DOE Award No.: DE-FE0023919

Quarterly Research Performance Progress Report

(Period Ending 06/30/22)

Deepwater Methane Hydrate Characterization & Scientific Assessment

Project Period 5: 10/01/20 - 09/30/22

Submitted by:

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DISCLAIMER

1 ACCOMPLISHMENTS

This report outlines the progress of the third quarter of the eighth fiscal year of the project (Budget Period 5, Year 2). Highlights from this period include:

- **UT-GOM2-1 Second Volume Published.**
  The second volume dedicated to UT-GOM2-1 results was published. Figure 1-1. shows a copy of the front cover. The volume included 10 papers, nine of which were written by GOM2 PIs and students. **See Section 1.2.2.2.7** Other – Publication and Presentation Work for more details.

Figure 1-1. Front cover of the second AAPG Bulletin dedicated to the work from UT-GOM2-1. See https://pubs.geoscienceworld.org/aapgbull/issue/106/5

1.1 Major Project Goals

The primary objective of this project is to gain insight into the nature, formation, occurrence and physical properties of methane hydrate-bearing sediments for the purpose of methane hydrate resource appraisal. This will be accomplished through the planning and execution of a state-of-the-art drilling, coring, logging, testing and analytical program that assess the geologic occurrence, regional context, and characteristics of marine methane hydrate deposits in the Gulf of Mexico Continental Shelf. Project Milestones are listed in Table 1-1, Table 1-2, and Table 1-3.

Table 1-1: Previous Milestones

Budget Period	Milestone	Milestone Description	Estimated Completion	Actual Completion	Verification Method
1	M1A	Project Management Plan	Mar-15	Mar-15	Project Management Plan
	M1B	Project Kick-off Meeting	Jan-15	Dec-14	Presentation
	M1C	Site Location and Ranking Report	Sep-15	Sep-15	Phase 1 Report
	M1D	Preliminary Field Program Operational Plan Report	Sep-15	Sep-15	Phase 1 Report
	M1E	Updated CPP Proposal Submitted	May-15	Oct-15	Phase 1 Report
	M1F	Demonstration of a Viable Pressure Coring Tool: Lab Test	Sep-15	Sep-15	Phase 1 Report
2	M2A	Document Results of BP1/Phase 1 Activities	Dec-15	Jan-16	Phase 1 Report
	M2B	Complete Updated CPP Proposal Submitted	Nov-15	Nov-15	QRPPR
	M2C	Scheduling of Hydrate Drilling Leg by IODP	May-16	May-17	Report directly to DOE PM
	M2D	Demonstration of a Viable Pressure Coring Tool: Land Test	Dec-15	Dec-15	PCTB Land Test Report, in QRPPR
	M2E	Demonstration of a Viable Pressure Coring Tool: Marine Test	Jan-17	May-17	QRPPR
	M2F	Update UT-GOM2-2 Operational Plan	Feb-18	Apr-18	Phase 2 Report
3	M3A	Document results of BP2 Activities	Apr-18	Apr-18	Phase 2 Report
	M3B	Update UT-GOM2-2 Operational Plan	Sep-19	Jan-19	Phase 3 Report
4	M4A	Document results of BP3 Activities	Jan-20	Apr-20	Phase 3 Report
	M4B	Demonstration of a Viable Pressure Coring Tool: Lab Test	Feb-20	Jan-20	PCTB Lab Test Report, in QRPPR
	M4C	Demonstration of a Viable Pressure Coring Tool: Land Test	Mar-20	Mar-20	PCTB Land Test Report, in QRPPR

Table 1-2: Current Milestones

Budget Period	Milestone	Milestone Description	Estimated Completion	Actual Completion	Verification Method
5	M5A	Document Results of BP4 Activities	Dec-20	Mar-21	Phase 4 Report
	M5B	Complete Contracting of UT-GOM2-2 with Drilling Vessel	May-21	Feb-22	QRPPR
	M5C	Complete Project Sample and Data Distribution Plan	Jul-22	Oct-21	Report directly to DOE PM
	M5D	Complete Pre-Expedition Permitting Requirements for UT-GOM2-2	Dec-21	-	QRPPR
	M5E	Complete UT-GOM2-2 Operational Plan Report	May-21	Sep-21	QRPPR
	M5F	Complete UT-GOM2-2 Field Operations	Jul-22	-	QRPPR

Table 1-3: Future Milestones

Budget Period	Milestone	Milestone Description	Estimated Completion	Actual Completion	Verification Method
6	M6A	Document Results of BP5 Activities	Dec-22	-	Phase 5 Report
	M6B	Complete Preliminary Expedition Summary	Dec-22	-	Report directly to DOE PM
	M6C	Initiate comprehensive Scientific Results Volume	Jun-23	-	Report directly to DOE PM
	M6D	Submit set of manuscripts for comprehensive Scientific Results Volume	Sep-24	-	Report directly to DOE PM

1.2 What Was Accomplishments Under These Goals

1.2.1 Previous Project Periods

Tasks accomplished in previous project periods (Phase 1, 2, 3, and 4) are summarized in Table 1-4, Table 1-5, Table 1-6, and Table 1-7.

Table 1-4: Tasks Accomplished in Phase 1

PHASE 1/BUDGET PERIOD 1	
Task 1.0	**Project Management and Planning**
Task 2.0	**Site Analysis and Selection**
Subtask 2.1	*Site Analysis*
Subtask 2.2	*Site Ranking / Recommendation*
Task 3.0	**Develop Operational Plan for UT-GOM2-2 Scientific Drilling Program**
Task 4.0	**Complete IODP Complimentary Project Proposal**
Task 5.0	**Pressure Coring and Core Analysis System Modifications and Testing**
Subtask 5.1	*PCTB Scientific Planning Workshop*
Subtask 5.2	*PCTB Lab Test*
Subtask 5.3	*PCTB Land Test Prep*

Table 1-5: Tasks Accomplished in Phase 2

PHASE 2/BUDGET PERIOD 2	
Task 1.0	**Project Management and Planning**
Task 6.0	**Technical and Operational Support of Complimentary Project Proposal**
Task 7.0	**Continued Pressure Coring and Core Analysis System Modifications and Testing**
Subtask 7.1	*Review and Complete NEPA Requirements for PCTB Land Test*
Subtask 7.2	*PCTB Land Test*
Subtask 7.3	*PCTB Land Test Report*
Subtask 7.4	*PCTB Modification*
Task 8.0	**UT-GOM2-1 Marine Field Test**
Subtask 8.1	*Review and Complete NEPA Requirements for UT-GOM2-1*
Subtask 8.2	*UT-GOM2-1 Operational Plan*
Subtask 8.3	*UT-GOM2-1 Documentation and Permitting*
Subtask 8.4	*UT-GOM2-1 Marine Field Test of Pressure Coring System*
Subtask 8.5	*UT-GOM2-1 Marine Field Test Report*
Task 9.0	**Develop Pressure Core Transport, Storage, and Manipulation Capability**
Subtask 9.1	*Review and Complete NEPA Requirements for Core Storage and Manipulation*
Subtask 9.2	*Hydrate Core Transport*
Subtask 9.3	*Storage of Hydrate Pressure Cores*
Subtask 9.4	*Refrigerated Container for Storage of Hydrate Pressure Cores*

Subtask 9.5	*Hydrate Core Manipulator and Cutter Tool*
Subtask 9.6	*Hydrate Core Effective Stress Chamber*
Subtask 9.7	*Hydrate Core Depressurization Chamber*
Task 10.0	**Core Analysis**
Subtask 10.1	*Routine Core Analysis (UT-GOM2-1)*
Subtask 10.2	*Pressure Core Analysis (UT-GOM2-1)*
Subtask 10.3	*Hydrate Core-Log-Seismic Synthesis (UT-GOM2-1)*
Task 11.0	**Update Science and Operational Plans for UT-GOM2-2 Scientific Drilling Program**
Task 12.0	**UT-GOM2-2 Scientific Drilling Program Vessel Access**

Table 1-6: Tasks Accomplished in Phase 3

PHASE 3/BUDGET PERIOD 3	
Task 1.0	**Project Management and Planning**
Task 6.0	**Technical and Operational Support of CPP Proposal**
Task 9.0	**Develop Pressure Core Transport, Storage, and Manipulation Capability**
Subtask 9.8	*X-ray Computed Tomography*
Subtask 9.9	*Pre-Consolidation System*
Task 10.0	**Core Analysis**
Subtask 10.4	*Continued Pressure Core Analysis (UT-GOM2-1)*
Subtask 10.5	*Continued Hydrate Core-Log-Seismic Synthesis (UT-GOM2-1)*
Subtask 10.6	*Additional Core Analysis Capabilities*
Task 11.0	**Update Science and Operational Plans for UT-GOM2-2 Scientific Drilling Program**
Task 12.0	**UT-GOM2-2 Scientific Drilling Program Vessel Access**
Task 13.0	**Maintenance and Refinement of Pressure Core Transport, Storage, and Manipulation Capability**
Subtask 13.1	*Hydrate Core Manipulator and Cutter Tool*
Subtask 13.2	*Hydrate Core Effective Stress Chamber*
Subtask 13.3	*Hydrate Core Depressurization Chamber*
Subtask 13.4	*Develop Hydrate Core Transport Capability for UT-GOM2-2 Scientific Drilling Program*
Subtask 13.5	*Expansion of Pressure Core Storage Capability for UT-GOM2-2 Scientific Drilling Program*
Subtask 13.6	*Continued Storage of Hydrate Cores from UT-GOM2-1*
Task 14.0	**Performance Assessment, Modifications, and Testing of PCTB**
Subtask 14.1	*PCTB Lab Test*
Subtask 14.2	*PCTB Modifications/Upgrades*
Task 15.0	**UT-GOM2-2 Scientific Drilling Program Preparations**
Subtask 15.1	*Assemble and Contract Pressure Coring Team Leads for UT-GOM2-2 Scientific Drilling Program*
Subtask 15.2	*Contract Project Scientists and Establish Project Science Team for UT-GOM2-2 Scientific Drilling Program*

Table 1-7: Tasks Accomplished in Phase 4

PHASE 4/BUDGET PERIOD 4	
Task 1.0	**Project Management and Planning**
Task 10.0	**Core Analysis**
Subtask 10.4	*Continued Pressure Core Analysis (GOM2-1)*
Subtask 10.5	*Continued Hydrate Core-Log-Seismic Synthesis (UT-GOM2-1)*
Subtask 10.6	*Additional Core Analysis Capabilities*
Subtask 10.7	*Hydrate Modeling*
Task 11.0	**Update Science and Operational Plans for UT-GOM2-2 Scientific Drilling Program**
Task 12.0	**UT-GOM2-2 Scientific Drilling Program Vessel Access**
Task 13.0	**Maintenance and Refinement of Pressure Core Transport, Storage, and Manipulation Capability**
Subtask 13.1	*Hydrate Core Manipulator and Cutter Tool*
Subtask 13.2	*Hydrate Core Effective Stress Chamber*
Subtask 13.3	*Hydrate Core Depressurization Chamber*
Subtask 13.4	*Develop Hydrate Core Transport Capability for UT-GOM2-2 Scientific Drilling Program*
Subtask 13.5	*Expansion of Pressure Core Storage Capability for UT-GOM2-2 Scientific Drilling Program*
Subtask 13.6	*Continued Storage of Hydrate Cores from UT-GOM2-1*
Subtask 13.7	*X-ray Computed Tomography*
Subtask 13.8	*Pre-Consolidation System*
Task 14.0	**Performance Assessment, Modifications, and Testing of PCTB**
Subtask 14.1	*PCTB Lab Test*
Subtask 14.2	*PCTB Modifications/Upgrades*
Subtask 14.3	*PCTB Land Test*
Task 15.0	**UT-GOM2-2 Scientific Drilling Program Preparations**
Subtask 15.3	*Permitting for UT-GOM2-2 Scientific Drilling Program*

1.2.2 Current Project Period

Current project period tasks are shown in Table 1-8.

Table 1-8: Current Project Tasks

PHASE 5/BUDGET PERIOD 5	
Task 1.0	**Project Management and Planning**
Task 10.0	**Core Analysis**
Subtask 10.4	*Continued Pressure Core Analysis (UT-GOM2-1)*
Subtask 10.5	*Continued Hydrate Core-Log-Seismic Synthesis (UT-GOM2-1)*
Subtask 10.6	*Additional Core Analysis Capabilities*
Subtask 10.7	*Hydrate Modeling*
Subtask 10.8	*Routine Core Analysis (UT-GOM2-2)*
Subtask 10.9	*Pressure Core Analysis (UT-GOM2-2)*
Subtask 10.10	*Core-log-seismic Integration (UT-GOM2-2)*
Task 11.0	**Update Science and Operational Plans for UT-GOM2-2 Scientific Drilling Program**
Task 12.0	**UT-GOM2-2 Scientific Drilling Program Vessel Access**
Task 13.0	**Maintenance and Refinement of Pressure Core Transport, Storage, and Manipulation Capability**
Subtask 13.1	*Hydrate Core Manipulator and Cutter tool*
Subtask 13.2	*Hydrate Core Effective Stress Chamber*
Subtask 13.3	*Hydrate Core Depressurization Chamber*
Subtask 13.4	*Develop Hydrate Core Transport Capability for UT-GOM2-2 Scientific Drilling Program*
Subtask 13.5	*Expansion of Pressure Core Storage Capability for UT-GOM2-2 Scientific Drilling Program*
Subtask 13.6	*Continued Maintenance and Storage of Hydrate Pressure Cores from UT-GOM2-1*
Subtask 13.7	*Maintain X-ray CT*
Subtask 13.8	*Maintain Preconsolidation System*
Subtask 13.9	*Transportation of Hydrate Core from UT-GOM2-2 Scientific Drilling Program*
Subtask 13.10	*Storage of Hydrate Cores from UT-GOM2-2 Scientific Drilling Program*
Subtask 13.11	*Hydrate Core Distribution*
Task 14.0	**Performance Assessment, Modifications, and Testing of PCTB**
Subtask 14.4	*PCTB Modifications/Upgrades*
Subtask 14.5	*PCTB Land Test III*
Task 15.0	**UT-GOM2-2 Scientific Drilling Program Preparations**
Subtask 15.3	*Permitting for UT-GOM2-2 Scientific Drilling Program*
Subtask 15.4	*Review and Complete NEPA Requirements*
Subtask 15.5	*Finalize Operational Plan for UT-GOM2-2 Scientific Drilling Program*
Task 16.0	**UT-GOM2-2 Scientific Drilling Program Field Operations**
Subtask 16.1	*Mobilization of a Scientific Ocean Drilling and Pressure Coring Capability*
Subtask 16.2	*Field Project Management, Operations and Research*
Subtask 16.3	*Demobilization of Staff, Labs, and Equipment*

1.2.2.1 Task 1.0 – Project Management & Planning

Status: Ongoing

- **Coordinate the overall scientific progress, administration and finances of the project:**
    - UT continued to monitor budget, scope, and schedule implications as a result of the delayed UT-GOM2-2 field program and communicate with the DOE project manager.
    - UT began planning and preparing to submit a budget period transition proposal to DOE in the next performance period (Y8Q4).
        1. UT held a web-conference with US DOE/NETL on April 14, 2022. UT presented an update on the project status, identified challenges and risks, proposed solutions, and presented an integrated plan forward to execute the UT-GOM2-2 field program in 2023.
        2. UT held a web-conference with the US DOE/NETL project manager on May 25, 2022 to plan the budget period transition. UT presented a plan to extend the current budget period, BP5, one additional year so that the UT-GOM2-2 field program could be performed within BP5. UT also proposed a minimal UT-GOM2-2 field program that can be accomplished with current funding, with a range of options for the program that could be performed within a range of funding requirements.
        3. UT submitted preliminary modification documents including a range of options for the UT-GOM2-2 field program with a wide range of funding requirements.

