"GoMCarb" Partnership"

Offshore Gulf of Mexico Partnership for Carbon Storage Resources and Technology Development

Cooperative Agreement: DE-FE0031558

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Gulf Coast Carbon Center,

Bureau of Economic Geology

Jackson School of Geosciences

The University of Texas at Austin

U.S. Department of Energy

National Energy Technology Laboratory

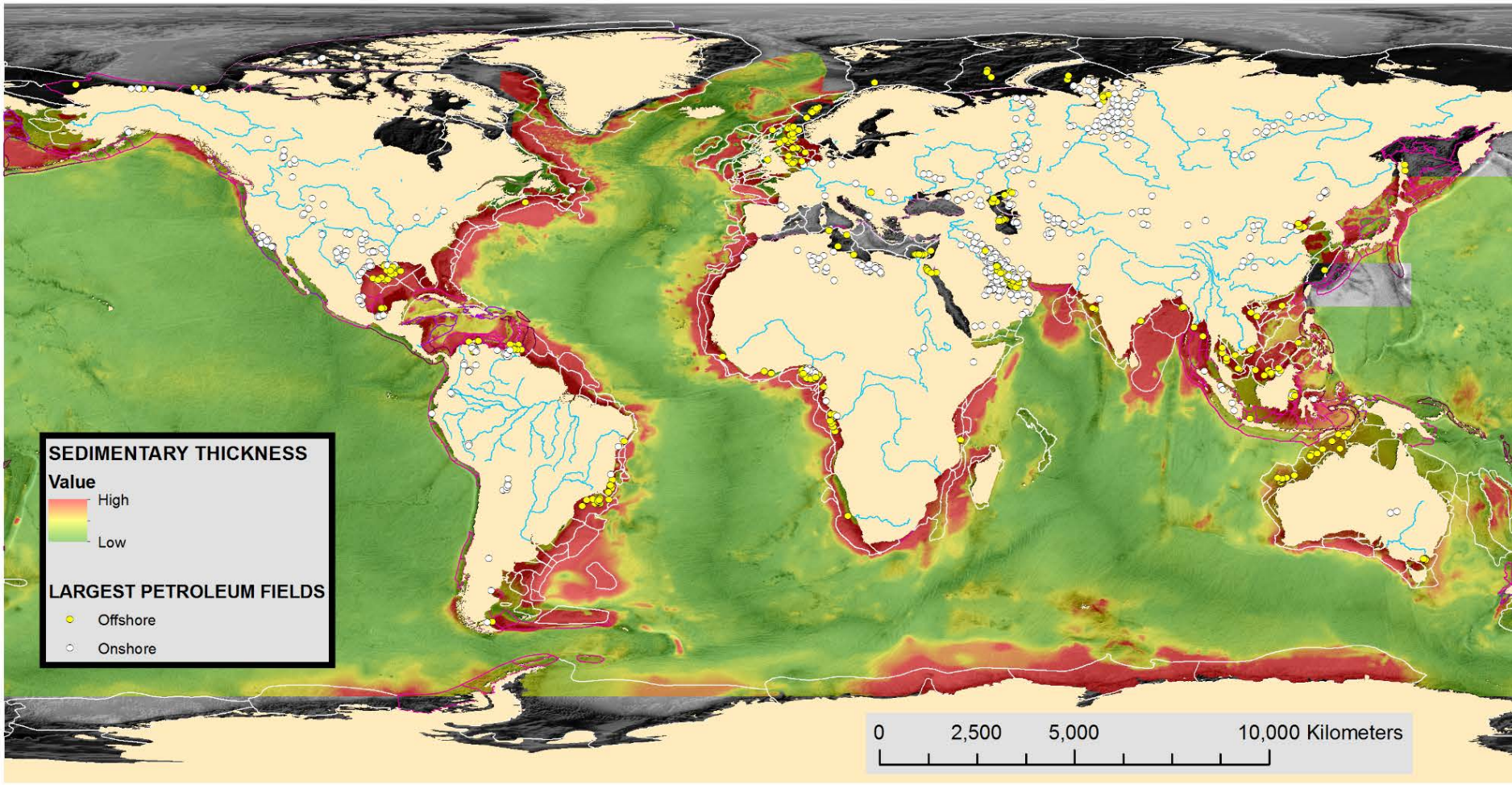
Addressing the Nation's Energy Needs Through Technology Innovation – 2019 Carbon Capture, Utilization, Storage, and Oil and Gas Technologies Integrated Review Meeting

August 26-30, 2019

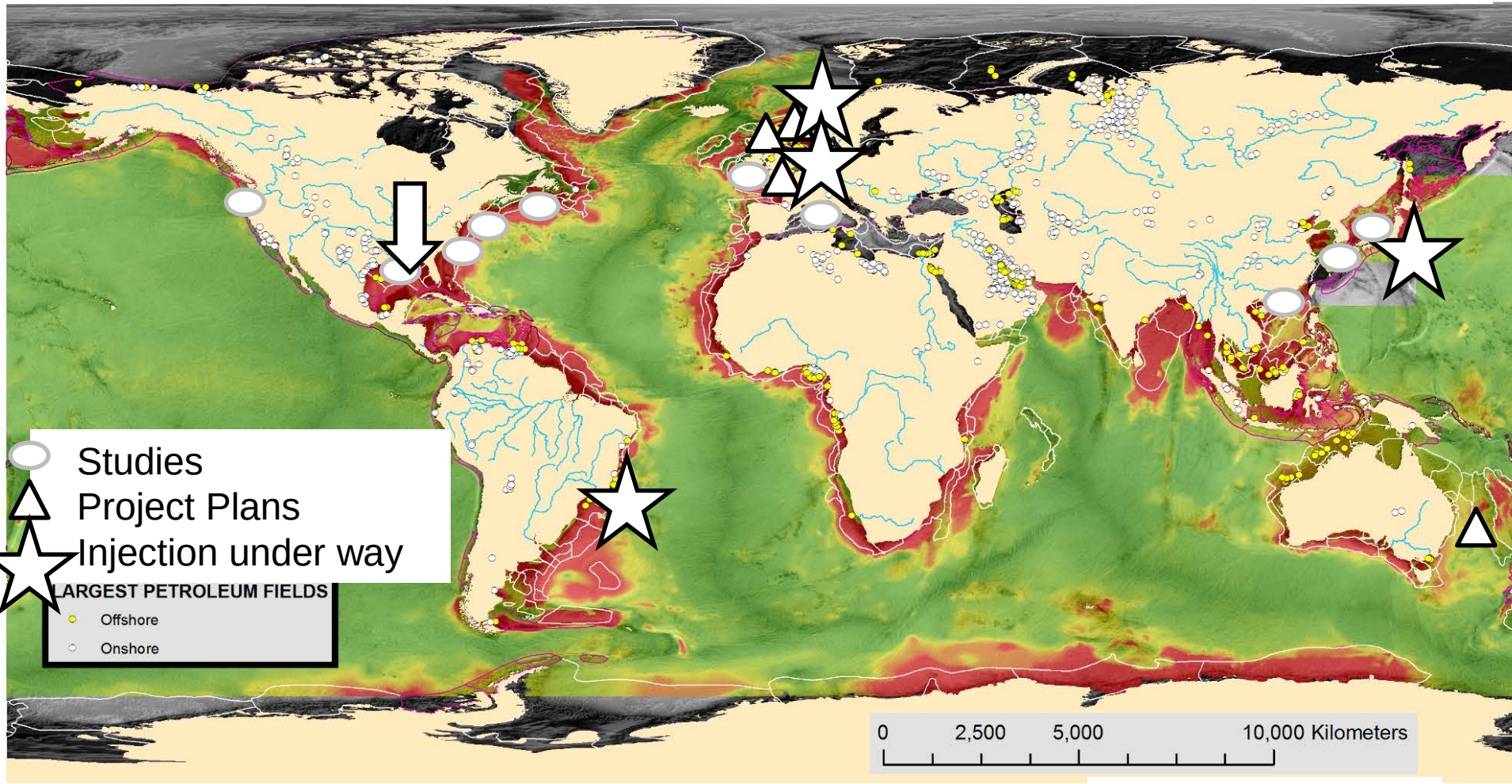
Presentation Outline

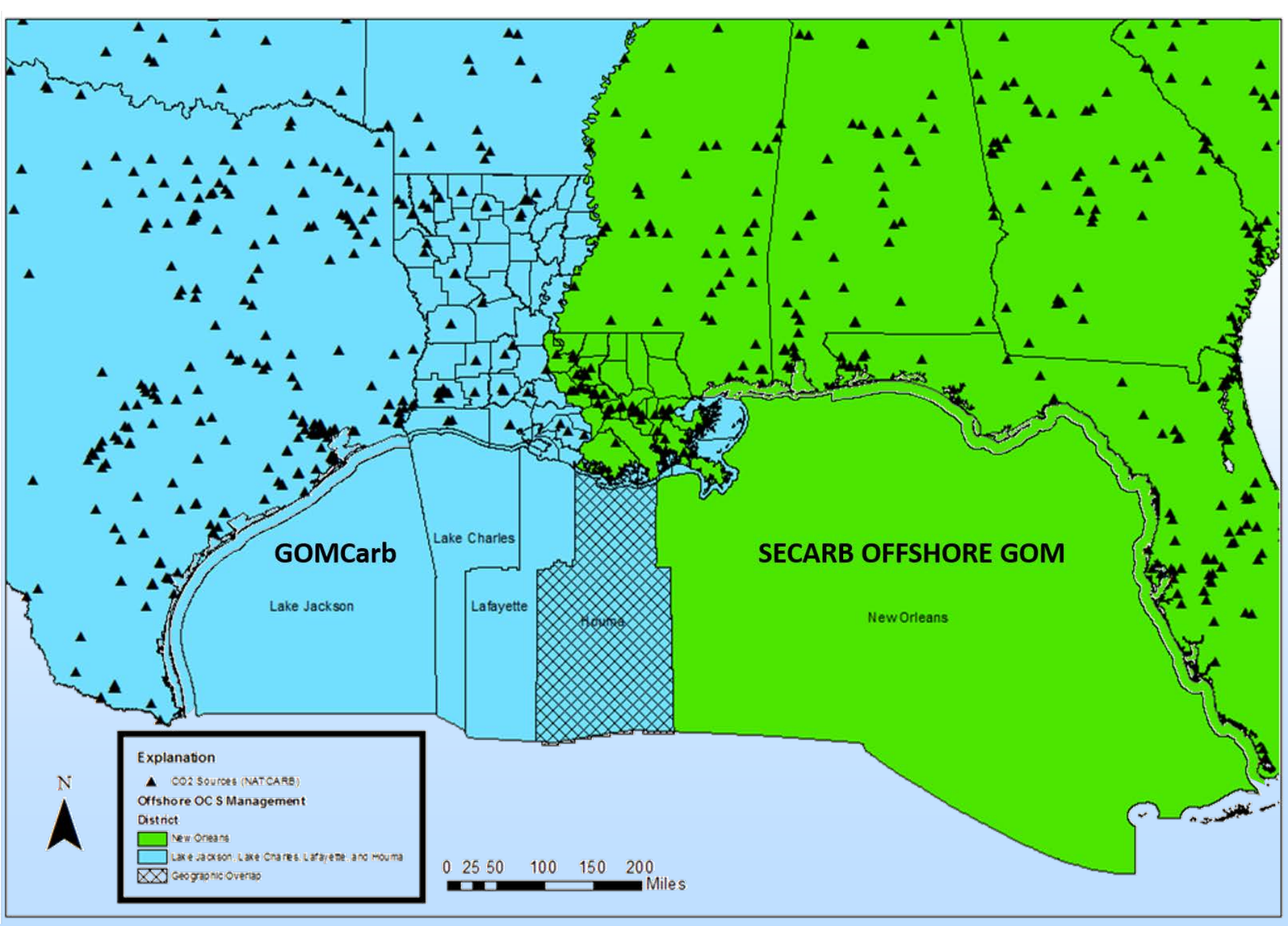
- Offshore storage portfolio
- Partners and collaborators
- Storage resource status
- Risk assessment - blowouts
- Monitoring
- Knowledge sharing – stakeholder surveys

