DOE Award No.: DE-FE0023919

Quarterly Research Performance Progress Report

(Period Ending 12/31/22)

Deepwater Methane Hydrate Characterization & Scientific Assessment

Project Period 5: 10/01/20 - 09/30/23

Submitted by:

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Signature

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

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DISCLAIMER

1 ACCOMPLISHMENTS

This report outlines the progress of the first quarter of the ninth fiscal year of the project, Oct. 1 – Dec. 31, 2022 (Budget Period 5, Year 3). Highlights from this period include:

- **AGU Presentations**
  GOM2 project team members presented at the American Geophysics Union fall meeting (Dec 12-16, Chicago, IL):
  - Creep and stress relaxation behavior of hydrate-bearing sediments: implications for stresses during production and geological sedimentation (Alejandro Cardona, Athma Bhandari, Peter Flemings)
  - Simultaneous CH4 Production and CO2 Storage in Hydrate Reservoirs (Zach Murphy, Peter Flemings, David DiCarlo, Kehua You)
  - Coarse-Grained Sediments are Potential Microbial Methane Factories in Marine Sediments (Kehua You, Stephen Phillips, Peter Flemings, Frederick S. Colwell, Jill Mikucki)
  - The Water Relative Permeability Behavior of Hydrate-bearing Sediment (Peter Flemings, Yi Fang, Kehua You, Alejandro Cardona)
  - Reactive Transport Modeling of Microbial Dynamics in Marine Methane Hydrate Systems (Li Wei, Alberto Malinverno, Rick Cowell, David Goldberg)

- **UT-GOM2-2 hydrates drilling program permitting**
  - UT completed a *Revised Exploration Plan* and formally submitted it to BOEM on October 21, 2022. BOEM subsequently approved the Revised Exploration Plan on December 8, 2022.
  - BOEM approved a *Right-of-Use and Easement Amendment* on December 8, 2022.
  - UT completed an *Application for Permit to Conduct Geological or Geophysical Exploration for Mineral Resources for Mineral Resources or Scientific Research on the OCS* (G&G Permit) and formally submitted it to BOEM on December 2, 2022. The permit application is currently under review.

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	Mar-23	-	QRPPR
	M5E	Complete UT-GOM2-2 Operational Plan Report	May-21	Sep-21	QRPPR
	M5F	Complete UT-GOM2-2 Field Operations	Jul-23	-	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-23	-	Phase 5 Report
	M6B	Complete Preliminary Expedition Summary	Dec-23	-	Report directly to DOE PM
	M6C	Initiate comprehensive Scientific Results Volume	Jun-24	-	Report directly to DOE PM
	M6D	Submit set of manuscripts for comprehensive Scientific Results Volume	Sep-25	-	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	**UT-GOM2-1 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	**UT-GOM2-1 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	**UT-GOM2-1 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	**UT-GOM2-1 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*
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	*Execute UT-GOM2-2 Field Program*
Optional Subtask 16.2	*Add Conventional Coring*
Optional Subtask 16.3	*Add Spot Pressure Coring*
Optional Subtask 16.4	*Add Second Hole at H-Location*
Optional Subtask 16.5	*Add Additional Cores and Measurements*
Task 17.0	**UT-GOM2-2 Core Analysis**
Subtask 17.1	*Routine UT-GOM2-2 Core Analysis*
Optional Subtask 17.2	*UT-GOM2-2 Expanded Core Analysis*

1.2.2.1 Task 1.0 – Project Management & Planning

Status: Ongoing

- **Coordinate the overall scientific progress, administration and finances of the project:**
  - UT monitored and controlled the project budget, scope, and schedule.
  - UT submitted a proposal to the U.S. Science Support Program to provide additional support for the UT-GOM2-2 dockside science party and program.
  - UT updated the Project Management Plan (PMP) to reflect changes to the project SOPO, schedule, and organization resulting from the BP5 continuation.

- **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 executed a new contract with Dr. Brandon Dugan of Colorado School of Mines (Mines). Mines will fill the role of the in situ temperature and pressure measurement lead.
    - Obtained DOE authorization
    - Negotiated scope of work, budget, and contract
  - 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.
  - UT continued to hold recurring technical meetings with Helix to plan the 2023 UT-GOM2-2 field program, and refine requirements for third party subcontracts covering drill pipe-make up, wireline operations, Drilling Fluid, supply boats, Dock services, Well certification, Deck layouts, etc.

- **Coordinate subcontractors:**
  - UT executed subcontract amendments for BP5A.
  - UT continued to monitor and control subaward and contractor efforts.

1.2.2.2 Task 10.0 – UT-GOM2-1 Core Analysis

Status: Ongoing

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

A. Pressurized Core Analysis

A1. Geomechanical viscoplastic behavior

- The in-situ stress state and geomechanical properties of hydrate-bearing sediments exert key controls on hydrate formation and gas production strategies. To illuminate further this geomechanical behavior, we have conducted an experimental study using constant rate uniaxial strain tests (CRS) in a sample from core 8FB3. These experiments included axial stress hold periods to explore the deformation and changes in the ratio of lateral to axial effective stress (K_0) with time.
- Results show the presence of hydrate enhances the sediment stiffness when the material is deformed at a rate of 1%/hr; the compression index C (slope of void ratio e vs. log σ'_a) is larger in the hydrate-free sample than the pressure core. However, the pronounced deformation during the stress-holds indicate the hydrate in the pore space promotes creep.
- Deformation versus time curves during the stress holds resemble a consolidation process (blue line, Figure 1-1a). However, the time scale for deformation is much larger than the theory of consolidation would suggest. Instead, a standard linear solid model (spring and dashpots) analysis reveals that secondary compression trends are related to viscous deformation (yellow line, Figure 1-1a).
- The stress ratio K_0 depends on the loading rate in hydrate-bearing sediments. K_0 approaches isotropic conditions (K_0 =1.0) during the stress holds (blue line, Figure 1-1b), contrasting the hydrate-free sediment behavior where K_0 remains constant with time (reconstituted sandy-silt - black line, Figure 1-1b). Our spring and dashpot model captures the increase in K_0 with time (yellow line, