



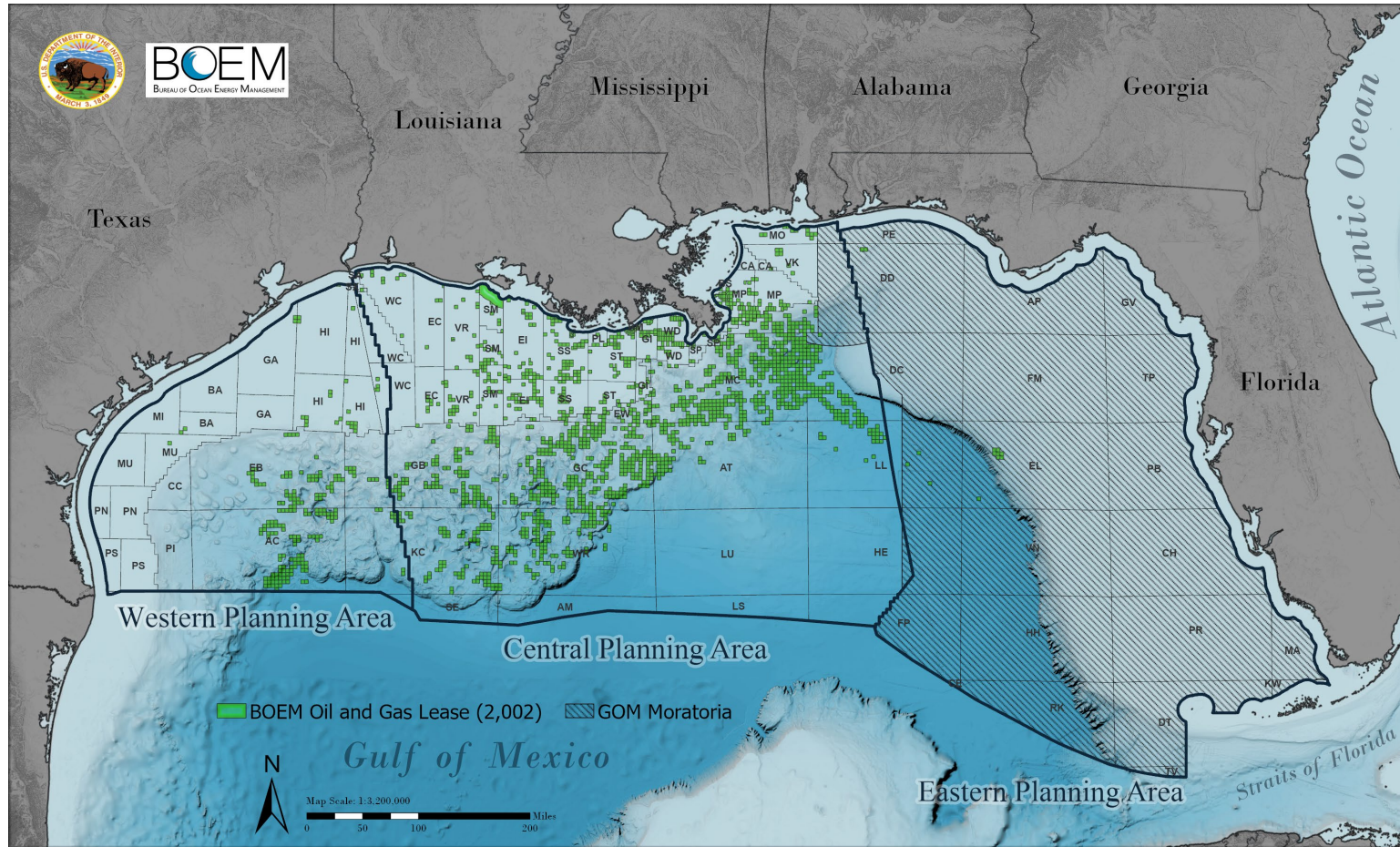
BOEM Bureau of
Ocean Energy Management

Identification of Tier 1 Depleted Reservoirs in the Gulf of Mexico

BOEM Gulf of Mexico Region Resource Evaluation

*Authors: Carlos Alonso, Larry Boudreau, Kellie Cross, Jeffery Keevan, Bryan Stephens, Shane Stradley,
Kevin Trosclair*

Gulf of Mexico Area Map



On November 15, 2021, Infrastructure Investment and Jobs Act, known as the Bipartisan Infrastructure Law (BIL) became law.

Section 40307 of the BIL amends Outer Continental Shelf Lands Act, OCSLA, to authorize the Secretary of the Interior to grant a lease, easement, or right-of-way on the outer Continental Shelf for activities that “provide for, support, or are directly related to the injection of a carbon dioxide stream into sub-seabed geologic formations for the purpose of long-term carbon sequestration”.



Depleted Reservoirs

Advantages

- Potential for greater available pressure margins
- Abundant geologic, geophysical, engineering and production data
- Proven trap and seal

Risks and Considerations

- Numerous legacy wells
- Smaller storage capacity
- Depleted reservoirs require an understanding of current reservoir temperatures and pressures