Global and US Offshore storage portfolio

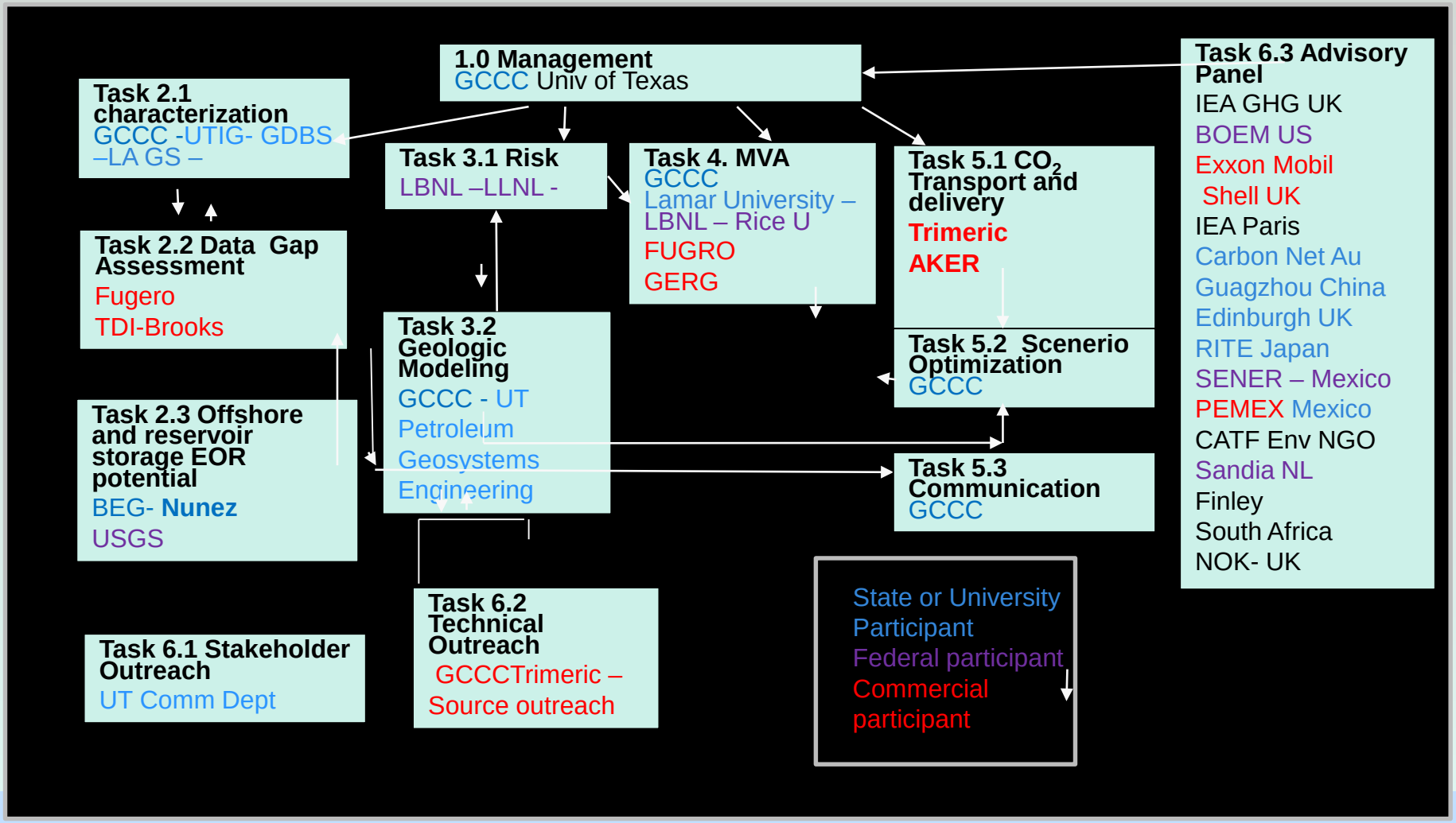


Global and US Offshore storage Status

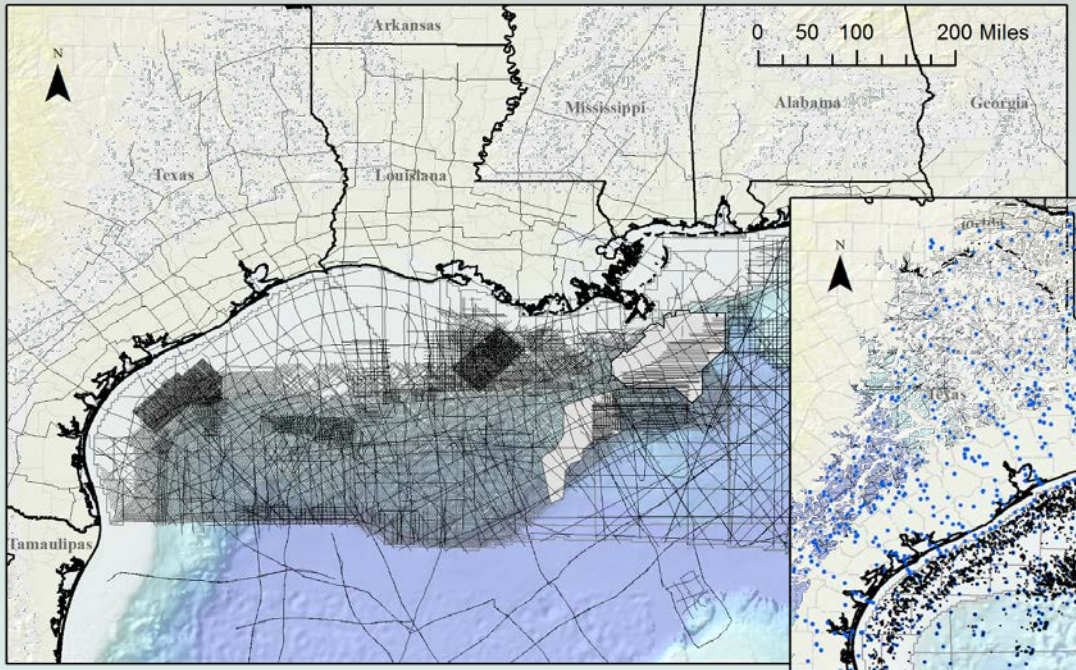



GOMCarb
SECARB OFFSHORE GOM
Lake Charles
Lake Jackson
Lafayette
Houma
New Orleans
Explanation
CO2 Sources (NATCARB)
Offshore OCS Management
District
New Orleans
Lake Jackson, Lake Charles, Lafayette, and Houma
Geographic Overlap
N
0 25 50 100 150 200
Miles

