Geophysical Research Abstracts
Vol. 20, EGU2018-8568, 2018
EGU General Assembly 2018

Induced seismicity in geo-energies

Victor Vilarrasa (1,2), Jesus Carrera (1,2), Sebastia Olivella (3), Jonny Rutqvist (4), and Lyesse Laloui (5)

(1) Institute of Environmental Assessment and Water Research, Spanish National Research Council (IDAEA-CSIC), Barcelona, Spain (victor.vilarrasa@idaea.csic.es), (2) Associated Unit: Hydrogeology Group (UPC-CSIC), Barcelona, Spain, (3) Dept. of Civil and Environmental Engineering, Technical University of Catalonia (UPC-BarcelonaTech), Barcelona, Spain, (4) Energy Geosciences Division, Lawrence Berkeley National Laboratory, CA, USA, (5) Laboratory of Soil Mechanics, École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland

Geo-energies, such as geothermal energy, geologic carbon storage or a combination of both, imply fluid injection/extraction that causes changes in the effective stress field, inducing (micro)seismicity. If felt, seismicity has a negative effect on public perception and may jeopardize wellbore stability and damage infrastructure. Thus, induced earthquakes should be minimized to successfully deploy geo-energies. However, the processes that trigger induced seismicity are not fully understood, which turns in a limited forecast ability of current predictive models. We aim at understanding the triggering mechanisms of induced seismicity and to develop methodologies to minimize its occurrence through dimensional and numerical analysis. We find that the properties of the injected fluid, e.g., water or CO_2, have a significant effect on pressure buildup evolution and thus, on fracture/fault stability. In addition to pressure changes, the injected fluid usually reaches the injection formation at a lower temperature than that of the rock, inducing rock contraction, thermal stress reduction and stress redistribution around the cooled region. The changes in fracture/fault stability are controlled by the initial stress state, i.e. normal faulting, strike-slip or reverse faulting stress regime. The presence of low-permeable faults crossing the injection formation induce local stress changes around them that may reduce their stability and eventually cause fault reactivation. To minimize the risk of inducing felt seismicity, we have developed characterization techniques to reduce the uncertainty on rock properties and subsurface heterogeneity both for the screening of injection sites and for the operation of projects. Overall, we contend that felt induced seismicity can be minimized provided that a proper site characterization, monitoring and pressure management are performed.