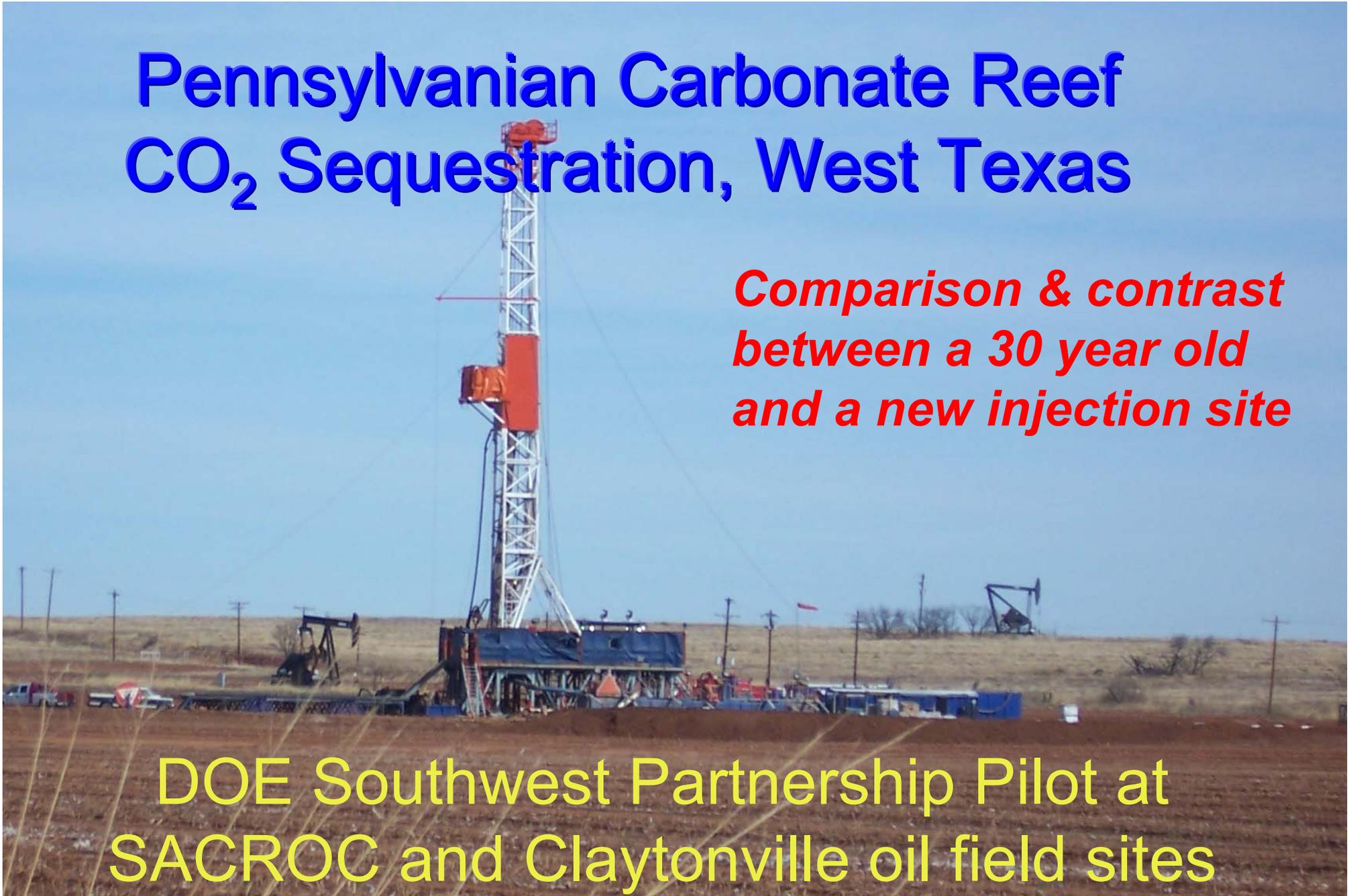


Pennsylvanian Carbonate Reef CO₂ Sequestration, West Texas

*Comparison & contrast
between a 30 year old
and a new injection site*

DOE Southwest Partnership Pilot at
SACROC and Claytonville oil field sites



Acknowledgements

Authors; Mark H. Holtz, Vanessa Núñez López, Rebecca C. Smith
The University of Texas, Austin

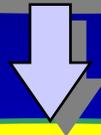
Special Acknowledgement to Industry
Sponsor Kinder Morgan



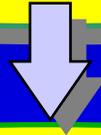
Subsurface Site Characterization Work Flow

Bureau of Economic Geology

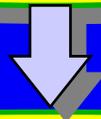
Ascertain Regional Geological Setting



Delineate Reservoir Architecture



Determine Fluid & Rock-fluid Properties



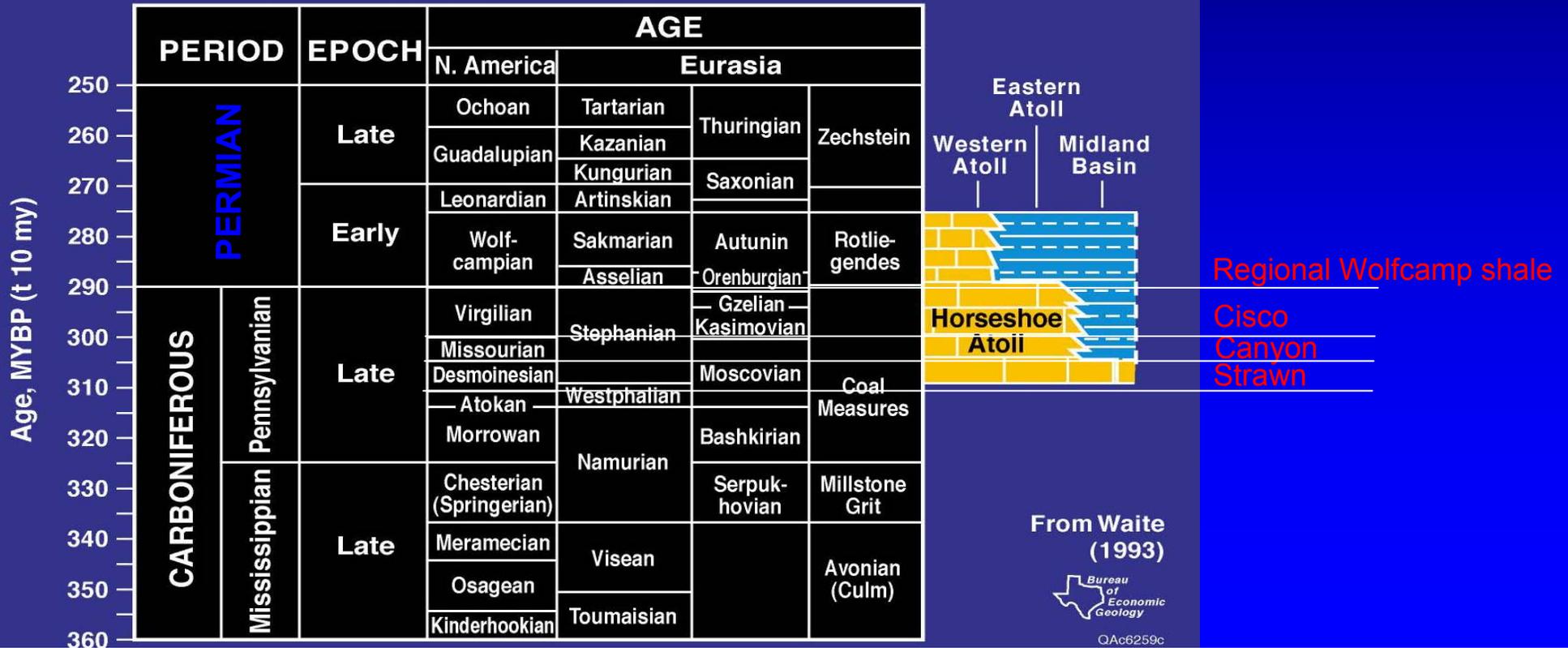
Construct Subsurface Model

West Texas Pennsylvanian Carbonate Reef Stratigraphic Setting

Bureau of Economic Geology

Reservoirs produce from Canyon- Middle Cisco age (290-307 Ma) platform and slope carbonates

