

# Southeast Offshore Storage Resource Assessment (SOSRA)

## Project Number: DE-FE0026086

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U.S. DEPARTMENT OF  
**ENERGY**



VirginiaTech



UNIVERSITY OF  
**SOUTH CAROLINA**



Advanced Resources  
International, Inc.

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Mastering the Subsurface Through Technology Innovation, Partnerships, and Collaboration  
Pittsburgh, PA  
August 01, 2017

# SOSRA

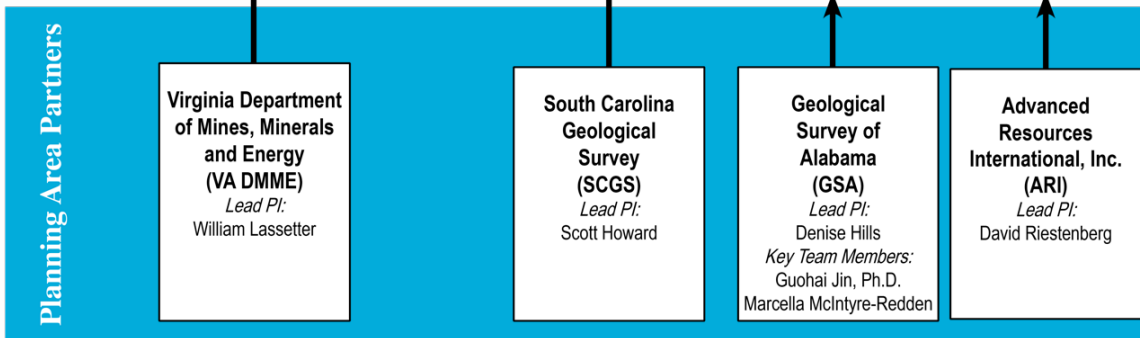
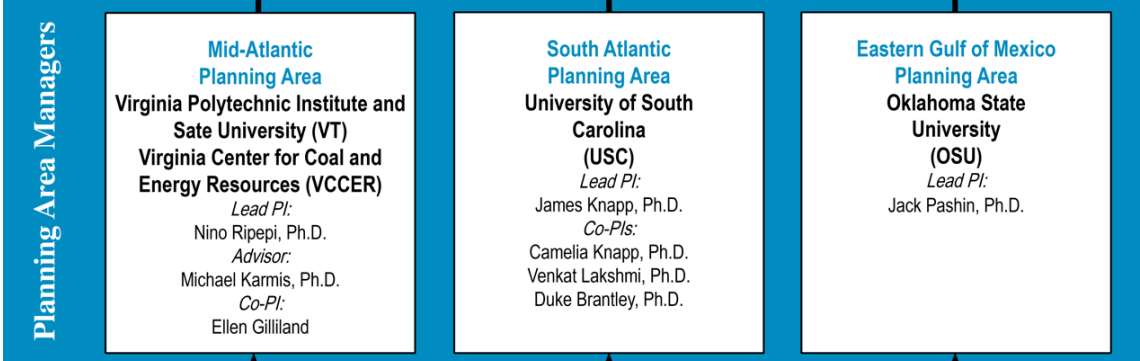
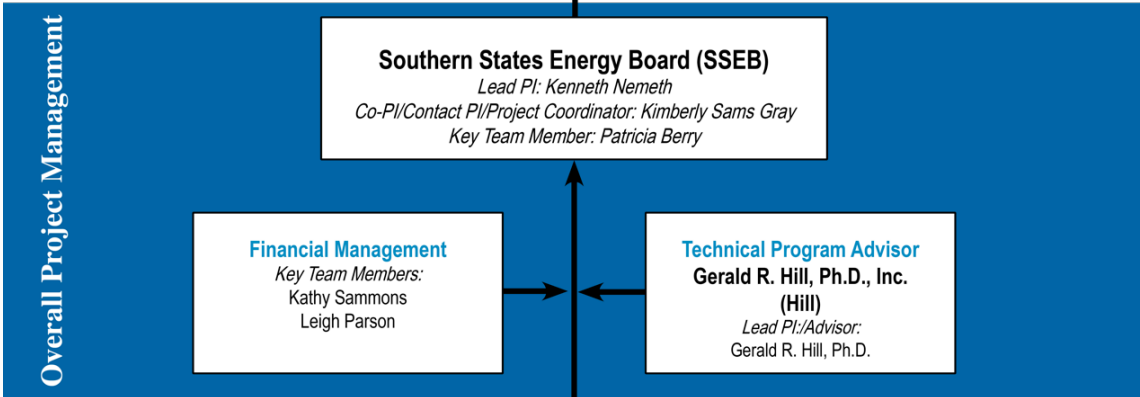
- **Southeast Offshore Storage Resource Assessment**
  - Managed by the Southern States Energy Board (SSEB)
  - SSEB appointed three planning area managers to each offshore region (Eastern GOM, South Atlantic, Mid-Atlantic)
  - Geologic characterization of offshore storage opportunities
  - Static volumetric assessment of storage capacity using NETL methodology

**U.S. Department of Energy (DOE)**  
**National Energy Technology Laboratory (NETL)**  
*Project Officer:*  
 Mary A. Sullivan

**Southern States Energy Board (SSEB)**  
*Lead PI: Kenneth Nemeth*  
*Co-PI/Contact PI/Project Coordinator: Kimberly Sams Gray*  
*Key Team Member: Patricia Berry*

**Financial Management**  
*Key Team Members:*  
 Kathy Sammons  
 Leigh Parson

**Technical Program Advisor**  
**Gerald R. Hill, Ph.D., Inc. (Hill)**  
*Lead PI/Advisor:*  
 Gerald R. Hill, Ph.D.



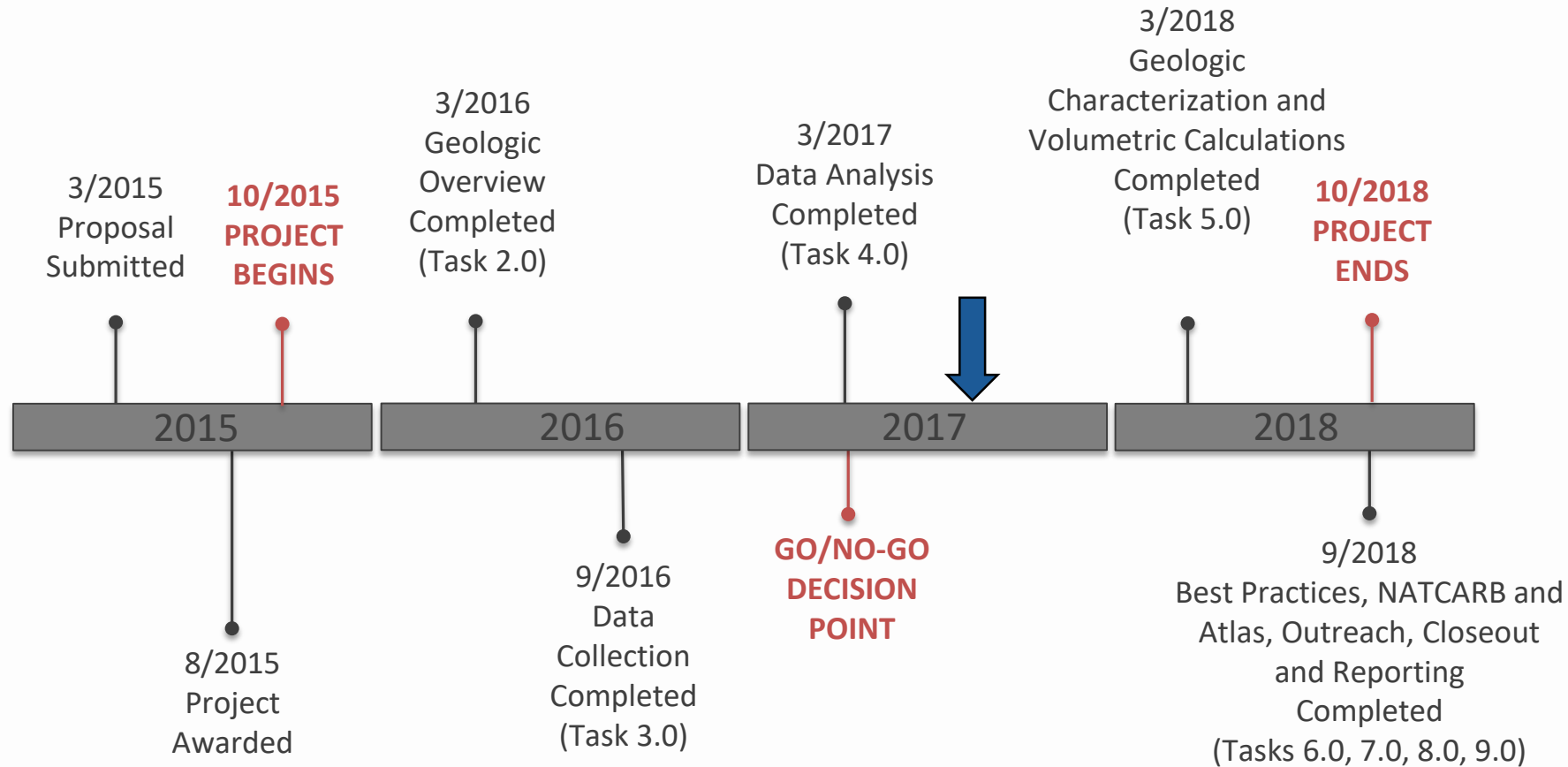
## Decision Making & Communications

### Advisory Committee:

state geological surveys, universities, state oil and gas boards, oil and gas companies, and utilities  
 (no contract, no decision making authority)



