NATIONAL ENERGY TECHNOLOGY LABORATORY

DOE Award No.: DE-FE0023919

Quarterly Research Performance Progress Report (Period Ending 9/30/2019)

Deepwater Methane Hydrate Characterization and Scientific Assessment

Project Period 3: 01/15/2018-09/30/2019

Submitted by:

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U.S. DEPARTMENT OF ENERGY | NATIONAL ENERGY TECHNOLOGY LABORATORY

Office of Fossil Energy

DISCLAIMER

1 ACCOMPLISHMENTS

This report outlines the progress of the fourth quarter of the fifth fiscal year of the project (Budget Period 3, Year 2). Highlights from this period include:

- **UT-GOM2-2 Planning:** UT, with Ohio State University and Pettigrew Engineering, completed an initial draft of the UT-GOM2-2 Scientific Drilling Program Operations Plan.

- **PCTB Development**: UT and the PCTB Development Team (including members of DOE, USGS, and Pettigrew Engineering), evaluated the results of the Bench Tests performed by Geotek in April-May, 2019. UT, with consultation from the PCTB Development Team, determined what modifications should be permanently incorporated into the PCTB based on the Bench Test results. UT requested that additional Bench Tests be conducted after modifications are made to vet the final PCTB configuration in a controlled environment prior to the Land Test. UT and Pettigrew Engineering developed a draft testing plan and schedule for the PCTB Land Test. UT and Schlumberger began contract negotiations.

- **Vessel of Opportunity**: UT determined that it was not feasible to pursue a logging-while-drilling (LWD) program during the proposed window of early 2020 aboard the Pacific Drilling Pacific Khamsin drillship under lease to Equinor ASA (Equinor). UT required a go/no-go decision by mid-July in order to complete contracting and permitting necessary for an early 2020 program. By this time, Equinor had not committed resources to assist UT with cost estimates and project planning, or indicated interest in proceeding with negotiations. Therefore, UT proceeded with the project budget period transition without consideration of a potential 2020 LWD program. If, in the near future, Equinor does commit resources towards further discussions with UT, the LWD program could not be accomplished in early 2020.

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.

We are currently updating project milestones to reflect changes made in the approved Budget Period 3 to Budget Period 4 transition. The Project Phase Milestones will be revised in the next QRPPR (period ending December 31, 2019) to reflect the updated Statement of Project Objectives (SOPO) and Project Management Plan (PMP).

Table 1-1: Previous Milestones

Project Phase	Milestone	Task	Milestone Description	Planned Completion	Actual Completion	Verification Method
Phase 1	M1A	1.0	Project Management Plan	03/2015	03/2015	Project Mgmt. Plan
	M1B	1.0	Project Kick-off Meeting	01/2015	12/2014	Presentation
	M1C	2.0	Site Location and Ranking Report	09/2015	09/2015	Phase 1 Report
	M1D	3.0	Preliminary Field Program Operational Plan Report	09/2015	09/2015	Phase 1 Report
	M1E	4.0	Updated CPP Proposal Submitted	05/2015	10/2015	Phase 1 Report
	M1F	2.0	Demonstration of a viable PCS Tool: Lab Test	09/2015	09/2015	Phase 1 Report
	M1G	--	Document results of BP1/Phase 1 Activities	12/2015	01/2016	Phase 1 Report
Phase 2	M2A	6.0	Complete Updated CPP Proposal Submitted	11/2015	11/2015	QRPPR
	M2B	6.0	Scheduling of Hydrate Drilling Leg by IODP	05/2016	05/2017	Report status to DOE PM
	M2C	7.0	Demonstration of a viable PCS tool for hydrate drilling through completion of land-based testing	12/2015	12/2015	PCTB Land Test Report (in QRPPR)
	M2D	8.0	Demonstration of a viable PCS tool for hydrate drilling through completion of a deepwater marine field test	01/2017	05/2017	QRPPR
	M2E	11.0	Update Field Program Operational Plan	02/2018	04/2018	Phase 2 Report
	M2F	--	Document results of BP2/Phase 2 Activities	04/2018	04/2018	Phase 2 Report

Table 1-2: Current Milestones

Project Phase	Milestone	Task	Milestone Description	Planned Completion	Actual Completion	Verification Method
Phase 3	M3A	14.0	Demonstration of a viable PCS tool for hydrate drilling: Lab Test	12/2018	--	PCTB Lab Test Report (in QRPPR)
	M3B	14.0	Demonstration of a viable PCS tool for hydrate drilling: Land Test	03/2019	--	PCTB Land Test Report (in QRPPR)
	M3C	15.0	Complete Refined Field Program Operational Plan Report	12/2018	--	QRPPR
	M3D	15.0	Completion of required Field Program Permit(s)	12/2018	--	QRPPR
	M3E	--	Document results of BP3/Phase 3 Activities	12/2019	--	Phase 3 Report

Table 1-3: Future Milestones

Project Phase	Milestone	Task	Milestone Description	Planned Completion	Actual Completion	Verification Method
Phase 4	M4A	16.0	Completion of planned field Research Expedition operations	03/2020	--	QRPPR
	M4B	17.0	Complete Preliminary Expedition Summary	09/2020	--	Report directly to DOE PM
	M4C	17.0	Complete Project Sample and Data Distribution Plan	05/2020	--	Report directly to DOE PM
	M4D	17.0	Contribute to IODP Proceedings Volume	09/2021	--	Report directly to DOE PM
	M4E	17.0	Initiate comprehensive Scientific Results Volume with appropriate scientific journal	09/2021	--	Report directly to DOE PM

1.2 WHAT WAS ACCOMPLISHMENTS UNDER THESE GOALS

1.2.1 PREVIOUS PROJECT PERIODS

Tasks accomplished in previous project phases (Phase 1 and Phase 2) are summarized in Table 1-4.

Table 1-4: Tasks completed during Phase 1 and Phase 2

Project Phase	Task	Description	QRPPR with Task Information
Phase 1	**Task 1.0**	**Project Management and Planning**	Y1Q1 - Y1Q4
	Task 2.0	**Site Analysis and Selection**	Y1Q1 - Y1Q4
	Subtask 2.1	*Site Analysis*	
	Subtask 2.2	*Site Ranking / Recommendation*	
	Task 3.0	**Develop Pre-Expedition Operational Plan**	Y1Q3 - Y1Q4
	Task 4.0	**Complete IODP CPP Proposal**	Y1Q2 - Y1Q4
	Task 5.0	**Pressure Coring and Core Analysis System Modifications and Testing**	Y1Q2 - Y1Q4
	Subtask 5.1	*Pressure Coring Tool with Ball Scientific Planning Workshop*	
	Subtask 5.2	*Pressure Coring Tool with Ball Lab Test*	
	Subtask 5.3	*Pressure Coring Tool with Ball Land Test Prep*	
Phase 2	**Task 1.0**	**Project Management and Planning *(Cont'd)***	Y2Q1 - Y4Q1
	Task 6.0	**Technical and Operational Support of CPP Proposal**	Y2Q1 - Y4Q1
	Task 7.0	**Cont'd. Pressure Coring and Core Analysis System Mods. and Testing**	Y2Q1 - Y3Q2
	Subtask 7.1	*Review and Complete NEPA Requirements (PCTB Land Test)*	
	Subtask 7.2	*Pressure Coring Tool with Ball Land Test*	
	Subtask 7.3	*PCTB Land Test Report*	
	Subtask 7.4	*PCTB Tool Modification*	
	Task 8.0	**Pressure Coring Tool with Ball Marine Field Test**	Y2Q1 - Y4Q1
	Subtask 8.1	*Review and Complete NEPA Requirements*	
	Subtask 8.2	*Marine Field Test Operational Plan*	
	Subtask 8.3	*Marine Field Test Documentation and Permitting*	
	Subtask 8.4	*Marine Field Test of Pressure Coring System*	
	Subtask 8.5	*Marine Field Test Report*	
	Task 9.0	**Pressure Core Transport, Storage, and Manipulation**	Y2Q2 - Y3Q3
	Subtask 9.1	*Review and Complete NEPA Requirements*	
	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	**Pressure Core Analysis**	Y3Q3 - Y4Q1
	Subtask 10.1	*Routine Core Analysis*	
	Subtask 10.2	*Pressure Core Analysis*	
	Subtask 10.3	*Hydrate Core-Log-Seismic Synthesis*	
	Task 11.0	**Update Pre-Expedition Operational Plan**	Y3Q3 - Y4Q1
	Task 12.0	**Field Program / Research Expedition Vessel Access**	Y3Q3

1.2.2 CURRENT PROJECT PERIOD

1.2.2.1 TASK 1.0 – PROJECT MANAGEMENT & PLANNING

Status: Ongoing

Coordinated the overall scientific progress, administration and finances of the project.

