Advancing Ability and Acceptance for Potential Subsea CO_2 Storage in the Eastern Gulf of Mexico

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Abstract

The potential and practicality of offshore geologic carbon dioxide (CO2) subsea storage is being explored through a Department of Energy (DOE) supported project entitled “Southeast Regional Carbon Storage Partnership: Offshore Gulf of Mexico” (SECARB Offshore). SECARB Offshore supports the DOE’s long-term objective to ensure a comprehensive assessment of the potential to implement offshore CO2 subsea storage in all Bureau of Ocean Energy Management (BOEM) Outer Continental Shelf (OCS) Oil and Gas Leasing Program Planning areas in the GOM. As an estimated 40% of U.S. anthropogenic CO2 emissions are generated in the southeast, with a large portion of these emissions generated within 100 km of the coastline, the eastern Gulf of Mexico (GOM) is a prime target for this type of storage. The project team has been assembling the knowledge base required for secure, long-term, large-scale CO2 subsea storage in the GOM with or without CO2 enhanced hydrocarbon recovery (CO2-EOR). The project team has confirmed that the storage potential in Cretaceous and Tertiary reservoirs in the eastern GOM is vast (e.g., ~1,000 Mt potential storage in the DeSoto Canyon Salt Basin alone). With the significant infrastructure already in place, abundant stacked saline formations, and depleted oil and gas reservoirs, the eastern GOM is an attractive prospect. However, offshore subsea CO2 storage has different challenges with respect to project development; monitoring, verification, and accounting (MVA); and outreach as compared to onshore CO2 storage. Thus, a significant effort moving forward will be surrounding education and outreach to facilitate engagement with stakeholders in potential CO2 storage in the offshore GOM. Such materials will describe the potential for CO2 storage in the offshore GOM, highlight the environmental and economic benefits that could accrue to the Gulf Coast region in pursuing this potential, characterize the risks associated with this pursuit, and document how offshore CO2 storage is currently being pursued effectively globally. The efforts need to be tailored for specific stakeholders – for example, commercial and recreational fishing industries may have different concerns than government officials – to be effective.

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NATIONAL ENERGY TECHNOLOGY LABORATORY