STRATIGRAPHIC COLUMN—HORSESHOE ATOLL



SACROC & Claytonville

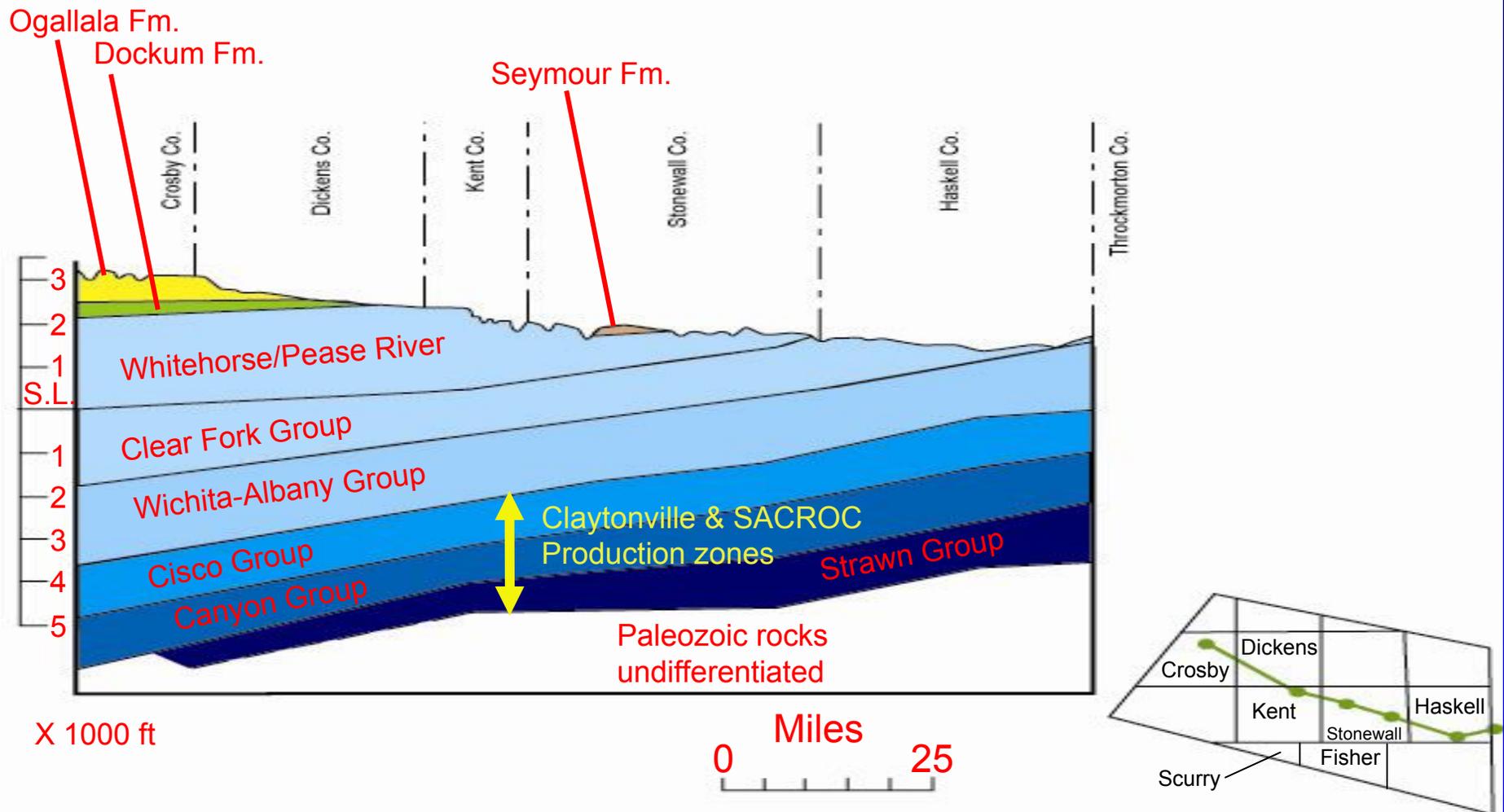
Location and Regional Geology

Bureau of Economic Geology



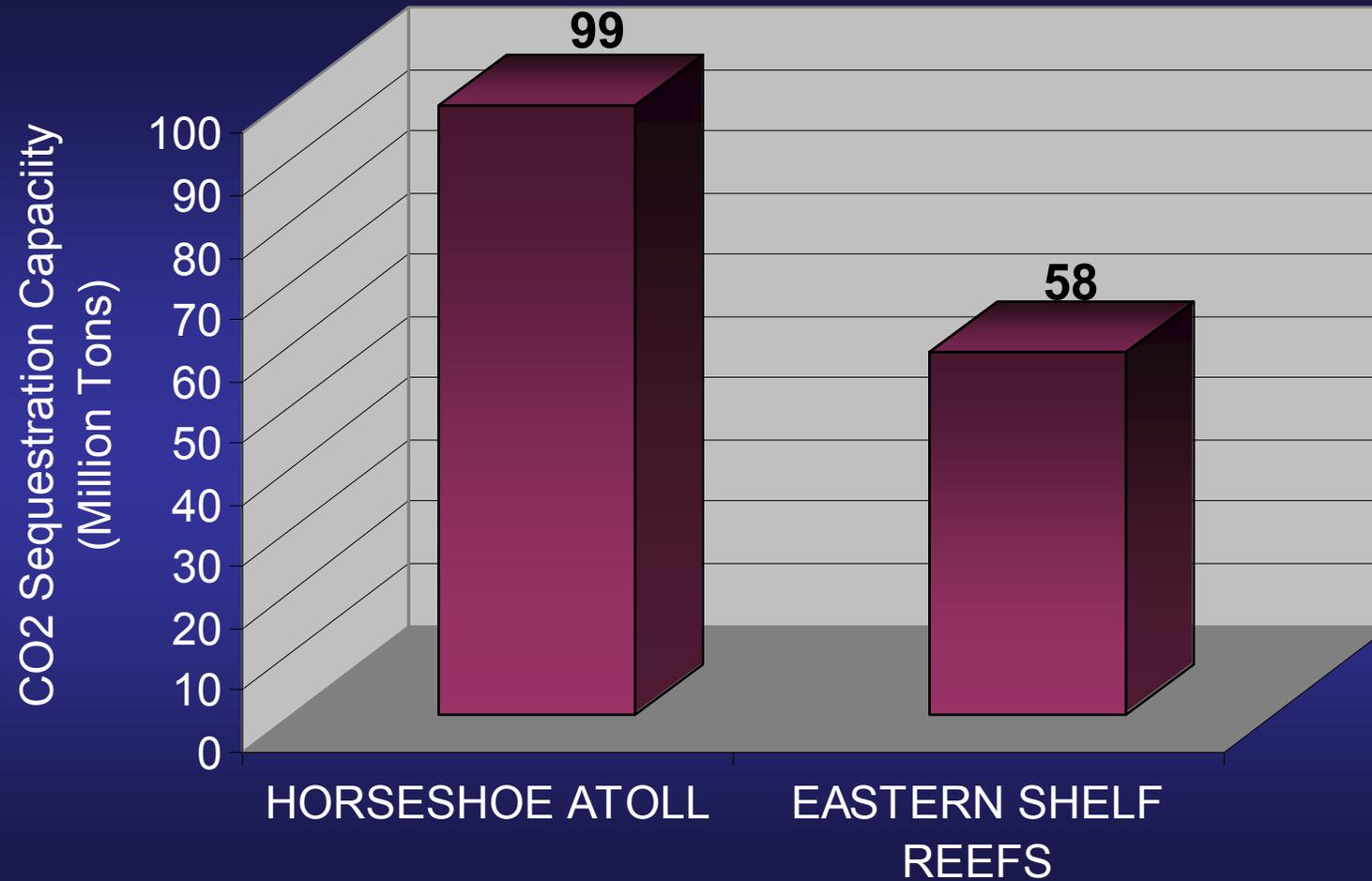
Eastern Shelf Stratigraphy

