

Validity test of three-dimensional simulation scheme by coiling of Stokes flow: toward plate-mantle simulation

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Reproducing a realistic plate tectonics with mantle convection simulation is one of the great challenges in computational geophysics. We have been developed a three dimensional Eulerian numerical procedure toward plate-mantle simulation, which solve a finite deformation of the plate in the mantle convection. Our method, combined with CIP-CSLR (conservative semi-Lagrangian advection scheme of constrained interpolation profile method with rational function) and ACuTE Method, enables us to solve advection and force balance equations even with a large and sharp viscosity jump, which plate and upper mantle boundary have.

One of the typical phenomena represented by our three dimensional simulation is a fluid rope coiling event, which sometimes occurs when a thin stream of viscous fluid is poured onto the bottom plane from a certain fall height.

In this presentation, we would like to show the coiling rope of a Stokes flow reproduced by two different methods: a three dimensional simulation and simplified quasilinear one dimensional solution. A comparison of enables us to estimate how accurate the simulation scheme is for large non-linear deformation problems toward the plate-mantle simulation.