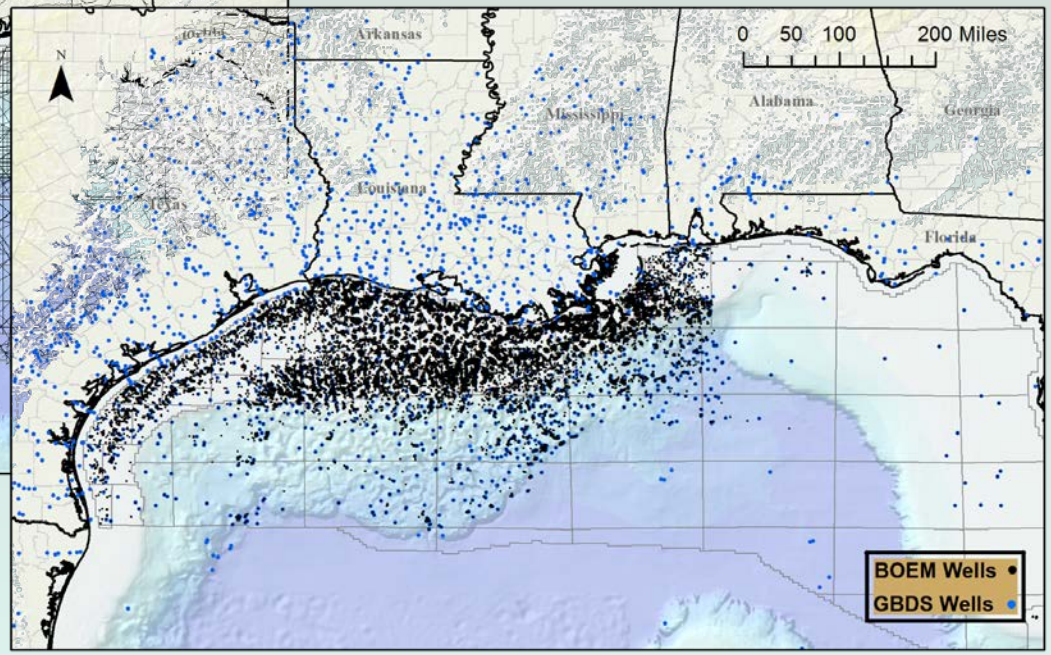
Partners and collaborators



Dense data



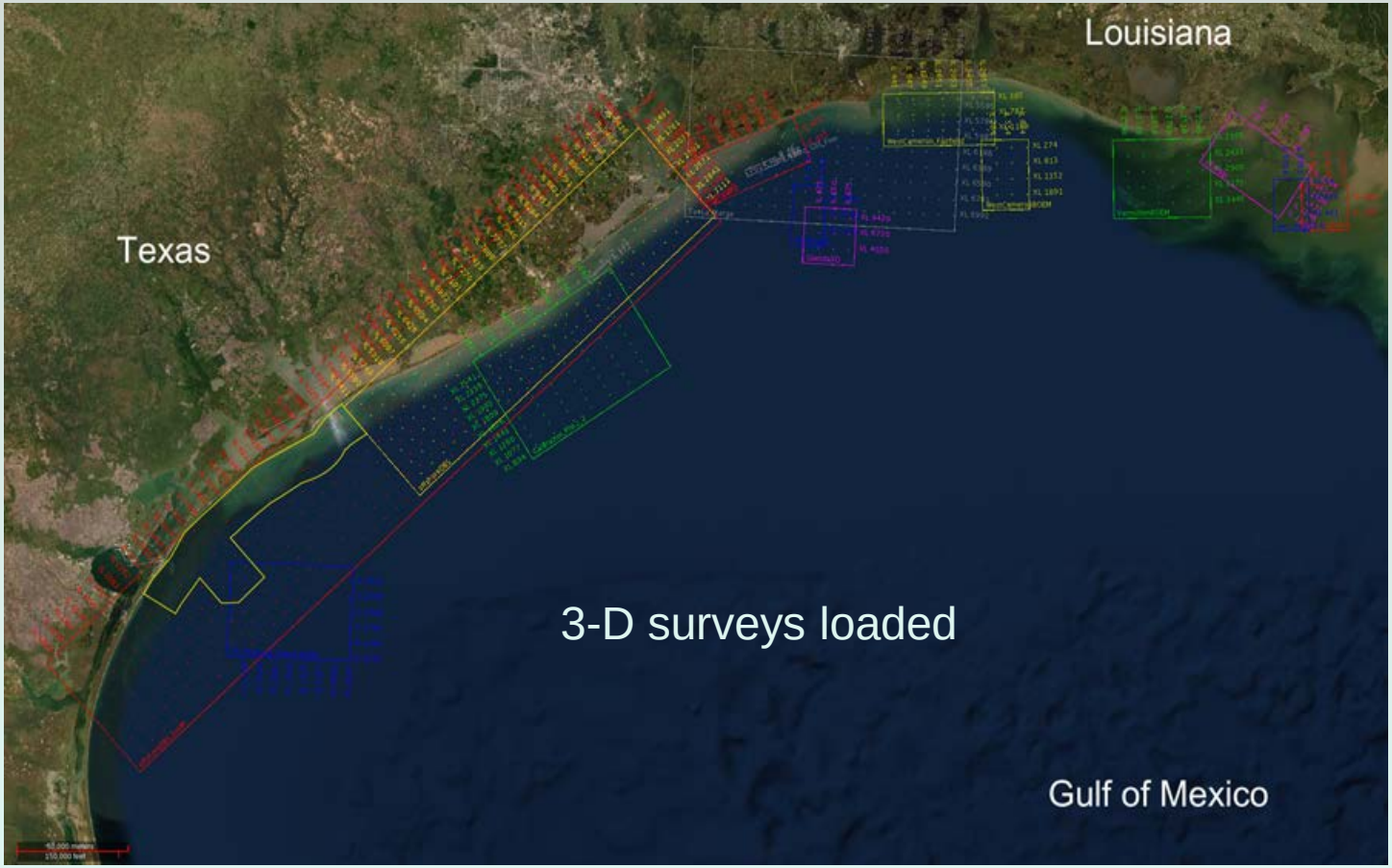
GDBS seismic lines



GDBS Well data

GCCC GULF COAST CARBON CENTER
BUREAU OF ECONOMIC GEOLOGY

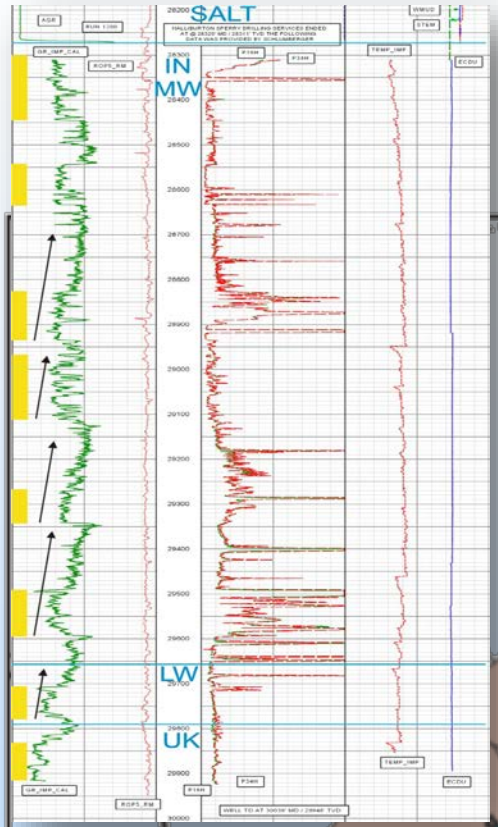
Dense data



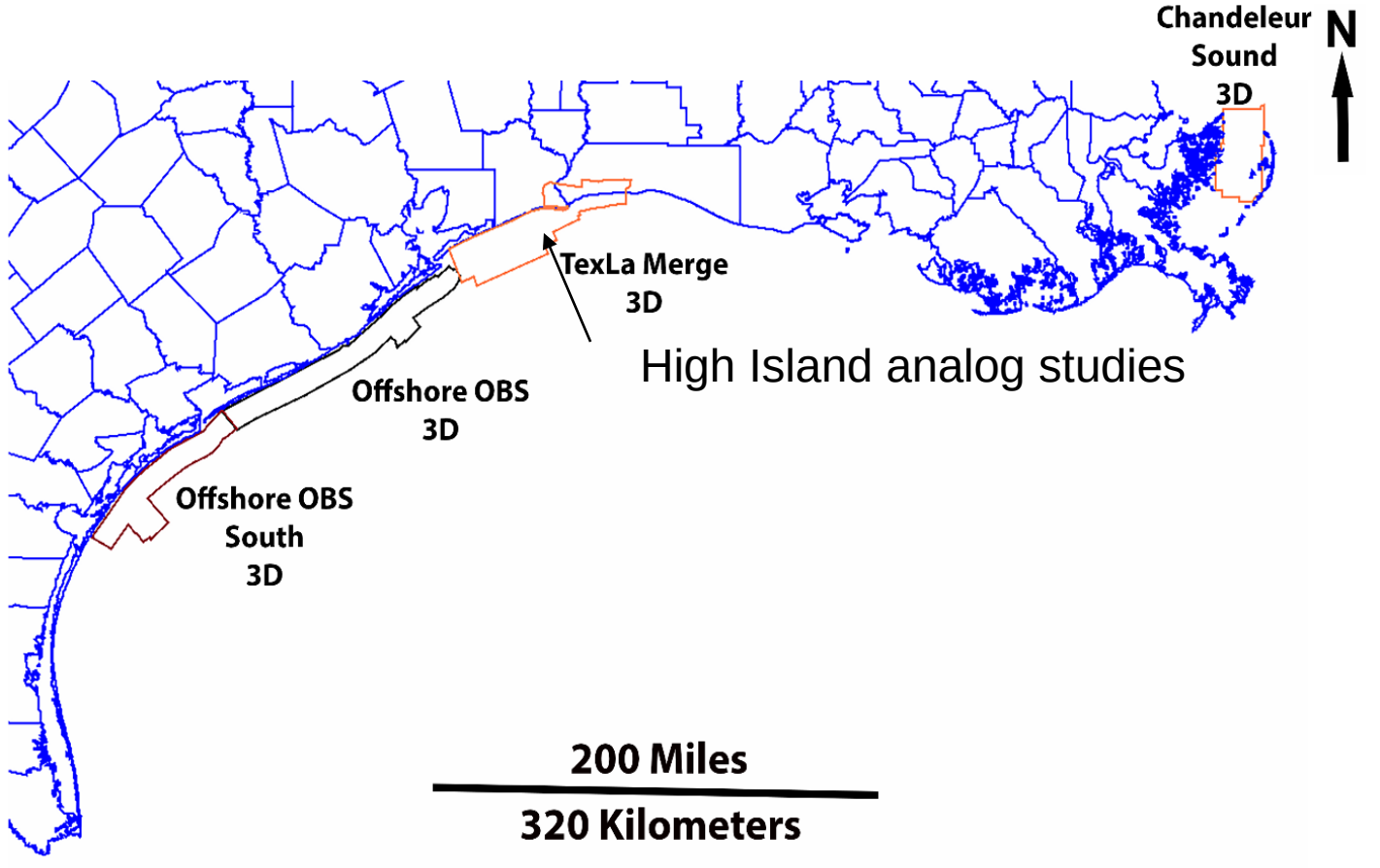
GCCC GULF COAST CARBON CENTER
BUREAU OF ECONOMIC GEOLOGY

Paleogeography and principal depositional systems of the Middle Miocene depositional episode

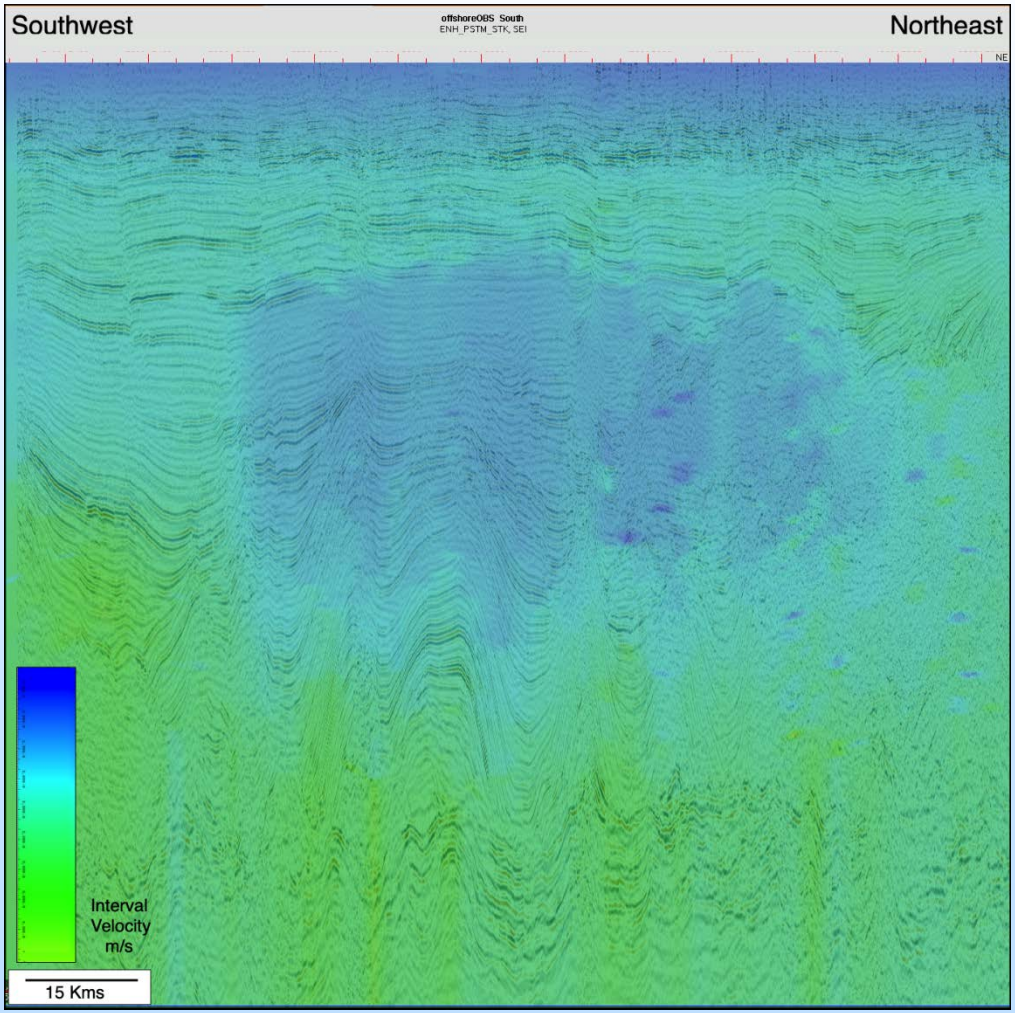
Stacked reservoirs separated by mudrocks
Focused near current coast
Arealy extensive



Storage Resource Assessment status



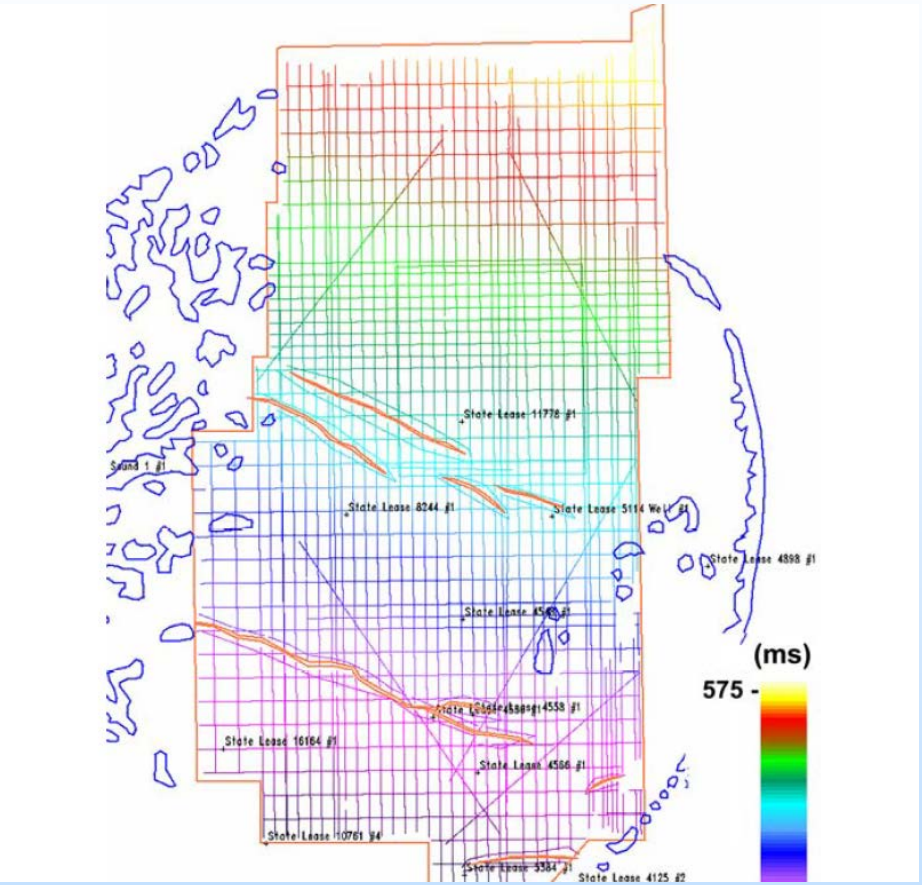
Initial look at newest survey – TX OBS (mid-Texas Coast)

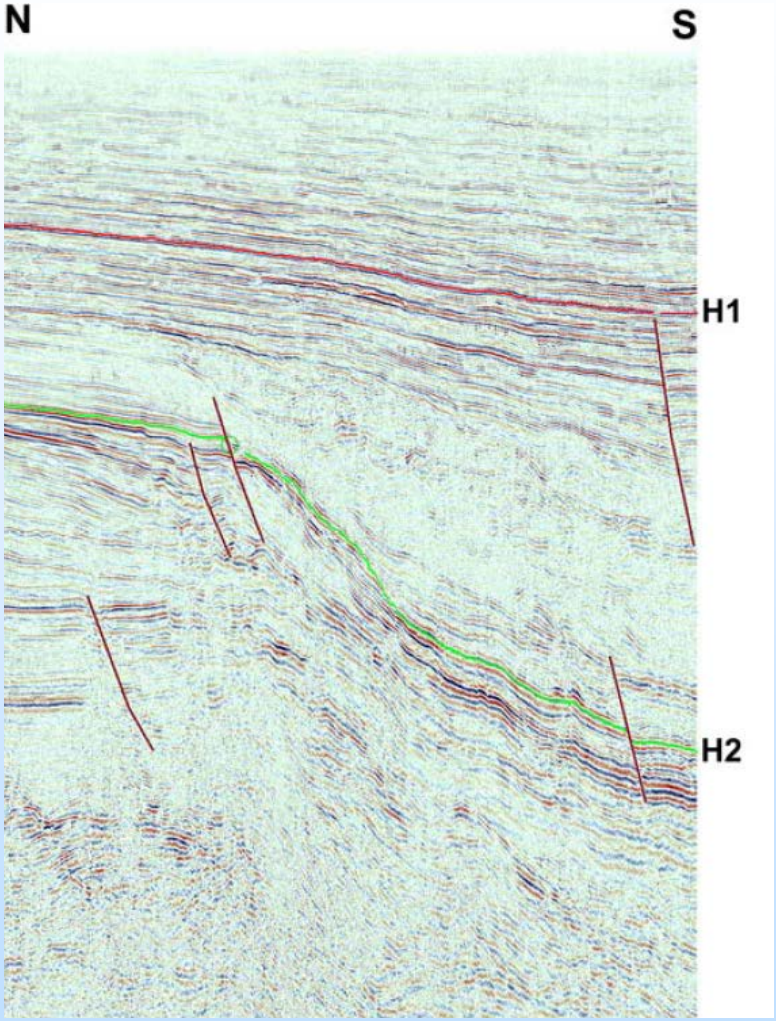


Seismic data owned by SEI, Inc. Interpretation is that of the Bureau of Economic Geology.

Chandeleur Sound, LA

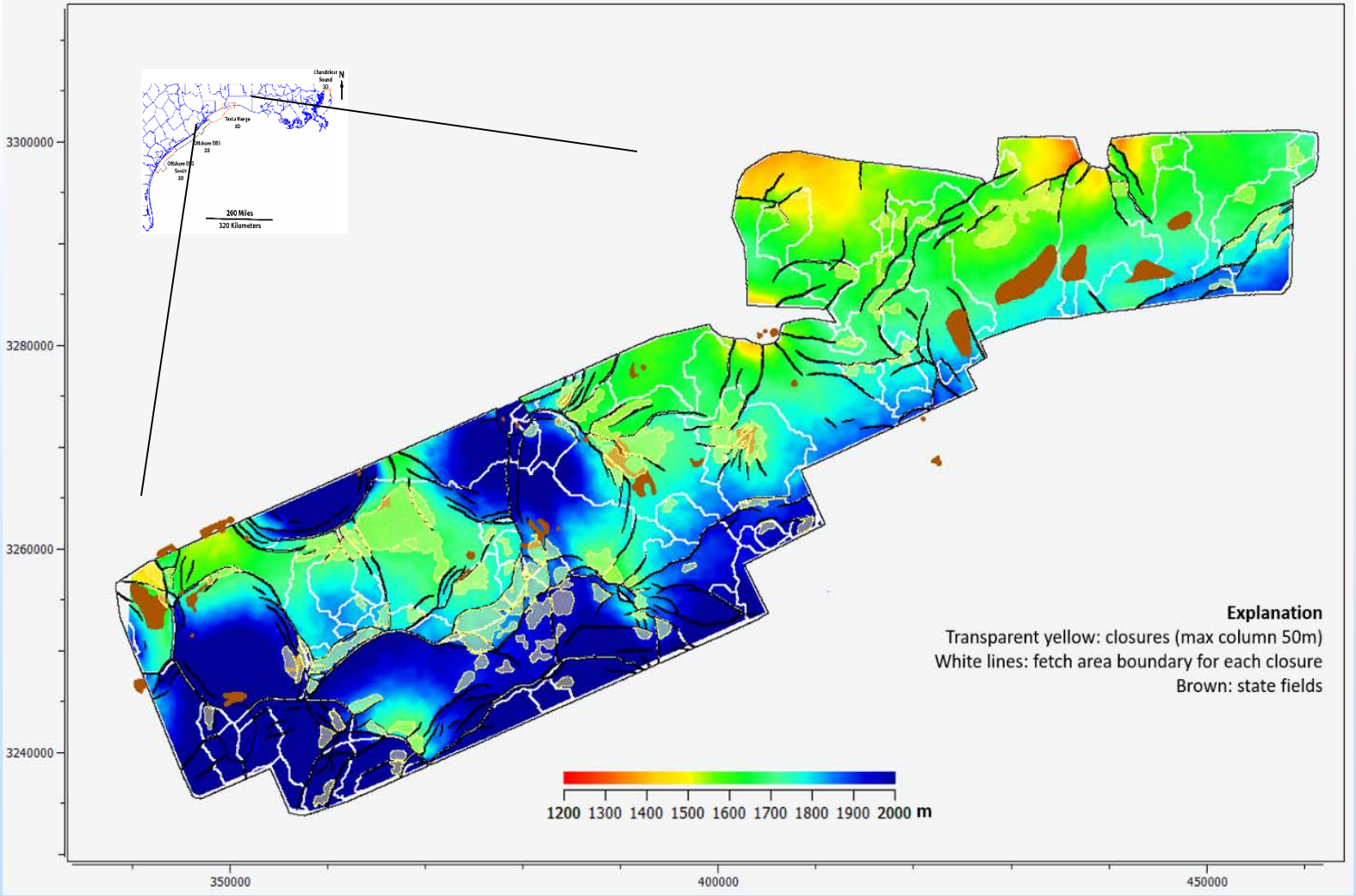
Gulf Basin Depositional Synthesis, UTIG



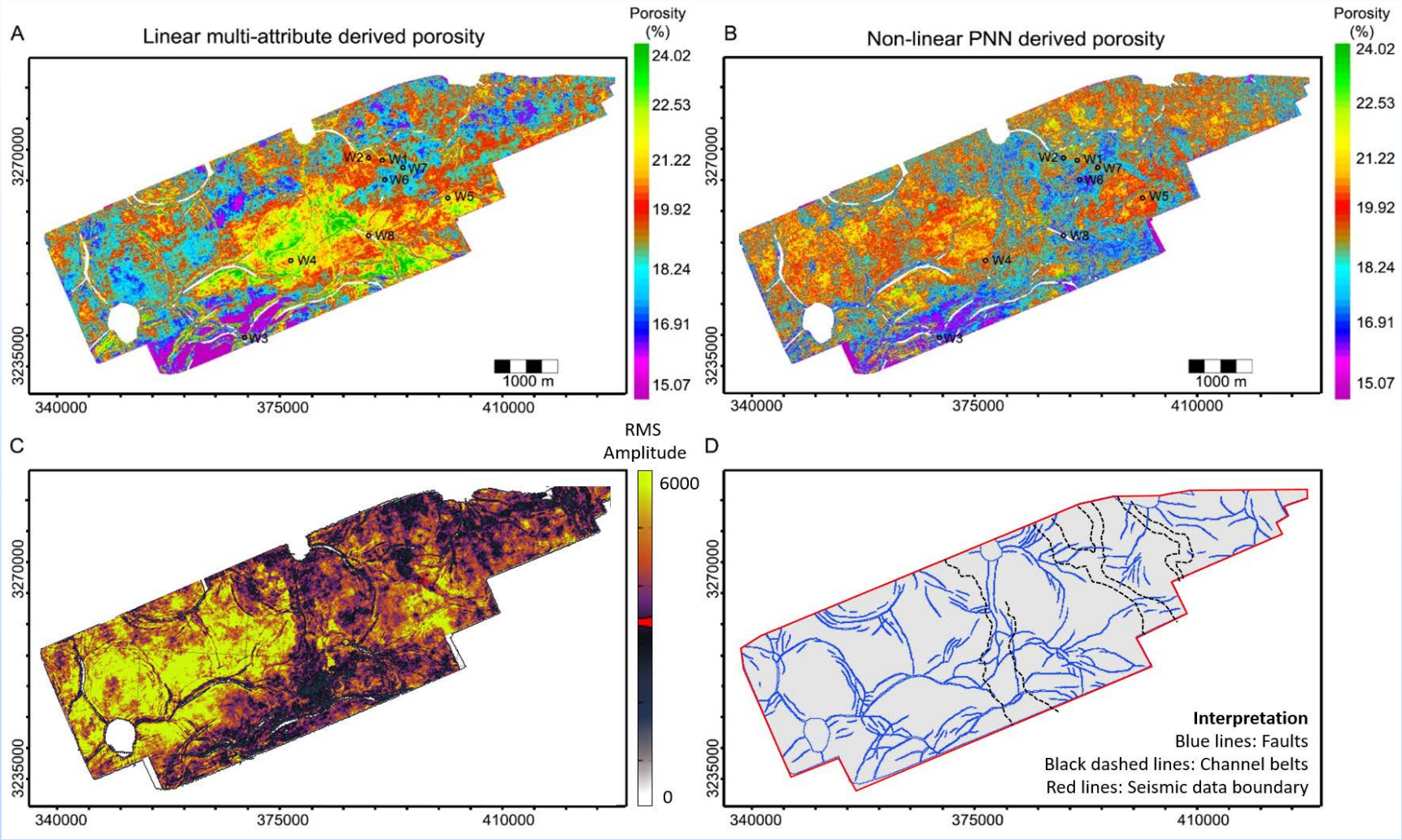


Seismic data owned by SEI, Inc. Interpretation is that of the Bureau of Economic Geology