Saline Aquifer

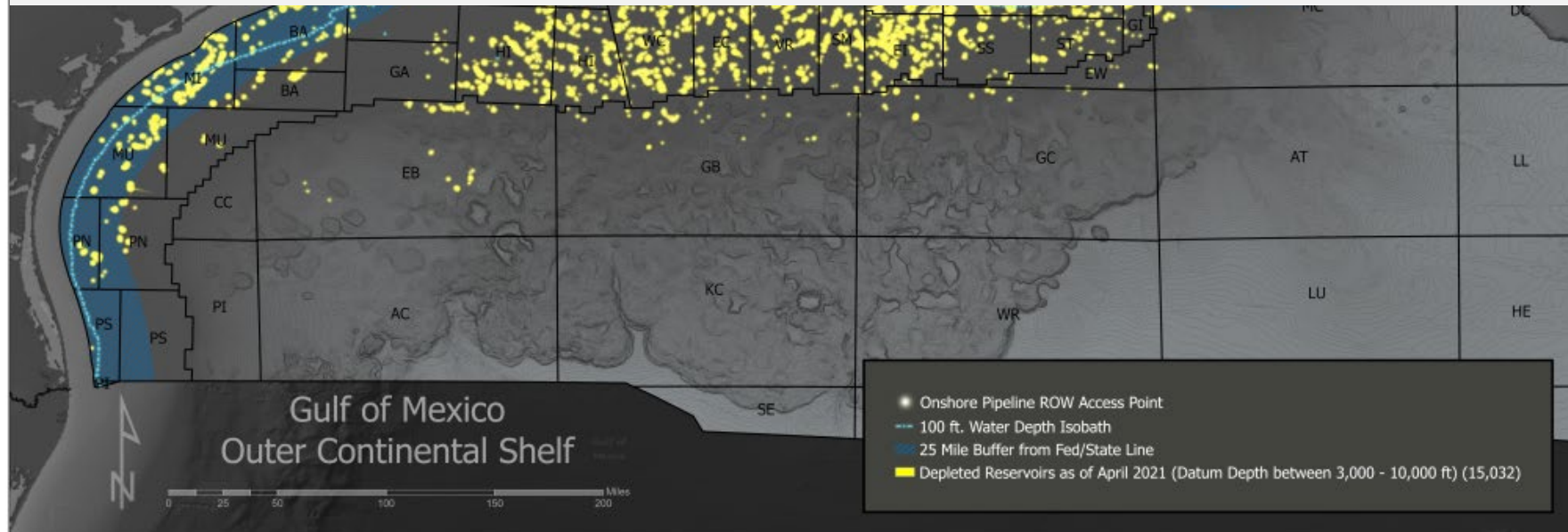
- **LARGE potential storage capacity**
- Fewer legacy wells
- Abundant geologic, geophysical, engineering and production data
- Multiple Stacked Reservoirs

- Unknown Seal integrity
- Smaller available pressure margin
- Monitoring challenges /economics



Depleted Reservoir Analysis

- Discussion on Development of - Gulf of Mexico CO₂ Available Storage Database (Gulf CO₂AST Database)
- An approach for site selection of depleted reservoirs in the GOM.



Gulf CO₂AST Database

Reservoir Status Code

Planning Area

Protraction

Field Name

Sand Name

Reservoir Name

Ecozone Code

Sand Classification

Play

Facies

Hydrocarbon Content

Reservoir Depth

Reservoir Permeability

Reservoir Porosity (effective)

Reservoir Initial Pressure

Drive Mechanism

Field Style Code

Field Trap

Field Trend

Reservoir CUM BOE

Field Trend

Reservoir Trap

Field Average Water Depth

Reservoir Structure Top Depth

Reservoir Gas Area

Reservoir Gas ACFT

Gas Evaluation Code

Reservoir Oil Area

Reservoir Oil ACFT

Oil Evaluation Code

Sand Well Count

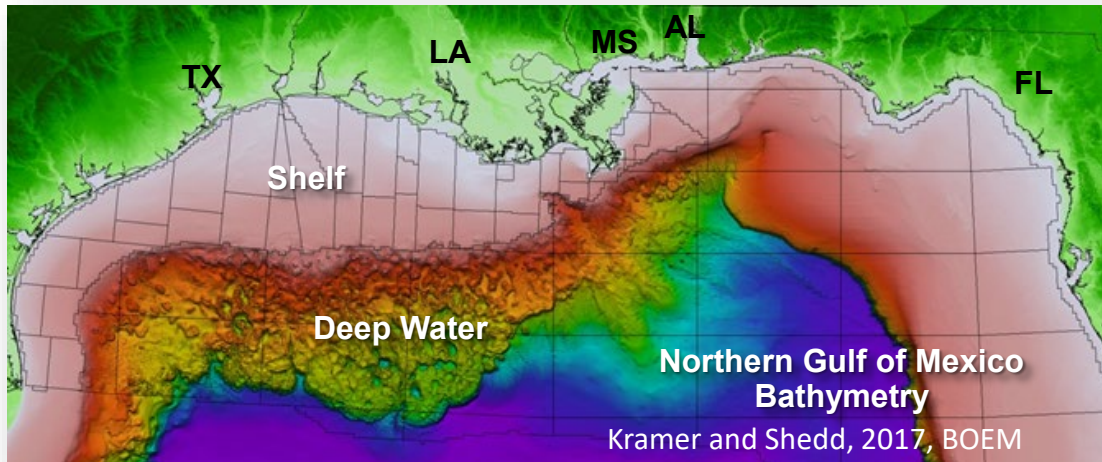
CO2 Storage Capacity Estimates



Site Selection Considerations

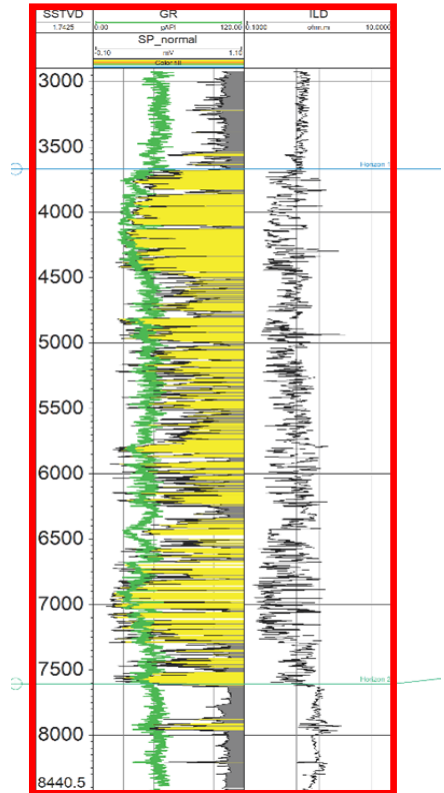
Site - Petroleum Exploration Approach

- Nearshore Federal OCS
 - Focus on <25 miles from fed/state boundary
- Shallow Water
 - Water depths less than 100 feet
- Informed site selection reduces outbound CO₂ pipeline mileage



Reservoir - Petroleum System Approach

- Trap type with maximum storage capacity
 - Anticlines with proven confining system (Depleted Reservoir with Top Seal)
- Depositional environment of preferred storage reservoirs
 - Stacked, shore-zone and deltaic deposits with sufficiently high porosity and permeability
- Select normal pressure reservoirs at depth for stable supercritical CO₂ storage (3,000' to 10,000' TVD)
- Presence of Top Seal

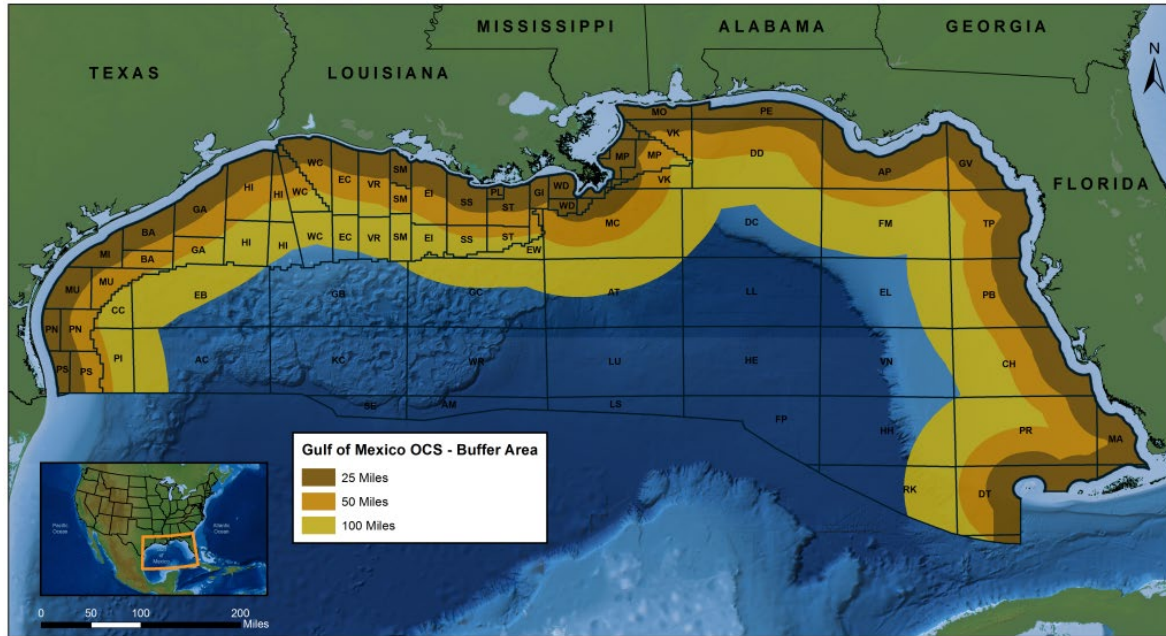


Offshore Gulf of Mexico well log showing ~4,000' sand package (yellow). This is a potential container for CO₂ storage in saline aquifers.

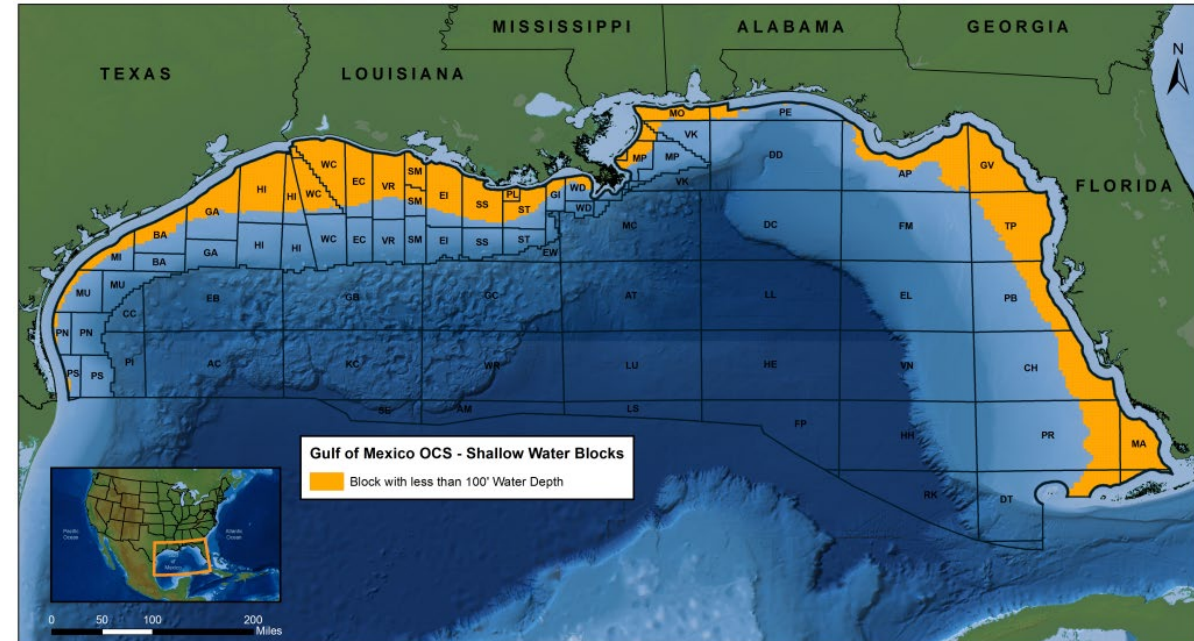


Spatial Analysis Considerations

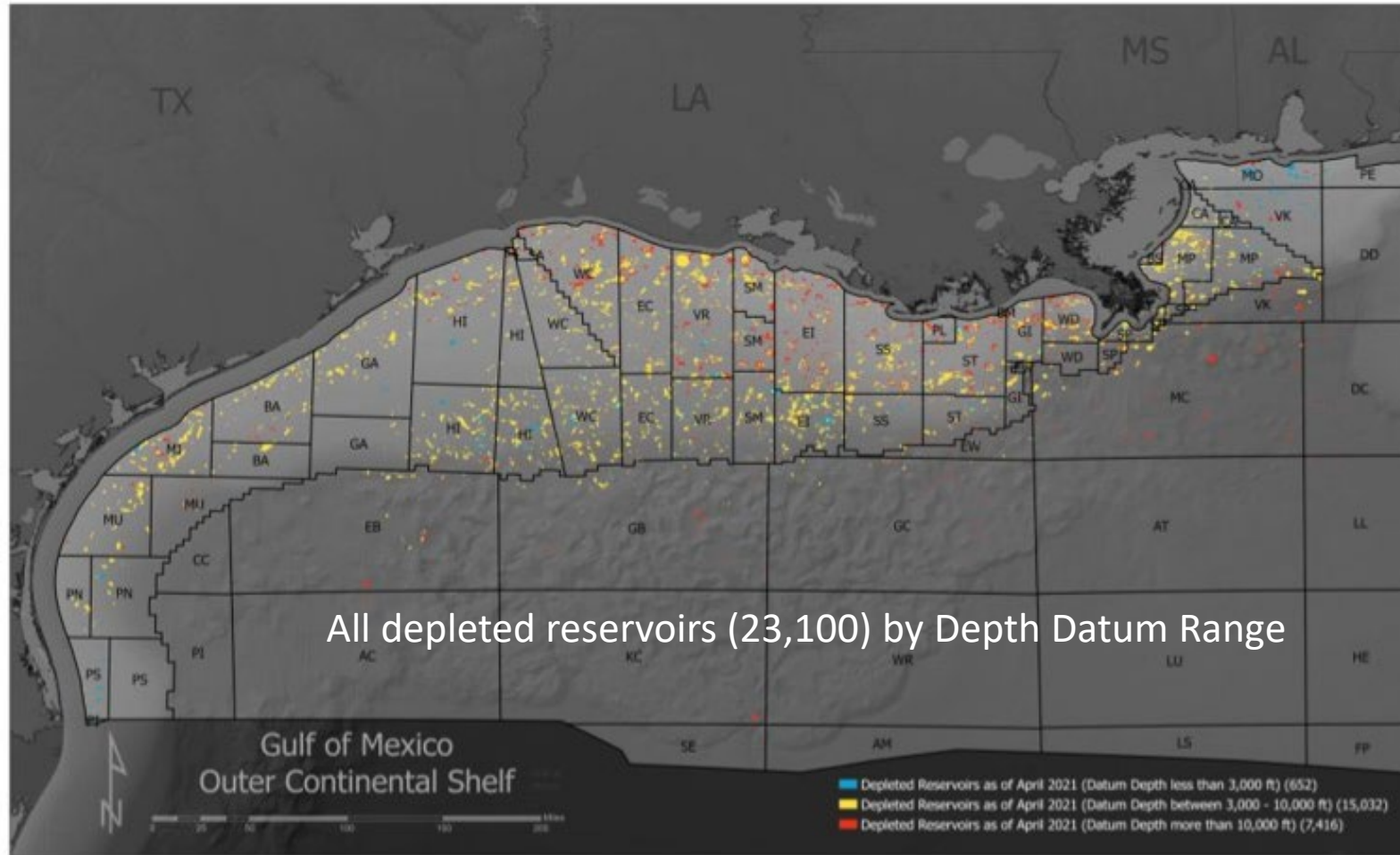
Distance Buffers from Fed/State Line



Water Depth less than 100 feet



Gulf of Mexico Depleted Reservoirs

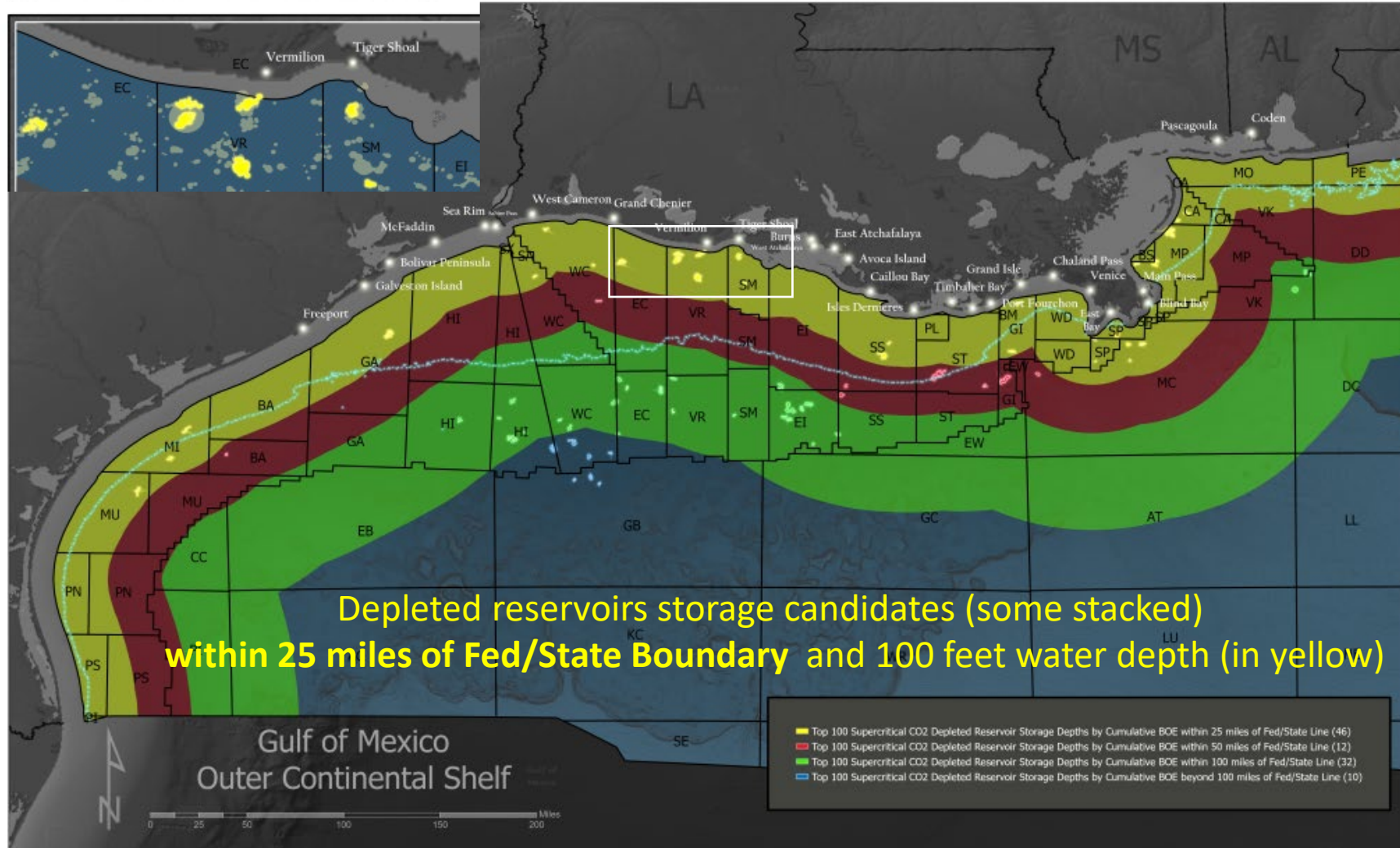


- Blue reservoirs < 3,000'
- Yellow reservoirs are 3,000' to 10,000'
