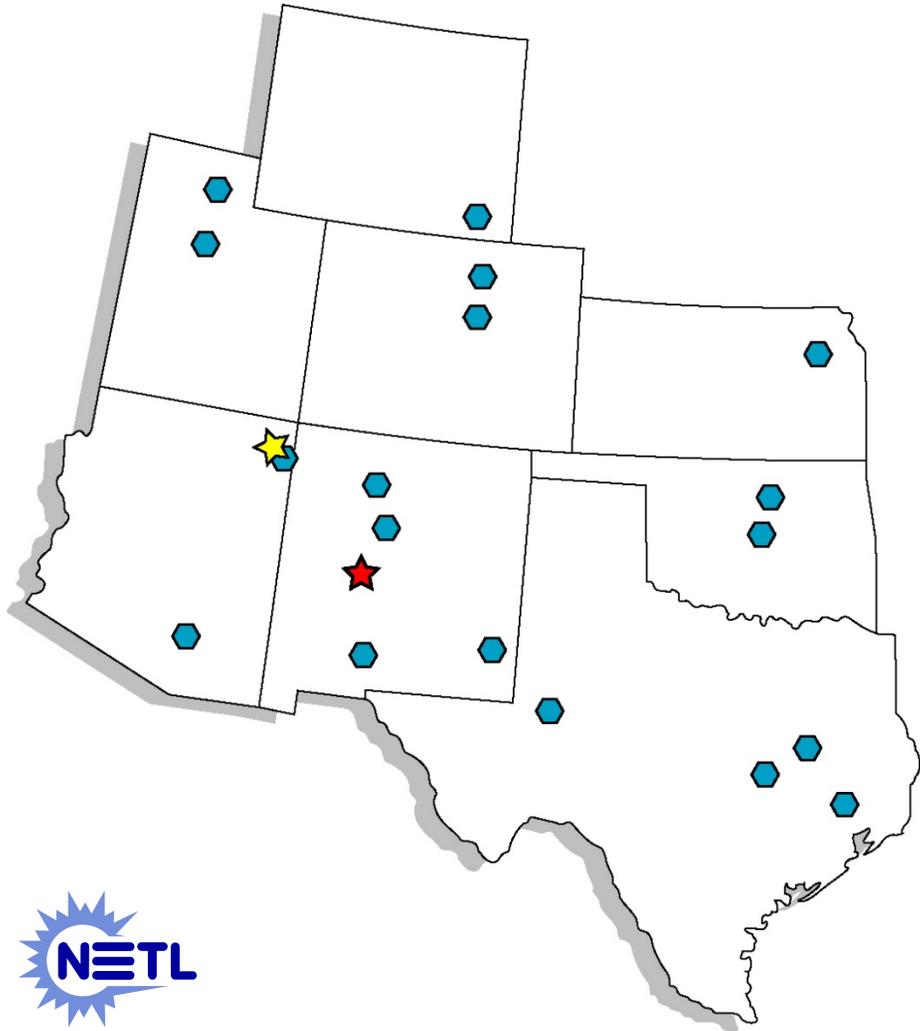


Southwest Regional Partnership on Carbon Sequestration



Pump Canyon Project Overview