# SOSRA Project Timeline

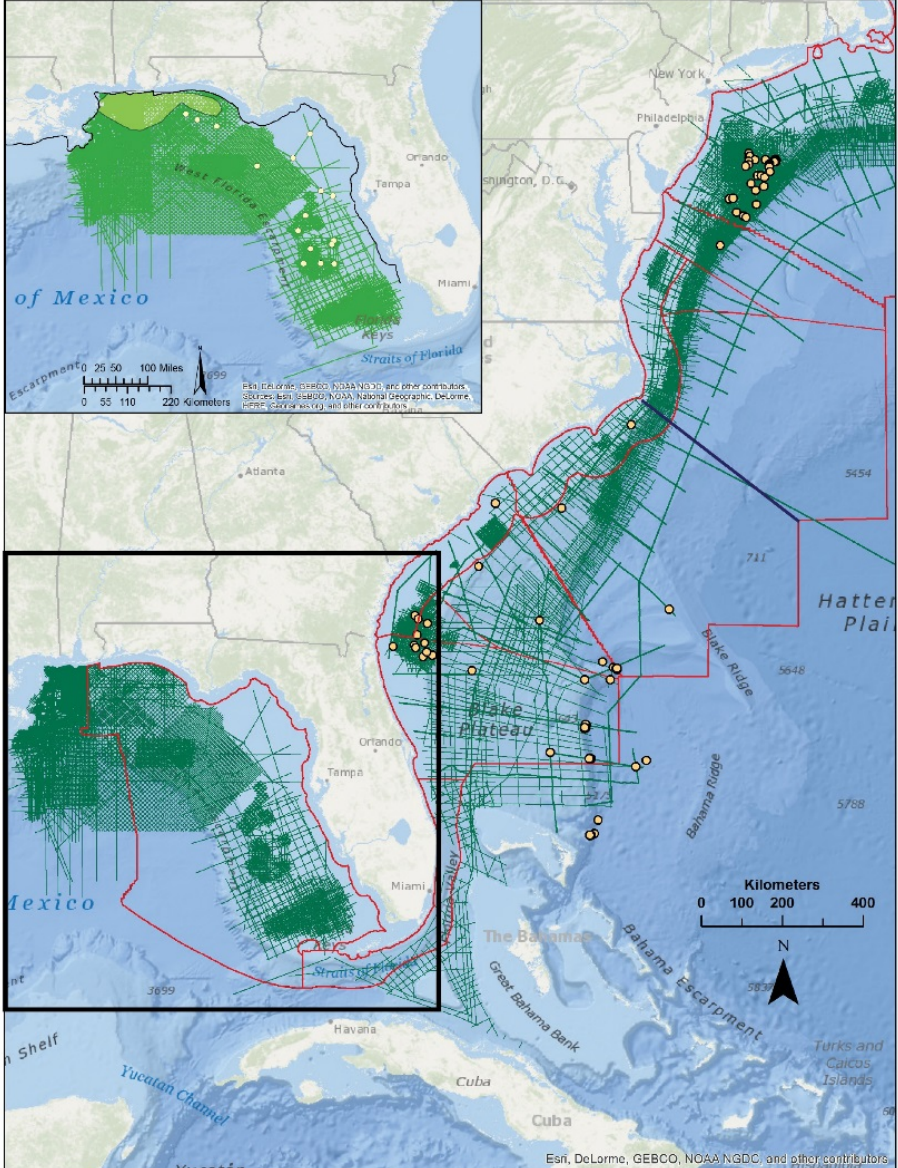
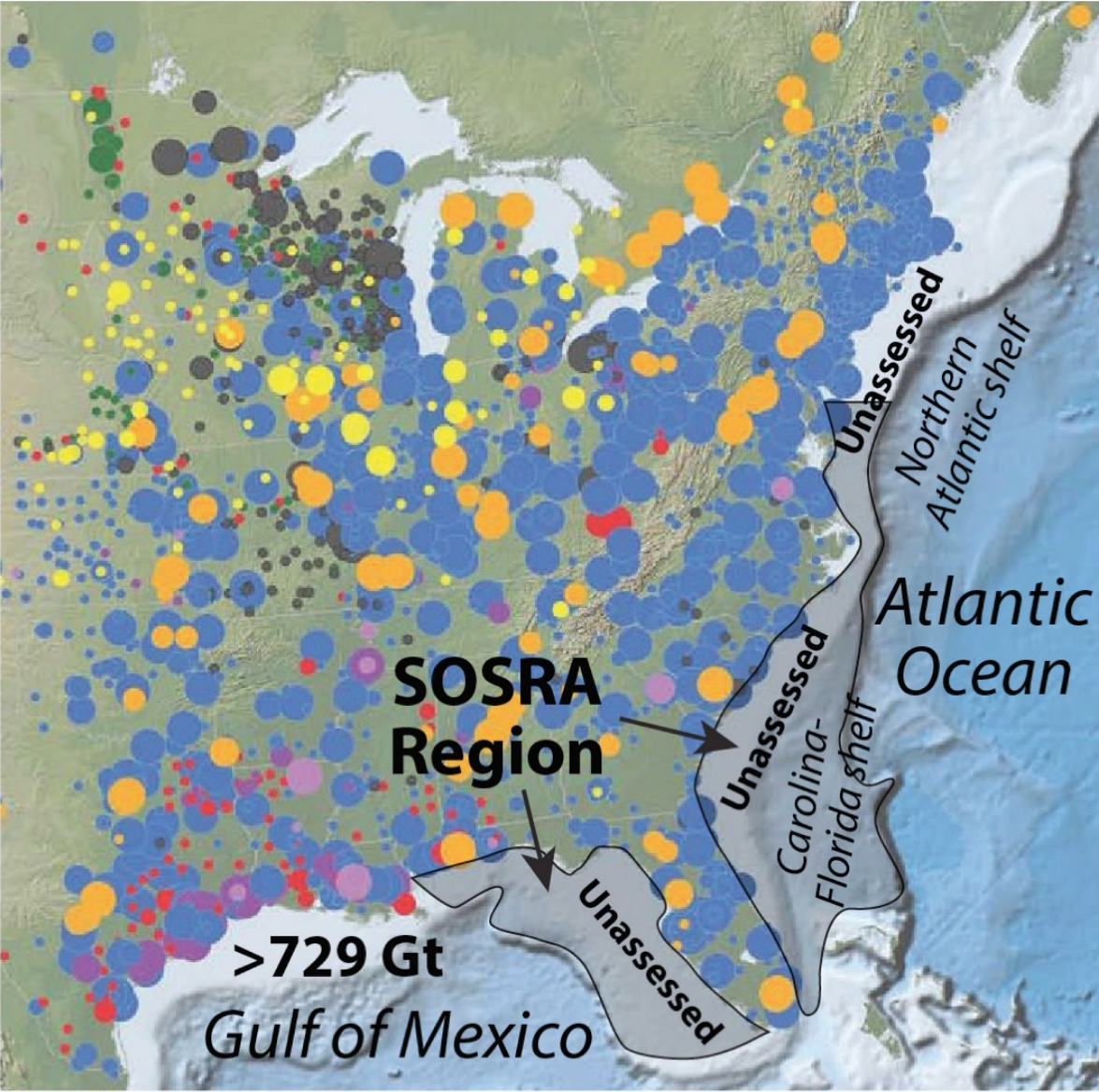


**GO/NO-GO DECISION POINT:** *The data collected and analyzed in Phase I is sufficient to perform a quality prospective storage resource assessment and the project should proceed to Phase II.*

*Note: Task 1.0, Project Management and Planning, extends throughout the entire program period.*

