

Tapping the Potential for Large Volume Sequestration – Frio Brine Pilot

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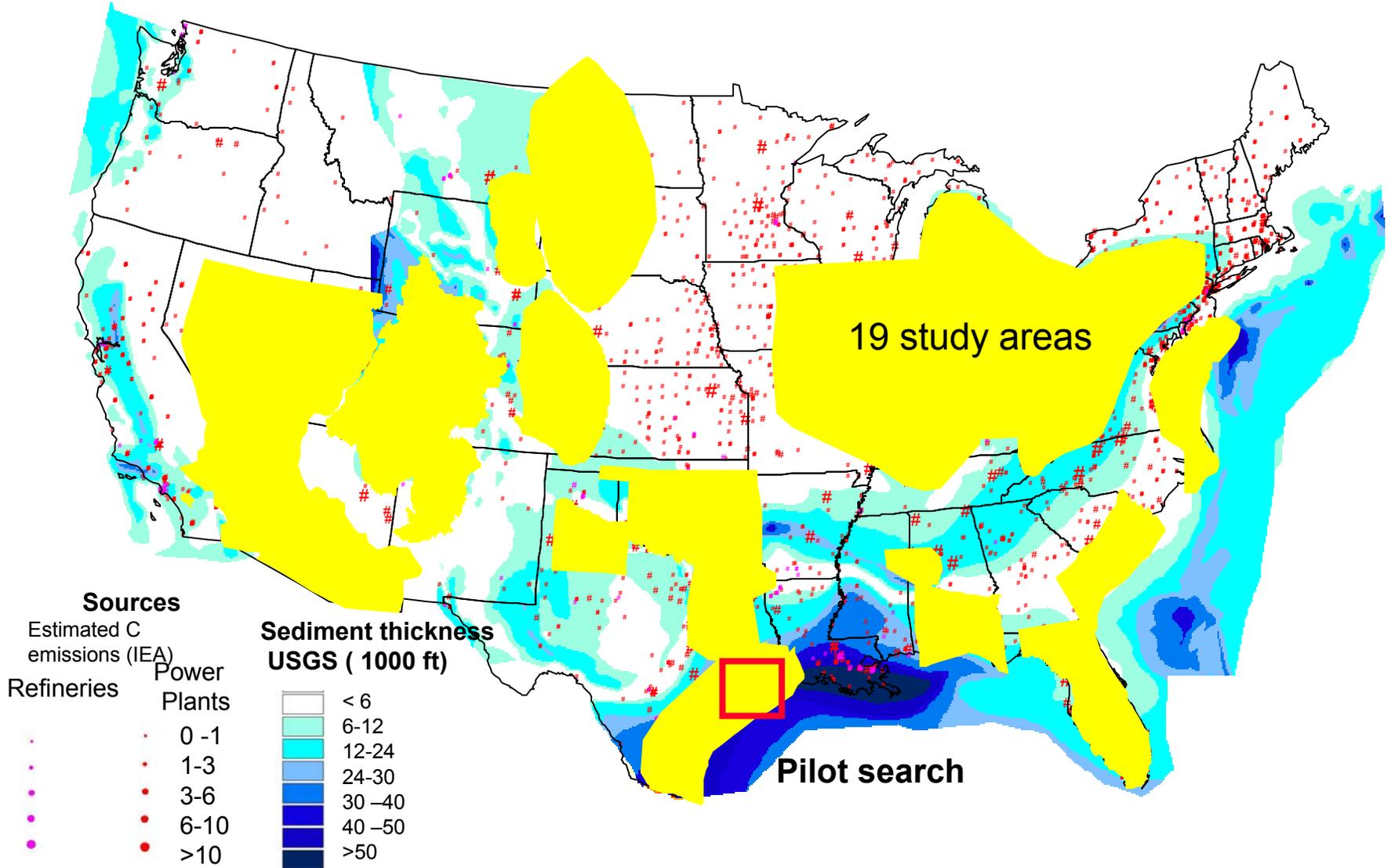
**Bureau of Economic Geology
The University of Texas at Austin**



Experiment Team

- **Bureau of Economic Geology**
- **Geo-Seq: Lawrence Berkeley National Lab (CA), Oakridge National Lab (TN), Lawrence Livermore National Lab (CA)**
- **National Energy Technology Laboratory (WV): monitoring technologies**
- **BP Texas City refinery/Praxair: source of CO₂**
- **National Energy Technology Laboratory DOE: Funding**
- **Texas American Resources Company: operator**
- **Sandia Technologies, Houston, TX: well construction, workovers, onsite work**
- **Bill Flanders, Transpetco, Midland: CO₂ injection expertise**

Site selection

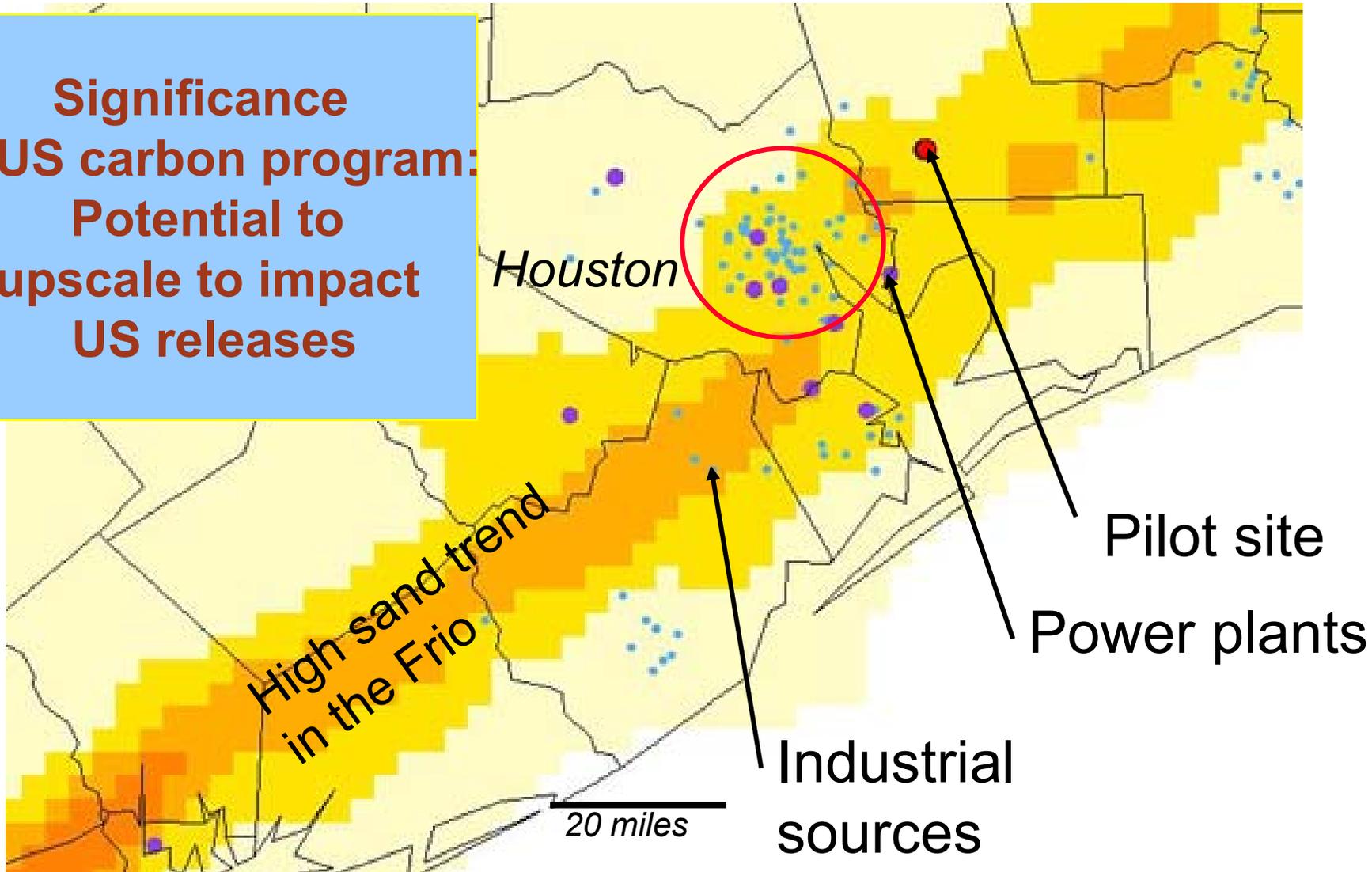


Site Criteria

- **Pilot of high significance to US sequestration program – results upscale to impact US releases**
- **Brine-bearing interval within an oil field**
- **Existing infrastructure**
- **High data density to support modeling**
- **Operator cooperation**
- **Acceptable to local community**
- **Acceptable risk of environmental impact**
- **Acceptable to regulators**
- **Small scale – within budget**
- **Strong opportunities for data collection**

