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# 2D numerical modelling of fluid percolation in the subduction zone

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Subducting slab dehydration and resulting aqueous fluid percolation triggers partial melting in the mantle wedge and is accompanied with the further melt percolation through the porous space to the region above the slab. This problem is a complex coupled chemical, thermal and mechanical process responsible for the magmatic arcs formation and change of the mantle wedge properties.
We have created a two-dimensional model of a two-phase flow in a porous media solving a coupled Darcy-Stokes system of equations for two incompressible media for the case of nonlinear visco-plastic rheology of solid matrix. Our system of equation is expanded for the high-porosity limits and stabilized for the case of high porosity contrasts. We use a finite-difference method with fully staggered grid in a combination with marker-in-cell technique for advection of fluid and solid phase.
We performed a comparison with a benchmark of a thermal convection in a porous media in a bottom-heated box to verify the interdependency of Rayleigh and Nusselt numbers with earlier obtained ones (Cherkaoui & Wilcock, 1999). We have demonstrated the stability and robustness of the algorithm in case of strongly non-linear visco-plastic rheology of solid including cases with localization of both deformation and porous flow along spontaneously forming shear bands. We have checked our model for the forming of localized porous channels under a simple shear stress (Katz et al, 2006).
We have developed a setup of a self-initiating due to gravitational instability subduction. With our coupled fluid-solid flow we have achieved a self-consistent water downward suction by a slab bending predicted by the other models with a simplified fluid kinematical motion implementation (Faccenda et al, 2009).
With this setup we have obtained a self-consistent upper crust weakening by a porous fluid pressure which was theoretically assumed in the previously existing subduction models (Gerya & Meilick, 2011; Faccenda et al, 2009; Crameri & Kaus, 2010). This fact proves the opinion of many researches that subduction is getting lubricated by a porous flow.
Currently we are performing the parameter space investigation and elaboration on how fluid pressure affects decoupling between the slab and overriding plate.
Further work will include implementation of processes of melting (pressure, temperature and water content dependant (Katz, 2003)) and serpentinization.
Ultimate goal is to create a next generation of subduction models which would be self-initiated and lubricated by a presence of the porous fluid, with a self-consistent melt generation and transport above the slabs including fluid/melt focussing phenomena.