

論文の内容の要旨

論文題目 Understanding Oscillation Phenomena Induced by Non-linear Magma Rheology
(非線形マグマレオロジーに起因する波動現象のメカニズム探究)

氏名 黒川 愛香

Movement of magmatic fluid has been widely recognized as a key process to induce volcanic tremor and long-period (LP) event. Since these magma-driven oscillation phenomena often precede eruptions, they have drawn wide attentions in terms of prediction of volcanic eruption. Their models proposed until now mainly describe interactions between magma flowing and elasticity of volcanic system and/or bubbles on the assumption that magma flows in a simple way. However, magma in itself has complex non-linear rheology, which can cause self-induced oscillation related to rheological multiplicity.

For that reason, this study aimed to explore possible link between magma-driven volcanic oscillations and non-linear magma rheology. In order to achieve the goal, two approaches were adopted. One is experimental study to understand underlying physics of flow instabilities in non-linear fluids, which have the rheological multiplicity. The other is analysis of volcanic tremors and LP events.

First, two fluctuation phenomena, which are pressure perturbation in the pipe flow and persistent stress fluctuation coupled to the local dynamics, were substantiated in the experiments. Although different mechanisms were proposed by linking to rheological properties, the important factor to generate the both phenomena is the multiplicity caused by aging. This common point suggests a relation between non-linear magma rheology and volcanic oscillation phenomena.

As another approach, analysis of volcanic tremors and LP events accompanied by the 1986 Izu-Oshima eruption was also performed for the purpose of understanding actual phenomena. The results demonstrated the apparent relation between temporal variations in eruption style and characteristics of LP events and tremors in terms of the waveform and the source location. Especially the temporal variation in volcanic oscillations below the summit is interpreted as indication of rheological change in magma inside the conduit with time.

Based on the results by the two approaches, finally a possible link between non-linear magma rheology caused by the change in crystal alignment and temporal shift in magma-driven volcanic oscillations at Izu-Oshima volcano was discussed. Although the proposed mechanism is an interpretation at the present stage, this study proposes the importance of aging in order to understand volcanic oscillation phenomena caused by non-linear magma rheology.