DE- FC26-05NT42591

December 13, 2007

Pittsburgh, Pennsylvania

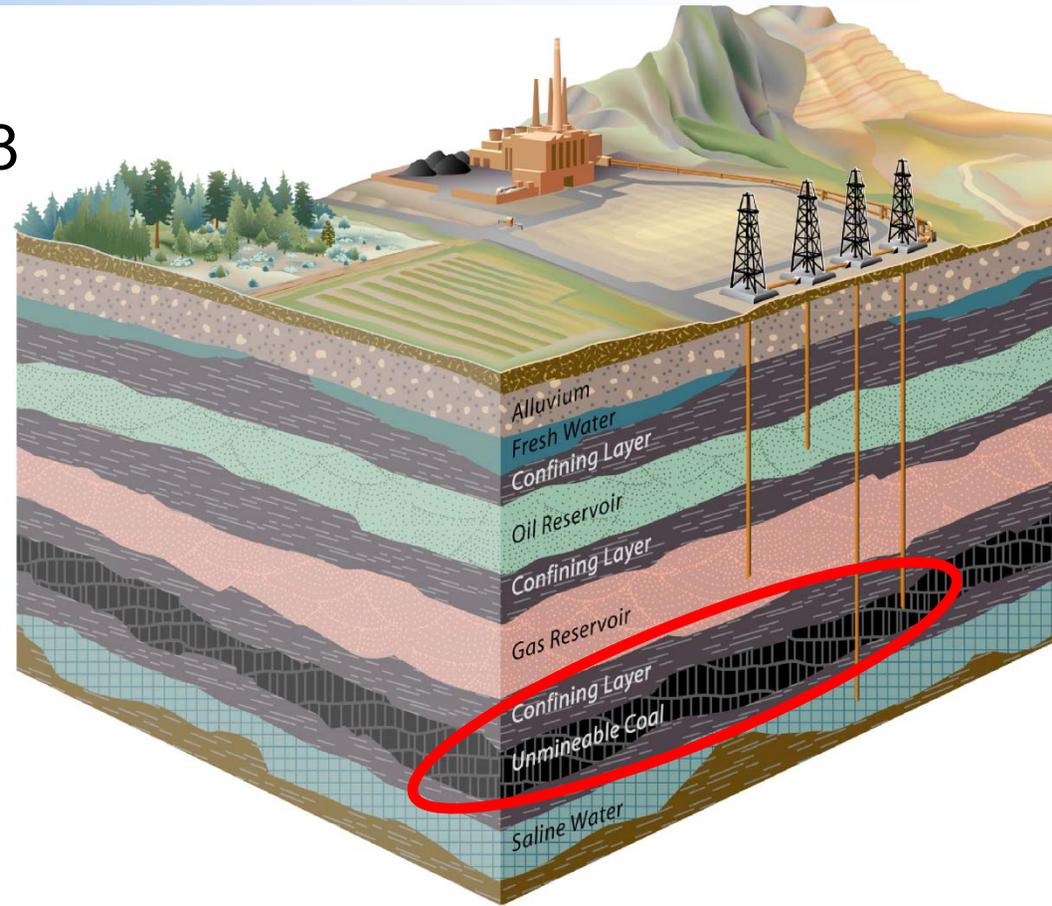
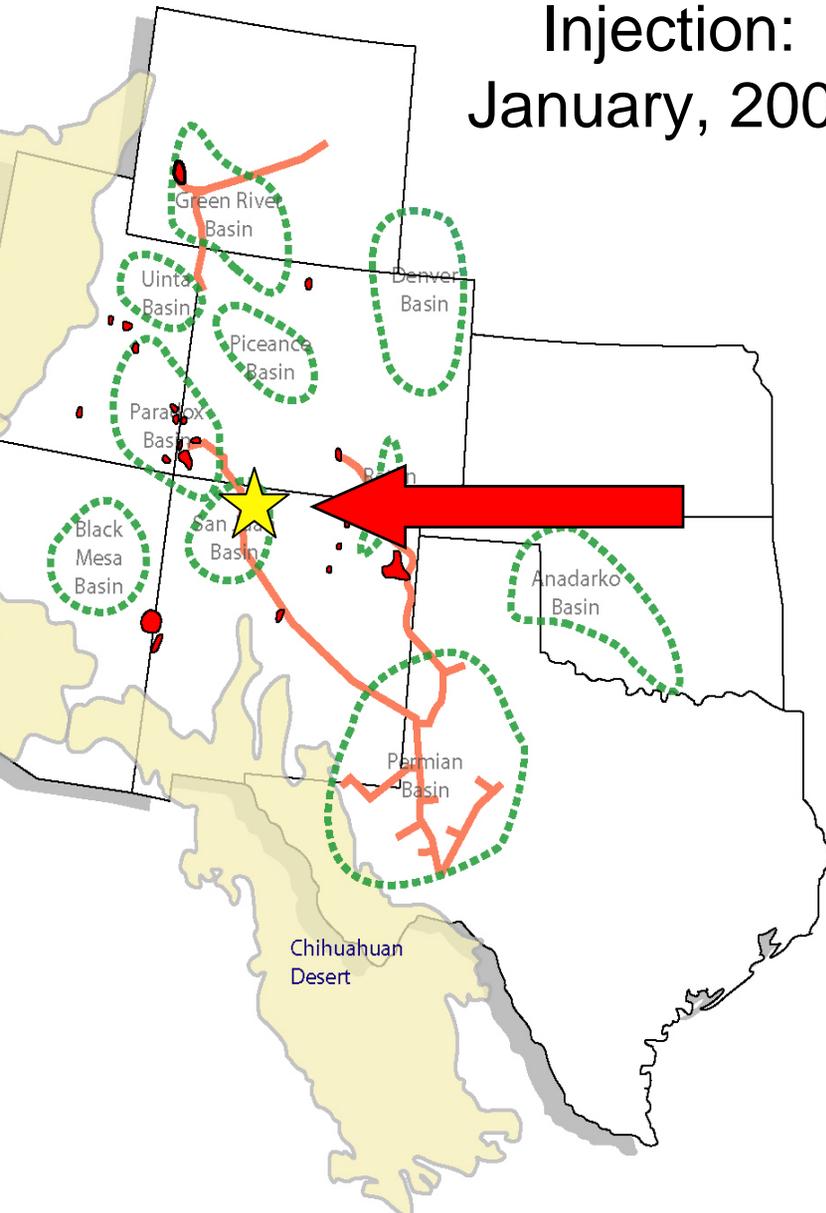