- **Communicate with project team and sponsors:**
    - Organized sponsor and stakeholder meetings.
    - Organized task-specific working meetings to plan and execute project tasks per the Project Management Plan and Statement of Project Objectives.
    - Managed SharePoint sites, email lists, and archive/website.

- **Coordinate and supervise service agreements:**
    - UT continued contractual discussions with Geotek for UT-GOM2-2 field operations.
    - UT held a meeting with Geotek on April 28, to clarify the plan forward and discuss the contractual scope of work, cost, terms, and conditions.
    - UT developed draft contract documents, and initiated the formal contract review process at UT.
    - UT continued to hold recurring technical/science meetings with Geotek to identify and address science and engineering challenges pertaining to UT Pressure Core Center and field science program for the UT-GOM2-2 Scientific Drilling Program.

- **Coordinate subcontractors:**
    - UT continued to monitor and control contractor efforts and scopes of work. All Sub submitted preliminary budgets for the proposed GOM2 modification package.

1.2.2.2 Task 10.0 – Core Analysis

Status: Ongoing

1.2.2.2.1 Subtask 10.4 – Continued Pressure Core Analysis (UT-GOM2-1)

A. Pressurized Core Analysis

A1. Strengthening pressure core analyses capabilities

- Geomechanical experiments, under uniaxial strain conditions, on pressure cores are very challenging to perform. Samples need to be accessed and manipulated remotely in pressurized vessels. Core degrades with time resulting in a decrease in sample diameter; this is challenging because the equipment is designed to perform best at the original diameter. Finally, it is difficult to achieve hydraulic seals in the grit-loaded environment that is present.
- UT continues to conduct benchmark studies using resedimented Boston Blue Clay (RBBC) in the Effective Stress Chamber to validate test protocols applicable to hydrate-bearing sediments. The properties of these RBBC artificial samples are well-known and can be carefully controlled. The goal of these studies is to identify test procedures that result in more precise and expeditious measurements.
- UT conducted six uniaxial strain compression tests on RBBC. These tests validated measurements using our new gearbox to achieve higher axial loads with controlled displacement. We tested our protocol to maintain uniaxial strain conditions under these high stress conditions.
- Subtask 13.2 Hydrate Core Effective Stress Chamber expands on these results.

1.2.2.2.2 Subtask 10.6 – Additional Analysis Capabilities

- Oregon State refined methods for characterizing microbes collected in Gulf of Mexico sediments and distinguishing these microbes from contamination that may occur during sample handling. Strategies for reducing such contamination are also being explored. Oregon State further optimized methods for extracting DNA from low biomass samples including an experiment to determine how to optimize DNA extraction from clays. A number of DNA samples were submitted for sequencing, and this sequencing was underway as the quarter ended.
- University of Washington continued with the development/refinement of analytical methods to quantify trace metal concentrations and ligands in marine sediment pore water, conducting initial tests of the new methods for detection limits, concentration ranges, precision, and accuracy. Based on the results of these initial tests, the method will be refined slightly, and they will begin analyzing samples collected during the GOM2-1 expedition
- University of New Hampshire continued work on their new *Elementar* CHNS Elemental Analyzer. UNH prepared and ran 30 replicates of a new CHNS lab standard from homogenized marine sediments

collected from the Great Bay Estuary, NH. They are also exploring the use of USGS Denver officer newly developed shale standard materials for additional testing at UNH.

1.2.2.2.3 Subtask 10.7 – Hydrate Modeling

- Comparison of pressure core images from the expedition in 2017 and after two years of storage reveals various amount of core degradation (core diameter shrinkage) within the hydrate-bearing sandy silt biscuits (Figure 1-2). We propose that core degradation is primarily caused by methane hydrate dissolution driven by dissolved methane diffusion from the pore water within the core to the surrounding methane-free drilling and storage water during long-term storage.
- UT developed a two-dimensional radial symmetric numerical model to simulate the core degradation based on the above hypothesis, and applied the numerical model to pressure core 8FB-1 (Figure 1-3). 8FB-1 is 60.9 cm in length and 4.5 cm in diameter. It is collected from the main methane hydrate reservoir at GC 955 at the depth of ~434 mbsf. 8FB-1 contains 7 biscuits. The top biscuit during storage is sandy silt with a length of ~4.9 cm. The bottom two biscuits are also sandy silts with a total length of ~36 cm. The rest are clayey silt. 8FB-1 is untouched since the collection and storage in 2017 until Spring 2021 when two water samples were collected from the top for chemical analysis.
- During storage, there is a concentration gradient of dissolved methane from the pore water in the core to the surrounding drilling water and storage water. This drive dissolved methane to diffuse from the pores of the core to the drilling and storage water with time. Methane hydrate dissolves to maintain the pore water dissolved methane concentration equaling the solubility. As a result, methane hydrate saturation gradually decreases from the top and radial edge of the core with time (Figure 1-3). Dissolved methane concentration gradually increases in the drilling and storage fluid. After 2 years of storage, hydrate disappeared from the radial edge at the top (Figure 1-3b). The total volume of hydrate loss equals 13.8 mL. Dissolved methane concentration reaches 34.9 mmol/kg and 75.7 mmol/kg, respectively, in the storage fluid at the top and bottom of the chamber. Salinity reaches 0.3 wt.% and 2.42 wt.%, respectively, in the storage fluid at the top and bottom of the chamber. Hydrate dissolution rate decreases with time as the concentration gradient of dissolved methane decreases. After another 2 years of storage (Figure 1-3c: 4 year), an additional amount of 3.2 mL hydrate disappeared from the core. At 6 year (Figure 1-3d), there is a total amount of 18.8 mL hydrate dissolution from the top and radial edge of the core (1.8 mL increment from 4 year). However, hydrate losses from the outer edge of the core, and the inner core still has a high hydrate saturation of ~90%. The system still does not reach a steady state given the concentration gradient of the dissolved methane and salinity at 6 year. The maximum amount of hydrate that could dissolve is 21.5 mL at steady state, corresponding to a maximum core volume loss of 59.7 mL.
- The predicted the volume of hydrate loss and the pore water dissolved methane concentration match the observations from core imaging and measured pore water methane concentration.

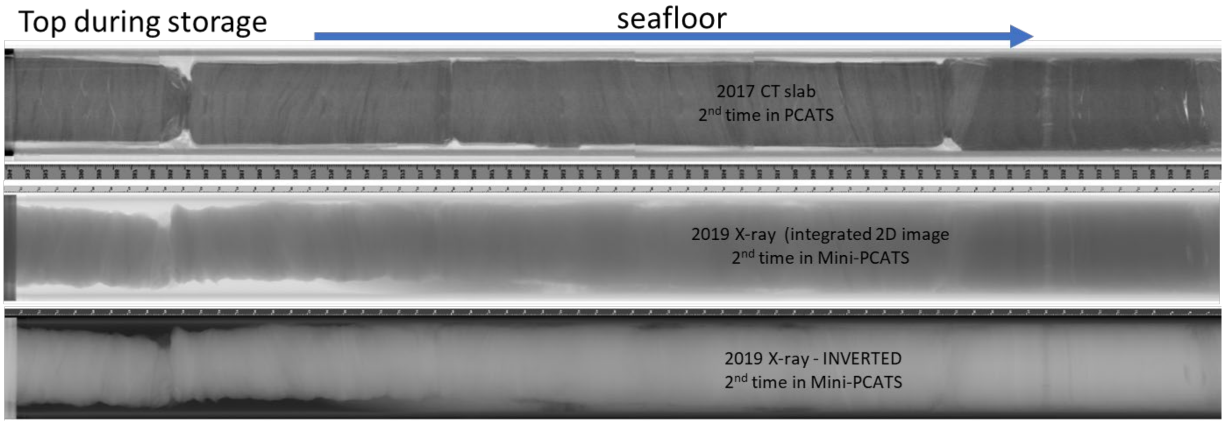
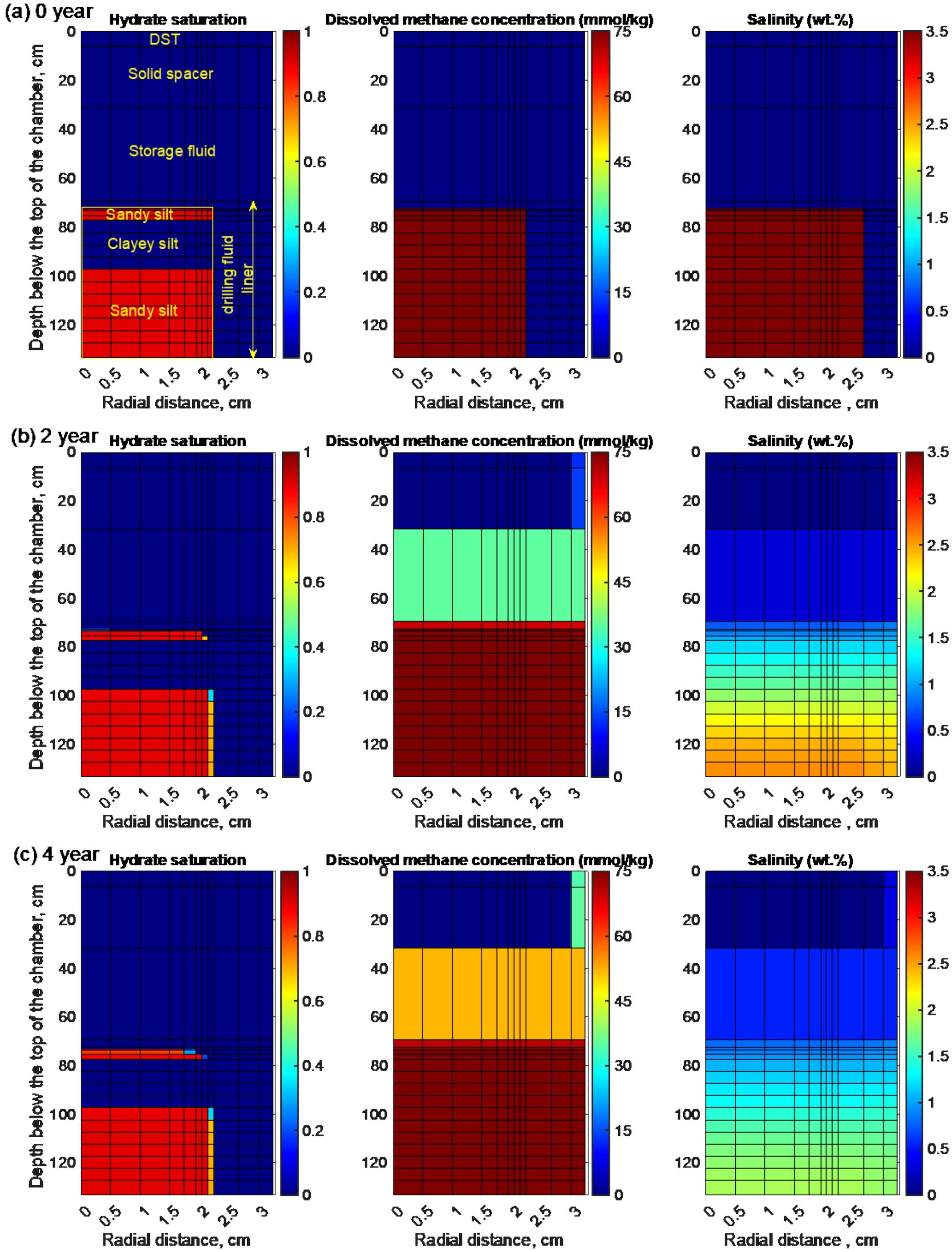


Figure 1-2: Images of the downside 77 cm core section H005-05FB-3 from before and after storage. Top image: CT 3D) cross section (slab section) of the bottom 77 cm of 5FB-3 taken using PCATS during the expedition in May of 2017. Lower density is bright and higher density is dark. Biscuits Interbedded layers of sandy silt and clayey silt are evident. Core outer edge is cleanly cut. Bottom most biscuit of sandy silt (far left) is slight smaller that higher up the core. Middle: X-ray (2D) image of the bottom 77 cm of 5FB-3 taken using Mini-PCATS after 2 years of storage in June of 2019 during which time the storage fluid was fully replace once. Lower density is bright and higher density is dark. Bottom image: X-ray (2D) image of the bottom 77 cm of 5FB-3 taken using Mini-PCATS after 2 years of storage in June of 2019 during which time the storage fluid was fully replace once. Higher density is bright and lower density is dark. The core edge after storage, especially at the very bottom (far left), is ratty and shrunken. Sediment appears to have fallen away and collected in the water between the core and the core liner. Clayey silt biscuit (far right) appears to have little to no radial loss.



