Geophysical Research Abstracts
Vol. 19, EGU2017-14152, 2017
EGU General Assembly 2017

Mohr-Coulomb envelopes of fault strength under creep conditions: insights from relaxation experiments on many rock types

Telemaco Tesei
Istituto Nazionale di Geofisica e Vulcanologia, Italy (telemaco.tesei@ingv.it)

The empirical Mohr-Coulomb criterion is the simplest description of fault strength under brittle conditions. The criterion has been developed to describe the strength of intact rocks and tectonites using classical experiments with imposed strain rates. The strength of a fault rock under imposed strain rate conditions is a good proxy of the faults resistance during accelerated motion (e.g. earthquake nucleation, slow slip, afterslip) and it is strongly dependent from the internal fabric, mineral composition and the presence of interstitial fluids. However, fault strength during long geological times is poorly constrained by laboratory experiments because deformation is controlled by slow processes such as pressure-solution and subcritical crack growth. Here I present friction experiments, carried out in a biaxial apparatus, in which experimental fault gouges are allowed to relax the stress after an initial phase of externally imposed slip (slide-hold tests). When imposed slip is halted, the experimental faults creep and relax part of the stress in the loading frame. Shear stress measured during relaxation, is interpreted to indicate the maximum strength of the experimental fault (and of the given microstructure) under imposed stress conditions.
Shear stress after relaxation is linearly proportional with imposed normal stress, defining a Mohr-Coulomb envelope for the creep strength of the experimental faults. Creep fault strength is systematically 6-10% lower than strength under imposed strain rate, for a wide variety of materials, from granite, to calcite to phyllosilicate-rich natural fault gouges. The creep strength could represent the threshold between faulting by slow, long term processes and the onset of dynamic instability.