

# Southeast Offshore Storage Resource Assessment: Mid-Atlantic



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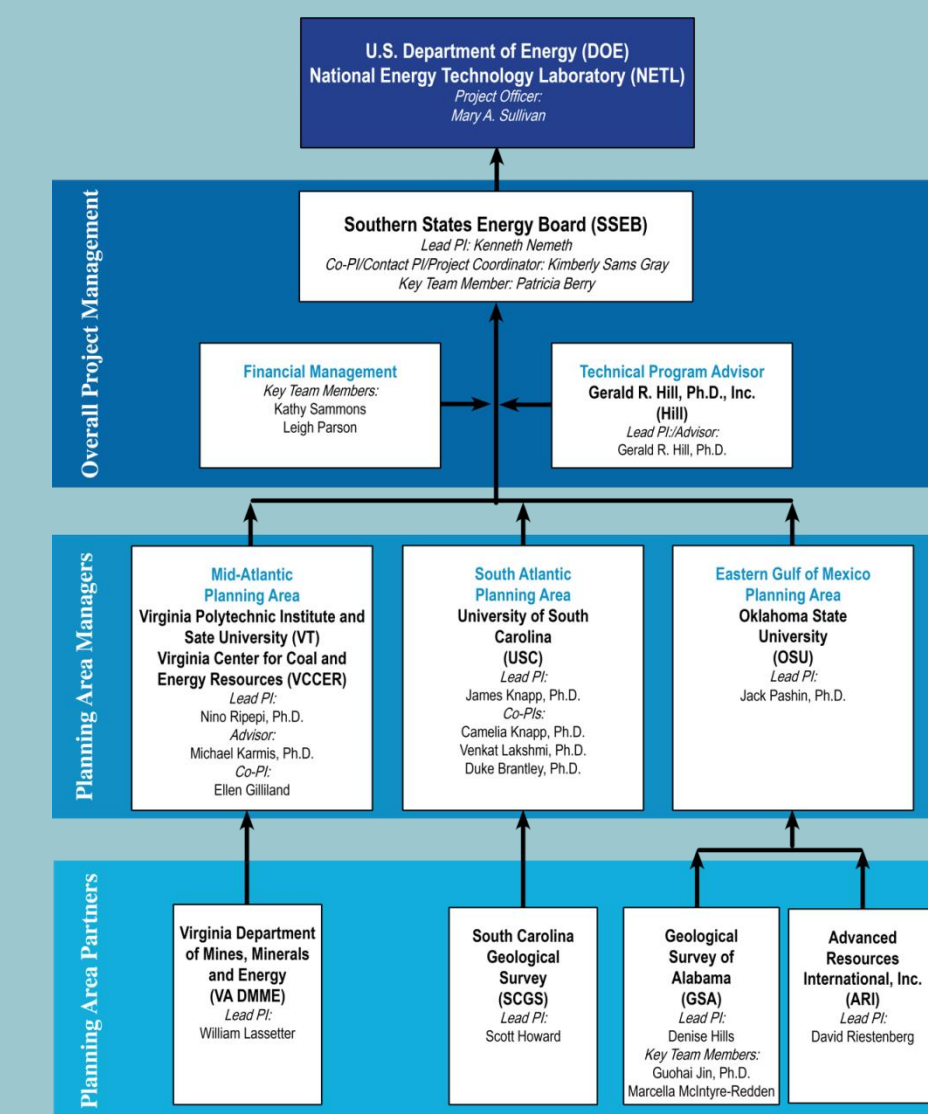
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## SOSRA Project Objectives and Scope of Work

The Southeast Offshore Storage Resource Assessment (SOSRA) project will provide a high quality prospective carbon dioxide (CO<sub>2</sub>) storage resource assessment of the eastern Gulf of Mexico, the Mid-Atlantic seaboard, and the South Atlantic seaboard.

The project is managed by Southern States Energy Board (SSEB) with technical tasks conducted by planning area project teams composed of local managers, researchers, and partners.

