



WESTCARB Annual Business Meeting

Rosetta Resources CO₂ Storage Project

**Rob Trautz¹, Sally Benson¹, Curt Oldenburg¹, Larry Myer^{1,2},
Ed Seeman³, Eric Hadsell³ and Bob Davis³**

¹Lawrence Berkeley National Laboratory
Berkeley, California 94720, rctraultz@lbl.gov

²California Energy Commission, Sacramento, California

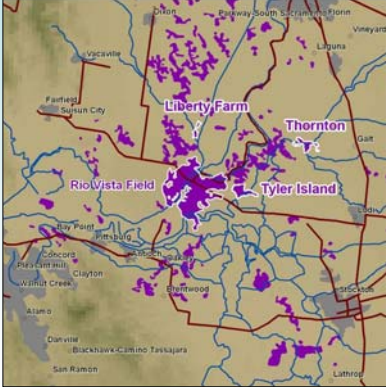
³Rosetta Resources, Inc.

*Phoenix, AZ
November 8–9, 2006*




Site Selection Process

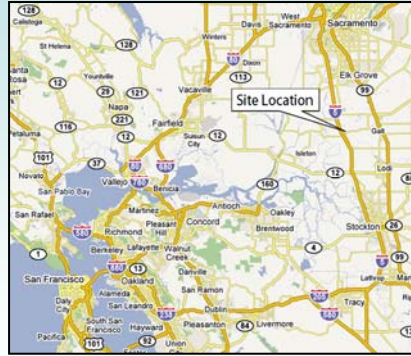
- Developed detailed site selection criteria:
 - Public Safety
 - Scientific
 - Logistics
- Prioritized and ranked criteria
- Reviewed site data
- Ranked sites based on criteria
- Selected Thornton Gas Field out of 9 sites



WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP



Thornton Gas Field Regional Site Attributes ...

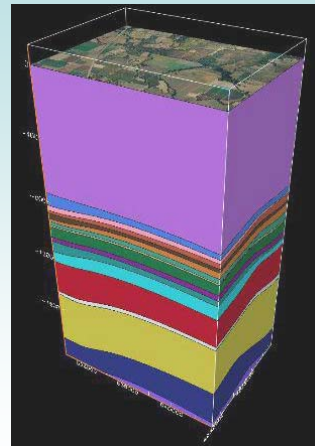


- Near major metropolitan areas offering products and services
- Near large industrial CO₂ point sources
- Along major transportation corridors providing easy site access
- Located near active natural gas fields and pipe line corridors in the Southern Sacramento Basin



Thornton Gas Field Geologic Attributes ...

- Stacked reservoir with multiple seals
- Thin depleted gas reservoir and saline zones greater than 1 km deep
- Thornton Gas Field is representative of numerous gas fields with 1.7 Gt CO₂ capacity in CA
- Thornton Gas Field is an analog for the Rio Vista field, the largest on shore natural gas field in CA (3.3 Tcf)

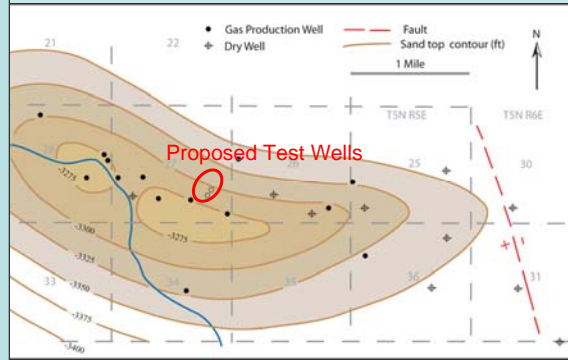


Thornton Geologic Model (courtesy Jeff Wagoner and Julio Freidmann, LLNL)



Thornton Gas Field Geologic Attributes ...

- Well defined anticline will safely store injected CO₂
- Existing wells and field have been abandoned
- Attic gas may be present providing potential economic incentive
- Located in the Central Valley where earthquake activity is relatively low

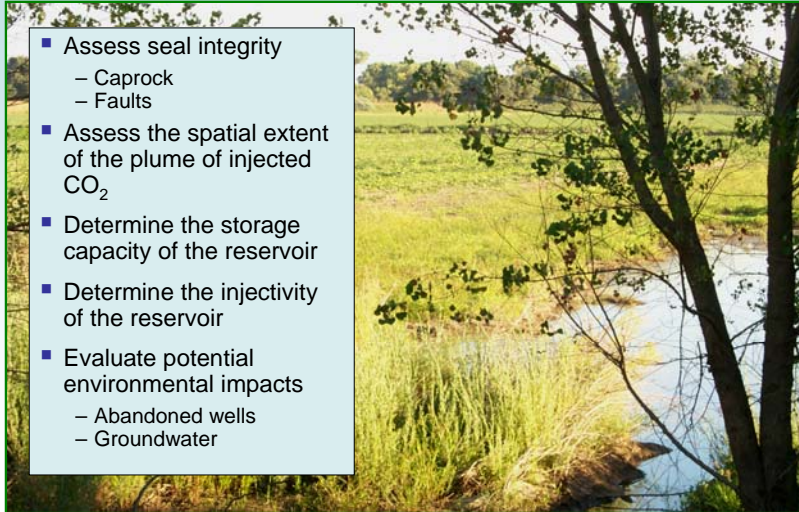


Thornton Gas Field Logistical/Cultural Attributes...

