Geophysical Research Abstracts
Vol. 21, EGU2019-13143, 2019
EGU General Assembly 2019

Fault reactivation during pore pressure oscillations

Corentin Noël, François Passelègue, Lucas Pimienta, and Marie Violay
EPFL, IIC, LEMR, Lausanne, Switzerland (corentin.noel@epfl.ch)

An increase in pore pressure decreases the effective normal stress acting on the fault, facilitating its reactivation. In nature, pore pressure is prone to vary cyclically in space and time (e.g. oceanic tides, seasonal hydrology, cyclic fluid injections in reservoirs), which could cause hydraulic fatigue on the onset of fault reactivation. While recent studies showed that cyclic fluid perturbations seem to trigger less seismicity compared to monotonic injections, only few experimental studies aimed at understanding the influence of pore pressure oscillations on hydraulic fatigue and on the onset of fault reactivation.
To investigate these issues, we performed triaxial laboratory experiments on Fontainebleau sandstone. Samples were saw-cut at 30° from the maximal principal stress and the fault surfaces were polished with sand paper to impose a constant roughness. All experiments were conducted at 30 MPa confining pressure, with an initial pore pressure of 10 MPa. We first determined the shear stress leading to the onset of fault slip. Subsequently, the load was decreased and kept constant at a slightly lower value. The system was then solicited by sinusoidal pore pressure oscillations of varying amplitudes (from 1 to 20 MPa) and periods (from 100 to 5000 s). During deformation, both fault mechanical results and acoustic emission (AE) signals were monitored to investigate the physics underlying the role of fluid pressure oscillations, i.e. the role of hydraulic fatigue, on the onset of fault reactivation and associated micro-seismicity. Our preliminary results show that: (1) large slip events occur at the first oscillation when the pore pressure allows fault reactivation; (2) increasing the amplitude of the pore pressure oscillations leads to larger mainshocks and subsequent aftershocks activity; (3) if amplitude of pore pressure is larger than 15 MPa, this acoustic activity is influenced by oscillations. Our first investigations suggest that pore pressure oscillations do not induce mechanical fatigue on the onset of fault reactivation.