



# SITE CHARACTERIZATION FOR CO<sub>2</sub> STORAGE FROM COAL-FIRED POWER FACILITIES IN THE BLACK WARRIOR BASIN OF ALABAMA

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## DE-FE0001910



# Southeastern Projects

Oil and Gas Fields  
of the SECARB Region

SECARB Coal Test  
CNX CBM well

SECARB Coal Test  
El Paso CBM well

DOE Site Characterization  
AL Power Plant Gorgas

Central Appalachian  
Unconventional Sinks

Kemper County IGCC  
Mississippi Power

DOE Site Characterization  
Triassic rift basins

SECARB EOR and Saline tests  
Cranfield, MS (BEG)

National Carbon Capture  
Center Wilsonville, AL

CCPI-3  
Houston, TX

UA Citronelle  
Geochemistry

SECARB Anthropogenic test  
Alabama Power Plant Barry

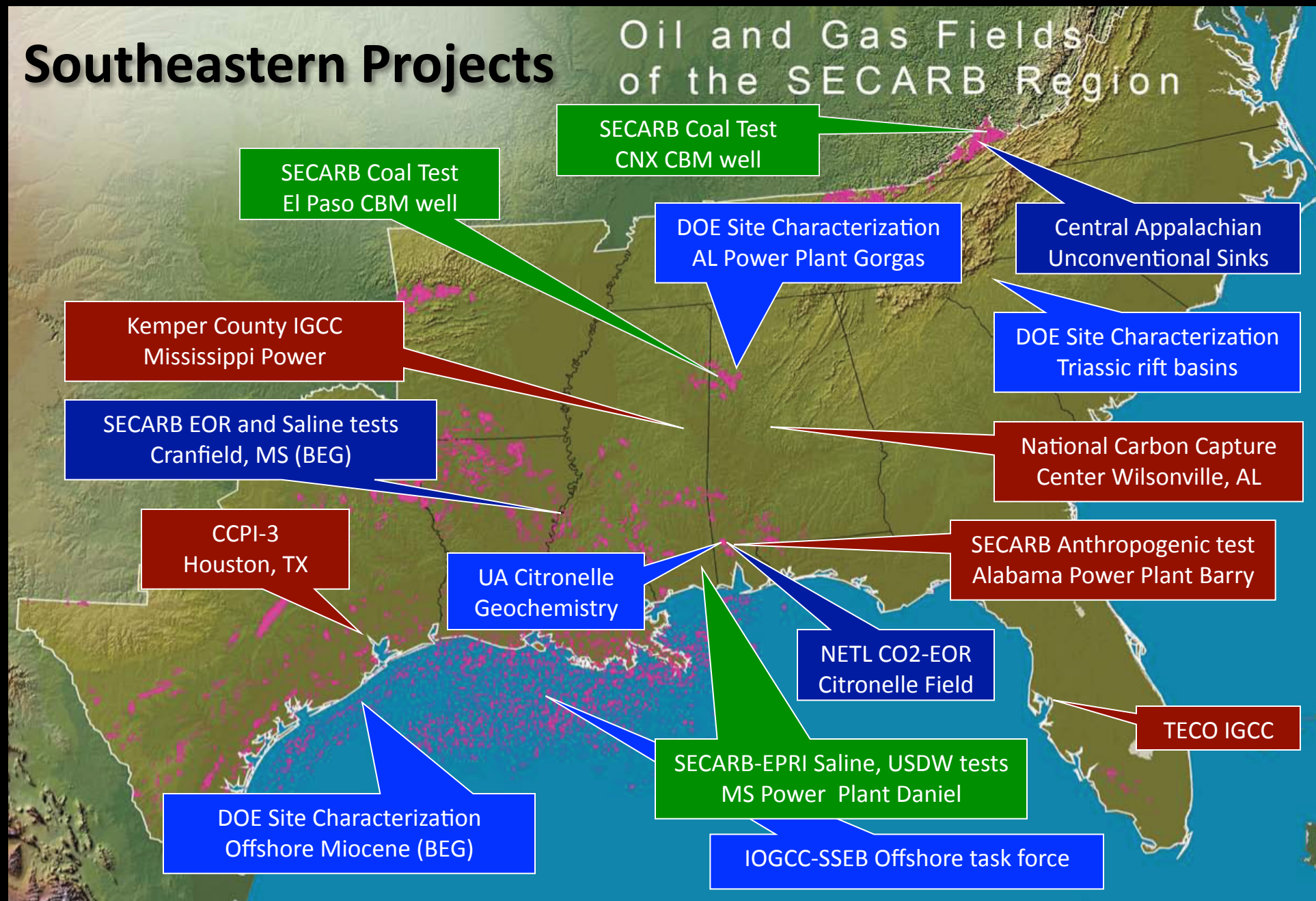
NETL CO<sub>2</sub>-EOR  
Citronelle Field

TECO IGCC

SECARB-EPRI Saline, USDW tests  
MS Power Plant Daniel

DOE Site Characterization  
Offshore Miocene (BEG)

IOGCC-SSEB Offshore task force







# **PROJECT TEAM**

**The University of Alabama (Lead)**  
**Geological Survey of Alabama**  
**Rice University**  
**University of Alabama at Birmingham**  
**Southern Company, Alabama Power**  
**Schlumberger Carbon Services**  
**Micro-g Lacoste**  
**SECARB**



# PROJECT GOALS

**Assess the risks associated with geologic carbon storage in the Black Warrior basin.**

**Develop a regional plan and BPM for carbon sequestration.**

**Analyze the CO<sub>2</sub> storage capacity and injectivity of stacked saline formations in the Cambrian-Pennsylvanian section of the Black Warrior basin.**

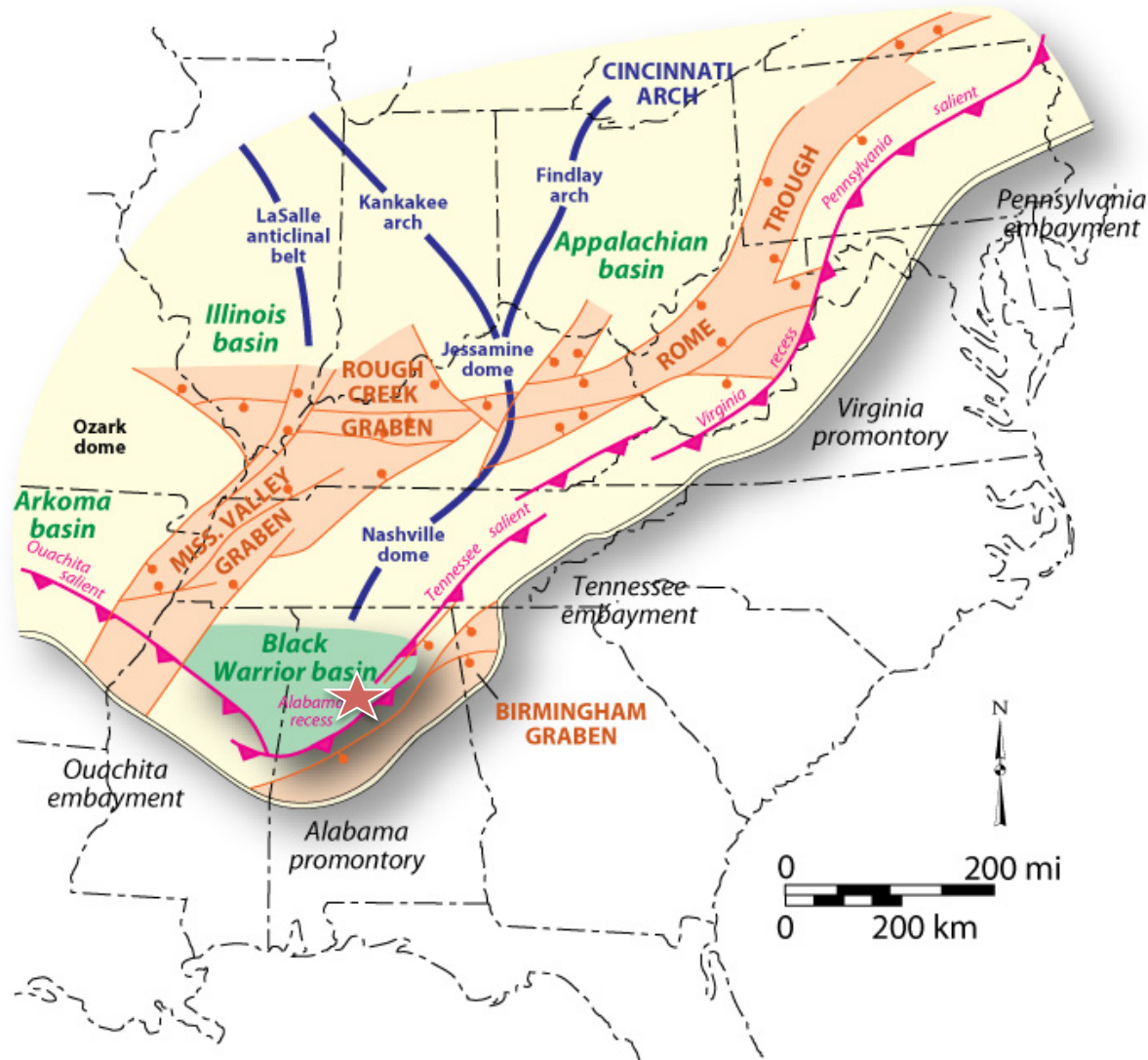


# PROJECT OBJECTIVES

- Assess saline reservoirs, O&G reservoirs
- Shoot 2-D seismic profiles
- Drill geologic test well at Plant Gorgas
- Core reservoirs and seals
- Quantify reservoir properties
- Analysis of mineralization, dissolution, seals
- Reservoir simulation
- Develop best practices manual
- Leave infrastructure at plant

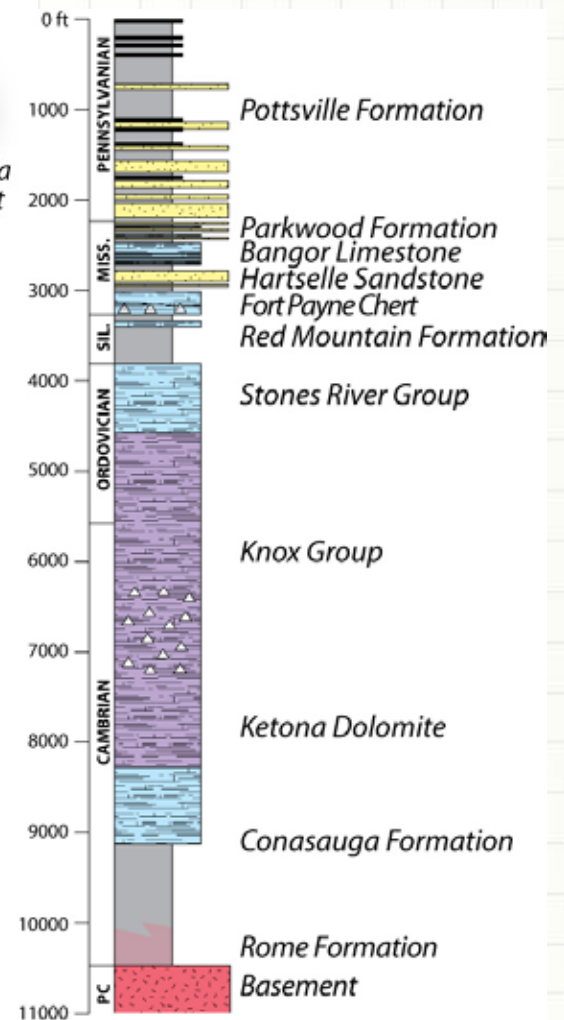
# REGIONAL SETTING

## Tectonic Framework



modified from Thomas (1988)

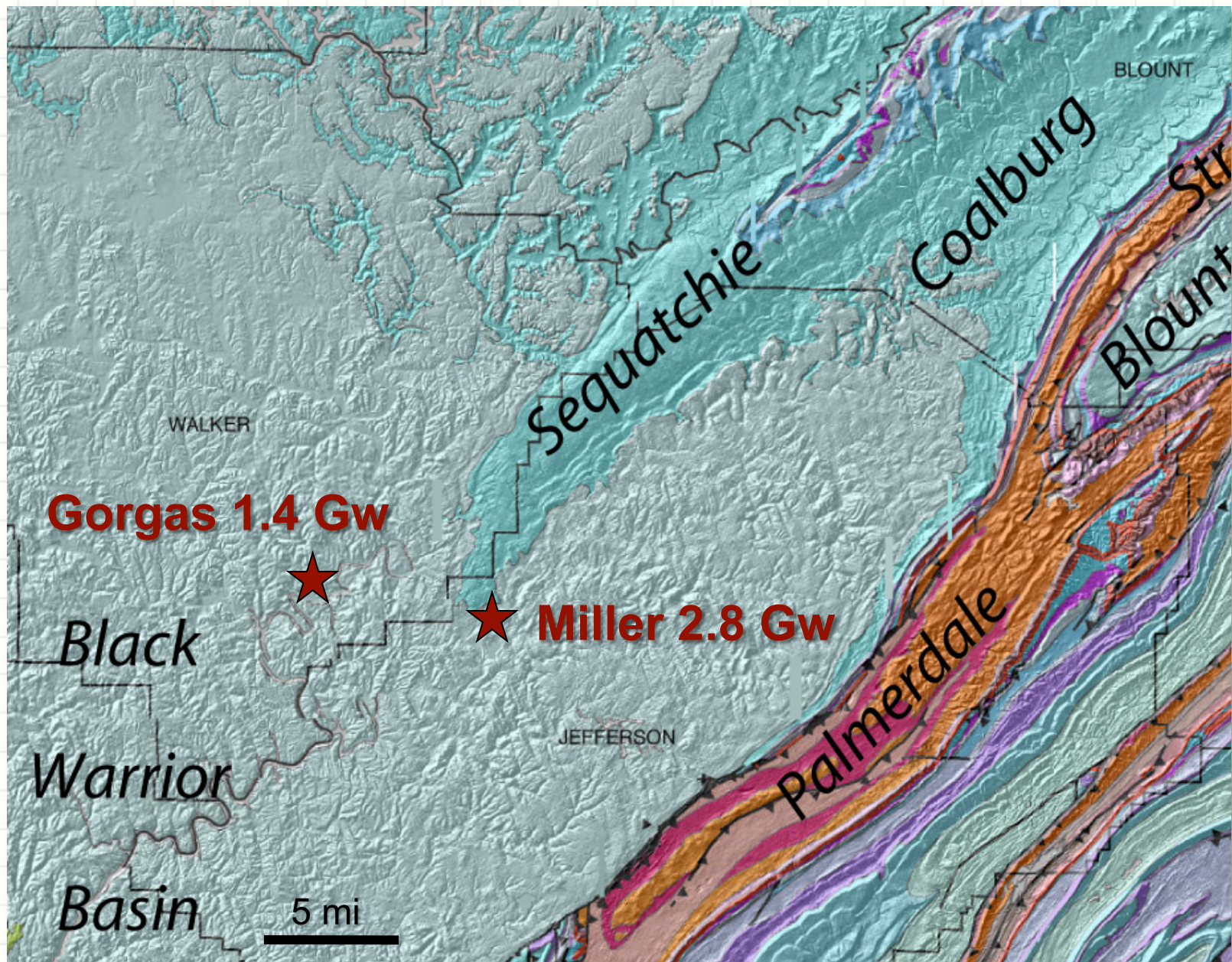
## Stratigraphy



Pashin (2011)



# GEOLOGIC MAP





# WILLIAM CRAWFORD GORGAS STEAM PLANT



**SOUTHERN  
COMPANY**

*Energy to Serve Your World®*





# SEISMIC REFLECTION

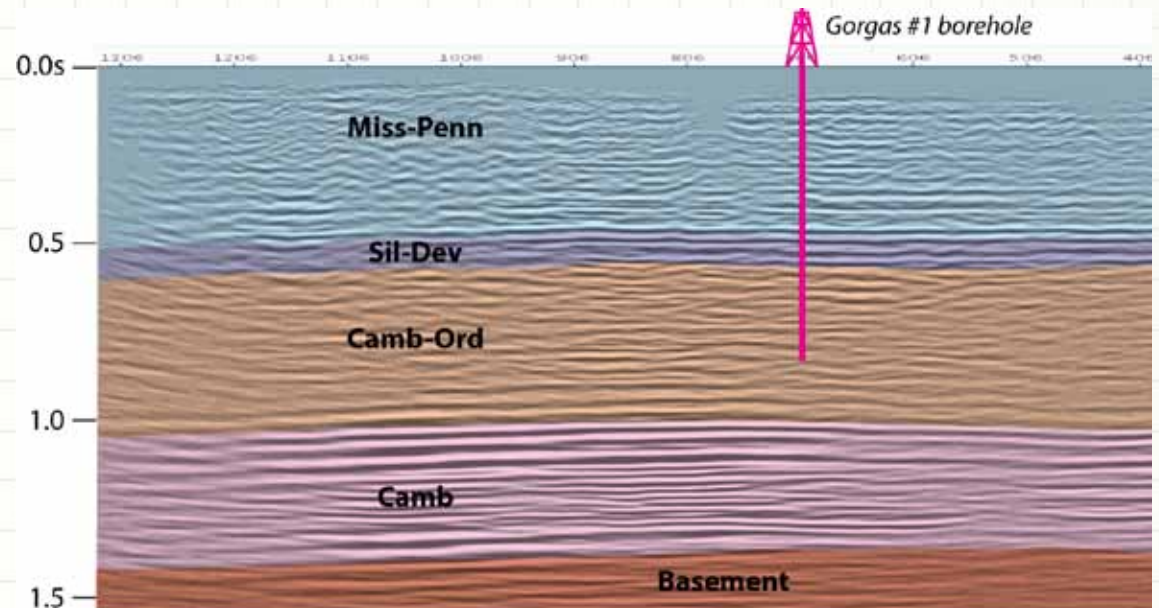
Western Geco Vibroseis crew



Lunch 'n Learn



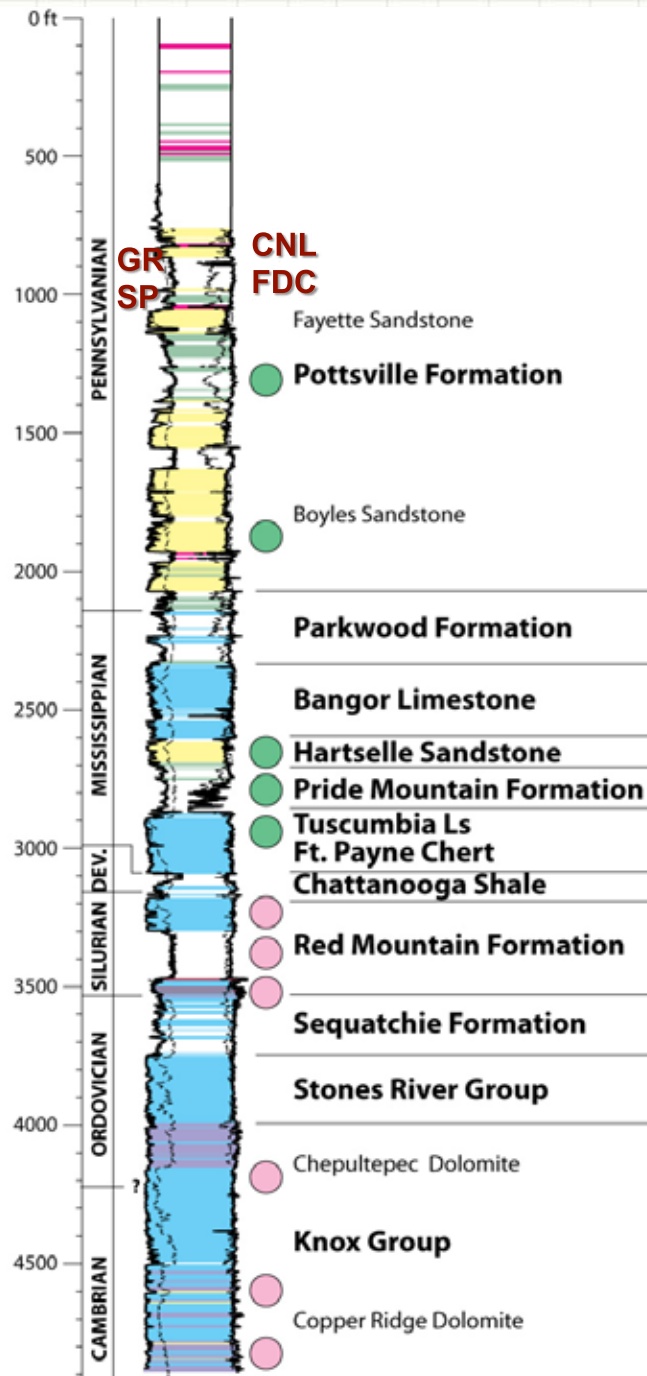
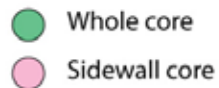
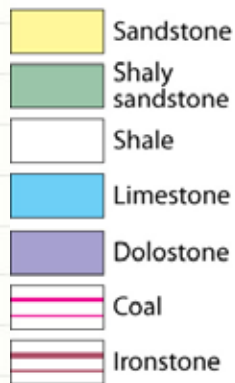
Seismic profile



