

Preliminary Evaluation of Offshore Transport and Geologic Storage of Carbon Dioxide (CO₂)

By Darrick Eugene

Presented to SECARB Stakeholders Meeting

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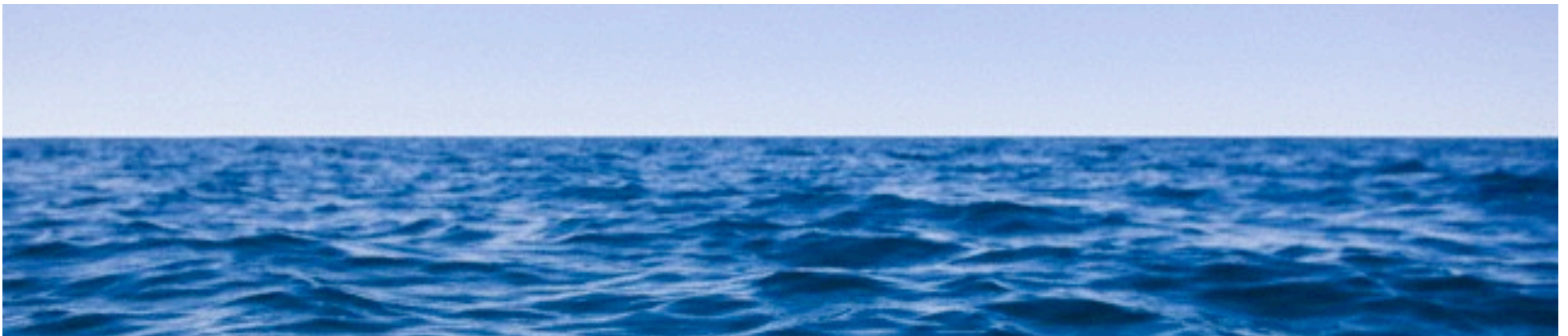


Background & Purpose

- ◆ Assembled Task Force of experts to develop the report. Collaborative effort with 13 principal authors and additional reviewers.
- ◆ Purpose: provide basic information and recommendations for evaluating the potential for CO₂ geologic storage in sub-seabed geologic structures
 - ◆ Legal and regulatory frameworks
 - ◆ Geological and technical topics

Offshore CCS

- Historically, development of offshore resources followed onshore development
 - 1859 - Col. Edwin Drake struck oil 69ft below the surface of the ground in Titusville, Pennsylvania
 - 1947 - Kerr McGee brings in the first producing oil well on the Outer Continental Shelf off Louisiana
- Due to certain advantages Offshore CCS could be developed simultaneously or in advance of onshore CCS
 - Enormous storage capacities
 - Isolation from populated areas
 - Absence of drinking water aquifers
 - Uniform (governmental) ownership of the sea-bed and the subsurface




Focus of Report

- CO₂ Storage in Sub-Seabed Geological Structures or CS-SSGS

- From the London Protocol's offshore storage risk assessment document
- Does not involve ocean-bottom CO₂ storage

- Offshore - State and Federal Waters

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*United States Continental Shelf Boundary Map,
Modified from BOEM*

Jurisdiction, Geography and Terminology

Term	Definition
Coastline	line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters
State Territorial Waters	<ol style="list-style-type: none">1) Seaward to a line three (3) geographical miles distant from the coastline,2) to the boundary line of each such State where in any case such boundary as it existed at the time such State became a member of the Union.
Outer Continental Shelf (EEZ)	<p>consists of the submerged lands, subsoil, and seabed, lying between the seaward extent of the States' jurisdiction and the seaward extent of Federal jurisdiction. Federal jurisdiction is defined under accepted principles of international law. Generally, the OCS begins 3-9 nautical miles from shore (depending on the state) and extends 200 nautical miles outward, or farther if the continental shelf extends beyond 200 nautical miles.</p> <p>http://ocsenergy.anl.gov/guide/ocs/index.cfm</p>

State Jurisdictional Topics

- ◆ Financial Assurance
 - ◆ Must be adequate to cover risk
- ◆ Sovereign Immunity
 - ◆ Can provide indemnity protection
 - ◆ Result in moral hazard
- ◆ Liability/Stewardship
 - ◆ State ownership



