Geophysical Research Abstracts
Vol. 19, EGU2017-15220, 2017
EGU General Assembly 2017

Effects of in-situ stress variations along faults on fluid induced seismicity

Federico Ciardo and Brice Lecampion

Geo Energy Laboratory – Gaznat Chair on Geo-Energy, École Polytechnique Fédérale de Lausanne (EPFL), Station 18, CH-1015 Lausanne (federico.ciardo@epfl.ch & brice.lecampion@epfl.ch)

Several observations of seismicity (events with magnitude larger than 3) associated with fluid injection (hydraulic fracturing) have revealed that the seismic source is located deeper than the depth of the injection interval.
In this contribution, we develop a model for the injection of fluid into a fault accounting for the variation of initial stresses and pore-pressure with depth along the fault – as well as the injection induced fluid pressure changes. Our aim is to investigate the effect of both stress variations and fault rupture properties on the nucleation and arrest of fluid induced dynamic rupture. We model the fault failure using a frictional weakening Mohr-Coulomb model which allows to capture the transition between quasi-static re-activation and the nucleation of a dynamic rupture. Such a transition intimately depends on the initial state of stresses and the residual fault properties. We develop a numerical solver based on a boundary element method and a finite volume scheme which are strongly coupled to jointly solve for deformation of the elastic medium, the fault rupture and fluid flow along the fault.

After demonstrating the efficiency of our numerical solver via comparisons against a reference solutions, we investigate the effect of different cases of stress and pore-pressure variations on the nucleation of dynamic rupture: from simple linear variation with depth to more complex stress and pore-pressure profiles. The spatial heterogeneities of fault frictional properties will also be tentatively investigated.