SOUTHERN STATES ENERGY BOARD

GEOLOGICAL SURVEY OF ALABAMA Founded 1848


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SOUTHERN STATES ENERGY BOARD
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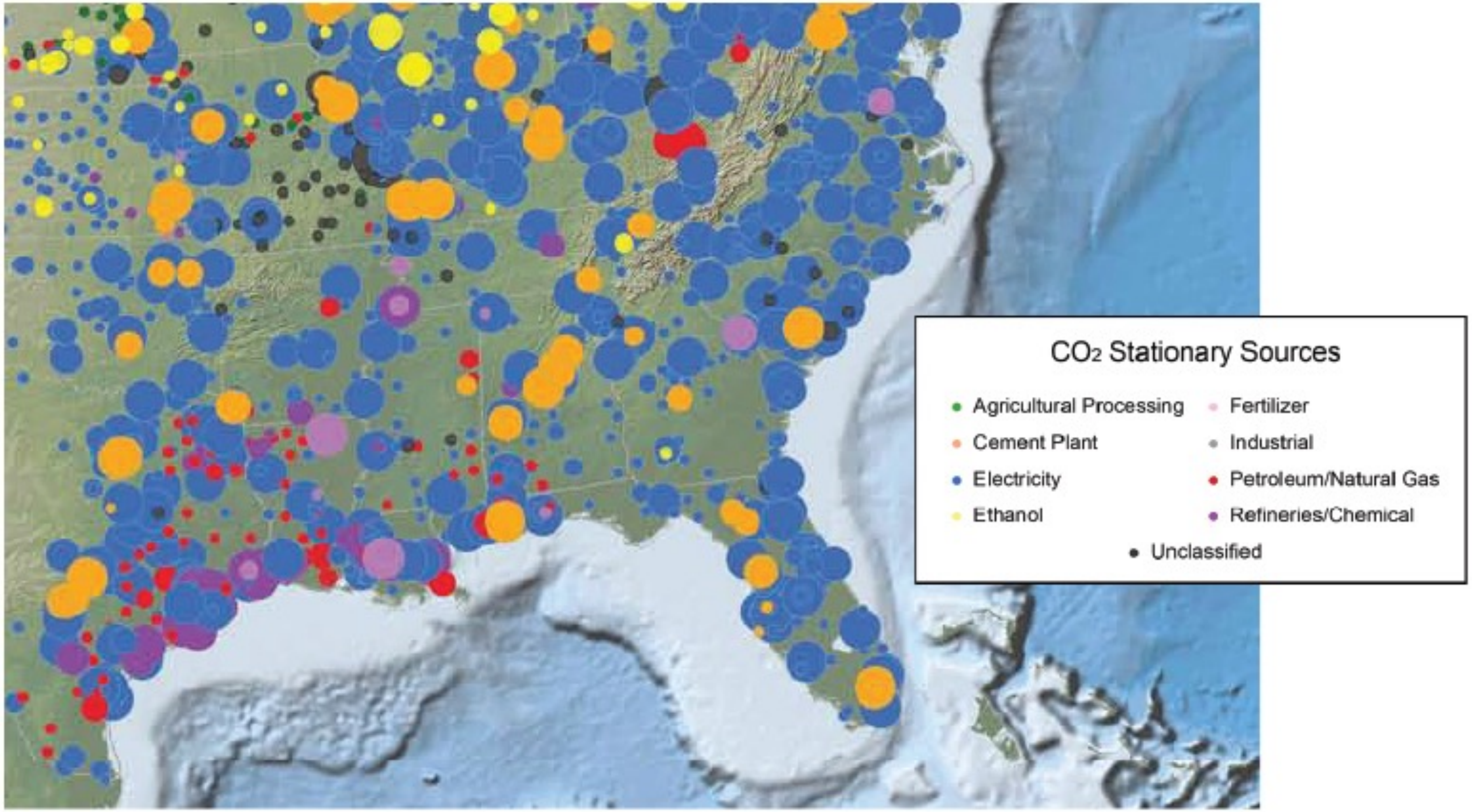