(a) 0 year
Hydrate saturation
DST
Solid spacer
Storage fluid
Sandy silt
Clayey silt
Sandy silt
drilling fluid liner
Depth below the top of the chamber, cm
Radial distance, cm
Dissolved methane concentration (mmol/kg)
Salinity (wt.%)
(b) 2 year
(c) 4 year

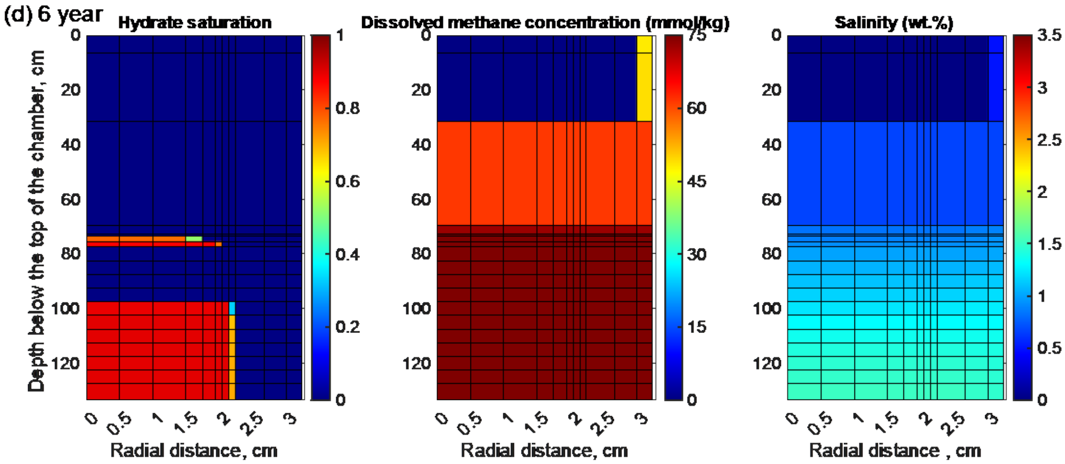


Figure 1-3: Simulated hydrate saturation, dissolved methane concentration and salinity at (a) 0 year, (b) 2 year, (c) 4 year, and (d) 6 year of storage for core 8FB-1.

1.2.2.2.4 Subtask 10.8 – Routine Core Analysis (UT-GOM2-2)

- Future Task.

1.2.2.2.5 Subtask 10.9 – Pressure Core Analysis (UT-GOM2-2)

- Future Task.

1.2.2.2.6 Subtask 10.10 – Core-log-seismic Integration (UT-GOM2-2)

- No Updates.

1.2.2.2.7 Other – Publication and Presentation Work

- AAPG Bulletin GC 955 dedicated Volume 2 and volume introduction was published. [Volume 106 Issue 5 | AAPG Bulletin | GeoScienceWorld]

Table 1-9: AAPG Vol 106, Issue 5

Primary Author	Reference
Flemings, Cook	Gas hydrates in Green Canyon Block 955, deep-water Gulf of Mexico: Part II, Insights and future challenges https://doi.org/10.1306/bltnintro030922
Oti	Using X-ray Computed Tomography (XCT) to Estimate Hydrate Saturation in Sediment Cores from Green Canyon 955, northern Gulf of Mexico https://doi.org/10.1306/05272120051
Moore	Integrated geochemical approach to determine the source of methane in gas hydrate from Green Canyon Block 955 in the Gulf of Mexico https://doi.org/10.1306/05272120087

Daigle	Pore structure of sediments from Green Canyon 955 determined by mercury intrusion https://doi.org/10.1306/02262120123
Wei	Methane migration mechanisms for the Green Canyon Block 955 gas hydrate reservoir, northern Gulf of Mexico https://doi.org/10.1306/06022120134
Santra	Occurrence of High-Saturation Gas Hydrate in a Fault-Compartmentalized Anticline and the Role of Seal- Green Canyon, Abyssal Gulf of Mexico https://doi.org/10.1306/08182120149
Yoneda	Comprehensive pressure core analysis for hydrate-bearing sediments from Gulf of Mexico Green Canyon Block 955, including assessments of geomechanical viscous behavior and NMR permeability https://doi.org/10.1306/04272120204
Fang	Permeability of methane hydrate-bearing sandy silts in the deepwater Gulf of Mexico (Green Canyon block 955) https://doi.org/10.1306/08102121001
Fang	Compression behavior of hydrate-bearing sediments https://doi.org/10.1306/01132221002
Phillips	Thermodynamic insights into the production of methane hydrate reservoirs from depressurization of pressure cores https://doi.org/10.1306/08182120216

- Ohio State submitted a manuscript on their machine learning results for JGR-Solid Earth, entitled, Estimating P-wave Velocity and Bulk Density in Near-seafloor Sediments Using Machine Learning. The submission uses all of the JIP Leg 2 logging-while-drilling data, Holes WR313-H and WR313-G in the Terrebonne Basin, to predict compressional velocity and bulk density with high accuracy. The results were summarized in the last quarterly report.

1.2.2.3 Task 11.0 – Update Science and Operations Plans for UT-GOM2-2 Scientific Drilling Program

Status: Complete (Milestones 5C, 5E)

1.2.2.4 Task 12.0 – UT-GOM2-2 Scientific Drilling Program Vessel Access

Status: Complete (Milestone 5B)

- UT started reviewing and updating specifications for quotes from the various third-party offshore subcontractors for a 2023 expedition. UT is providing specification guidance to Helix regarding required services, materials, equipment, and personnel. Helix will negotiate nineteen contracts on UT's behalf.

1.2.2.5 Task 13.0 – Maintenance & Refinement of Pressure Core Transport, Storage, & Manipulation Capability

Status: UT conducted a new core degradation simulation on pressure core 8FB-1 (see subtask 10.7), collected new pore water samples for chemical analysis (see Table 1-10), and is analyzing core volume loss by comparing the CT images collected in 2017 and 2019 in ImageJ now.

- UT continues to make progress on understanding the mechanisms and extent of core degradation during high pressure storage in fresh water. Work continues on extracting samples of storage fluid from high pressure chambers. The method of storage fluid extraction was refined. New samples were extracted from the top and bottom of two pressure chambers, analyzed for salinity and dissolved methane concentration as shown in Table 1-10. Results were compared to the initial storage fluid condition (0 ppt salinity and 0 mol/kg of methane), pore water salinity (estimated by quantitative degassing to be equivalent to seawater at 3 ppt), and methane saturation (7.50 x 10^{-2} mol/kg). Results confirm that the storage fluid has not reached equilibrium (storage fluid is still not saturated with methane), meaning that the cores are still degrading but degrading very slowly (over many years).

Table 1-10. Measured salinity and dissolved methane concentration of newly extracted storage fluid samples.

Pressure core name	5FB-2		8FB-1		8FB-2		8FB-3	
Sampling position	Top	Bottom	Top	Top	Top	Bottom	Top	Bottom
Gas volume collected (cm3)	4.3	8.5	2.7	8.6	3.2	5.8	10.2	12.4
Water mass collected (g)	7.0	7.2	3.8	7.6	7.4	6.9	7.0	7.0
Salinity (wt.%)	0	0.2	0.1	0.1	0.0	0.2	0.0	0.2
Experimental pressure (MPa)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Experimental temperature (°C)	6	6	25	25	25	25	25	25
Dissolved methane concentration (mmol/kg)	27.1	50.6	31.2	48.7	19.5	36.5	60.9	73.8
Methane solubility in storage chamber (mmol/kg)	75.9 ± 3.2	75.9 ± 3.2	75.9 ± 3.2	75.9 ± 3.2	75.9 ± 3.2	75.9 ± 3.2	75.9 ± 3.2	75.9 ± 3.2
Month/Year of sampling	02/22	02/22	05/21	06/21	02/22	02/22	06/22	06/22

- Previous simulations of core degradation have modeled a change in storage fluid salinity and dissolved methane concentration as a function of time and space (see Y7Q1 (Flemings, 2021a) or Y7Q2 (Flemings, 2021b)). These modeled changes are a result of dissolved methane diffusion and advection from the pore space into the fresh storage fluid, and loss of hydrate in the pore space of the exposed surfaces of the core. Modeling of the dissolved methane concentration and salt diffusion and advection expected after 15 months predicted dissolved methane concentrations around 5 x 10^{-2} mol/kg with low salinity at the top of the chamber and dissolved methane concentrations close to saturation with higher salinity at the bottom of the chamber. Measurements of the new sample are consistent with the model and further confirm our interpretation of the degradation mechanism being the loss of hydrate as methane is pulled into the fresh storage fluid, and that the degradation mechanism is slow and still occurring. The majority of the equipment to allow UT to create and exchange methane-charged water has been delivered to UT. The pressure vessel has been delivered after it had undergone a manufacturing delay. The next step is to fabricate a mobile stand for the vessel to begin assembly of the equipment in Q4, 2022.

1.2.2.5.1 *Subtask 13.1 – Hydrate Core Manipulator and Cutter Tool*

- The mini-PCATS system underwent a saw maintenance teardown. Seals and bearings were replaced and mini-PCATS sediment traps were cleaned. The new cutter retention plate was installed to prevent bent cutter wheel shafts.
- The X-ray system underwent quarterly calibration.
- The P-wave Velocity system underwent a calibration.
- Core H005-08FB-03 was brought into mPCATS.
    - Remainder of core cut and placed back into original storage chamber.
    - One sub-sample was cut from the remaining core in mPCATS and placed in an Effective Stress Chamber test section.

    Core 08FB-03-03 in Test Section 2. Test section was attached to the Hydrate Effective Stress Chamber.

1.2.2.5.2 *Subtask 13.2 – Hydrate Core Effective Stress Chamber*

A focus of the last year has been to refine our experimental approach to studying permeability and compression behavior under uniaxial strain. These steps are summarized below. Broadly, a series of incremental steps have been made to better control the experiments.

- Previously, we assumed that the confining fluid and the cell were incompressible and thus that no lateral strain occurred during vertical deformation. In fact, due to the system compressibility there was some lateral strain. We have revised our approach to better achieve uniaxial strain. UT now routinely conducts uniaxial strain compression tests using a procedure that considers the axial and the volumetric strain. We estimate the volume strain from the pore fluid expelled, we know the vertical displacement, and we adjust the confining pressure to maintain uniaxial strain ($\Delta V_{uniaxial} = A_{sample}\ \Delta L$).
- Previously, we could not precisely measure the vertical displacement precisely above 5 MPa. To measure displacement at higher effective stresses, we installed a new 100 kN load cell and a new gearbox ratio. This allows higher axial loading on the sample via mechanical operation. We tested these upgrades using six resedimented Boston Blue Clay (RBBC) samples and compare experimental results with benchmark datasets.

- Figure 1-4 only shows the last of these tests (RBBC-15). We conducted two loading cycles in sample RBBC-15. The second loading cycle tests an initial stiffer specimen (similar to a pressure core). Results show accurate values for the RBBC-15 during the test; therefore, we expect good performance of the tool when testing pressure cores at high stresses.
- We are now focusing on whether system compressibility is causing us to over-estimate the vertical displacement. UT conducted calibration tests at high stresses using a steel sample. Results revealed that equipment deformation can cause errors in the estimates of sample length and hence errors of estimated pore volume expelled of up to ~10%. UT will continue to conduct calibration tests to obtain accurate data and implement new pump modes that correct for these effects.
- We are also focusing on making a 'production test' on a hydrate-bearing sample. A key variable for our effort is the temperature of the sample. UT received a custom-made temperature monitoring system and sensors from Geotek for the UT effective stress chamber to measure the temperature directly. This new capability allows us to track temperature inside the sample and confining chambers.

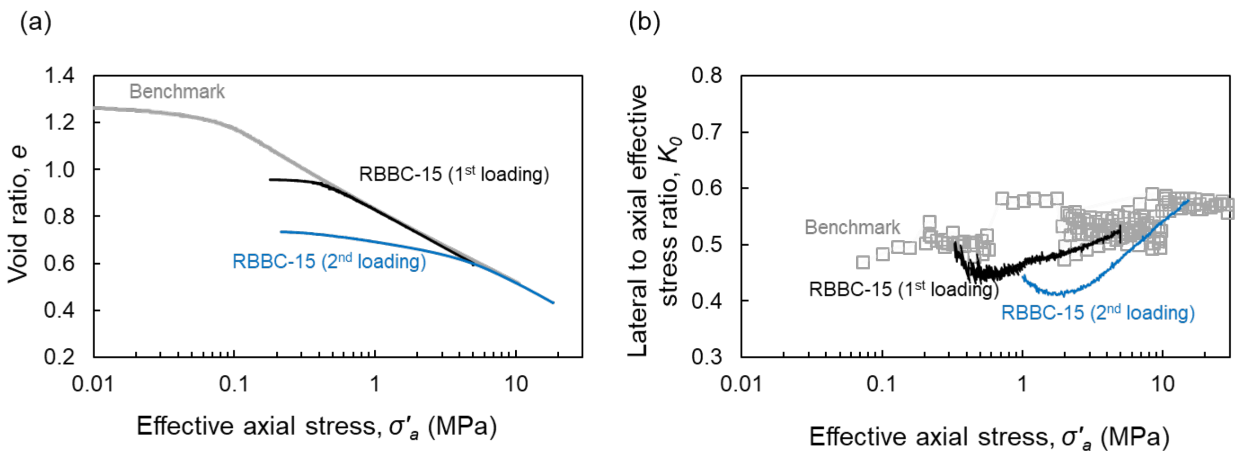


Figure 1-4: Resedimented Boston Blue Clay (RBBC) (a) compression and (b) lateral to axial effective stress ratio data for samples RBBC-15.The 2nd loading for sample RBBC-15 validates the performance of the UT Effective Stress Chamber for stiffer samples (similar to pressure cores).

1.2.2.5.3 Subtask 13.3 – Hydrate Core Depressurization Chamber

- The system underwent maintenance and cleaning.

