Bureau of Ocean Energy Management

Environmental Monitoring Study for Carbon Capture, Utilization, Transportation, and Storage (CCUTS) Activities on the Outer Continental Shelf (OCS)

20th Meeting of the Standing Committee on Offshore Science and Assessment

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BOEM Information Need

- BOEM was given new authority, under the 2021 Bipartisan Infrastructure Law (BIL)
  - Amended the OCSLA leasing provisions to authorize the DOI to grant leases, easements, and rights-of-way on the OCS for the purpose of CO_2 sequestration on the OCS.
  - Specified that DOI develop rules within one year of its enactment.
- To support BOEM's new authority and rulemaking, inform leasing and management decisions, facilitate reviews associated with the deployment of CCUTS projects, environmental studies and analyses will be needed to comply with the NEPA and other environmental statutes.

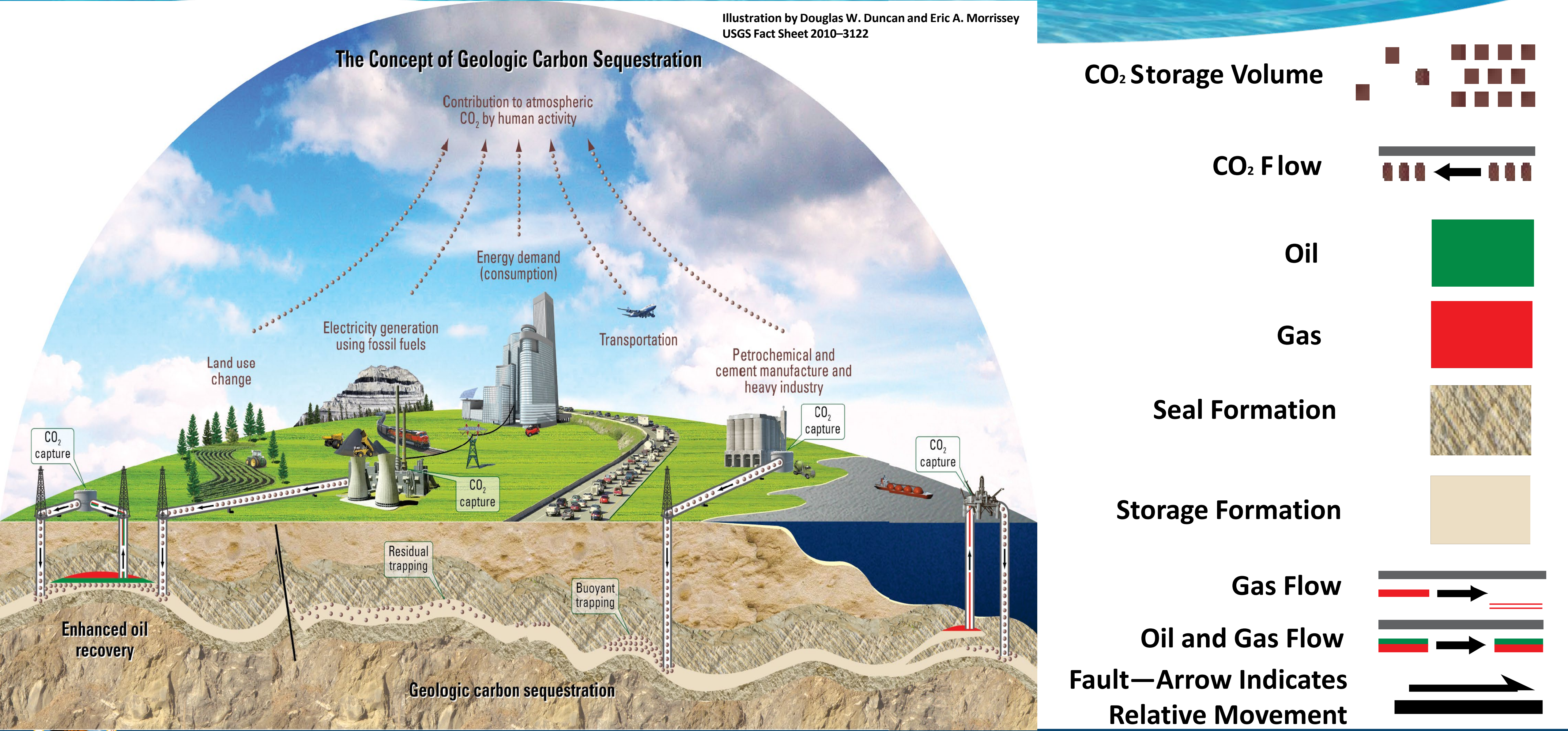
PICOC Summary

Problem	**BOEM has new authority to oversee CO_2 capture, utilization, transportation, and sub-seabed sequestration (storage) on the OCS. Information on potential impacts of these activities on the human and marine environment is needed to inform leasing and management decisions**
Intervention	**Conduct a literature review and synthesis to determine: (1) the human and environmental resources that may be impacted; (2) the human and environmental resources monitoring that will be required during each phase of a CCUTS project, pre-injection, during injection, and post-injection; and (3) the most effective monitoring methods and protocols for the CO_2 plume and pressure front during each project phase. The mechanisms and pathways by which CO_2 may impact a resource.**
Comparison	**BOEM needs more information about the potential environmental impacts of CCUTS activities for each OCS Region, in particular, how a CO_2 plume migrates and potential leaking may affect environmental resources during each phase of a CCUTS project.**
Outcome	**The analysis will aid BOEM's ongoing rulemaking efforts, program development, and future operational needs NEPA analyses, lease planning, lease stipulations, consultations, plan approvals, etc.). Study results will also provide direction for future studies that address gaps in information needs.**
Context	**All OCS Regions (Atlantic, GOM, Pacific, Alaska)**

Background – Administration Goals and Initiatives

- CO_2 capture and removal is an essential part of current climate mitigation models (IPCC 2005, NAS 2019, IEA 2021) and thus a strong component of the United States' goal to mitigate the climate crisis and reach net-zero carbon emissions by 2050.
- Executive Order 14008: Tackling the Climate Crisis at Home and Abroad (January 2021)
- DOI Authority under BIL OCSLA Amendments (November 2021)
- CEQ recently published guidance (87 FR 8808) recommending agencies consider developing programmatic and tiered environmental documents and programmatic biological opinions to facilitate efficient and effective environmental reviews process.

Background – Concept of Anthropogenic CO_2 Emissions and Storage



Study Objectives

- Determine potential human, marine, coastal environments that may be impacted by CO_2. Determine mechanisms for environmental impacts from CO_2. Determine potential impacts to these resources.
- Based on potentially impacted environmental resources, determine the most effective monitoring methods and protocols that may be implemented during each phase of a CCUTS project, pre-injection, during injection, and post-injection.
- Determine pathways and mechanisms for CO_2 impacts. Determine the best monitoring methods and protocols for tracking the CO_2 plume and pressure front during and after injection operations.
- Synthesize information for use in the current rulemaking, new program development, and programmatic and regional level environmental analyses that will assess the potential impacts of CCUTS activities on the marine and human environment.
- Guide development of future environmental studies that would address information gaps.

