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Simulation of geomechanical effects of CO2 injection in fractured reservoir

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Saline aquifers are good alternates for geological storage of CO2, a promising way to reduce the concentration of the greenhouse gas in the atmosphere. CO2 can be directly injected in aquifer at high pressure; the injection rate is determined according to the porosity and permeability of the injection zone at those high pressures. The injection of CO2 in saline aquifers can have a significant impact on the geochemistry and the geo-mechanics of the reservoirs. In this paper, the geological storage of CO2 in saline aquifers is studied. A 2D hydro-chemical mechanical model is created which is composed of aquifer and cap rock with fractures. A reactive transport reservoir simulator RetrasoCodeBright (RCB) has been used to simulate the storage of CO2 in this model. An advantage of this code compared to other codes is the implicit geo-mechanical module, which allows simulating deformation, heat transport and fluid flow in multiphase flow along with reactive transport. The geological consequences of CO2 injection and migration within the reservoir are specially studied through stress changes in the reservoir.

Gas phase flow and liquid phase flow are investigated to study how fluid flow is affected by injection and how gas migrates from injection point to surrounding. Gas phase flow through fractures is specially studied, because fractures accelerate gas migration towards upward direction which helps CO2 to escape storage site aquifer in shorter time period. Understanding of fractures role in breakthrough of CO2 out from aquifer has significant importance in this study.

Changes in pH within the reservoir are also investigated in order to identify areas where CO2 accumulation is higher. In particular we focus on the more detailed coupled reasons behind higher or lower dissolution of CO2 in different areas of reservoir. Due to CO2 injection, minerals will dissociate in regions with low pH or precipitate in regions with high pH, which imply changes on the stability of the reservoir due to probable changes in porosity and permeability. These changes have largest impact around the CO2 injection area where changes are significant and they have direct impact both on injection rate and on stability of reservoir at injection point.