1.2.2.5.4 Subtask 13.4 – Develop Hydrate Core Transport Capability for UT-GOM2-2

- UT has negotiated with Geotek to perform transport of hydrate-bearing pressure cores that will be recovered during UT-GOM2-2 to the UT Austin Pressure Core Center. Geotek has developed the required technology and resources, and maintains valid DOT permits for pressure core transport operations.

1.2.2.5.5 Subtask 13.5 – Expansion of Pressure Core Storage Capability for UT-GOM2-2

- After obtaining and evaluating a single example of the new design, UT has determined that the base needs to be enlarged slightly to ensure proper access to pressure chamber valves and pressure relief lines. A refined design will be produced and sent out for updated quotes. UT continues to evaluate the quad base design for long-term feasibility in terms of pressure maintenance access and pressure relief.
- Expansion of pressure maintenance system is required to increase storage capability sufficient to receive UT-GOM2-2 cores. UT has obtained a finalized quote for additional pressure maintenance manifolds. Expansion of pressure safety venting system will also be required. UT has obtained a finalized quote for additional venting lines. UT continues to evaluate how to streamline the expansion of the pressure maintenance system and venting system.
- Evaluation and maintenance testing of methane monitoring system and possible expansion being explored.

1.2.2.5.6 Subtask 13.6 – Continued Storage of Hydrate Cores from UT-GOM2-1

- Core storage expansion in the PCC is anticipated to accommodate any remaining pressure cores acquired from UT-GOM2-1, even when additional cores are collected during UT-GOM2-2 and transferred to the PCC. UT is undergoing preparation to ship ten, pressure core storage chambers to Geotek in Q4, 2022. This shipment will allow more open storage space for the remaining cores from UT-GOM2-1 and the anticipated cores from UT-GOM2-2.

1.2.2.5.7 Subtask 13.7 – X-ray Computed Tomography

- The X-Ray CT continues to operate as designed.
- During this period, the system was calibrated.
- The Dell Image Reconstruction computer continues operate properly after undergoing warranty repair in the previous quarter.

1.2.2.5.8 Subtask 13.8 – Pre-Consolidation System

UT conducted a long-term test (5 days) on the pre-consolidation system attached to the Effective Stress Chamber. This test is the result of repaired hydraulic accumulators that were fixed in the last quarter. The test used a steel dummy sample and applied pressure and effective stresses expected in pressure core conditions. Test results indicate a successful pressure maintenance throughout the entire 5 days. This suggests the preconsolidation system can be used to store pressure cores with effective stresses applied in both axial and confining directions.

1.2.2.5.9 Subtask 13.9 – Transportation of Hydrate Core from UT-GOM2-2 Scientific Drilling Program

Future Task.

1.2.2.5.10 Subtask 13.10 – Storage of Hydrate Cores from UT-GOM2-2 Scientific Drilling Program
Future Task.

1.2.2.5.11 Subtask 13.11 – Hydrate Core Distribution
Future Task.

1.2.2.6 Task 14.0 – Performance Assessment, Modifications, And Testing of PCTB

Status: Complete

1.2.2.6.1 Subtask 14.4 – PCTB Modifications/Upgrades
Status: Complete

1.2.2.6.2 Subtask 14.5 – PCTB Land Test III
Status: Complete

1.2.2.7 Task 15.0 – UT-GOM2-2 Scientific Drilling Program Preparations

Status: In Progress

1.2.2.7.1 Continued Development of WR 313 Geology & Geohazards

- In collaboration with Bureau of Economic Geology (BEG), UT completed salt basin restoration for the Terrebonne Basin. Based on salt basin restoration, UT has performed 2D time-transient hydromechanical and thermal modeling along two transects crossing the Terrebonne basin (Figure 1-5).
- Based on the coupled hydromechanical and geothermal models, UT has predicted zones of significant pore overpressure (Figure 1-5A) and low temperature (Figure 1-5B) due to rapid sedimentation rates (~1-5 mm/yr) established in the central part of the Terrebonne basin during Plio-Pleistocene.
- Ut has completed gas hydrate stability zone modeling along the selected 2D transects in the Terrebonne basin. A major conclusion is that due to the rapid sedimentation, Terrebonne depositional system is not at temperature and pressure equilibrium, which results in ~3 times deeper base of GHSZ compared to a similar system if it was at equilibrium (i.e. at sed. rates <~0.5 mm/yr) (Figure 1-5).

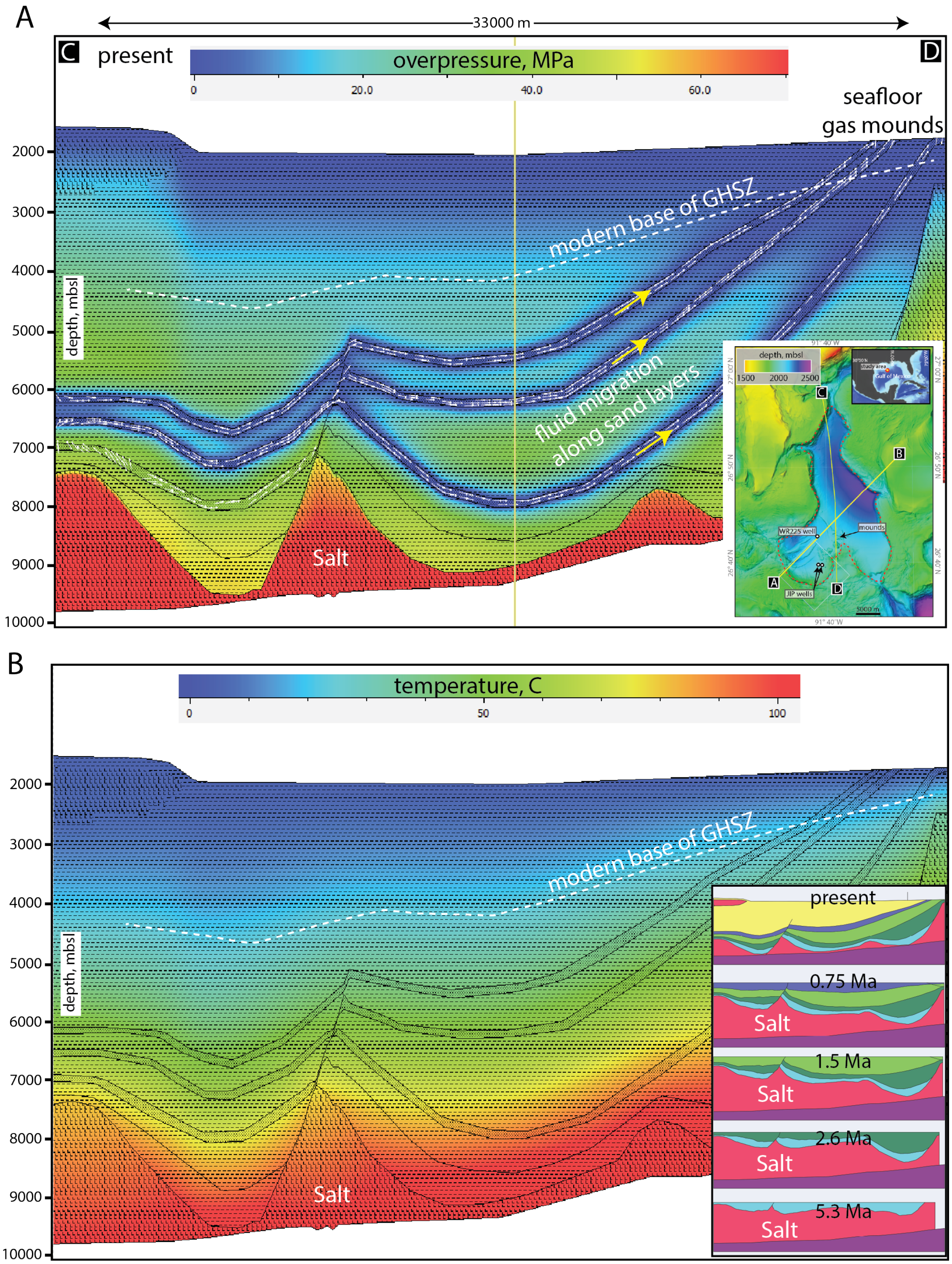


Figure 1-5: A) Modern pore overpressure along the transect C-D crossing Terrebonne basin from north to south (location in the inset). The model shows zones of high overpressure (20-40 Mpa) in the central Terrebonne driving fluid flow along permeable sand layers. B) Low sediment temperature predicted in the central Terrebonne basin due to rapid sedimentation rates is the main driver of the deep GHSZ base reaching 2000 mbsf. Inset shows salt basin restoration for 5 Ma-present time used in the transient 2D basin modeling.

- Lamont-Doherty Earth Observatory at Columbia University (LDEO) continued working on reaction-transport modeling of microbial methanogenesis. The focus is on developing an improved model of how microbes, which may be present only in discrete depth intervals, break down solid organic matter and eventually produce methane. The goal of this work is to assist in the interpretation of the geochemical and microbiological measurements that will be collected in the GOM2-2 drilling expedition.

1.2.2.7.2 Subtask 15.3 – Permitting for UT-GOM2-2 Scientific Drilling Program

- The status of permit submission and approval for the UT-GOM2-2 field program is shown in Table 1-11.
- UT is deferring submission of specific UT-GOM2-2 permits that are only valid for a limited term. These includes the BOEM Application for Permit to Conduct Geological or Geophysical Exploration for Mineral Resources or Scientific Research on the Outer Continental Shelf, Bureau of Safety and Environmental Enforcement (BSEE) Application for Permit to Drill (APD), the National Pollutant Discharge Elimination System (NPDES) Notice of Intent (NOI), and the US Coast Guard (USCG) Letter of Determination (LOD).

Table 1-11: UT-GOM2-2 Permit Status

AGENCY	REQUIREMENT	STATUS	TRACKING INFO
BOEM	Qualified Operator Certification	Approved 03/21/17	No. 3487
BOEM	BOEM Qualification Update	Approved 01/10/22	Dr. Daniel Jaffe, VPR
BOEM	Lease Bond	Approved 07/19/21	Bond No. ROG000193
BOEM	Right-of-Use and Easement (RUE)	Approved 11/12/21 Effective 02/11/22	OCS-G 30392
BOEM	Initial Exploration Plan	Approved 11/12/21	N-10162
BOEM	Permit to Conduct Geological or Geophysical Exploration for Mineral Resources or Scientific Research on the OCS	Complete – Submission deferred (only valid 1 year)	--
BSEE	Application for Permit to Drill (APD)	--	--
BSEE	Application for Permit to Modify (APM)	--	--
LDNR	CZM Consistency Cert.	Approved 11/05/21	C20210156
US CG	Letter of Determination (LOD)	--	--
US DOE	NEPA Environmental Questionnaire (EQ)	Approved 03/10/22	--
US EPA	NPDES Electronic Notice of Intent (eNOI)	--	--

1.2.2.7.3 Subtask 15.4 – Review and Complete NEPA Requirements

Status: In Progress

- A NEPA Categorical Exclusion for the UT-GOM2-2 field program was granted on Mar. 10, 2022.
- UT will complete a NEPA EQ for the dockside science location once confirmed by Helix.

1.2.2.7.4 Subtask 15.5 – Finalize Operational Plan for UT-GOM2-2 Scientific Drilling Program

Status: Complete (Milestones M5C, M5E)

1.2.2.8 Task 16.0 – UT-GOM2-2 Scientific Drilling Program Field Operations

Status: Future Task

1.2.2.8.1 Subtask 16.1 – Mobilization of Scientific Ocean Drilling and Pressure Coring Capability

Future Task.

1.2.2.8.2 Subtask 16.2 – Field Project Management, Operations, and Research

Future Task.

1.2.2.8.3 Subtask 16.3 – Demobilization of Staff, Labs, and Equipment

Future Task.

1.3 What Will Be Done In The Next Reporting Period To Accomplish These Goals

1.3.1 Task 1.0 – Project Management & Planning

- UT will submit a project modification to DOE in the next reporting period. The current Budget Period 5 (BP5) terminates on September 30, 2022. UT will propose to extend BP5 for one year, through September 30, 2023. UT will revise the Statement of Project Objectives and submit a formal request for project modification and continuation from FY23 through the end of the project.
- UT will continue to execute the project in accordance with the approved Project Management Plan and Statement of Project Objectives.
- UT will continue to manage and control project activities in accordance with their established processes and procedures to ensure subtasks and tasks are completed within schedule and budget constraints defined by the Project Management Plan.
- UT will execute contracts with third party contractors (e.g. Geotek) to perform UT-GOM2-2 in 2023.
- UT will review and analyze project budget and schedule implications for delaying the UT-GOM2-2 field program, and will notify the DOE Project Manager of findings and proposed a plan forward.

1.3.2 Task 10.0 – Core Analysis

- UT will continue analyzing the petrophysical and geomechanical properties of pressure cores using the UT Effective Stress Chamber. The updated and validated test protocols provide more reliable measurements.
- UT will simulate gas production using the UT Effective Stress Chamber. Similar to field conditions, these tests will maintain a constant total vertical stress under uniaxial strain conditions while samples are being dissociated. We will measure produced gas, lateral stress, compression and temperature throughout the entire test.
- UT will conduct geomechanical tests on reconstituted samples made of UT-GOM2-1 sandy-silt lithofacies material. These tests will be performed in traditional geotechnical systems and will help assess the effect of hydrate on the geomechanical behavior of these samples.
- Oregon State will continue working on improving DNA extraction techniques for UT-GOM2-2
- Ohio State with UT will continue developing reference hydrate saturation curves for UT-GOM2-2
- UT, Ohio State, UW, UNH, Oregon State, and Tufts will continue working on UT-GOM2-2 protocols and supply lists

1.3.3 Task 11.0 – Update Operations Plan for UT-GOM2-2 Scientific Drilling Program

- Task Complete

1.3.4 Task 12.0 – UT-GOM2-2 Scientific Drilling Program Vessel Access

- Task Complete

1.3.5 Task 13.0 – Maintenance And Refinement Of Pressure Core Transport, Storage, & Manipulation Capability

- The Mini-PCATS, PMRS, analytical equipment, and storage chambers will undergo continued observation and maintenance at regularly scheduled intervals and on an as-needed basis. Installation of new or replacement parts will continue to ensure operational readiness.
- UT will work with Geotek to install and test the new temperature sensors in the UT Effective Stress Chamber. In addition, UT and Geotek will modify the Geotek software (KayNought) to fix recurring software crashes and allow retrieval of the actuator during stress-hold tests.
- UT will work with the pump company to revise our protocol to conduct uniaxial strain tests to include equipment compressibility. This new version of the pump sequencer will correct for length and pore volume expelled associated to equipment deformation.
- UT will work to conduct atmospheric and pressurized tests of the new temperature monitoring capabilities of the UT Effective Stress Chamber.
- UT will work with Geotek to return ten of the core storage chambers to allow for opening up core storage capabilities in the UT Pressure Core Center in preparation for UT-GOM2-2.
- UT will begin assembly of the mobile stand for the methane-charged water equipment to test for the mitigation of core degradation.