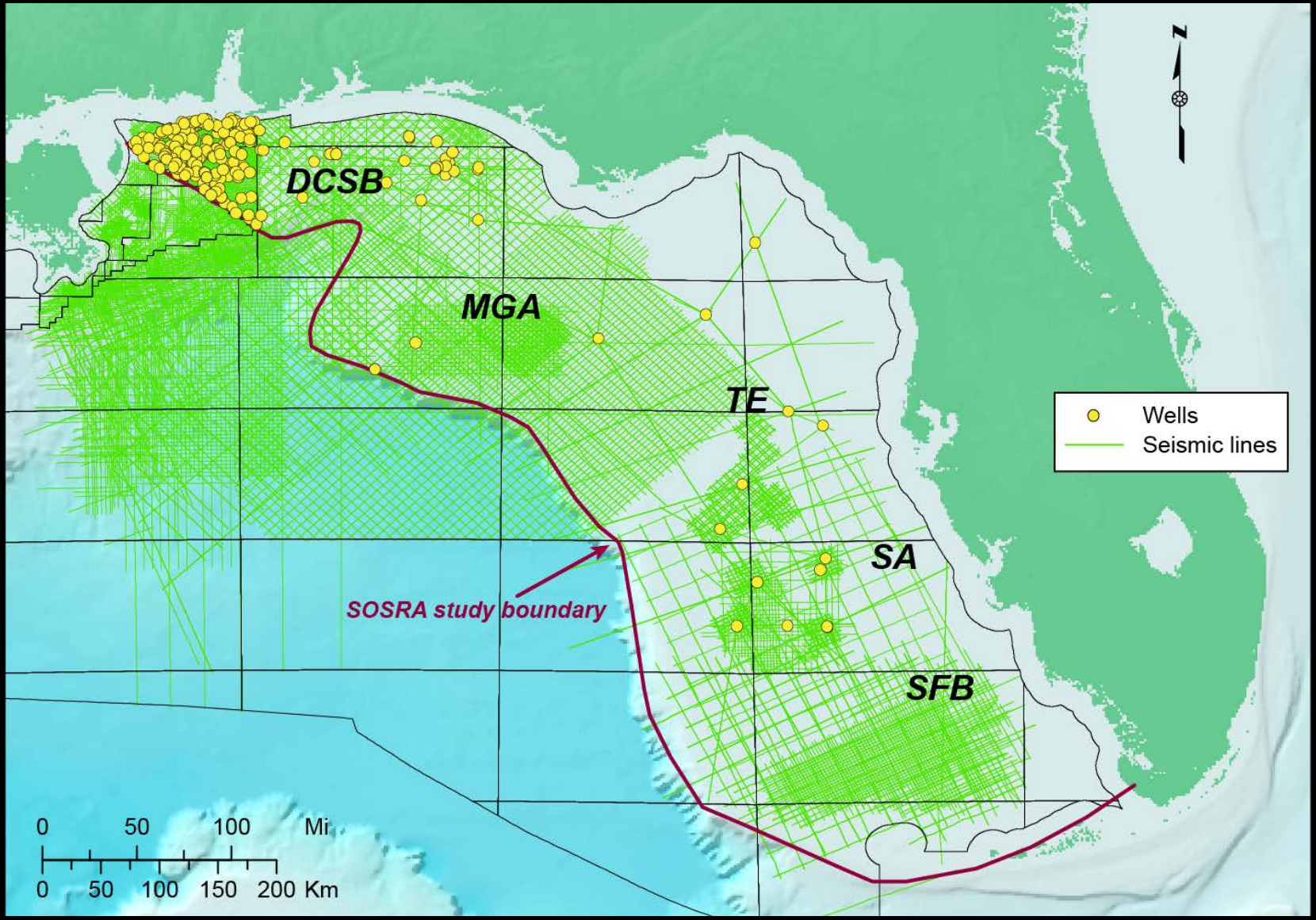


# Summary – SOSRA





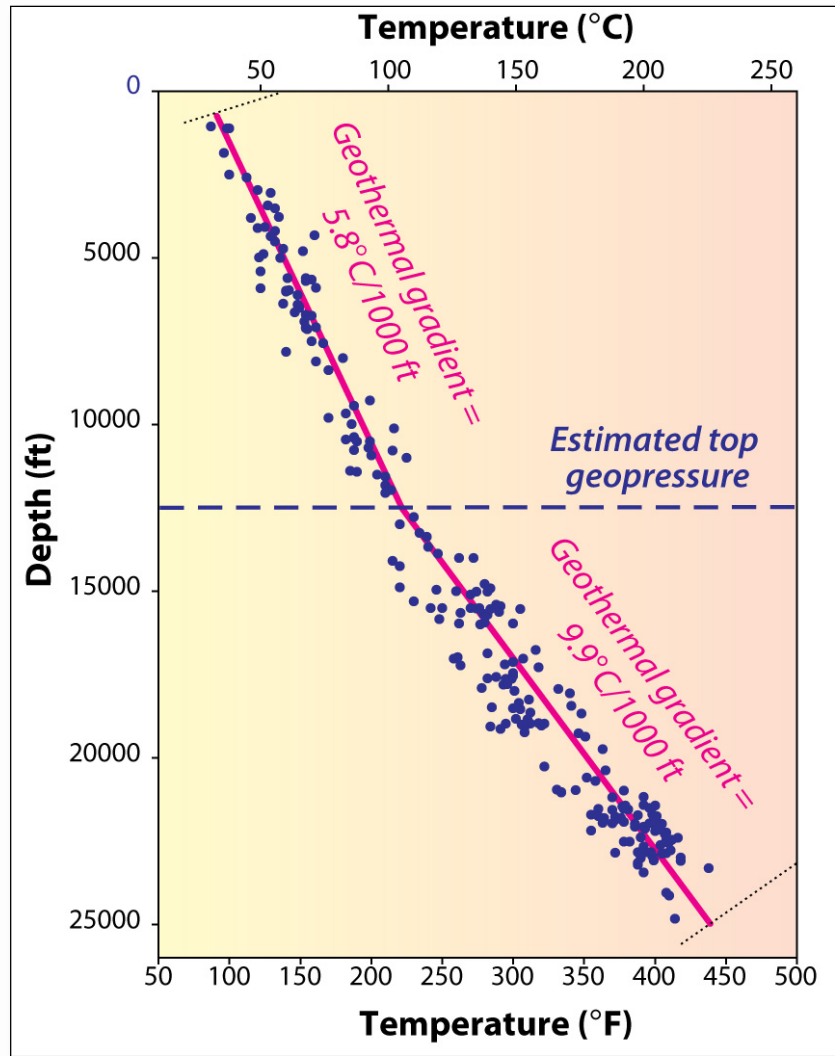
# EGOM Study Area and Subregions



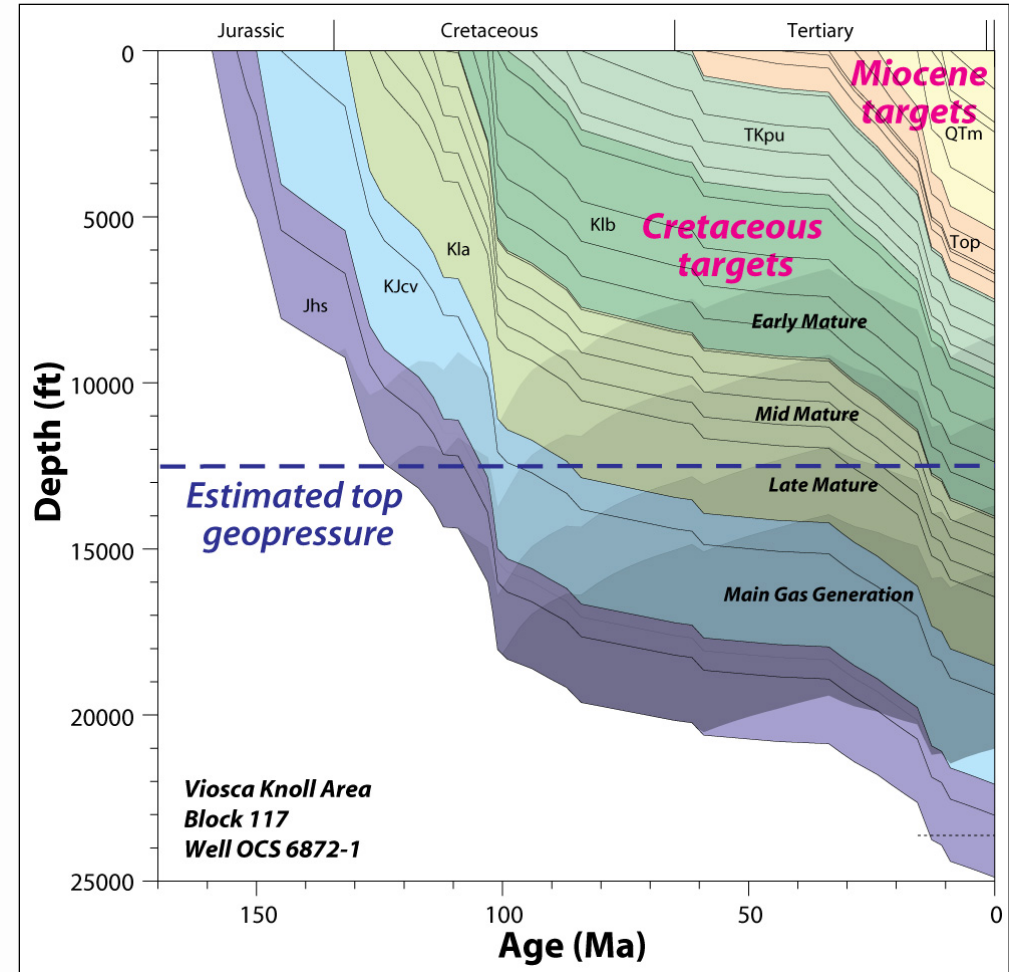
- DCSB** DeSoto Canyon Salt Basin
- MGA** Middle Ground Arch
- TE** Tampa Embayment
- SA** Sarasota Arch
- SFB** South Florida Basin

# Geothermal and Burial Data, DCSB

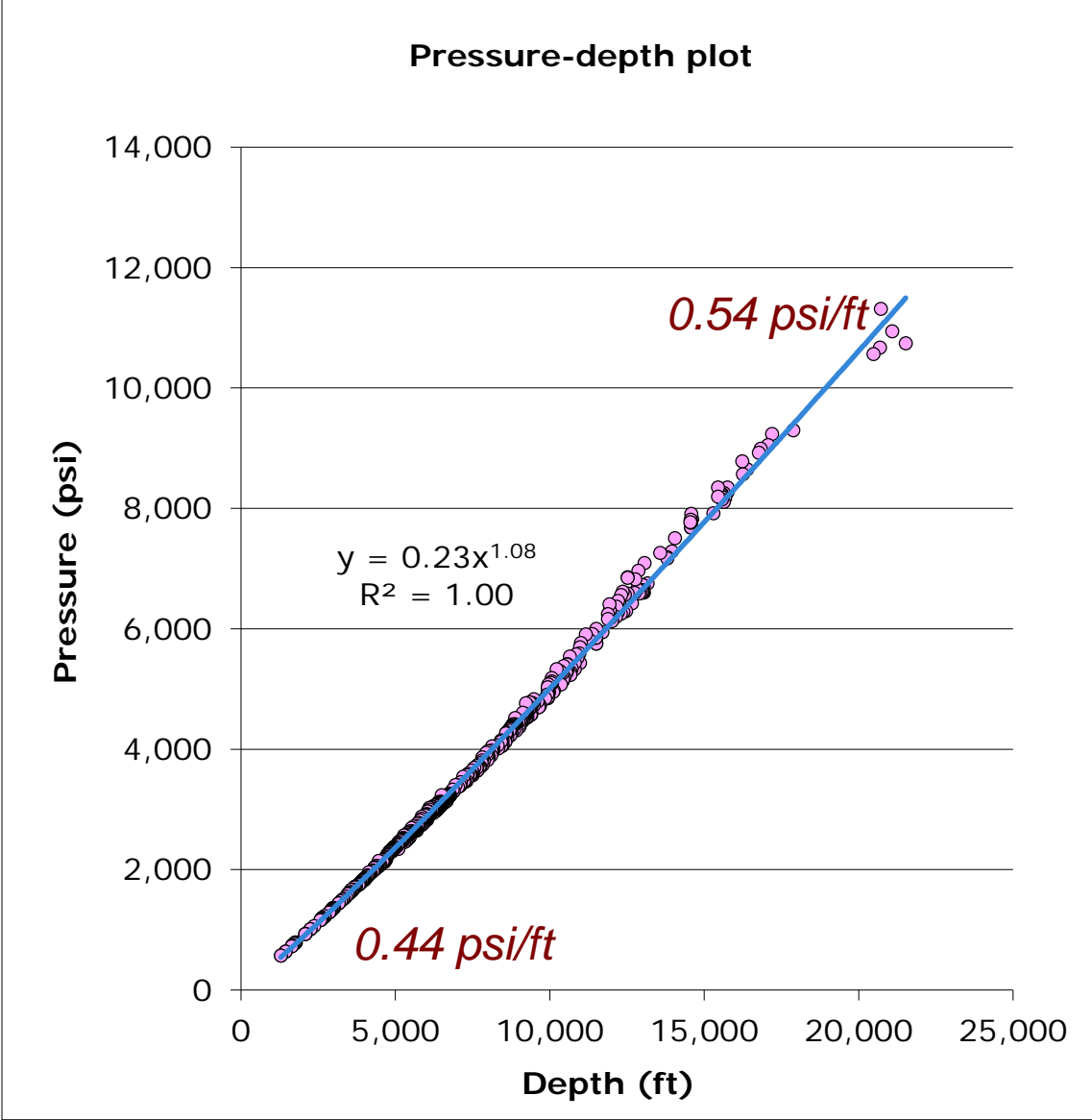
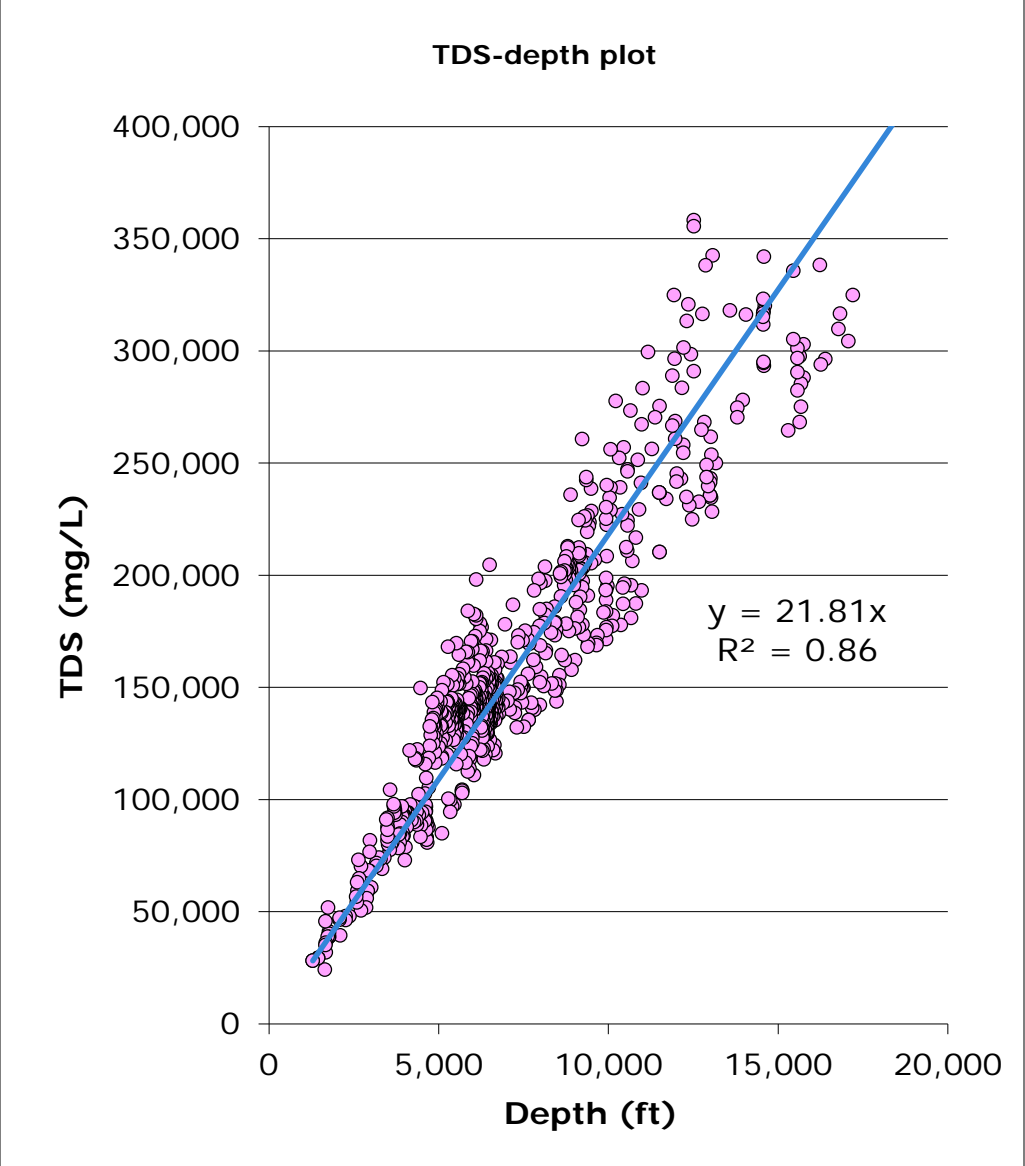
## Temperature-depth profile



