**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 Dongxiao 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.