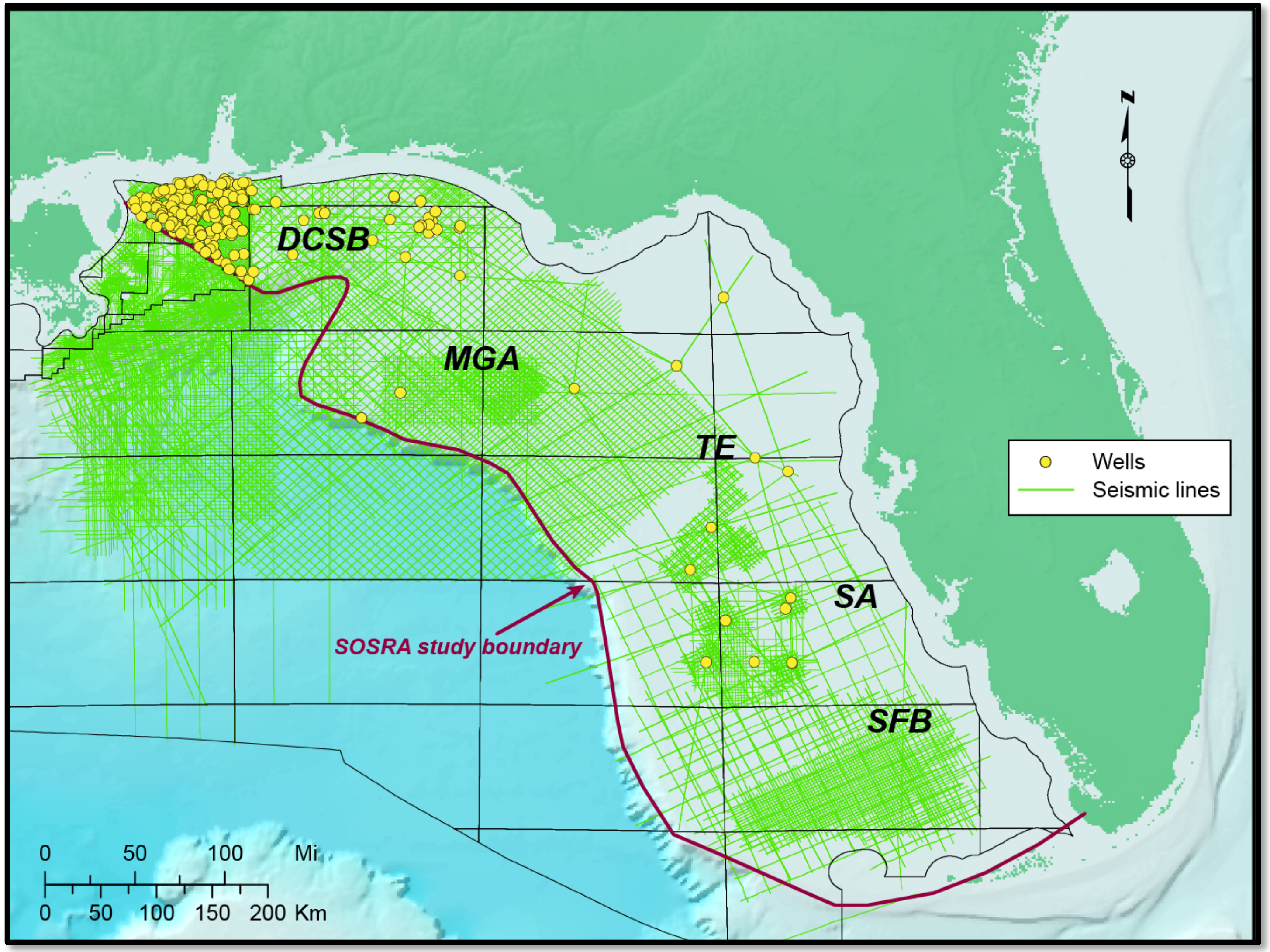
BATTELLE
CRESCENTRI
RESOURCE INNOVATION
GEOLOGICAL SURVEY OF ALABAMA
Founded 1848
IOM
·LAW·
LSU
OKLAHOMA STATE UNIVERSITY
STOREGGA
sas
Schlumberger
VT