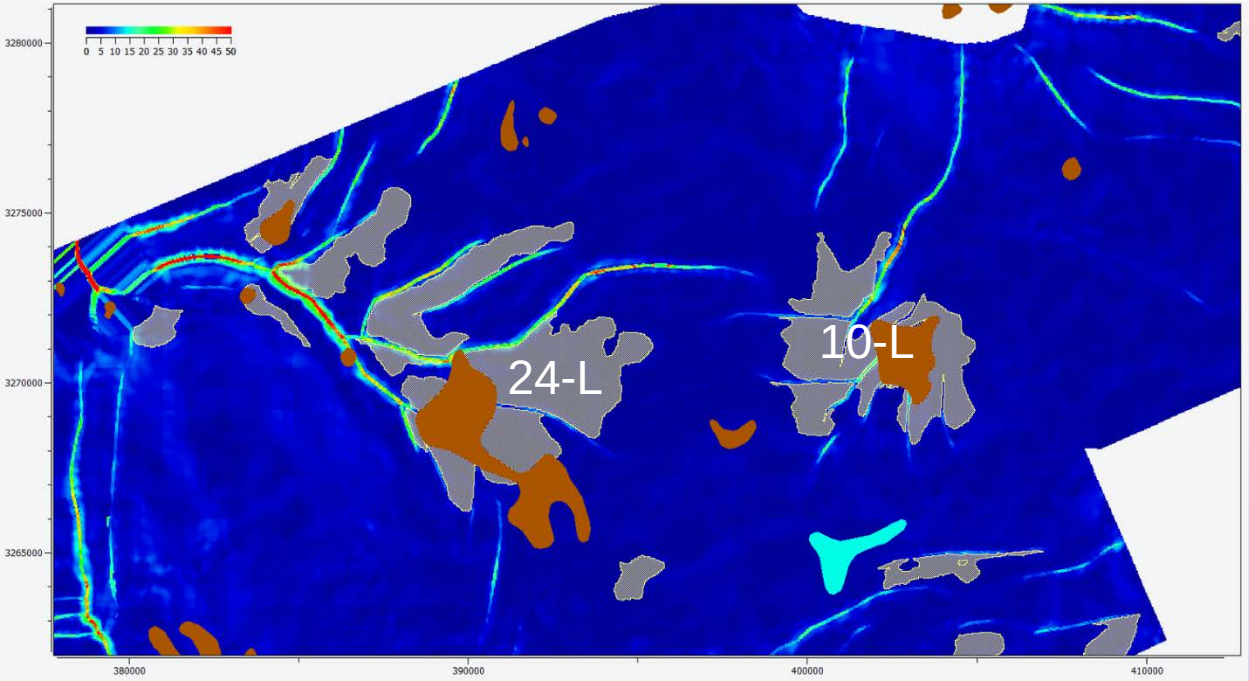
High Island Analog studies



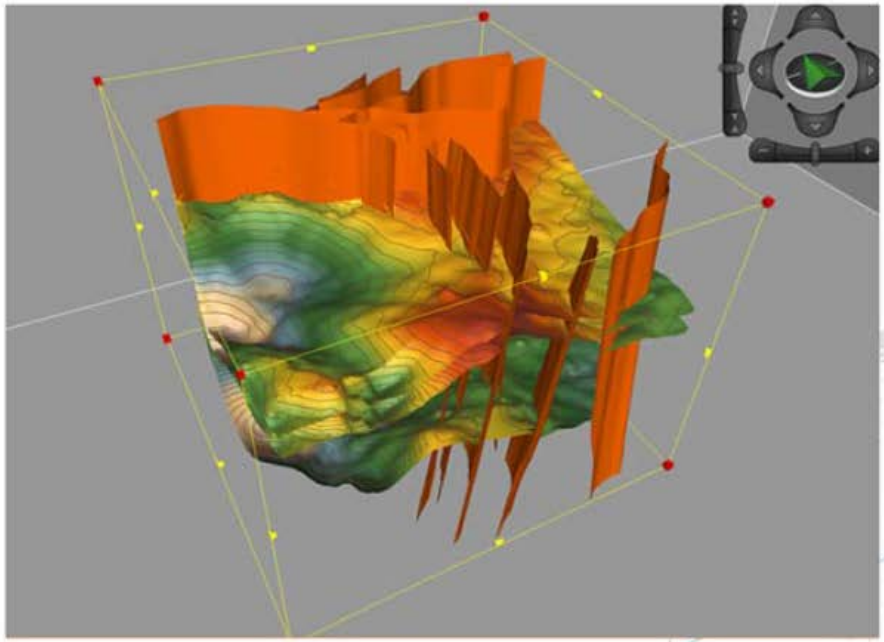
High Island Prospect Evaluation

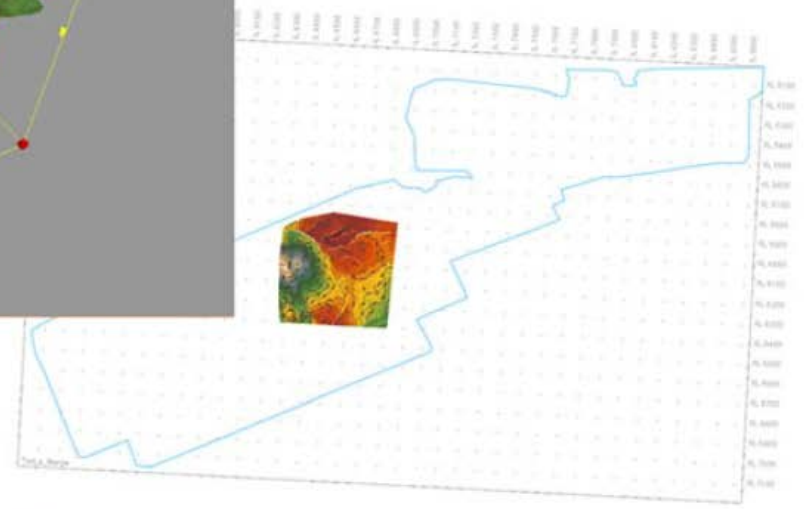


Analogs

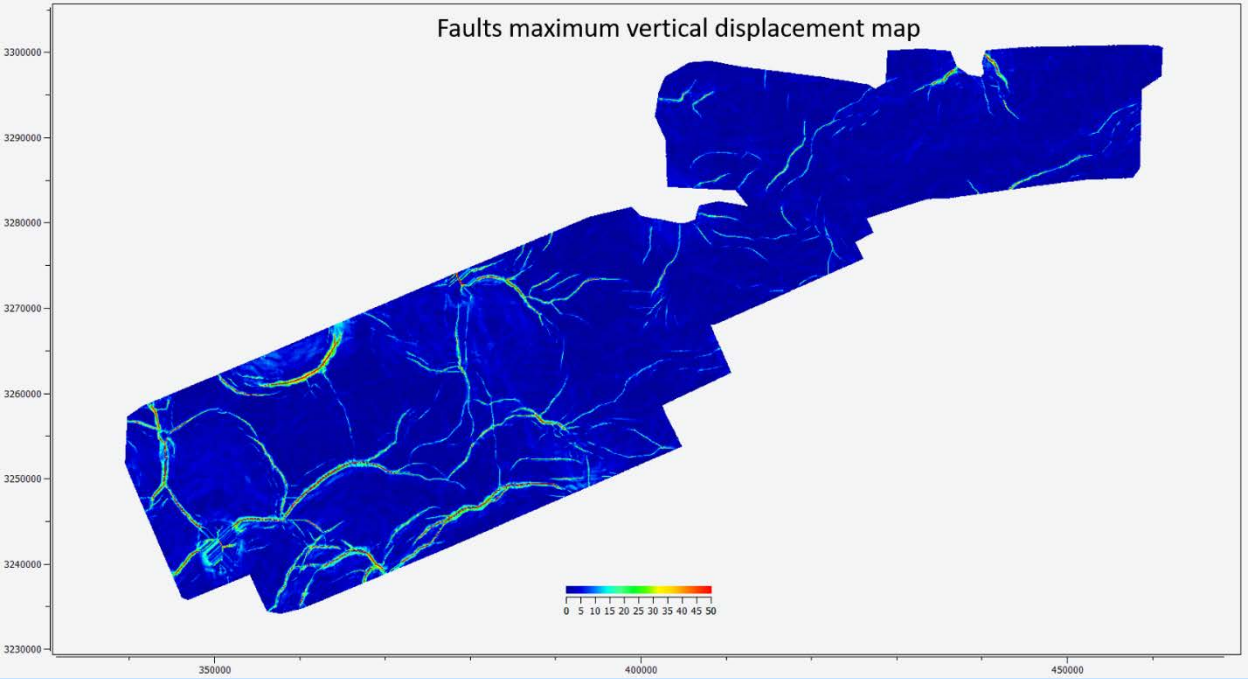

0 5 10 15 20 25 30 35 40 45 50
3280000
3275000
3270000
3265000
380000
390000
400000
410000
24-L
10-L

High Island prospect studies: Three-D models



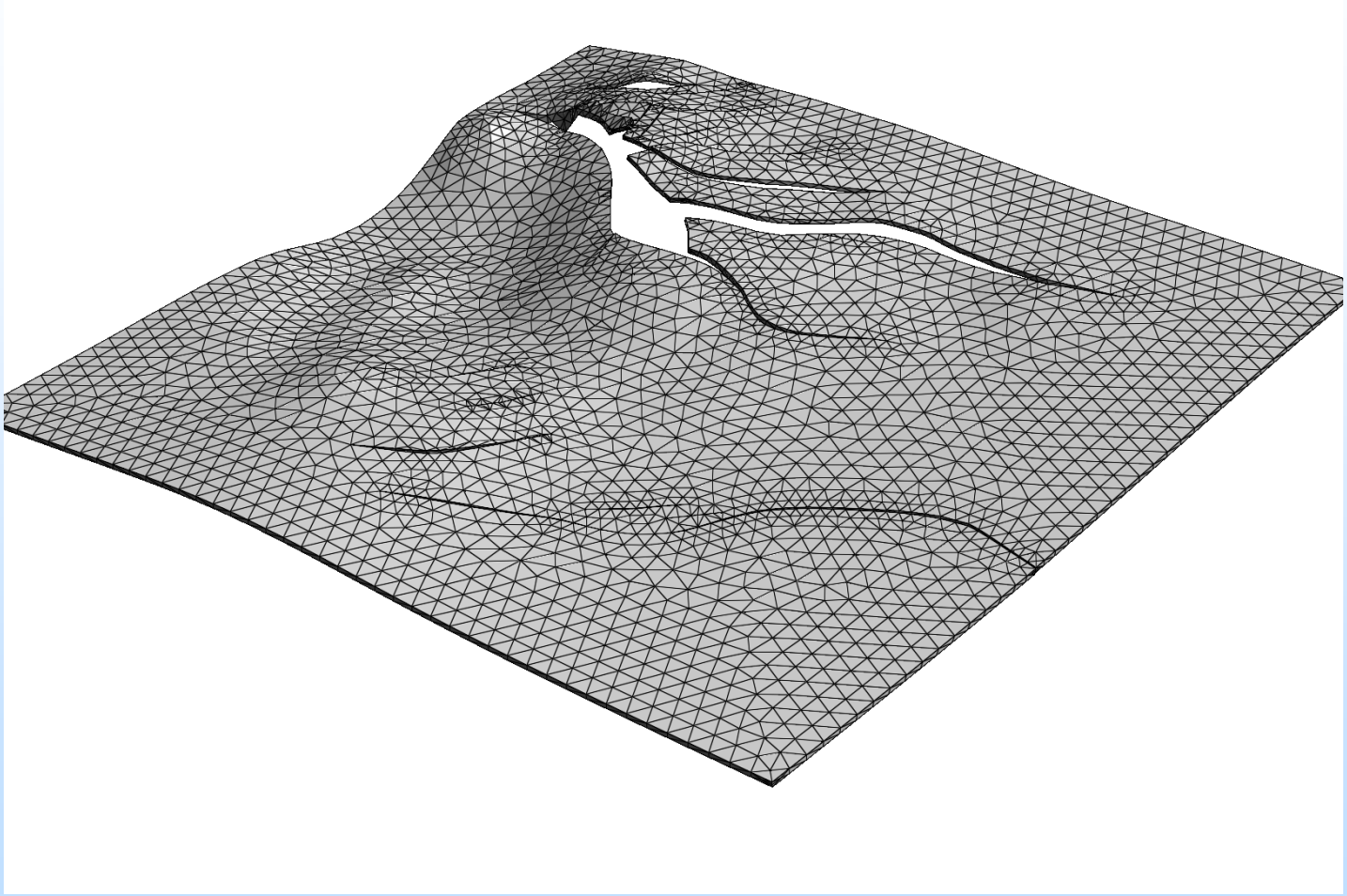


High Island Fault Studies



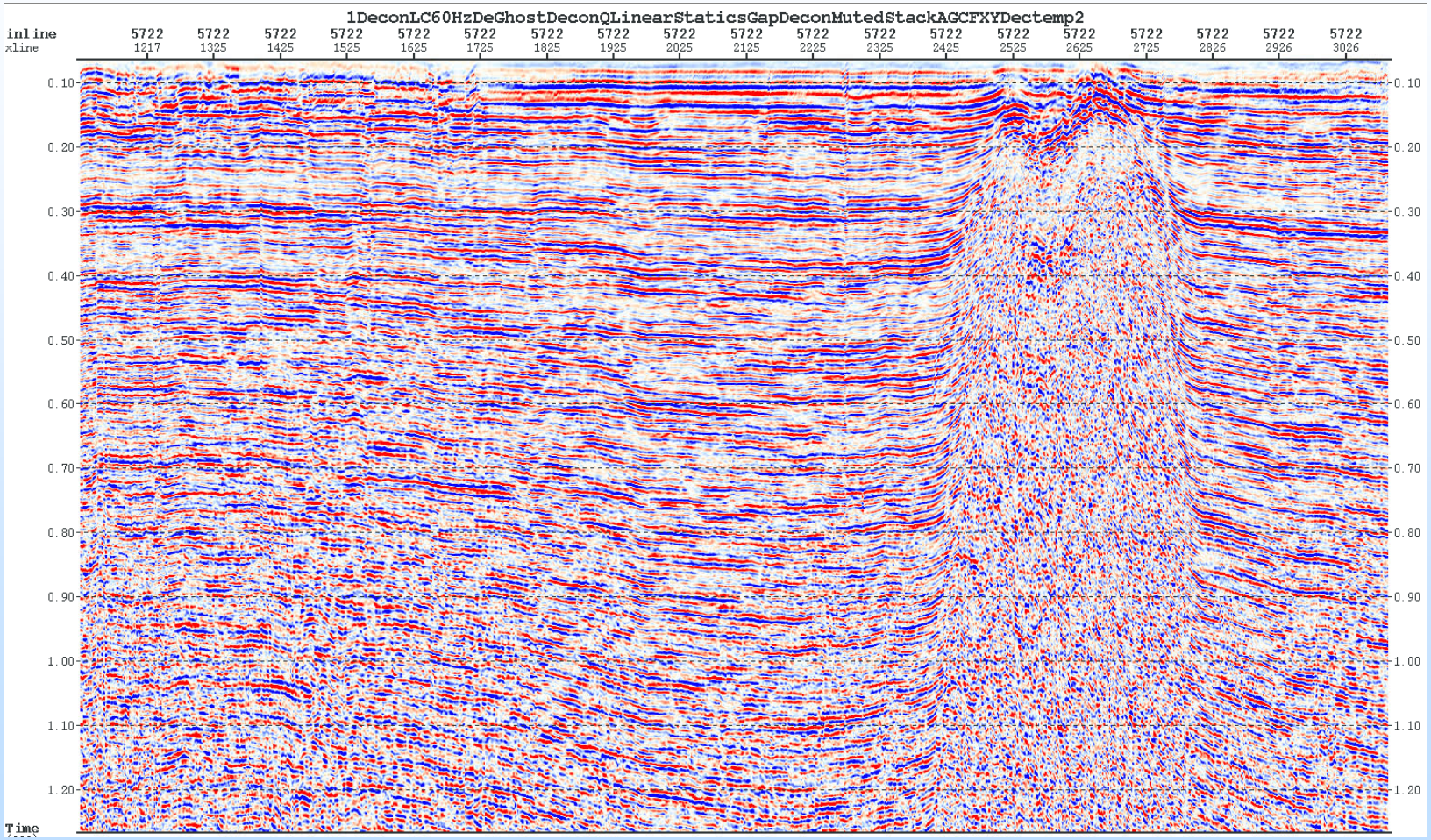
Risk Assessment – Faults

Josh White, LLNL



Reprocessing High Resolution

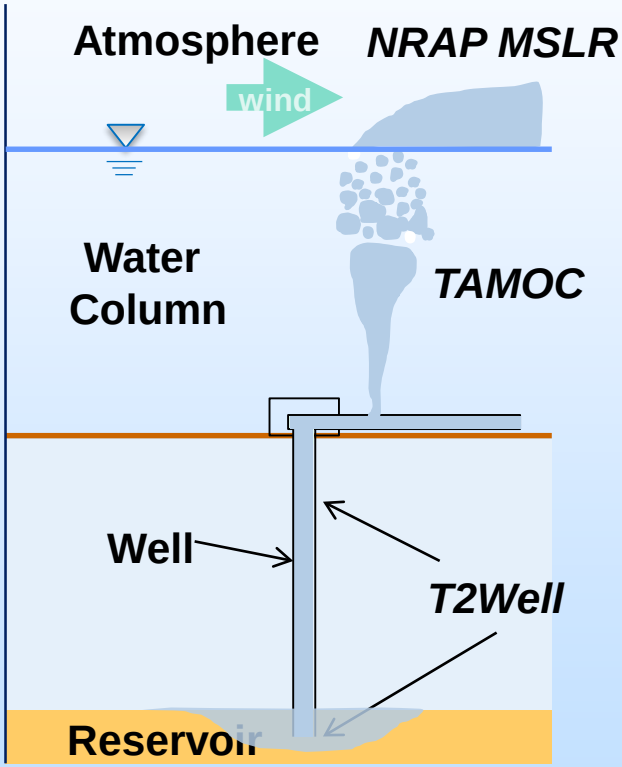
Ye Feng BEG



Risk Assessment of Offshore CO_2 Wells and Pipelines

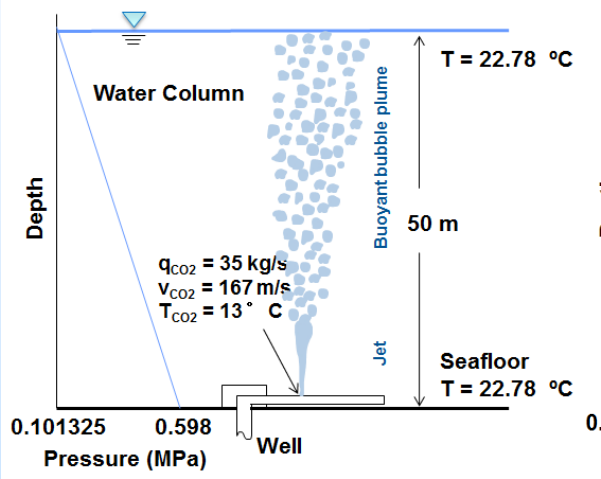
Curtis M. Oldenburg, Lehua Pan, Yingqi Zhang, and Quanlin Zhou (LBNL)

- Offshore GCS needs sub-sea risk assessment
- For the GoMCarb project, we are coupling three existing models to understand consequences of offshore CO_2 leaks and blowouts
  - T2Well for reservoir-well flow
  - TAMOC for jet and buoyant plume flow in the water column
  - NRAP MSLR for atmospheric dispersion



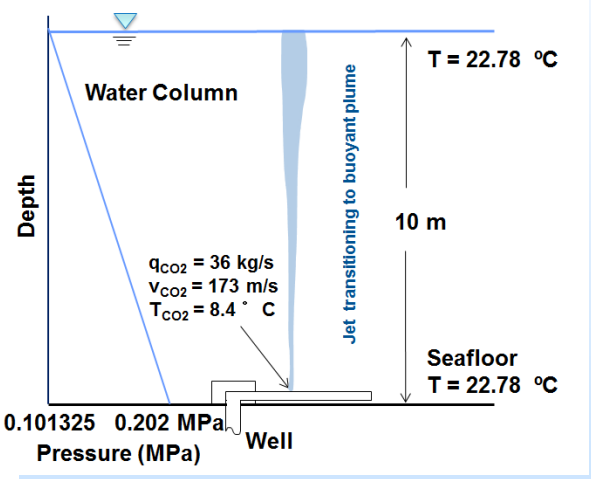
To understand effects of water column (depth), we simulated a large CO_2 blowout (~35 kg/s) for two cases

Case I (50 m depth)



CO_2 transitions from jet to buoyant plume and mostly dissolves during rise in 50 m case

Case II (10 m depth)



CO_2 mostly jet-like in 10 m case with very little dissolution

- **Preliminary results show**
  - Median bubble size is ~0.5 mm
  - 99% of the CO_2 is dissolved in the seawater for a blowout at 50 m depth (v. little surface emission)
  - 94% of the CO_2 is emitted at the sea surface for a blowout at 10 m depth (v. little dissolution)
  - The CO_2 concentration in air reduces by a factor of 100 within 0.5 km of the emission site in the 10 m case under light wind (1 m/s at 10 m elevation).

Offshore Monitoring

- Adaption of global experience to GoM Conditions
  - STEMM CCS, Northern Lights, Tomakomai
- Pipelines – Daniel Chen. Lamar Univ.
- High resolution seismic
  - Improved skills from Tomakomai
- DAS in this setting –Jonathan Ajo Franklin (Rice University)

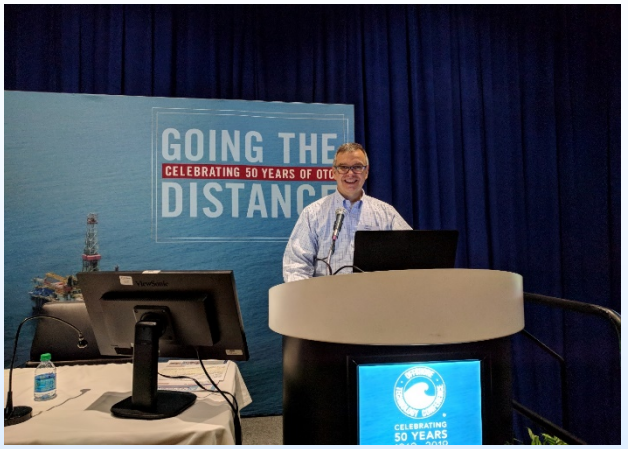
Infrastructure

