Geophysical Research Abstracts
Vol. 13, EGU2011-10761, 2011
EGU General Assembly 2011

Coupled petrological-thermomechanical modelling of lithospheric processes: methodology and examples

Taras Gerya and James Connolly
Swiss Federal Institute of Technology, Department of earth Science, Zurich, Switzerland (taras.gerya@erdw.ethz.ch, +41 1 632 10 80)

Large-scale geodynamic processes inherently involve complex phase transformations in deforming rocks. These phase transformations strongly affect physical properties of geological materials and thus should be taken into account in thermomechanical geodynamic calculations. We developed a coupled petrological-thermomechanical modeling approach to account for the dynamical effects of phase transformations (including melting and melt extraction) on various geodynamic processes. We included density changes due to phase transitions and melt extraction in both the continuity and the momentum equations, and latent heat of mineral reactions and adiabatic and shear heating in the energy conservation equation. The continuity equation is solved in Lagrangian form with substantive time derivative of density computed from moving active markers. The model rheology is visco-(elasto)-plastic and dependent on pressure, temperature, stresses and strain rate as well as chemical and mineralogical composition. The petrological model covers both crustal rocks and the entire mantle down to core-mantle boundary and is derived by free energy minimization together with estimates for the thermodynamic properties of crustal and mantle minerals. We applied a well-tested marker-in-cell method and conservative finite-differences to solve governing equations in 2-D and 3-D. Discussed applications include intraoceanic and oceanic-continental subduction with growing magmatic arcs, collision with spontaneous slab breakoff, intrusion emplacement into the crust and mid-ocean ridge processes.