Bureau of Economic Geology



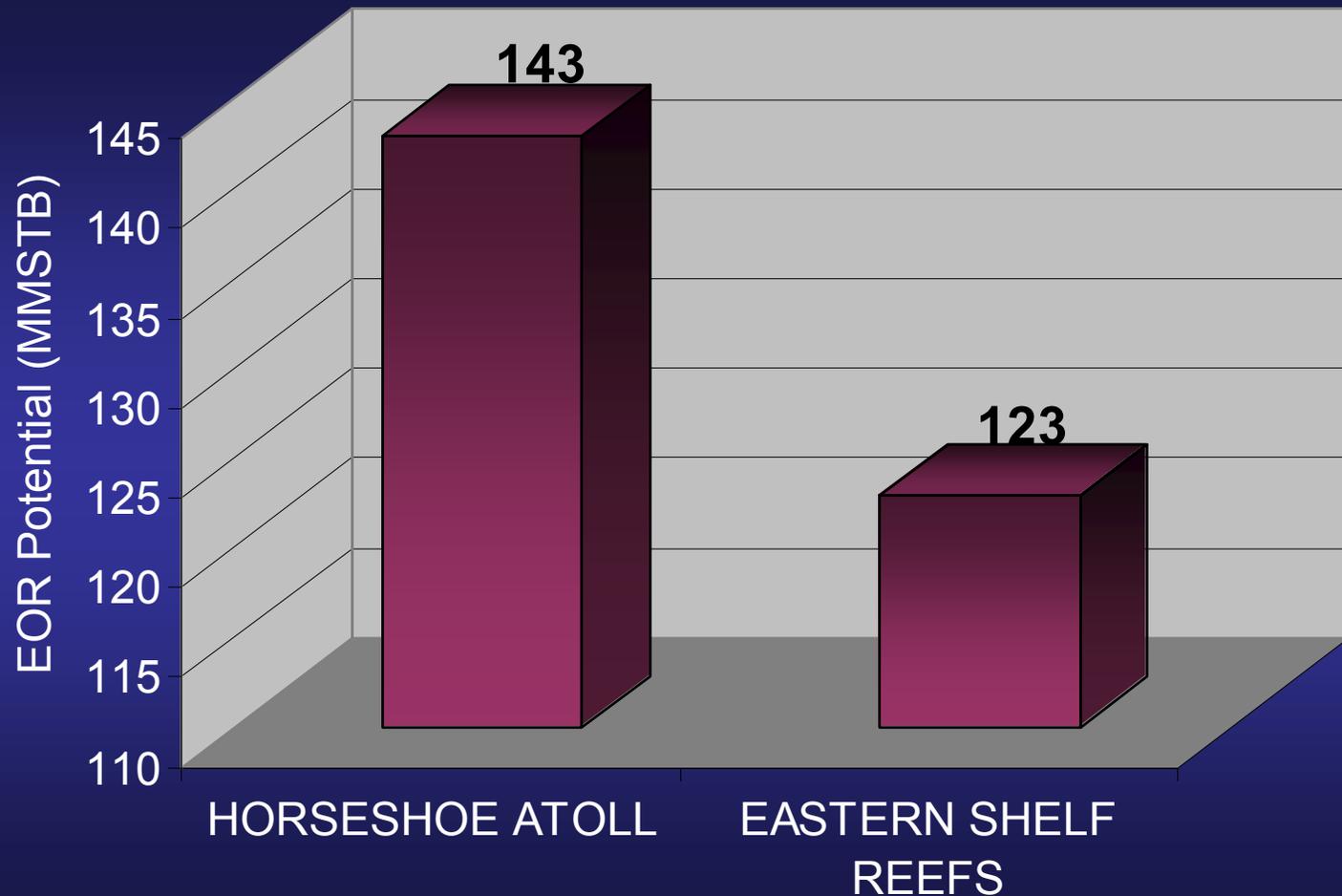
Pennsylvanian Reef CO₂ Sequestration Potential

Bureau of Economic Geology



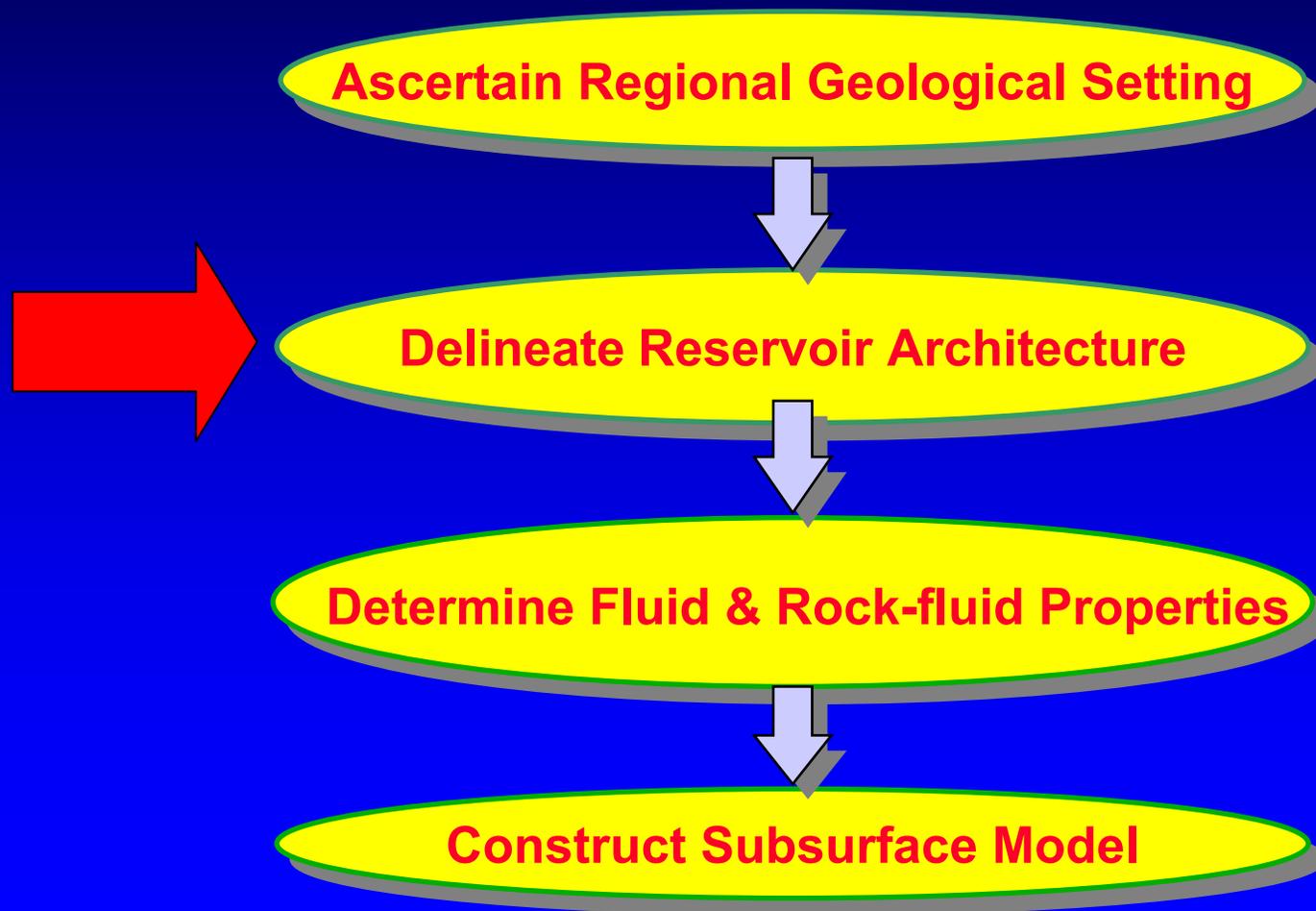
Pennsylvanian Reef CO₂ Miscible EOR Resource Potential