## Burial history curve

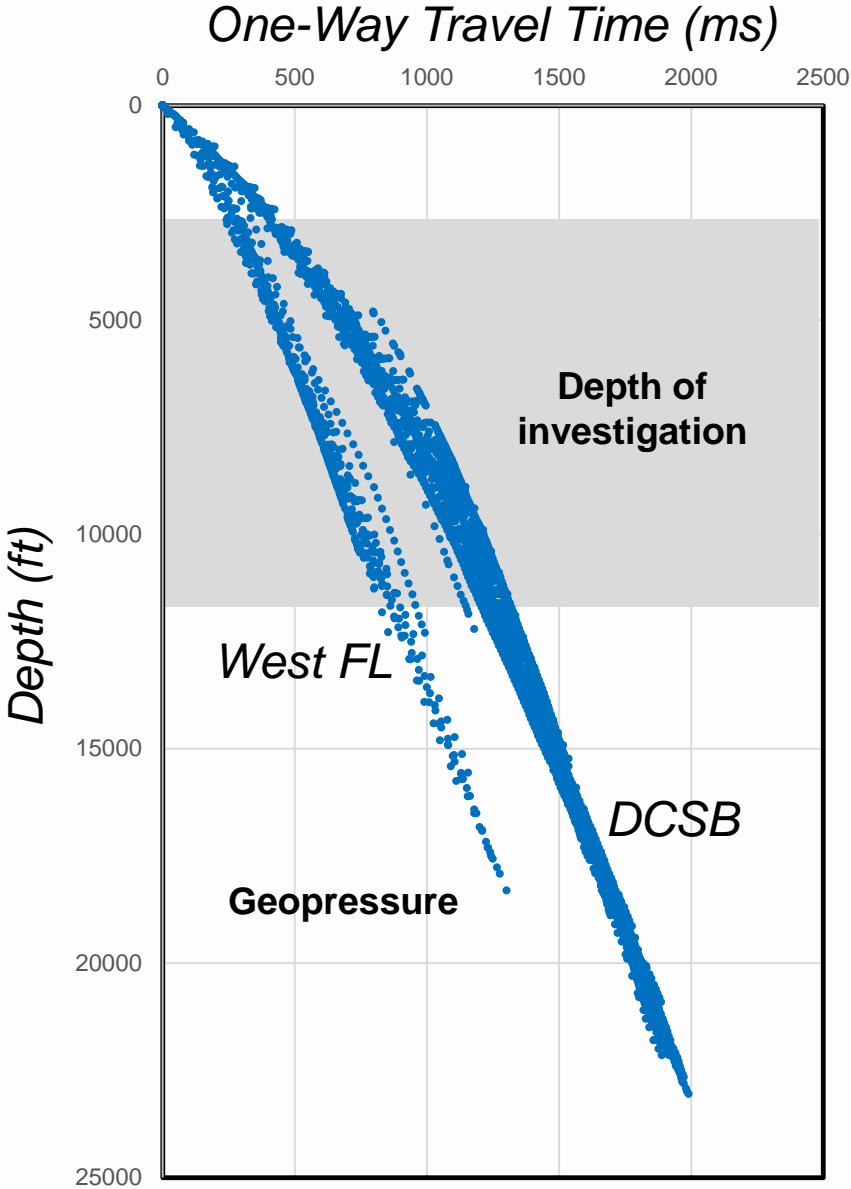
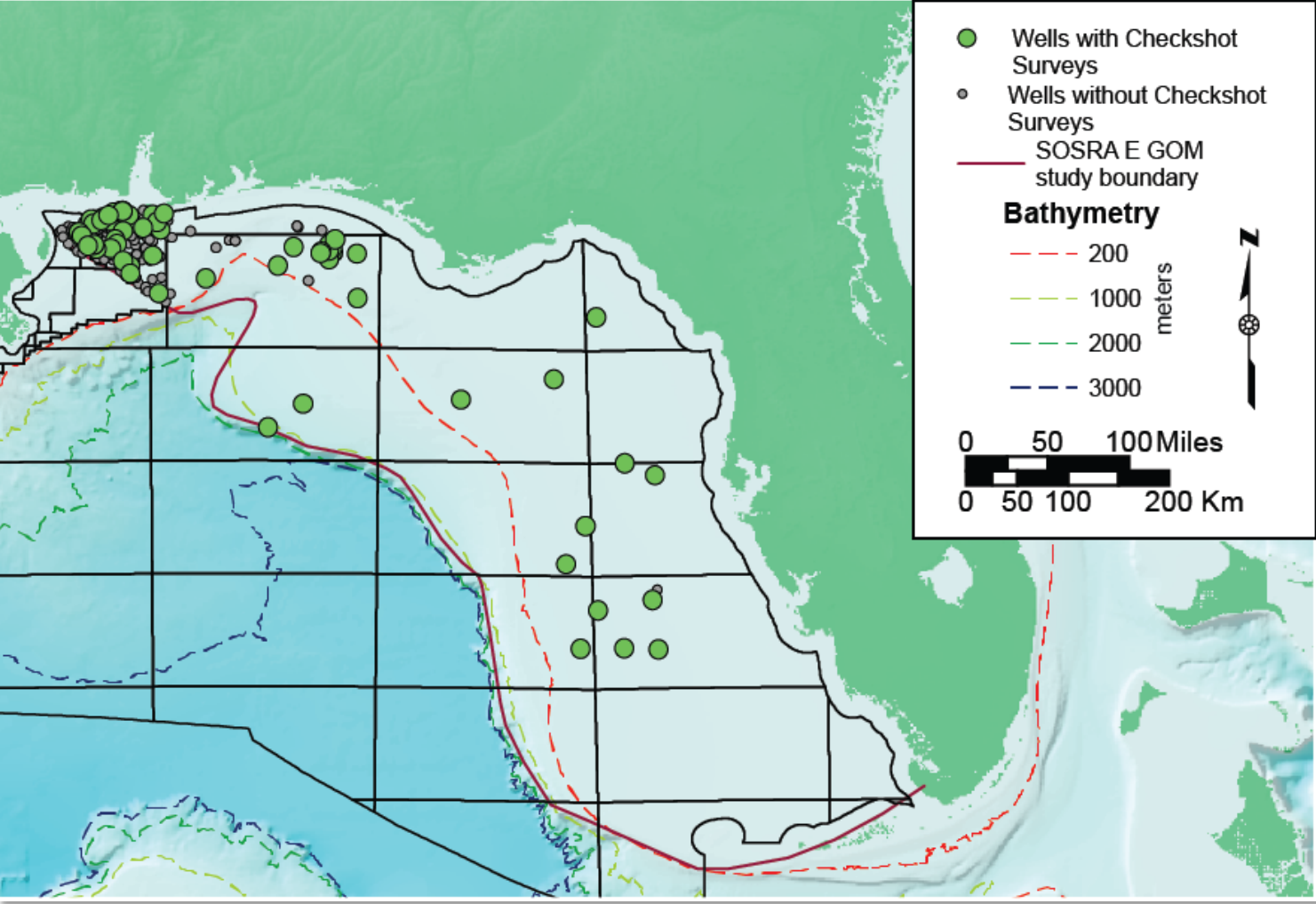


# Normal Brine, Pressure Gradients, Onshore Eastern Gulf



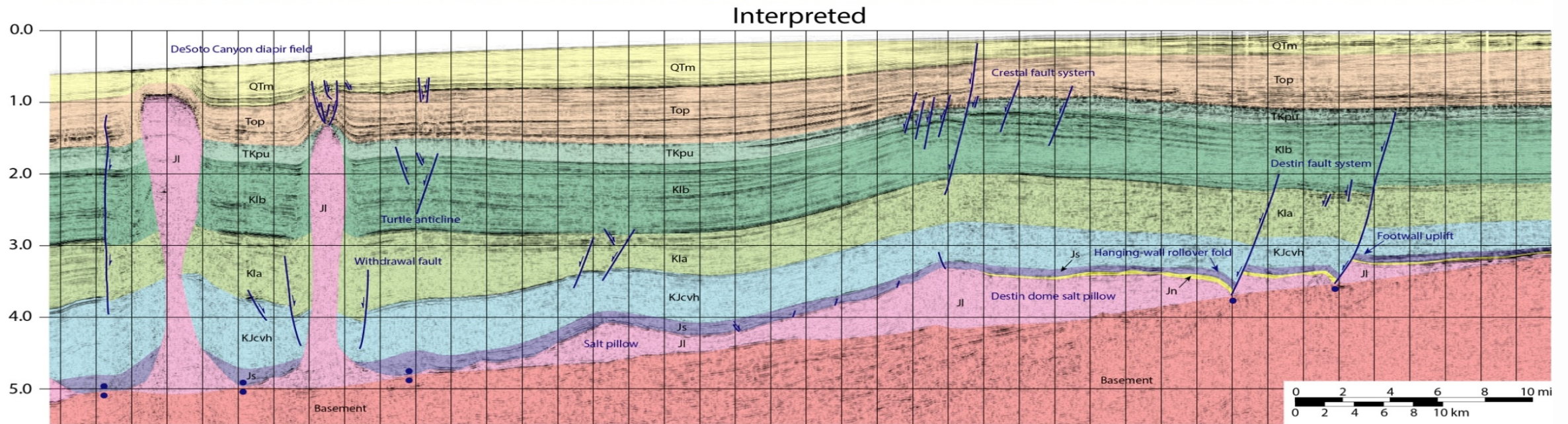
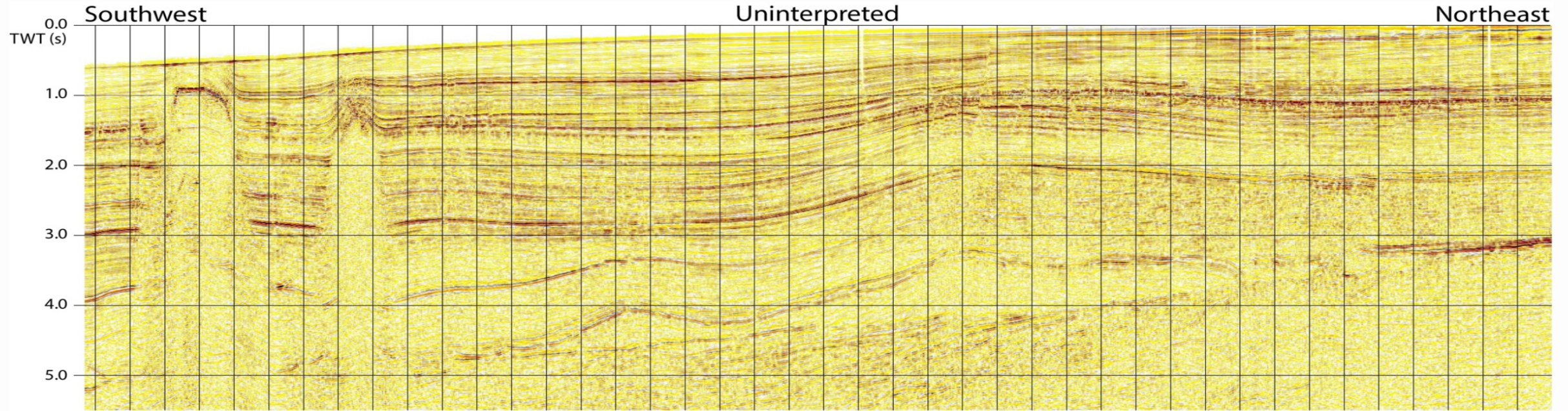


# Seismic Velocity Surveys



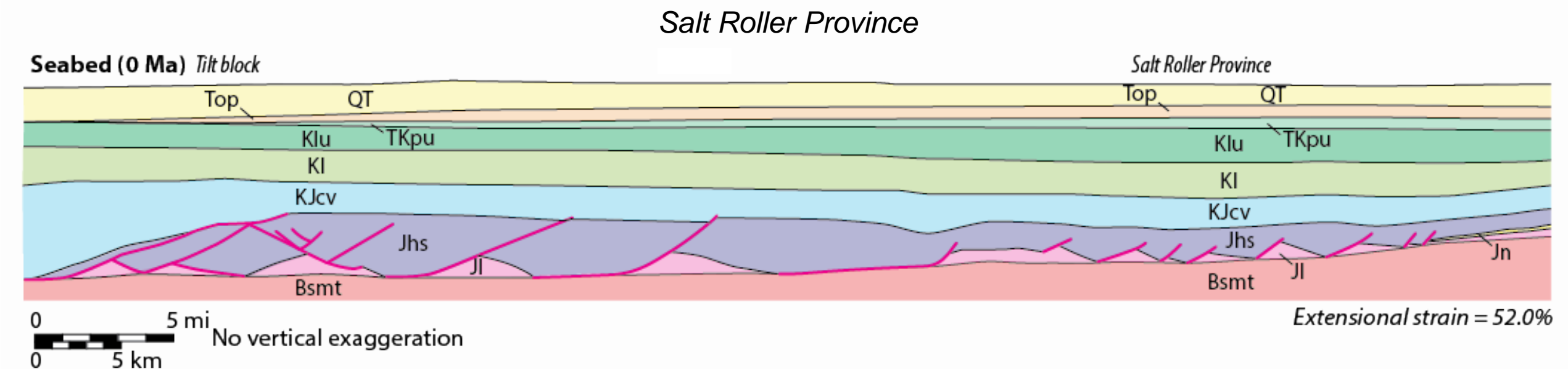
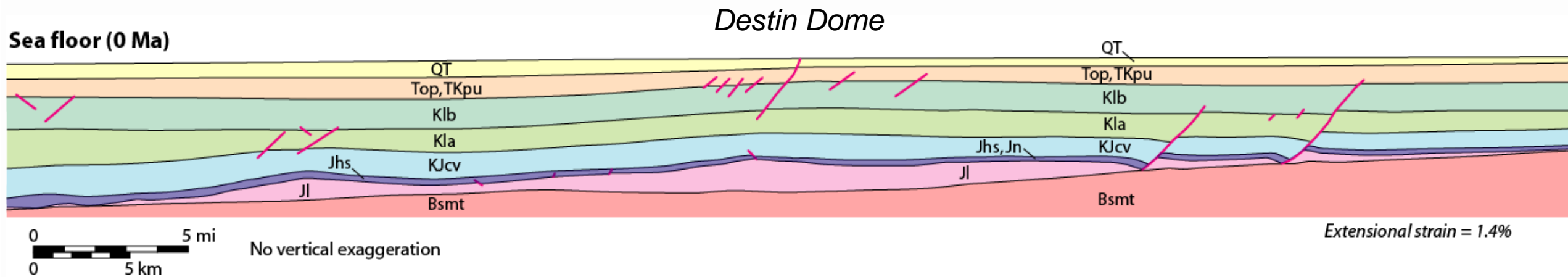


