Shear heating and subduction initiation

Marcel Thielmann and Boris J. P. Kaus
ETH Zurich, Switzerland (marcel.thielmann@erdw.ethz.ch)

Despite it's importance in geodynamics, the processes that result in subduction initiation remain incompletely understood. Shear heating has been put forward as a mechanism to create lithospheric-scale shear zones (e.g. Ogawa 1987, Regenauer-Lieb et al. 2001). A scaling analysis highlighted the governing parameters that control shear localization (Kaus and Podladchikov 2006), and showed that the boundary between localization and no localization is quite sharp. Recently, this scaling analysis was extended to include more realistic lithospheric rheologies and structures and it could be demonstrated that shear-heating induced lithospheric scale localization might occur for Earth-like parameters (Crameri and Kaus, submitted). It however is unclear if all lithospheric-scale shear zones evolve into self-sustaining subduction zones. Here, we therefore use viscoelastoplastic 2D geodynamical numerical simulations to investigate under which conditions lithospheric failure results in the formation of an evolved subduction zone. The results are compared with analytical scaling laws for shear localization in the lithosphere.