

# Preliminary Geologic Characterization and Modeling Work at the Southwest Partnership's San Juan Basin Site

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## Abstract

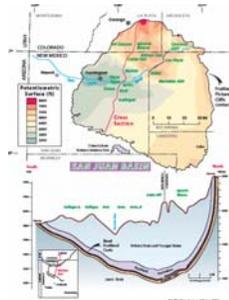
Site characterization and modeling of the injection process are important steps in a successful sequestration project. The Southwest Regional Partnership will be injecting about 75,000 tons of carbon dioxide into a coal seam in the San Juan Basin. The location of the injection well has recently been identified, and injection is planned to start in November of 2007. As part of this project, several groups are working together to characterize the geology of the site and to simulate the injection of CO<sub>2</sub> at the site. Information from available well logs in the surrounding regions has been used to put together a geologic model for the site and to identify the depths and thickness of the seams where injection and production will occur. Further information will be learned from seismic surveys that are planned at the site. Many years of production history (of coalbed methane) are available and will be used to calibrate the models that will be used for simulating CO<sub>2</sub> injection. Multiple simulators and coal-CH<sub>4</sub>-CO<sub>2</sub> shrinkage/swelling models will be used to predict the movement of CO<sub>2</sub> within the coal seam. Additionally, a geomechanical model will be developed for the site, which will be used to help design a tiltmeter survey for the planned injection. As with most site characterization studies, this study is a work in progress. Information that has been learned to date, as well as future plans, will be presented.

## Injection Plans

- Injection planned for last quarter of 2007 for ~1 year.
- Original project designed for sequestering 75,000 tons CO<sub>2</sub> in Basal Fruitland coal; equivalent to 3,450 Mscf/d CO<sub>2</sub> injection for the injection period.
- Injection rate may be limited by pressure gradient to <200 Mscf/d assuming a 0.5 psi/ft gradient or 1,500 psia. (Early breakthrough may be a concern, so injection will occur near in situ pressure till system stabilizes.)
- Production will be continued at surrounding wells during the injection period and produced gases will be monitored.

## Site Characterization

The site is located in the fairway of the San Juan Basin. Three individual coal seams make up the production zones; however, injection will only occur in the basal fruitland (deepest) coal seam. The injection location is approximately 3000ft below the surface and is near three production wells. An existing CO<sub>2</sub> pipeline passes near the injection location. Logs from several nearby wells are available to use in building a geologic model for the site. Several seismic lines are proposed for the site to aid in site characterization, as well as in time-lapse monitoring. Isopach maps have been developed for each of the three coal seams. Primary cleat orientations have been identified. Coal seams exhibit high gas production with relatively little water production. The fairway has high permeabilities in the range of 100mD.



## Geomechanical Modeling

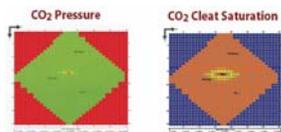


Sample of ground deformation due to injection

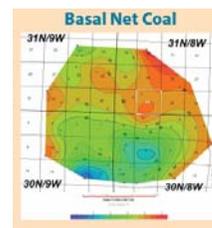
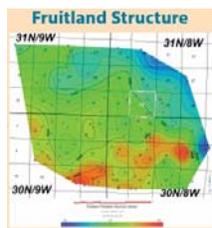
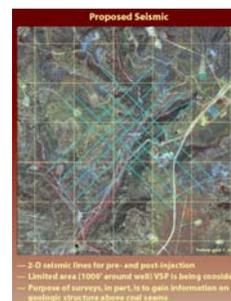
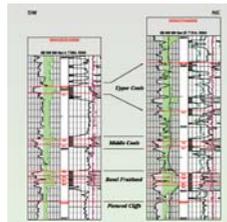
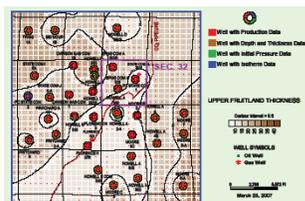


Ground deformation after a relaxation period

## Reservoir Simulation



Over 15 years of production data, from September 1990 to March 2007, is available for history matching. Pressure gradient is around 0.5 psi/ft, and initial formation pressures were around 1600psi. Current operating pressures are under 100psi, which is near abandonment pressure. The produced gas contains between 20 and 30 mole % of carbon dioxide. Initial gas content was about 450 scf/ton of CH<sub>4</sub>, and the Langmuir volume constant for CO<sub>2</sub> is around 750 scf/ton, based on samples from elsewhere in the basin. Using their COMET model, ARI has begun history matching data from the three coal seams. Preliminary simulations have predicted migration of CO<sub>2</sub> within the coal seam, changes in formation pressures, and changes in production associated with enhanced recovery. Partners from the Colorado Geologic Survey and NETL will also be performing simulations at the site, to compare results and examine multiple models of coal shrinkage and swelling.



Coals appear to swell in the presence of carbon dioxide. Such swelling will exert stresses on the surrounding rocks, causing them to deform. Tiltmeter arrays will be used at the ground's surface to monitor changes in inclination. Additionally, InSAR data may be collected to monitor ground movement, depending on modeling results and cost. Information from these monitoring techniques will be used to validate geomechanical models of the site. The potential for such techniques to be used for monitoring the migration of carbon dioxide within the coal seam will be examined.