WHY THE EASTERN GULF OF MEXICO IS ATTRACTIVE FOR CCUS

Sources of Anthropogenic CO_2 are Favorably Located



Wealth of Existing Data and Infrastructure



DCSB DeSoto Canyon Salt Basin

MGA Middle Ground Arch

TE Tampa Embayment

SA Sarasota Arch

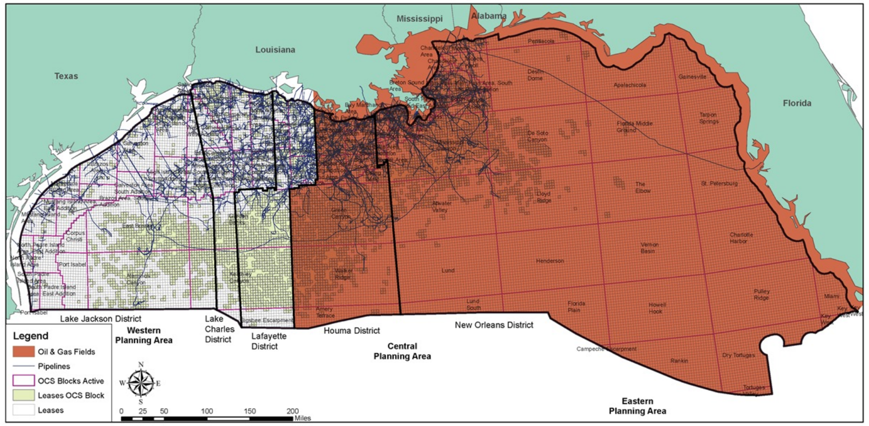
SFB South Florida Basin

SECARB Offshore

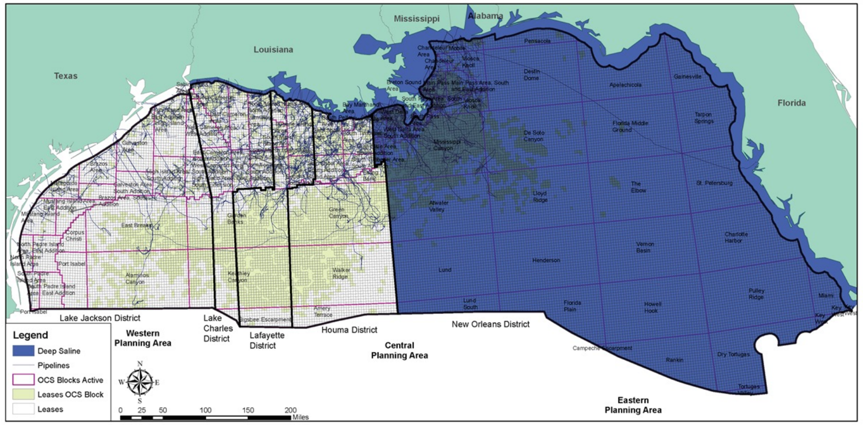
FEDERAL WATERS		
	Depleted Oil & Gas Fields, and Potentially Associated CO_2-EOR	**Deep Saline**
Western Planning Area	No	No
Central Planning Area	Study Area is East of Houma District's Western Boundary (includes Houma District)	Study Area is East of New Orleans District's Western Boundary (excludes Houma District)
Eastern Planning Area	All	All

STATE WATERS		
	Depleted Oil & Gas Fields, and Potentially Associated CO_2-EOR	**Deep Saline**
Texas	No	No
Louisiana	Partial, Includes State Waters East of Houma District Boundary Extension	Partial, Excludes Chandeleur Sound/Islands
Mississippi	Yes	Yes
Alabama	Yes	Yes
Florida (West Coast)	Yes	Yes

