Introduction to CO_2 Storage

Carbon dioxide storage in subsurface geologic formations is one option to reduce significant levels of CO_2 emitted to the atmosphere. Fundamental science and engineering principles indicate that such systems should be feasible and safe: the energy cost of preparing CO_2 for injection can be as low as a few percent of the heating value of the original fuel; and the very existence of oil and gas reservoirs is proof that buoyant fluids can be contained in the subsurface for millions of years. Carbon dioxide has been injected safely into subsurface reservoirs for many years for enhanced oil recovery. However, long-term CO_2 storage does carry a risk of possible leaks to the atmosphere. The costs and risks are not insurmountable, but research is required to make these concepts economically and technologically feasible.

GCEP-funded scientists are investigating a range of research concepts in CO_2 storage, from rock characterization in the presence of CO_2 to simulations, models and theory that predict and monitor fluid flow. The following four GCEP research activities are taking place in the area of CO_2 Storage.

Collaborative Research on Carbon Sequestration in Saline Aquifers in China is being carried out by a group of researchers at three institutions that include Professors Dongsxiao Zhang and Kristian Jessen of University of Southern California, Professors Qingdong Cai, Bin Gong, and Yi Zheng of Peking University, and Professors Yilian Li, Yanxin Wang, and Jianmei Cheng of China University of Geosciences. This project is addressing fundamental issues associated with large-scale sequestration of CO_2 in saline formations with emphasis on developing the potential for CO_2 sequestration projects in China. Over the last year there have been three research aims have been addressed including 1) pressure and salt buildup during CO_2 injection, 2) validating numerical simulations and 3) improving the performance of a reactive transport simulator.

A research effort on Linking Chemical and Physical Effects of CO_2 Injection to Geophysical Parameters is led by Professors Gary Mavko of Stanford University and Andreas Luttge of Rice University. This project aims to demonstrate techniques for quantitatively predicting the combined seismic signatures of CO_2 saturation, chemical changes to the rock face, and pore pressure. This report also presents geochemical results from Rice University showing several important findings.

Katharine Maher and co-investigators Dennis Bird and Gordon Brown from Stanford University are looking into the reactivity of CO_2 in the subsurface. They are investigating a range of homogeneous and heterogeneous reactions that occur as a result of the injection of CO_2 into several different underground environments. The goal of the research is to predict and manipulate reservoir reactivity and reaction products during emplacement of CO_2. This work has begun to shift from identifying key processes that control the reactions toward integrating the data into models that describe and predict the experimental and field systems.

Professor Sally Benson's team continues to study the fundamental science behind the long-term fate and trapping of CO_2 storage in saline aquifers. They conduct experimental investigations and numerical simulations to address important questions about the currently accepted multiphase flow theory needed to reliably predicting field-scale performance.