# DCSB Destin Dome

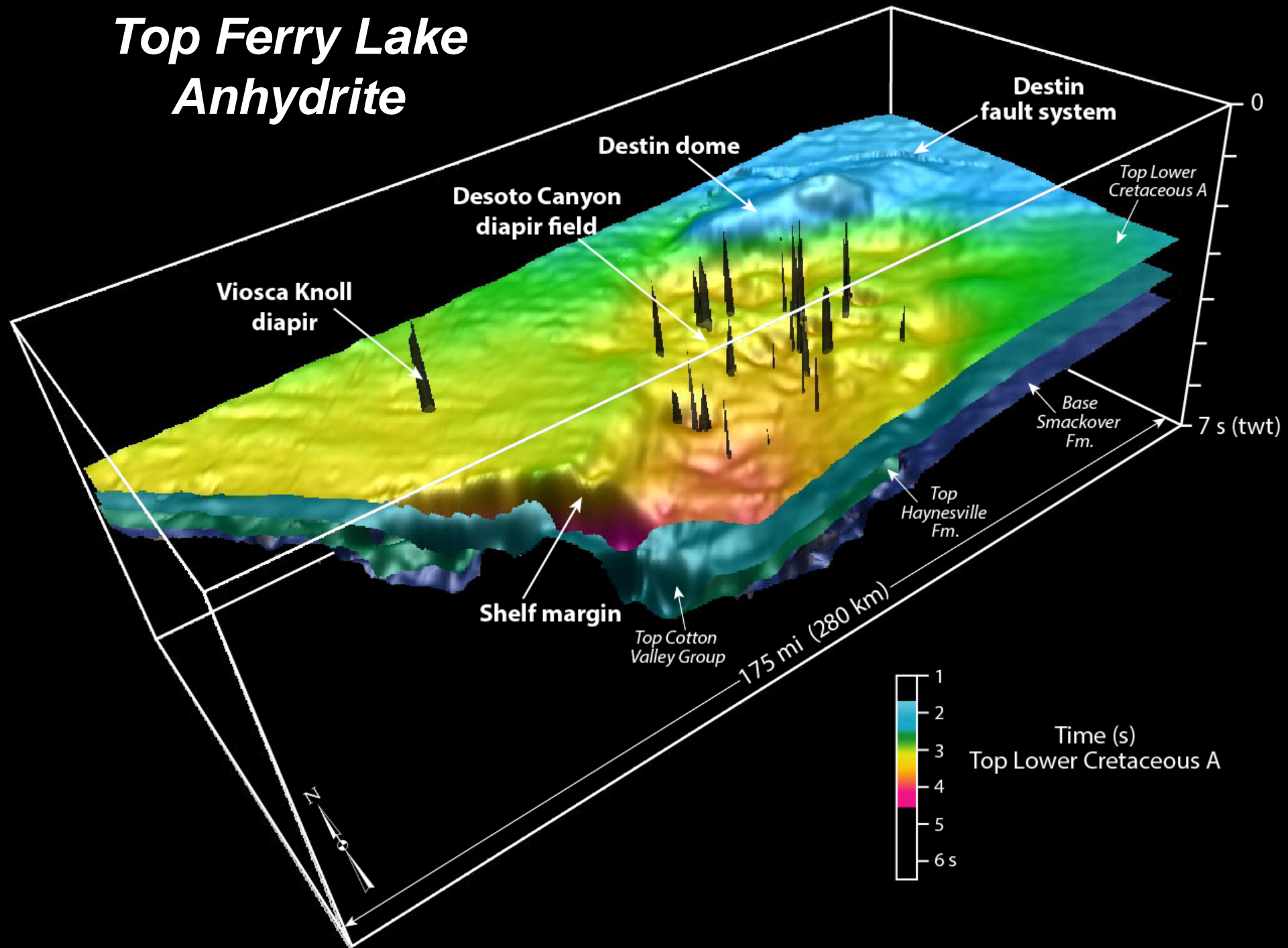




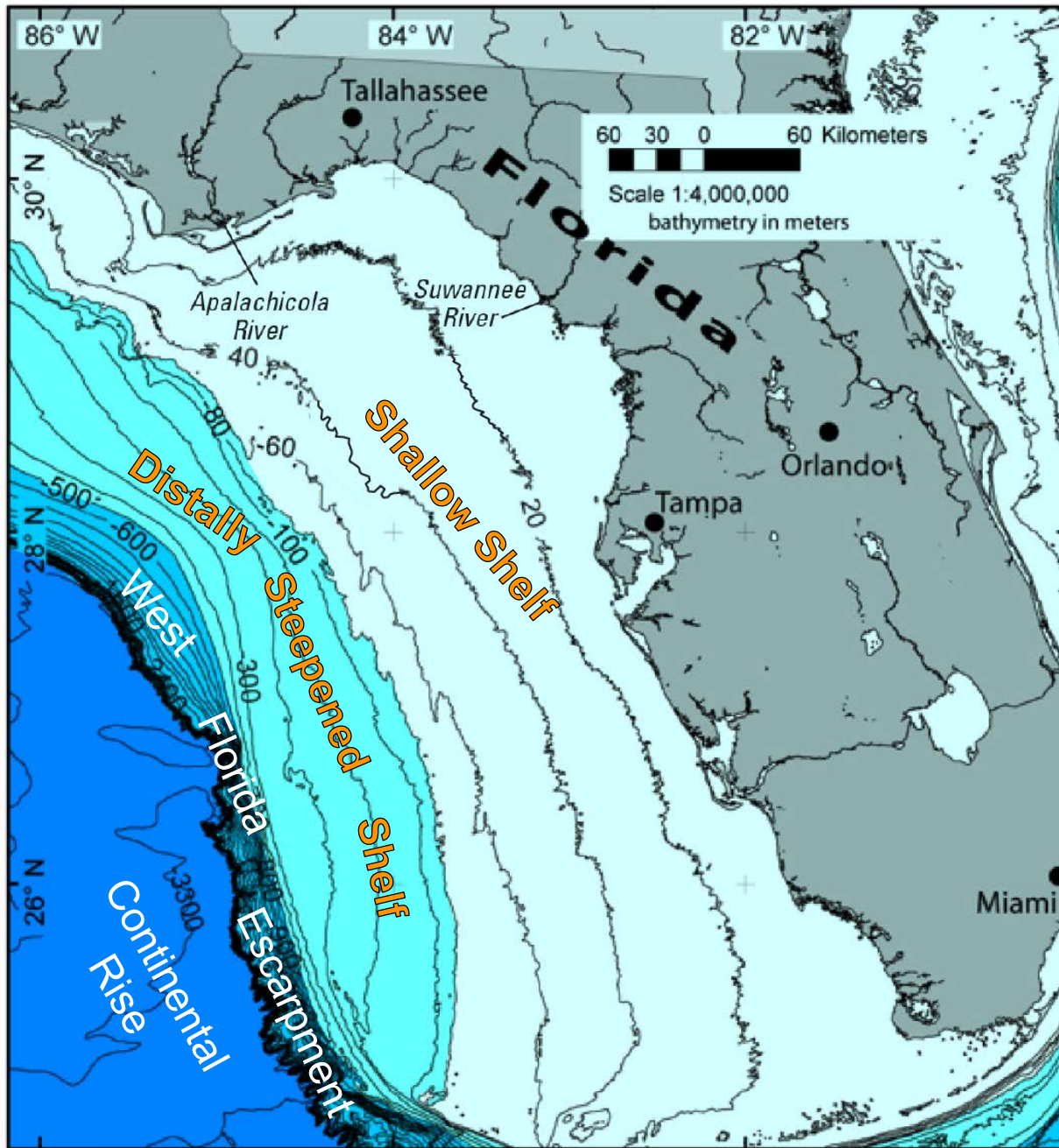
# Depth-Converted Structural Cross Sections, DeSoto Canyon Salt Basin



# Top Ferry Lake Anhydrite



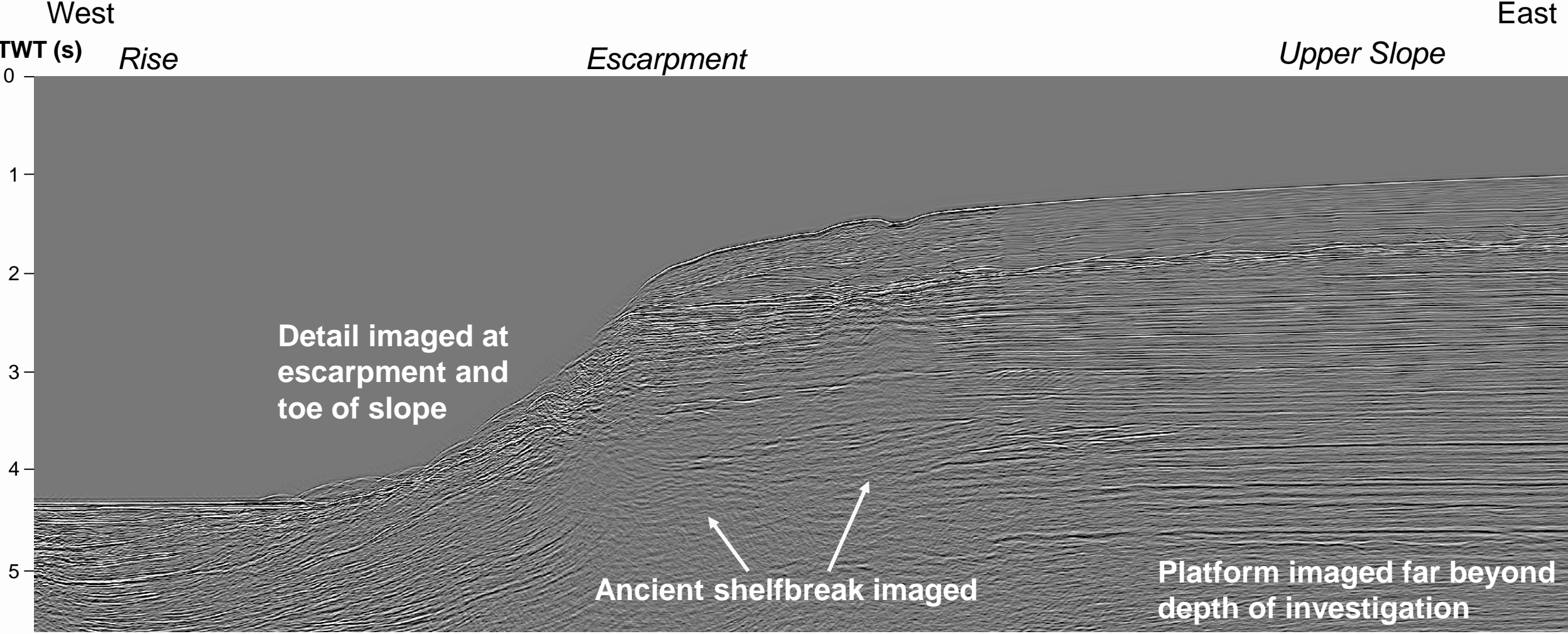
# West Florida Shelf Bathymetry



- Broad, shallow, region near shore (NE of 80 m contour).
- Distally steepening outer shelf leading to West Florida Escarpment.