1.3.6 Task 14.0 – Performance Assessment, Modifications, And Testing Of PCTB

- Task complete.

1.3.7 Task 15.0 – UT-GOM2-2 Scientific Drilling Program Preparations

- UT will continue to evaluate what amendments or modifications to currently approved permits will be required by BOEM as a result of shifting the UT-GOM2-2 expedition schedule from 2022-2023.
- Helix will continue to request quotes from various third-party subcontractors and UT will provide specification guidance to Helix regarding required services, materials, equipment, and personnel.
- UT will complete a NEPA Environmental Questionnaire for the dockside science location once it is confirmed by Helix.

1.3.8 Task 16.0 – UT-GOM2-2 Scientific Drilling Program Field Operations

- Future Task.

2 PRODUCTS

Project publications webpage: https://ig.utexas.edu/energy/gom2-methane-hydrates-at-the-university-of-texas/gom2-publications/

2.1 Publications

Boswell, R., Collet, T.C., Cook, A.E., Flemings, P.B., 2020, Introduction to Special Issue: Gas Hydrates in Green Canyon Block 955, deep-water Gulf of Mexico: Part I: AAPG Bulletin, v. 104, no. 9, p. 1844-1846, http://dx.doi.org/10.1306/bltnintro062320.

Chen, X., and Espinoza, D. N., 2018a, Ostwald ripening changes the pore habit and spatial variability of clathrate hydrate: Fuel, v. 214, p. 614-622. https://doi.org/10.1016/j.fuel.2017.11.065

Chen, X., Verma, R., Espinoza, D. N., and Prodanović, M., 2018, Pore-Scale Determination of Gas Relative Permeability in Hydrate-Bearing Sediments Using X-Ray Computed Micro-Tomography and Lattice Boltzmann Method: Water Resources Research, v. 54, no. 1, p. 600-608. https://doi.org/10.1002/2017wr021851

Chen, X. Y., and Espinoza, D. N., 2018b, Surface area controls gas hydrate dissociation kinetics in porous media: Fuel, v. 234, p. 358-363. https://doi.org/10.1016/j.fuel.2018.07.030

Chen, X.Y., Espinoza, D. N., Tisato, N., Flemings, P. B., in press, Gas Permeability, Pore Habit and Salinity Evolution during Methane Hydrate Dissociation in Sandy Sediments: Energy & Fuels, Manuscript ID: ef-2022-017204.R2

Cook, A. E., and Portnov, A., 2019, Gas hydrates in coarse-grained reservoirs interpreted from velocity pull up: Mississippi Fan, Gulf of Mexico: COMMENT: Geology, v. 47, no. 3, p. e457-e457. https://doi.org/10.1130/g45609c.1

Cook, A. E., and Sawyer, D. E., 2015, The mud-sand crossover on marine seismic data: Geophysics, v. 80, no. 6, p. A109-A114. https://doi.org/10.1190/geo2015-0291.1

Cook, A. E., and Waite, W. F., 2018, Archie's Saturation Exponent for Natural Gas Hydrate in Coarse-Grained Reservoirs, v. 123, no. 3, p. 2069-2089. https://doi.org/10.1002/2017jb015138

Daigle, H., Fang, Y., Phillips, S.C., Flemings, P.B., 2022, Pore structure of sediments from Green Canyon 955 determined by mercury intrusion: AAPG Bulletin, v. 106, no. 5, p. 1051-1069. https://doi.org/10.1306/02262120123

Darnell, K. N., and Flemings, P. B., 2015, Transient seafloor venting on continental slopes from warming-induced methane hydrate dissociation: Geophysical Research Letters, p. n/a-n/a. https://doi.org/10.1002/2015GL067012

Darnell, K. N., Flemings, P. B., and DiCarlo, D., 2019, Nitrogen-Driven Chromatographic Separation During Gas Injection Into Hydrate-Bearing Sediments: Water Resources Research. https://doi.org/10.1029/2018wr023414

Ewton, E., 2019, The effects of X-ray CT scanning on microbial communities in sediment coresHonors]: Oregon State University, 21 p.

Fang, Y., Flemings, P. B., Daigle, H., Phillips, S. C., Meazell, P. K., and You, K., 2020, Petrophysical properties of the Green Canyon block 955 hydrate reservoir inferred from reconstituted sediments: Implications for hydrate formation and production: AAPG Bulletin, v. 104, no. 9, p. 1997–2028, https://doi.org/10.1306/01062019165

Fang, Y., Flemings, P.B., Daigle, H., Phillips, S.C., O'Connel, J., 2022, Permeability of methane hydrate-bearing sandy silts in the deepwater Gulf of Mexico (Green Canyon block 955): AAPG Bulletin, v. 106, no. 5, p. 1071-1100. https://doi.org/10.1306/08102121001

Fang, Y., Flemings, P.B., Germaine, J.T., Daigle, H., Phillips, S.C., 2022, Compression behavior of hydrate-bearing sediments: AAPG Bulletin, v. 106, no. 5, p. 1101-1126. https://doi.org/10.1306/01132221002

Flemings, P. B., Phillips, S. C., Boswell, R., Collett, T. S., Cook, A. E., Dong, T., Frye, M., Guerin, G., Goldberg, D. S., Holland, M. E., Jang, J., Meazell, K., Morrison, J., O'Connell, J., Pettigrew, T., Petrou, E., Polito, P. J., Portnov, A., Santra, M., Schultheiss, P. J., Seol, Y., Shedd, W., Solomon, E. A., Thomas, C., Waite, W. F., and You, K., 2020, Pressure coring a Gulf of Mexico Deepwater Turbidite Gas Hydrate Reservoir: Initial results from the UT-GOM2-1 hydrate pressure coring expedition: AAPG Bulletin, v. 104, no. 9, p. 1847-1876. https://doi.org/10.1306/05212019052

Flemings, P. B., Phillips, S. C., Collett, T., Cook, A., Boswell, R., and Scientists, U.-G.-E., 2018, UT-GOM2-1 Hydrate Pressure Coring Expedition Summary, *in* Flemings, P. B., Phillips, S. C., Collett, T., Cook, A., Boswell, R., and Scientists, U.-G.-E., eds., UT-GOM2-1 Hydrate Pressure Coring Expedition Report: Austin, TX, University of Texas Institute for Geophysics.

Flemings, P.B., Cook, A.E., Collett, T., Boswell, R., 2022 Gas hydrates in Green Canyon Block 955, deep-water Gulf of Mexico: Part II, Insights and future challenges: AAPG Bulletin, v. 106, no. 5, p. 937-947. https://doi.org/10.1306/bltnintro030922

Hillman, J. I. T., Cook, A. E., Daigle, H., Nole, M., Malinverno, A., Meazell, K., and Flemings, P. B., 2017a, Gas hydrate reservoirs and gas migration mechanisms in the Terrebonne Basin, Gulf of Mexico: Marine and Petroleum Geology, v. 86, no. Supplement C, p. 1357-1373. https://doi.org/10.1016/j.marpetgeo.2017.07.029

Hillman, J. I. T., Cook, A. E., Sawyer, D. E., Küçük, H. M., and Goldberg, D. S., 2017b, The character and amplitude of 'discontinuous' bottom-simulating reflections in marine seismic data: Earth and Planetary Science Letters, v. 459, p. 157-169. https://doi.org/10.1016/j.epsl.2016.10.058

Johnson, J.E., MacLeod, D.R., Phillips, S.C., Purkey Phillips, M., Divins, D.L., 2022. Primary deposition and early diagenetic effects on the high saturation accumulation of gas hydrate in a silt dominated reservoir in the Gulf of Mexico. Marine Geology, Volume 444, 2022, 106718, https://doi.org/10.1016/j.margeo.2021.106718.

MacLeod, D.R., 2020. Characterization of a silty methane-hydrate reservoir in the Gulf of Mexico: Analysis of full sediment grain size distributions. M.S. Thesis, pp. 165, University of New Hampshire, Durham NH, U.S.A.

Majumdar, U., and Cook, A. E., 2018, The Volume of Gas Hydrate-Bound Gas in the Northern Gulf of Mexico: Geochemistry, Geophysics, Geosystems, v. 19, no. 11, p. 4313-4328. https://doi.org/10.1029/2018gc007865

Majumdar, U., Cook, A. E., Shedd, W., and Frye, M., 2016, The connection between natural gas hydrate and bottom-simulating reflectors: Geophysical Research Letters. https://doi.org/10.1002/2016GL069443

Meazell, K., Flemings, P., Santra, M., and Johnson, J. E., 2020, Sedimentology and stratigraphy of a deepwater gas hydrate reservoir in the northern Gulf of Mexico: AAPG Bulletin, v. 104, no. 9, p. 1945–1969, https://doi.org/10.1306/05212019027

Meyer, D. W., 2018, Dynamics of gas flow and hydrate formation within the hydrate stability zone [Doctor of Philosophy: The University of Texas at Austin.

Meyer, D. W., Flemings, P. B., and DiCarlo, D., 2018a, Effect of Gas Flow Rate on Hydrate Formation Within the Hydrate Stability Zone: Journal of Geophysical Research-Solid Earth, v. 123, no. 8, p. 6263-6276. https://doi.org/10.1029/2018jb015878

Meyer, D. W., Flemings, P. B., DiCarlo, D., You, K. H., Phillips, S. C., and Kneafsey, T. J., 2018b, Experimental Investigation of Gas Flow and Hydrate Formation Within the Hydrate Stability Zone: Journal of Geophysical Research-Solid Earth, v. 123, no. 7, p. 5350-5371. https://doi.org/10.1029/2018jb015748

Moore, M., Phillips, S., Cook, A.E. and Darrah, T., (2020) Improved sampling technique to collect natural gas from hydrate-bearing pressure cores. Applied Geochemistry, Volume 122, November 2020, p. 104773, https://doi.org/10.1016/j.apgeochem.2020.104773.

Moore, M.T., Phillips, S.C., Cook, A.E., Darrah, T.H., 2022, Integrated geochemical approach to determine the source of methane in gas hydrate from Green Canyon Block 955 in the Gulf of Mexico: AAPG Bulletin, v. 106, no. 5, p. 949-980. https://doi.org/10.1306/05272120087

Oti, E.A., Cook, A.E., Phillips, S.C., Holland, M.E., 2022 Using X-ray Computed Tomography (XCT) to Estimate Hydrate Saturation in Sediment Cores from Green Canyon 955, northern Gulf of Mexico: AAPG Bulletin, v. 106, no. 5, p. 1127-1142. https://doi.org/10.1306/05272120051

Phillips, S. C., Flemings, P. B., Holland, M. E., Schulthiss, P. J., Waite, W. F., Jang, J., Petrou, E. G., and H., H., 2020, High concentration methane hydrate in a silt reservoir from the deep-water Gulf of Mexico: AAPG Bulletin, v. 104, no. 9, p. 1971–1995. https://doi.org/10.1306/01062018280

Phillips, S. C., Flemings, P. B., You, K., Meyer, D. W., and Dong, T., 2019, Investigation of in situ salinity and methane hydrate dissociation in coarse-grained sediments by slow, stepwise depressurization: Marine and Petroleum Geology, v. 109, p. 128-144. https://doi.org/10.1016/j.marpetgeo.2019.06.015

Portnov, A., Cook, A. E., Heidari, M., Sawyer, D. E., Santra, M., and Nikolinakou, M., 2020, Salt-driven evolution of a gas hydrate reservoir in Green Canyon, Gulf of Mexico: AAPG Bulletin, v. 104, no. 9, p. 1903–1919, http://dx.doi.org/10.1306/10151818125

Phillips, S.C., Flemings, P.B., You, K., Waite, W.F., 2022, Thermodynamic insights into the production of methane hydrate reservoirs from depressurization of pressure cores AAPG Bulletin, v. 106, no. 5, p. 1025-1049. https://doi.org/10.1306/08182120216

Portnov, A., Cook, A. E., Sawyer, D. E., Yang, C., Hillman, J. I. T., and Waite, W. F., 2019, Clustered BSRs: Evidence for gas hydrate-bearing turbidite complexes in folded regions, example from the Perdido Fold Belt, northern Gulf of Mexico: Earth and Planetary Science Letters, v. 528. https://doi.org/10.1016/j.epsl.2019.115843

Portnov, A., Santra, M., Cook., A.E., and Sawyer, D.E, (2020, accepted & online) The Jackalope gas hydrate system in the northeastern Gulf of Mexico. Journal of Marine and Petroleum Geology. https://doi.org/10.1016/j.marpetgeo.2019.08.036

Santra, M., Flemings, P., Meazell, K., and Scott, E., 2020, Evolution of Gas Hydrate-bearing Deepwater Channel-Levee System in Abyssal Gulf of Mexico – Levee Growth and Deformation: : AAPG Bulletin, v. 104, no. 9, p. 1921–1944, https://doi.org/10.1306/04251918177

Santra, M., Flemings, P.B., Heidari, M., You, K., 2022, Occurrence of High-Saturation Gas Hydrate in a Fault-Compartmentalized Anticline and the Role of Seal- Green Canyon, Abyssal Gulf of Mexico: AAPG Bulletin, v. 106, no. 5, p. 981-1003. https://doi.org/10.1306/08182120149

Sawyer, D. E., Mason, R. A., Cook, A. E., and Portnov, A., 2019, Submarine Landslides Induce Massive Waves in Subsea Brine Pools: Scientific Reports, v. 9, no. 1, p. 128. https://doi.org/10.1038/s41598-018-36781-7

Sheik, C. S., Reese, B. K., Twing, K. I., Sylvan, J. B., Grim, S. L., Schrenk, M. O., Sogin, M. L., and Colwell, F. S., 2018, Identification and Removal of Contaminant Sequences From Ribosomal Gene Databases: Lessons From the Census of Deep Life: Front Microbiol, v. 9, p. 840. https://doi.org/10.3389/fmicb.2018.00840

Smart, K (2018). Modeling Well Log Responses in Hydrate Bearing Silts. Ohio State University. Undergraduate Thesis.