- Monitored and controlled project scope.
- Monitored and controlled project costs.
- Continued to coordinate response to DOE's request to explore the feasibility of a logging-while-drilling (LWD) program in early 2020 aboard the Pacific Drilling Pacific Khamsin drillship while under lease to Equinor.
- Completed BP3 to BP4 budget period transition:
    - Refined and updated the Statement of Project Objectives
    - Updated the project schedule through the anticipated end of project: September, 2024
    - Engaged subawards and vendors to obtain cost estimates
    - Developed cost projections and revised the overall project budget
    - Held meetings with DOE project manager to review draft budget period modification proposal
    - Submitted final budget period transition proposal to DOE on July 29, 2019

Communicated with project team and sponsors.

- Organized and coordinated regular project team and stakeholder meetings.
- Communicated development of a new expedition plan to the Sponsors, subawards, and project team
- Managed SharePoint sites, email lists, and archive/website.

Coordinated and supervised subcontractors and service agreements.

- Actively managed subcontractors and service agreements.
- Monitored progress and schedule of PCTB bench testing program.
  Initiated contracting discussions with Schlumberger for planned use of the Cameron Testing and Training Facility (CTTF) for the PCTB Land Test.
- Negotiated modification to all subcontract budgets and statements of work

Compared identified risks with those documented in the Project Management Plan to ensure all risks are identified and monitored. Communicated risks and possible outcomes to project team and stakeholders.

- Actively monitored project risks as needed and reported identified risks to project team and stakeholders.

1.2.2.2 TASK 6.0 – TECHNICAL & OPERATIONAL SUPPORT OF THE COMPLIMENTARY PROJECT PROPOSAL

Status: Closed (See *Task 15: Field Program / Research Expedition Preparation* for UT-GOM2-2 plan forward).

1.2.2.3 TASK 9.0 – PRESSURE CORE TRANSPORT, STORAGE, AND MANIPULATION

Status: Complete (See Task 13 for continued UT Pressure Core Center (PCC) activities).

1.2.2.4 TASK 10.0 – PRESSURE CORE ANALYSIS

Status: Ongoing

1.2.2.4.1 Subtask 10.4 – Continued Pressure Core Analysis

A. Pressurized Core Analysis

- UT with others solidified the lithofacies identification for GC 955. Three lithofacies were previously distinguished and referenced using the generic names of lithofacies 1, 2 and 3 (Figure 1-1). They are identified as silty clay, sandy silt, and clayey silt, respectively. Details will be published in Flemings et al, (Flemings et al. In review) and Meazell et al. (Meazell, Flemings, and Santra in review).
    - Silty clay
        - Grain size (hydrometer): D50: 1.4 µm, greater than 55% clay. Massive to laminated.
        - Habit: can have low (e.g. 3% or less) hydrate saturation in fractures
        - Location: Defined only in Core H005 1FB (above reservoir)
    - Sandy Silt:
        - Grain size (hydrometer): D50: 35-55 µm, 40% sand, less than 10% clay
        - Ripple-laminated. Ripples can contain clay drapes.
        - Habit: high hydrate saturation
        - Can contain mud layers less than 0.5 cm thick.
        - Fraction of sandy silt is very high (more than 90%).
    - Clayey Silt
        - Grain size (hydrometer): D50: 2-4.6 µm, Sand fraction: <<10%, Clay fraction: 38-52%
        - Structure-less to laminated clayey silt that can contain sandy siltstone layers less than 0.5 cm thick.

- o Habit: Low to no hydrate

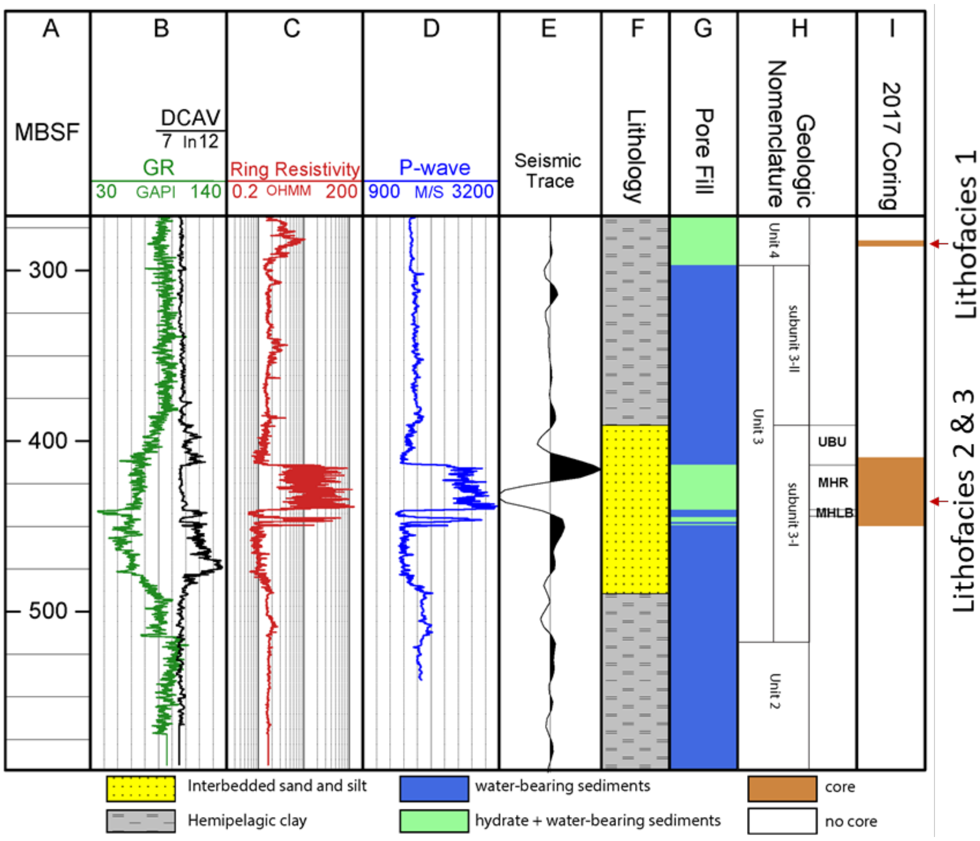

Figure 1-1. Location and previous generic names (far right) of GC 955 lithofacies from U

- UT with others, determined and summarized the PCATS and LWD porosities. Different porosity values may result from porosity measurements using PCATS (CT, p-wave, and gamma density), LWD, moisture and density measurements, and mercury porosimetry. PCATS porosity is calculated from the best-estimated bulk density (ρ_b) of the core sediments assuming only water and hydrate are present in the pores. The best-estimated bulk density (ρ_b) is adjusted from PCATS bulk density (ρ^*_b) that is an apparent value because the core sediments (i.e., bulk core volume V_b) do not occupy all of the volume with the core liner (V_t). The PCATS porosity is not measured in situ. The LWD porosity is calculated from the LWD bulk density (ρ_b) of the core sediments assuming only water and hydrate in the pores. The LWD porosity is an in-situ porosity as the LWD bulk density is measured in situ. But LWD porosity is subject to limitations because the LWD porosity is based on LWD values that average over a considerable vertical data sampling interval resolution. No core expansion is observed in the sandy silt lithofacies in the PCATS CT images. Both PCATS and LWD porosities, *n*, were determined to be 0.38 for core section H005-04FB-8 with a measured hydrate saturation of 83%. These methodologies are described in detail by Fang et al. (Fang et al. in review).

A.1. Quantitative Degassing and Gas Analysis

- UT continued quantitative depressurization of pressure core and analysis of the resultant gases. Samples were selected to fill in the gaps and increase the resolution of estimated variation in hydrate saturation downhole. During this quarter, we degassed intervals from core section UT-GOM2-1-H005-05FB-2; this core had a hydrate saturation of 93%.

A2. Permeability measurement of pressure core

- UT continued permeability measurement of UT-GOM2-1 pressure cores. During this quarter, we cut pressure core section UT-GOM2-1-H005-01FB-4 and UT UT-GOM2-1-H005-7FB-3. To measure the best-quality intrinsic permeability of 1FB-4 (silty clay lithofacies), we decided to use constant rate strain (CRS) test for 1FB4 (Figure 1-2). The X-ray CT images were obtained before and after CRS test (Figure 1-3). The measurement of effective permeability of 7FB-3 is still in process.