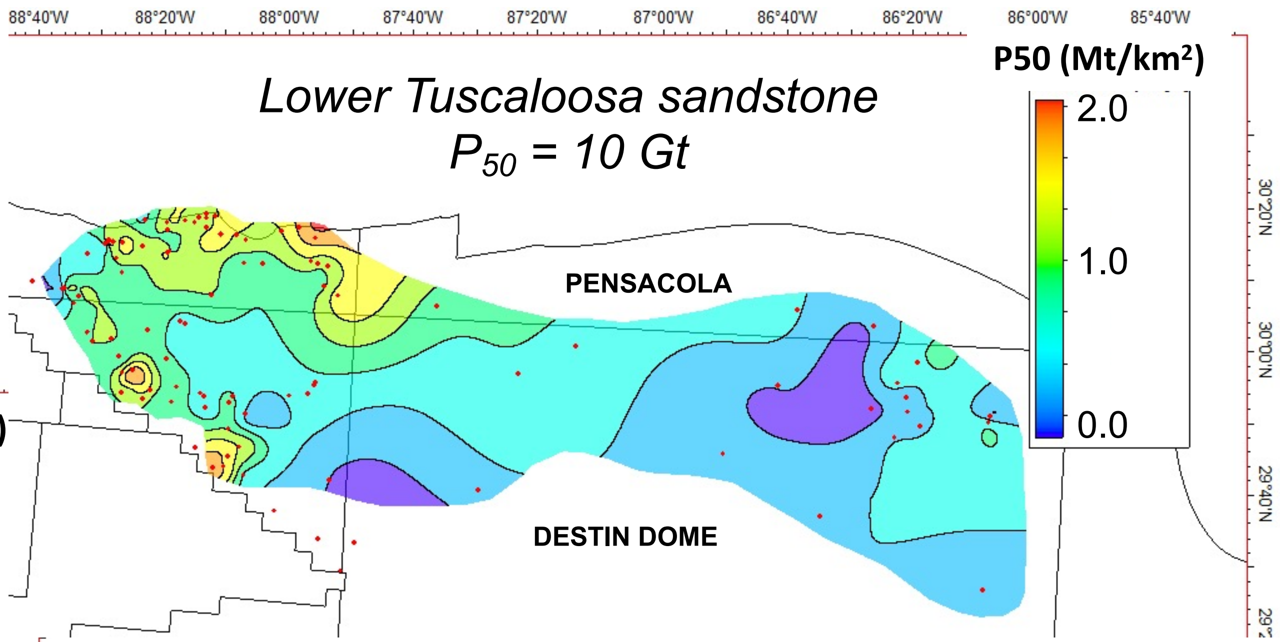
Study Area | Oil and Gas

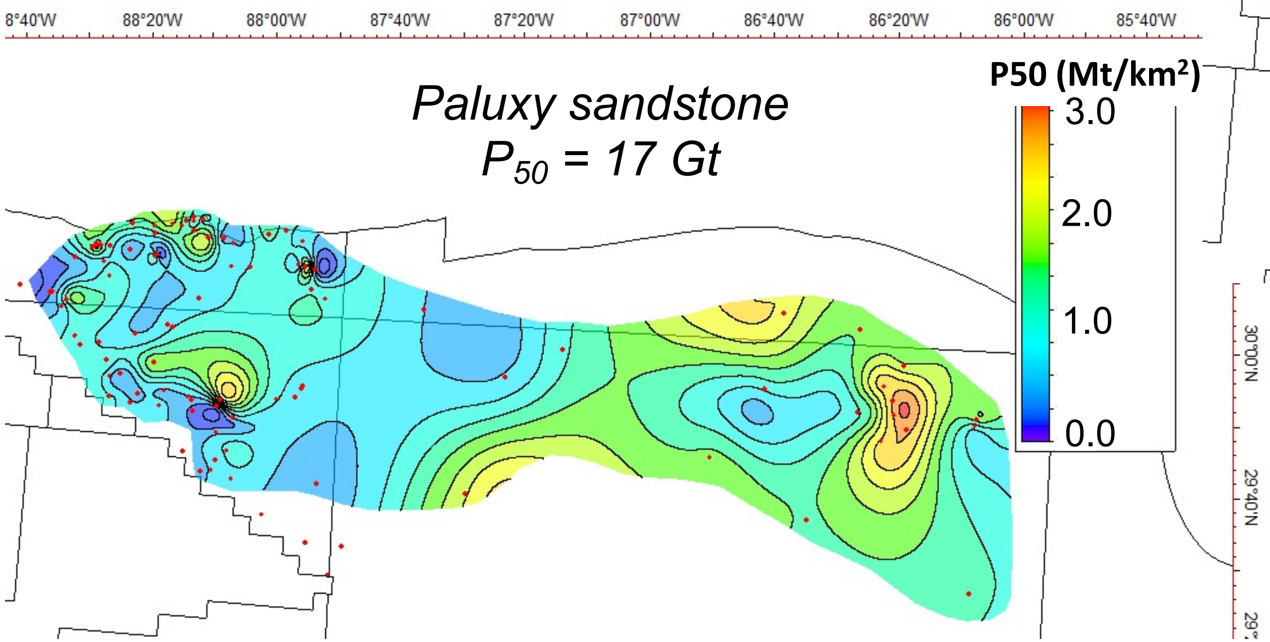


Study Area | Saline Formations