Smith, A. J., Flemings, P. B., Liu, X., and Darnell, K., 2014, The evolution of methane vents that pierce the hydrate stability zone in the world's oceans: Journal of Geophysical Research: Solid Earth, p. 2013JB010686. https://doi.org/10.1002/2013JB010686

Thomas, C., Phillips, S. C., Flemings, P. B., Santra, M., Hammon, H., Collett, T. S., Cook, A., Pettigrew, T., Mimitz, M., Holland, M., and Schultheiss, P., 2020, Pressure-coring operations during the University of Texas Hydrate Pressure Coring Expedition, UT-GOM2-1, in Green Canyon Block 955, northern Gulf of Mexico: AAPG Bulletin, v. 104, no. 9, p. 1877–1901. https://doi.org/10.1306/02262019036

Wei, L., Cook, A., Daigle, H., Malinverno, A., Nole, M., and You, K., 2019, Factors Controlling Short-Range Methane Migration of Gas Hydrate Accumulations in Thin Coarse-Grained Layers: Geochemistry, Geophysics, Geosystems, v. 20, no. 8, p. 3985-4000. https://doi.org/10.1029/2019gc008405

Wei, L., Cook, A.E., You, K., 2022, Methane migration mechanisms for the Green Canyon Block 955 gas hydrate reservoir, northern Gulf of Mexico: AAPG Bulletin, v. 106, no. 5, p. 1005-1023. https://doi.org/10.1306/06022120134

Yoneda, J., Jin, Y., Muraoka, M., Oshima, M., Suzuki, K., Waite, W.F., Flemings, P.B., 2022, Comprehensive pressure core analysis for hydrate-bearing sediments from Gulf of Mexico Green Canyon Block 955, including assessments of geomechanical viscous behavior and NMR permeability: AAPG Bulletin, v. 106, no. 5, p. 1143-1177. https://doi.org/10.1306/04272120204

You, K., Summa, L., Flemings, P., Santra, M., and Fang, Y., 2021, Three-Dimensional Free Gas Flow Focuses Basin Wide Microbial Methane to Concentrated Methane Hydrate Reservoirs in Geological System: Journal of Geophysical Research: Solid Earth, v. 126, no. 12, p. e2021JB022793. https://doi.org/https://doi.org/10.1029/2021JB022793

You, K., and Flemings, P. B., 2018, Methane hydrate formation in thick sandstones by free gas flow: Journal of Geophysical Research: Solid Earth, v. 123, p. 4582-4600. https://doi.org/10.1029/2018JB015683

You, K., Flemings, P. B., Malinverno, A., Collett, T. S., and Darnell, K., 2019, Mechanisms of Methane Hydrate Formation in Geological Systems: Reviews of Geophysics, v. 0, no. ja. https://doi.org/10.1029/2018rg000638

You, K., Kneafsey, T. J., Flemings, P. B., Polito, P., and Bryant, S. L., 2015, Salinity-buffered methane hydrate formation and dissociation in gas-rich systems: Journal of Geophysical Research: Solid Earth, v. 120, no. 2, p. 643-661. https://doi.org/10.1002/2014JB011190

You, K., Summa, L., Flemings, P. B., Santra, M., and Fang, Y., (2021), Three-dimensional free gas flow focuses basin-wide microbial methane to concentrated methane hydrate reservoirs in geological system, Journal of Geophysical Research: Solid Earth, 126, e2021JB022793.

You K., and Flemings, P. B., (2021), Methane hydrate formation and evolution during sedimentation, Journal of Geophysical Research: Solid Earth, 126, e2020JB021235.

2.2 Conference Presentations/Abstracts

Colwell, F., Kiel Reese, B., Mullis, M., Buser-Young, J., Glass, J.B., Waite, W., Jang, J., Dai, S., Phillips, S. 2020. Microbial Communities in Hydrate-Bearing Sediments Following Long-Term Pressure Preservation. Presented as a poster at 2020 Gordon Research Conference on Gas Hydrates

Cook. A., Waite, W. F., Spangenberg, E., and Heeschen, K.U., 2018, Petrophysics in the lab and the field: how can we understand gas hydrate pore morphology and saturation? Invited talk presented at the American Geophysical Union Fall Meeting, Washington D.C.

Cook, A.E., and Waite, B., 2016, Archie's saturation exponent for natural gas hydrate in coarse-grained reservoir. Presented at Gordon Research Conference, Galveston, TX.

Cook, A.E., Hillman, J., Sawyer, D., Treiber, K., Yang, C., Frye, M., Shedd, W., Palmes, S., 2016, Prospecting for Natural Gas Hydrate in the Orca & Choctaw Basins in the Northern Gulf of Mexico. Poster presented at American Geophysical Union, Fall Meeting, San Francisco, CA.

Cook, A.E., Hillman, J., & Sawyer, D., 2015, Gas migration in the Terrebonne Basin gas hydrate system. Abstract OS23D-05 presented at American Geophysical Union, Fall Meeting, San Francisco, CA.

Cook, A. E., & Sawyer, D., 2015, Methane migration in the Terrebonne Basin gas hydrate system, Gulf of Mexico. Presented at American Geophysical Union, Fall Meeting, San Francisco, CA.

Chen X., Espinoza, D.N., Tisato, N., and Flemings, P.B., 2018, X-Ray Micro-CT Observation of Methane Hydrate Growth in Sandy Sediments. Presented at the AGU Fall Meeting 2018, Dec. 10–14, in Washington D.C.

Darnell, K., Flemings, P.B., DiCarlo, D.A., 2016, Nitrogen-assisted Three-phase Equilibrium in Hydrate Systems Composed of Water, Methane, Carbon Dioxide, and Nitrogen. Presented at American Geophysical Union, Fall Meeting, San Francisco, CA.

Dong, T., Lin, J. -F., Flemings, P. B., Gu, J. T., Polito, P. J., O'Connell, J., 2018, Pore-Scale Methane Hydrate Formation under Pressure and Temperature Conditions of Natural Reservoirs. Presented to the AGU Fall Meeting 2018, Washington D.C., 10-14 December.

Ewton, E., Klasek, S., Peck, E., Wiest, J. Colwell F., 2019, The effects of X-ray computed tomography scanning on microbial communities in sediment cores. Poster presented at AGU Fall Meeting.

Erica Ewton et al., 2018, The effects of X-ray CT scanning on microbial communities in sediment cores. Poster presented at American Geophysical Union, Fall Meeting, Washington, D.C. OS23D-1657

Espinoza D.N., Chen X., Luo J.S., Tisato N., Flemings P.B., 2010, X-Ray Micro-CT Observation of Methane Hydrate Growth and Dissociation in Sandy Sediments. Presented to the Engineering Mechanics Institute Conference 2019, Pasadena, CA, 19 June.

Fang, Y., et al., 2020, Petrophysical Properties of Hydrate-Bearing Siltstone from UT-GOM2-1 Pressure Cores. Presented at the AAPG virtual Conference, Oct 1, Theme 9: Analysis of Natural Gas Hydrate Systems I & II

Fang, Y., et al., 2018, Permeability, compression behavior, and lateral stress ration of hydrate-bearing siltstone from UT-GOM2-1 pressure core (GC-955 – northern Gulf of Mexico): Initial Results. Poster presented at American Geophysical Union, Fall Meeting, Washington, D.C. OS23D-1650

Fang, Y., Flemings, P.B., Daigle, H., O'Connell, J., Polito, P., 2018, Measure permeability of natural hydrate-bearing sediments using K0 permeameter. Presented at Gordon Research Conference on Gas Hydrate, Galveston, TX. Feb 24- Mar 02, 2018.

Flemings, P.B., et al., 2020 Pressure Coring a Gulf of Mexico Deep-Water Turbidite Gas Hydrate Reservoir: The UT-GOM2-1 Hydrate Pressure Coring Expedition. Presented at the AAPG virtual Conference, Oct 1, Theme 9: Analysis of Natural Gas Hydrate Systems I & II

Flemings, P., Phillips, S., and the UT-GOM2-1 Expedition Scientists, 2018, Recent results of pressure coring hydrate-bearing sands in the deepwater Gulf of Mexico: Implications for formation and production. Talk presented at the 2018 Gordon Research Conference on Natural Gas Hydrate Systems, Galveston, TX, February 24-March 2, 2018.

Fortin, W., 2018, Waveform Inversion and Well Log Examination at GC955 and WR313 in the Gulf of Mexico for Estimation of Methane Hydrate Concentrations. Presented at Gordon Research Conference on Natural Gas Hydrate Systems, Galveston, TX.

Fortin, W., Goldberg, D.S., Küçük, H. M., 2017, Prestack Waveform Inversion and Well Log Examination at GC955 and WR313 in the Gulf of Mexico for Estimation of Methane Hydrate Concentrations. EOS Trans. American Geophysical Union, Fall Meeting, New Orleans, LA.

Fortin, W., 2016, Properties from Seismic Data. Presented at IODP planning workshop, Southern Methodist University, Dallas, TX.

Fortin, W., Goldberg, D.S., Holbrook, W.S., and Küçük, H.M., 2016, Velocity analysis of gas hydrate systems using prestack waveform inversion. Presented at Gordon Research Conference on Natural Gas Hydrate Systems, Galveston, TX.

Fortin, W., Goldberg, D.S., Küçük, H.M., 2016, Methane Hydrate Concentrations at GC955 and WR313 Drilling Sites in the Gulf of Mexico Determined from Seismic Prestack Waveform Inversion. EOS Trans. American Geophysical Union, Fall Meeting, San Francisco, CA.

Goldberg, D., Küçük, H.M., Haines, S., Guerin, G., 2016, Reprocessing of high resolution multichannel seismic data in the Gulf of Mexico: implications for BSR character in the Walker Ridge and Green Canyon areas. Presented at Gordon Research Conference on Natural Gas Hydrate Systems, Galveston, TX.

Hammon, H., Phillips, S., Flemings, P., and the UT-GOM2-1 Expedition Scientists, 2018, Drilling-induced disturbance within methane hydrate pressure cores in the northern Gulf of Mexico. Poster presented at the 2018 Gordon Research Conference and Seminar on Natural Gas Hydrate Systems, Galveston, TX, February 24-March 2, 2018.

Heber, R., Kinash, N., Cook, A., Sawyer, D., Sheets, J., and Johnson, J.E., 2017, Mineralogy of Gas Hydrate Bearing Sediment in Green Canyon Block 955 Northern Gulf of Mexico. Abstract OS53B-1206 presented at American Geophysical Union, Fall Meeting, New Orleans, LA.

Hillman, J., Cook, A. & Sawyer, D., 2016, Mapping and characterizing bottom-simulating reflectors in 2D and 3D seismic data to investigate connections to lithology and frequency dependence. Presented at Gordon Research Conference, Galveston, TX.

Johnson, J., et al., 2020, Grain Size, TOC, and TS in Gas Hydrate Bearing Turbidite Facies at Green Canyon Site 955, Gulf of Mexico. Presented at the AAPG virtual Conference, Oct 1, Theme 9: Analysis of Natural Gas Hydrate Systems I & II

Johnson, J.E., Phillips, S.C., and Divins, D.L., 2018, Tracking AOM through TOC and Elemental S: Implications for Methane Charge in Gulf of Mexico Marine Sediments. Abstract OS13A-08 presented at 2018 Fall Meeting, AGU, San Francisco, Calif., 14-18 Dec. Oral Presentation

Johnson, J., 2018, High Porosity and Permeability Gas Hydrate Reservoirs: A Sedimentary Perspective. Presented at Gordon Research Conference on Natural Gas Hydrate Systems, Galveston, TX.

Kinash, N. Cook, A., Sawyer, D. and Heber, R., 2017, Recovery and Lithologic Analysis of Sediment from Hole UT-GOM2-1-H002, Green Canyon 955, Northern Gulf of Mexico. Abstract OS53B-1207 presented at American Geophysical Union, Fall Meeting, New Orleans, LA.

Küçük, H.M., Goldberg, D.S, Haines, S., Dondurur, D., Guerin, G., and Çifçi, G., 2016, Acoustic investigation of shallow gas and gas hydrates: comparison between the Black Sea and Gulf of Mexico. Presented at Gordon Research Conference on Natural Gas Hydrate Systems, Galveston, TX.

Liu, J. et al., 2018, Pore-scale CH4-C2H6 hydrate formation and dissociation under relevant pressure-temperature conditions of natural reservoirs. Poster presented at American Geophysical Union, Fall Meeting, Washington, D.C. OS23D-2824

Malinverno, A., Cook, A. E., Daigle, H., Oryan, B., 2017, Methane Hydrate Formation from Enhanced Organic Carbon Burial During Glacial Lowstands: Examples from the Gulf of Mexico. EOS Trans. American Geophysical Union, Fall Meeting, New Orleans, LA.

Malinverno, A., 2016, Modeling gas hydrate formation from microbial methane in the Terrebonne basin, Walker Ridge, Gulf of Mexico. Presented at Gordon Research Conference on Natural Gas Hydrate Systems, Galveston, TX.

Meazell, K., and Flemings, P.B., 2021, Seal capacity and fluid expulsion in hydrate systems. Presented at IMAGE 2021, SEG/AAPG Annual Conference. Denver, Colorado. Theme 9: Hydrocarbons of the future.

Meazell, K., Flemings, P. B., Santra, M., and the UT-GOM2-01 Scientists, 2018, Sedimentology of the clastic hydrate reservoir at GC 955, Gulf of Mexico. Presented at Gordon Research Conference on Natural Gas Hydrate Systems, Galveston, TX.

Meazell, K., & Flemings, P.B., 2016, Heat Flux and Fluid Flow in the Terrebonne Basin, Northern Gulf of Mexico. Presented at American Geophysical Union, Fall Meeting, San Francisco, CA.