# Data Quality – West Florida

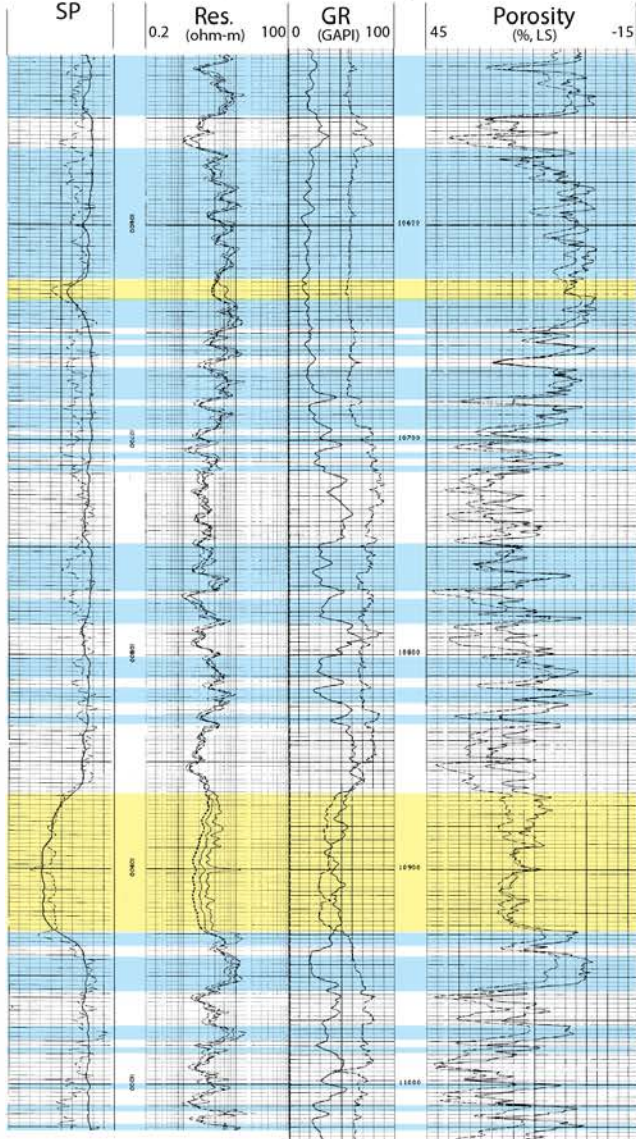


1 km



# Prospective EGOM Sinks

Well G02468, Desoto Canyon Salt Basin



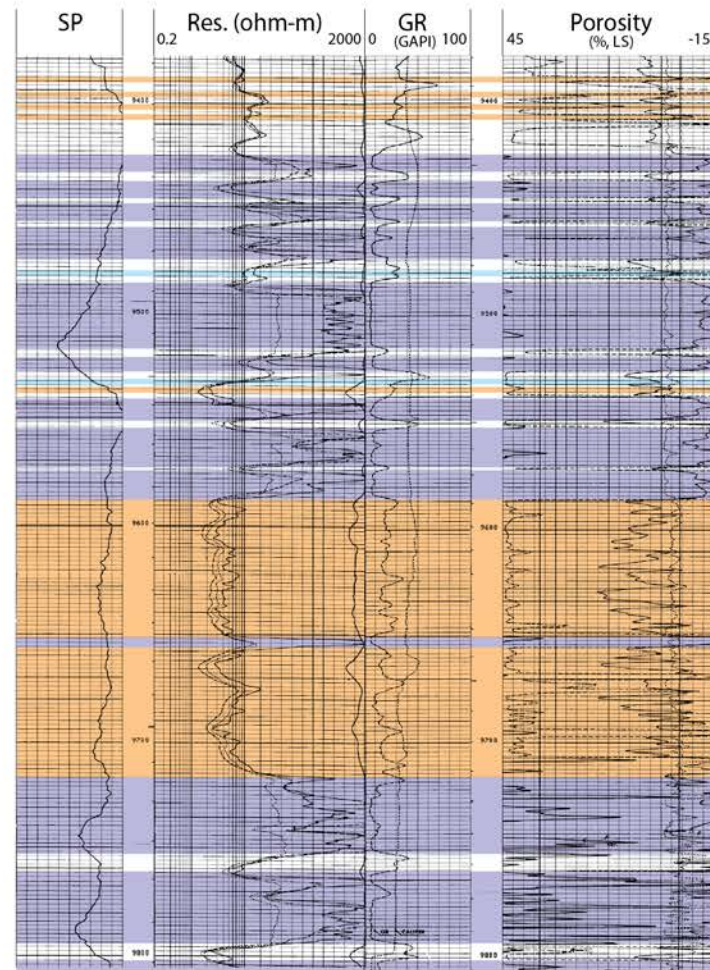
**Paluxy Formation**

*Major prospects in sandstone of Tuscaloosa Group and Paluxy Fm.*

*Topseal*

**Reservoir**  
*Porosity locally >20%*

Well G3912, West Florida Shelf



**Punta Gorda Anhydrite**

*Topseal*

**Reservoir**

*Porosity locally >15%*

**Reservoir**

*Major prospects in porous dolomite associated with anhydrite intervals*

Shale

Sandstone

Limestone

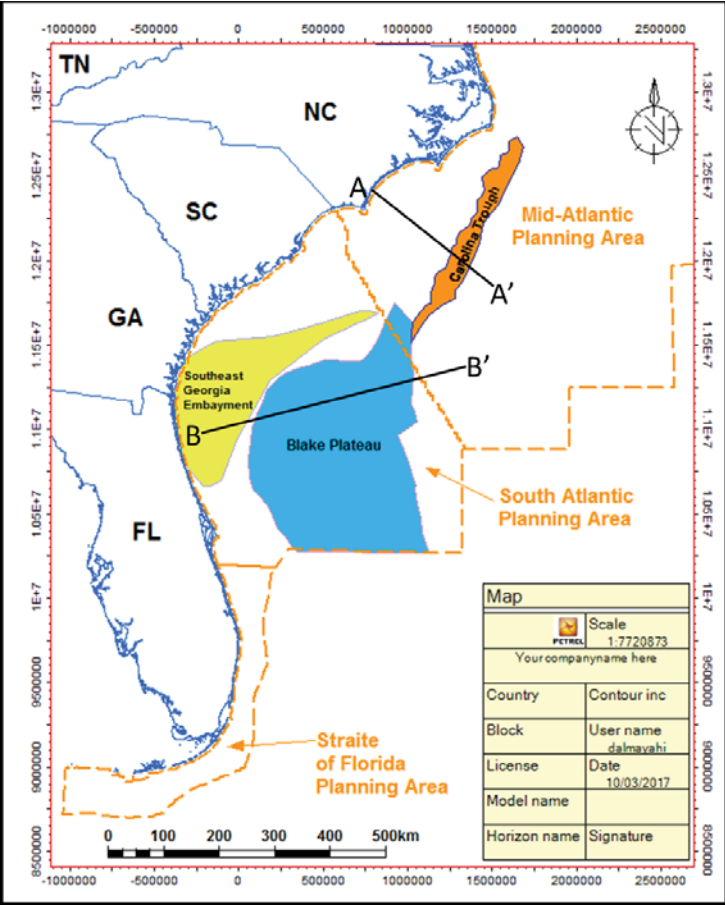
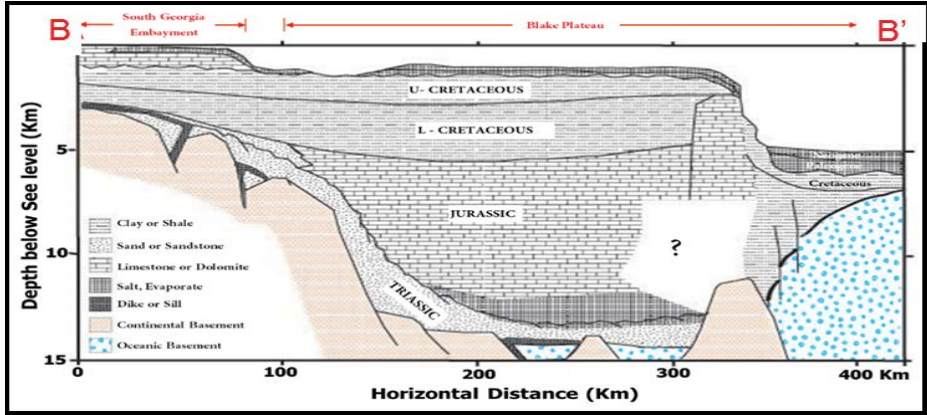
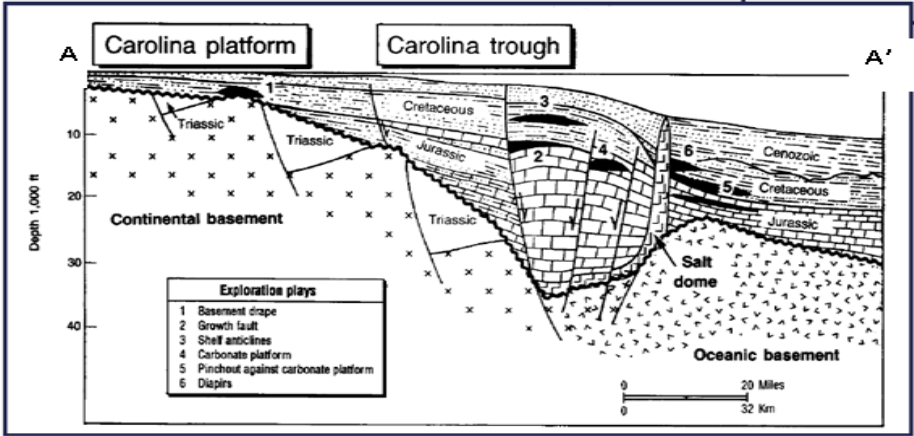
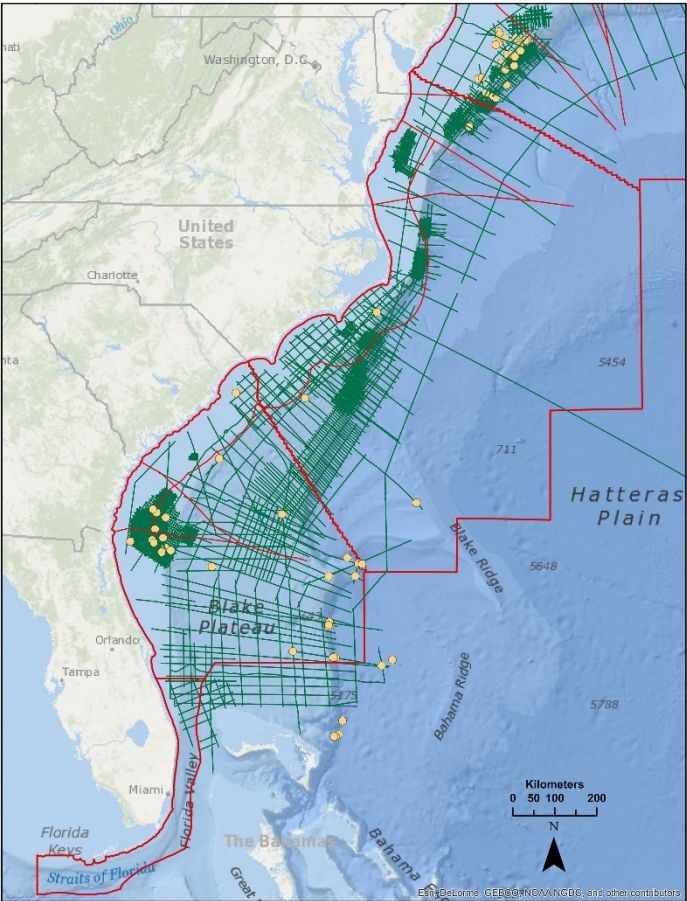
Dolomite

