高粘度混相流コードの開発：マグマダイナミクスシミュレーションにむけて
Development of coupled Stokes–DEM simulation scheme for geodynamical magmatic studies

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For geodynamical magmatic studies such as crystal settling at the melting roof of a magma chamber, we develop a robust and efficient simulation scheme for solving high-viscosity fluid and particle dynamics in a coupled computational fluid dynamics and discrete element method (CFD–DEM) framework. The high-viscosity fluid is treated by the Stokes-flow approximation, where the fluid interacts with particles via the drag force in a cell-averaged manner. The particles are tracked with contact forces by DEM. To efficiently solve such Stokes–DEM coupled equations, we propose two key techniques. One is formulation of particle motion without the inertial term, allowing a larger time step at higher viscosities. The other is a semi-implicit treatment of the cell-averaged particle velocity in the fluid equation to stabilize the calculation. We will explain some details of our model developments in the presentation. A series of numerical experiments shows that our proposed scheme can handle sinking particles in a high-viscosity fluid; such problems are difficult for the conventional CFD–DEM method. Then we will discuss our targeting geodynamical problems tackled with this simulation method.

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