# WELL LOGS

## Gorgas #1 borehole

### EXPLANATION



Seals with coal sinks south of site

Saline formations south of site

Seals, saline formations, hydrocarbon reservoirs west of site

Saline formations, oil reservoirs

Seal

Saline formation

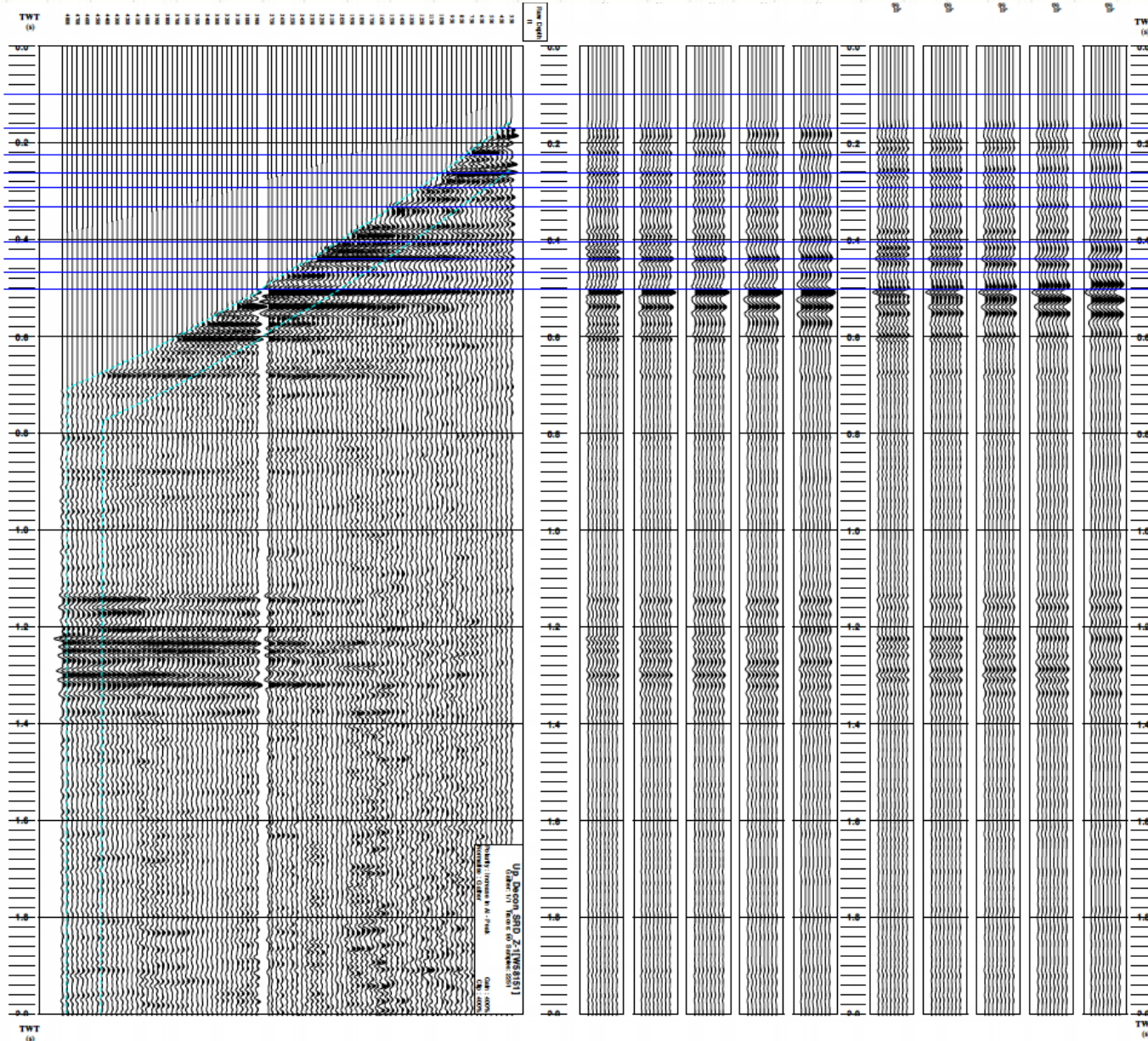
Seal

Saline formations





# VERTICAL SEISMIC PROFILES

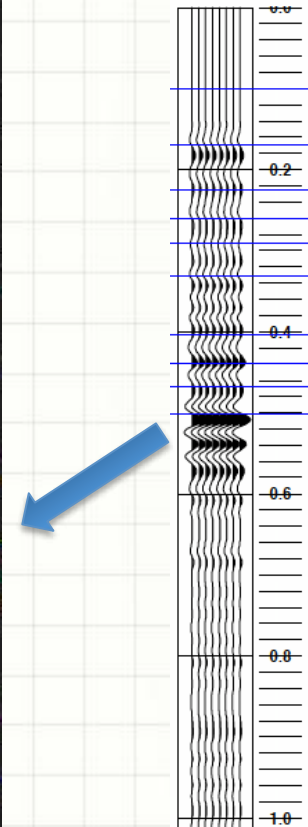
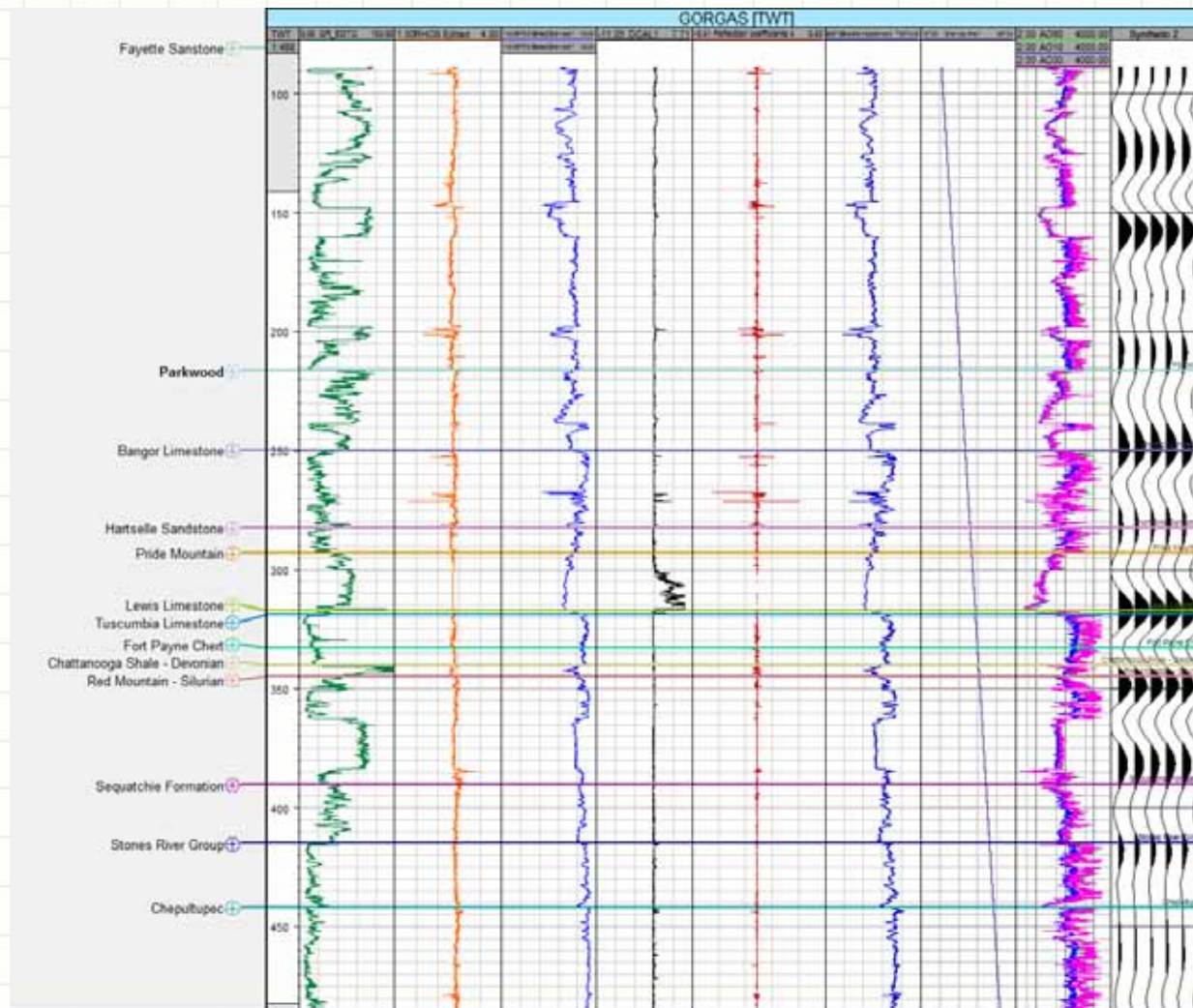


