Geophysical Research Abstracts, Vol. 9, 06824, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-06824

Effect of CO2 injection on compaction of carbonate rocks

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Carbon dioxide sequestration in depleted oil/gas reservoirs and saline aquifers is one of the most promising long-term carbon dioxide management strategies. Possible reservoir formations include limestones, chalks and carbonate- cemented sandstones. To evaluate possible CO_2 escape scenarios, and to model the long-term behavior of such reservoirs, data concerning the response of carbonate rocks to carbon dioxide introduction are needed. In addition to minor direct dissolution effects, recent modelling work has suggested that CO_2 injection into carbonates enhances compaction creep by 7 orders of magnitude, due to acidification of the pore fluid. In our tests, compaction was systematically investigated under controlled conditions similar to typical reservoir condition.Uniaxial compaction experiments were conducted on dry and wet calcite samples of various grain sizes (1, 1-20, 20-40, 28-37, 37-50, 50-75 μm) at temperatures between 25- 150º C, applied effective stress of 4-50 MPa, and 5-10 MPa CO_2 pressures.

The result of the experiments showed that compaction of calcite in presence of water is dependent on: grain size, applied stress and pH of the solution. The strain rates are linearly increasing with the increase of grain size; furthermore an increase in the applied stress led to an increase of the strain rates. Injection of CO_2 into the system determined an increase of the strain rates up to 3 orders of magnitude in comparison with CO_2free cases. The results suggest that a combined effect of dissolution and microcracking may provide an explanation for the dependence of strain rates on the grain size and on the applied stress. Further experiments will be employed to determine the effect of impurities (Mg, Mn, Fe) on the compaction rates of calcite in presence of CO2.Future numerical models should take into account the effect of these parameters

to estimate the effect of carbon dioxide storage into carbonate reservoirs.