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3D Numerical modelling of crustal polydiapirs

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Multiwavelength Rayleigh-Taylor instabilities in a hot orogenic crust may generate polydiapirs. One or various partially molten layers, less dense, rise(s) through denser colder overburden by gravity instabilities. The present contribution expands on the work by Weinberg and Schmeling (1992) who investigated variations in density and viscosity stratification in a three layers system, and observed various modes of diapiric ascent: single, imbricated or multi-wavelength. Employing the finite volume method (FVM) and the volume of fluid (VOF) method, we present results of computational fluid dynamics (CFD) simulations for two parallel programs (one open-source, OpenFOAM, and one from IMFT called JADIM) in 2D and in 3D. We investigate the ascent mode of buoyant diapirs initiating from various initial conditions. Results from our numerical simulations are in reasonable agreement with the 2D results of Weinberg and Schmeling, who tested density differences ranging from 400 to 700 $kg.m^{-3}$ and viscosity ratios ranging from 1 to 200. Using the Boussinesq approximation, we also provide 3D simulations of a two layers system heated from below. In this case, the lower layer is initially denser and quiescent and the density inversion is thermally driven (Rayleigh-Benard instability). We obtained results analogous to the 3D laboratory experiments by Davaille and co-authors. We draw new conclusions for 3D modelling of a three layers system dedicated to partially molten hot orogenic roots, and display preliminary comparisons with a field example.