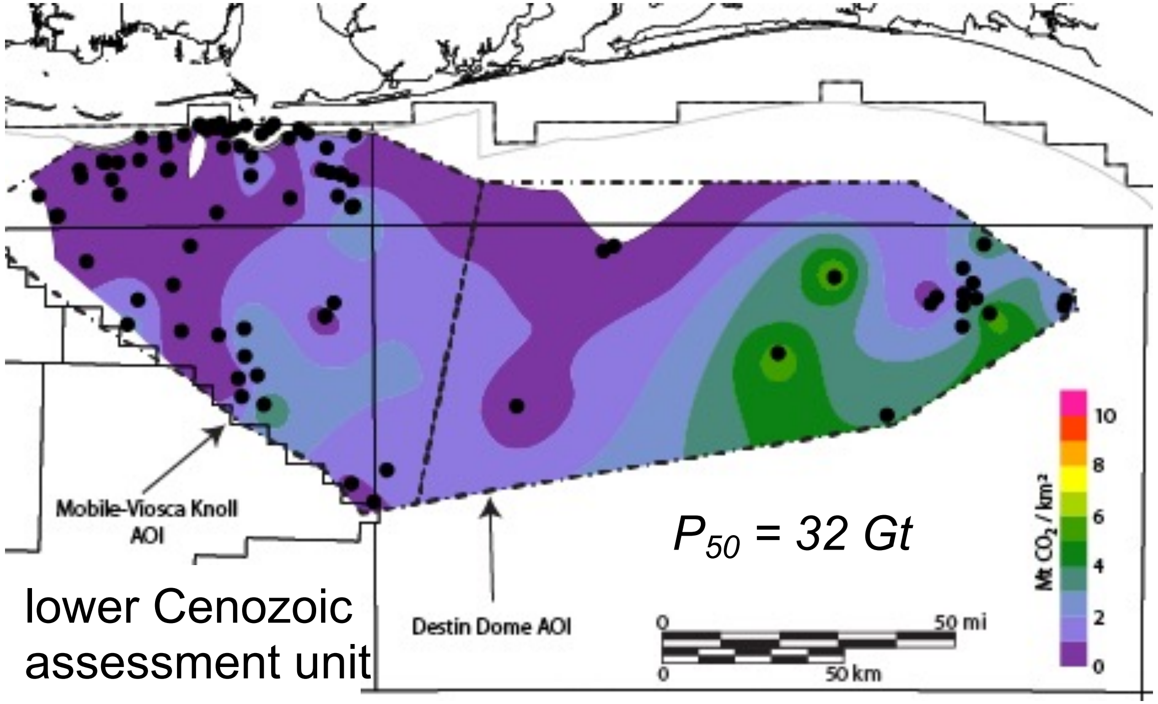


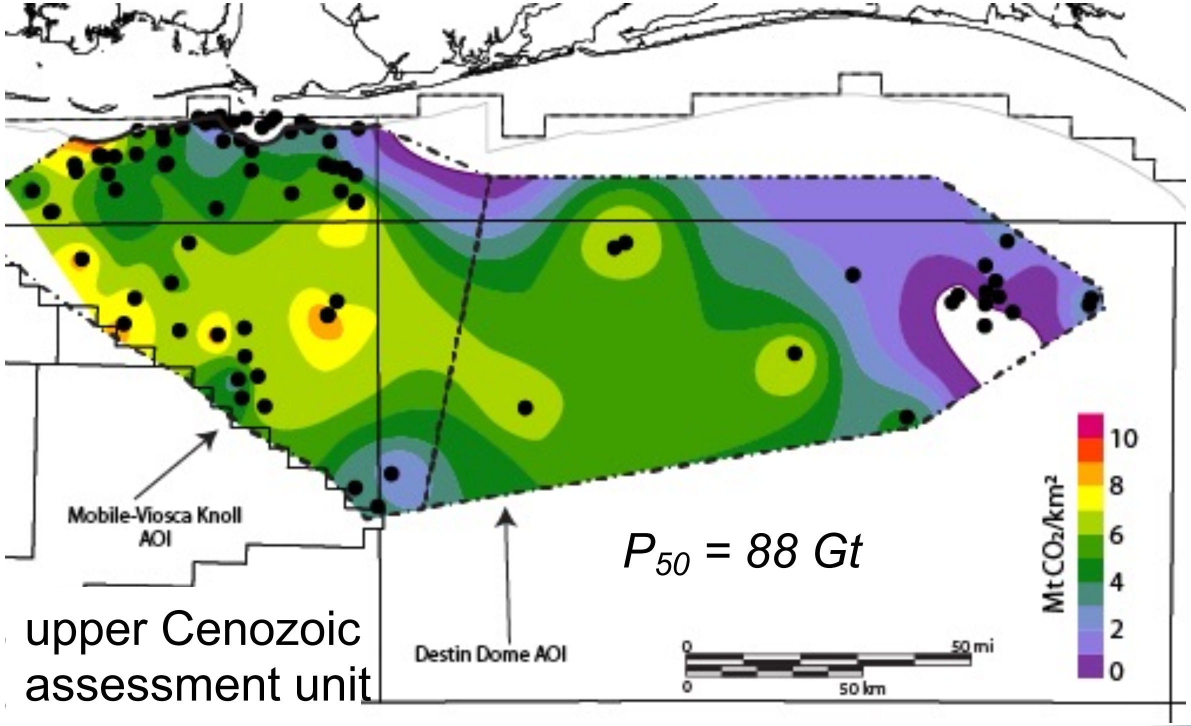
DCSB Estimated CO_2 Storage Resource (P50) - Cretaceous