Anhydrite

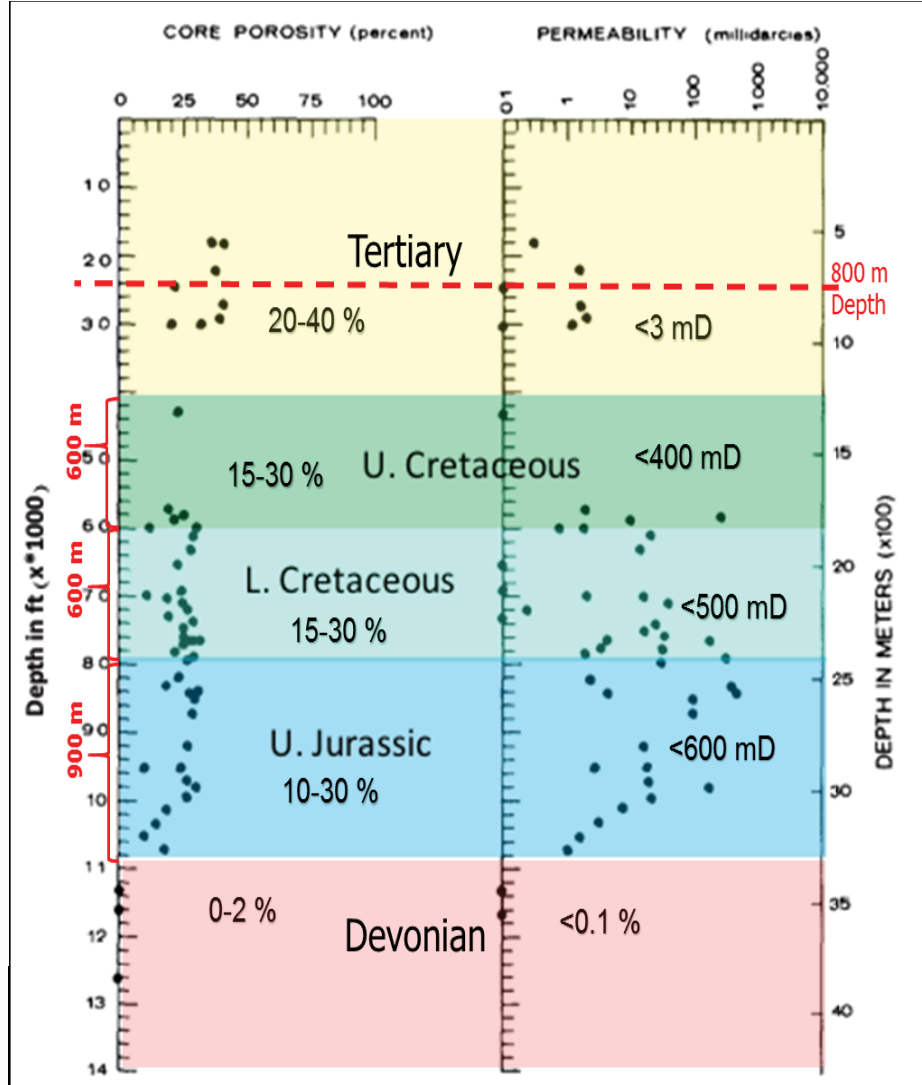


# South and Mid-Atlantic Planning Areas

- Total of six exploration wells, on Georgia/Florida shelf
- Major depocenters in Carolina Trough and Blake Plateau Basin



# Prospective Mesozoic Section



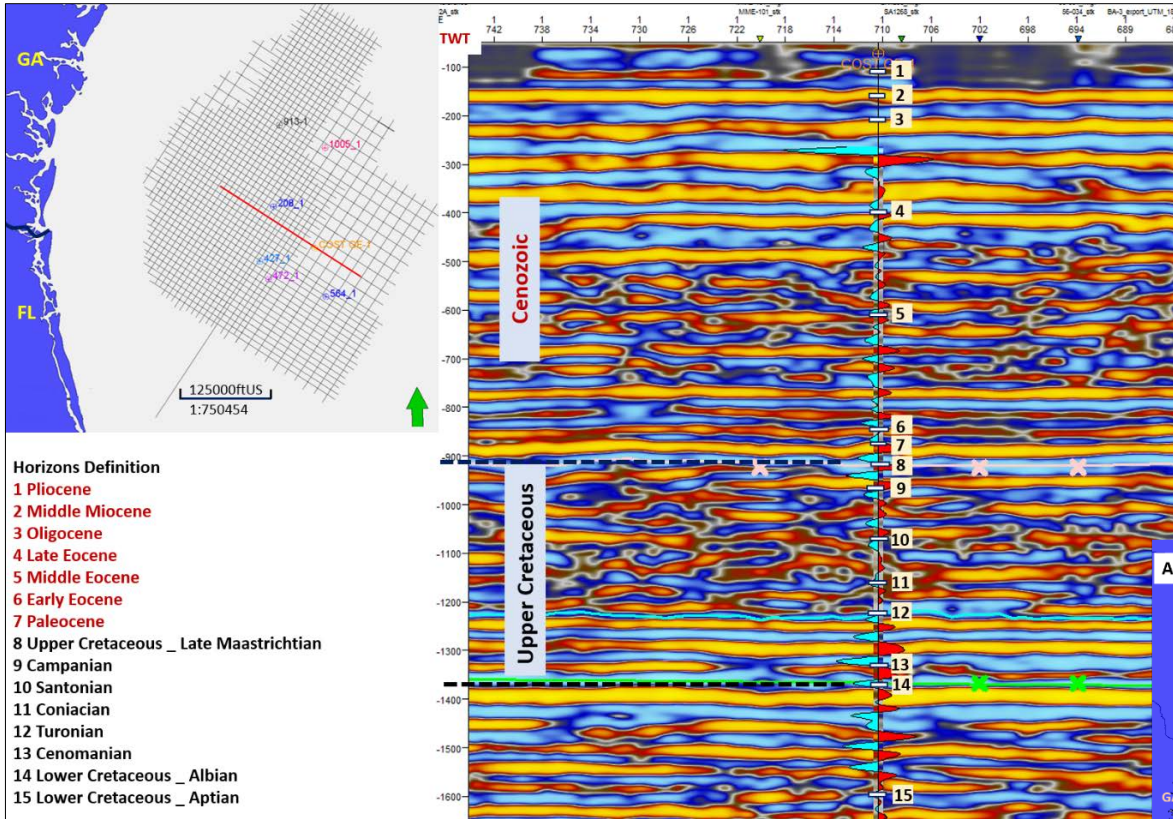
Scholle (1979)

Reservoir Properties	Positive Indicators	Cautionary Indicators
Depth	>800 m, <2500 m	<800 m, >2500 m
Reservoir thickness	>50 m	<20 m
Porosity	>20%	<10%
Permeability	>500 mD	<200 mD
Salinity	>100 g l <sup>-1</sup>	<30 g l <sup>-1</sup>
Stratigraphy	Uniform	Complex lateral variation and complex connectivity of reservoir facies
Capacity	Estimated effective capacity much larger than total amount of CO <sub>2</sub> to be injected	Estimated effective capacity similar to total amount of CO <sub>2</sub> to be injected
<b>Caprock Properties</b>		
Lateral continuity	Stratigraphically uniform, small or no faults	Lateral variations, medium to large faults
Thickness	>100 m	<20 m

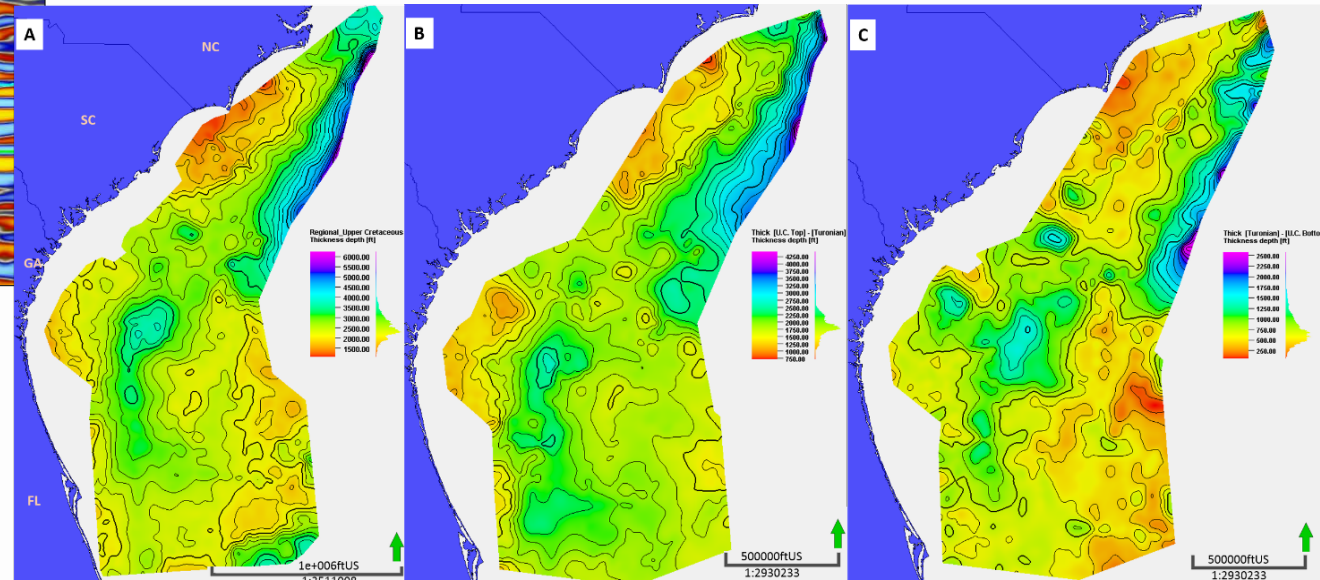
Chadwick et al (2008)



# Upper Cretaceous Prospective Sink



- Flat-lying, regionally extensive, structurally uncomplicated thick stratigraphic section
- Significant porosities (15-30%) and permeabilities (3.5-450 mD) within interbedded clastic and carbonate rocks
- Appropriate depths (4,000-6,000 ft.) for CO<sub>2</sub> storage



Almutairi et al (in prep)



# Data Coverage — Mid-Atlantic Planning Area

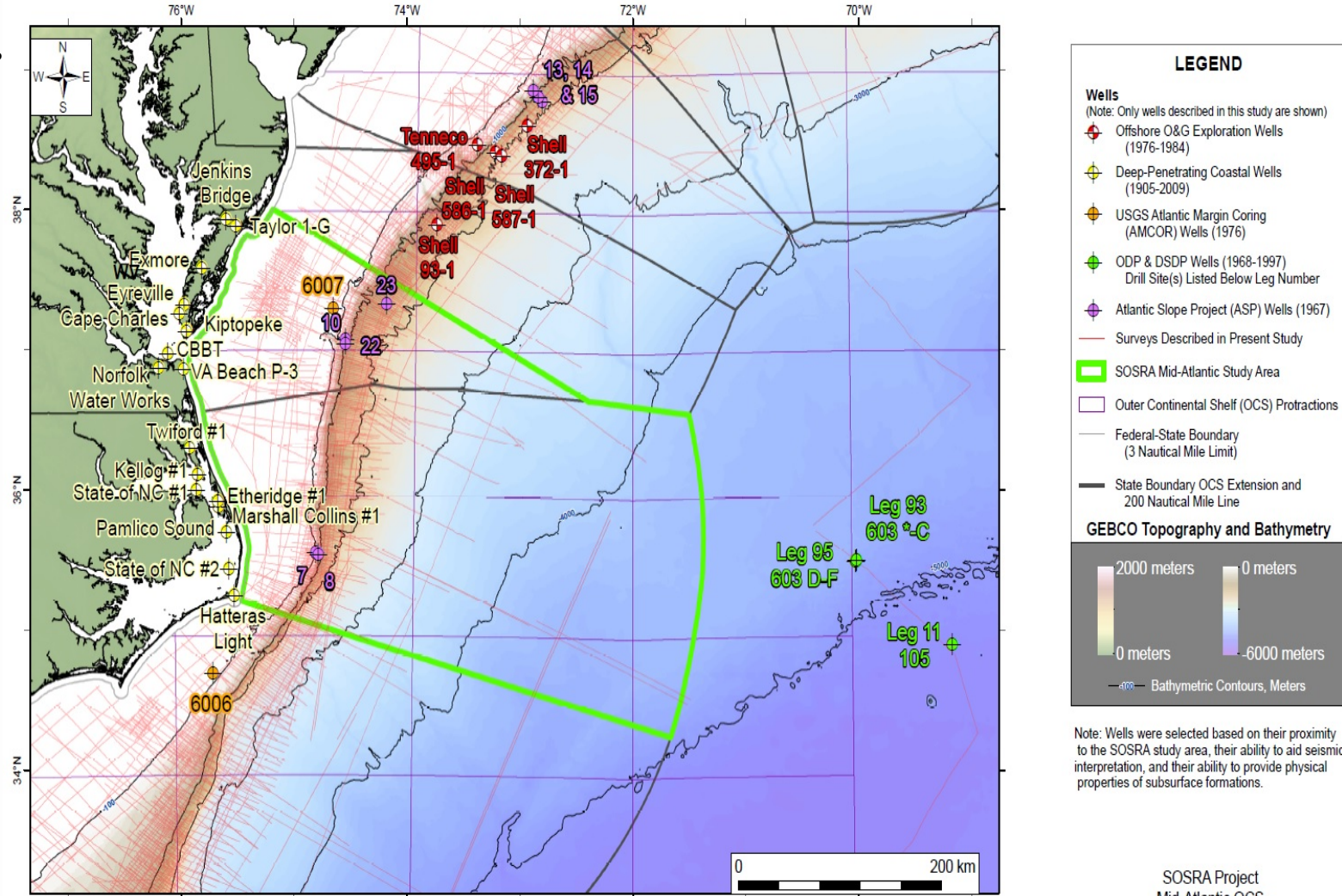
Over 1,000 lines and 34 wells (only 5 offshore) were selected for the study of the Mid-Atlantic Region.