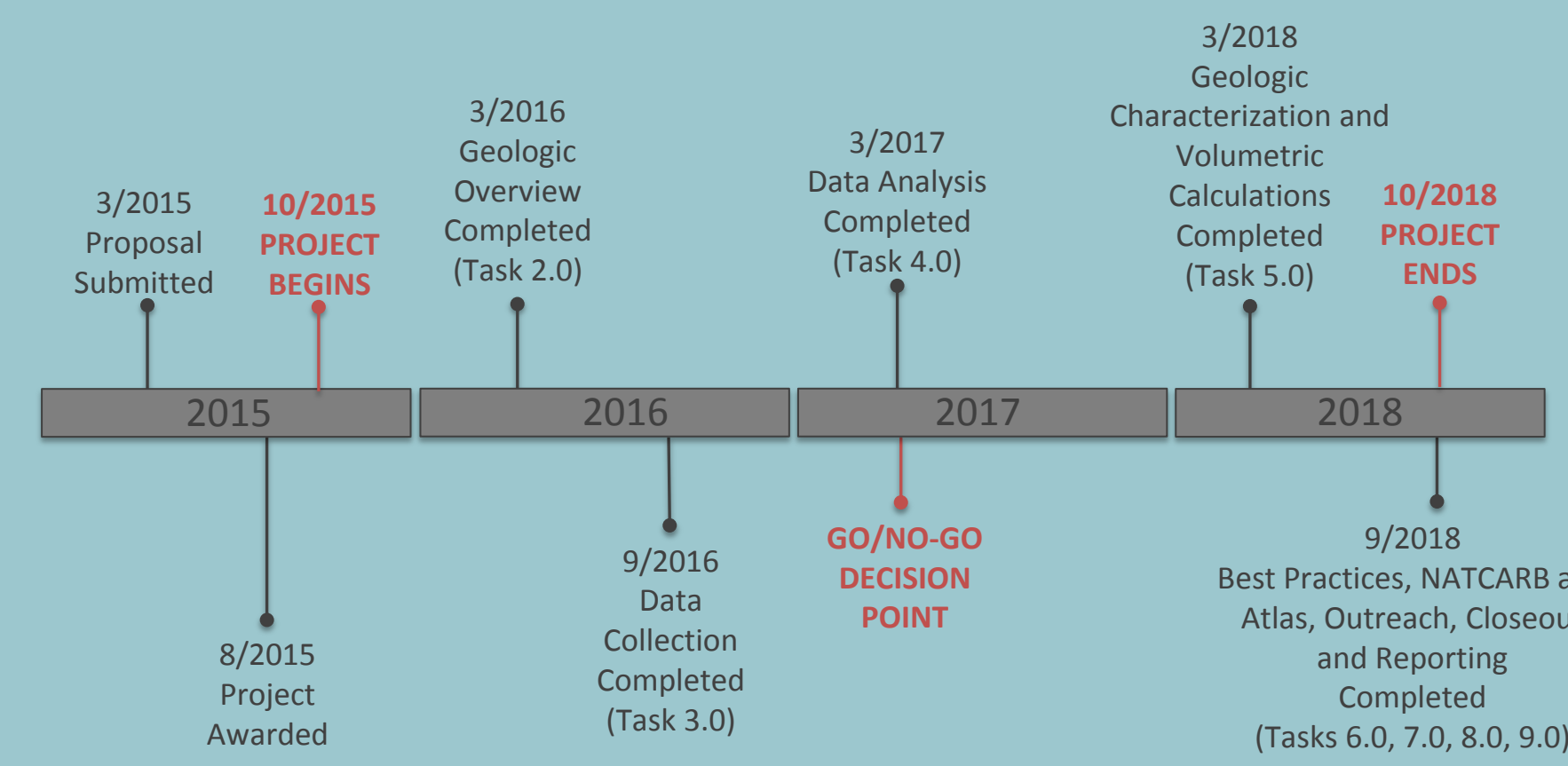


SOSRA Organizational Chart

The SOSRA project will utilize existing geologic and geophysical data sets to identify target reservoirs for CO<sub>2</sub> storage, determine reservoir properties (porosity and permeability) and spatial extents, and estimate prospective storage resources.

The quantitative resource estimation will be based on DOE's volumetric approach outlined in *The United States 2012 Carbon Utilization and Storage Atlas* for saline formations and oil and gas reservoirs.

