Geophysical Research Abstracts
Vol. 13, EGU2011-8103, 2011
EGU General Assembly 2011

Hydromechanical Characterization Test for CO2 Sequestration in Deep Saline Aquifers

Victor Vilarrasa (1,2), Sebastia Olivella (2), Jesus Carrera (1,3)

(1) GHS, Institute of Environmental Assessment and Water Research (IDAEA), CSIC, Jordi Girona 18-26, 08034 Barcelona, Spain (victor.vilarrasa@upc.edu), (2) GHS, Dept Geotechnical Engineering and Geosciences, Universitat Politecnica de Catalunya, UPC-BarcelonaTech, Jordi Girona 1-3, 08034 Barcelona, Spain, (3) Energy City Foundation (CIUDEN), Spanish Government, CO2 Geological Storage Programme, Avenida de Compostilla 2, Ponferrada 24400, Spain

The large amounts of CO2 that will be injected in deep saline aquifers as a supercritical fluid can dramatically increase fluid pressure around the injection zone. This reduces the effective stresses and increases shear stresses and consequently the rock undergoes deformations. The fluid pressure evolution and the deformation patterns are dependent on the hydraulic and mechanical properties of the reservoir and the caprock. Hydraulic and mechanical properties can be determined from core samples in the laboratory. However, the resulting values are not representative at the field scale. We propose a hydromechanical test for site characterization that consists of injecting water at high pressure while measuring pressure and deformation evolution at different points of the caprock and reservoir, both in the injection well and observation wells. While the hydraulic properties can be determined from the interpretation of pumping tests, the mechanical properties of the aquifer and caprock can be determined from the pressure and displacement measurements. A dimensional analysis of this hydromechanical problem gives three dimensionless numbers that govern the hydromechanical behaviour. Two dimensionless numbers depend on the mechanical properties of the rock. The other one depends on the geometry and can be set equal to one, reducing the number of dimensionless numbers to two. We plot the dimensionless pressure and vertical displacement as a function of the two dimensionless numbers. We can then estimate the values of the Young's modulus and the Poisson ratio of the aquifer and the caprock by introducing the field measurements in these plots. Furthermore, the capability of the caprock of supporting high injection pressures can be evaluated by progressively increasing the injection pressure and monitoring microseismicity. The maximum sustainable injection pressure coincides with the onset of microseismicity. The time evolution of microseismicity can give information on the permeability anisotropy, fault reactivation and plastic strain propagation. However, it is recommendable to avoid large number of microseismicity events in order to keep the caprock integrity and prevent the formation of preferential paths towards the ground surface for future CO2 injection.