Geophysical Research Abstracts
Vol. 13, EGU2011-4979, 2011
EGU General Assembly 2011

Experimental investigation of coupled processes affecting caprock seal integrity for CO2 sequestration

Katriona Edlmann, Christopher McDermott, and Stuart Haszeldine
United Kingdom (kedlmann@staffmail.ed.ac.uk)

Geological storage of CO2 in deep aquifers or depleted oil/gas reservoirs is considered a solution for reducing excess CO2 currently being emitted to the atmosphere. Low permeability caprocks trap the CO2 that is stored in the underlying porous reservoir or aquifer rock. Although the caprock acts as a seal, its lower boundary is in contact with CO2 saturated fluids. The thermo-hydro-mechanical and chemical (THMC) interactions between the CO2, pore fluid and caprock will alter the integrity of the caprock. Possible leakage of CO2 through the development of fluid flow pathways in the cap rock induced either by mechanical effects associated with pressure build up or by chemical interactions between the CO2, pore fluid brine and cap rock minerals during CO2 injection and storage must be understood and quantified.

Experimental studies into the CO2-brine-rock interactions induced by CO2 injection are limited due to the aggressive brine/CO2 mixtures, the "elusive" nature of supercritical CO2 and the complex pressure and temperature requirements. The aim of the experiments undertaken at Edinburgh University are to recreate the in-situ reservoir and fluid pressures, temperatures, fluid concentrations with multi-phase supercritical CO2 brine fluid flow on representative caprock analogues. To this end a flow-through pressure cell has been designed and built to allow multi-phase fluid flow of supercritical CO2 and brine through intact and fractured caprock samples (60mm long and 38mm diameter) at in-situ conditions of temperatures up to 80oC and pressures up to 690MPa. Caprock samples are obtained from analogous sites both within the UK and USA.

During fluid flow differential pressure is measured and fluid samples taken for detailed chemical analysis. Rock samples pre- and post- CO2 flow are investigated using a full suite of analysis techniques including; SEM, XRD, X-Ray CT, XRF and the ion microscope.

Results we present to date demonstrate that preferential flow paths may develop due to chemical, mechanical thermal and flow coupling in the caprock. Particularly we highlight mineral dissolution / alteration, micro fracture creation and existing fracture reactivation.