## 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.

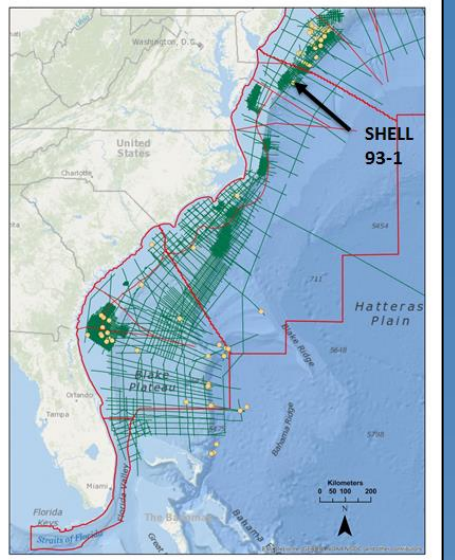
## Technical Tasks

### Data Collection

Existing geologic and geophysical datasets acquired for previous studies of the offshore Mid-Atlantic region will be collected to perform the Prospective Storage Resource Assessment and will be compiled into a Comprehensive Project Database (Deliverable 3.0).

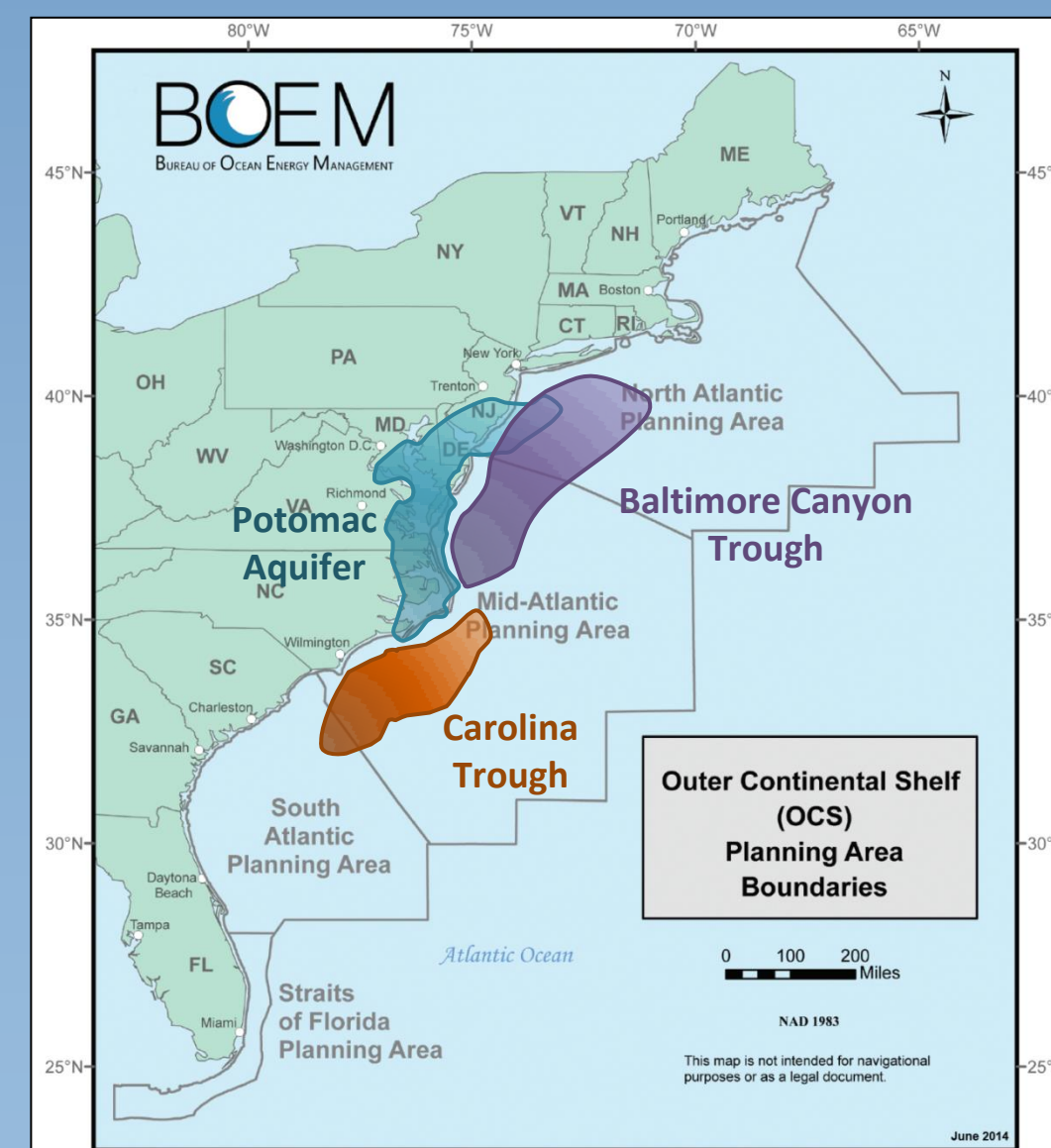
### Mid-Atlantic Data Overview

- **Wells**
  - Atlantic Slope Project (1967): 13
  - Atlantic Margin Coring (1976): 3
  - Ocean Drilling Program (1987): 2
  - Shell Oil and Gas Exploration (1984): 1
  - Shell 93-1 has the only velocity measurement
- **2D multi-channel seismic data**