Background – Concept of CO_2 Plume Migration

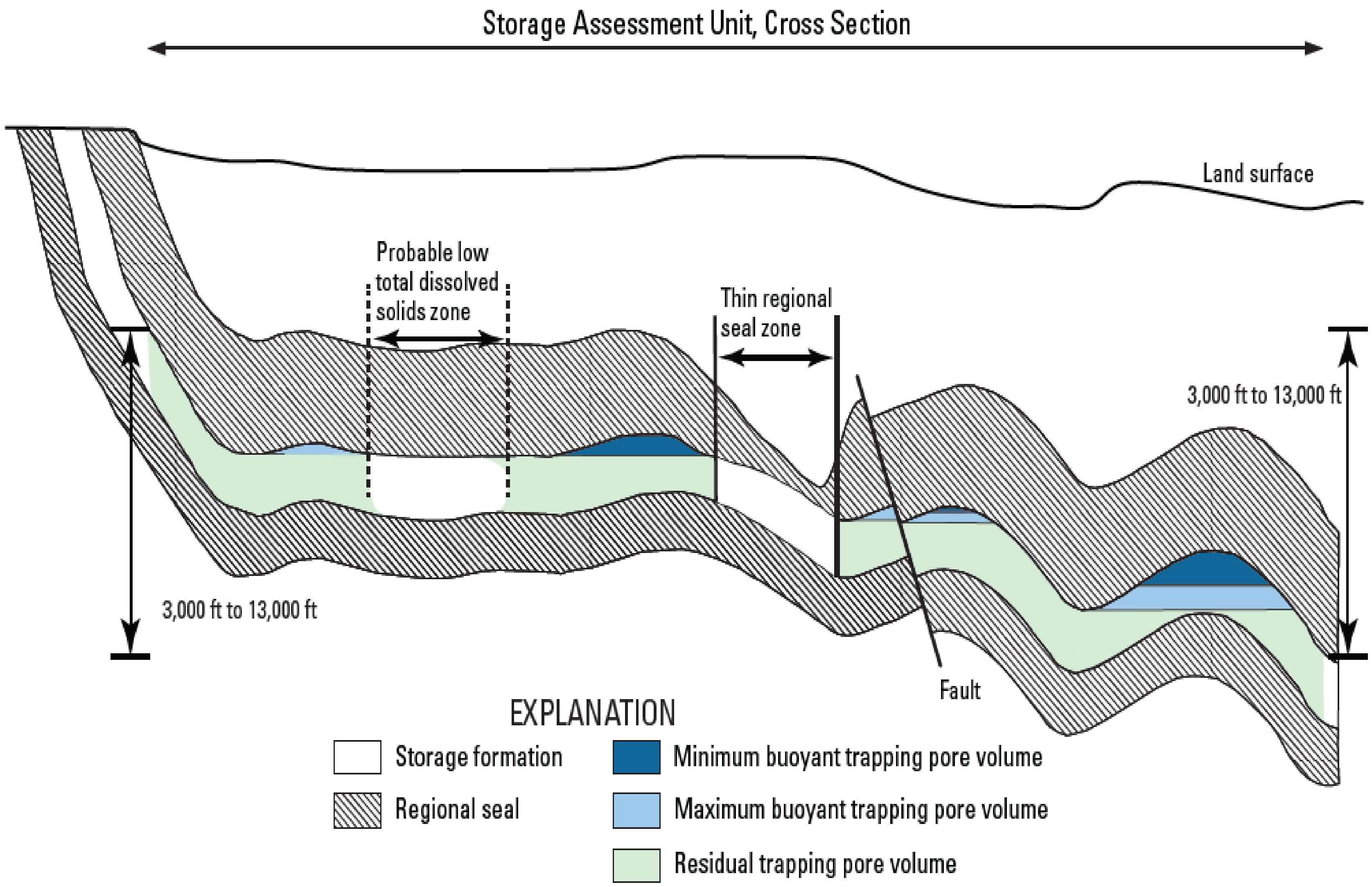
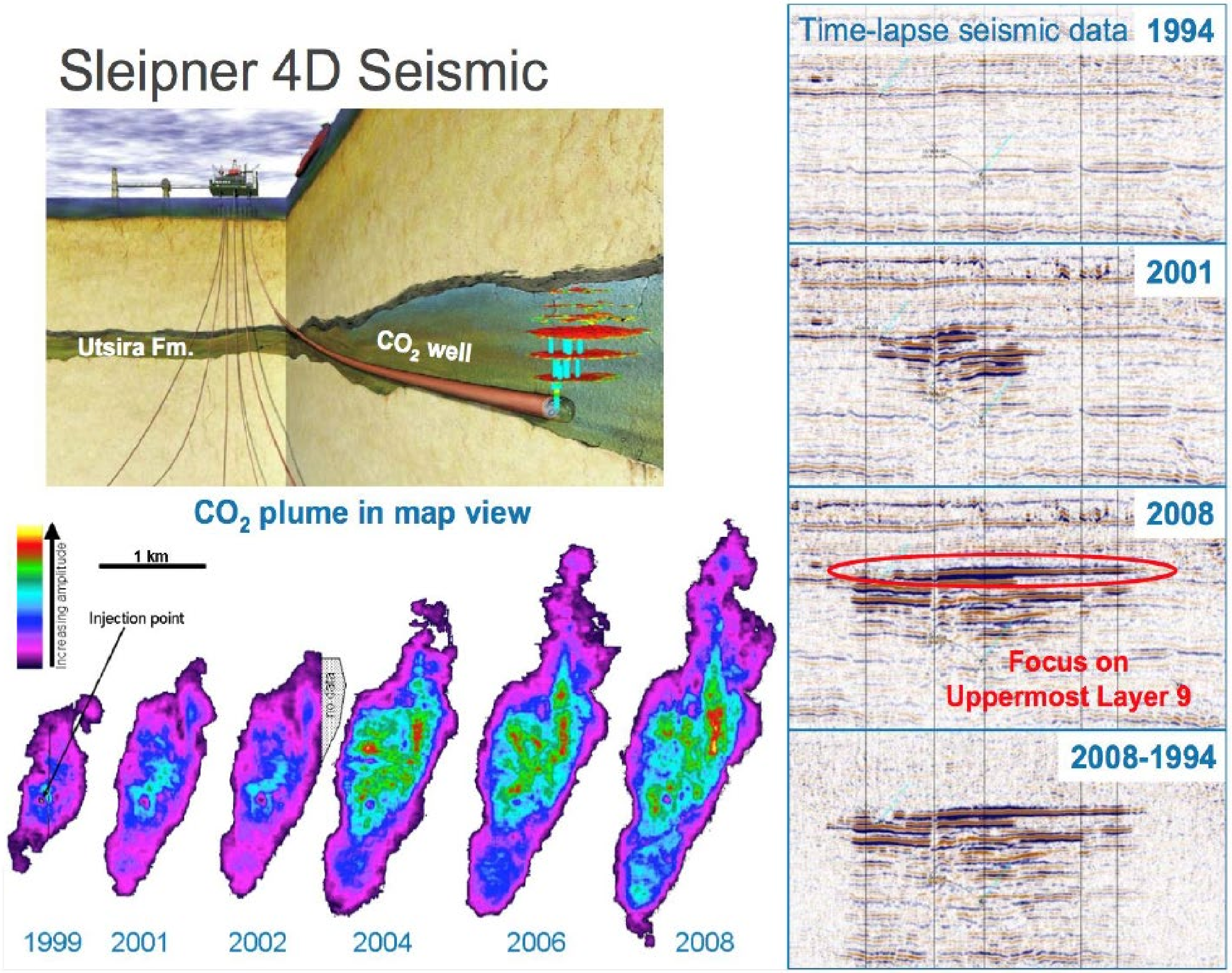