A3. Capillary behavior of GC 995 lithofacies, intact cores and compromised cores

- UT continued studying the capillary behavior of the silty clay lithofacies in the UT-GOM2-1 pressure cores (Figure 1-4).
- The capillary pressure of silty clay at 0 effective stress is larger than both reconstituted sandy silts and clayey silt.

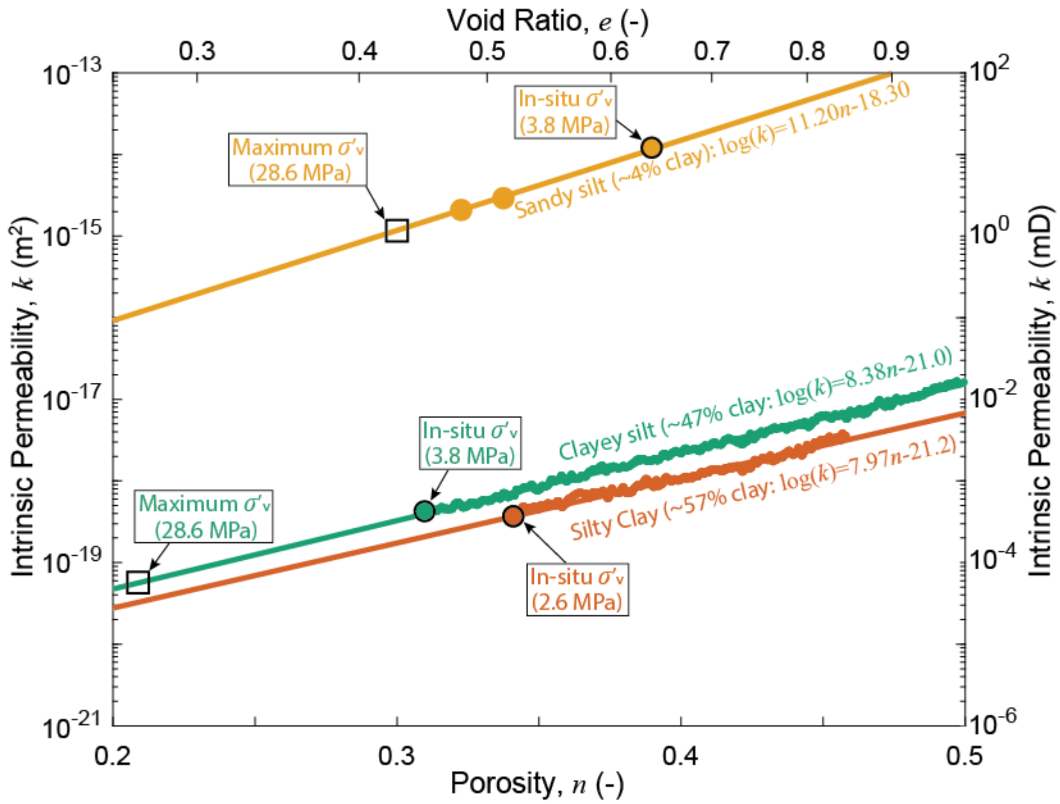

Figure 1-2. Intrinsic(k_o) permeabilities of reconstituted clayey silt (11FB-1, bluish green), reconstituted sandy silt (4FB-8, orange) and intact silty clay (1FB4, vermillion).

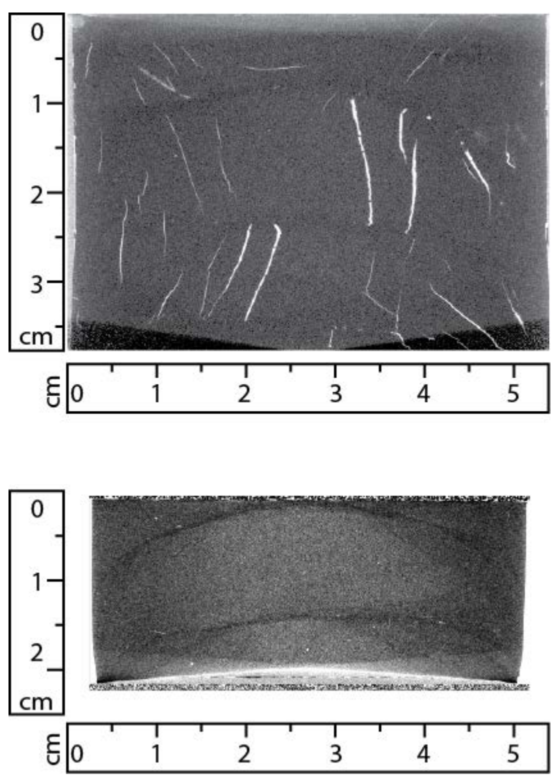

Figure 1-3. (a) CT image of 1FB4 after hydrate dissociation. (b) CT image of 1FB4 after CRS test.

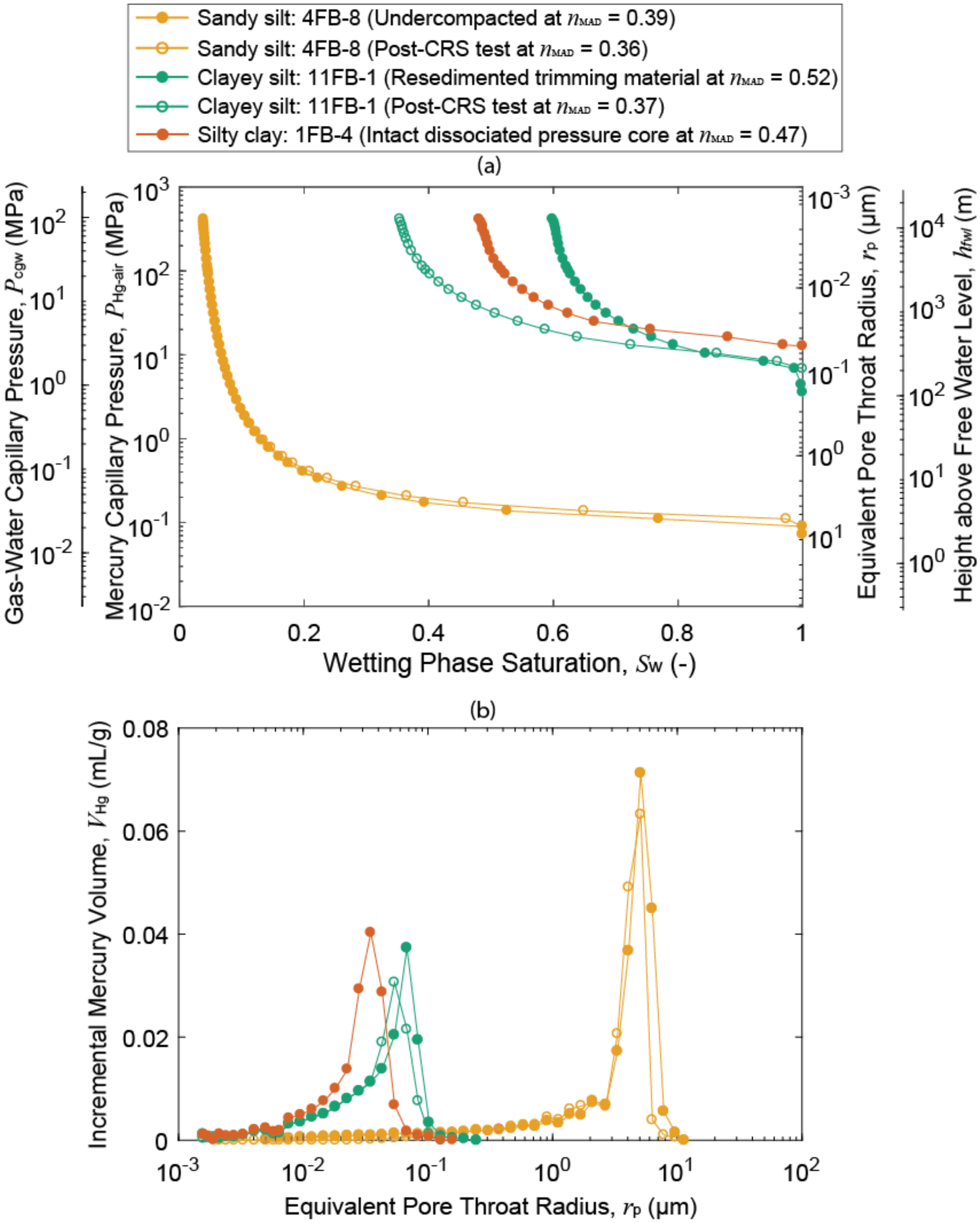

Figure 1-4. Results of Mercury injection capillary pressure measurement of reconstituted sandy silts from 4FB8, reconstituted clayey silt from 11FB1, and intact core 1FB4. (a) Hg-air entry pressure curves. (b) Incremental Mercury injection volume with pore throat diameter.