Bureau of Economic Geology



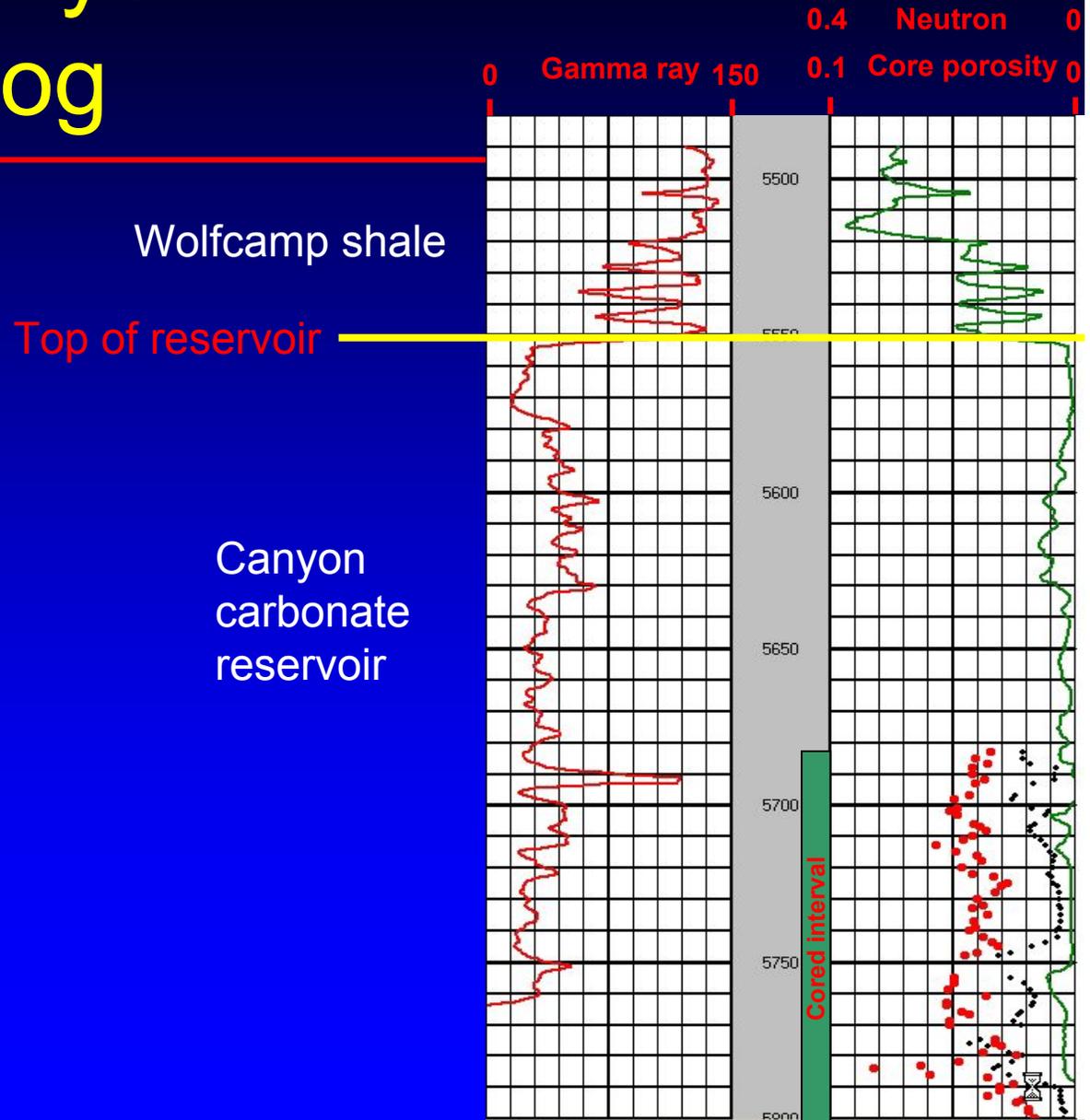
Subsurface Site Characterization Work Flow

Bureau of Economic Geology



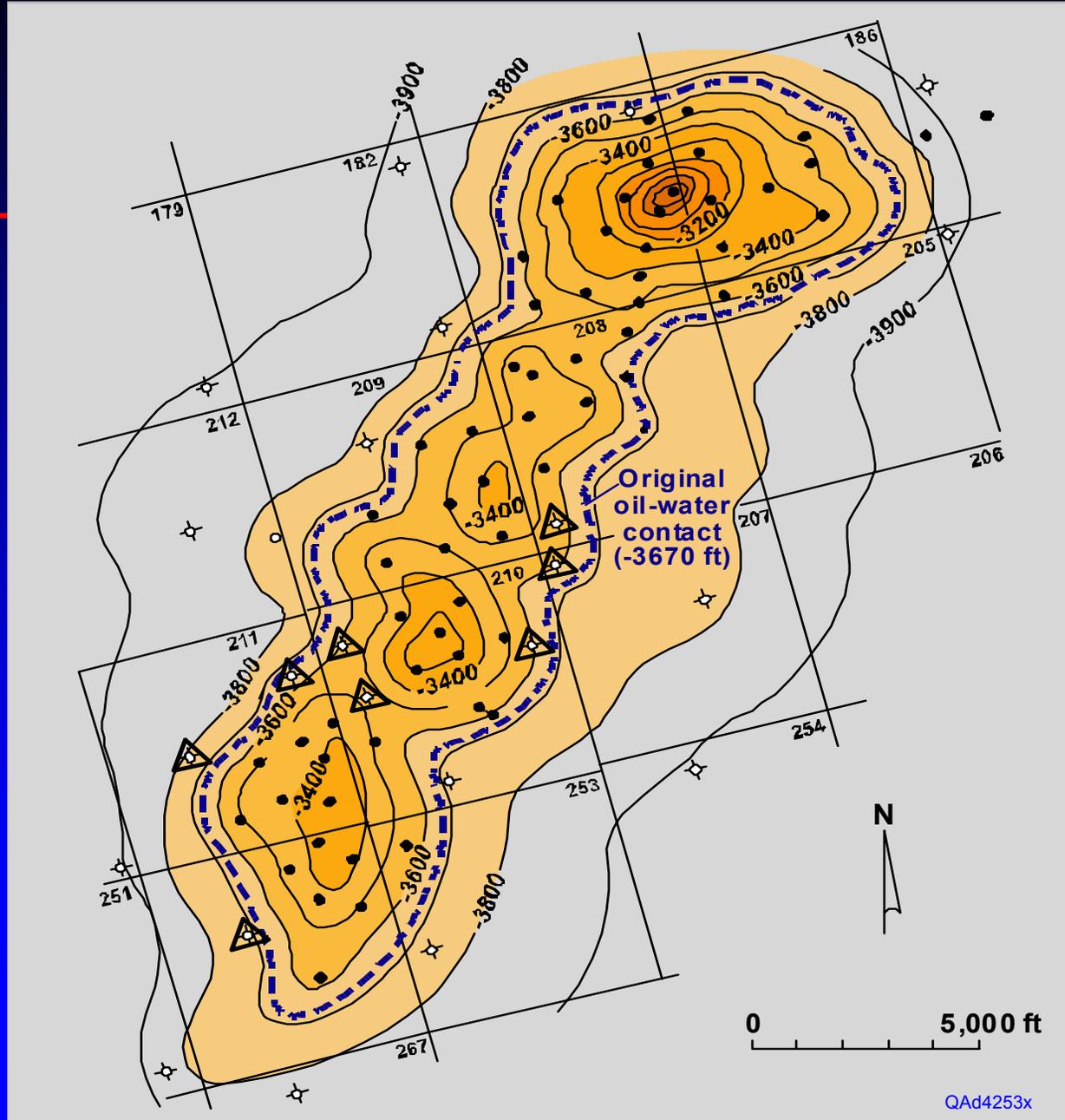
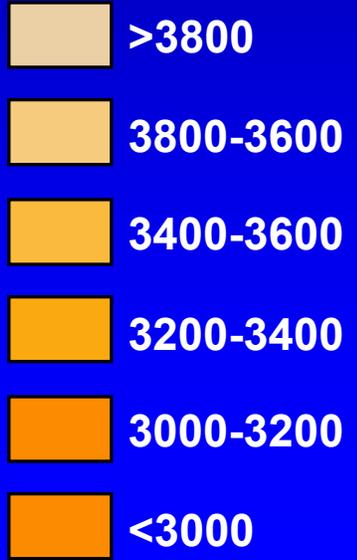
Claytonville Canyon Lime Type Log