  - 19 seismic surveys, approx. 5500 line miles
- **Proprietary data sets**
- **Ties from outside study area**



These datasets include 2D seismic surveys, well logs, and additional available public or proprietary data. Because geologic structures and the surveys acquired to study them will cross planning area borders, it will also be important to include data from adjacent planning areas. This will support a consistent, integrated interpretation of offshore geology and will increase data coverage as well as model accuracy by providing additional well ties.

## Mid-Atlantic Study Area



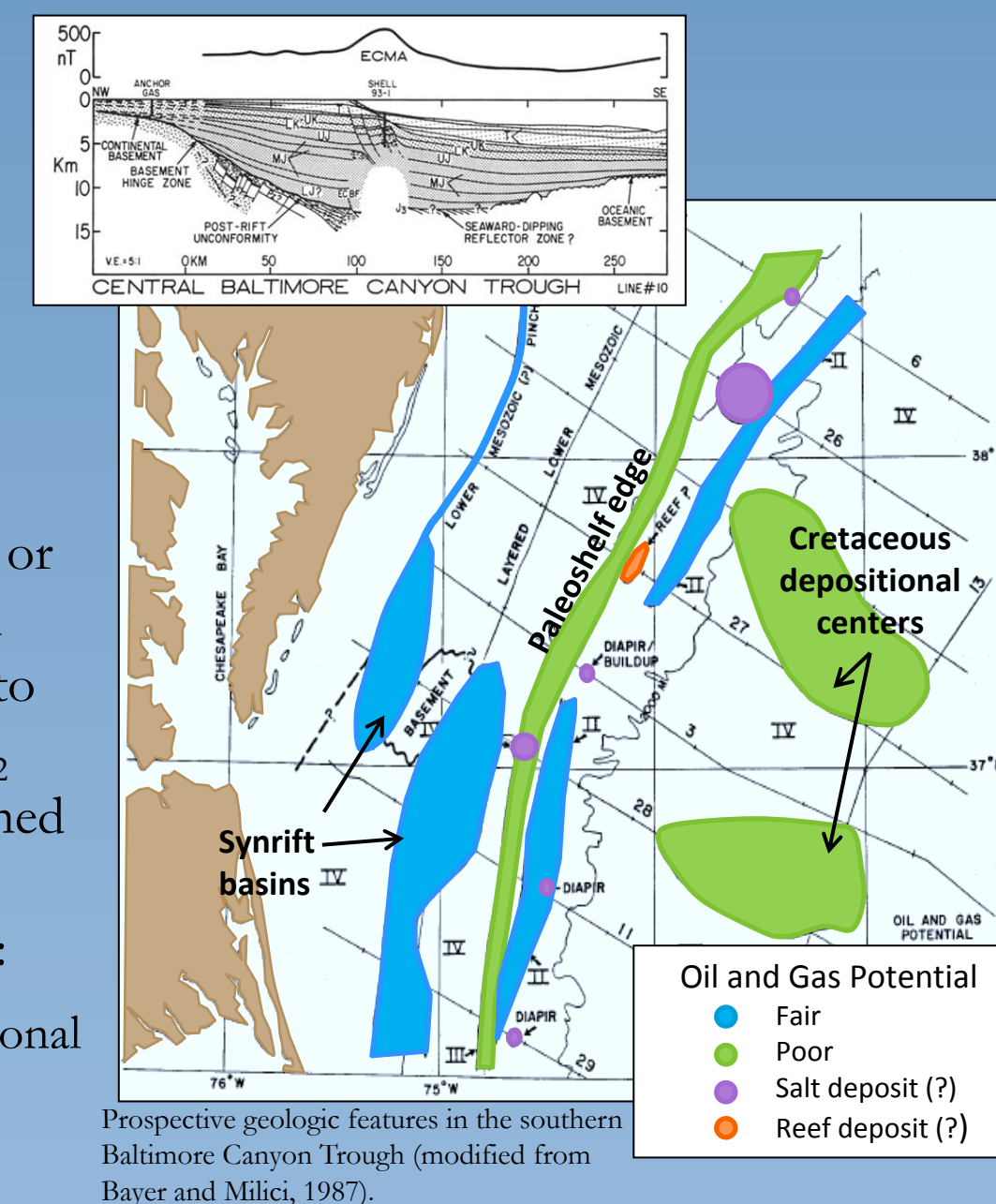
Overview of main geologic provinces in the Mid-Atlantic Study Area (modified from BOEM, USGS, GCCC, and Bayer and Milici, 1987).