- UT conducted CT scanning and core logging of pressure core stored since the UT-GOM2-1 expedition to assess core degradation over time. An example is shown in Figure 1-5 where the top image shows a core as it was scanned using PCATS at Pore Fourchon in May, 2017. The lower image shows the core as it was scanned in September of this year.

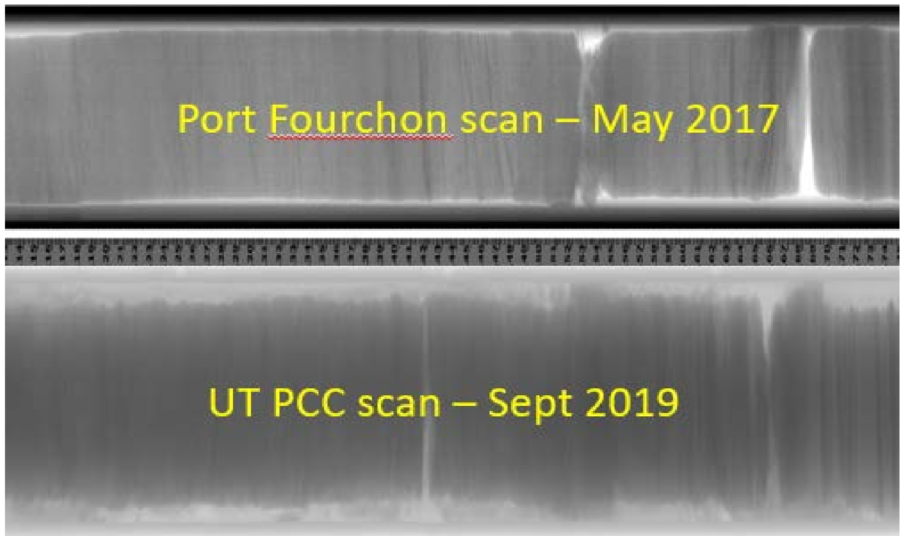

Figure 1-5 Top PCATS scan of H005-07FB-3 using PCATS at Port Fourchon in May of 2017. Bottom scan of H005-07FB-3 using Mini-PCATS in the PCC at UT in September of 2019.

A4. Pressure Core Distribution

- Oregon State, Georgia Tech, and the USGS (Figure 1-6) visited UT to perform experiments using the USGS BIO chamber (Santamarina et al. 2012) on UT-GOM-1 pressure cores with the goal of conducting high pressure sampling and anoxic depressurization to improve DNA and 16S RNA analysis of these low biomass sediments. The BIO chamber was successfully attached to Mini-PCATS. 16-17 cm core sections were transferred to the BIO chamber including one sample from each of the three identified UT-GOM2-1 lithofacies: silty clay, sandy silt, and clayey silt (Figure 1-7). Using the BIO chamber, sub-samples were scrapped under pressure and transferred to smaller bio-reactors and are currently stored at UT. Remaining sediment was placed in bags under N_2 atmosphere in a glove box, stored in liquid nitrogen and transferred to Texas A&M Corpus Christi to be analyzed in Brandi Kiel Reese's clean Lab. Results will be compared to those characterized at ExxonMobil which were rapidly depressurized during core recovery or quantitative degassing on the vessel and in Port Fourchon.

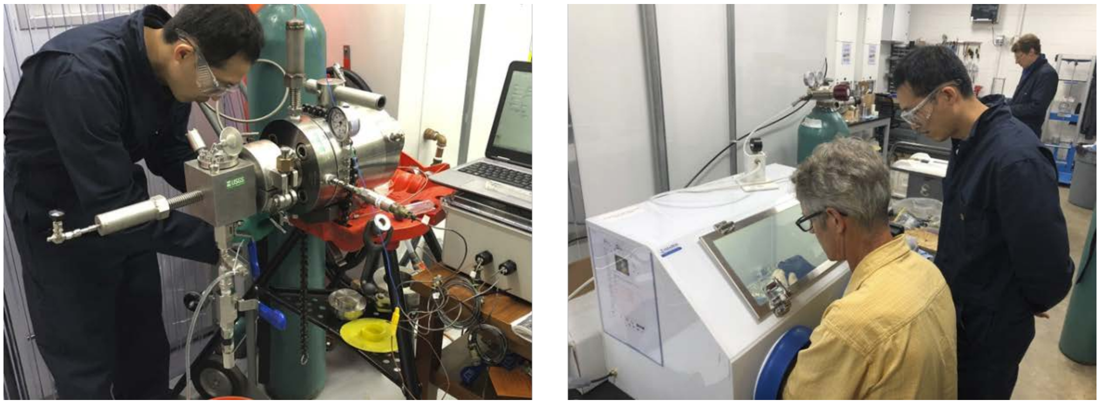

Figure 1-6 Photos of USGS and Oregon State researchers in the UT PCC working on the BIO chamber (left) and moving sediment to bags in an anoxic environmental chamber.

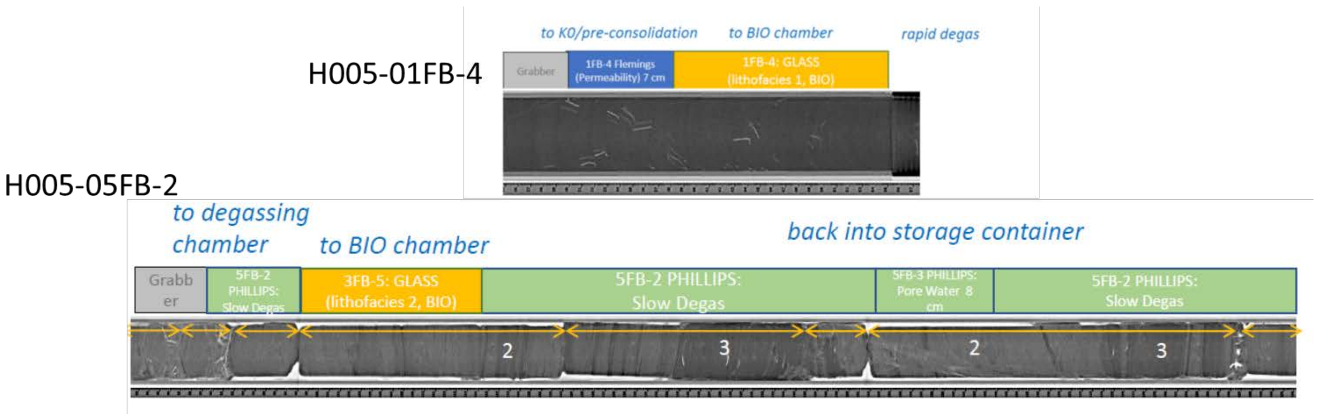

Figure 1-7 Sections of UT-GOM2-1 pressure core (identified in yellow) cut and transferred to the USGS Bio chamber (Santamarina et al. 2012).

- UT began executing the research agreement and material transfer agreement between UT and the National Institute of Advanced Industrial Science and Technology (AIST) (Japan) for the transfer of two previously identified high hydrate saturation 35 cm pressure core sections. Sections from UT-GOM2-1-3FB-5 and 5FB-3 (Figure 1-8) where transfer to two AIST chambers manufactured by Geotek (Figure 1-9). The chambers are attached to the UT pressure maintenance and relief system (PMRS) until AIST can transport them to Japan in the next quarter.

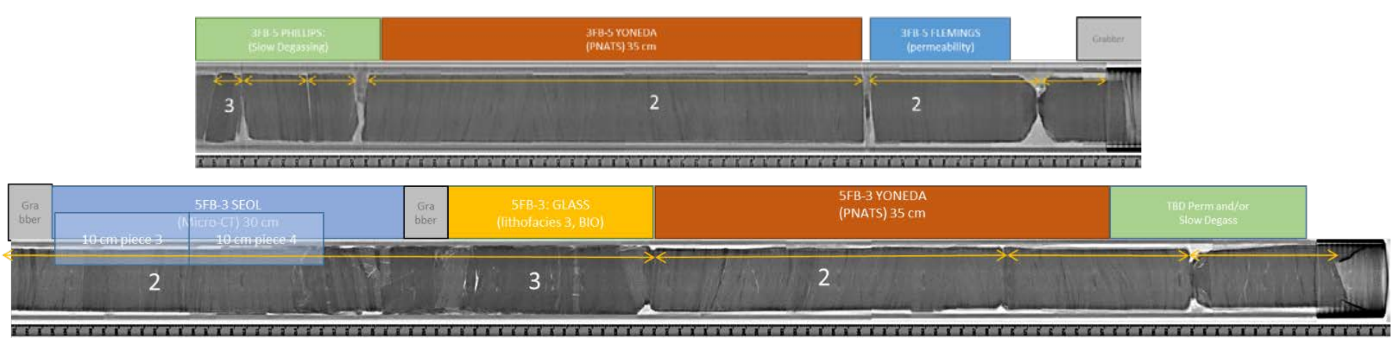

Figure 1-8 Sections of UT-GOM2-1 pressure core (identified in orange) cut and transferred to AIST chambers.

