Numerical modeling of two-phase flow in geodynamics : State of the art, benchmark and perspectives

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The dynamics of two-phase (or two-component) media is a well-studied field with numerous natural applications to solid earth physics. Some important geophysical problems falling within the scope of the two-phase (or multi-phase) approach are for example : Magma segregation and dynamics, Earth's Core formation, tectonic plate generation, water transport at subduction zone, etc.

For some years, in addition to the commonly used set of equations derived by McKenzie [1], a new theoretical formulation [2] is available to describe two-phase flow mixtures. In parallel, improvements of computers efficiency have made numerical solving of such a complex system more and more tractable. The combination of these two facts result ed in the existence of a large number of numerical codes not only using different numerical techniques to solve for the equations governing two-phase flow dynamics but also solving for different sets of governing equations.

For the sake of clarity, a benchmark of available codes has been launched. We have designed a set of 1-D and 2-D experiments that allowed to compare the efficiency (computer time) and accuracy of the numerical schemes and the possibilities offered by the different theoretical approaches. These experiments have been chosen to be general enough to permit the comparison of codes initially build to deal with very a large range of settings.

Among all two-phase geodynamical systems, the percolation of geophysical fluids at subduction zone is particularly complicated to model. This complexity comes from the richness and variety of processes taking place in subducting factories (melting, dehydration, diapirism, dykes, phase transition, dip angle, trench migration, etc.) and incidentally suggests paths to follow. A review of principal numerical approaches will be presented with special emphasis on the field constrains required by geodynamicists in their quest towards the big picture of subduction zones.

References

[1] McKenzie D. (1984) *J. Petrol.*, **25** 713-765.
[2] Bercovici et al. (2001) *J. Geophys. Res.*, **106(B5)** 8887-8906.