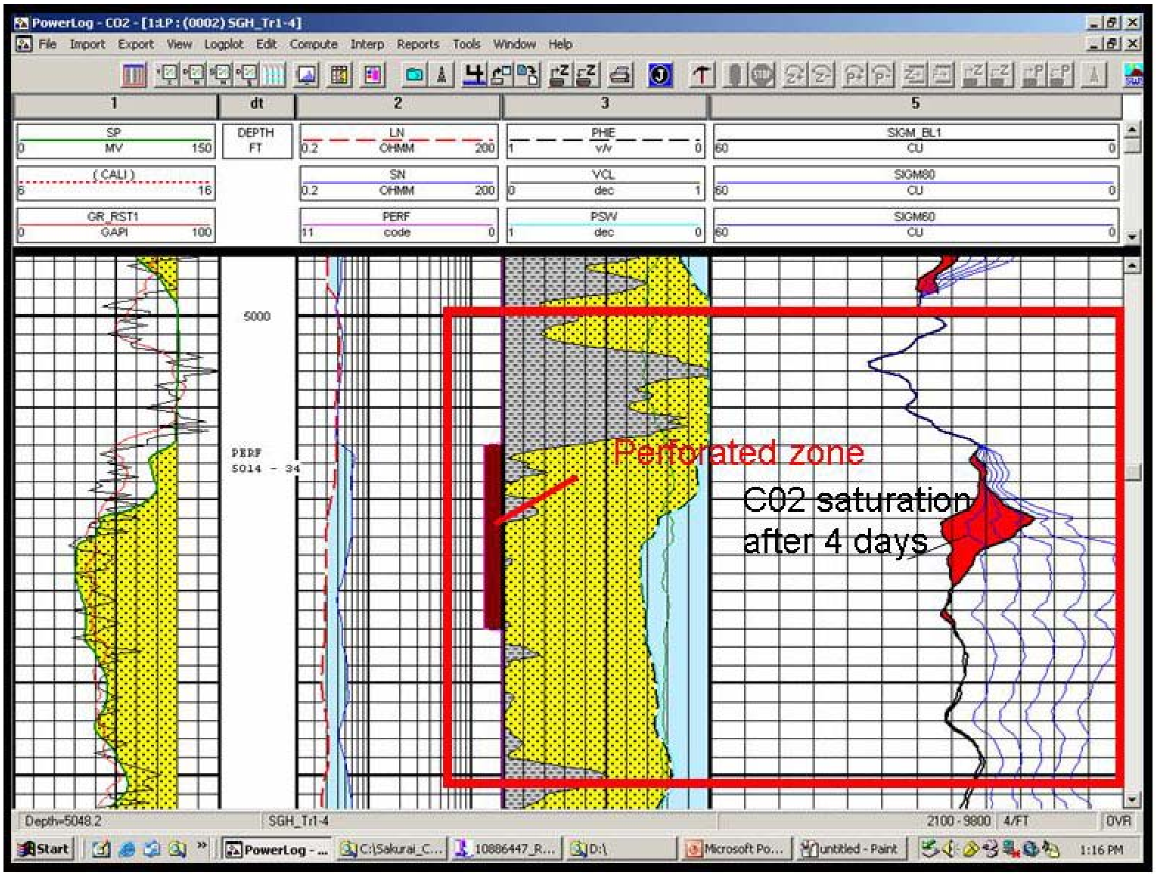
Field Experiment for CO_2 Sequestration

Website: http://www.beg.utexas.edu/

Bureau researchers led by Dr. Susan Hovorka have succeeded in the key injection and breakthrough phase of a unique field experiment testing whether carbon dioxide can be stored in underground brine-bearing sandstone. This $4.14 million DOE-funded project is part of an ongoing research initiative of the Gulf Coast Carbon Center (GCCC) to develop new capabilities to enable cost-effective sequestration of CO_2 as part of a global fight against the possible negative consequences of greenhouse gas buildup in the atmosphere. The GCCC is conducting the experiment with the participation of 16 institutions from the United States, Australia, and Canada.