Acknowledgements

- Many thanks to the U.S. Department of Energy, NETL, ConocoPhillips, and Kinder Morgan for supporting this project
- We express our gratitude also to our many industry partners, who have committed a great deal of time, funding and other general support for these projects
- The work presented today is co-authored by all partners in the Southwest Partnership

Southwest Phase II Portfolio

Injection:
January, 2008

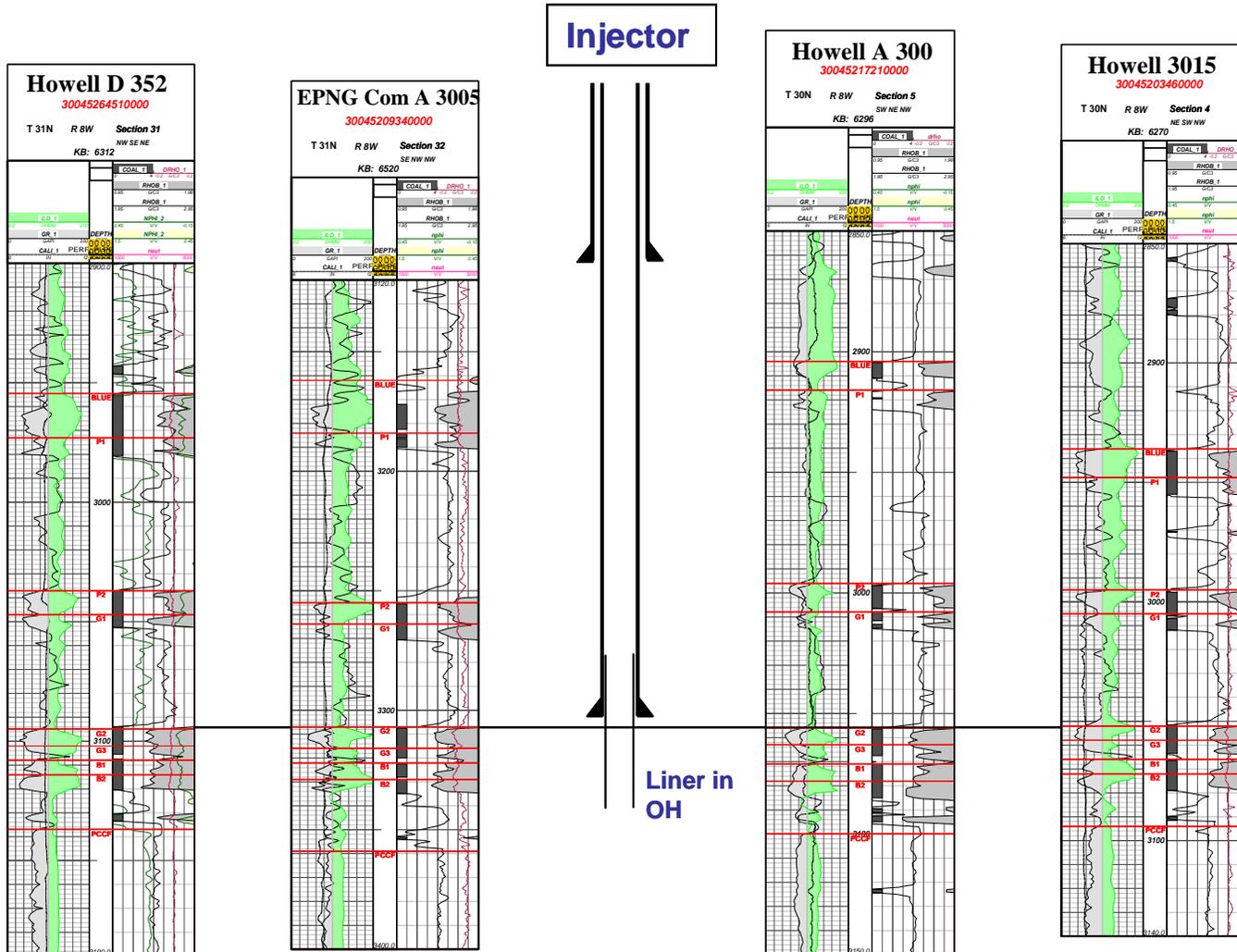


- San Juan Basin, NM: 35,000 tons/year**
- **Combined enhanced coalbed methane recovery with sequestration**
 - Surface riparian restoration for terrestrial sequestration

Demonstration Program Overview

- Drill one CO₂ injection well between three existing CBM producer wells.
- Inject into basal coal using pressure-control for ~1 year; rate to be determined on-site (very slowly at first to minimize potential for formation fracturing and/or early CO₂ breakthrough).
- In the event of early CO₂ breakthrough, backup plan is to recomplete into middle coal, then upper coal if necessary.

