Geologic Framework and CO_2 Storage Potential of the Eastern Gulf of Mexico Continental Shelf

Jack C. Pashin and Jingyao Meng, Oklahoma State University
Denise J. Hills, Guohai Jin, and Marcella R. McIntyre, Geological Survey of Alabama; Richard A. Esposito, Southern Company

INTRODUCTION

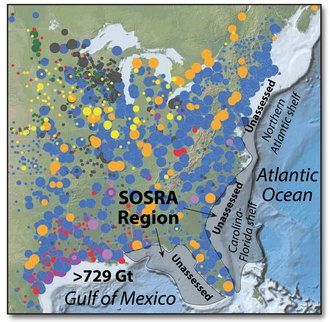
The southeast accounts for about 40% of anthropogenic CO_2 emissions in the United States. The Gulf of Mexico Basin contains a thick (5-20 km) succession of Mesozoic and Cenozoic sedimentary rocks, and the region boasts giant capacity for storage of CO_2 in saline formations and mature hydrocarbon reservoirs. Mature onshore reservoirs host commercial CO_2-EOR operations, and the potential for storage in saline formations and mature reservoirs has been proven in multiple field tests in Alabama and Mississippi. However, access to onshore saline formations may be limited by a range of ownership, infrustructure, and regulatory issues. Offshore formations may provide even larger capacity, and governmental ownership may facilitate broader access than is available onshore.

No comprehensive assessment of offshore CO_2 storage capacity is available in the eastern Gulf of Mexico, and this study is designed to fill this need. This effort is part of a larger project sponsored by the U.S. Department of Energy through the Southern States Energy Board that is assessing the storage potential of the continental shelf in the Gulf of Mexico from Mississippi to South Florida, as well as the Atlantic shelf from Florida to Maryland. The project is in the early stages, and the current focus is geological characterization.

This poster summarizes the geology of the eastern Gulf of Mexico from the DeSoto Canyon Salt Basin to the South Florida Basin. Numerous coal-fired power facilities exist near the Gulf of Mexico shoreline, with most emissions concentrated in Mississippi, Alabama, the western Florida Panhandle, and southern Florida. Numerous opportunities exist for storage in siliciclastic strata of the DeSoto Canyon Salt Basin, which include the same formations that have been tested onshore. However, less is known about the reservoir characteristics of the carbonate formations that are present in the bulk of the study region. Multiple reservoir seals that can help ensure safe, permanent storage are widespread in the region and include anhydrite, chalk, and shale.

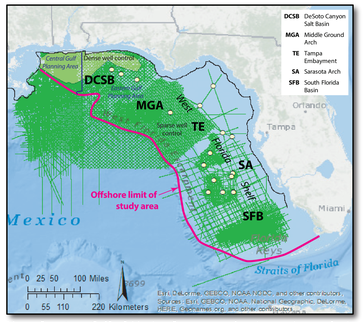
STUDY AREA

SOSRA Region



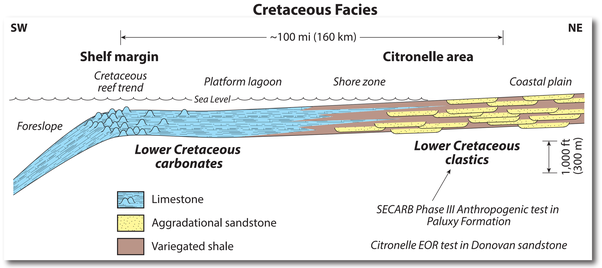
Map showing location of SOSRA region in relation to point source CO_2 emissions in the eastern United States (after NETL, 2012; SSEB, 2014).

Eastern Gulf of Mexico Focus Area



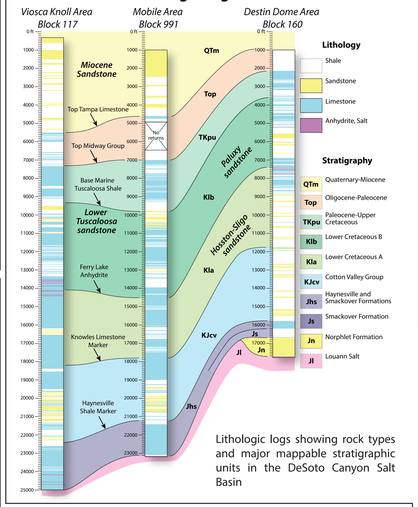
Map of eastern Gulf of Mexico focus area showing major geologic provinces. Green lines show reflection seismic control, yellow circles and shaded area indicate well control. Offshore limit of study area defined largely by location of Cretaceous reef trend.

Cretaceous Facies



Cretaceous facies in the region are dominated by siliciclastic coastal plain deposits that pass basinward into reef-rimmed carbonate platform deposits. Siliciclastic strata include formations that have been tested for CO_2 storage potential onshore, whereas the storage potential of carbonate formations is less certain.