Meazell, K., & Flemings, P.B., 2016, New insights into hydrate-bearing clastic sediments in the Terrebonne basin, northern Gulf of Mexico. Presented at Gordon Research Conference on Natural Gas Hydrate Systems, Galveston, TX.

Meazell, K., & Flemings, P.B., 2016, The depositional evolution of the Terrebonne basin, northern Gulf of Mexico. Presented at 5th Annual Jackson School Research Symposium, University of Texas at Austin, Austin, TX.

Meazell, K., 2015, Methane hydrate-bearing sediments in the Terrebonne basin, northern Gulf of Mexico. Abstract OS23B-2012 presented at American Geophysical Union, Fall Meeting, San Francisco, CA.

Moore, M., Darrah, T., Cook, A., Sawyer, D., Phillips, S., Whyte, C., Lary, B., and UT-GOM2-01 Scientists, 2017, The genetic source and timing of hydrocarbon formation in gas hydrate reservoirs in Green Canyon, Block GC955. Abstract OS44A-03 presented at American Geophysical Union, Fall Meeting, New Orleans, LA.

Morrison, J., Flemings, P., and the UT-GOM2-1 Expedition Scientists, 2018, Hydrate Coring in Deepwater Gulf of Mexico, USA. Poster presented at the 2018 Gordon Research Conference on Natural Gas Hydrate Systems, Galveston, TX.

Murphy, Z., et al., 2018, Three phase relative permeability of hydrate bearing sediments. Poster presented at American Geophysical Union, Fall Meeting, Washington, D.C. OS23D-1647

Naim, F., Cook, A., Konwar, D. (2021) Estimating P-wave velocity and Bulk Density in Hydrate Systems using Machine Learning, in IMAGE 2021, SEG/AAPG Annual Conference. Denver, Colorado

Oryan, B., Malinverno, A., Goldberg, D., Fortin, W., 2017, Do Pleistocene glacial-interglacial cycles control methane hydrate formation? An example from Green Canyon, Gulf of Mexico. EOS Trans. American Geophysical Union, Fall Meeting, New Orleans, LA.

Oti, E., Cook, A., Phillips, S., and Holland, M., 2019, Using X-ray Computed Tomography (XCT) to Estimate Hydrate Saturation in Sediment Cores from UT-GOM2-1 H005, Green Canyon 955 (Invited talk, U11C-17). Presented to the AGU Fall Meeting, San Francisco, CA.

Oti, E., Cook. A., Phillips, S., Holland, M., Flemings, P., 2018, Using X-ray computed tomography to estimate hydrate saturation in sediment cores from Green Canyon 955 Gulf of Mexico. Talk presented at the American Geophysical Union Fall Meeting, Washington D.C.

Oti, E., Cook, A., 2018, Non-Destructive X-ray Computed Tomography (XCT) of Previous Gas Hydrate Bearing Fractures in Marine Sediment. Presented at Gordon Research Conference on Natural Gas Hydrate Systems, Galveston, TX.

Oti, E., Cook, A., Buchwalter, E., and Crandall, D., 2017, Non-Destructive X-ray Computed Tomography (XCT) of Gas Hydrate Bearing Fractures in Marine Sediment. Abstract OS44A-05 presented at American Geophysical Union, Fall Meeting, New Orleans, LA.

Phillips, S.C., et al., 2020, High Concentration Methane Hydrate in a Silt Reservoir from the Deep-Water Gulf of Mexico. Presented at the AAPG virtual Conference, Oct 1, Theme 9: Analysis of Natural Gas Hydrate Systems I & II

Phillips, S.C., Formolo, M.J., Wang, D.T., Becker, S.P., and Eiler, J.M., 2020. Methane isotopologues in a high-concentration gas hydrate reservoir in the northern Gulf of Mexico. Goldschmidt Abstracts 2020. https://goldschmidtabstracts.info/2020/2080.pdf

Phillips, S.C., 2019, Pressure coring in marine sediments: Insights into gas hydrate systems and future directions. Presented to the GSA Annual Meeting 2019, Phoenix, Arizona, 22-25 September. https://gsa.confex.com/gsa/2019AM/meetingapp.cgi/Paper/338173

Phillips et al., 2018, High saturation of methane hydrate in a coarse-grained reservoir in the northern Gulf of Mexico from quantitative depressurization of pressure cores. Poster presented at American Geophysical Union, Fall Meeting, Washington, D.C. OS23D-1654

Phillips, S.C., Flemings, P.B., Holland, M.E., Schultheiss, P.J., Waite, W.F., Petrou, E.G., Jang, J., Polito, P.J., O'Connell, J., Dong, T., Meazell, K., and Expedition UT-GOM2-1 Scientists, 2017, Quantitative degassing of gas hydrate-bearing pressure cores from Green Canyon 955. Gulf of Mexico. Talk and poster presented at the 2018 Gordon Research Conference and Seminar on Natural Gas Hydrate Systems, Galveston, TX, February 24-March 2, 2018.

Phillips, S.C., Borgfedlt, T., You, K., Meyer, D., and Flemings, P., 2016, Dissociation of laboratory-synthesized methane hydrate by depressurization. Poster presented at Gordon Research Conference and Gordon Research Seminar on Natural Gas Hydrates, Galveston, TX.

Phillips, S.C., You, K., Borgfeldt, T., Meyer, D.W., Dong, T., Flemings, P.B., 2016, Dissociation of Laboratory-Synthesized Methane Hydrate in Coarse-Grained Sediments by Slow Depressurization. Presented at American Geophysical Union, Fall Meeting, San Francisco, CA.

Portnov, A., Cook, A. E., Frye, M. C., Palmes, S. L., Skopec, S., 2021, Prospecting for Gas Hydrate Using Public Geophysical Data in the Northern Gulf of Mexico. Presented at in IMAGE 2021, SEG/AAPG Annual Conference. Denver, Colorado. Theme 9: Hydrocarbons of the future.

Portnov A., et al., 2018, Underexplored gas hydrate reservoirs associated with salt diapirism and turbidite deposition in the Northern Gulf of Mexico. Poster presented at American Geophysical Union, Fall Meeting, Washington, D.C. OS51F-1326

Portnov, A., Cook, A., Heidari, M., Sawyer, D., Santra, M., Nikolinakou, M., 2018, Salt-driven Evolution of Gas Hydrate Reservoirs in the Deep-sea Gulf of Mexico. Presented at Gordon Research Conference on Natural Gas Hydrate Systems, Galveston, TX.

Santra, M., et al., 2020, Gas Hydrate in a Fault-Compartmentalized Anticline and the Role of Seal, Green Canyon, Abyssal Northern Gulf of Mexico. Presented at the AAPG virtual Conference, Oct 1, Theme 9: Analysis of Natural Gas Hydrate Systems I & II

Santra, M., et al., 2018, Channel-levee hosted hydrate accumulation controlled by a faulted anticline: Green Canyon, Gulf of Mexico. Poster presented at American Geophysical Union, Fall Meeting, Washington, D.C. OS51F-1324

Santra, M., Flemings, P., Scott, E., Meazell, K., 2018, Evolution of Gas Hydrate Bearing Deepwater Channel-Levee System in Green Canyon Area in Northern Gulf of Mexico. Presented at Gordon Research Conference and Gordon Research Seminar on Natural Gas Hydrates, Galveston, TX.

Treiber, K, Sawyer, D., & Cook, A., 2016, Geophysical interpretation of gas hydrates in Green Canyon Block 955, northern Gulf of Mexico, USA. Poster presented at Gordon Research Conference, Galveston, TX.

Varona, G., Flemings, P.B., Santra, M., Meazell, K., 2021, Paleogeographic evolution of the Green Sand, WR313. Presented at in IMAGE 2021, SEG/AAPG Annual Conference. Denver, Colorado. Theme 9 Gas Hydrates and Helium Sourcing.

Wei, L. and Cook, A., 2019, Methane Migration Mechanisms and Hydrate Formation at GC955, Northern Gulf of Mexico. Abstract OS41B-1668 presented to the AGU Fall Meeting, San Francisco, CA.

Wei, L., Cook, A. and You, K., 2020, Methane Migration Mechanisms for the GC955 Gas Hydrate Reservoir, Northern Gulf of Mexico. Abstract OS029-0008. AGU 2020 Fall Meeting

Worman, S. and, Flemings, P.B., 2016, Genesis of Methane Hydrate in Coarse-Grained Systems: Northern Gulf of Mexico Slope (GOM^2). Poster presented at The University of Texas at Austin, GeoFluids Consortia Meeting, Austin, TX.

Yang, C., Cook, A., & Sawyer, D., 2016, Geophysical interpretation of the gas hydrate reservoir system at the Perdido Site, northern Gulf of Mexico. Presented at Gordon Research Conference, Galveston, TX, United States.

You, K., M. Santra, L. Summa, and P.B. Flemings, 2020, Impact of focused free gas flow and microbial methanogenesis kinetics on the formation and evolution of geological gas hydrate system, Abstract presented at 2020 AGU Fall Meeting, 1-17 Dec, Virtual

You, K., et al. 2020, Impact of Coupled Free Gas Flow and Microbial Methanogenesis on the Formation and Evolution of Concentrated Hydrate Deposits. Presented at the AAPG virtual Conference, Oct 1, Theme 9: Analysis of Natural Gas Hydrate Systems I & II

You, K., Flemings, P. B., and Santra, M., 2018, Formation of lithology-dependent hydrate distribution by capillary-controlled gas flow sourced from faults. Poster presented at American Geophysical Union, Fall Meeting, Washington, D.C. OS31F-1864

You, K., and Flemings, P. B., 2018, Methane Hydrate Formation in Thick Marine Sands by Free Gas Flow. Presented at Gordon Research Conference on Gas Hydrate, Galveston, TX. Feb 24- Mar 02, 2018.

You, K., Flemings, P.B., 2016, Methane Hydrate Formation in Thick Sand Reservoirs: Long-range Gas Transport or Short-range Methane Diffusion? Presented at American Geophysical Union, Fall Meeting, San Francisco, CA.

You, K.Y., DiCarlo, D. & Flemings, P.B., 2015, Quantifying methane hydrate formation in gas-rich environments using the method of characteristics. Abstract OS23B-2005 presented at 2015, Fall Meeting, AGU, San Francisco, CA, 14-18 Dec.

You, K.Y., Flemings, P.B., & DiCarlo, D., 2015, Quantifying methane hydrate formation in gas-rich environments using the method of characteristics. Poster presented at 2016 Gordon Research Conference and Gordon Research Seminar on Natural Gas Hydrates, Galveston, TX.

2.3 Proceeding of the UT-GOM2-1 Hydrate Pressure Coring Expedition

Volume contents are published on the UT-GOM2-1 Expedition website and on OSTI.gov.

2.3.1 Volume Reference

Flemings, P.B., Phillips, S.C, Collett, T., Cook, A., Boswell, R., and the UT-GOM2-1 Expedition Scientists, Proceedings of the UT-GOM2-1 Hydrate Pressure Coring Expedition, Austin, TX (University of Texas

Institute for Geophysics, TX), https://dx.doi.org/10.2172/1646019

2.3.2 Prospectus

Flemings, P.B., Boswell, R., Collett, T.S., Cook, A. E., Divins, D., Frye, M., Guerin, G., Goldberg, D.S., Malinverno, A., Meazell, K., Morrison, J., Pettigrew, T., Philips, S.C., Santra, M., Sawyer, D., Shedd, W., Thomas, C., You, K. GOM2: Prospecting, Drilling and Sampling Coarse-Grained Hydrate Reservoirs in the Deepwater Gulf of Mexico. Proceeding of ICGH-9. Denver, Colorado: ICGH, 2017. http://www-udc.ig.utexas.edu/gom2/UT-GOM2-1%20Prospectus.pdf.

2.3.3 Expedition Report Chapters

Flemings, P.B., Phillips, S.C, Collett, T., Cook, A., Boswell, R., and the UT-GOM2-1 Expedition Scientists, 2018. UT-GOM2-1 Hydrate Pressure Coring Expedition Summary. In Flemings, P.B., Phillips, S.C, Collett, T., Cook, A., Boswell, R., and the UT-GOM2-1 Expedition Scientists, Proceedings of the UT-GOM2-1 Hydrate Pressure Coring Expedition, Austin, TX (University of Texas Institute for Geophysics, TX). https://dx.doi.org/10.2172/1647223.

Flemings, P.B., Phillips, S.C, Collett, T., Cook, A., Boswell, R., and the UT-GOM2-1 Expedition Scientists, 2018. UT-GOM2-1 Hydrate Pressure Coring Expedition Methods. In Flemings, P.B., Phillips, S.C, Collett, T., Cook, A., Boswell, R., and the UT-GOM2-1 Expedition Scientists, Proceedings of the UT-GOM2-1 Hydrate Pressure Coring Expedition: Austin, TX (University of Texas Institute for Geophysics, TX). https://dx.doi.org/10.2172/1647226

Flemings, P.B., Phillips, S.C, Collett, T., Cook, A., Boswell, R., and the UT-GOM2-1 Expedition Scientists, 2018. UT-GOM2-1 Hydrate Pressure Coring Expedition Hole GC 955 H002. In Flemings, P.B., Phillips, S.C, Collett, T., Cook, A., Boswell, R., and the UT-GOM2-1 Expedition Scientists, Proceedings of the UT-GOM2-1 Hydrate Pressure Coring Expedition: Austin, TX (University of Texas Institute for Geophysics, TX). https://dx.doi.org/10.2172/1648313

Flemings, P.B., Phillips, S.C, Collett, T., Cook, A., Boswell, R., and the UT-GOM2-1 Expedition Scientists, 2018. UT-GOM2-1 Hydrate Pressure Coring Expedition Hole GC 955 H005. In Flemings, P.B., Phillips, S.C, Collett, T., Cook, A., Boswell, R., and the UT-GOM2-1 Expedition Scientists, Proceedings of the UT-GOM2-1 Hydrate Pressure Coring Expedition: Austin, TX (University of Texas Institute for Geophysics, TX). https://dx.doi.org/10.2172/1648318

2.3.4 Data Reports

Fortin, W.F.J., Goldberg, D.S., Küçük, H.M., 2020, Data Report: Prestack Waveform Inversion at GC 955: Trials and sensitivity of PWI to high-resolution seismic data, In Flemings, P.B., Phillips, S.C, Collett, T., Cook, A., Boswell, R., and the UT-GOM2-1 Expedition Scientists, Proceedings of the UT-GOM2-1 Hydrate Pressure Coring Expedition: Austin, TX (University of Texas Institute for Geophysics, TX). http://dx.doi.org/10.2172/1647733, 7 p.

