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Stokes–DEM 法によるマグマだまりの粒子–流体混相シミュレーション
Stokes–DEM coupled simulation for a granular media of magma chamber

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The dynamics of a granular media has been suggested to play an important role in a reheated magma chamber by a hot intrusion (e.g. Burgisser and Bergantz, 2011). Although several mechanisms, such as Rayleigh Taylor instability, unzipping, and rhythmic convection (e.g. Shibano et.al. 2012, 2013) have been proposed for characterizing an evolution of crystalline magma chamber, their contributions in the long geodynamical time scale are not clear yet. Thus we performed dynamical numerical simulations of the granular material in three dimensions to investigate the thermal evolution of the magma chamber.

In order to solve high-viscosity fluid and particle dynamics for modelling a melt–crystal jammed state of the magma, we have developed a coupled Stokes–DEM simulation code with two key techniques: formulation of particle motion without inertia and semi-implicit treatment of particle motion in the fluid equation (Furuichi and Nishiura, G-cubed, 2014). Our simulation can successfully handle sinking particles in a high-viscosity fluid.

In our simulation, the top fluid–particle jammed layer is heated by the hot basal fluid at the bottom. This initial setting represents the first-stage toy model for an erosion process at a melting roof of the magma chamber. We have investigated the dynamical patterns of the settling particles which strongly depend on the rheology of the granular layer. In addition, we have also examined the dynamical role of the density of the basal hot melt. Our numerical result indicates the possibility of the spontaneous formulation of crystal rich layer on the basal dense melt layer.

Keywords: Magma chamber, Viscous granular material, Magmatic dyamics, Reactivation, Discrete element method, Stokes flow