- Rural setting minimizes public nuisance
- Site is already cultivated
- One surface and one mineral right owner
- Reservoir is not unitized



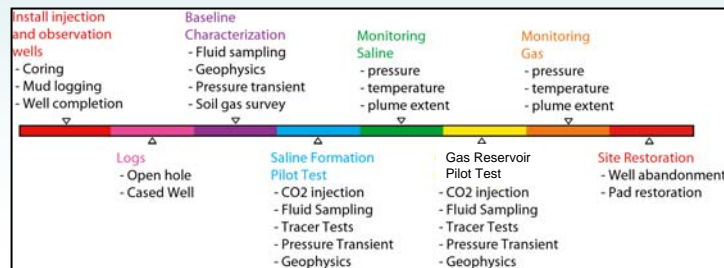
Objectives Common to Saline and Gas Zone Pilot Tests



- Assess seal integrity
 - Caprock
 - Faults
- Assess the spatial extent of the plume of injected CO₂
- Determine the storage capacity of the reservoir
- Determine the injectivity of the reservoir
- Evaluate potential environmental impacts
 - Abandoned wells
 - Groundwater

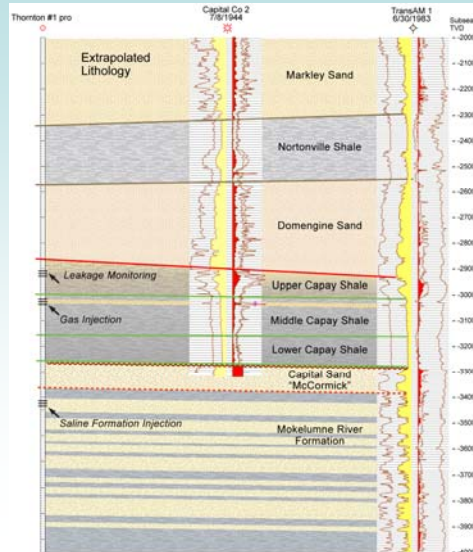
Test Sequence

- Four Main Elements
 - Well installation and baseline characterization
 - CO₂ injection
 - Monitoring
 - Site restoration



Well Installation and Baseline Characterization

- Dual completion
- Mudlogging
- Coring
- Open hole and cased well logs
- Baseline fluid sampling
 - Composition
 - Fluid properties
- Short-duration transient pressure testing
- Environmental sampling

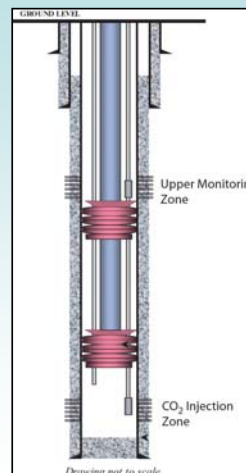


WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP

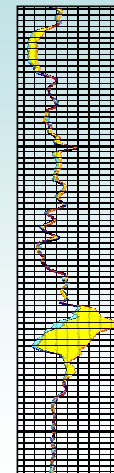


Assess Seal Integrity

- Geomechanical analysis
 - Safe injection pressure
- Monitor pressure and water quality in a shallow formation above injection zone
- Obtain RST logs from injection and observation wells before and after CO₂ injection



Pressure Monitoring



RST Log

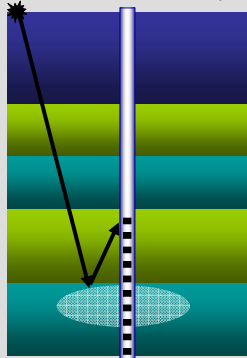
WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP



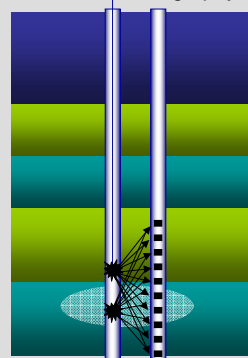
Assess the Spatial Extent of the CO₂ Plume

- Seismic Imaging
 - Vertical seismic profiling (VSP)
 - Cross-well seismic

Vertical Seismic Profile (VSP)



