Geophysical Research Abstracts
Vol. 20, EGU2018-8897, 2018
EGU General Assembly 2018

Geomechanical response of shale to geo-energies applications

Victor Vilarrasa (1,2), Roman Makhnenho (3), and Jonny Rutqvist (4)

(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) Department of Civil & Environmental Engineering, University of Illinois at Urbana-Champaign, USA, (4) Energy Geosciences Division, Lawrence Berkeley National Laboratory, CA, USA

Geo-energy applications such as geologic carbon storage, nuclear waste storage, and geothermal energy, imply pressure and temperature changes that induce rock deformation. In these applications, shales often serve as barriers to avoid or limit fluid and waste migration. As a result, maintaining the sealing capacity of shales is crucial for the success of geo-energy applications. We focus on the thermo-hydro-mechanical coupled processes that shales may undergo during these applications. We use, as representative of shale, the properties of Opalinus clay, a Jurassic shale from Mont Terri underground rock laboratory, which we have measured in the laboratory at conditions corresponding to 1 km depth. We first fully saturate the rock specimens with in-situ brine. Poromechanical parameters are measured in drained, undrained, and unjacketed compression experiments for both intact rock and remolded specimens. Remolded shale is representative of sheared material that may be found in faults. We find that the permeability of remolded shale is only one order of magnitude higher than that of the intact rock and that its entry pressure is 4 MPa, which represents a reduction by a factor of two with respect to intact rock. To assess the implications of these changes in shale properties on the safety of geologic carbon storage, we model CO_2 injection into a deep saline aquifer bounded by a low-permeability fault. We assume that the fault core is a clay rich geomaterial and that the damage zone in the sections of the fault that are in contact with the caprock and baserock have the properties of remolded shale. We find that the low-permeability of the fault limits fluid flow across and along the fault and causes additional reservoir pressurization. This higher pressure buildup does not compromise caprock integrity, but induces stress changes around the fault that may eventually lead to fault reactivation. Yet, the high entry pressure and low-permeability of sheared shale would prevent upward CO_2 migration along the fault if CO_2 reached a reactivated fault.