- Red reservoirs > 10,000'
- Total of 15,032 depleted reservoirs (4/2021) in the 3,000' to 10,000' subsea depth window for supercritical CO₂.





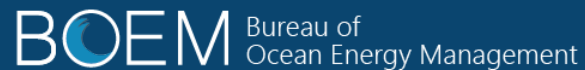
Spatial Analysis



CCS (Tier 1)

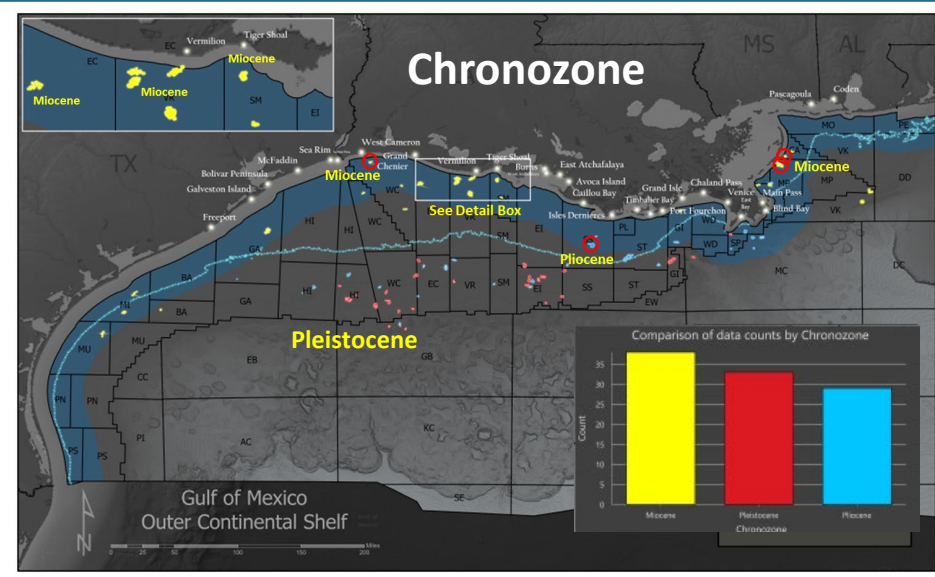
19 Fields
(Distance and
Water Depth)