Federal Jurisdiction - Agencies

- ◆ Federal Agencies

- ◆ Department of Interior

- ◆ Bureau of Ocean Energy Management

- ◆ Bureau of Safety and Environmental Enforcement

- ◆ Environmental Protection Agency

- ◆ National Oceanic and Atmospheric Administration

Federal Jurisdiction – Offshore Land Statutes

Statute	Description
Outer Continental Shelf Lands Act	Implements Federal Jurisdiction over submerged lands on the OCS seaward of state boundaries. Gives the Secretary of the Interior authority to oversee mineral exploration and development, leasing, easements and rights-of-way for energy related purposes
Submerged Lands Act	Grants title to the states to the “land beneath navigable waters” and natural resources within the following limits: <ol style="list-style-type: none">1) Seaward to a line three (3) geographical miles distant from the coastline,2) to the boundary line of each such State where in any case such boundary as it existed at the time such State became a member of the Union, or3) As approved by Congress

Federal Jurisdiction – Administrative Statutes

Statute	Description
Coastal Zone Management Act	Requires consistency between any offshore federally licensed activity and authorized state coastal management plans
Archeological and Historical Preservation Act	Allows for the recovery from Federal licensees of costs for identification, surveys, evaluation, and data recovery regarding historic properties within project areas
National Historic Preservation Act	

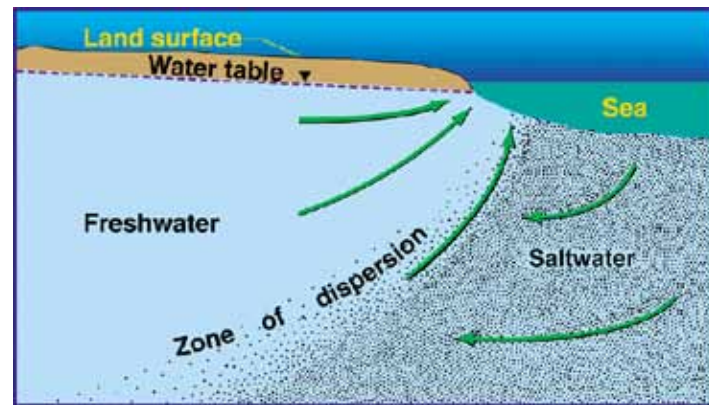
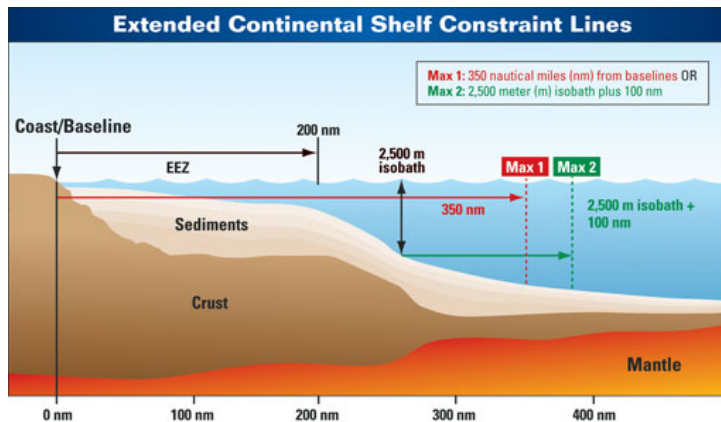
Federal Jurisdiction – Environmental Statutes

- ◆ Federal Environmental Statutes
 - ◆ NEPA
 - ◆ Clean Air Act
 - ◆ Clean Water Act
 - ◆ Endangered Species Act
 - ◆ Marine Mammal Protection Act



Federal Jurisdiction – Environmental Statutes cont'd

- 💧 Safe Drinking Water Act
 - 💧 Covers UIC Activity in State territorial waters
 - 💧 Not applicable on Federal OCS



Source: US Geological Survey available at <http://water.usgs.gov/ogw/gwrp/saltwater/salt.html>

