Experimental Study on Rayleigh-Taylor Instability of a Viscous Fluid Containing Granular material

Hiroki Michioka[1], Ikuro Sumita[2], Atsuko Namiki[3]

[1] Natural Sci & Tec., Kanazawa Univ, [2] Earth Sci., Kanazawa Univ., [3] Dept. Earth Sci., Kanawasa Univ.

Rayleigh-Taylor instability (R-T instability) of viscous fluids has been studied extensively, both theoretically and experimentally. However, R-T instability of a viscous fluid including granular materials has been hardly studied.An experimental study of such a system was carried out by Voltz et al. (2000,2001). However, their experiments were done using a low viscous fluid or granular materials of low packing fraction, and a detailed parameter dependence was not studied.The purpose of this study is to investigate the behavior of R-T instability of a viscous fluids containing granular materials with high packing fraction (about 0.6) from laboratory experiments, and to clarify their parameter dependence.

The parameter dependence of the R-T instability was studied by changing the viscosity of the glycerine solution and the grain size of the glass beads, analyzing the video images.We then compared the experimental result with the results of linear stability analysis of a viscous fluid with large viscosity contrast. The experimental results show that the growth rate of the plume is inversely proportional to the viscosity of the glycerine solution and proportional to the grain size.This dependence agree with the results of linear stability analysis of two viscous fluids, if we scale the effective thickness of the layer of the glass beads as several grain size, and the viscosity of the layer of glass beads as several hundred times that of the layer of glycerine solution.

We finally applied the experimentally derived scaling law to magma chamber.