Well 22-3



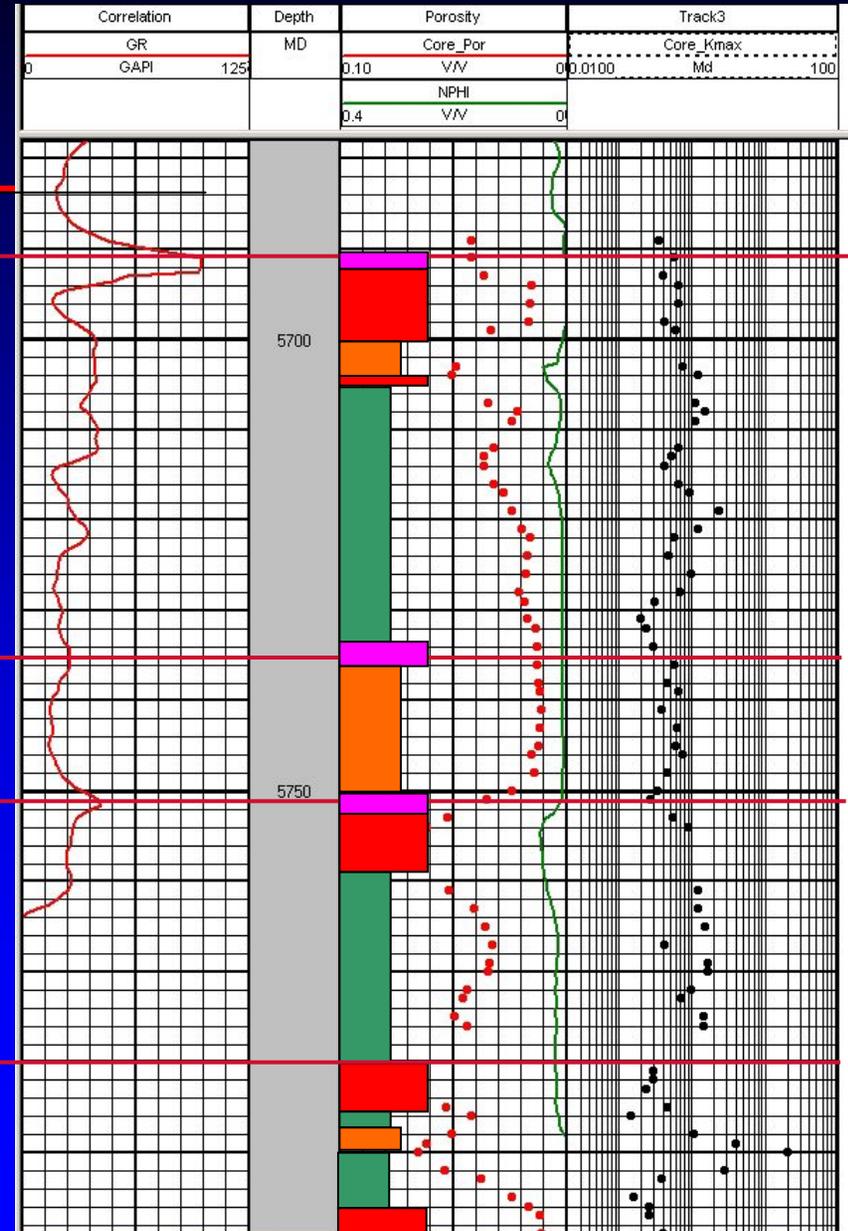
Claytonville Top of Structure

 Water injection well
Subsea depth to top of reservoir (ft)



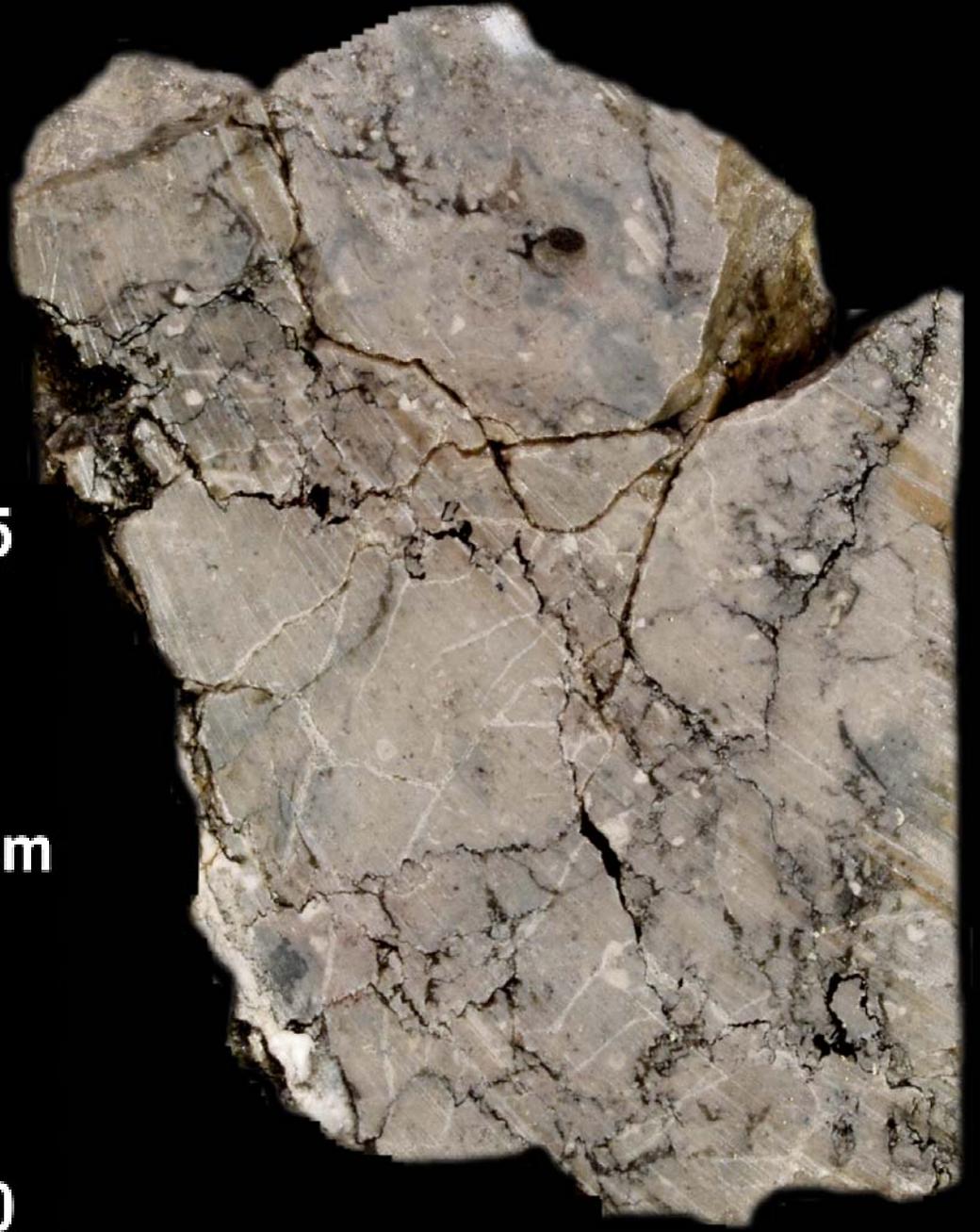
Lower reservoir composed of shoaling upward cycles