Zero-offset  
VSP clearly  
images key  
horizons

Offset VSPs  
are still  
being  
processed



# WELL-SEISMIC INTEGRATION



Zero-offset VSP

Gamma Density Sonic Caliper RC Acoustic Impedance T-D Resistivity Synthetic



# GORGAS #1 CORES

**Fayette shale**



**Boyles SS**



**Tuscumbia LS**



**Pride Mtn. shale**

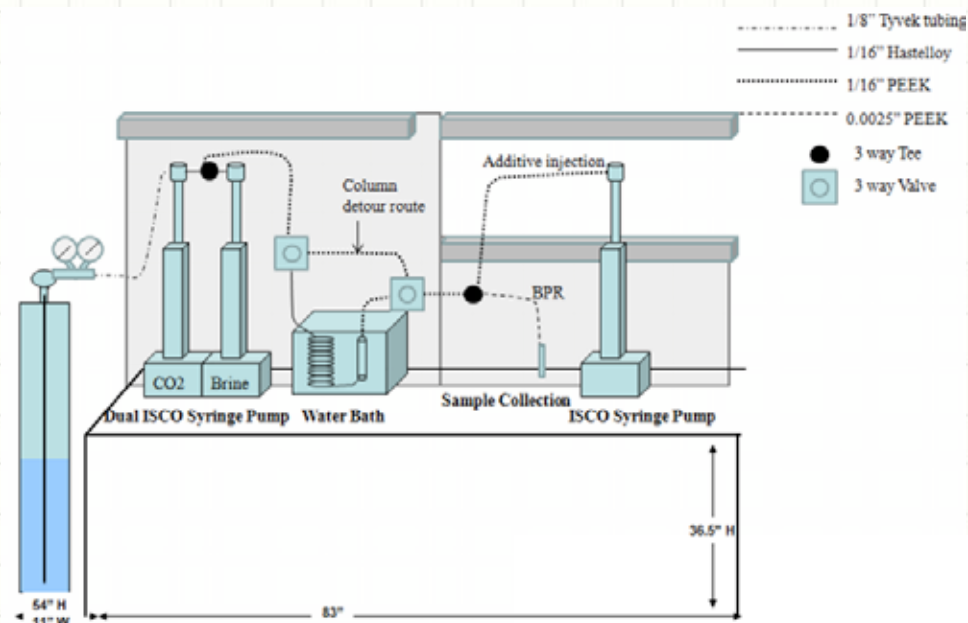


Core diameter = 4 "

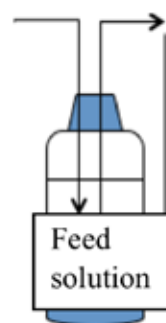




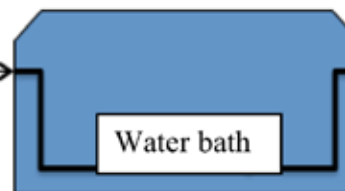
# MINERALIZATION, DISSOLUTION



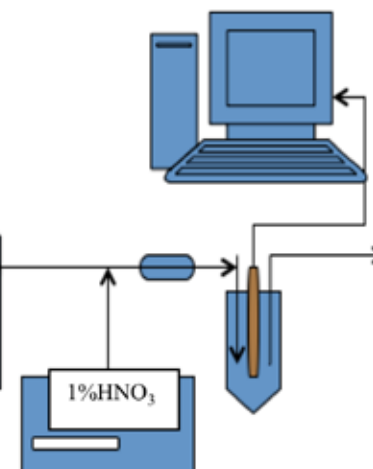
100%CO<sub>2</sub>



Pump  
Q=5-450ml/min

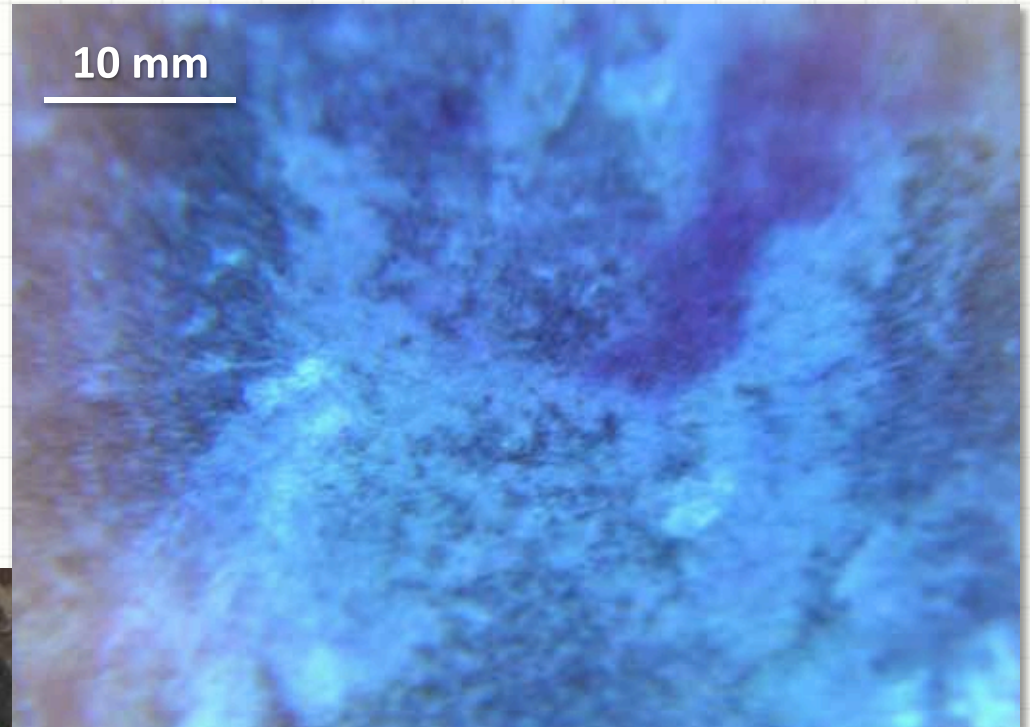


Stainless/ carbon steel tubing  
 L=5 inch  
 O.D.=1/4 inch  
 Crossing area A=0.165 cm<sup>2</sup>