## Key Geologic Provinces

### Baltimore Canyon Trough

The Baltimore Canyon Trough has been explored previously for oil and gas development. Several prospective geologic features were identified in the region offshore from Virginia but were not well defined, and most were considered to have only fair or poor production potential. The SOSRA project will revisit this region of the Baltimore Canyon Trough to assess reservoir and seal quality with a focus on CO<sub>2</sub> storage and capacity. Several datasets will be combined in order to improve the delineation of key geologic features associated with the province, which include:

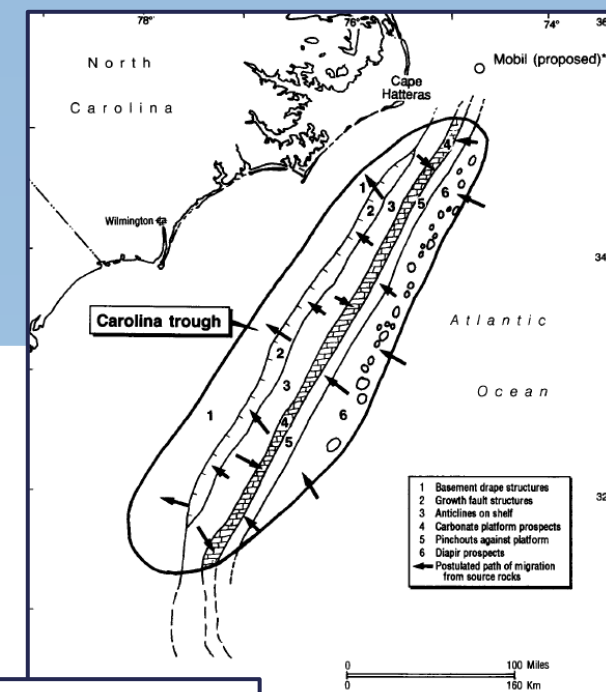
- Synrift basins
- Paleoshelf margins including the Cretaceous-Jurassic shelf edge
- A stratigraphic pinchout of Lower Mesozoic strata
- Cretaceous depositional centers
- Salt diapirs
- Horst and graben structures
- Carbonate seals



Prospective geologic features in the southern Baltimore Canyon Trough (modified from Bayer and Milici, 1987).

