Geophysical Research Abstracts
Vol. 19, EGU2017-14463, 2017
EGU General Assembly 2017

Hydrofracturing, fluid pressure gradients and channel drainage

Daniel Koehn (1) and Renaud Toussaint (2)

(1) Glasgow, Geographical and Earth Sciences, Glasgow, United Kingdom (daniel.koehn@glasgow.ac.uk), (2) CNRS, Géophysique Expérimentale, IPGS-EOST, France

Build up of fluid overpressure and the development of fluid pressure gradients leads to hydrofracturing in the Earth's crust. We illustrate the complexity of the developing effective stress and fracture patterns with a hybrid numerical model linking pressure gradients to solid deformation. In the model fluid pressure rise below a seal leads to a decrease of the mean and differential stress of the solid. In a closed system where fluid pressure rise below a seal is not local, the main principle stresses flip with the effective horizontal stress becoming zero and the effective vertical stress tensile leading to horizontal hydrofractures. Such a system leads to the development of a hydraulic breccia if initially local high fluid pressure pulses produce vertical fractures. We argue that fluid pressure gradients have to be taken into account to understand effective stresses in the Earth's crust. Depending on the boundary conditions a reservoir with fluid overpressure is drained vertically or horizontally. At the moment when draining channels develop the surrounding solid matrix is slightly compressed. This can be seen as the selection of a compaction wavelength in the system. The channels are dynamic but prefer a given wavelength. We show that effective stresses react anisotropic to overpressure, that overpressure leads to fracture orientation flip and that dynamic opening and closing channels drain the system.