Figure 1-9 Photo of the AIST pressure chamber in the UT PCC.

B. Depressurized Pressure Core Analysis

- No update

1.2.2.4.2 Subtask 10.5 – Continued Hydrate Core-Log-Seismic Synthesis

- No update

1.2.2.4.3 Subtask 10.6 – Additional Analysis Capabilities

- The new pre-consolidation system delivered to UT in June, 2019 was installed and testing and is now in use. The system allows for multiple K0 permeameter samples to be cut and stored at applied effective stress in preparation for analysis and then loaded directly in to the K0 permeameter to measure permeability and compressibility. This subtask is now complete.

1.2.2.4.4 Other: Publications

- UT, Ohio State, Oregon State, University of Washington, Columbia, and University of New Hampshire all spent time this quarter preparing UT-GOM2-1 Data Reports. Data Report archive of experimental or observational data that is not captured in publications. The reports highlight methods and results but do not include any interpretation of the results. Table 1-5 shows the data reports. These reports will be reviewed and posted in the next quarter. When finalized, Data Reports will reside on the UT-GOM2-1 Expedition Report Electronic Volume (https://ig.utexas.edu/energy/genesis-of-methane-hydrate-in-coarse-grained-systems/expedition-ut-gom2-1/reports/) and in the UT-GOM2-1 Data Directory (http://www-udc.ig.utexas.edu/gom2/).

Table 1-5 Data Reports prepared during the quarter. Data Reports will reside on the UT-GOM2-1 Expedition Report Electronic Volume (https://ig.utexas.edu/energy/genesis-of-methane-hydrate-in-coarse-grained-systems/expedition-ut-gom2-1/reports/) and in the UT-GOM2-1 Data Directory (http://www-udc.ig.utexas.edu/gom2/)

Authors	Data Report
Cook, Sawyer	X-Ray Diffraction of Sediments from Green Canyon Block 955, Gulf of Mexico
Cook, Sawyer	Surface area and pore size measurements of two hydrate-bearing sediment samples from Green Canyon Block 955 (GC955), Gulf of Mexico
Cook, Sawyer	High-Resolution Microscopy Images of Sediments from Green Canyon Block 955, Gulf of Mexico
Cook, Darrah	Noble Gas and Hydrocarbon Composition of Gases Dissociated from Pressurized Cores from GC 955, Gulf of Mexico
Divins, Johnson, Cook Sawyer	UT-GOM2-1 Lithostratigraphic Core Description Logs at Site GC 955, Holes H002 and H005
Divins, Johnson	UT-GOM2-1 Sediment Grain Size Measurements at Site GC 955, Holes H002 and H005
Colwell	Effect of sample collection and X-ray scanning on geological cores
Goldberg	Prestack Waveform Inversion at GC 955: Trials and sensitivity of PWI to high-resolution seismic data
Solomon	Pore Water Geochemistry
Thomas	UT-GOM2-1 Pressure Coring

- UT submitted revisions and additional manuscripts to Vol. 1 of the AAPG Bulletin special issue dedicated to UT-GOM2-1 including:
    - *Flemings et al. (in review) Concentrated hydrate in a deepwater Gulf of Mexico turbidite reservoir: initial results from the UT-GOM2-1 Hydrate Pressure Coring Expedition, American Association of Petroleum Geologist Bulletin*
    - *Phillips et al. (in review) Extremely high concentration of methane hydrate in a deepwater silt reservoir from the northern Gulf of Mexico (Green Canyon 955), American Association of Petroleum Geologist Bulletin*
    - *Meazell et al., under revision, Silt-rich channel-levee hydrate reservoirs of Green Canyon 955, American Association of Petroleum Geologist Bulletin*
    - *Thomas (in press) Pressure-coring operations during Expedition UT-GOM2-1 in Green Canyon Block 955, northern Gulf of Mexico, American Association of Petroleum Geologist Bulletin*
    - *Fang et al. (in review) Petrophysical Properties of the GC 955 Hydrate Reservoir Inferred from Reconstituted Sediments: Implications for Hydrate Formation and Production, American Association of Petroleum Geologist Bulletin*
- Ohio State is working on three AAPG submissions covering XCT saturation, gas sampling, and the effects of degassing on gas geochemistry

1.2.2.5 TASK 13.0 – MAINTENANCE & REFINEMENT OF PRESSURE CORE TRANSPORT, STORAGE, & MANIPULATION

Status: Ongoing

Continued to store, stabilize, and perform tests on pressure core acquired from UT-GOM2-1 Marine Field Test (May-June 2017). Performed weekly pressure checks on pressure chambers.

1.2.2.5.1 Subtask 13.1: Hydrate Core Manipulator and Cutter Tool

- Six cores scanned and subsampled with the aid of the new CT scanner system:
    1. Core H005-1FB-4 – BIO Chamber, K0 samples
    2. Core H005-5FB-2 – BIO Chamber, Degas samples
    3. Core H005-5FB-3 – BIO Chamber, AIST samples
    4. Core H005-6FB-3 – BIO Chamber, Degas, Raman Chamber samples
    5. Core H005-3FB-5 – AIST, Degas samples
    6. Core H005-7FB-3 – Scanned in preparation for K0 sample cutting
- Core 1FB-4 K0 sample placed in Preconsolidation System, system functioned well.
- AIST Storage Chambers
    1. Pressure tested for BIO sampling run. Chambers held pressure.
    2. Two samples transferred, each approximately 35 cm in length
- USGS BIO sampler chamber
    1. Four core sections sample under pressure, each approximately 16 cm in length
    2. Same sections sampled at atmospheric pressure, in an anoxic environment
- System cleaned and cutter blades replaced after each sampling.
  Seals and O-rings replaced in mPCATS actuator drive system.

1.2.2.5.2 Subtask 13.2: Hydrate Core Effective Stress Chamber

- Test Sections cleaned and reset for upcoming K0 sampling of Core 7FB-3
- One pressure core sample from core H005-1FB-4 was extruded and sealed for storage on the Preconsolidation System.

1.2.2.5.3 Subtask 13.3: Hydrate Core Depressurization Chamber

- Completed two degassing tests during Q3:
    1. H005-5FB-2
    2. H005-3FB-5

1.2.2.5.4 Subtask 13.4: Hydrate Core Transport Capability for Field Program

- Future Task (UT-GOM2-2).

1.2.2.5.5 Subtask 13.5: Maintenance and Expansion of Pressure Core Storage Capability

- Continued to assess current capabilities and requirements for storing pressure cores that will be acquired in during UT-GOM2-2.

1.2.2.5.6 Subtask 13.6: Transportation of Hydrate Core (Field Program)

- Future Task (UT-GOM2-2).

1.2.2.5.7 Subtask 13.7: Storage of Hydrate Cores (Field Program)

- Future Task (UT-GOM2-2).

1.2.2.5.8 Subtask 13.8: Hydrate Core Distribution

- Future Task (UT-GOM2-2).

1.2.2.6 TASK 14.0 – PERFORMANCE ASSESSMENT, MODIFICATIONS, AND TESTING OF DOE PRESSURE CORING SYSTEM

Status: Ongoing

1.2.2.6.1 Subtask 14.1: PCTB Lab Testing and Analysis

The PCTB Development Team (including members of UT, DOE, USGS, and Pettigrew Engineering) held a web-conference on July 18, 2019 to review the results of the PCTB Bench Tests performed by Geotek in April-May, 2019. The PCTB Development Team:

1. Reviewed PCTB performance issues observed during 2017 UT-GOM2-1 Marine Test,
2. Reviewed the methodologies and results of the bench tests performed by Geotek in 2019,
3. Reviewed Geotek's recommendations for PCTB modifications (**Error! Reference source not found.**),
4. Determined which proposed PCTB modifications to authorize (**Error! Reference source not found.**), and
5. Identified the need for additional bench testing to be completed prior to the PCTB Land Test.