Figure 4. Schematic cross section through a storage assessment unit (SAU) illustrating the relation between buoyant and residual trapping types in the storage formation (SF). The SAU minimum depth limit of 3,000 feet (914 meters, or almost 1 kilometer) ensures that carbon dioxide (CO_2) is in a supercritical state to maximize the storage resource per unit volume. A depth of 13,000 ft (3,962 m, or almost 4 km) is the lower limit accessible with average injection pressures and is the lower limit for a standard SAU. A deep SAU can be defined for depths greater than 13,000 ft (3,962 m) if favorable reservoir conditions exist. The lateral limit of the SAU is defined by the location where the top of the storage formation reaches the defined depth limit. Also shown are zones that may be excluded from an SAU because the regional seals are thin or because water in the storage formation is probably low in total dissolved solids (TDS less than 10,000 milligrams per liter). Modified from Brennan and others (2010) and Blondes, Brennan, and others (2013).

USGS Circular 1386
National Assessment of Geologic Carbon Dioxide Storage Resources—Results

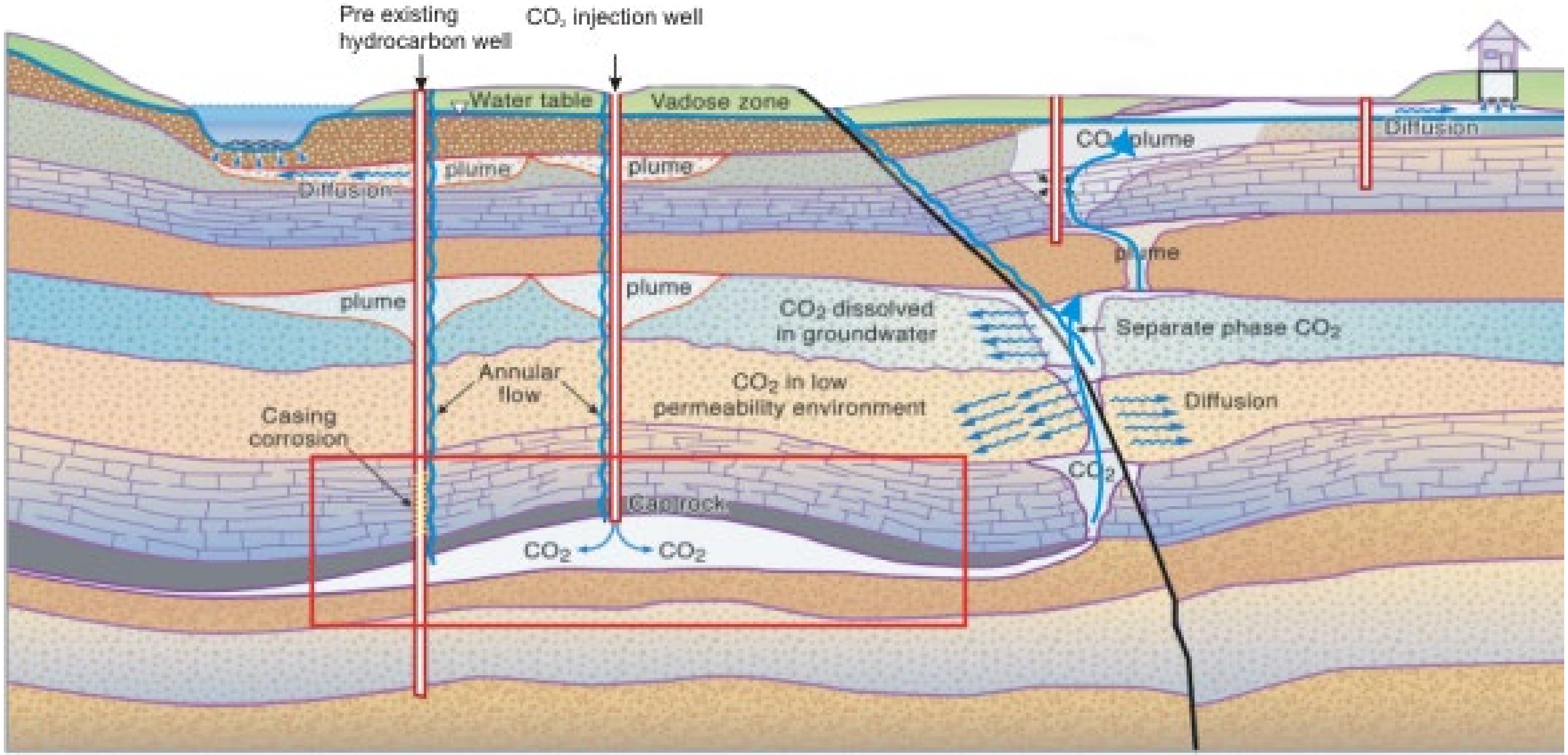
Background – Concept of CO_2 Plume Migration



DOE GEOPHYSICAL TECHNIQUES FOR CO2 PLUME MONITORING TECHNICAL REPORT (2017)

Figure 1.2. 4D seismic monitoring for the Sleipner storage project. Upper left shows a schematic of the injection into the Utsira formation with the rising buoyant CO_2 plume (blue and red). Right side figure shows a series of 2D vertical slices through the 3D data volume and through the injected CO_2 plume with the changing reflection amplitude clearly visible. The lower left is a series of horizon slices through the top layer containing CO_2 (layer 9 as indicated on the 2008 vertical slice) and plotted to show the interpreted extent of the amplitude change caused by CO_2 (purple, blue, green and red indicate different reflection amplitude changes). Figure courtesy P. Ringrose, see also Chadwick et al. (2010).

Background – Concept of CO_2 Potential Leakage Pathways



