Aim of the project

The main aim of the project is to predict optimal parameters such as pressure and volume flow during injection of CO_2 into saline aquifers. In aquifers brine occupies pore spaces in rock. Injected CO_2 displaces brine. In the result the whole system works like a big tank. In naïve model increasing pressure of injected a CO_2 will result in a higher CO_2 flow. As a result we are able to store more CO_2 in shorter time. However, higher pressure can lead to salt precipitation. Small salt crystals work like plugs which clog pores in rock and reduce or even prevent gas flow. Moreover, increase of a pressure in our "tank" can have a negative impact on souring rock resulting in leakage or damage. Since this processes is not easily reversible we have to predict under what conditions this precipitation will occur and what impact rock have this injection. In order to do this we have to study interaction of CO_2 and brine with various types of rocks under wide range of pressures, temperatures. Another task is to analyze mixing/equilibrium of CO_2 and brine and observe their flow through microchannels.

Scope of research

Since this kind of studies are can be not possible to perform directly underground we have to reproduce reservoir conditions in a laboratory. Since studies aquifers are at great depth rocks are under high pressure. For a strength measurements we use press which can determine deformations of a rock sample under various types of loads. Experiments are performed for samples obtained from wells. In the nest step analysis is repeated for samples treated with brine and gas under high pressure. Then results for both approaches are compared. This shows possible change of geomechanical and geophysical properties.

Flow dynamic is studies with the use of miniature system which pumps CO_2 and brine through rock sample. The sample can be heated or treated with a high pressure. The flow can be observed by microscope and composition analyzer. This gives us information under which conditions microcannels can be plug. In which regions salt crystals stats to precipice and how this influence the flow.

Motivation

The idea of the studies came from a problem of CO_2 storage. Several methods and types of geological structures are suitable for a gas storage. Saline aquifers are widespread often they are placed close to CO_2 main sources which can make the whole sequestration process easier cheaper. However, behavior of injected CO_2 and its impact on this kind of structures is not well known.

Expected effects

The main effects is understating a salt precipitation process under high pressure in rock formations. This can lead to building new, accurate thermodynamic models which can be later used in prediction optimization of CO_2/brine/rock interaction. Another effect is construction new state-of-the-art equipment which can simulate reservoir conditions and measure thermodynamic and geomechanic quantities governing this interaction.