Geophysical Research Abstracts
Vol. 13, EGU2011-11822, 2011
EGU General Assembly 2011

The influence of carbon-dioxide on the strength and stability of CO_2-sequestration reservoir fault zones

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Rising levels of CO_2 in the Earth's atmosphere appear to be to be resulting in a greenhouse effect that is causing the global mean temperature to rise beyond what it would be without anthropogenic forcing. Human emissions of CO_2 to the atmosphere have been increasing since the beginning of the industrial revolution, drastically so beginning in the late 1940's, and continuing to rise today. Since 1940 worldwide carbon emissions have increased from about 1.3-billion tonnes per year to the present levels in excess of 8-billion tonnes per year, leading to an increase of atmospheric CO_2 concentration of approximately 30

Of the many methods of mitigating human induced impact on the global climate, including increased use of nuclear, wind, geothermal, and hydrogen based energy sources; electric and more fuel efficient vehicles; reforestation; and improved agricultural techniques, one of the most immediately practical solutions is Carbon Capture and Storage (CCS). CCS involves the capture of CO_2 at large point sources, such as ammonia and cement manufacturing plants and coal burning power plants, followed by injection and storage in depleted oil and gas reservoirs and/or deep saline aquifers.

The risks associated with CO_2 sequestration lead to a great deal of concern on the part of the public-at-large, which must be mitigated if CCS projects are to become a truly acceptable solution to human influence on the Earth's climate. The basic concerns of the public with regard to CCS are "Will the CO_2 stay where we put it?" and "What dangers are associated with putting it down there?" We aim to address the latter of these concerns, specifically in regards to measuring the frictional strength and stability of caprock derived fault gouge and the influence of long term CO_2 reaction on these same properties, as many potential reservoirs are bounded laterally by relatively impermeable fault zones. It has long been understood that changing the state of stress in a reservoir by altering the pore pressure through extraction or injection of fluids (oil, water, CO_2, etc.) can result in reactivation of fault zones in the reservoir and caprock, potentially resulting in earthquakes. In the case of CO_2 sequestration, not only is the changing fluid pressure of the reservoir an important factor in the reactivation of fault zones, but also the potential for long term alteration of the strength and stability of the bounding and interior faults. By conducting direct shear experimental analyses at reservoir temperature and pressure conditions (35 MPa and 115 °C) we seek to answer the following questions: What are the frictional strength and stability properties of fault gouge in a real world potential sequestration reservoir? What mineralogical changes will long term reaction with supercritical CO_2 impart upon caprock fault gouge? Will these changes alter the strength and stability of fault zones in the sequestration area?