EGU21-2268, updated on 21 May 2022
https://doi.org/10.5194/egusphere-egu21-2268
EGU General Assembly 2021

Self-weakening feedbacks in the ductile lithospheric mantle: looking for a realistic mantle rheology enabling plate boundary formation

Fanny Garel[1], Catherine Thoraval[1], Andrea Tommasi[1], Sylvie Demouchy[1], and D. Rhodri Davies[2]
[1]Montpellier, Géosciences Montpellier, Montpellier, France (fanny.garel@gm.univ-montp2.fr)
[2]Research School of Earth Science, Australian National University, Canberra, Australia

Deformed plate boundaries, rigid lithospheric plates, and the more deformable asthenospheric mantle underneath, are for the most part made of homogeneous peridotite, which most abundant mineral is olivine. The key ingredient explaining such contrasted mechanical properties is the rheology, with deformation mechanisms depend on physical conditions and on intrinsic, possibly inherited, material properties such as grain size or crystal orientation. Here, we investigate plate break-up using thermo-mechanical models of subduction with a deforming upper plate. Our models feature cutting-edge low-temperature dislocation creep ensuring a continuity in rheology from asthenosphere to lithosphere. We discuss the dynamical transition from lithosphere to asthenosphere at the base of the plates, and how this transitions shallows during plate extension. The potential of deformation to localize from the base of the lithospheric plate is evaluated through the partitioning between diffusion and dislocation creep and its evolution resulting from a feedback related to strain-rate dependent viscosity. We analyze the evolution of physical fields to understand why deformation sometimes (but not always) localize to form a new plate boundary.