Cross-Section

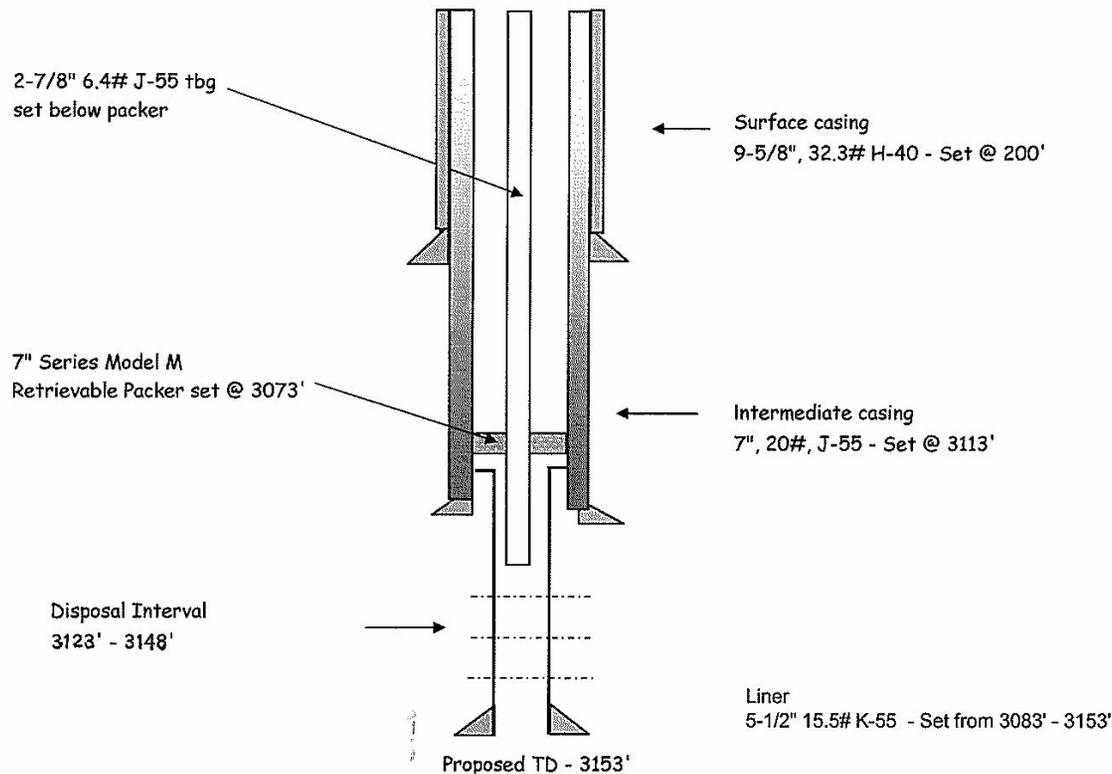


Well Schematic

EPNG Com A INJECTION Well #1

Lease - E-1196-B
 Unit F, 2500' FNL & 2665' FWL
 Sec. 32, T31N, R8W
 San Juan County, New Mexico

Proposed Wellbore Schematic



Formation	Measured Depth	Subsea Depth
Ojo Alamo	2003	4330
Kirtland	2073	4260
Fruitland Coal	2840	3493
Upper Coal	2978	3353
Middle Coal	3068	3265
Lower Coal	3123	3210
TD	3153	

Well Drilling & Completion Program

- Drill to Kirtland shale (overlying Fruitland)
- Core Kirtland
- Log well
- Drill to shale overlying Basal coal. Collect coal cuttings.
- Core Shale
- Run and cement casing
- Drill Basal coal. Collect coal cuttings.
- Log well
- Perform baseline VSP
- Run Liner
- Install injection equipment (downhole and surface)
- Start injection