Regional Setting of Pilot Site

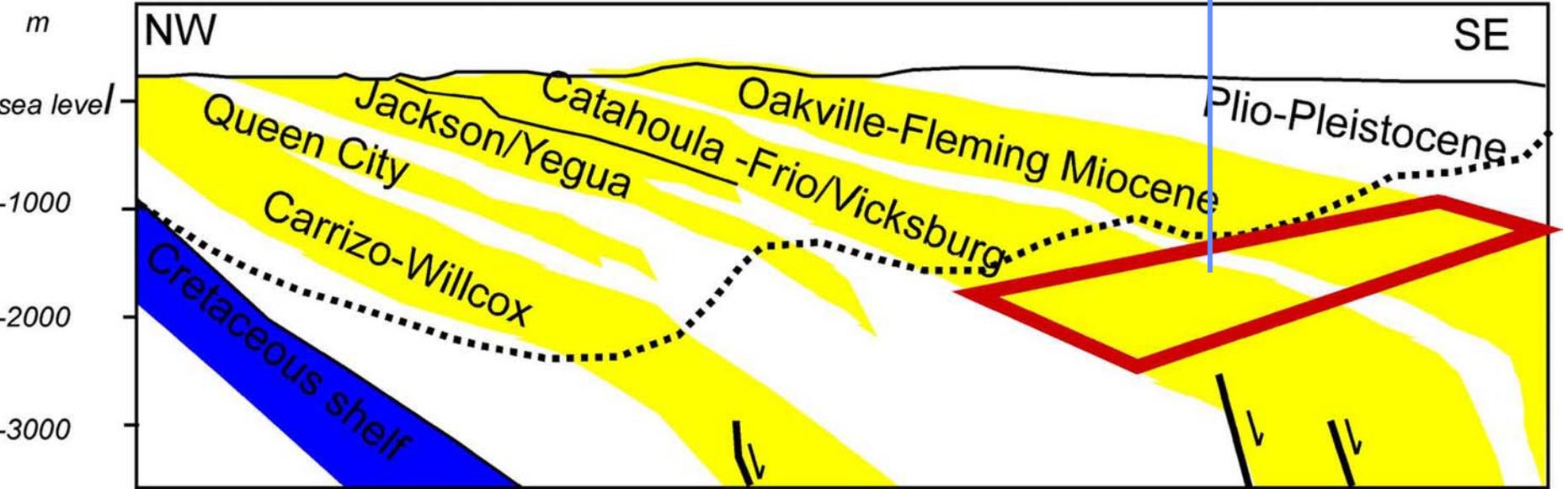
**Significance
to US carbon program:
Potential to
upscale to impact
US releases**



Regional Geologic Setting – Cross Section

20 miles

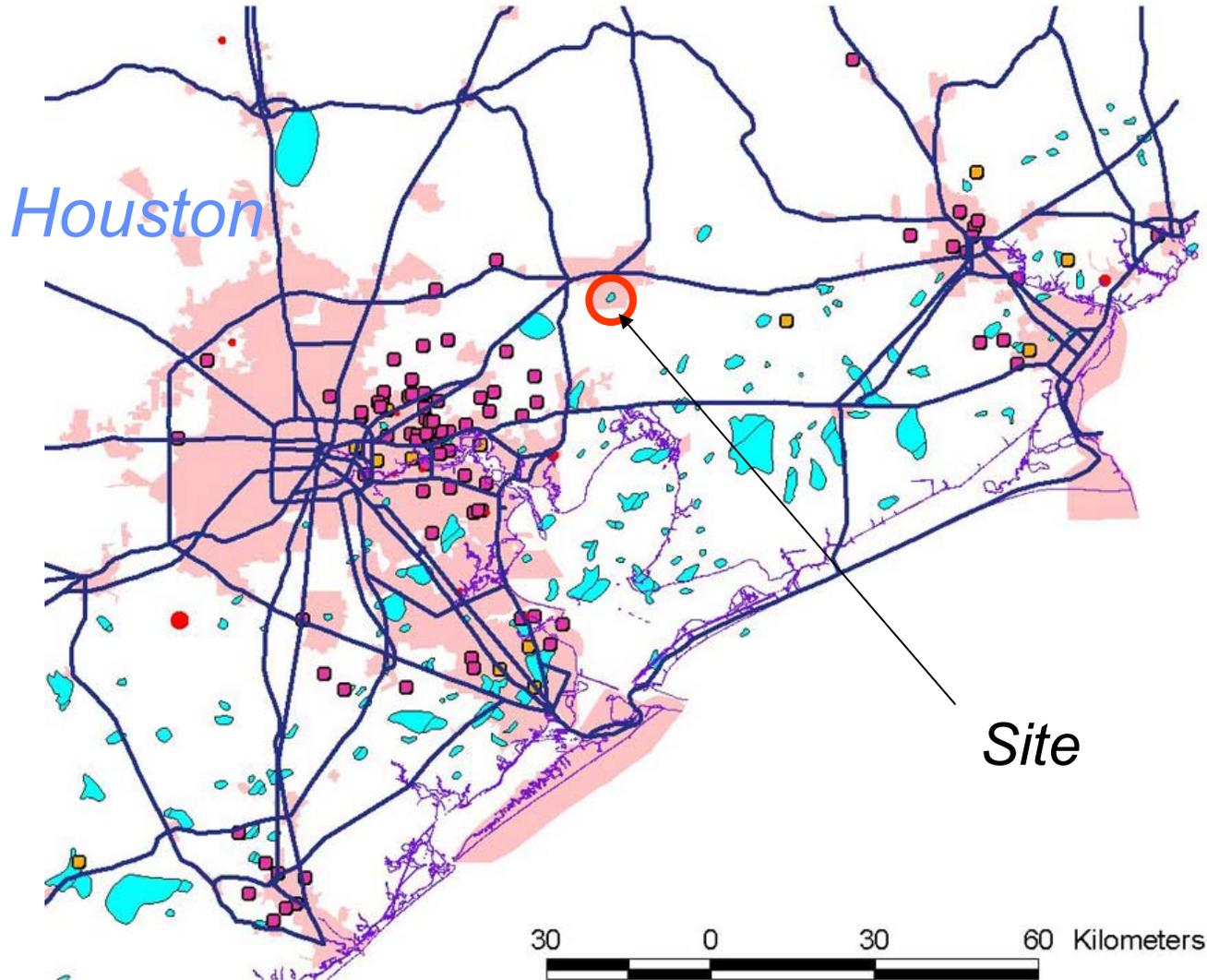
Pilot site



-  Sandstone dominated units
-  Mud-dominated units
-  Carbonate dominated units

-  Base meteoric system
-  Major growth fault zone

Site Location



- 50-year-old oil field in the Yegua and Frio Formations
- Operator is a small independent
- Flank of a salt dome, steep dips, fault bounded compartments



Project Evolution

1998-2001 – BEG assessment of onshore US targets for sequestration in brine formations and in Texas for EOR

2001-2002 – recommendations that investigations move to pilot scale partner with GEOSEQ team