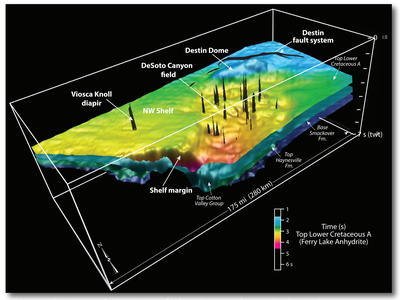
Lithologic Logs



Lithologic logs showing rock types and major mappable stratigraphic units in the DeSoto Canyon Salt Basin

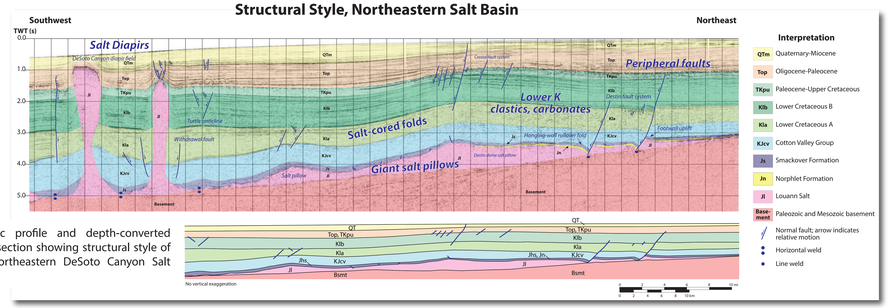
DESOTO CANYON SALT BASIN

3D Model, DeSoto Canyon Salt Basin



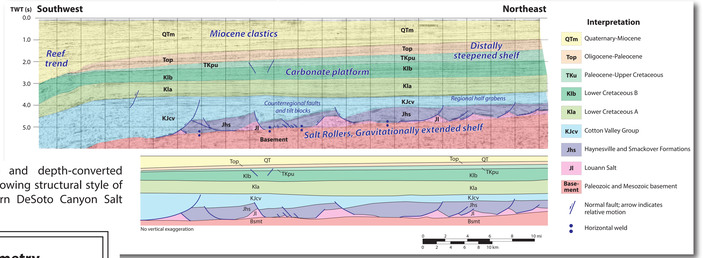
3D visualization of the top of the Ferry Lake Anhydrite showing major structural features of the DeSoto Canyon Salt Basin.

Structural Style, Northeastern Salt Basin



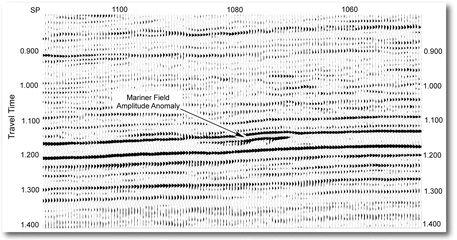
Seismic profile and depth-converted cross section showing structural style of the northeastern DeSoto Canyon Salt Basin.

Structural Style, Northwestern Salt Basin



Seismic profile and depth-converted cross section showing structural style of the northwestern DeSoto Canyon Salt Basin.

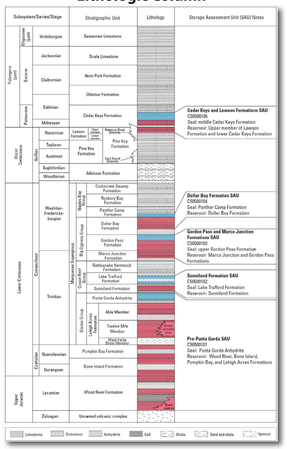
Miocene Sandstone



Seismic profile from Mariner Field, southern Mississippi showing amplitude anomaly (bright spot) associated with natural gas accumulation (after Handford and Baria, 2003). Preliminary analysis indicates that the bulk of the storage capacity in Miocene sandstone resides in saline formations below the commercial gas accumulations.

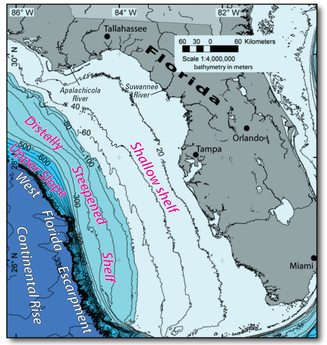
WEST FLORIDA SHELF

Lithologic Column



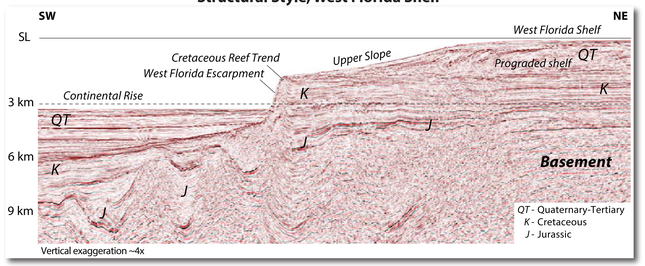
Stratigraphic column of the onshore South Florida Basin showing predominance of carbonate formations (after Roberts-Ashby et al., 2015). Prospective CO_2 sinks in red; evaporite seals in blue.

Shelf Bathymetry



Bathymetric map of the West Florida Shelf (source: USGS). Note progressive steepening of the continental slope, culminating in the West Florida Escarpment.

Structural Style, West Florida Shelf



Pre-stack, depth-converted seismic profile showing geologic architecture along a transect from the West Florida Shelf to the continental rise (after Roberts and Erickson, 2009). Note major carbonate platform bounded by Cretaceous reef trend and overlain by prograded shelf. Structures southwest of platform include apparent Mesozoic minibasins below subhorizontal Cenozoic strata of the continental rise.

OBSERVATIONS AND ISSUES

- Large portfolio of potential sinks and seals in eastern Gulf of Mexico focus area.
- Seismic and well data being compiled for assessment of capacity and preliminary screening for feasibility.
- Geophysical log coverage variable; diverse log suite focuses on proven hydrocarbon reservoir intervals.
- Complex stratigraphic and structural architecture in DeSoto Canyon Salt Basin.
- Relatively simple Cretaceous carbonate platform and distally steepened prograded shelf in West Florida.
- How does reservoir quality in siliciclastic formations with proven onshore storage potential compare wth that in the same formations offshore?
- Is sufficient porosity, permeability available in carbonate units to support commercial offshore storage?
- How robust are Miocene reservoir seals outside of proven gas production areas?

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