DSCB Estimated CO_2 Storage Resource (P50) - Cenozoic





ONSHORE SUBSURFACE CO_2 STORAGE VS OFFSHORE SUBSEA CO_2 STORAGE

Project Development: Geologic Characterization

Onshore Action	Description for BPM	Comparison to Offshore
Model development - Data Requirements and cost	Identify data requirements to optimize modeling results; conduct cost vs. benefit analysis to determine value of acquiring new data.	Data acquisition costs offshore tend to be significantly higher; data tends to be lower density due to higher cost
Characterize Subsurface Geology - Geological and Geophysical	Establish geologic and geophysical framework of targeted injection and confining intervals for each Potential Site.	No difference
Test Models	Test scenarios for a range of reservoir parameters and boundary conditions.	No difference
Acquire and Analyze New Data - Outcrop Studies	Conduct detailed mapping, sampling, and analysis of storage reservoir and caprock intervals within the vicinity of the designated Potential Site.	Existing data will be sparser, and new data more difficult to obtain, due to significantly higher cost and more difficult logistics
Acquire and Analyze New Data - Geophysical Data Acquisition	Conduct 2D or 3D seismic or other geophysical survey for improved stratigraphic and structural characterization of reservoir and caprock intervals.	Marine surveys generally have more complete data coverage than onshore; likely to already exist for areas of interest so may not be necessary to acquire new data - may just need to license existing data
Acquire and Analyze New Data - Appraisal Well	Drill and log appraisal well, if needed, to constrain site-specific reservoir properties and caprock integrity.	Offshore wells are significantly more expensive and can be more difficult logistically.

Project Development: Risk Framework

Attribute/Risk	Offshore GOM	Comparison to Onshore
Caprock Seal Properties	Generic risk of CO2 leaking through the caprock, through the overburden, and to the seabed is considered negligible.	No difference between onshore and offshore
Induced seismicity; stress	Low risk item (Soft rocks and large sedimentary stack above crystalline basement) but micro-seismic monitoring is an option onshore (surface or well based).	Risk not as critical due to a lack of buildings offshore; also, basin characteristics in the Gulf not prone to significant seismicity concerns.
Ground surface/seabed	Difficult, expense to monitor; lower density that onshore.	Easier access to monitoring locations onshore; lends itself to frequent, high density monitoring
Legacy wells; P&A'd wells	Probably highest risk category for leakage from offshore operations.	Similar relative risks in the offshore
Monitoring Wells	Very expensive. Focus in offshore will be limiting new wells, little or no dedicated monitoring wells offshore	Marine surveys generally have more complete data coverage than onshore; likely to already exist for areas of interest so may not be necessary to acquire new data - may just need to license existing data
Injection strategy	Plume area offshore is of lesser concern as long as there are manageable leakage risks within AoR. Goal is to limit number of injection wells.	Goal is generally to limit plume area/AoR.

Project Development: MVA

Atmospheric	Aqueous Column	Shallow Subsurface	Deep Subsurface
Intelligent Monitoring Systems (IMS) and SCADA[1]			
optical CO_2 sensors[2]	seafloor penetrometers	Well integrity testing tests (internal and external integrity)[3]	
atmospheric tracers[2]	seafloor penetrometers	remote sensing (satellite imagery)[4]	wireline logging
	aqueous geochemistry and salinometers	soil/vadose zone geochemistry[5]	tracers (PFCs, isotopes)
	echo sounder systems (acoustic monitoring for bubbles)	shallow groundwater geochemistry[5]	borehole fluid sampling
	surface deformation (tiltmeters, extensometers, accelerometers, nano bottom pressure recorders)	ecosystem stress monitoring (including remote sensing)[6]	Crosswell geophysical methods, including electrical methods and crosswell seismic[7]

High	Moderate	Low

Public Outreach

- Public outreach tactics for offshore subsea CO_2 storage have a lot of similarities to onshore, for example
  - Integrating public outreach with project management
  - Developing outreach materials tailored to specific audiences
- Differences arise when
  - Identifying key stakeholders, as onshore stakeholders will be different than offshore stakeholders
  - Developing key messages, as onshore storage concerns are not identical to offshore subsea storage concerns