- Cycle Top _____
- Breccia
 - Grainstone
 - Skeletal pkst
 - Crinoid wkst
 - Mudstone



Fractured
Mudstone
Webb # 3
5,687b ft

5
cm
0



Crinoid
Wackystone
Webb # 3
5,684 ft



Grainstone

Webb # 3

5,778 ft



Breccia

Webb # 3

5,726b ft



**Breccia
Webb # 2
5,448 ft**



Webb # 2 5,448 ft

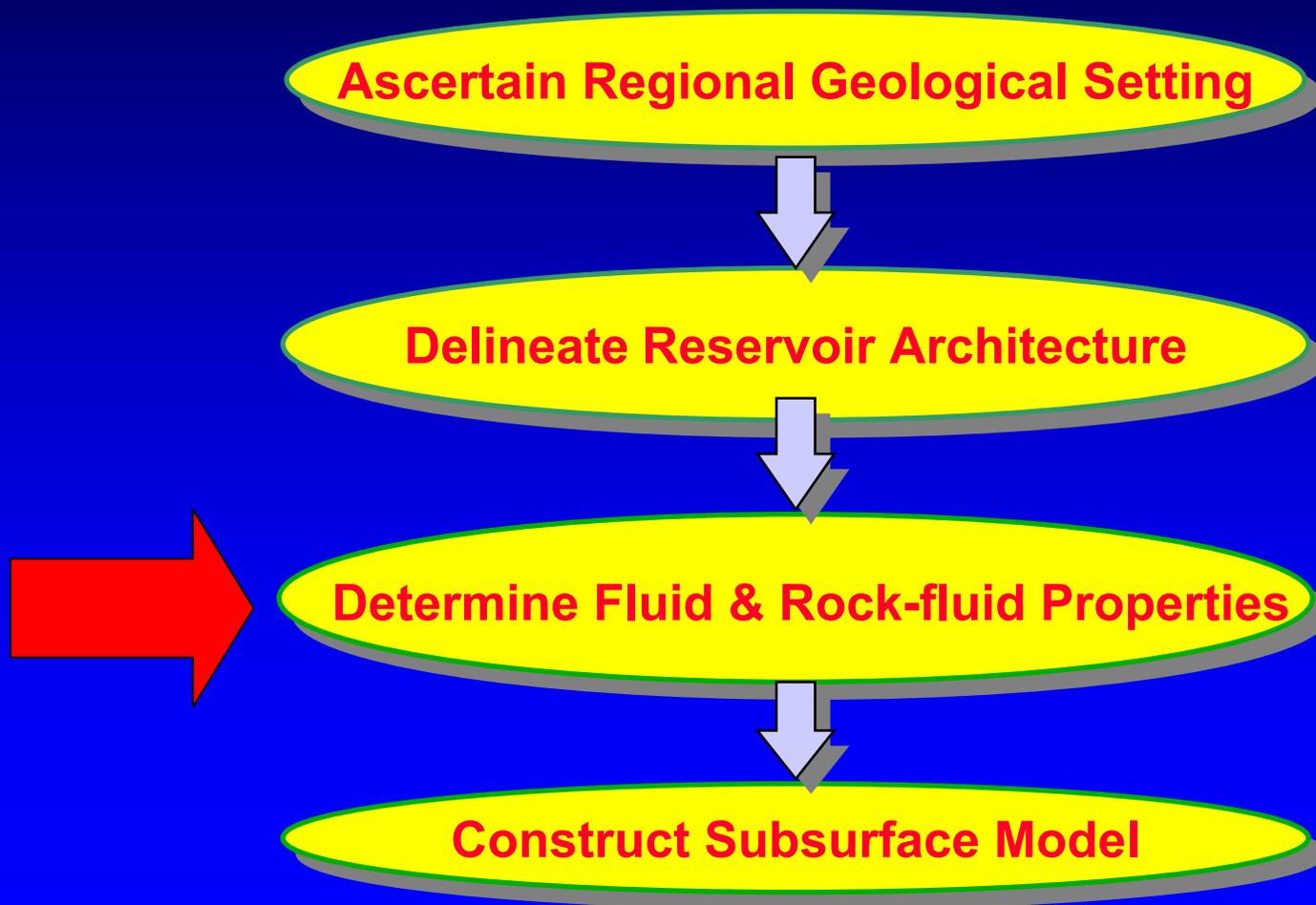


Large
Vugs
Webb #2
5,448a



Subsurface Site Characterization Work Flow

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Tasks For Establishing Fluid Flow Trends in a Reservoir

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- 1. Ascertain the initial fluid Properties**
 - 1. Reservoirs fluid properties**
 - 2. Overlying water properties**
- 2. Rock-fluid petrophysical properties**
- 3. Generate a production time series analysis**
- 4. Assess well test data**
- 5. Determine flow directions of injected fluids**

Reservoir Fluid Characteristics

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- Initial GOR: 1200 scf/STB
- Oil API gravity: 42
- Original oil formation volume factor: 1.510
- Bubble point pressure (psi): 1850
- Oil viscosity @ P_b (cp): 0.35
- Sulfur content of oil: 0.32
- Gas gravity: 1.13
- Connate water salinity (PPM): 59,000

