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Thermo-mechanical numerical modeling of subduction processes

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Numerical simulation is a powerful tool to gain insight on the subduction process. In this work we employ multi-phase finite element modeling to study the geometry, kinematics and the mechanical behavior of subduction zones in some special cases: slab breakoff, subduction of overthickened oceanic crust, changes in the subduction velocity, etc. Using a 2-D upper-mantle model 660-km deep and 3000-km wide, we have investigated, with an extended finite-element method (X-FEM) and a Level Set technique to track the interfaces, the evolution of thermo-mechanical phenomena related to these complex geological processes.

We test the effect of newtonian and non-newtonian mantle rheology. Experimentally determined flow laws have both, strong non-linear temperature- and stress-dependence, which leads to large local variations in viscosity with direct consequences on the ridge subduction process. The model accounts for density and thermal conductivity variation, both depending on pressure and temperature.