ratio

Volume ratio between erupted material and deflation depends on a shape of the deflation source, and on a ratio between rigidity of host rock and magma bulk modulus. If we assume a spherical magma at the depth of 5 km and adopt 30 GPa of host rock rigidity, the ratio exceeds 3 even for gas-free magma, and it is difficult to explain the ratio of 2.7 based on observation. In order to discuss the volume ratio and further to estimate the gas content, we will reexamine source parameters and the rigidity of the host medium.

Keywords: Izu-Oshima volcano, ground deformation, physical properties of magma