Darshan Sachde, Ray Mc Kaskle, Katherine Drombrowski, Trimeric

- 10-L Existing well analysis – 33 wells
  - Diameters 5.5” to 10.8”
  - Depth 5,800 to 14,000 ft
  - Key risk, any value?
- Two existing pipelines in 10-L
  - Assess suitability for retrofit
- Future Aker Solutions
  - Options for new well completions

Knowledge Sharing

American Beach and Shore Preservation Association



50th annual Offshore Technology Conference

Events hosted at Lamar University, Beaumont: Joint project meetings, Community interactions

Upcoming: International Offshore Conference Series: 4th International Workshop on Offshore CCS with STEMM-CCS final results. GCCC UT, IEAGHG, STEMM-CCS. Hosted by University of Bergen, 11-13 Feb 2020

Joint GoMCarb-SECARB meeting

Figure 1.2 – Group photo at Walter Umphrey State Park, stop 1 on the field trip. Note the facility in the

Information Seeking Studies

R Lim[1],L. Atkinson[1], Ln Kahlor[1],Hilary Clement Olson[2], Emily Moskal[2]
[1]Stan Richards School of Advertising and PR, Moody College of Communication,, The University of Texas at Austin

- **Low CCS awareness.** Around 10% among people in the U.S (Boyd et al., 2017); 67% knew very little about CCS (Kahlor et al. 2017)
- **Climate change.** Perceive as an environmental risk, seriousness → higher support (Selma et al. 2014)
- **Trust.** Trust varied by different information source (e.g., lower trust government and oil & gas industry, higher trust university scientists) (Kahlor et al. 2017)
- **Benefits and risks perception.** Impacts CCS support/opposition (Huijteset al. 2007; Tokushige et al. 2007; Wallquist et al. 2012)
- **Misconception.** Based on past experiences (e.g., similar industries, capture processes, etc.), and inaccurate info (Ashworth et al., 2015)

How to create messages that resonate with stakeholders in Coastal Areas

- Data collection in Port Arthur area July, 2019
- Early messages
- Jobs/clean industry
- Hurricanes/flood

U.S Fish and Wildlife
Lamar University
Big Thicket Association
Texas Point Nat'l Wildlife Refuge
McFadden Nat'l Wildlife Refuge
Coastal Fisheries (TPWD)

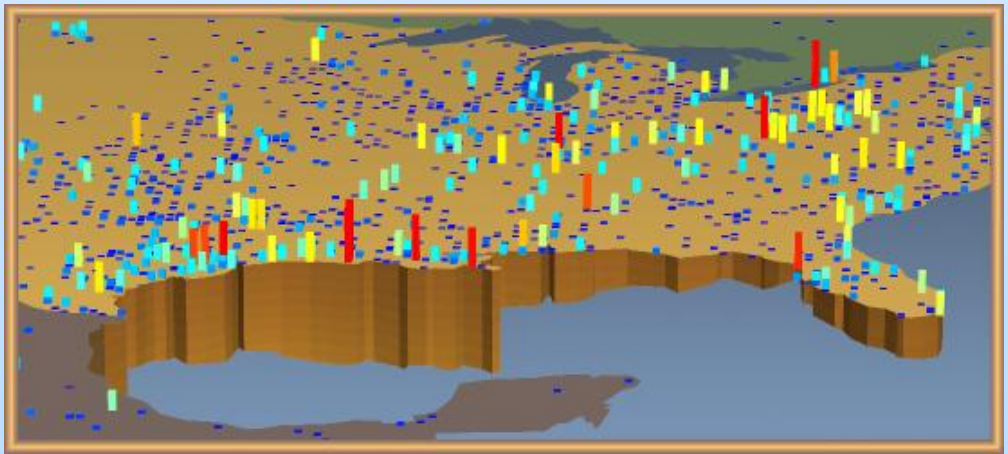
Sea Rim State Park
Community In-Power and Development Ass. Inc.
International Seafarers Ass.
Realtors, lawyers