## Areal Coverage Method:

- Line/grid Spacing: Regional, Semi-Regional, Exploration scale
- Location of offshore wells outside the study area. Presence of 5 exploration wells at the North of the region.

## Results:

Unlike the sparse distribution of well data, the seismic data collected on the Mid-Atlantic margin is of sufficient density to perform the interpretation task.





# Quality Analysis

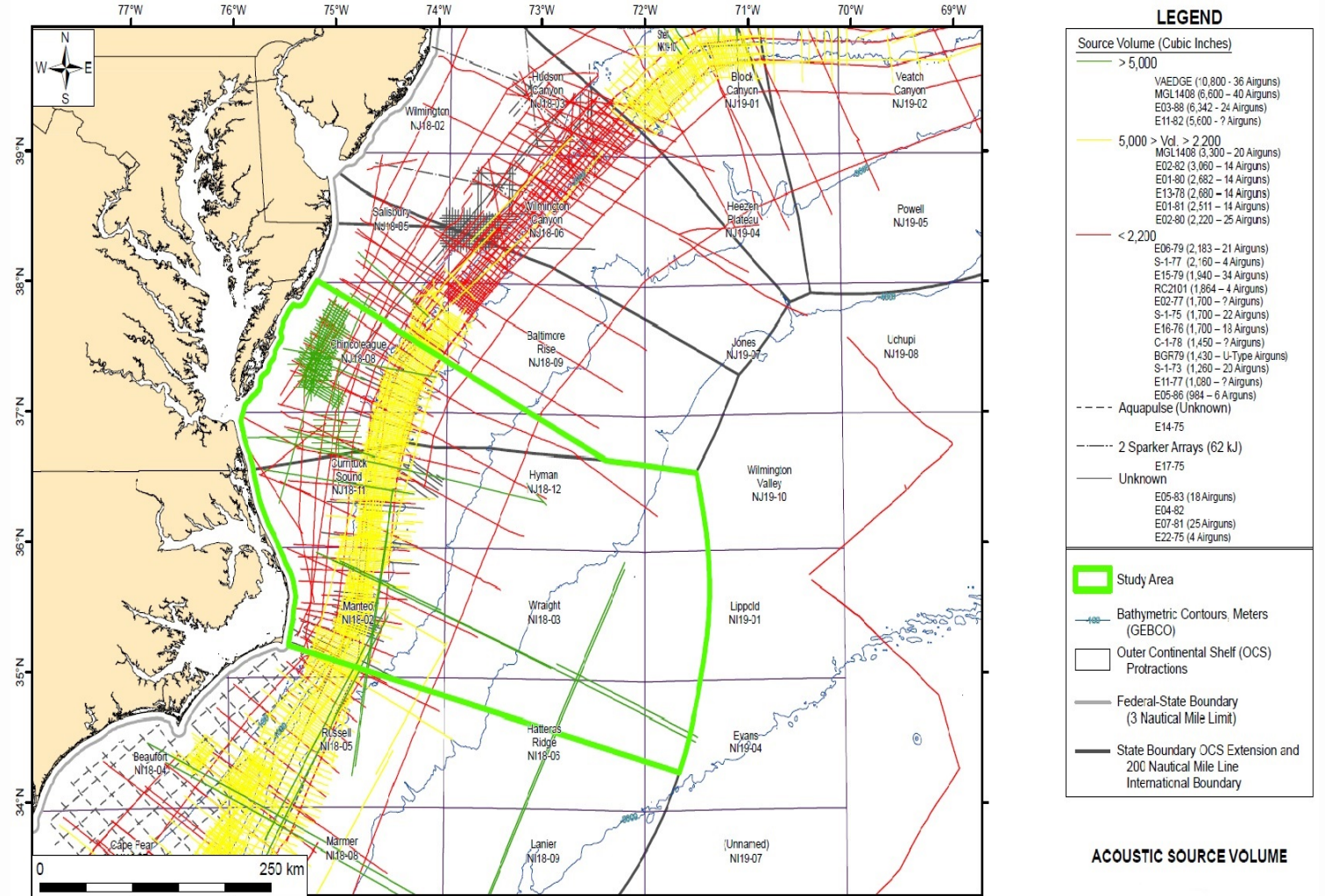
Over 1,000 lines and 34 wells (only 5 offshore) were selected for the study of the Mid-Atlantic Region.

## Quality Assessment Method:

- Resolution: frequency analysis, data stacked or migrated
- Survey Design: source volume and cable length
- Benefit of reprocessing: identify lines of poor quality and potentially reprocess if needed

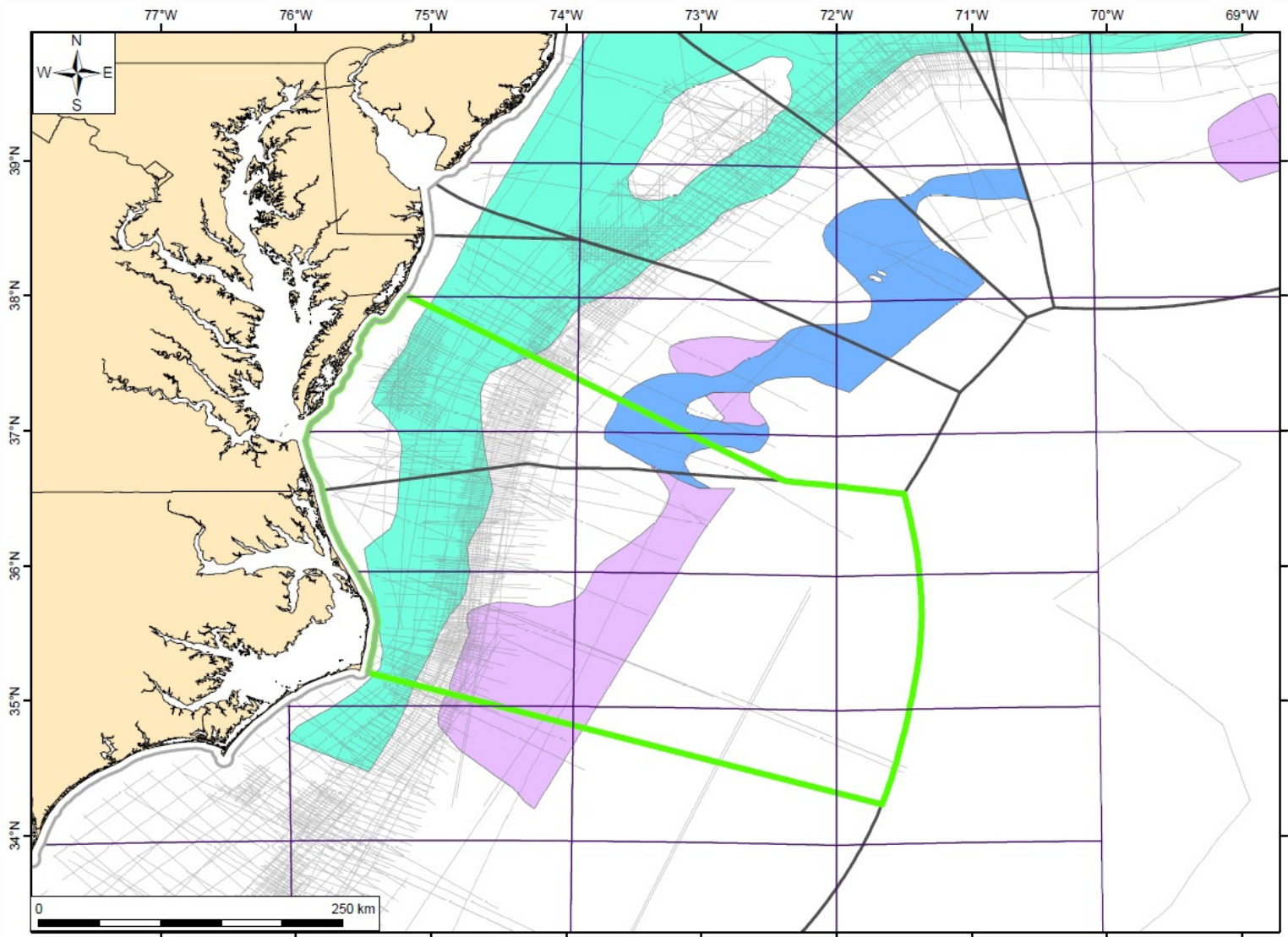
## Results:

The quality varies from fair to poor and is better for more recent data. Offshore wells were QC'd to improve their quality.



# Seismic Interpretation – Cretaceous Sinks

EON ERA	PERIOD	EPOCH	Age in millions of years before present		
Phanerozoic	Cenozoic	Quaternary	Holocene	Present	
			Pleistocene	0.01	
		Tertiary	Neogene	Pliocene	1.6
				Miocene	5.3
				Oligocene	23.7
			Paleogene	Eocene	36.6
				Paleocene	57.8
				<b>Cretaceous</b>	68.4
				Jurassic	144
				Triassic	208
	Paleozoic	Carboniferous	Permian	245	
			Pennsylvanian	286	
			Mississippian	320	
			Devonian	360	
Silurian	408				
Ordovician	438				
Cambrian	505				
			570		



**LEGEND**

Extent of Potential Early Cretaceous to Jurassic CO<sub>2</sub> Reservoirs<sup>1</sup>

- Confining Unit: 110
- Confining Unit: 105
- Confining Unit: 100

Study Area

- Seismic Tracklines Described in Report
- Outer Continental Shelf (OCS) Protraction
- Federal-State Boundary (3 Nautical Mile Limit)
- State Boundary OCS Extension and 200 Nautical Mile Line International Boundary

**Notes:**  
<sup>1</sup>Potential Early Cretaceous to Jurassic CO<sub>2</sub> Reservoirs: Source of reservoir extent: Klitgord et al. (1994)  
 Confining Units:  
 Early Cretaceous shale (Base Barremian, Seismic Reflector 110)  
 Early Cretaceous shale (Base Aptian/Albian, Seismic Reflector 105)  
 Late Cretaceous clay (Base Cenomanian/Turonian, Seismic Reflector 100)  
 Reservoirs: Early Cretaceous and Jurassic limestones, sandstones and siltstones

**POTENTIAL CO<sub>2</sub> RESERVOIRS: EARLY CRETACEOUS TO JURASSIC**



# Concluding Thoughts

- Giant potential for offshore CO<sub>2</sub> storage.
- Large portfolio of potential sinks and seals in eastern Gulf and Atlantic regions.
- Seismic and well data being interpreted.
- Geopressure >12,000 ft; main storage prospects in Cretaceous-Miocene section.
- High porosity reservoirs identified in sandstone and carbonate; seals include mudrock, chalk, and evaporites.
- Pristine reservoir potential represented by much of the southeast offshore.