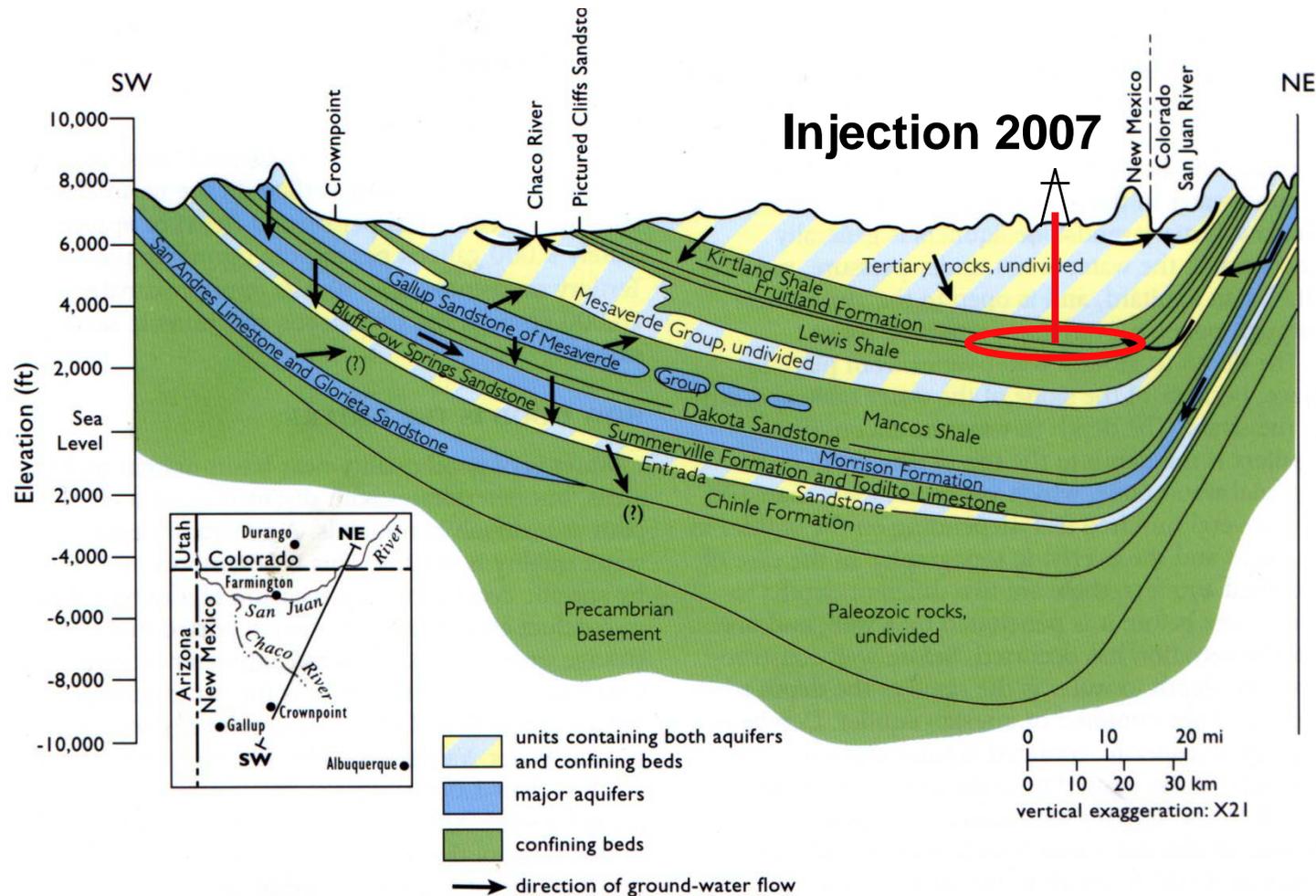
MMV Program Overview

- Injection Well (COP)
 - Core/Cuttings (Kirtland shale, Fruitland coals) (NETL, NMT)
 - Logging (gamma ray, density, sonic, FMI)
 - Injection rate
 - Bottomhole and surface pressure
- Offset Producer Wells (COP)
 - Production rates, pressures
 - Gas/water compositions
 - Pressure transient analysis
- Shallow Monitoring Wells (WVU)
 - ~4 wells ~ 600 feet deep
- Surface
 - VSP (baseline plus one time-lapse after injection commences) (Schlumberger)
 - Tiltmeters (Pinnacle)
 - Surface flux (NETL)
- Modeling (ARI, NMT)
 - Reservoir characterization
 - Flow modeling

Hydrogeomechanical Impacts

A fundamental research question: will injection of CO₂ cause detectable swelling of the target reservoir?

Yes, injection rates of ~millions tons/year make it a possibility, especially in coal seams.