# CARBONIFEROUS RESERVOIRS

**Hartselle SS  
(fluoroscope)**



**Water beading on  
Tuscumbia LS**

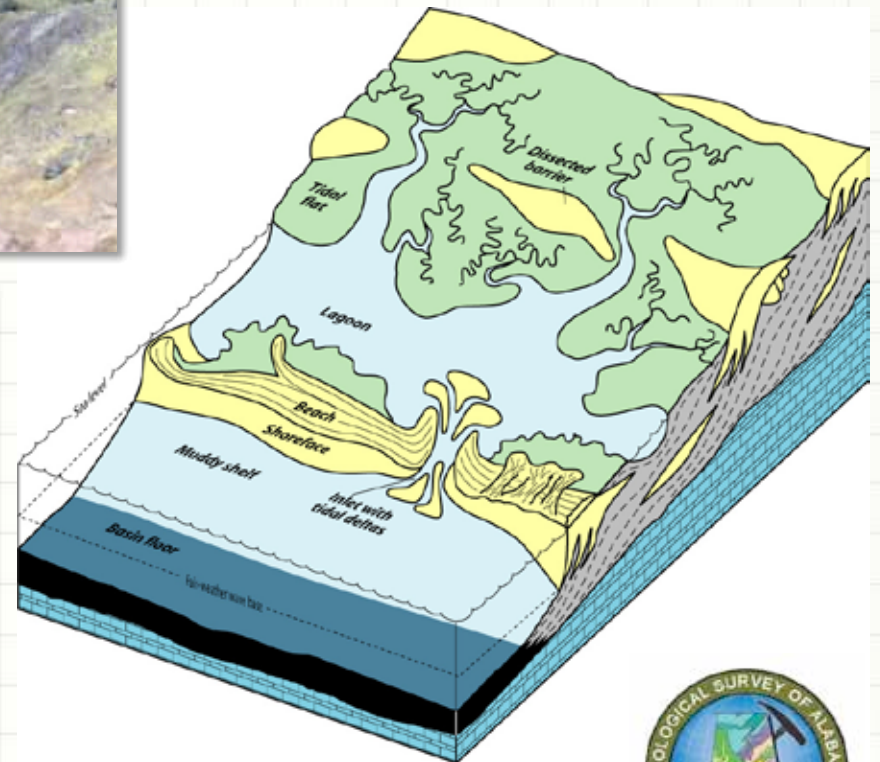




# HARTSELLE SS

OOIP ~7.5 Billion bbl

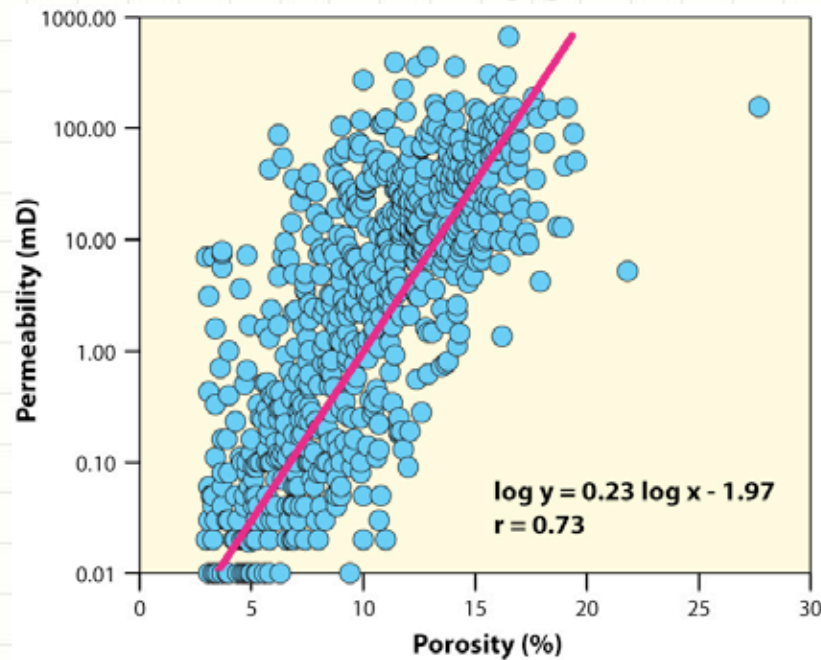
Beach-barrier model



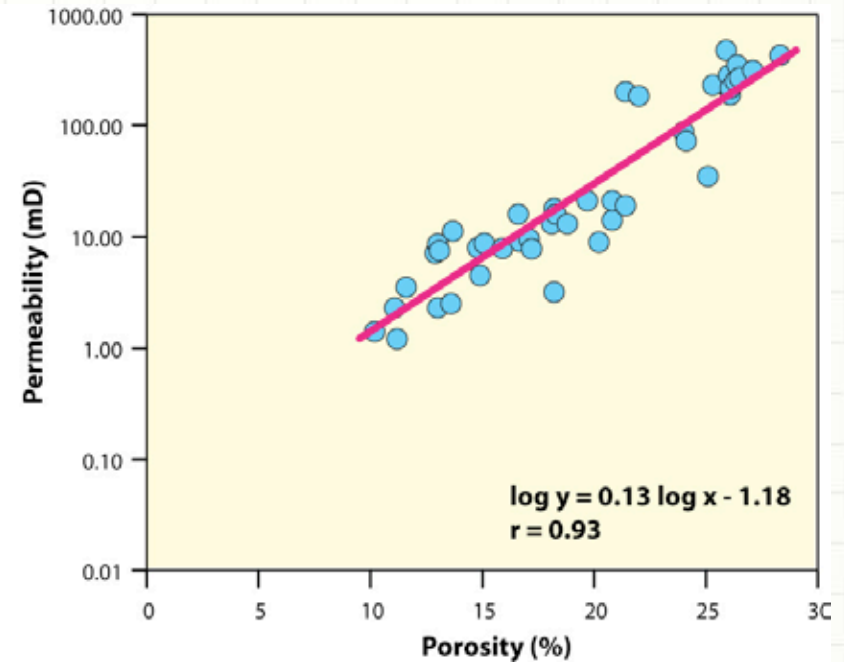


# POROSITY, PERMEABILITY

Mississippian



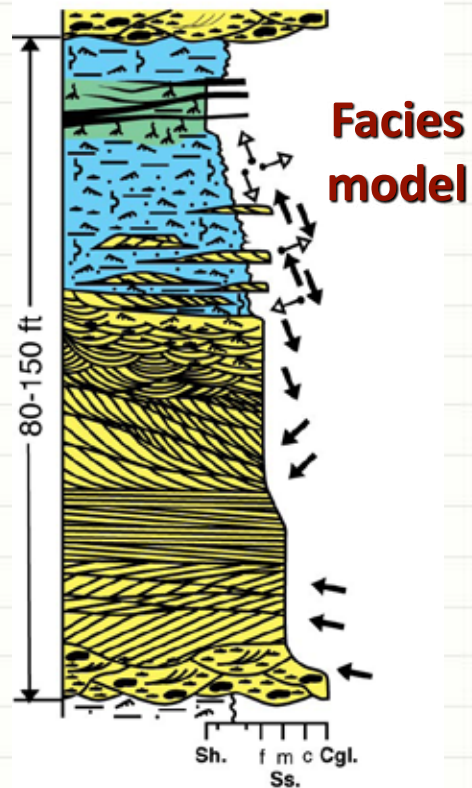
Pottsville





# BEACH AND TIDAL DEPOSITS

Sigmoid cross-beds with clay drapes



Wedge-planar cross-beds

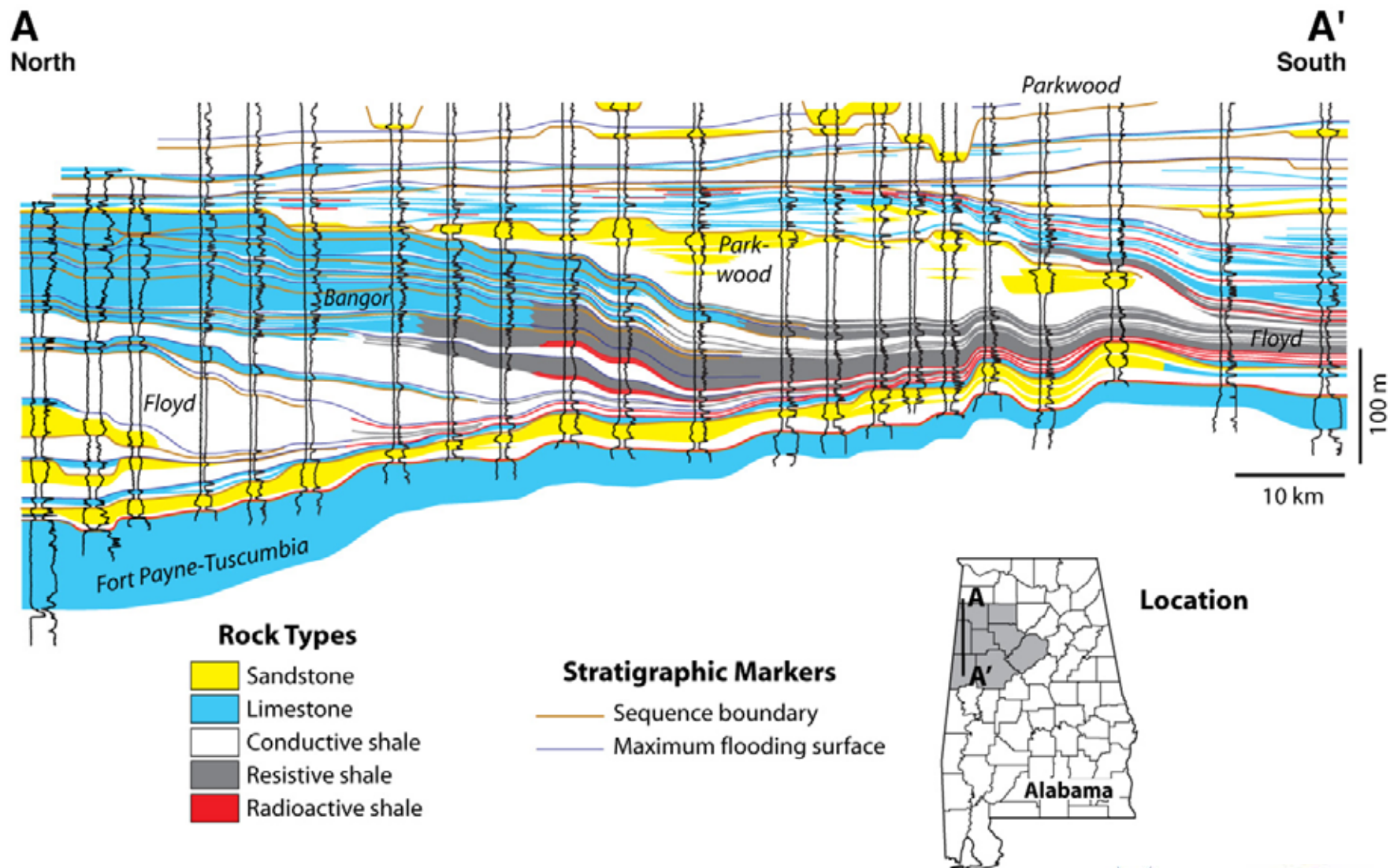


Mesotidal shore zone