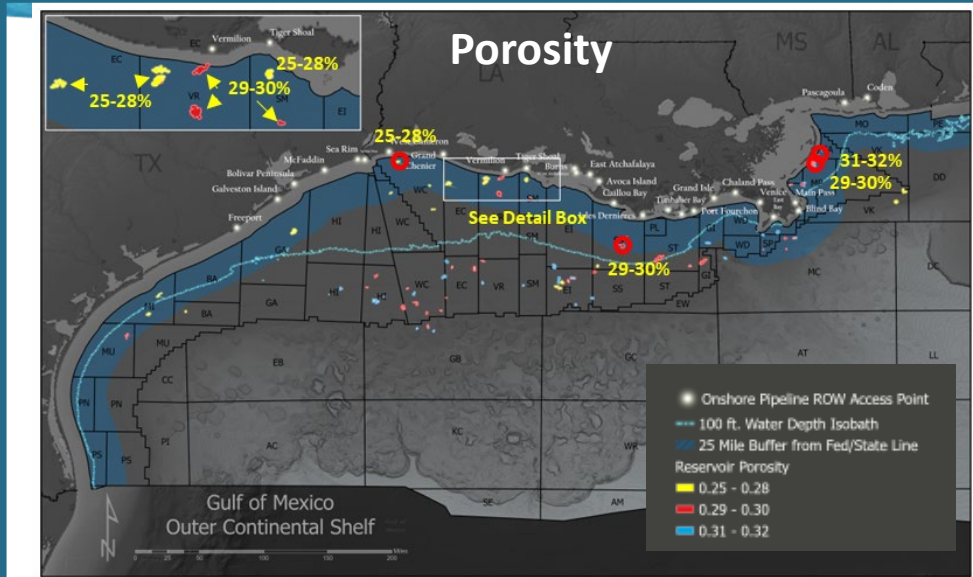
11

Reservoir Properties

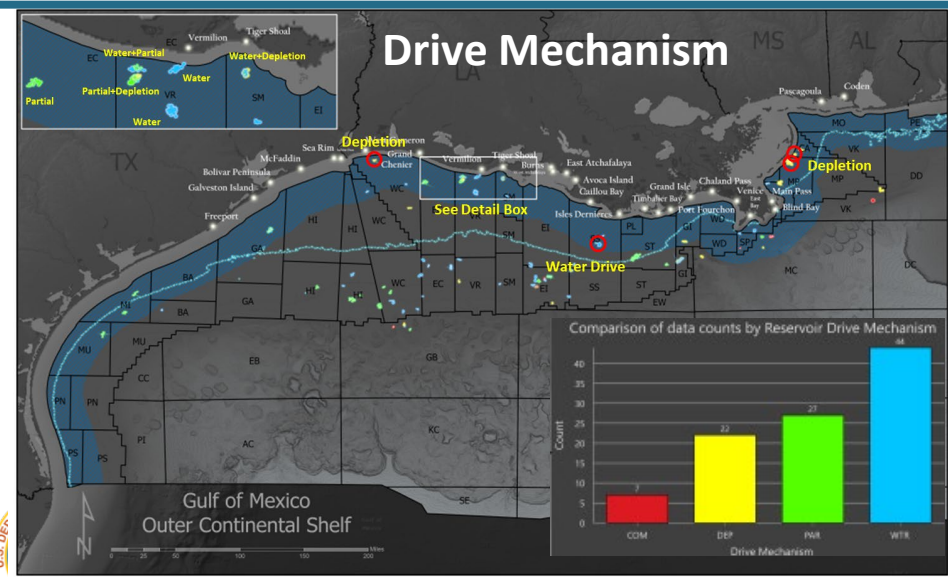


Pleistocene, Pliocene, and Miocene aged stacked shore-zone, deltaic deposits

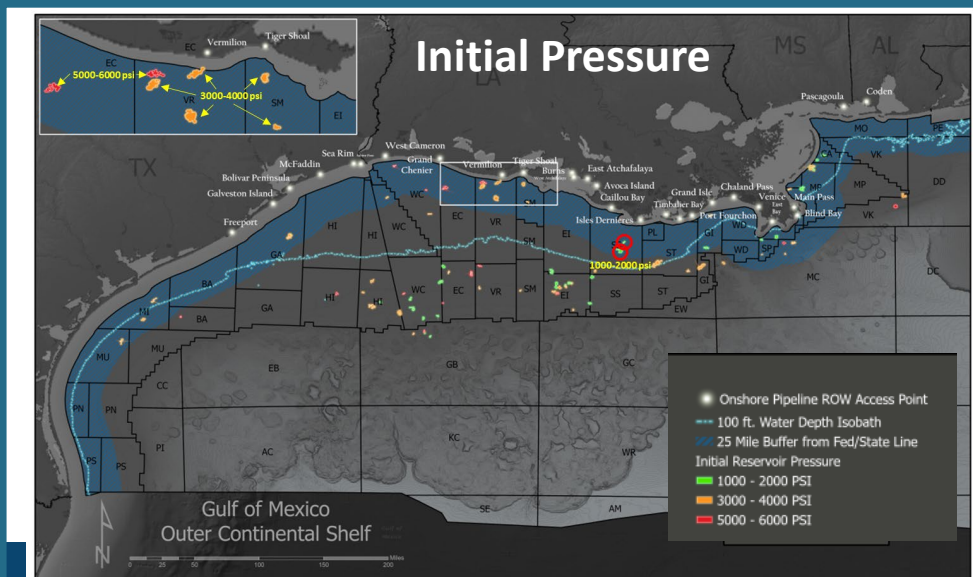
Identify storage assessment units



Porosity ranges from 25%-32%



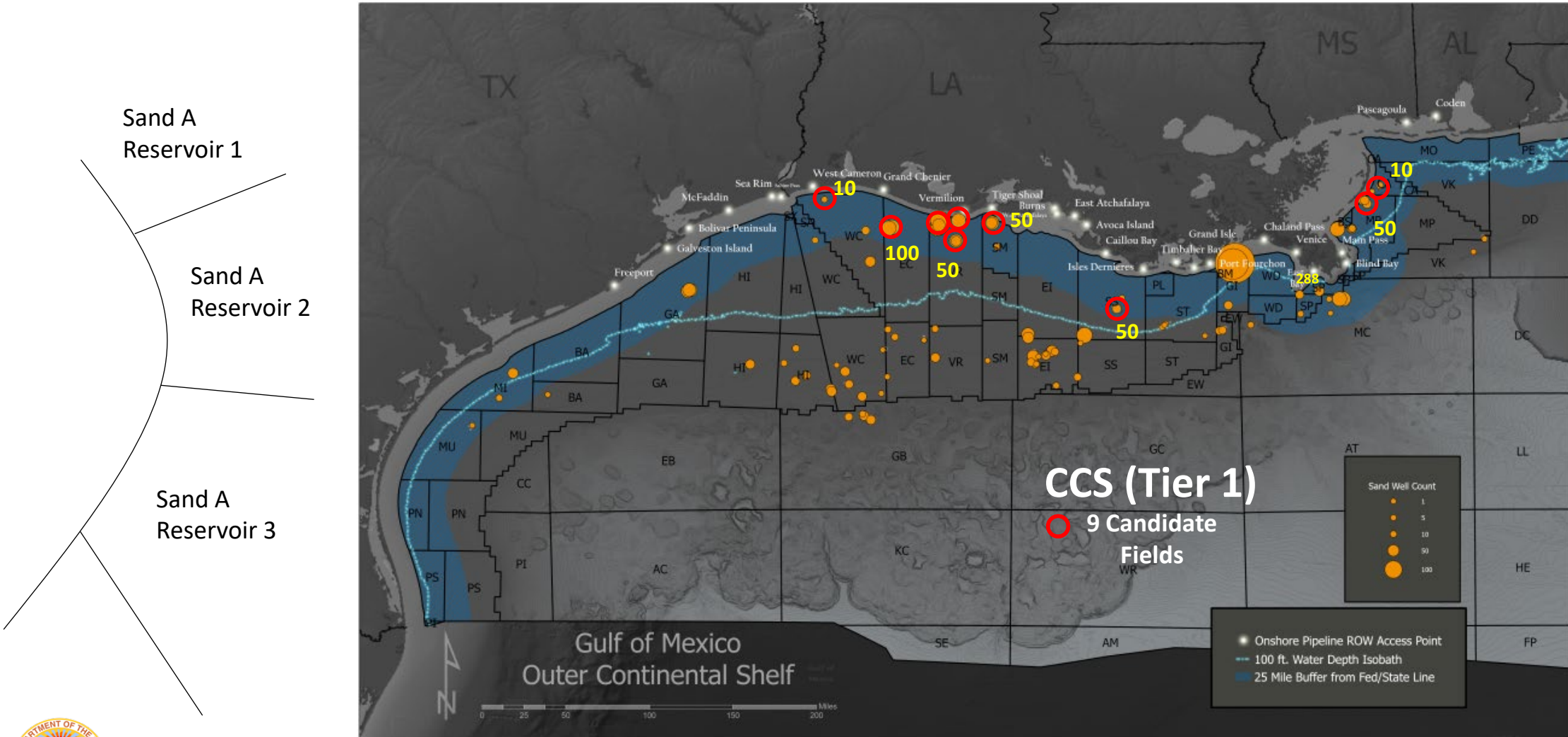
Water, partial, depletion, and combination drives



Initial pressures range from 1,000 – 6,000 psi.