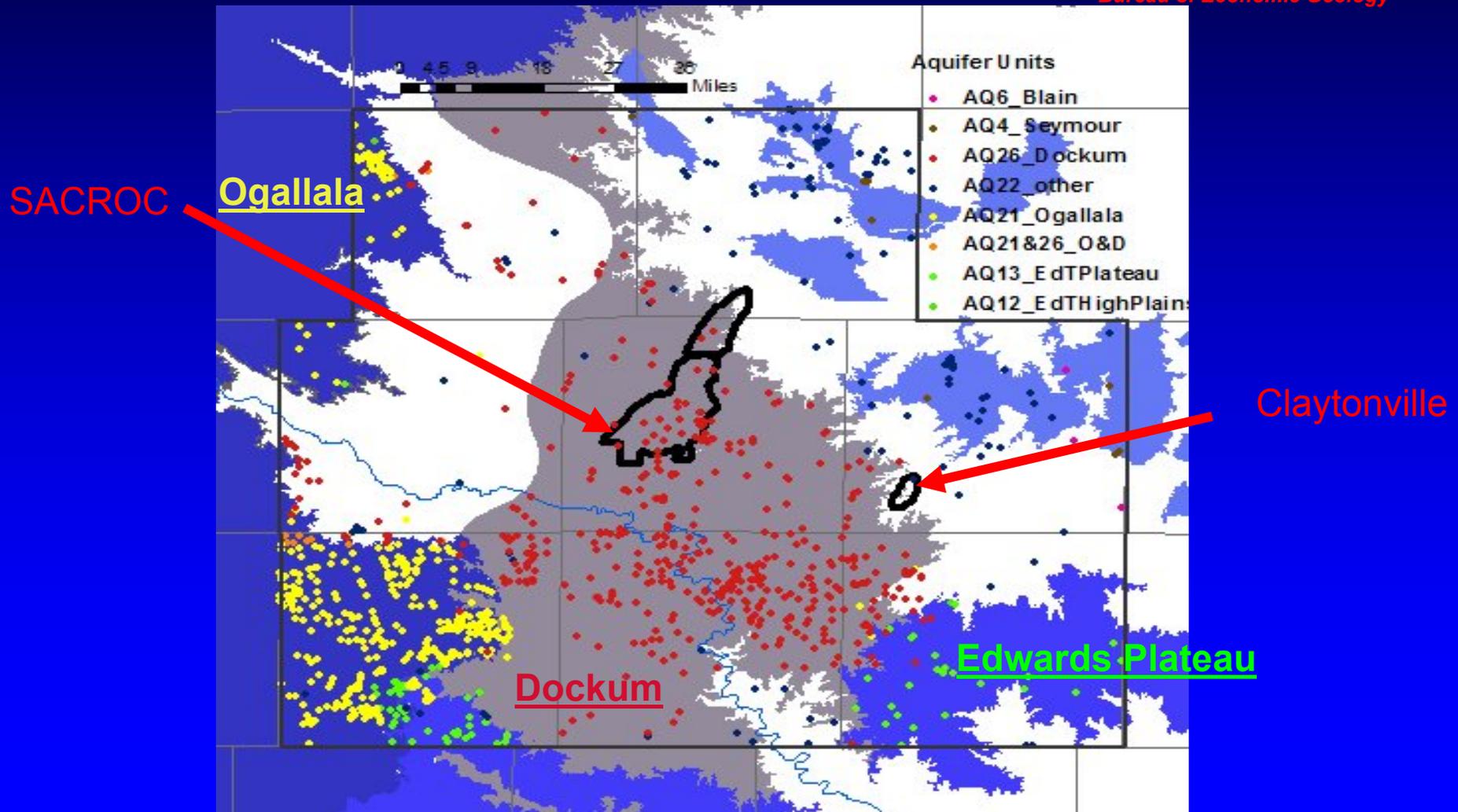
Groundwater Characterization

Bureau of Economic Geology

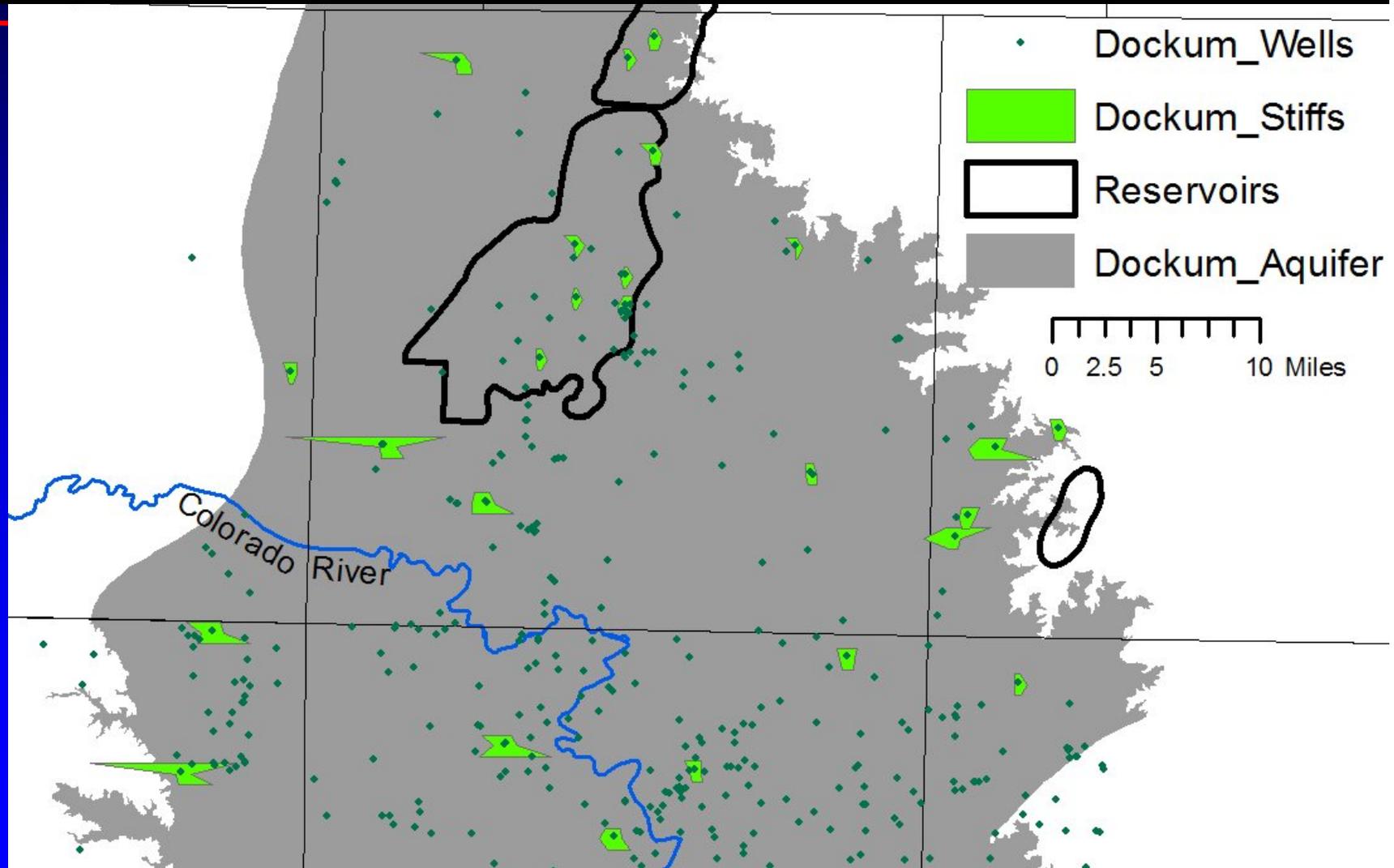
- Compile existing data from eight county study area
- Identify regional variability of existing analyses,
- Additional groundwater sampling (Install 4 new water wells in Claytonville)
 - major ion, total organic carbon,
 - stable isotopes of hydrogen (D/H), oxygen ($^{18}\text{O}/^{16}\text{O}$), and carbon ($^{13}\text{C}/^{12}\text{C}$);
 - Sr isotopes (reservoir brines and shallow groundwater)
 - pH, temperature, and alkalinity field measurements,
- Geochemical equilibrium and flowpath modeling to identify groundwater mixing.

Major and Minor Aquifers and Sample Wells

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Mapping water chemistry with stiff diagrams