8/2001 - Proposal of brine pilot site in the Frio to DOE/NETL

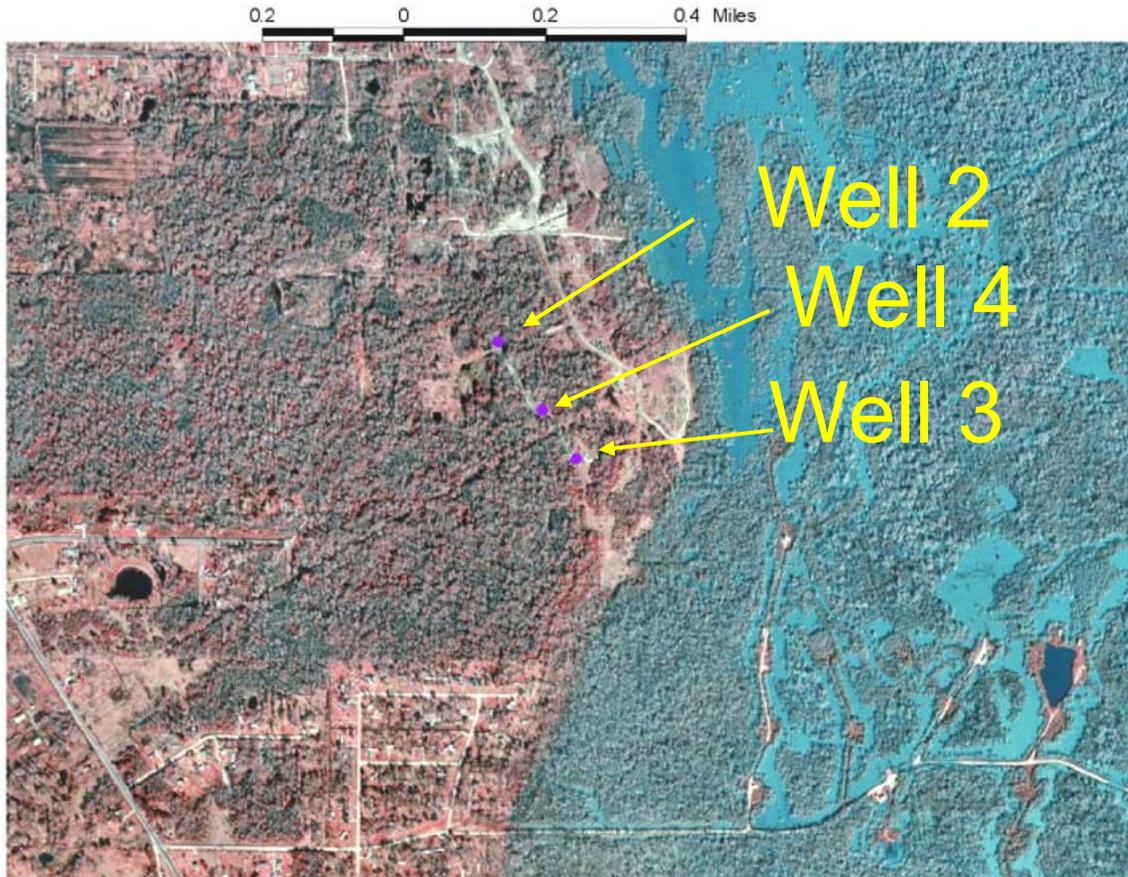
2/2002 - Selection of Frio brine pilot site by DOE/NETL

6/2002 Select Sandia Technologies – Field Service Provider

8/2002 Frio Pilot project began

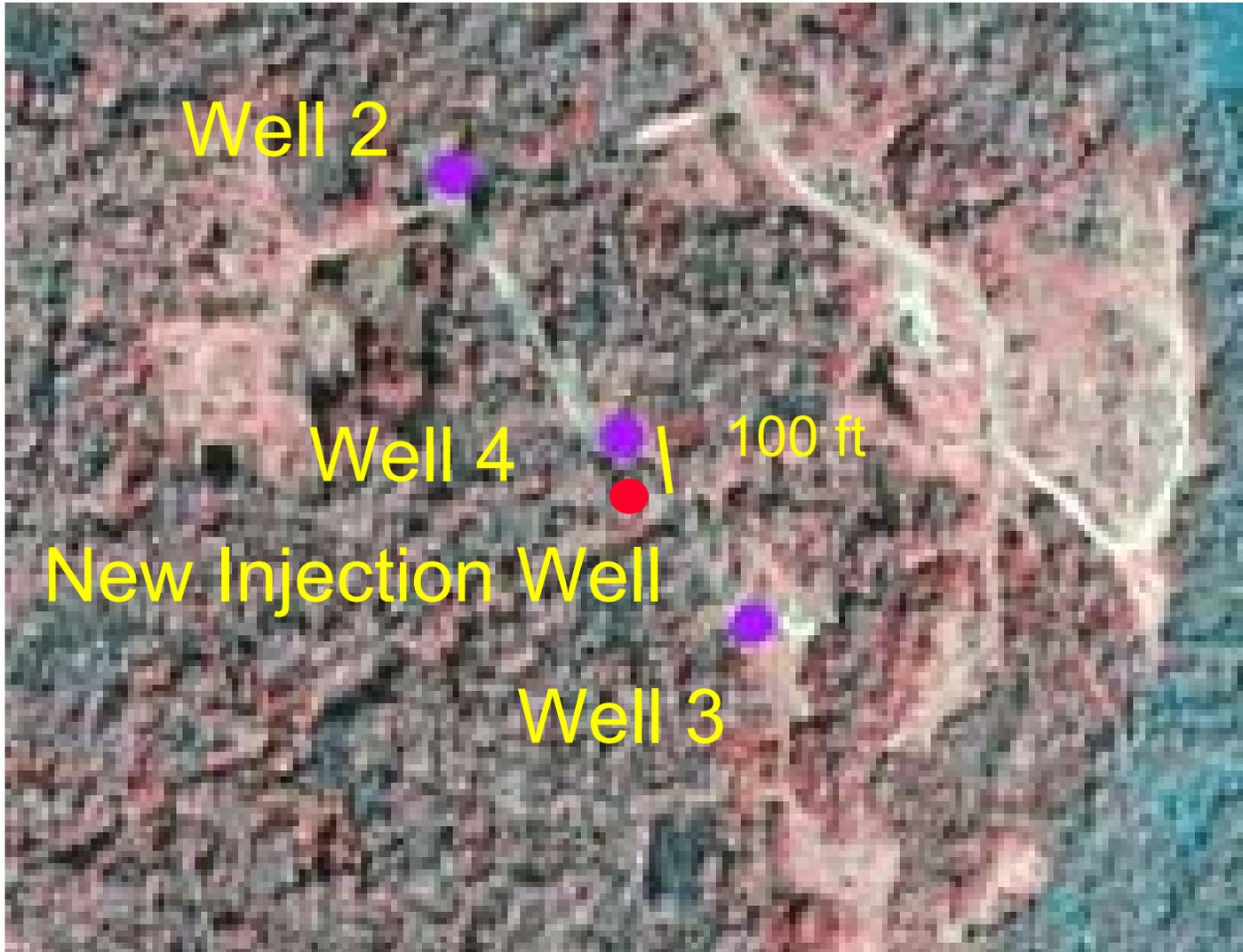
4/2002- 4/2003 Modeling and monitoring design – Geo-Seq