Accomplishments to Date

- Mapping analog sites at level of detail needed to advance toward real projects. .
- Broaden coverage in basin
- Begin assessments of fault risk
- Complete initial blowout risk assessment
- Begin knowledge sharing
- Begin stakeholder engagement work

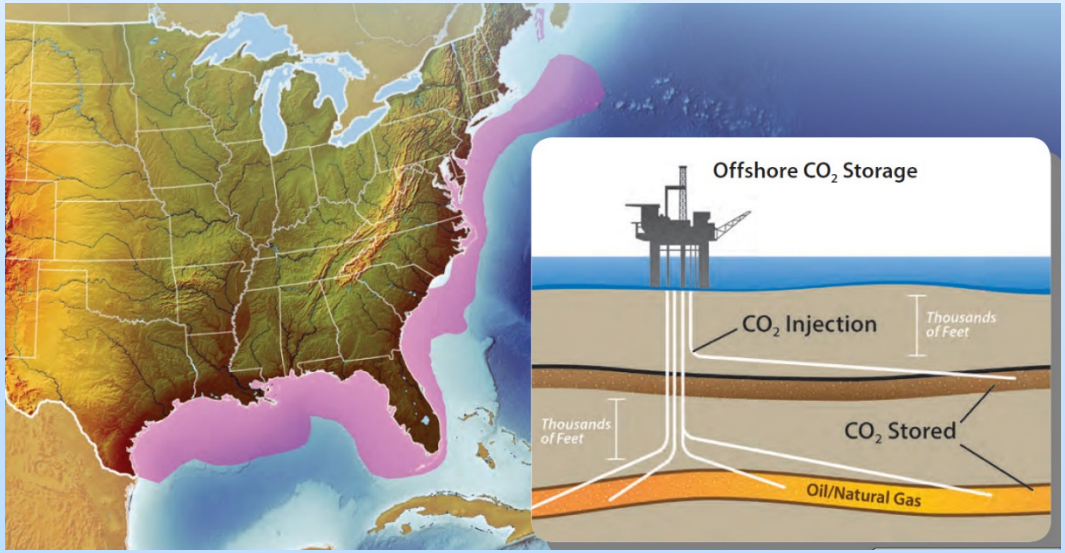
Lessons Learned

- Dense data requires strategic approach to support rapid progress: use detailed "analog" sites to probe deeply into data needs.
- Infrastructure evaluation remains challenging – data are incomplete and scattered
- Shallow water near-shore setting is different from deeper offshore settings – e.g. blowout response



Synergy Opportunities

- Strong global opportunities to leverage US efforts
- Possibility for US leadership in future.
- Collaboration with SECARB offshore and groups working offshore Atlantic and Pacific



Next Steps

- Project in full swing
- Continued characterization of regions followed by analog sites
- Modeling efforts –esp. fluid flow and geomechanics will be a next step
- Shallow-Gulf specific risks, monitoring, and infrastructure.

Appendix

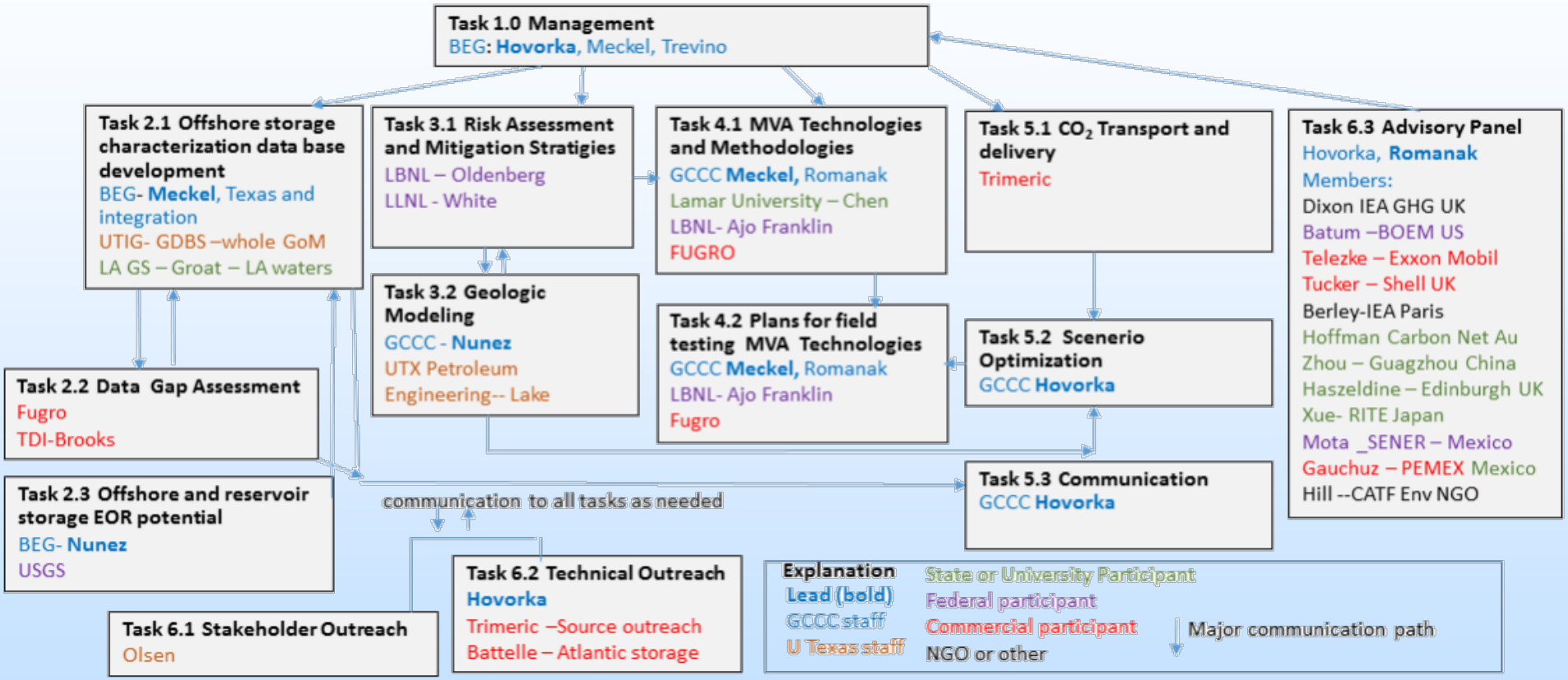
Benefit to the Program

- **Establishment of a Government-Academic-Industry Partnership for Offshore CCS Research.**
- **Determining the CO_2 storage resource potential of offshore oil, gas, and saline bearing formations.**
- **Improving carbon storage efficiency and security by advancing new and early-stage monitoring tools and models.**
- **Improving capabilities to evaluate and manage environmental risks and uncertainty through integrated risk-based strategic monitoring and mitigation protocols**
- **Disseminating findings and lessons learned to the broader CCS community and key stakeholders**

Project Overview: Goals and Objectives

- The primary objective of this FOA is to develop an Offshore Carbon Storage Partnership that is similar in structure to the existing RCSPs Characterization Phase, but is focused on sub-seafloor saline or hydrocarbon reservoir-associated geologic storage.
- Assemble the knowledge base required for secure, long-term, large-scale CO_2 storage, with or without enhanced hydrocarbon recovery.
- Identify and address knowledge gaps, regulatory issues, infrastructure requirements, and technical challenges associated with offshore CO_2 storage.

GoMCarb Organizational Chart



Gantt Chart

Partnership for Offshore Carbon Storage Resources and Technology Development in the Gulf of Mexico		BUDGET PERIOD 1								BUDGET PERIOD 2							
		YEAR 1 (2018)				YEAR 2 (2019)				YEAR 3 (2020)				YEAR 4 (2021)			
Task	Tasks	qtr 1	qtr2	qtr3	qtr4	qtr 1	qtr2	qtr3	qtr4	qtr 1	qtr2	qtr3	qtr4	qtr 1	qtr2	qtr3	qtr4
		J-F-M	A-M-J	J-A-S	O-N-D	J-F-M	A-M-J	J-A-S	O-N-D	J-F-M	A-M-J	J-A-S	O-N-D	J-F-M	A-M-J	J-A-S	O-N-D
		2018				2019				2020				2021			
1	**Project Management, Planning, and Reporting**	M1		M2													
	Revision and Maintenance of Project Management Plan	D1a D1b							G-NG								
	Progress Report	Q	Q	Q	Q/A	Q	Q	Q	Q/A	Q	Q	Q	Q/A	Q	Q	Q	Q/A/FR
2	**Offshore Storage Resources Characterization**						M4								M8		
2.1	Database Development		D2.1a		M3		D2.1b				D2.1c				D2.1d		
2.2	Data Gap Assessment		D2.2a				D2.2b				D2.2c				D2.2d		
2.3	Offshore EOR Potential		D2.3a				D2.3b				D2.3c				D2.3d		
3	**Risk Assessment, Simulation and Modeling**								M5				M6				
3.1	Risk Assessment and Mitigation Strategies				D3.1a				D3.1b				D3.1c				D3.1d
3.2	Geologic Modeling				D3.2a				D3.2b				D3.2c				D3.2d
4	**Monitoring, Verification, Accounting (MVA) and Assessment**												M7				
4.1	MVA Technologies and Methodologies				D4.1a				D4.1b				D4.1c				D4.1d
4.2	Plans for Field Testing of MVA Technologies				D4.2a				D4.2b				D4.2c				D4.2d
5	**Infrastructure, Operations, and Permitting**																
5.1	CO2 Transport and Delivery			D5.1a				D5.1b				D5.1c				D5.1d	
5.2	Scenario Optimization			D5.2a				D5.2b				D5.2c				D5.2d	
5.3	Communication			D5.3a				D5.3b				D5.3c				D5.3d	
6	**Knowledge Dissemination**																M9
6.1	Stakeholder Outreach	D6.1a				D6.1b				D6.1c				D6.1d			
6.2	Technical Outreach	D6.2a				D6.2b				D6.2c				D6.2d			
6.3	Advisory Panel				D6.3a				D6.3b				D6.3c				6.3d

Q = Quarterly Report; A = Annual Report; M = Milestone; DP = Decision Point; D = Deliverable; G-NG = Go/no-go decision point; FR = Final Report