UT held a web-conference with Geotek on September 5, 2019. In this meeting, UT conveyed which proposed modifications to the PCTB would be authorized and those that were declined or needed further evaluation (**Error! Reference source not found.**).

Additionally, in the September 5, 2019 meeting, UT proposed the need for additional bench tests at the Geotek testing facility prior to the Land Test. UT conveyed the decision that it is critical to bench test the final PCTB configuration that will be land-tested and eventually deployed at sea during the UT-GOM2-2 Scientific Drilling Program. Therefore, once approved modifications to the PCTB have been made, supplemental bench testing will be required to:

1. Confirm the final shear pin design,

2. Confirm the flow diverter seals work as intended, and
3. Determine the effect of seawater and drilling mud on the performance of the upgraded PCTB.

Geotek is currently developing a statement of work for the approved PCTB modifications and supplemental bench tests. These tests will be conducted in the next reporting period.

1.2.2.6.2 Subtask 14.2 Pressure Coring System Modifications/Upgrades

Geotek proposed six permanent modifications be incorporated into the PCTB, based on the results of the bench tests performed in April-May, 2019. UT, with consultation from the PCTB Development Team approved five of the proposed modifications, as shown in Table 1-6.

Table 1-6: Proposed and Approved Modifications to PCTB

No.	Proposed Modification	Decision
1	All sliding parts should be coated with a friction reducing coating.	**Accept** - All sliding parts should be coated.
2	Single Trigger Mechanism is vetted and should be kept.	**Accept** - The single trigger mechanism should be permanently incorporated in the PCTB.
3	Point seals should replace lip seals in the sleeve valve.	**Accept** - Point seals should replace lip seals
4	Modify the QLS, bearing housing, and lift sub to run the prototype diverter seal. Also modify the Regulator Sub so the seal cannot inadvertently seal and cause hydraulic lock	**Accept** - The issues with the diverter seal need to be corrected
5	Shear pin works as designed and allows a dwell after ball valve closure. It also may help unlatch and release the tool from the BHA by causing a slide hammer like action.	**Partially Reject** - We recognize the need of the shear pin to keep the IT plug from moving while sealing the autoclave but have concerns about the shear value necessary to see/create the dwell for ball closure. Request a lower yield shear pin design so that redesign of the overtravel spring is not required.
6	Overtravel Spring needs to be redesigned to prevent the PCTB from unlatching from the BHA before the tool is fully stroked, sealed, and pressure section fired. It additionally needs to unlatch from the BHA easily.	**Reject** - We are concerned about ramifications of redesigning overtravel spring. We do not think we need a shear value higher than 500-600lbs, thus we do not think we need to redesign the overtravel spring.

1.2.2.6.3 Subtask 14.3: PCTB Land-Based Testing and Analysis

The PCTB Land Test at the Schlumberger Cameron Testing and Training Facility (CTTF) is scheduled for March, 2020. In this reporting period, UT and Pettigrew Engineering continued planning activities for the Land Test. A draft Test Procedure and Time Estimate were developed. Both documents were shared with Geotek and Schlumberger.

The Land Test is projected to occur over 8 24-hour days at Schlumberger CTTF in Cameron, Texas. The testing procedure requires 3 coring runs of the PCTB-FB and 3 coring runs of the PCTB-CS to be carried out to test core recovery capability in simulated field conditions. The PDT/T2P will also be tested to characterize the overall PDT and T2P function under simulated field conditions. The testing procedure requires two tests of the PDT and T2P. The current testing plan includes a provision for 3 coring runs to test the Geotek rotary core barrel (G-RCB) with the PCTB-FB. However, recent discussions between UT, Geotek, and Pettigrew Engineering have indicated that field testing of the G-RCB may not be necessary if the G-RCB can be tested at the Geotek testing facility in Salt Lake City, Utah.

1.2.2.7 TASK 15.0 – FIELD PROGRAM / RESEARCH EXPEDITION OPERATIONS

Status: In Progress

1.2.2.7.1 Subtask 15.1: Review and Complete NEPA Requirements

Future Task.

1.2.2.7.2 Subtask 15.2: Finalize Detailed Operational Plan for Field Program

- In this reporting period, UT with Ohio State and Pettigrew Engineering completed a draft UT-GOM2-2 Scientific Drilling Program Operations Plan.

- UT coordinated a total of three teleconferences with personnel from Ohio State and Pettigrew Engineering:
    1. On July 22, 2019 the team met to develop the Operations Plan outline and assign section leads.
    2. On August 12, 2019 the team reviewed the initial draft, collected feedback, identified key areas requiring further development.
    3. On August 22, 2019 the team met for a final review of the entire document.
    4. Subsequently, individual sections met on an as-needed basis to complete the draft.

- By the close of this quarter the operations plan was approximately 95% complete, only requiring minor modifications and edits to certain figures and tables.

- The draft Executive Summary (UT-GOM2-2 Operations Plan, Section 1.0) is provided below:

  Two wells will be drilled in Walker Ridge Block 313 in the northern Gulf of Mexico. The surface location of each well will be within approximately 100 feet of an LWD well previously drilled with Logging While Drilling (LWD) technology as part of the 2009 JIP II Methane Hydrates LWD program. Water depths at the locations range between 6,460 and 6,580 feet msl. In the first well (H002), multiple pressure-cores will be obtained from three hydrate-bearing targets (Red, Blue, & Orange sands) using the PCTB-FB tool. The depth of the targets ranges from 957 to 2,710 fbsf. In addition, intermittent spot pressure-cores will *be acquired throughout the borehole. In the second well (G002), both conventional cores (RCB, APC, and XCB tools), pressure cores (PCTB-CS and PCTB-FB tools), and temperature and pressure measurements (T2P tool) will be obtained using the PCTB-CS and PCTB-FB BHAs. The primary targets include the top hole to ~250 fbsf and three hydrate-bearing sands (Aqua, Blue, and Kiwi sands). The depths of the target hydrate sands range from 351 to 3,082 fbsf. In addition, intermittent spot pressure-cores, temperature & pressure measurements, and conventional cores will be acquired. The wells will be permanently abandoned at the conclusion of the program. There will be no pipelines or other facilities installed that would require decommissioning.*

The Geotek Ltd. Pressure Core Analysis and Transfer System (PCATS) will be used onboard to perform characterization, cutting, and transfer of pressure cores. Sections of pressure cores will be selected for quantitative degassing, with gas chromatograph, or preserved and shipped for future analysis at UT and other institutions. Pressure cores will be demobilized via supply vessel. PCATS and quantitative degassing will also be used dockside to complete the processing of any remaining pressure core not addressed onboard.

The Geotek Ltd MSCL-IR scanner will be used to scan conventional core as the reach the rig floor. Core will be cut into 1.5 m sections. Pore water squeezing will be conducted on sections of conventional core onboard to assess ephemeral properties. Pore water samples will also be preserved for additional analysis on shore. Conventional core samples will also be cut and preserved for moisture and density, microbiology, and other physical properties. Dockside, conventional core will be scanned using the Geotek Ltd. MSCL and shipped for 3D CT imaging. After imaging, core will be split, photographed, and scanned. A team of scientist will conduct conventional core analysis and preserve plugs of material for future analysis at various institutions.

The scientific program will require approximately 11 weeks to complete (Table 1-7). The program begins with a one-week period for staging equipment in the port of embarkation. Mobilization, requiring 3.7 days, involves transporting equipment and personnel to the drilling vessel and preparing for field science operations. The onboard drilling and science program will require 31.8 days, followed by demobilization of personnel and equipment, requiring 2.9 days. A dockside core analysis program will then be initiated, requiring an estimated 30 days to complete. This is followed by approximately 3 days of final demobilization.

Table 1-7. UT-GOM2-2 Scientific Drilling Program Schedule.

No.	TASK	LOCATION	ESTIMATED DURATION (DAYS)	CUMULATIVE DURATION (DAYS)
1	Premobilization Staging	Port of Embarkation	7.0	7.0
2	Mobilization	Port of Embarkation	3.7	10.7

3	*H002 Coring Program*	*Walker Ridge 313*	*15.2*	*25.9*
4	*G002 Coring Program*	*Walker Ridge 313*	*16.6*	*42.5*
5	*Stage 1 Demobilization*	*Walker Ridge 313*	*2.9*	*45.4*
6	*Dockside Core Processing*	*Port Fourchon, LA*	*30.0*	*75.4*
7	*Stage 2 Demobilization*	*Port Fourchon, LA*	*3.0*	*78.4*

The UT-GOM2-2 Scientific Drilling Program is part of the Deepwater Methane Hydrate Characterization & Scientific Assessment Project (DE-FE0023919), funded by the Department of Energy and advised by the United States Geological Survey (USGS) and the Bureau of Ocean Energy Management (BOEM). The objective of the 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 through the planning and execution of drilling, coring, logging, testing and analytical activities that assess marine methane hydrate deposits in the Gulf of Mexico Continental Margin. The UT-GOM2-2 Scientific Drilling Program fulfills Task 16.0 of the Deepwater Methane Hydrate Characterization & Scientific Assessment Statement of Project Objectives.