Site Details

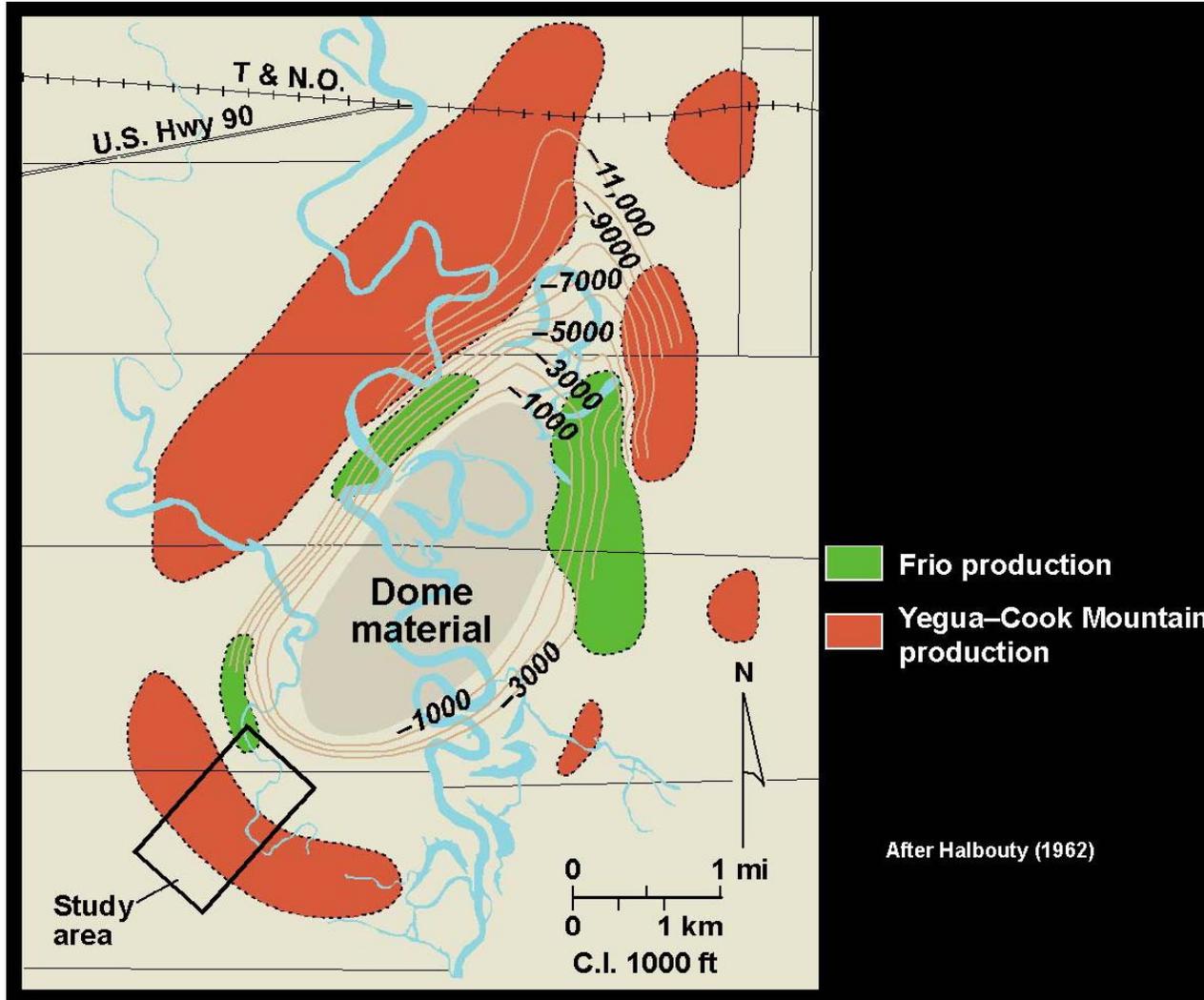


- **Historic oil field**
- **Uplands adjacent to the Trinity floodplain**
- **Acceptable land use, minimal environmental and community impact**
- **Abundant reservoir data**

