

## Introduction to CO<sub>2</sub> Storage

Carbon dioxide storage in subsurface geologic formations is one option to reduce significant levels of CO<sub>2</sub> emitted to the atmosphere. Fundamental science and engineering principles indicate that such systems should be feasible and safe: the energy cost of preparing CO<sub>2</sub> 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 or coalbed methane. However, long-term CO<sub>2</sub> 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<sub>2</sub> storage, from rock characterization in the presence of CO<sub>2</sub> to simulations, models and theory that predict and monitor fluid flow. The largest GCEP program in CO<sub>2</sub> storage focuses on coalbeds, and the progress to date has advanced the understanding of CO<sub>2</sub> and coal interactions for what is otherwise a poorly understood area. Another area of ongoing research covers CO<sub>2</sub> storage in saline aquifers. The following ongoing GCEP research activities are taking place in the area of CO<sub>2</sub> 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 Professor Dongxiao Zhang 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<sub>2</sub> in saline formations with emphasis on developing the potential for CO<sub>2</sub> sequestration projects in China. This work involves: a comprehensive review of sedimentary basins in China in terms of basin characteristics and its proximity to CO<sub>2</sub> point sources; an experimental study to investigate the dynamic behavior of CO<sub>2</sub> migration in the context of storage in saline aquifers; and modeling and simulation for microscopic interactions and macroscopic long-term fate of injected CO<sub>2</sub> versus the host environment.

Professor Sally Benson's team continues to study the fundamental science behind long-term fate and trapping of CO<sub>2</sub> storage in saline aquifers. They develop experimental investigations and numerical simulations to address important questions and assess which, if any, modifications to currently accepted multiphase flow theory are needed and develop approaches for reliably predicting field-scale performance.

A third research effort on Linking Chemical and Physical Effects of CO<sub>2</sub> Injection to Geophysical Parameters has recently begun 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<sub>2</sub> saturation, chemical changes to the rock face, and pore pressure.