- UT also started to develop the UT-GOM2-2 Science and Sample Distribution plan including detailed science objectives, core types and coring locations, core cutting and preservation, core analyses and methodology, and distribution of cores and other samples.

1.2.2.7.3 Subtask 15.3: Permitting for Field Program

- No activity this period.

1.2.2.7.4 Subtask 15.4: Assemble and Contract Pressure Coring Team Leads for Field Program

- No activity this period.

1.2.2.7.5 Subtask 15.5: Contract Project Scientists and Establish Project Science Team for Field Program

- Future Task.

1.2.2.7.6 New Subtask: Vessel of Opportunity for 2020 LWD Program

- Throughout early July, UT continued efforts to obtain resources and information from Equinor that would allow further planning and feasibility-study of a 2020 LWD program aboard the Pacific Drilling Pacific Khamsin drillship while under long-term lease to Equinor.
- After the last in-person meeting between UT and Equinor in the previous reporting period, Equinor informed UT that at the time they did not have time or resources to commit to further discussions with UT. Furthermore, Equinor indicated that any further information or discussion should be at Equinor’s discretion once their path forward with the Pacific Khamsin became clear, and only then if they had a large gap in the schedule that would allow evaluation for further options.

- UT required a go/no-go decision my mid-July in order to initiate and complete required contracting and permitting for a 2020 LWD program. Because, by this time, Equinor had not indicated further interest in continuing with negotiations or committed resources to assist UT with cost estimates and project planning. UT determine that if, in the near future, Equinor does commit resources towards further discussions with UT, the LWD program could not be accomplished in early 2020.

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 continue to execute the project in accordance with the approved PMP, 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 PMP.

Key project management and planning goals for the next quarter include:

- Update the Project Management Plan to reflect changes in the Statement of Work and schedule made during the Budget Period 3 to Budget Period 4 transition.
- Complete the Phase 3 performance report and submit to DOE.
- Continue to coordinate and plan Task 14.3: PCTB Land-Based Testing and Analysis.
- Continue to coordinate development of technical requirements and scope of work for a drilling vessel.
- Complete budget and planning documents required for the BP3-BP4 budget period transition. UT intends to deliver the formal packaged of necessary supporting information to DOE by late July, 2019.

1.3.2 TASK 6.0: TECHNICAL & OPERATIONAL SUPPORT OF COMPLIMENTARY PROJECT PROPOSAL (CONT'D FROM PRIOR PHASE)

- UT will continue to plan and prepare for the UT-GOM2-2 expedition independently. Technical and operational support of the UT-led UT-GOM2-2 field program will be conducted under Task 15 – Field Program Preparation.

1.3.3 TASK 10.0: PRESSURE CORE ANALYSIS (CONT'D FROM PRIOR PHASE)

1.3.3.1 SUBTASK 10.4: CONTINUED PRESSURE CORE ANALYSIS

A. Pressure Core Analysis

- UT will continue looking into pressure core degradation over time. Results may feed into UT-GOM2-2 planning, specifically the PCATS confining fluid used on-board and or at UT.

A1. Quantitative Degassing and Gas Analysis

- We will continue the quantitative depressurization of pressure core and gas analysis:

- We will continue to uncompromised, high quality core, to increase resolution of estimated variation in hydrate saturation downhole. We will also quantitatively degas samples to provide constraints on adjacent samples selected for permeability.

A2. Steady-state Permeability Tests

- UT will continue the k0 permeability measurement of pressure core sample 7FB-3.
    1. We will perform the pressure core analysis of 7FB-3. This analysis will include (1) measure the effective permeability of pressure core at in-situ stress; (2) measure the intrinsic permeability at in-situ stress; (3) CT-scan of the core after core is taken out of the Ko system; (4) laser grain size distribution; (5) Hg-porosity measurement; (6) Mercury injection capillary measurement.

A4. Pressure Core and Data Distribution

- Once AIST has picked up their pressure cores this subtask will be complete. All pressure cores have been distributed from UT to other institutions.

1.3.3.2 SUBTASK 10.5: CONTINUED HYDRATE CORE-LOG-SEISMIC SYNTHESIS

- OSU will continue work to see if there is significant lateral heterogeneity between holes, especially to see if a tie can be done using compressional velocity measurements.

1.3.3.3 SUBTASK 10.6: ADDITIONAL CORE ANALYSIS CAPABILITIES

- The Pre-consolidation System will be installed and tested.
    - System will be upgraded from 0.5 L to 3.0 L accumulators once the larger accumulators are sent to UT by Geotek.
- UT will order critical consumable parts to avoid (potential) long Mini-PCATS shut down time.

1.3.3.4 OTHER: PUBLICATIONS

- In support of the AAGP Special Publication Vol I and II, Cook and Flemings will continue to participate as Special Volume Editors.
- UT and subcontractors will continue working on UT-GOM2-1 Data Reports.
- UT and subcontractors will continue working on submissions to the AAPG volumes.

1.3.4 TASK 13.0: MAINTENANCE AND REFINEMENT OF PRESSURE CORE TRANSPORT, STORAGE, & MANIPULATION

- Mini PCATS, the PMRS, and all storage chambers will undergo continued observation and maintenance at regularly scheduled intervals and on an as-needed basis.

1.3.5 TASK 14.0: PERFORMANCE ASSESSMENT, MODIFICATIONS, AND TESTING OF DOE PRESSURE CORING SYSTEM

- In the next reporting period, approved modifications will be permanently incorporated into the PCTB.
- Supplemental Bench Tests will be conducted to vet the final PCTB design that will be land-tested and deployed at sea during the UT-GOM2-2 Scientific Drilling Program.
- UT will develop an Operation's Plan for the Land Test that will occur at the Schlumberger Cameron Testing and Training Facility (CTTF) in March, 2020. UT and Schlumberger will execute a contract agreement providing UT access to CTTF for the Land Test scope of work.

1.3.6 TASK 15.0: FIELD PROGRAM PREPARATIONS

- UT will develop vessel requirements and scope of services that will be used as the basis for vessel acquisition.
- Permitting has currently been put on hold while the UT-GOM2-2 Operations Plan is being finalized. In the next reporting period OSU and UT will continue working to fulfill permitting requirements for Terrebonne locations as required by the revised operations plan. We assume that UT-GOM2-2 will occur in 2022 as directed by DOE.
- UT will solicit review of the UT-GOM2-2 Operations Plan from Geotek and the GOM2 Advisory Team. The UT-GOM2-2 Operations Plan will then be finalized and submitted to DOE.
- UT will continue to develop the UT-GOM2-2 Science and Sample Distribution which will be reviewed with subcontractors, the Core Analysis Team, and the Technical Advisory Group.
    - Oregon State continued developing the microbiology plan and protocols for the evaluation of low biomass samples from the GOM2-2 expedition including: 1) determination of best practices for minimizing the effects of polymerase chain reaction inhibitors present in sediment cores (as needed to optimize DNA-based community characterization studies, and 2) determination of primary contaminants in the Colwell Geomicrobiology lab at Oregon State such that these taxa can be recognized and distinguished from authentic microbes in Gulf of Mexico sample material.

2 PRODUCTS

2.1 PUBLICATIONS, CONFERENCE PAPERS, AND PRESENTATIONS

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*. doi: 10.1130/G45609C.1

Cook. A. E., and Waite, W. F., (2018). Archie's saturation exponent for natural gas hydrate in coarse-grained reservoirs. Journal of Geophysical Research. DOI: 10.1002/2017JB015138

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.

Cook, A.E., & Sawyer, D. (2015). The mud-sand crossover on marine seismic data. Geophysics, v. 80, no. 6, A109-A114. 10.1190/geo2015-0291.1.

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

Yi Fang, 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 K_0 permeameter. Presented at Gordon Research Conference on Gas Hydrate, Galveston, TX. Feb 24- Mar 02, 2018.

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.

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, UT-GOM2-1 Hydrate Pressure Coring Expedition Report. University of Texas at Austin Institute for Geophysics, Austin, TX. https://ig.utexas.edu/energy/genesis-of-methane-hydrate-in-coarse-grained-systems/expedition-ut-gom2-1/reports/

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.