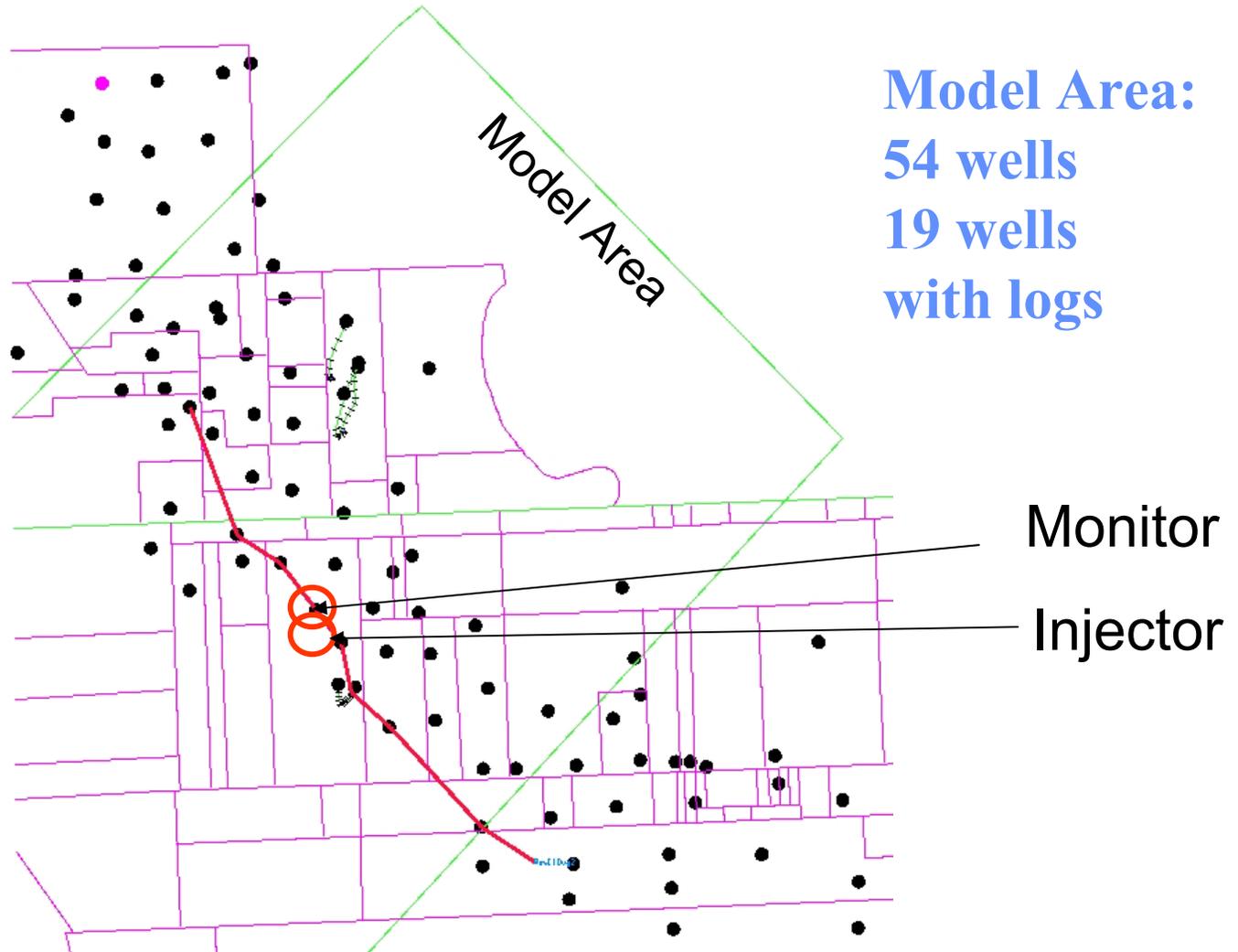
Well Locations



Site Geologic Setting



Production Base Map



Structural Cross Section

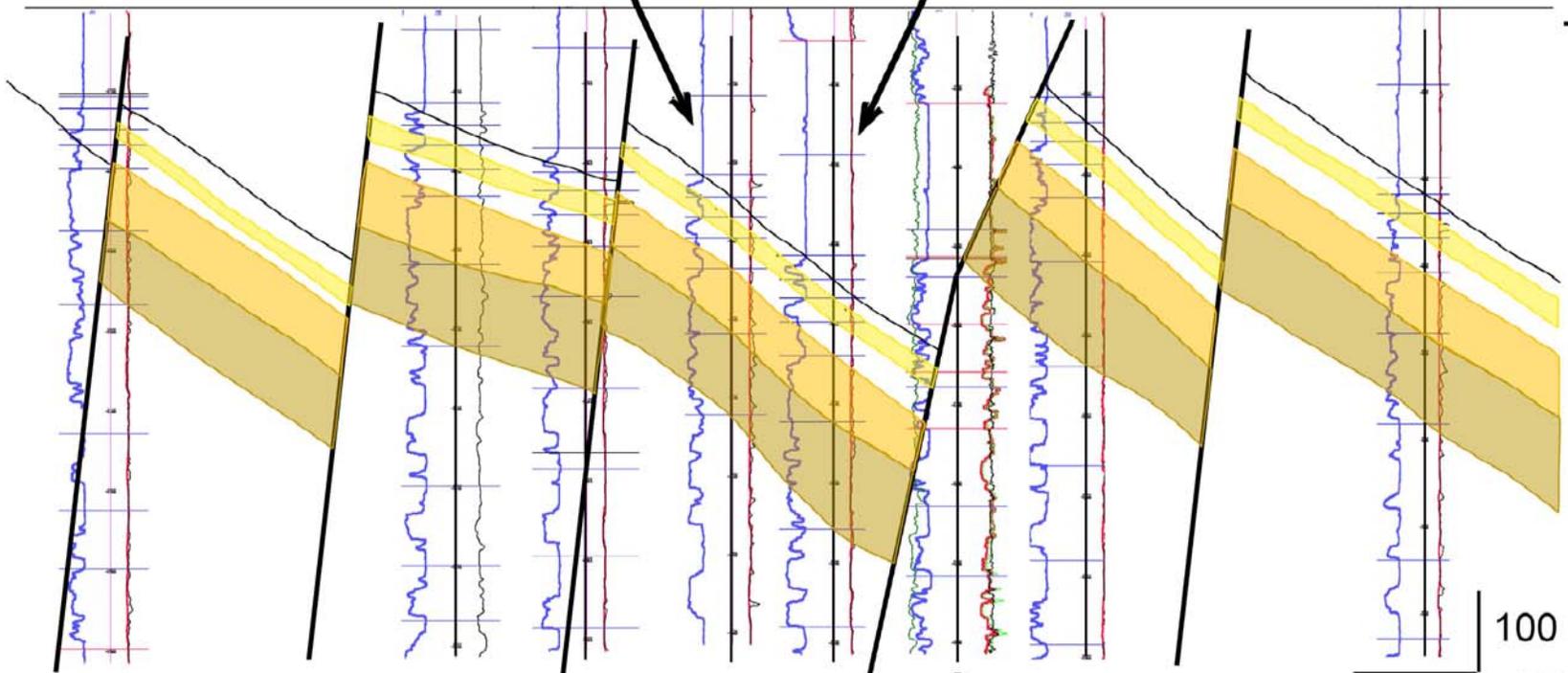
NW

SE

Well # 4

Well # 3

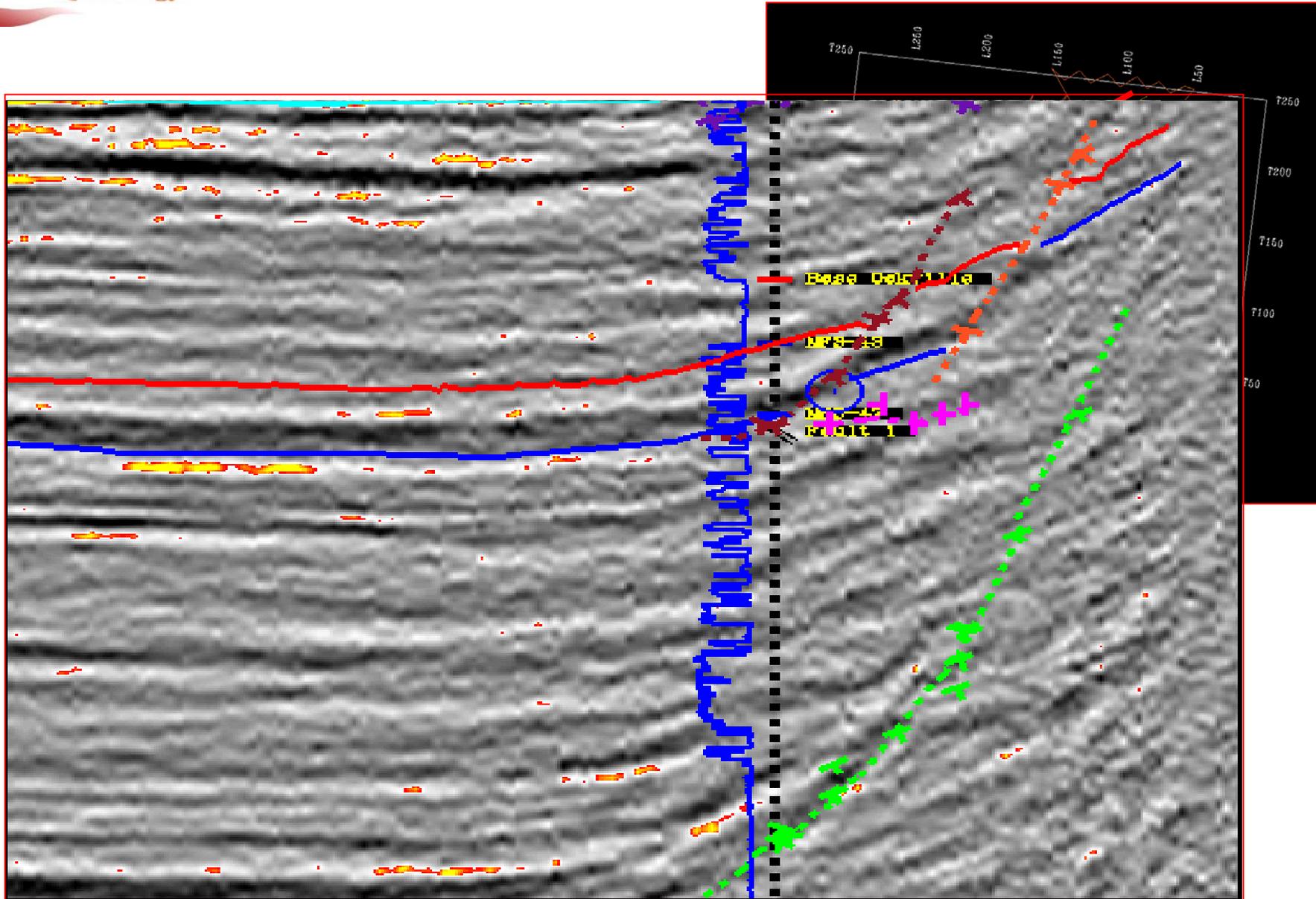
-4,600 ft.



Bend in section

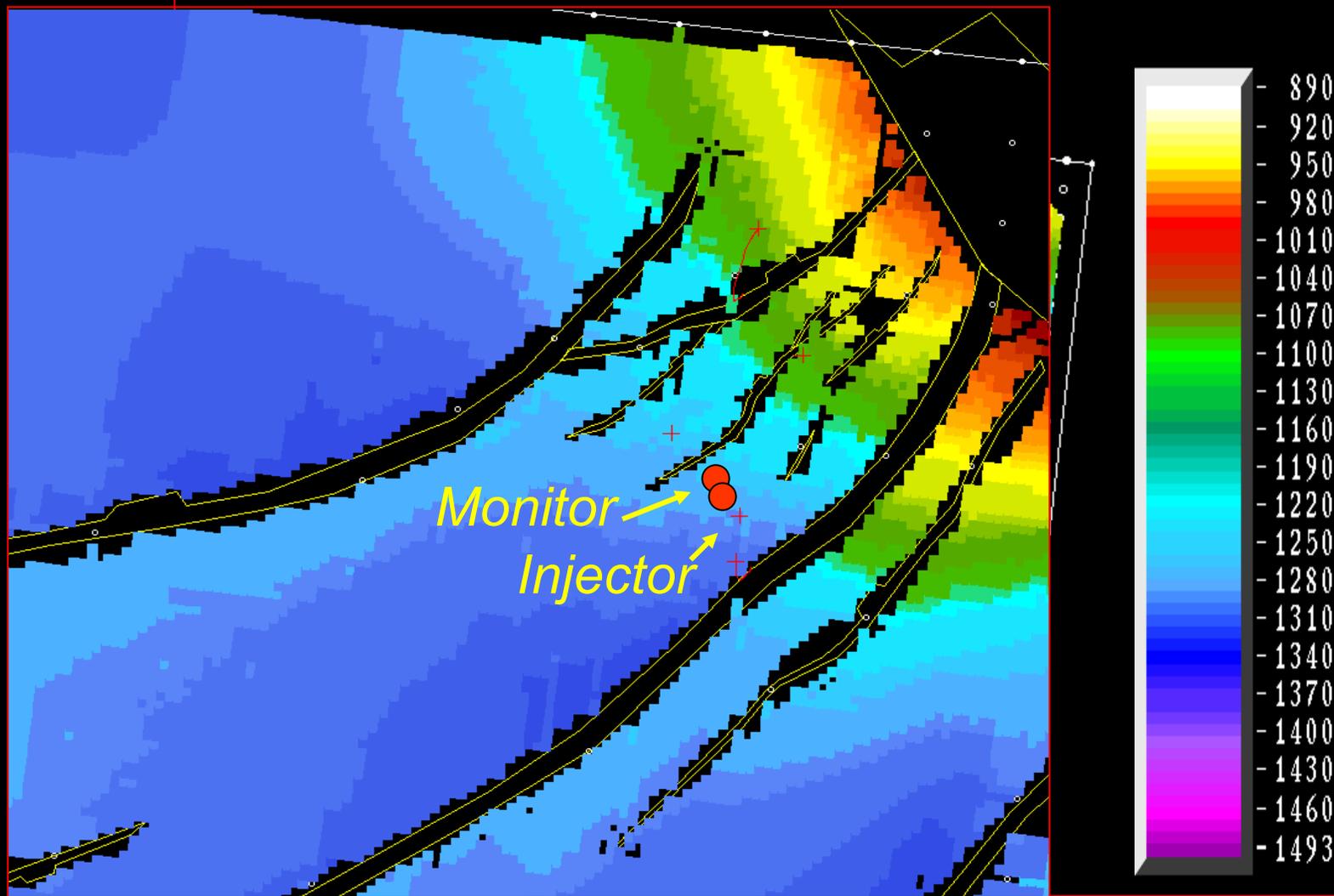
100
500 FT.