Depletion pressure is a necessary consideration for stability of supercritical CO₂ phase

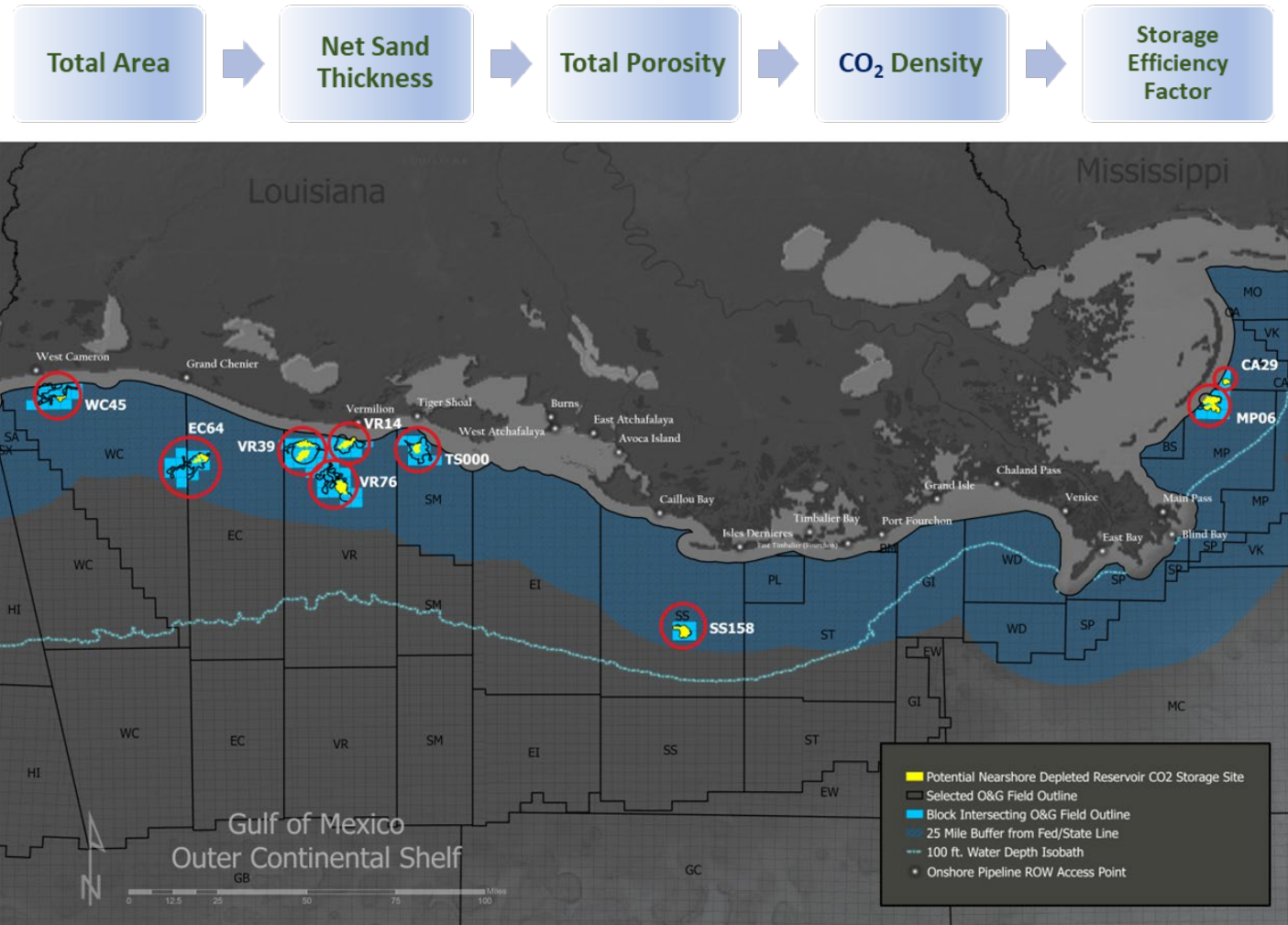
Legacy Well (Sand Penetrations)



Top 21 Candidate Depleted Reservoirs

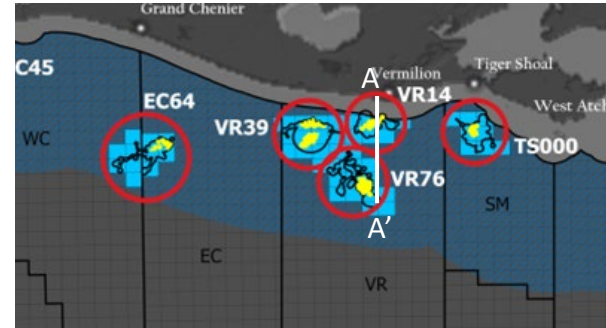
Tier 1 Priority, Listed West to East (9 Fields, 21 Reservoirs):

1. **West Cameron 45 Field** – 1 Depleted Reservoir (9600 RA)
2. **East Cameron 64 Field** – 3 Depleted Reservoirs (OC R2, OC R3, and OC R13)
3. **Vermilion 39 Field** – 7 Depleted Reservoirs (7800 RAB, 7800 RC, 8000 RA, 8400 RA, 9500 RH, 9500 RJ, and 10200 RF)
4. **Vermilion 14 Field** – 1 Depleted Reservoir (Big2_1 C)
5. **Vermilion 76 Field** – 2 Depleted Reservoirs (BA2 RA, and CRSM1 RA)
6. **Tiger Shoal 000 Field** (Northern SMI) – 2 Depleted Reservoirs (N1 III, and Q1 III)
7. **Ship Shoal 158 Field** – 1 Depleted Reservoir (GQ RA)
8. **Main Pass 6 Field** – 3 Depleted Reservoirs (4800 RI, 6900 RI, and 7800 RI)
9. **Chandeleur Area 29 Field** – 1 Depleted Reservoir (MD RA)



