Geophysical Research Abstracts
Vol. 19, EGU2017-10072, 2017
EGU General Assembly 2017
© Author(s) 2017. CC Attribution 3.0 License.

Impact of grain size evolution on necking and pinch-and-swell formation in calcite layers

Stefan Markus Schmalholz and Thibault Duretz
University of Lausanne, Institut de sciences de la Terre, Lausanne, Switzerland (stefan.schmalholz@unil.ch)

The formation of necking zones and the associated formation of pinch-and-swell structure is one form of strain localization in extending, competent layers. Natural pinch-and-swell structure in centimetre-thick calcite layers typically shows a reduction of grain size from swell towards pinch. However, the impact of grain size evolution on necking and pinch-and-swell formation is incompletely understood. We perform zero-dimensional (0D) and 2D thermo-mechanical numerical simulations to quantify the impact of grain size evolution on necking for extension rates between $10^{-12}s^{-1}$ and $10^{-14}s^{-1}$ and temperatures around $350\,^{\circ}$C. For a combination of diffusion and dislocation creep we calculate grain size evolution according to the paleowattmeter (grain size is proportional to mechanical work rate) or the paleopiezometer (grain size is proportional to stress). Numerical results fit two observations: (i) grain size reduction from swells towards pinches, and (ii) dislocation creep dominated deformation in swells and significant contribution of diffusion creep in pinches. Modelled grain size in pinches (10 to 60 μm) and swells (70 to 800 μm) is close to observed grain size in pinches (15 to 27 μm) and in swells (250 to 1500 μm). Grain size evolution has only a minor impact on necking suggesting that grain size evolution is a consequence, and not the cause of necking. Viscous shear heating and grain size evolution had a negligible thermal impact in the simulations.