Cross-Well Tomography



Assess Storage Capacity

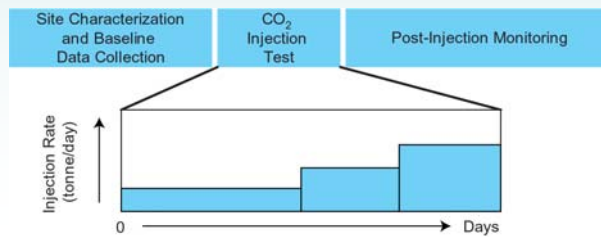
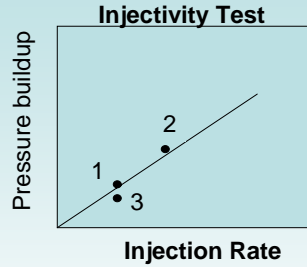
- Separate Phase CO₂
 - Fluid sampling
 - Seismic imaging
 - RST Log
- Dissolved CO₂
 - Natural and introduced tracers



U-Tube Sampler (Barry Freifeld, LBNL)

Determine the Injectivity of the Reservoir

- Inject CO₂ at three or more rates
- Measure pressure buildup in the formation



WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP

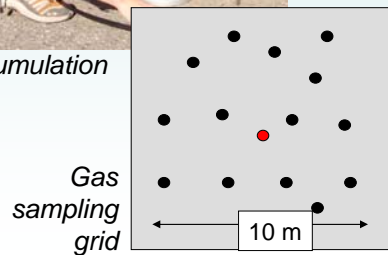


Evaluate Environmental Impacts of CO₂ Injection (Pre- and Post-Injection Surveys)

- Drill and sample shallow groundwater well
- Collect and analyze soil gas concentrations and fluxes in the vicinity of abandoned wells



Flux accumulation chamber



WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP

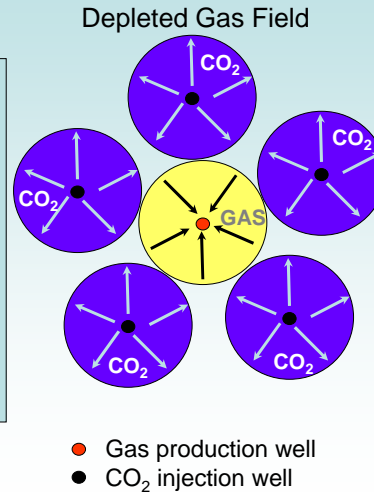


Gas Reservoir Objective

CO₂ Storage Enhanced Gas Recovery (CSEGR)

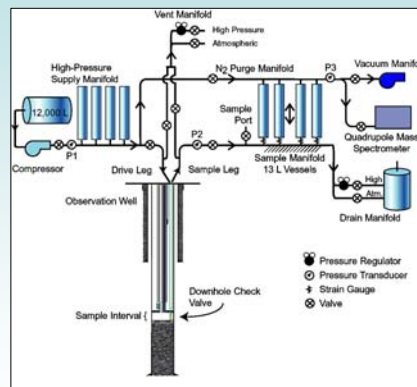
Primary Mechanisms

- Repressurize depleted natural gas reservoir using CO₂
- Use CO₂ to sweep natural gas toward producing wells



Gas Reservoir Pilot Test: Challenges

- Assess mixing between CO₂ and CH₄ causing methane dilution
- Sampling multi-component fluids with different phases
- Imaging CO₂ methane/water displacement is difficult



*U-tube fluid sampler
(Freifeld and Trautz 2006)
Barry Freifeld, LBNL*

Summary

The project is ...

- Negotiating site access
- Gaining valuable permitting experience
- Developing important relations with state and federal regulators
- Reaching out to the Thornton community through public outreach

... has developed a

Comprehensive set of pilot test objectives, priorities and plans

and

Will begin testing in 2007

WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP
westcarb.org

PUBLIC MEETING

Storing Carbon Dioxide to Fight Global Warming: Thornton Depleted Gas Reservoir Storage Test

Purpose
This informational meeting is being held to discuss plans for a research project to test "carbon sequestration," a promising new technology that can help carbon dioxide (CO₂) leave from the atmosphere to help global warming. Also known as CO₂ capture and storage, carbon sequestration involves adding gas separation equipment at large industrial facilities, such as power plants, refineries, and cement plants, to remove CO₂ that would otherwise be emitted with the gas. The "captured" CO₂ is compressed and injected deep "off" in stable underground geological geologic formations for long-term storage.

Depleted oil and gas reservoir and similar formations filled with subsurface that cannot be made profitable, such as those located in the Delta, are excellent candidates for safe, permanent CO₂ storage. As a potential co-benefit, CO₂ captured and stored may be produced in conjunction with the oil or gas.

Programme is welcome to attend the meeting to be held with questions about our proposed project. [Please see our Q & A section on the back of this announcement.]

LOCATION
Common River Preserve Visitor Center
1100 Franklin Boulevard
Oak, CA 94612
Visitor Center phone: 916-961-0101

The Common River Visitor Center is located between Oak and Fremont on Franklin Boulevard, 1.1 miles south of Paris City Road. For help with directions, visit www.commonriver.org or call the Visitor Center.

17