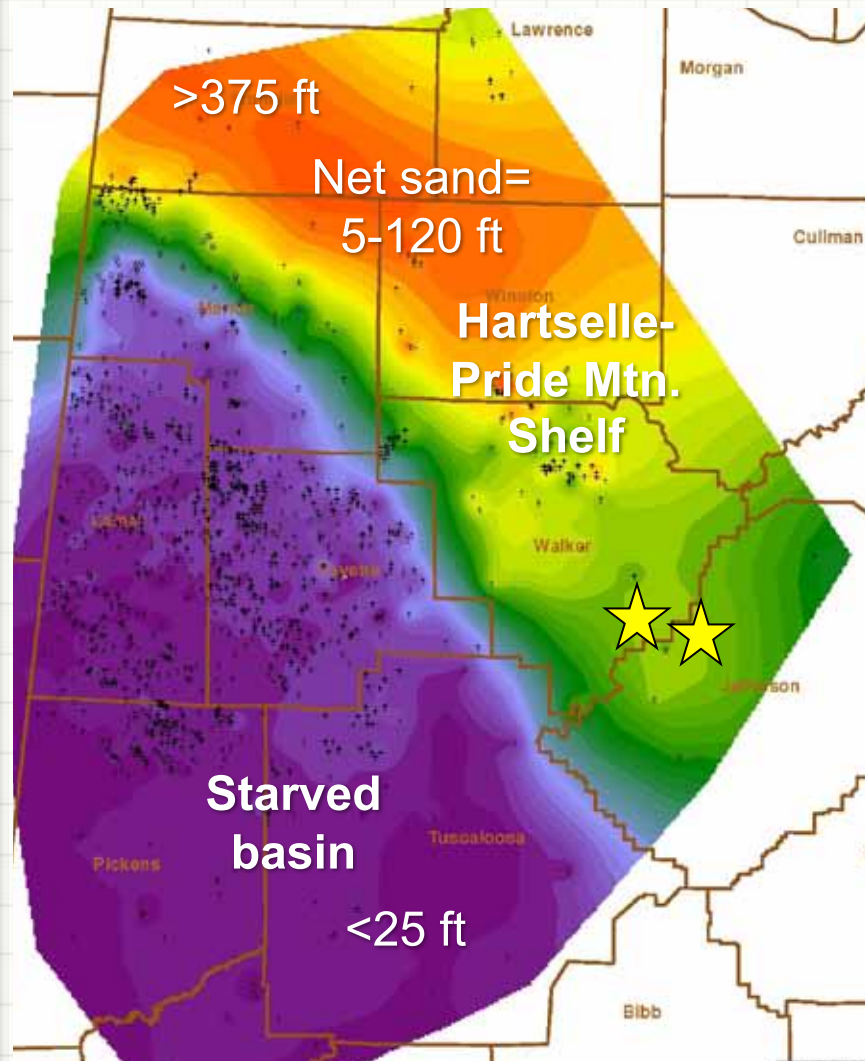
# MISSISSIPPIAN CROSS-SECTION



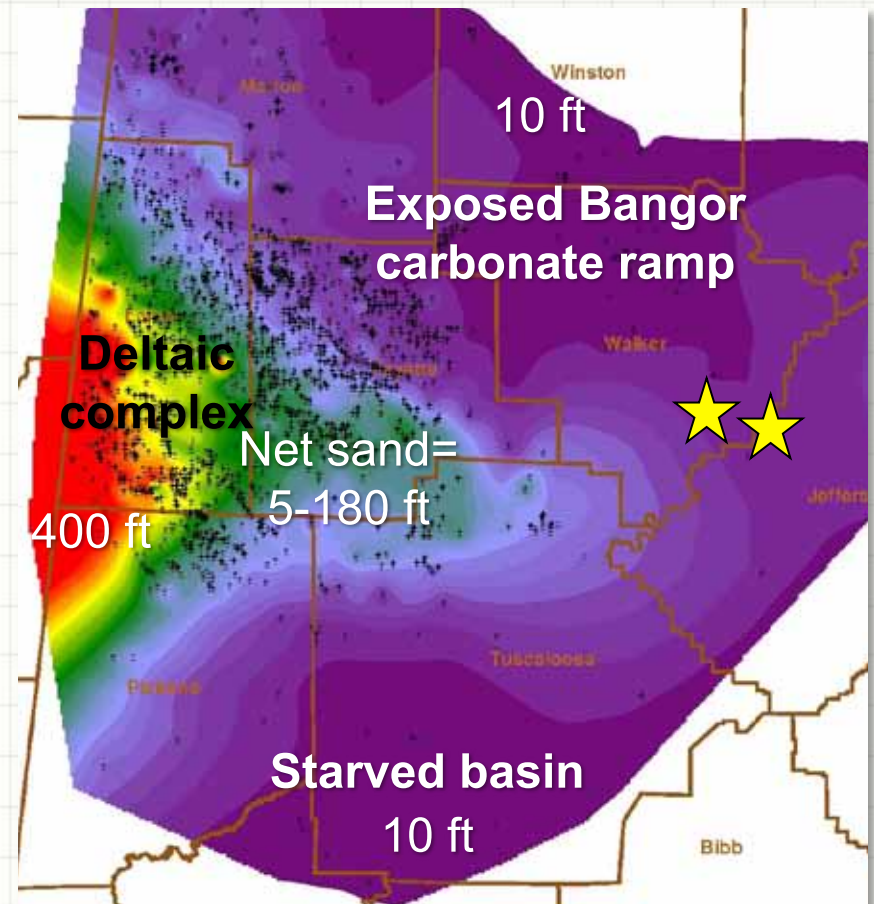
# SUBSURFACE MAPS



## Pride Mtn.-Hartselle



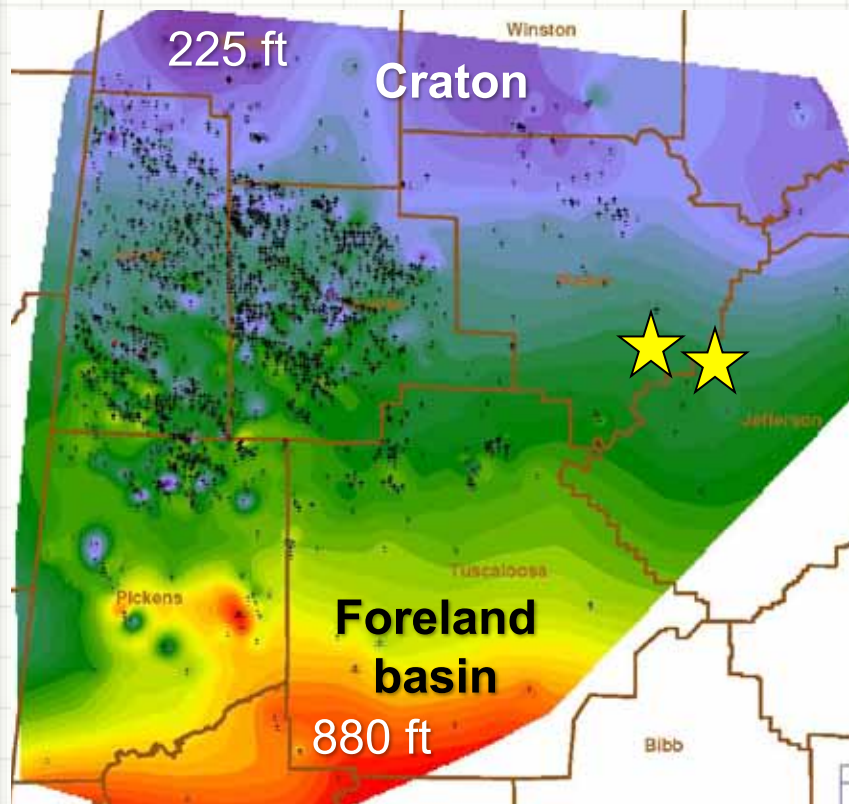
## Parkwood Fm.



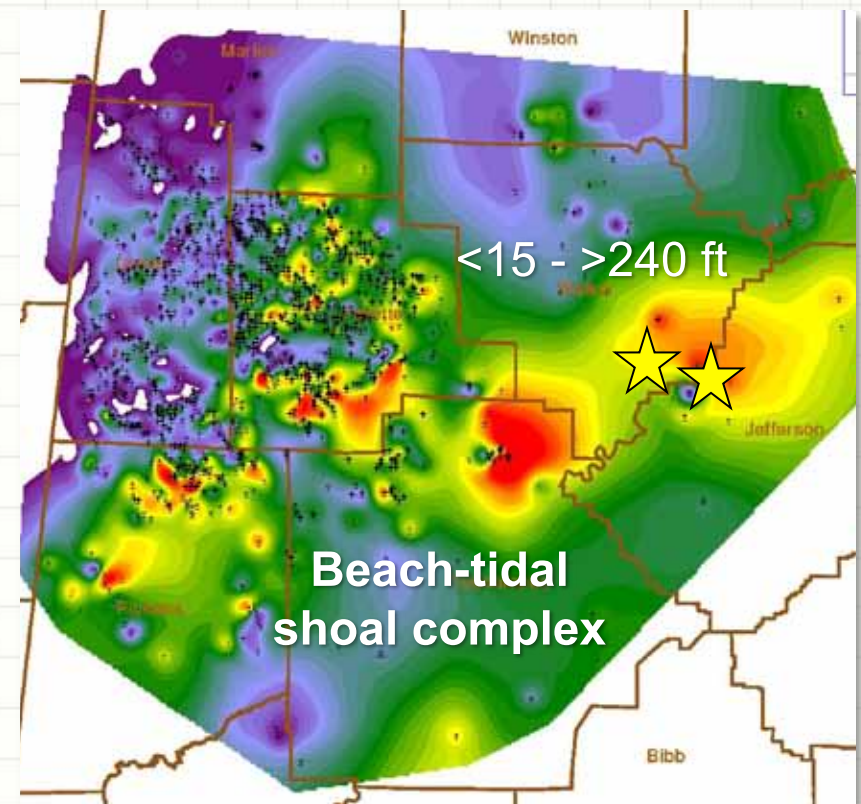


# LOWER BOYLES SANDSTONE

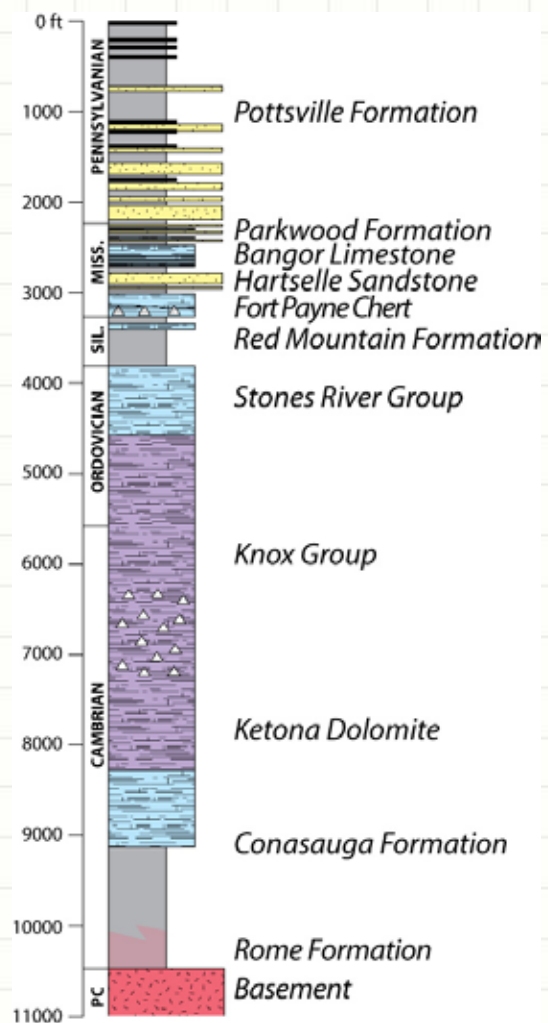
**Interval Isopach**



**Net porous sandstone**



# NATCARB ASSESSMENT



Formation	Low (Mt)	Medium (Mt)	High (Mt)
Pottsville	185	1,377	2,552
Parkwood	21	151	838
Bangor	32	24	44
Hartselle-Pride Mtn.	9	64	119
Tuscumbia	19	141	263
<b>Total</b>	<b>266</b>	<b>1,757</b>	<b>3,816</b>

Cambrian-Devonian being assessed





# OUTREACH AND EDUCATION

- ✓ **Seismic Lunch 'n Learn**
- ✓ **RECS 2011**
- ✓ **Korean delegation**
- ✓ **Gorgas site visits**
- ✓ **SECARB-Ed**



# CONCLUDING REMARKS

- **Regional characterization approaching completion**
- **Gorgas #1 well drilled, cored, logged, and tested**
- **Geological and geophysical data being analyzed and prepared for incorporation into reservoir and seal models**
- **Laboratory work, including mineralization experiments, is ongoing**