Representative NE-SW Line

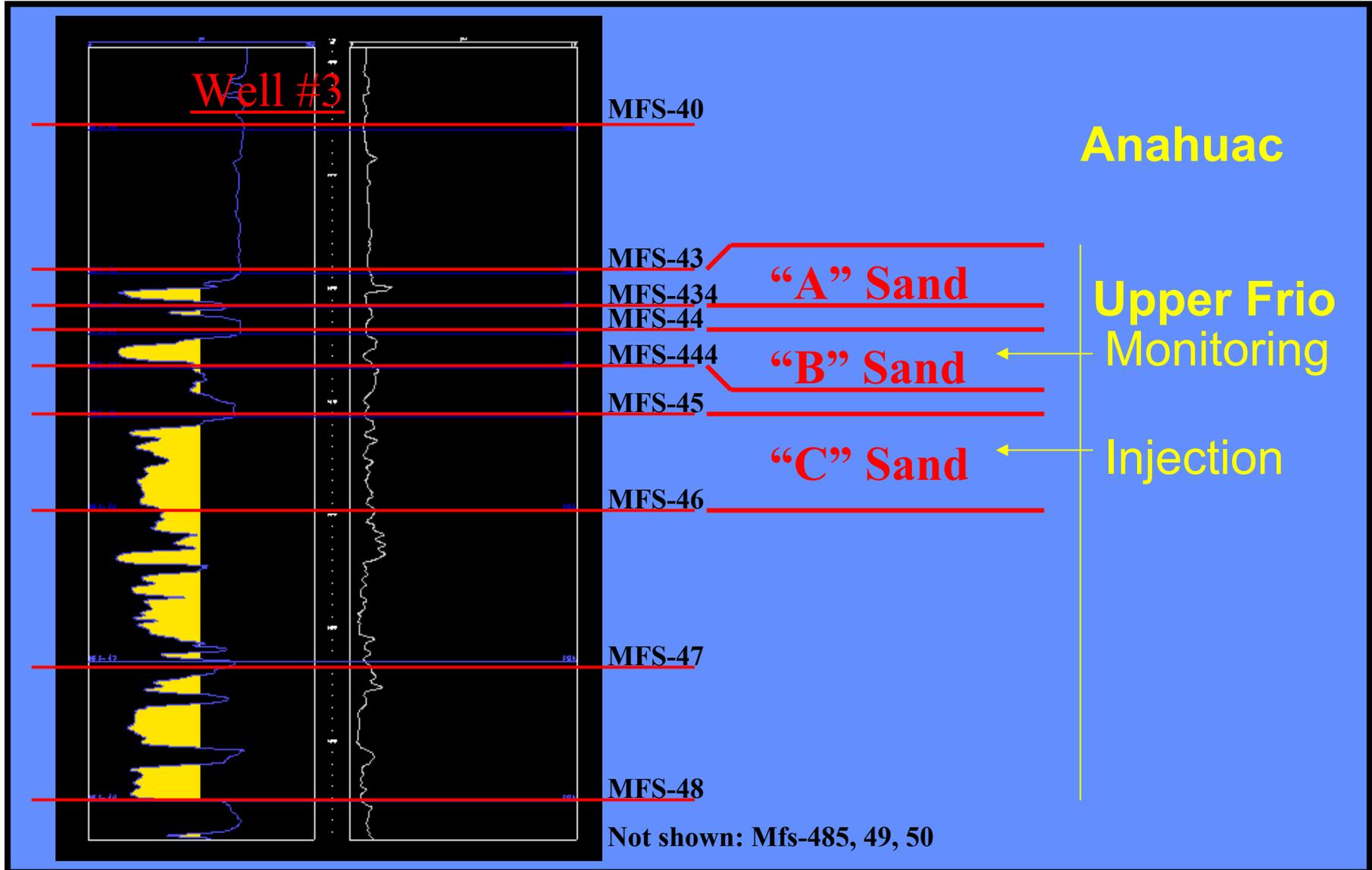


SEISMIC MAPPING

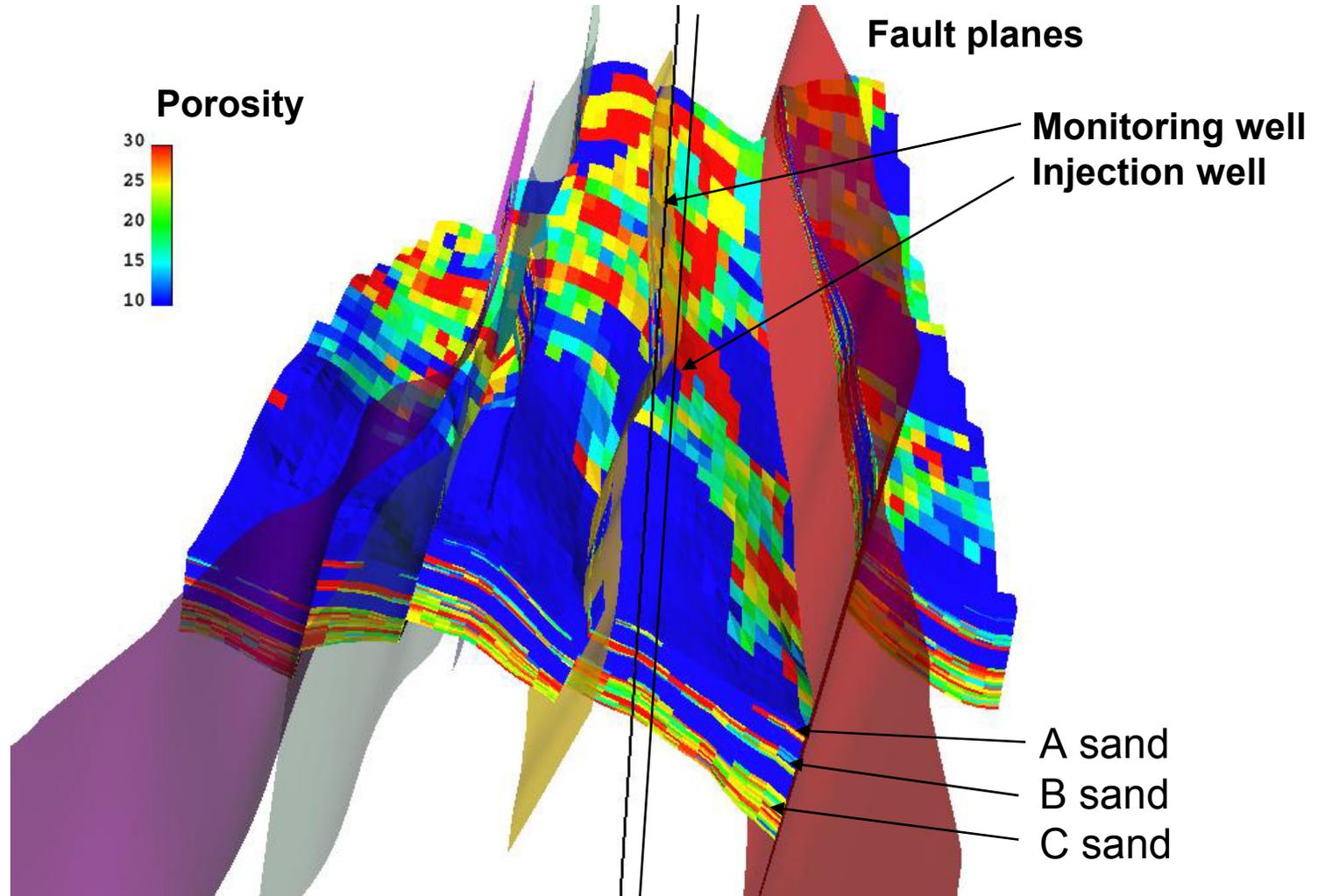
Time Structure on top MFS-43



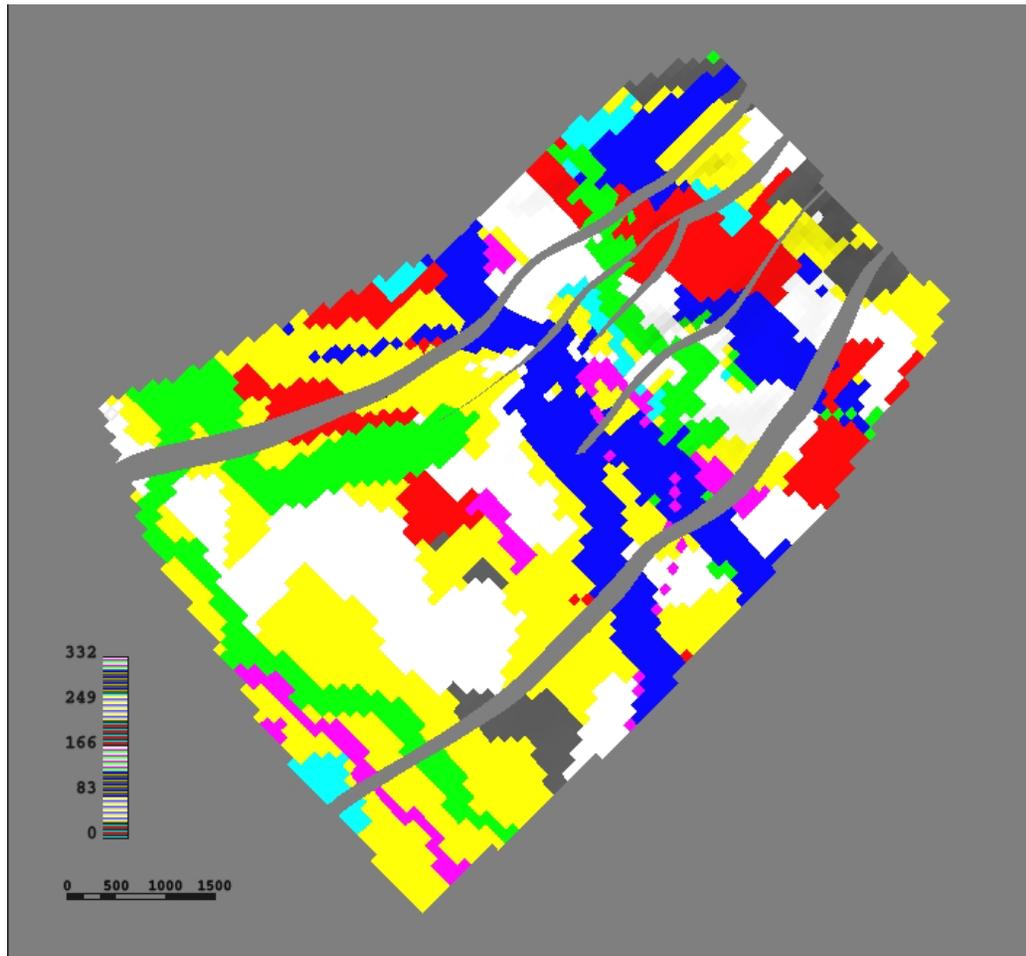
Stratigraphy



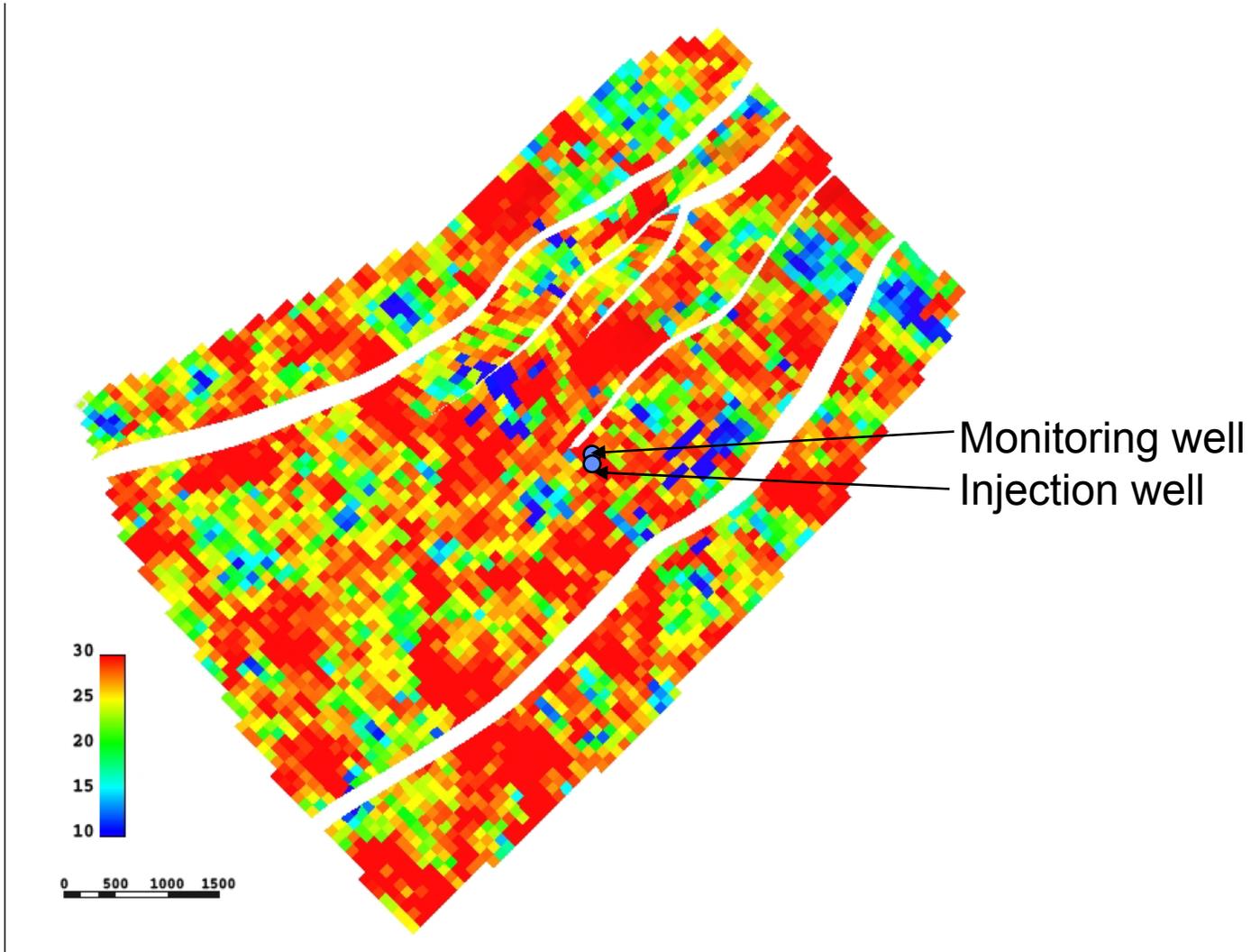
Reservoir Model



Heterogeneity Model



Typical Distribution of Porosity in "C"



- **Inject in new well**
 - **72 ft thick, upper Frio “C” reworked fluvial sandstone**
 - **Average 26% porosity at monitoring well, 100’s of Darcy’s, somewhat heterogeneous**
 - **Complex mineralogy – quartz, feldspar, rock fragments, clays**
 - **15 degrees dip estimated at injection well**
 - **Depth ~ 4900 ft**
 - **Brine, little or no hydrocarbon**
 - **3250 tones CO₂ from hydrogen plant, delivered by truck**
 - **Injection period a few weeks**
- **Monitor in recompleted #4 well**
 - **100 feet away, directly updip**
 - **Monitoring period 6 months to a year planned**
 - **Monitor in “C” as well as overlying “B” sand**

Pilot Progress

- **Model “Zero” preparation**
 - **Geologically constrained but simplified and probabilistic**
- **Reservoir Characterization**
- **Deterministic reservoir model created**
- **EA for NEPA**
 - **Federal NEPA**
 - **State Class 5 “experimental” well permit**
- **Experiment design**
- **Enter existing well**
- **Drill new well**
- **CO₂ injection**
- **Monitoring**
- **Assessment, concept and model validation**



Monitoring and Verification

- **Base-line and post injection monitoring**
 - **Surface: water, soil gas, introduced PFC tracers, passive seismic**
 - **Down hole seismic: cross well and VSP**
 - **Wireline logging**
 - **Natural and introduced tracers (PFC's, noble gasses)**
 - **Tilt?**
 - **Geochemical modeling**
 - **TOUGH2 modeling**
- (for more detail, please see additional talks Wednesday morning)**