Infrastructure Considerations

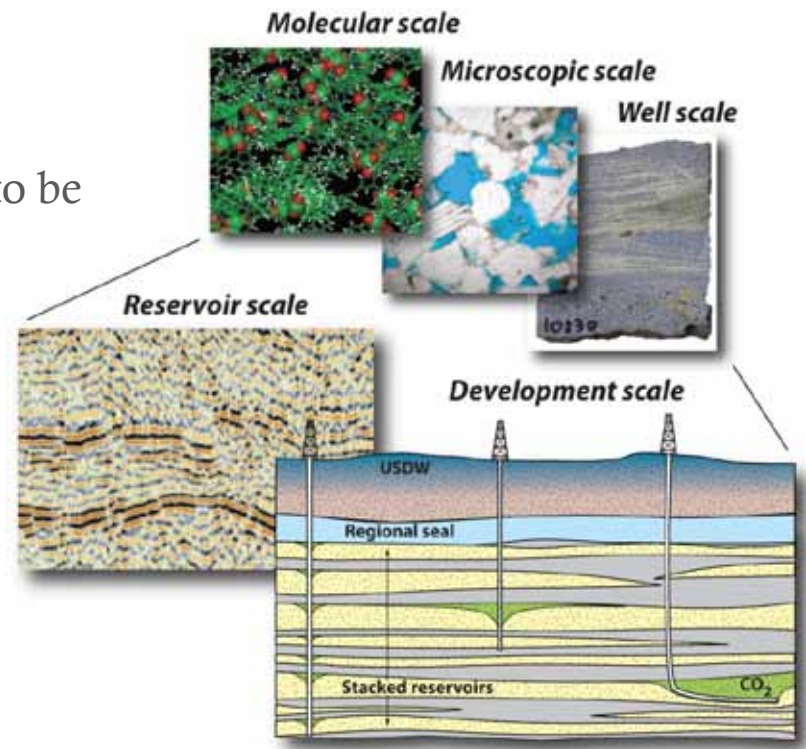
- ◆ CO₂ sources, capture technologies, pipeline systems, platforms, injection and monitoring wells



*Aerial view of the Sleipner production platform of the North Sea Shelf,
www.statoil.com.*

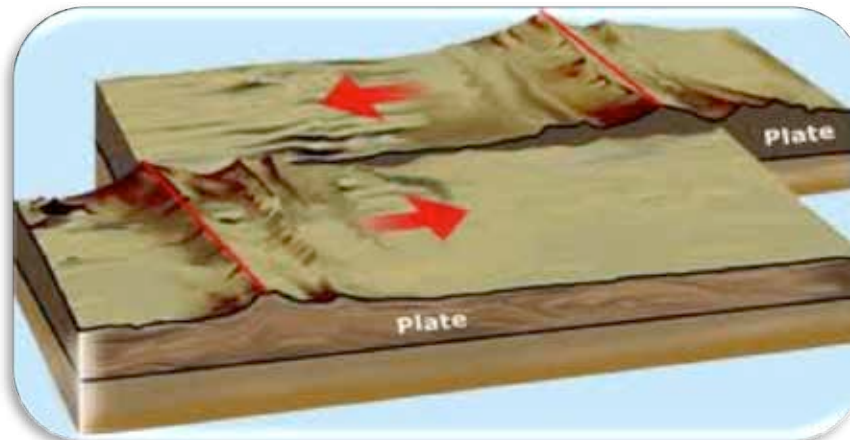
Site Selection and Characterization

- ◆ Social Characterization (public perception and support)
- ◆ Infrastructural Site Selection
 - ◆ Source-sink relationships
 - ◆ Locations of industrial, military, and recreational facilities
 - ◆ Locations of oil and gas fields, pipelines, shipping lanes, fisheries, and other areas to be avoided or minimally impacted
- ◆ Environmental Site Selection
 - ◆ Areas of environmental sensitivity
- ◆ Technical Site Selection (geologic and engineering factors)
 - ◆ Reservoir type
 - ◆ Reservoir properties
 - ◆ Seal integrity
 - ◆ Pathways for fluid migration