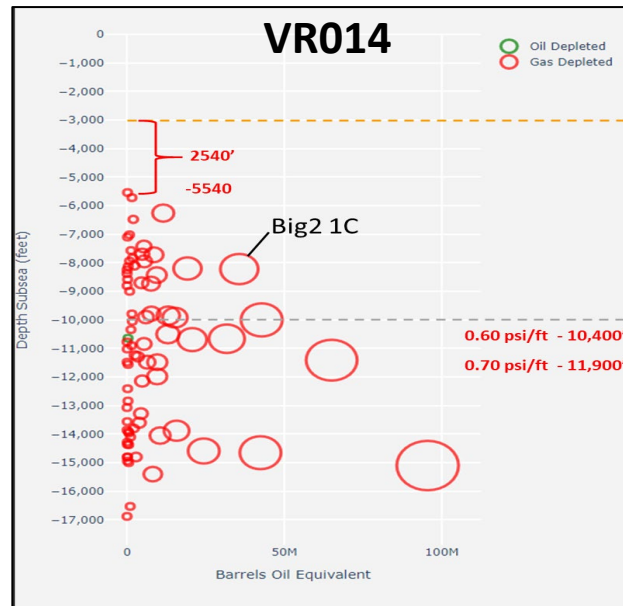
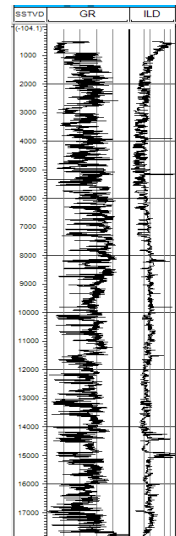
Additional Characterization: Reservoir Size vs. Depth

- Reservoirs vertically distributed in compartments
- 2540' between shallowest reservoir and top critical interval
- Leakage history
- Shallow section High net to gross – no charge or no seal?



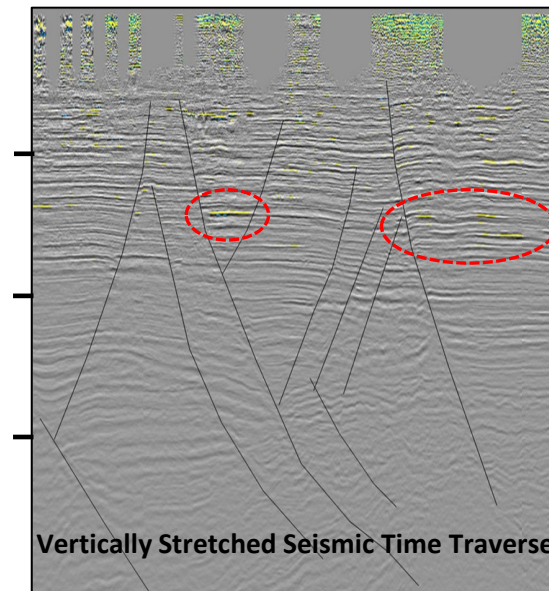
- Reservoirs concentrated above top pressure
- Shallowest reservoir near top critical interval (biogenic gas?)

VR014

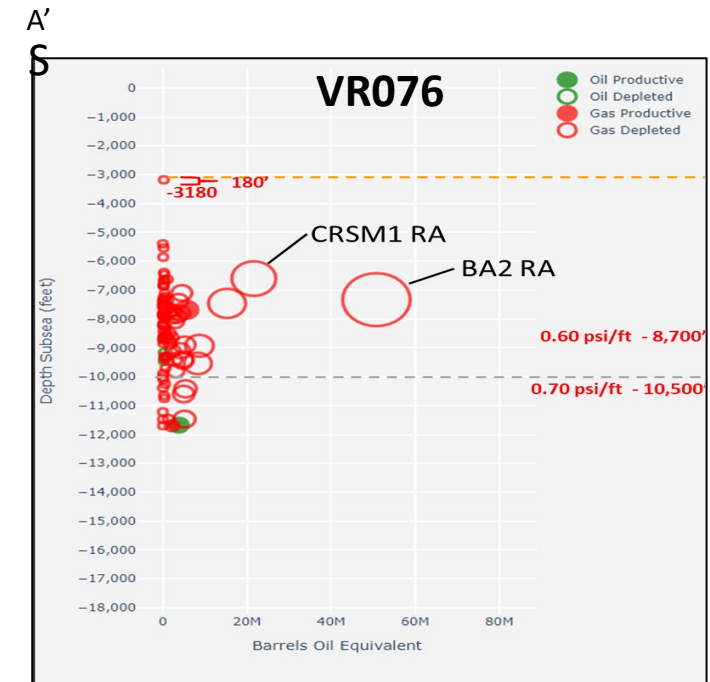


Pressure gradients are from Burke et al. (2012)

Near Surface Faults
VR014 VR076



Survey I91-063 / B-63-91-LA



Pressure gradients are from Burke et al. (2012)



Summary

- The Gulf of Mexico and other OCS areas are poised to play a significant role in the nation's mission to reduce Greenhouse Gas emissions.
- The geology of the offshore Gulf of Mexico is conducive to safely and permanently store large amounts of CO₂ in subsurface reservoirs, both saline aquifers and depleted oil and gas reservoirs.
- Gulf CO₂AST database created to characterize depleted reservoirs
- 21 Depleted Reservoirs near shore in shallow waters were identified. (No Tier 2 yet!)



Thank you

Seismic Data: Released by BOEM and Available from National Archive of Marine Seismic Surveys (NAMSS)

<https://walrus.wr.usgs.gov/namss/>

Publicly Available Data: <https://www.data.boem.gov/>





Bureau of Ocean Energy
Management

BOEM.gov



Contact:

John Filostrat

Office of Communications

(504) 284 - 8605