Hydrogeomechanical Impacts: Coal Swelling

Geertsma (1973) proposed an analytical equation for surface displacement associated with subsurface swelling:

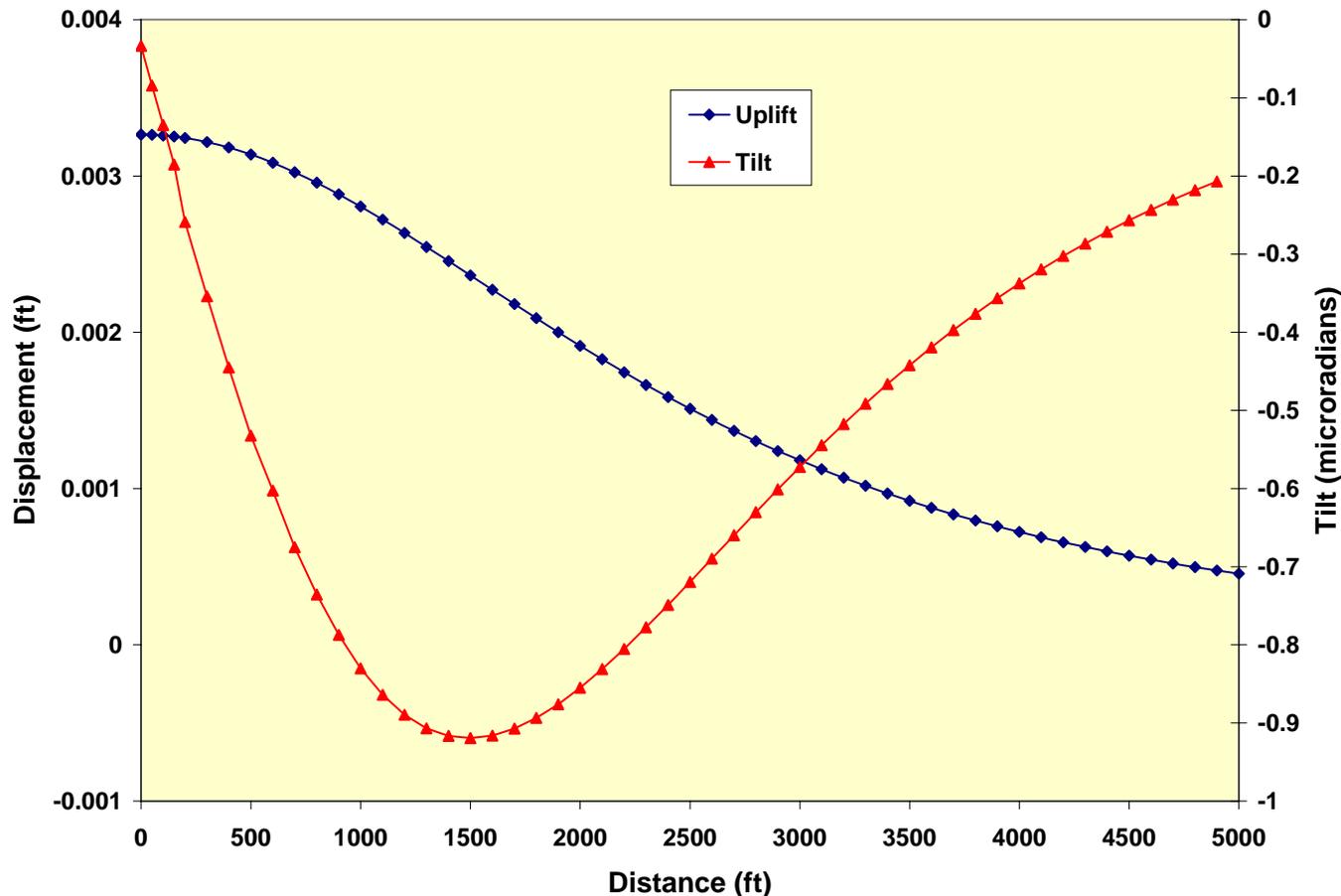
$$u_z = -2c_m(1-\nu)\Delta pHR \int_0^{\infty} J_1(Rt)J_0(rt)e^{-Dt} dt$$

And Eason (1955) provides a solution for an equation of this form:

$$u_z = -2c_m(1-\nu)\Delta pH \begin{cases} \frac{-k\eta}{4\sqrt{\rho}} F_o(k) - \frac{1}{2} \Lambda_o(k, p) + 1 & \rho < 1 \\ \frac{-k\eta}{4} F_o(k) + \frac{1}{2} & \rho = 1 \\ \frac{-k\eta}{4\sqrt{\rho}} F_o(k) + \frac{1}{2} \Lambda_o(k, p) & \rho > 1 \end{cases}$$

Hydrogeomechanical Impacts: Coal Swelling

A plot of this analytical solution:



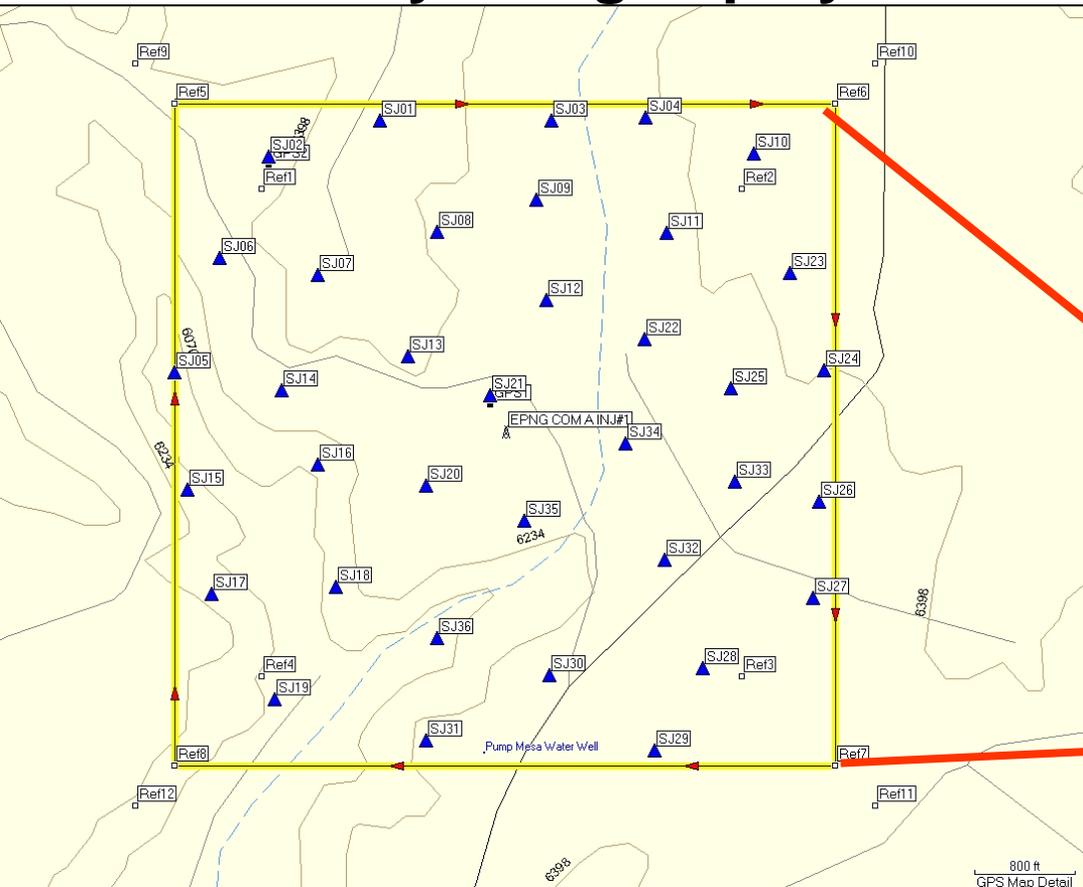
**Suggesting
that this tilt
should be
detectable
at the
surface:**

tiltmeters

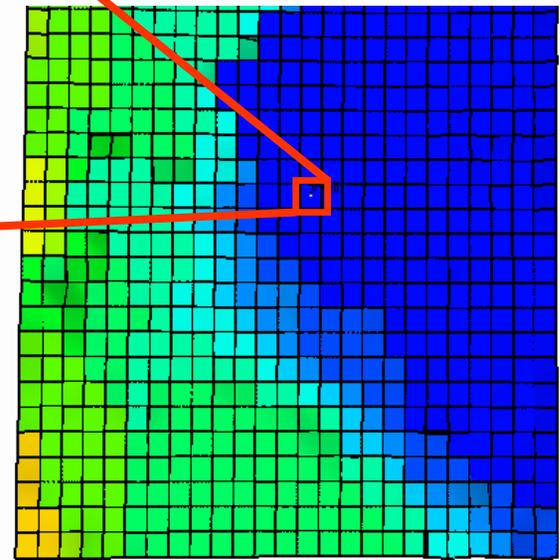
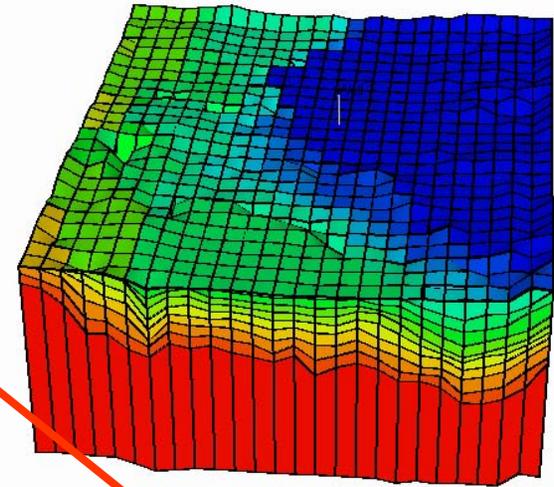
Hydrogeomechanical Impacts: Coal Swelling