Heber, R., Cook, A., Sheets, J., Sawyer, 2020. Data Report: High-Resolution Microscopy Images of Sediments from Green Canyon Block 955, Gulf of Mexico. In Flemings, P.B., Phillips, S.C, Collett, T., Cook, A., Boswell, R., and the UT-GOM2-1 Expedition Scientists, Proceedings of the UT-GOM2-1 Hydrate Pressure Coring Expedition: Austin, TX (University of Texas Institute for Geophysics, TX). https://dx.doi.org/10.2172/1648312, 6 p.

Heber, R., Cook, A., Sheets, J., and Sawyer, D., 2020. Data Report: X-Ray Diffraction of Sediments from Green Canyon Block 955, Gulf of Mexico. In Flemings, P.B., Phillips, S.C, Collett, T., Cook, A., Boswell, R., and the UT-GOM2-1 Expedition Scientists, Proceedings of the UT-GOM2-1 Hydrate Pressure Coring Expedition: Austin, TX (University of Texas Institute for Geophysics, TX). https://dx.doi.org/10.2172/1648308, 27 p.

Johnson, J.E., MacLeod, D.R., Divins, D.L., 2020. Data Report: UT-GOM2-1 Sediment Grain Size Measurements at Site GC 955, Holes H002 and H005. In Flemings, P.B., Phillips, S.C, Collett, T., Cook, A., Boswell, R., and the UT-GOM2-1 Expedition Scientists, Proceedings of the UT-GOM2-1 Hydrate Pressure Coring Expedition: Austin, TX (University of Texas Institute for Geophysics, TX). http://dx.doi.org/10.2172/1823030, 87 p.

Johnson, J.E., Divins, D.L., 2020, Data Report: UT-GOM2-1 Lithostratigraphic Core Description Logs at Site GC 955, Holes H002 and H005. In Flemings, P.B., Phillips, S.C, Collett, T., Cook, A., Boswell, R., and the UT-GOM2-1 Expedition Scientists, Proceedings of the UT-GOM2-1 Hydrate Pressure Coring Expedition: Austin, TX (University of Texas Institute for Geophysics, TX)., http://dx.doi.org/10.2172/1823034, 30 p.

Phillips, I.M., 2018. Data Report: X-Ray Powder Diffraction. In Flemings, P.B., Phillips, S.C, Collett, T., Cook, A., Boswell, R., and the UT-GOM2-1 Expedition Scientists, Proceedings of the UT-GOM2-1 Hydrate Pressure Coring Expedition: Austin, TX (University of Texas Institute for Geophysics, TX). https://dx.doi.org/10.2172/1648320 14 p.

Purkey Phillips, M., 2020, Data Report: UT-GOM2-1 Biostratigraphy Report Green Canyon Block 955, Gulf of Mexico. In Proceedings of the UT-GOM2-1 Hydrate Pressure Coring Expedition: Austin, TX (University of Texas Institute for Geophysics, TX)., http://dx.doi.org/10.2172/1823039, 15 p.

Solomon, E.A., Phillips, S.C., 2021, Data Report: Pore Water Geochemistry at Green Canyon 955, deepwater Gulf of Mexico, In Flemings, P.B., Phillips, S.C, Collett, T., Cook, A., Boswell, R., and the UT-GOM2-1 Expedition Scientists, UT-GOM2-1 Hydrate Pressure Coring Expedition Report: Austin, TX (University of Texas Institute for Geophysics, TX), http://dx.doi.org/ 10.2172/1838142, 14 p

2.4 Processing of the UT-GOM2-2 Hydrate Coring Expedition

Volume contents will be published on the UT-GOM2-2 Expedition Proceedings website and on OSTI.gov.

2.4.1 Prospectus

Peter Flemings, Carla Thomas, Tim Collett, Fredrick Colwell, Ann Cook, John Germaine, Melanie Holland, Jesse Houghton, Joel Johnson, Alberto Malinverno, Kevin Meazell, Tom Pettigrew, Steve Phillips, Alexey Portnov, Aaron Price, Manasij Santra, Peter Schultheiss, Evan Solomon, Kehua You, UT-GOM2-2

Prospectus: Science and Sample Distribution Plan, Austin, TX (University of Texas Institute for Geophysics, TX). http://dx.doi.org/10.2172/1827729, 141 p.

2.5 Websites

- Project Website:

https://ig.utexas.edu/energy/genesis-of-methane-hydrate-in-coarse-grained-systems/

- UT-GOM2-2 Expedition Website

https://ig.utexas.edu/energy/gom2-methane-hydrates-at-the-university-of-texas/gom2-2-expedition/

- UT-GOM2-1 Expedition Website:

https://ig.utexas.edu/energy/genesis-of-methane-hydrate-in-coarse-grained-systems/expedition-ut-gom2-1/

- Project SharePoint:

https://sps.austin.utexas.edu/sites/GEOMech/doehd/teams/

- Methane Hydrate: Fire, Ice, and Huge Quantities of Potential Energy:

https://www.youtube.com/watch?v=f1G302BBX9w

- Fueling the Future: The Search for Methane Hydrate:

https://www.youtube.com/watch?v=z1dFc-fdah4

- Pressure Coring Tool Development Video:

https://www.youtube.com/watch?v=DXseEbKp5Ak&t=154s

2.6 Technologies Or Techniques

Nothing to report.

2.7 Inventions, Patent Applications, and/or Licenses

Nothing to report.

3 CHANGES/PROBLEMS

3.1 Changes In Approach And Reasons For Change

UT will continue to coordinate efforts to plan and execute the UT-GOM2-2 expedition in 2023. See Section 3.2 and 3.3 for further discussion.

3.2 Actual Or Anticipated Problems Or Delays And Actions Or Plans To Resolve Them

In December, 2021, UT and US DOE determined that performing UT-GOM2-2 in 2022 was no longer viable, and made the decision to pursue a 2023 field program. UT has been working towards developing and finalizing a plan to perform UT-GOM2-2 in 2023, which will be finalized in the BP5 budget period modification for FY23 in the next reporting period.

3.3 Changes That Have A Significant Impact On Expenditures

The decision to defer UT-GOM2-2 from 2022 to 2023 will have a significant impact on project costs. UT is continuing to evaluate the scale of these impacts, which will be finalized in the BP5 budget period modification for FY23 in the next reporting period.

We anticipate numerous financial impacts to the current budget and spending projections:

- The US is currently experience record high inflation. According to the U.S. Department of Labor, Bureau of Labor Statistics report no. USDL-22-1470, the all items index has undergone the largest 12-month increase since 1981.
- The contractual vessel costs (Helix Well Ops.) are greater in 2023 than in 2022.
- Current trends in the offshore drilling market indicate that rates are increasing.
- Fuel prices are increasing which will impact costs of operating the Helix vessel, offshore contractors (e.g. supply boats, helicopters), shipping and trucking.
- Some large contractual expenditures planned for 2021-2022 must be shifted to 2022-2023.
- Delaying UT-GOM2-2 will require expanding the GOM2 program by one year.

3.4 Change Of Primary Performance Site Location From That Originally Proposed

None.

4 SPECIAL REPORTING REQUIREMENTS

4.1 Current Project Period

Task 1.0 – Revised Project Management Plan

Subtask 15.5 – Final UT-GOM2-2 Scientific Drilling Program Operations Plan

4.2 Future Project Periods

Task 1.0 – Revised Project Management Plan

Subtask 17.1 – Project Sample and Data Distribution Plan

Subtask 17.3 – UT-GOM2-2 Scientific Drilling Program Scientific Results Volume

5 BUDGETARY INFORMATION

The Budget Period 5 cost summary is provided in Table 5-1.

Table 5-1: Phase 5 / Budget Period 5 Cost Profile

Baseline Reporting Quarter	Budget Period 5							
	Y1Q1		Y1Q2		Y1Q3		Y1Q4	
	10/01/20-12/31/20		01/01/21-03/31/21		04/01/21-06/30/21		07/01/21-09/30/21	
	Y1Q1	Cumulative Total	Y1Q2	Cumulative Total	Y1Q3	Cumulative Total	Y1Q4	Cumulative Total
Baseline Cost Plan								
Federal Share	$ 587,651	$ 31,973,595	$ 581,151	$ 32,554,746	$ 5,466,306	$ 38,021,052	$ 581,151	$ 38,602,203
Non-Federal Share	$ 150,293	$ 23,871,255	$ 148,630	$ 24,019,885	$ 1,398,018	$ 25,417,903	$ 148,630	$ 25,566,533
Total Planned	$ 737,944	$ 55,844,850	$ 729,781	$ 56,574,631	$ 6,864,324	$ 63,438,955	$ 729,781	$ 64,168,736
Actual Incurred Cost								
Federal Share	$ 589,548	$ 29,766,294	$ 426,667	$ 30,192,961	$ 2,072,269	$ 32,265,230	$ 598,900	$ 32,864,131
Non-Federal Share	$ 220,056	$ 23,547,000	$ 374,124	$ 23,921,124	$ 623,736	$ 24,544,860	$ 222,682	$ 24,767,542
Total Incurred Cost	$ 809,604	$ 53,313,294	$ 800,791	$ 54,114,085	$ 2,696,006	$ 56,810,091	$ 821,582	$ 57,631,673
Variance								
Federal Share	$ 1,897	$ (2,207,301)	$ (154,484)	$ (2,361,785)	$ (3,394,037)	$ (5,755,822)	$ 17,750	$ (5,738,072)
Non-Federal Share	$ 69,763	$ (324,255)	$ 225,493	$ (98,761)	$ (774,281)	$ (873,043)	$ 74,052	$ (798,991)
Total Variance	$ 71,661	$ (2,531,556)	$ 71,010	$ (2,460,546)	$ (4,168,318)	$ (6,628,864)	$ 91,801	$ (6,537,063)
Baseline Reporting Quarter	**Budget Period 5**							
	Y2Q1		Y2Q2		Y2Q3		Y2Q4	
	10/01/21-12/31/21		01/01/22-03/31/22		04/01/22-06/30/22		07/01/22-09/30/22	
	Y2Q1	Cumulative Total	Y2Q2	Cumulative Total	Y2Q3	Cumulative Total	Y2Q4	Cumulative Total
Baseline Cost Plan								
Federal Share	$ 4,433,883	$ 43,036,085	$ 749,973	$ 43,786,058	$ 20,274,089	$ 64,060,147	$ 710,837	$ 64,770,984
Non-Federal Share	$ 700,232	$ 26,266,765	$ 118,441	$ 26,385,206	$ 3,201,835	$ 29,587,040	$ 112,261	$ 29,699,301
Total Planned	$ 5,134,114	$ 69,302,850	$ 868,414	$ 70,171,264	$ 23,475,924	$ 93,647,188	$ 823,097	$ 94,470,285
Actual Incurred Cost								
Federal Share	$ 466,675	$ 33,330,806	$ 607,849	$ 33,938,654	$ 543,438	$ 34,482,092		
Non-Federal Share	$ 254,642	$ 25,022,184	$ 281,474	$ 25,303,658	$ 258,413	$ 25,562,071		
Total Incurred Cost	$ 721,317	$ 58,352,990	$ 889,323	$ 59,242,313	$ 801,851	$ 60,044,163		
Variance								
Federal Share	$ (3,967,208)	$ (9,705,280)	$ (142,124)	$ (9,847,404)	$ (19,730,651)	$ (29,578,055)		
Non-Federal Share	$ (445,590)	$ (1,244,581)	$ 163,033	$ (1,081,548)	$ (2,943,422)	$ (4,024,969)		
Total Variance	$ (4,412,798)	$ (10,949,860)	$ 20,909	$ (10,928,952)	$ (22,674,073)	$ (33,603,024)		

6 BIBLIOGRAPHY

Flemings, P. B., 2021a, Y7Q1 Quarterly Research Performance Progress Report (Period ending 12/31/2020), Deepwater Methane Hydrate Characterization and Scientific Assessment, DOE Award No.: DE-FE0023919.

-, 2021b, Y7Q2 Quarterly Research Performance Progress Report (Period ending 3/31/2021), Deepwater Methane Hydrate Characterization and Scientific Assessment, DOE Award No.: DE-FE0023919.

7 ACRONYMS

Table 7-1: List of Acronyms

ACRONYM	DEFINITION
AAPG	American Association of Petroleum Geologists
APD	Application for Permit to Drill
APM	Application for Permit to Modify
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
CHNS	Carbon, Hydrogen, Nitrogen, Sulfur
CPP	Complimentary Project Proposal
DNA	Deoxyribonucleic Acid
DOE	U.S. Department of Energy
GC	Green Canyon
GHSZ	Gas Hydrate Stability Zone
IODP	International Ocean Discovery Program
JGR	Journal of Geophysical Research
JIP	Joint Industry Project
LDEO	Lamont-Doherty Earth Observatory
LOD	Letter of Determination
NEPA	National Environmental Policy Act
NETL	National Energy Technology Laboratory
NMR	Nuclear Magnetic Resonance
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
OCS	Outer Continental Shelf
OSTI	Office of Scientific and Technical Information
PCATS	Pressure Core Analysis and Transfer System
PCC	Pressure Core Center
PCTB	Pressure Core Tool with Ball Valve
PI	Principle Investigator
PM	Project Manager
PMP	Project Management Plan
PMRS	Pressure Maintenance and Relief System
QRPPR	Quarterly Research Performance and Progress Report
RBBC	Resedimented Boston Blue Clay
RPPR	Research Performance and Progress Report
RUE	Right-of-Use-and-Easement

SOPO	Statement of Project Objectives
UNH	University of New Hampshire
USCG	United States Coast Guard
USGS	United States Geological Survey
UT	University of Texas at Austin
UW	University of Washington
WR	Walker Ridge
XCT	X-ray Computed Tomography

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