### Carolina Trough

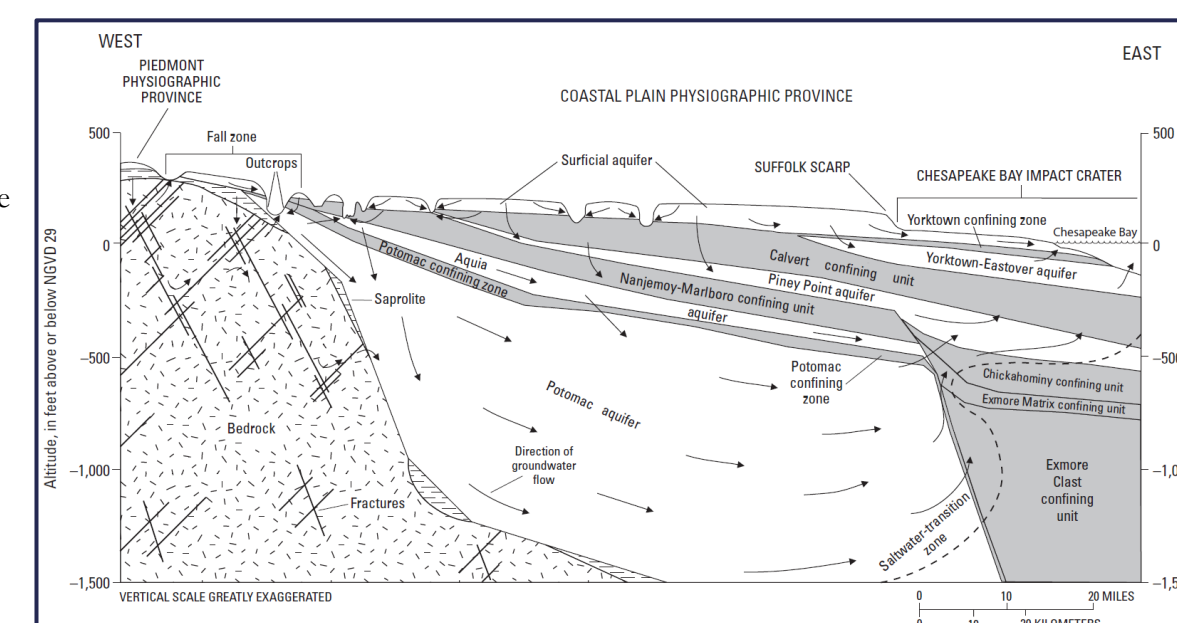
The Carolina Trough is a largely unexplored salt basin which extends along the coasts of North and South Carolina and is roughly 60 miles wide. Prospective reservoirs include sedimentary rocks from the Upper and Lower Cretaceous with salt diapirs providing structural traps.