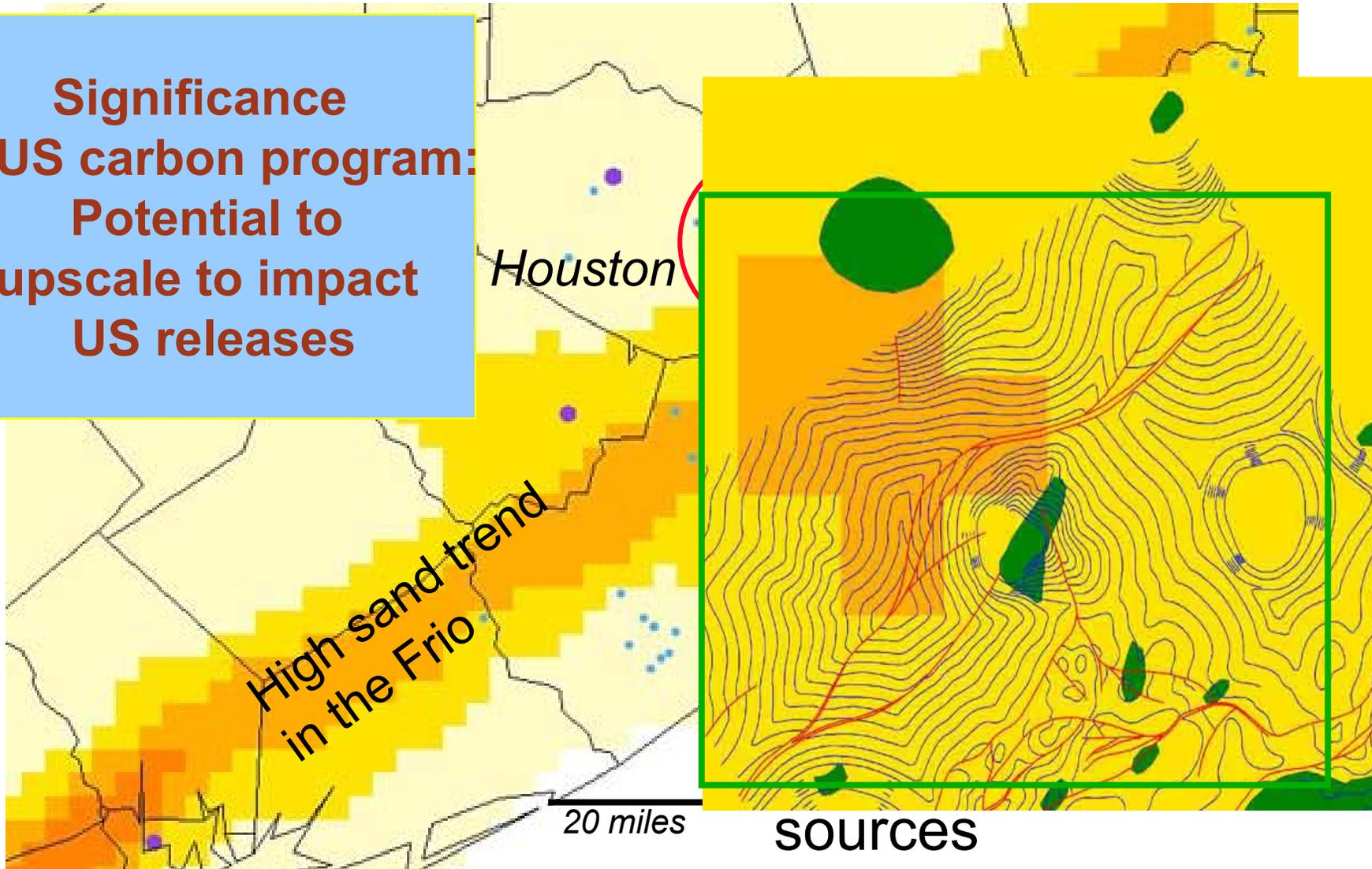
Pilot Goals

Early success in a high-permeability, high-volume sandstone representative of a broad area that is an ultimate target for large-volume sequestration.

- **Demonstrate that CO₂ can be injected into a brine formation without adverse health, safety, or environmental effects**
- **Determine the subsurface distribution of injected CO₂**
- **Demonstrate validity of conceptual models**
- **Develop experience necessary for success of large-scale CO₂ injection experiments**

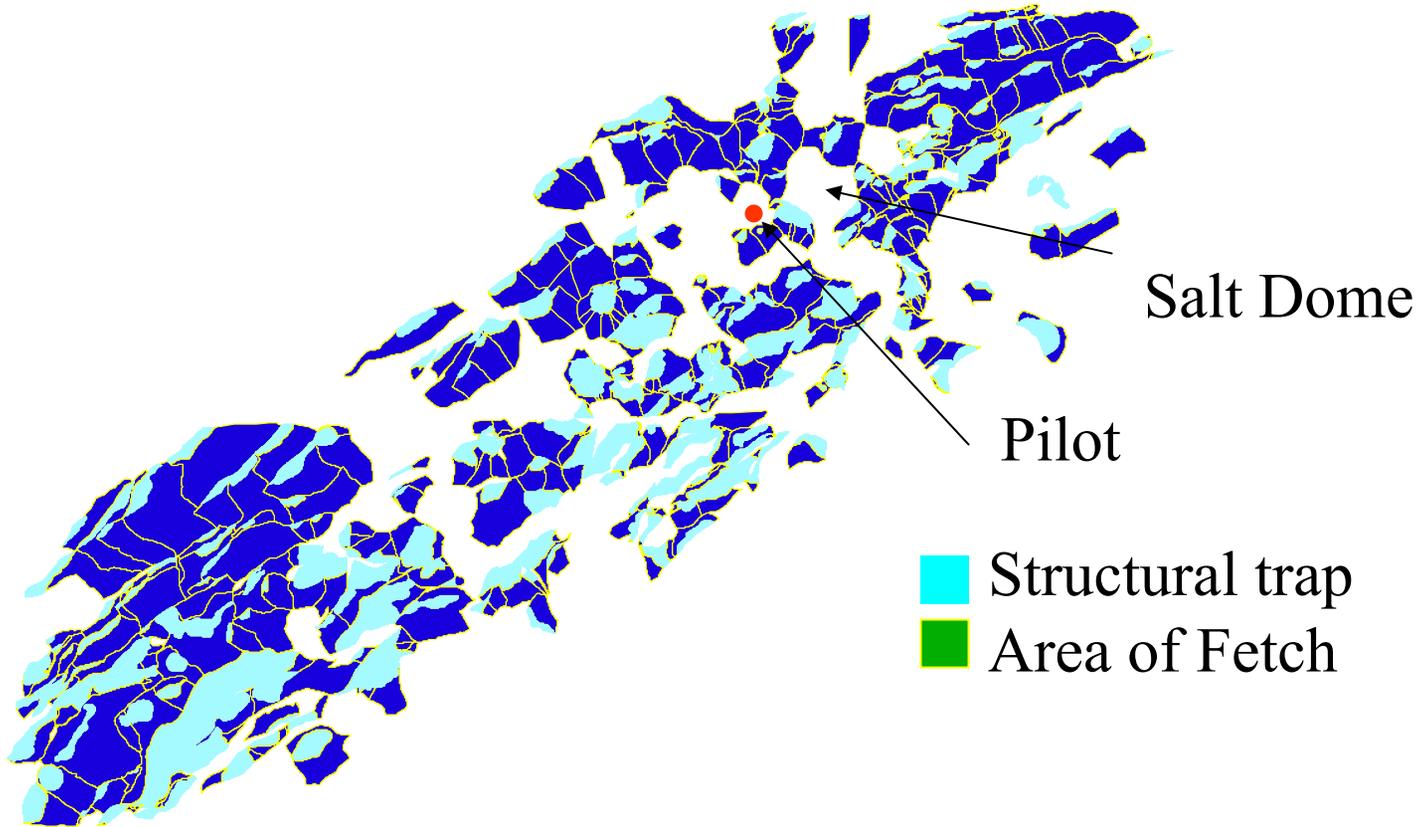
Scaling-Up to Regional

**Significance
to US carbon program:
Potential to
upscale to impact
US releases**





Statistical Model for Assessing Regional Sequestration Capacity



LONG-TERM FATE OF INJECTED CO₂