On October 4, 2004, after extensive numerical modeling, site preparation, and field and drilling operations, researchers began injecting 1,600 tons of CO_2 (produced commercially by refineries and fertilizer plants) into a South Liberty oil field east of Houston, Texas. The target is the Oligocene Frio Formation, a saltwater-saturated formation 5,050 feet below the surface. The injected CO_2 will be closely monitored using downhole tools to measure pressure, temperature, and saturation of brine and CO_2 within the rock; sample the fluid at depth to follow its geochemical evolution; and trace fluid movement using noble gases, SF6, perfluorocarbons, and fluorescent dyes injected with the CO_2 as markers. These measurements will be compared with model predictions to assess their correctness.

In early results on October 6, 2004, CO_2 was detected in the observation well 100 feet away from the injection well about 51 hours after the beginning of injection. The presence of CO_2 was evidenced by a significant decrease in pH, which is consistent with the presence of carbonic acid formed by dissolution of CO_2 in water. A geochemistry team led by Dr. Yousif Kharaka of the U.S. Geological Survey and Bureau researcher Seay Nance work 24-hour shifts to analyze produced fluids. The image below is a graph of the change in CO_2 saturation after 4 days.



In the photo below, workers are installing stainless-steel tubing to sample downhole brine in the observation well using a system designed and operated by Dr. Barry Freifeld and Rob Trautz of Lawrence Berkeley National Lab. Two 5,100-foot lengths of tubing (on spools) are attached to the exterior of steel pipe and connected at depth through a packer to a sampling inlet. The packer isolates the target sandstone interval. The tube is filled with nitrogen, which is then vented, pulling formation brine to surface.

Nitrogen gas is pumped into one end of the tube and expels the sample at formation pressure into a surface facility (photo below), where gas analyses are conducted and water samples are collected for chemical analyses. Schlumberger's Reservoir Saturation Tool (RST) was used to measure saturation of CO_2 in the sandstone shortly after breakthrough and at the end of injection. Schlumberger researcher T. S. Ramakrishna and Bureau researcher Shinichi Sakurai calculated that CO_2 filled part of the pores of 12 feet of sandstone, with a maximum of 70 percent of the pore space filled with CO_2.

The Frio Brine Pilot experiment is designed to field test modeling, monitoring, and verification techniques that can be applied to CO_2 storage in high-permeability, high-volume sandstones and is a significant step in an international effort against greenhouse gas buildup in the atmosphere. The site is representative of a broad area that is an ultimate target for large-volume storage because it is part of a regionally extensive, thick sandstone trend that underlies a concentration of industrial sources and power plants along the Gulf Coast of the United States. Development of geologic storage in this region has excellent potential for up-scaling to impact U.S. releases.

The Frio Brine Pilot is funded by the U.S. Department of Energy, National Energy Technology Lab, Dr. Karen Cohen, project manager. The Bureau of Economic Geology, Jackson School of Geosciences, The University of Texas at Austin, is the lead institution, with Dr. Scott Tinker, Director, and Dr. Susan Hovorka, Principal Investigator. GEO-SEQ, a research consortium directed by Dr. Sally Benson and Dr. Larry Myer, is fielding a spectrum of surface and subsurface geophysical, hydrologic, geochemical modeling, and monitoring approaches. GEO-SEQ includes Lawrence Berkeley National Lab, Oak Ridge National Lab, Lawrence Livermore National Lab, and the Alberta Research Council. SEQURE, the CO_2 monitoring group of the

National Energy Technology Lab, is focused on near-surface monitoring. Dr. Yousif Kharaka, U.S. Geologic Survey, is leading the subsurface geochemical sampling. Sandia Technologies LLP is the field service provider, bringing its waste-injection expertise and managing on-site subcontractors. Schlumberger is providing logging, core, and water sampling expertise. Texas American Resources donated well access and the preinjection 3-D seismic survey used for characterization. Local property owners have donated land access for the experiment. BP has provided project review and advice. The Australian CO_2CRC is currently negotiating to add its expertise to the project team.

END