Geophysical Research Abstracts
Vol. 19, EGU2017-9414, 2017
EGU General Assembly 2017

Aseismic creep along the North Anatolian Fault quantified by coupling microstructural strain and chemical analyses

Maor Kaduri (1,2), Jean-Pierre Gratier (1,2), François Renard (1,2,3), Ziyadin Çakir (4), Cécile Lasserre (1,2)

(1) ISTerre, Univ. Grenoble Alpes, CS 40700, 38058 Grenoble cedex 9, France (maorkaduri@gmail.com), (2) ISTerre, CNRS, CS 40700, 38058 Grenoble cedex 9, France, (3) Department of Geosciences, Physics of Geological Processes, University of Oslo, box 1048, 0316 Blindern, Oslo, Norway, (4) Istanbul Technical University, Department of Geology, Istanbul, Turkey

In the last decade aseismic creep has been noted as one of the key processes along tectonic plate boundaries. It contributes to the energy budget during the seismic cycle, delaying or triggering the occurrence of large earthquakes. Several major continental active faults show spatial alternation of creeping and locked segments. A great challenge is to understand which parameters control the transition from seismic to aseismic deformation in fault zones, such as the lithology, the degree of deformation from damage rocks to gouge, and the stress driven fault architecture transformations at all scales.

The present study focuses on the North Anatolian Fault (Turkey) and characterizes the mechanisms responsible for the partition between seismic and aseismic deformation. Strain values were calculated using various methods, e.g. Fry, R-ϕs from microstructural measurements in gouge and damage samples collected on more than 30 outcrops along the fault. Maps of mineral composition were reconstructed from microprobe measurements of gouge and damage rock microstructure, in order to calculate the relative mass changes due to stress driven processes during deformation. Strain values were extracted, in addition to the geometrical properties of grain orientation and size distribution. Our data cover subsamples in the damage zones that were protected from deformation and are reminiscent of the host rock microstructure and composition, and subsamples that were highly deformed and recorded both seismic and aseismic deformations. Increase of strain value is linked to the evolution of the orientation of the grains from random to sheared sub-parallel and may be related to various parameters: (1) relative mass transfer increase with increasing strain indicating how stress driven mass transfer processes control aseismic creep evolution with time; (2) measured strain is strongly related with the initial lithology and with the evolution of mineral composition: monomineralic rocks are stronger (less deformed) than polymineralic ones; (3) strain measurements allow to evaluate the cumulated geological displacement accommodated by aseismic creep and the relative ratio between seismic and aseismic displacement for each section of an active fault. These relations allow to quantify more accurately the aseismic creep processes and their evolution with time along the North Anatolian Fault which are controlled by a superposition of two kinds of mechanisms: (1) stress driven mass transfer (pressure solution and metamorphism) that control local and regional mass transfer and associated rheology evolution and (2) grain boundary sliding along weak mineral interfaces (initially weak minerals or more often transformed by deformation-related reactions).