Tasks For Establishing Fluid Flow Trends in a Reservoir

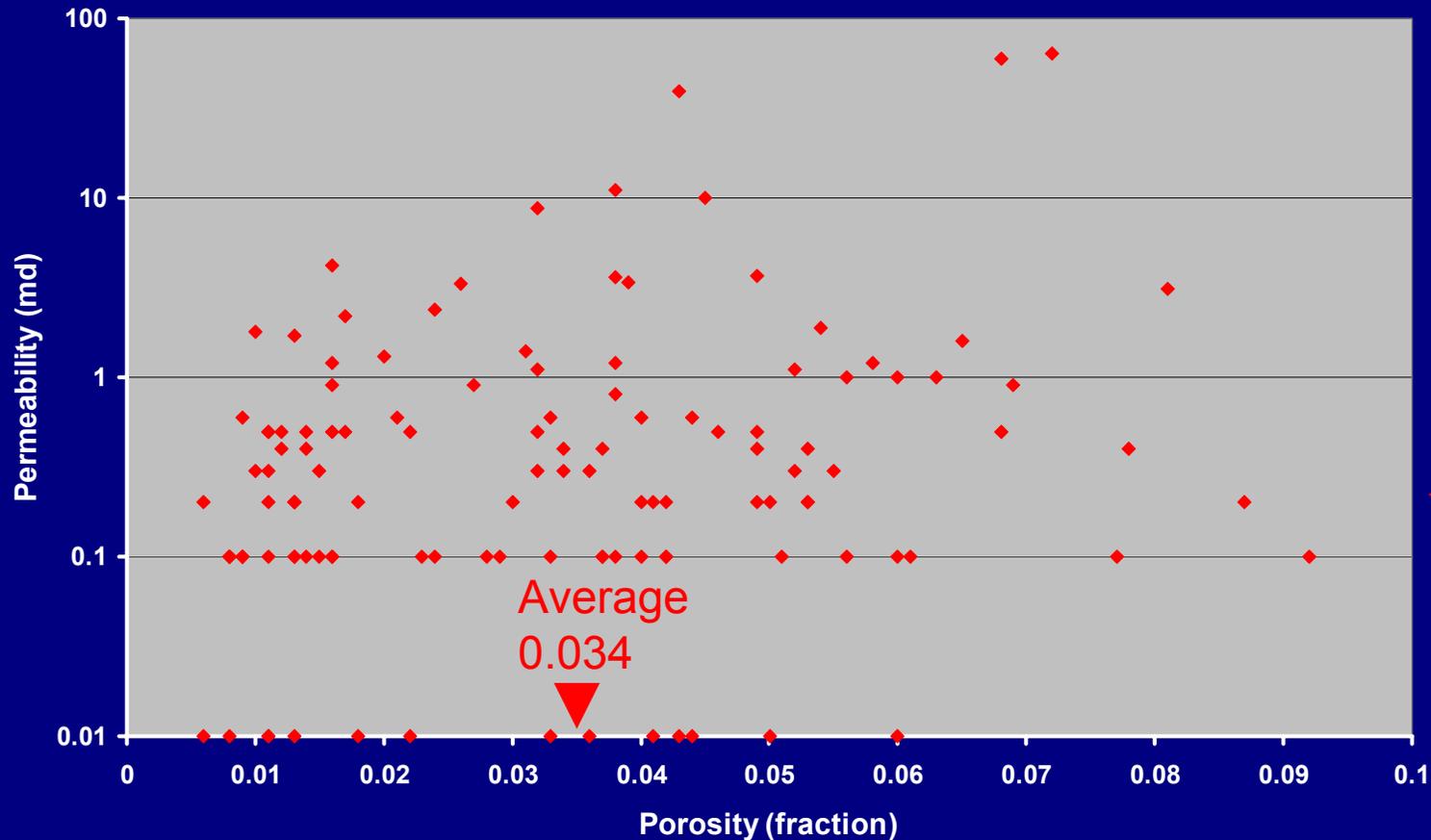
Bureau of Economic Geology

1. **Ascertain the initial fluid Properties**
 1. Reservoirs fluid properties
 2. Overlying water properties
2. **Rock-fluid petrophysical properties**
3. **Generate a production time series analysis**
4. **Assess well test data**
5. **Determine flow directions of injected fluids**

Porosity-Permeability Character Core Data Well 22-3

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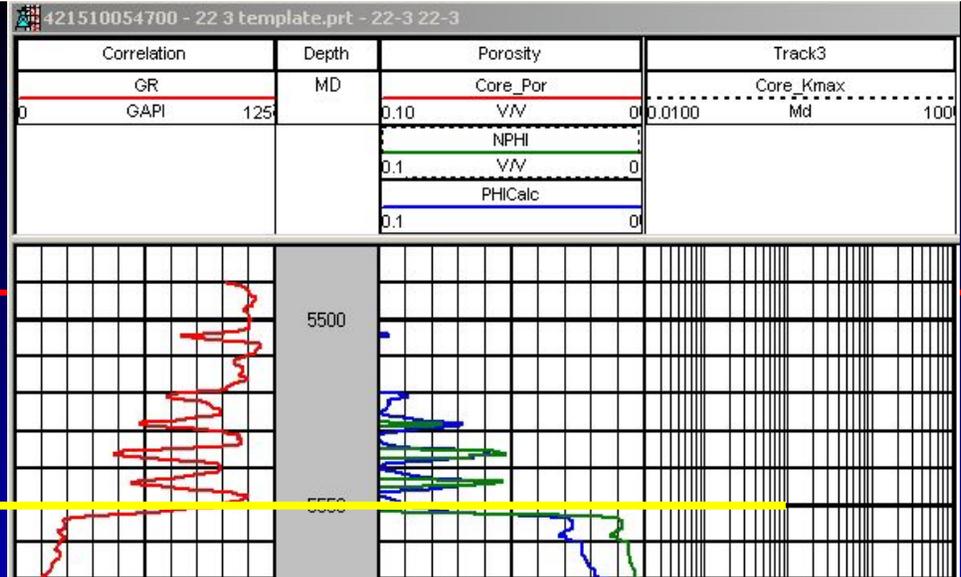
Puzzle is in the petrophysics ?



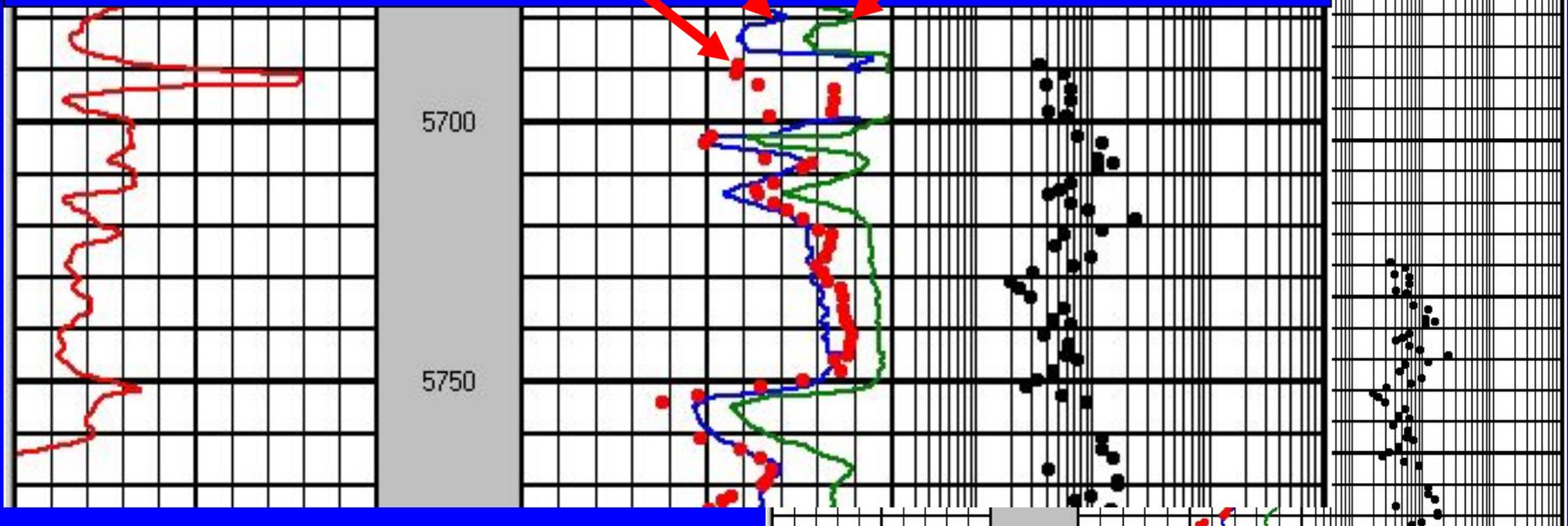
Permeability
Geometric
Average
0.283 md

Transform derived porosity

Top of reservoir



Core Transform Log



Summary

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- The SACROC/Claytonville Southwest Carbon Phase 2 project is being implemented in a Carbonate Pennsylvanian Reef setting
- Project is a comparison/contrast between a 30 year old injection site and a new injection site
- Progress to date
 - 3 D seismic and VSP
 - New well drilled, cored and wireline logs obtained
 - Subsurface characterization in progress
- CO₂ injection scheduled for spring 2007



Thank you