Tiltmeter array being deployed this month:

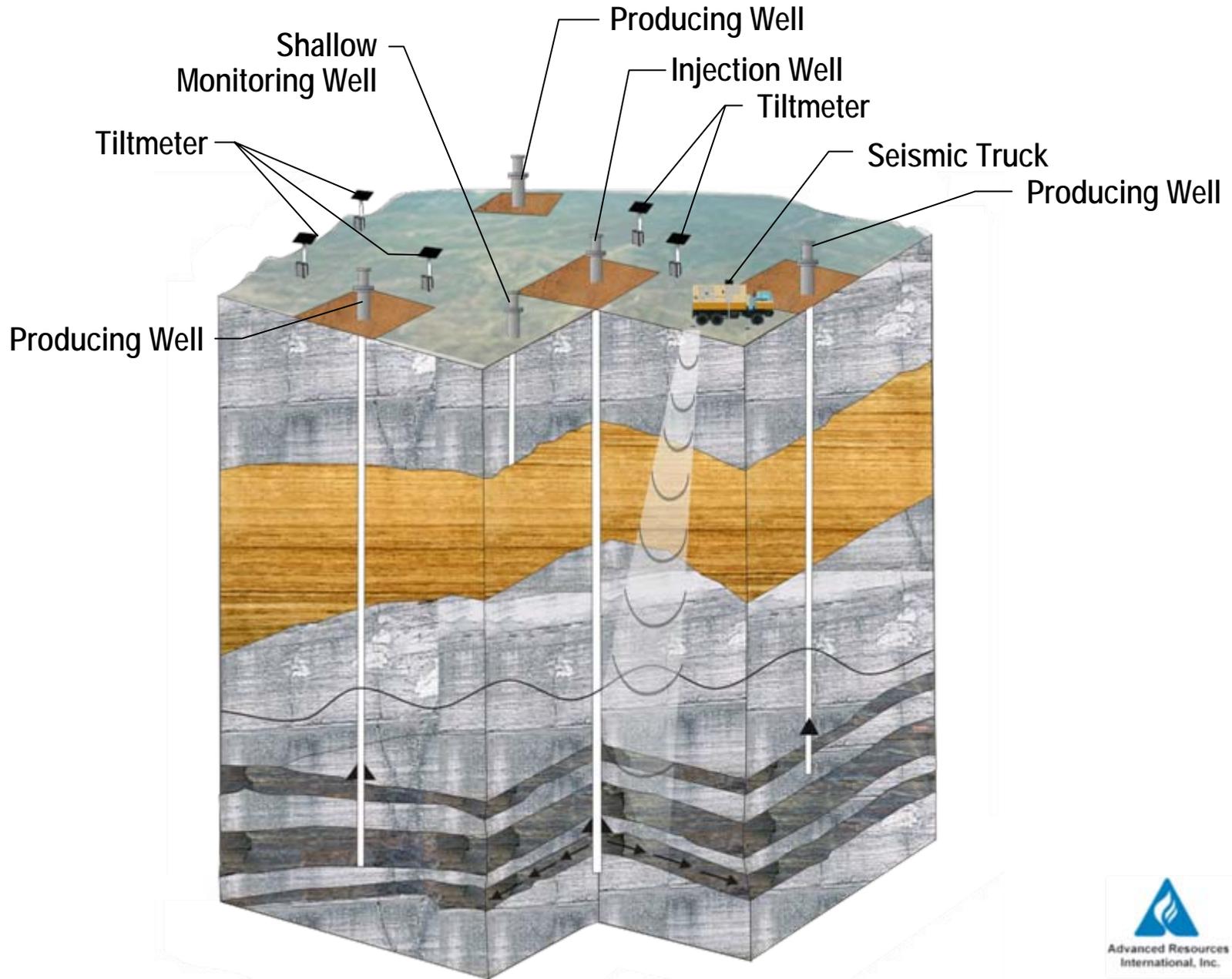
160 km



250 m



Site Plan Overview



Surveys/Permitting (LANL)

- Injection Well
 - APD/UIC permit received (NMOCD)
- Pipeline
 - ROW and FONSI received (BLM, SLO)
- MMV Program
 - Work Authorization Agreement received (COP)
 - Archeological surveys performed (BLM, SLO)
 - Section 106 approval pending (SHPO)
- NEPA
 - Categorical exclusion for all activities received
- SECTION 106 (National Historic Preservation Act)
 - Pending

Schedule

- Injection well scheduled for drilling in December.
- Pipeline construction underway, for completion in December.
- CO₂ injection scheduled to start in early 2008.



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