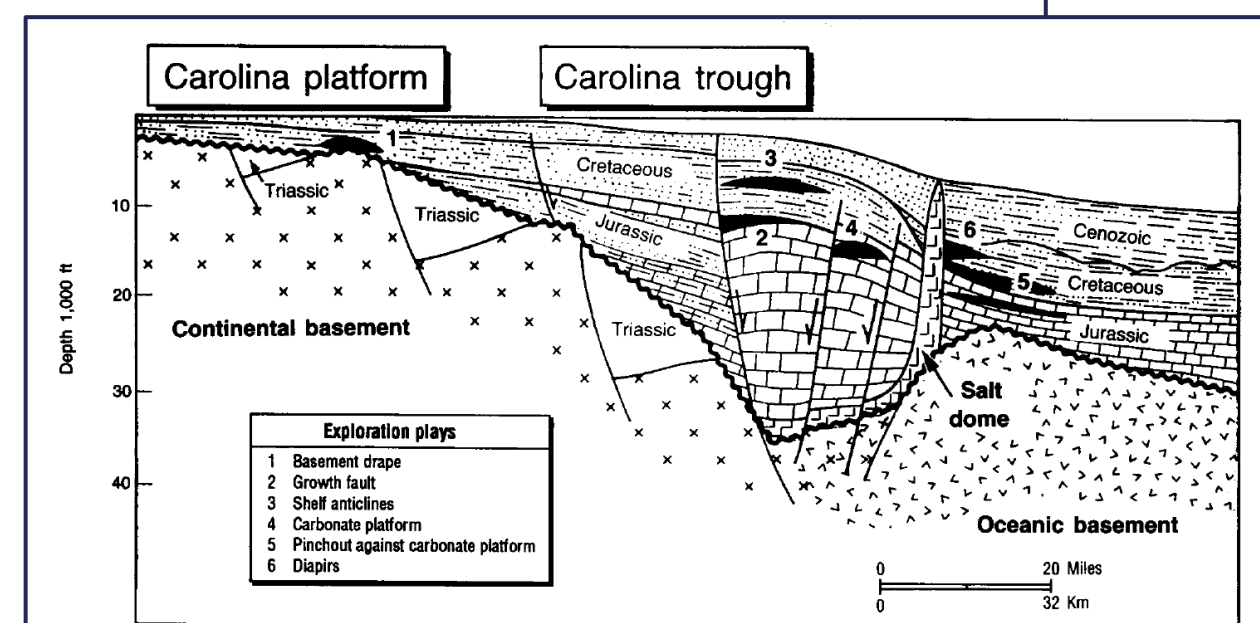
### Potomac Aquifer

Initial characterization of the Potomac Aquifer indicates permeability ranges the for Mid-Cretaceous sandstone that are well-suited to store CO<sub>2</sub> and the presence of multiple potential confining zones. The estimated boundary for the aquifer places it outside the defined study area due to the 50-mile exclusionary buffer for the coastline. However, the SOSRA project will include characterization of the aquifer and its boundaries because of its proximity to the study area and potential to constrain surrounding geology.

Generalized geologic cross section depicting the hydrology and groundwater flow for the Virginia Coastal Plain (from USGS, 2013).



Above: Possible oil and gas exploration prospects and hydrocarbon migration paths for the Carolina Trough (from Carpenter and Amato, 1992). Left: Generalized structural cross section for the Carolina Trough (modified from Carpenter and Amato, 1992).



## Data Analysis

An initial assessment of datasets compiled for the Comprehensive Project Database will be conducted and summarized in a **SOSRA Data Quality and Coverage Evaluation (Deliverable 4.2)**. This evaluation will determine whether the database is sufficient to conduct the Prospective Storage Resource Assessment and will support a **Go/No-Go Decision Point**.

Further data analysis will be performed with industry-standard software, including Schlumberger's Petrel E&P Software Platform for seismic interpretation. Analysis will involve creating synthetic seismograms to tie well log information to 2D seismic data, seismic interpretation of geologic structures and stratigraphy, and the identification of candidate carbon sinks. This work will be conducted in coordination with the technical team for the South Atlantic Study Area to ensure interpretations are consistent and integrated. A **Summary of Data Analysis (Deliverable 4.4)** will document workflows and present initial results.

## Geologic Characterization and Volumetric Calculations

The Prospective Storage Resource Assessment will be based on detailed characterization of the carbon storage formations identified through seismic data analysis and interpretation. Reservoir properties, including porosity and permeability characteristics and spatial extents, will be

US-DOE CO <sub>2</sub> Storage Resource Mass Estimates (from Goodman et al., 2011)	
For oil/gas reservoirs:	For saline aquifers:
$G_{CO_2} = A h_n \phi_e (1 - S_{wi}) B \rho_{CO_2} \sigma_d E_{oil/gas}$	$G_{CO_2} = A_i h_g \phi_{tot} \rho E_{saline}$
<small>A<sub>i</sub> = area, h<sub>n</sub> = net thickness, φ<sub>e</sub> = avg. effective porosity, S<sub>wi</sub> = initial water saturation, B = initial oil/gas formation volume factor, ρ<sub>CO<sub>2</sub></sub> = standard CO<sub>2</sub> density, E = storage efficiency factor</small>	<small>A<sub>i</sub> = total area, h<sub>g</sub> = gross formation thickness, φ<sub>tot</sub> = total porosity, ρ = CO<sub>2</sub> density, E<sub>saline</sub> = storage efficiency factor</small>

## Outreach and Impacts

The SOSRA project will support decisions related to the commercial deployment of carbon storage operations in coastal margins of the southeastern U.S. through the Prospective Storage Resource Assessment and through the development of project deliverables aimed at knowledge

sharing. These include input to best practices manuals (Deliverables 6.1 and 6.2), NatCarb data and atlas contributions (Deliverable 7.0), a technology transfer plan and report (Deliverable 8.2), and recommendations for modeling-based MVA, infrastructure development, and target area development (Deliverables 9.1, 9.2, and 9.3).



(from USCG)



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