Geophysical Research Abstracts
Vol. 18, EGU2016-17076, 2016
EGU General Assembly 2016

Thermo-mechanically coupled deformation with the finite difference method

Thibault Duretz, Ludovic Raess, Yury Podladchikov, and Stefan Schmalholz
Switzerland (thibault.duretz@unil.ch)

Numerous geological observations are the result of thermo-mechanical processes. In particular, tectonic processes such as ductile shear localization can be induced by the intrinsic coupling that exists between deformation, energy and rheology. In order to study these processes, we have designed two-dimensional implicit and explicit finite difference models. These models take into account a temperature-dependent power-law rheology as well as diffusion, advection, and conversion of mechanical work into heat. For implicit models, different non-linear solving strategies were implemented (implicit/explicit thermo-mechanical coupling, Picard/Newton linearisations). We model thermo-mechanically activated shear localization in lower crustal conditions using these different numerical methods. We show that all methods capture the thermo-mechanical instability and exhibit similar temporal evolution. We perform quantitative comparisons with specifically designed tests (conservation of energy, analytical solution, scaling law). For implicit approaches, we discuss the treatment of thermo-mechanical coupling (implicit/explicit) and the impact of the imposed accuracy (tolerance) of the non-linear solvers. We compare the accuracy of the explicit method with the one of the implicit methods. Numerical algorithms based on explicit methods to study thermo-mechanical shear localisation are attractive because they are easy to program and very comprehensible.