Leakage scenario diagram adapted from Sally Benson

Methods

- A **literature review and synthesis** will be conducted to:
  - Compile existing knowledge on **potential CCUTS impacts on the human and marine environment** over the lifetime of individual projects as well as the potential cumulative scenario of projects in each OCS Region.
  - Identify and determine the most effective **monitoring methods and protocols for human and environmental resources** for each phase of the project.
  - Identify and determine the most effective **monitoring methods and protocols for tracking the migration of the CO_2 plume and pressure front**.
  - Identify **relevant onshore technologies** that are translatable to the offshore.
  - Identify **information needs** to inform future BOEM studies to address gaps.

Research Questions

1. What information and data are currently available on the potential environmental impacts from offshore CCUTS activities on the human and marine environment?
2. What are the most effective monitoring methods and protocols for tracking the migration of the CO_2 plume and pressure front during the injection and post-injection phases of a CCUTS project? What are the mechanisms and pathways by which CO_2 may impact a resource?
3. What are the most effective monitoring methods and protocols for each potentially impacted human and environmental resources pre-injection and during injection and post-injection for CCUTS projects in each OCS Region (Atlantic, Gulf of Mexico, Pacific, Alaska)?
4. What information and data are currently available regarding potential environmental impacts and associated monitoring methods from CCUTS activities in the onshore environment that can be translated to the offshore environment?
5. What are the gaps in understanding potential environmental impacts from CCUTS activities on the human and marine environment?
6. What are the gaps in understanding that may affect the efficacy of monitoring protocols and methods for the CO_2 plume and pressure front as well as the environmental resources of the OCS?

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