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.

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.E., Sawyer, D., Küçük, H.M., and Goldberg, D.S. (2017). The character and amplitude of bottom-simulating reflectors in marine seismic data. Earth & Planetary Science Letters, doi:http://dx.doi.org/10.1016/j.epsl.2016.10.058

Hillman, J.I.T., Cook, A.E., Daigle, H., Nole, M., Malinverno, A., Meazell, K. and Flemings, P.B. (2017). Gas hydrate reservoirs and gas migration mechanisms in the Terrebonne Basin, Gulf of Mexico. Marine and Petroleum Geology, doi:10.1016/j.marpetgeo.2017.07.029

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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.

Jiachao Liu 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

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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.

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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.

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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.

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2.2 WEBSITE(S) OR OTHER INTERNET SITE(S)

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

2.3 TECHNOLOGIES OR TECHNIQUES

Nothing to report.

2.4 INVENTIONS, PATENT APPLICATIONS, AND/OR LICENSES

Nothing to report.

3 CHANGES/PROBLEMS

3.1 CHANGES IN APPROACH AND REASONS FOR CHANGE

Nothing to report.

3.2 ACTUAL OR ANTICIPATED PROBLEMS OR DELAYS AND ACTIONS OR PLANS TO RESOLVE THEM

Nothing to report.

3.3 CHANGES THAT HAVE A SIGNIFICANT IMPACT ON EXPENDITURES

Nothing to report.

3.4 CHANGE OF PRIMARY PERFORMANCE SITE LOCATION FROM THAT ORIGINALLY PROPOSED

Nothing to report.

4 SPECIAL REPORTING REQUIREMENTS

4.1 CURRENT PROJECT PERIOD

Task 1.0 – Revised Project Management Plan

Subtask 14.3 – PCTB Land Test Report

Subtask 15.2 – Final Research Expedition Operational 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 – IODP Proceedings Expedition Volume

Subtask 17.4 – Expedition Scientific Results Volume

5 BUDGETARY INFORMATION

Phase 3 (Budget Period 3) cost summary is outlined below (Table 5-1). Note: Y4 in the table is Y5 of the overall project including BP1.

Table 5-1: Phase 3 (Budget Period 3) Cost Profile

Baseline Reporting Quarter			Budget Period 3					
			Y4Q2		Y4Q3		Y4Q4	
			01/01/18-03/31/18		04/01/18-06/30/18		07/01/18-09/30/18	
			Y4Q2	Cumulative Total	Y4Q3	Cumulative Total	Y4Q4	Cumulative Total
Baseline Cost Plan								
Federal Share			$ 1,066,233	$ 22,778,167	$ 788,190	$ 23,566,357	$ 1,270,466	$ 24,836,823
Non-Federal Share			$ 358,558	$ 20,625,085	$ 358,558	$ 20,983,643	$ 358,558	$ 21,342,201
Total Planned	Phase 2 Extension		$ 1,424,791	$ 43,403,252	$ 1,146,748	$ 44,550,000	$ 1,629,024	$ 46,179,024
Actual Incurred Cost								
Federal Share			$ 394,532	$ 21,967,474	$ 433,578	$ 22,401,052	$ 518,480	$ 22,919,532
Non-Federal Share			$ 211,985	$ 20,999,161	$ 207,161	$ 21,206,322	$ 155,856	$ 21,362,178
Total Incurred Cost			$ 606,517	$ 42,966,635	$ 640,739	$ 43,607,374	$ 674,336	$ 44,281,710
Variance								
Federal Share			$ (671,701)	$ (810,693)	$ (354,612)	$ (1,165,305)	$ (751,986)	$ (1,917,291)
Non-Federal Share			$ (146,573)	$ 374,076	$ (151,397)	$ 222,679	$ (202,702)	$ 19,977
Total Variance			$ (818,274)	$ (436,617)	$ (506,009)	$ (942,626)	$ (954,688)	$ (1,897,314)
Baseline Reporting Quarter	Budget Period 3							
	Y5Q1		Y5Q2		Y5Q3		Y5Q4	
	10/01/18-12/31/18		01/01/19-03/31/19		04/01/19-06/30/19		07/01/19-09/30/19	
	Y5Q1	Cumulative Total	Y5Q2	Cumulative Total	Y5Q3	Cumulative Total	Y5Q4	Cumulative Total
Baseline Cost Plan								
Federal Share	$ 5,665,774	$ 30,502,597	$ 458,336	$ 30,960,933	$ 6,464,836	$ 37,425,769	$ 458,336	$ 37,884,105
Non-Federal Share	$ 496,980	$ 21,839,181	$ 496,980	$ 22,336,161	$ 496,980	$ 22,833,140	$ 496,980	$ 23,330,120
Total Planned	$ 6,162,754	$ 52,341,778	$ 955,316	$ 53,297,094	$ 6,961,816	$ 60,258,909	$ 955,316	$ 61,214,225
Actual Incurred Cost								
Federal Share	$ 1,094,173	$ 24,013,705	$ 524,054	$ 24,537,759	$ 904,289	$ 25,442,048	$ 627,763	$ 26,069,811
Non-Federal Share	$ 351,676	$ 21,713,855	$ 116,074	$ 21,829,929	$ 262,542	$ 22,092,471	$ 423,472	$ 22,515,943
Total Incurred Cost	$ 1,445,849	$ 45,727,560	$ 640,128	$ 46,367,688	$ 1,166,831	$ 47,534,519	$ 1,051,235	$ 48,585,753
Variance								
Federal Share	$ (4,571,601)	$ (6,488,892)	$ 65,718	$ (6,423,174)	$ (5,560,547)	$ (11,983,721)	$ 169,427	$ (11,814,294)
Non-Federal Share	$ (145,303)	$ (125,326)	$ (380,906)	$ (506,232)	$ (234,438)	$ (740,670)	$ (73,508)	$ (814,177)
Total Variance	$ (4,716,905)	$ (6,614,218)	$ (315,188)	$ (6,929,406)	$ (5,794,985)	$ (12,724,391)	$ 95,919	$ (12,628,472)

*Note: Methodology updated with Y5Q2 report; Cumulative totals now reflect those of overall project

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7 ACRONYMS

Table 7-1: List of Acronyms

ACRONYM	DEFINITION
AAPG	American Association of Petroleum Geologists
AIST	National Institute of Advanced Industrial Science and Technology
ASW	Air-Saturated Water
BET	Brunauer-Emmett-Teller
BGS	British Geological Survey
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
CFD	Computational Fluid Dynamics
CFR	Code of Federal Regulation
CNPL	Calcareous Nannofossil Plio-Pleistocene
CPP	Complimentary Project Proposal
CT	Computed Tomography
CTTF	Cameron Test Testing Facility
DOE	U.S. Department of Energy
ECORD	European Consortium for Ocean Research Drilling
EFB	ECORD Facility Board
EPSP	Environmental Protection and Safety Panel
ESSAC	ECORD Science Support and Advisory Committee
ESO	European Science Operator
GHSZ	Gas Hydrate Stability Zone
HPTC	High Pressure Temperature Corer
IMO	International Maritime Organization
IODP	International Ocean Discovery Program
JOGMEC	Japanese Oil, Gas, and Metals National Corporation
JR	JOIDES Resolution
JRFB	JOIDES Resolution Facility Board
JRSO	JOIDES Resolution Science Operator
mbsf	meters below sea floor
MODU	Mobile Offshore Drilling Unit
MS	Mass Spectrometry
MSP	Mission Specific Platform
NEPA	National Environmental Policy Act
NETL	National Energy Technology Laboratory
OCS	Outer Continental Shelf
ORCAB	Orca Basin
OSU	Ohio State University
PCATS	Pressure Core Analysis and Transfer System
PCC	Pressure Core Center

ACRONYM	DEFINITION
PCS	Pressure Coring System
PCTB	Pressure Core Tool with Ball Valve
PM	Project Manager
PMP	Project Management Plan
PMRS	Pressure Maintenance and Relief System
QRPPR	Quarterly Research Performance and Progress Report
RFP	Request for Proposal
RFQ	Request for Qualifications
RPPR	Research Performance and Progress Report
SEP	Site Evaluation Panel
SOPO	Scope of Project Objectives
SSDB	Site Survey Data Bank
TBONE	Terrebonne Basin
TOC	Total Organic Carbon
UNH	University of New Hampshire
USCG	United States Coast Guard
USGS	U.S. Geological Survey
USIO	United States Implementing Organization
UT	University of Texas at Austin
UW	University of Washington
XCT	X-ray Computed Tomography
XRD	X-ray Diffraction

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