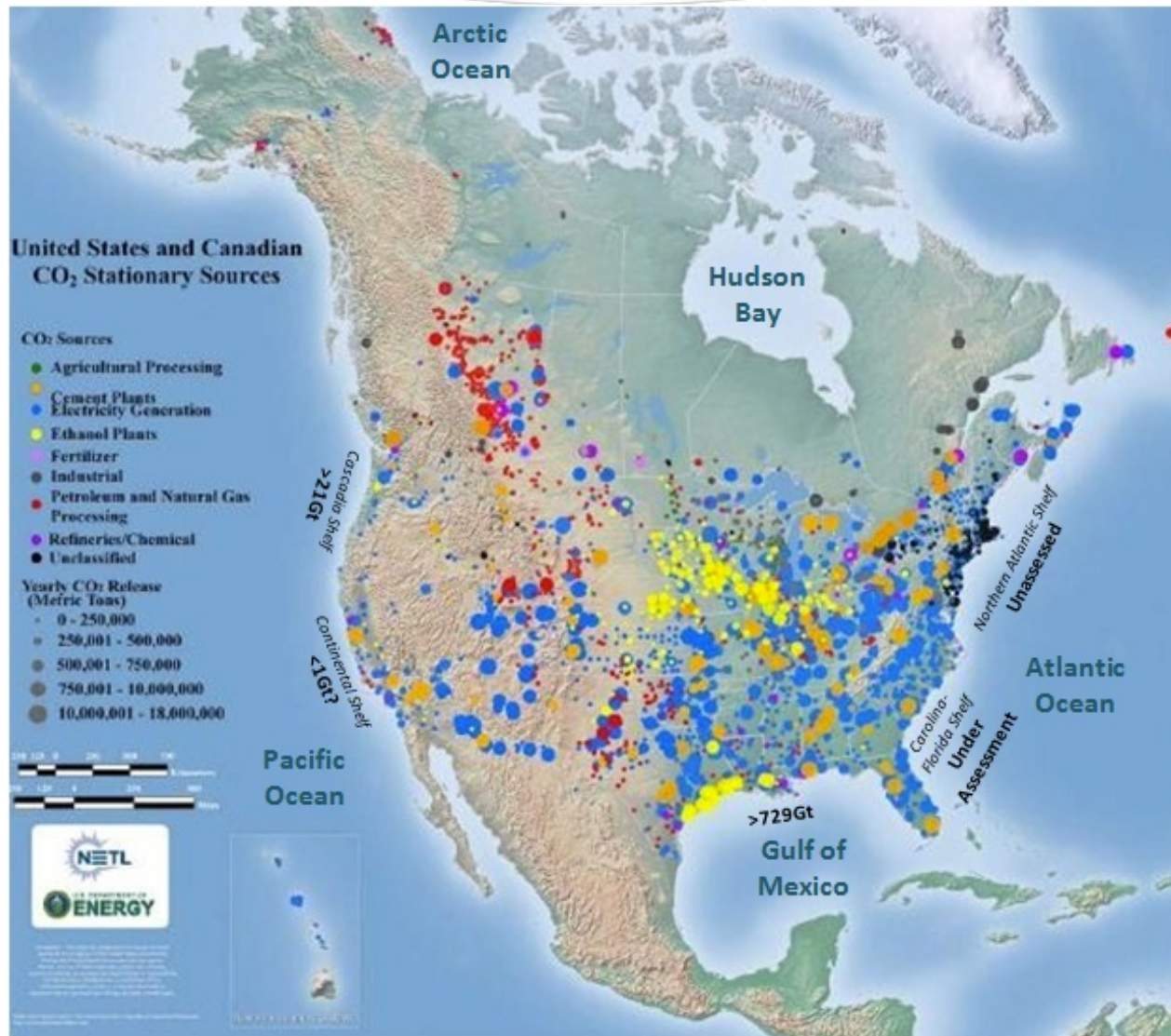


Capacity of U.S. Offshore Geologic Sinks

- ◆ Diversity in terms of tectonic style and sediment thickness
 - ◆ Pacific Rim: active continental margins, sediment thickness 40,000 feet
 - ◆ Atlantic Shelf: passive continental margin, sediment thickness in places over 15,000 feet
 - ◆ Gulf of Mexico: passive continental margin, sediment thickness can exceed 50,000 feet



Capacity of U.S. Offshore Geologic Sinks cont'd



Generalized map showing preliminary assessments of offshore CO₂ capacity and the relationship to anthropogenic CO₂ sources in the United States (map from NETL, capacities from multiple sources).

Risk Analysis & Environmental Protection

- ◆ Potential risks associated with offshore geologic storage operations
 - ◆ London Protocol: Risk Assessment and Management Framework for CO₂ Sequestration in Sub-seabed Geological Structures”
- ◆ Most risks are similar to onshore CCUS projects.
- ◆ Risks specific to offshore projects could include:
 - ◆ Accidents on the platform during drilling and other operations
 - ◆ Impact of CO₂ leakage to the marine environment and ecosystems (acidification and alteration of the ionic composition of seawater)
 - ◆ Long-term degradation of offshore infrastructure by exposure to the marine environment

Monitoring, Verification, and Accounting

- ◆ MVA program similar to onshore projects
 - ◆ Effective and accurate approach to operational and environmental controls
 - ◆ MVA Plan
- ◆ Sleipner: Repeat 3D seismic surveys have been conducted since the inception of the project
- ◆ Offshore Task Force: **Monitoring techniques and strategies should be site specific and risk based**
- ◆ MVA tools are being developed for offshore projects but need further testing

Recommendations

Stay Tuned...

QUESTIONS?

Darrick Eugene
deugene@thetexascapitol.com
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