Numerical simulation of volcanic tremor excitation by instability of two-phase flow

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Seismic waves which are distinct from those excited by fault rupture are often observed around active volcanos. These seismic waves are called volcanic tremor and are considered to be excited by physicochemical phenomena associated with magma and water-steam mixture. Volcanic tremors are often observed as precursors of eruption activities.

It is important not only for the prediction of volcanic eruptions but also for the understanding of volcano dynamics to reveal the mechanism of volcanic tremors. Many models of volcanic tremors have been advocated until now, and most of them deal with elastic resonance phenomena of cracks containing fluid, or of magma chambers. However, there are features which cannot be explained in the frame work of the existing models for the observed volcanic tremors.

It is widely known in the fields of nuclear reactor engineering and fluid engineering that pipe flows of gas-liquid two phases with heat supply cause flow instability. Flow instability are phenomena in which flow velocities and densities oscillate in time even if the amount of inflow is fixed. On the other hand at active volcanos, water and steam are usually emitted from fumaroles. Therefore, it is anticipated that the two-phase instability flow arises in the volcanic edifice.

The flow instability has seldom been considered as a source of volcanic tremor. In this study, we model volcanic tremor by numerical simulating flow instability, and compare the results with the volcanic tremors currently observed at the Aso volcano, Kyushu, Japan.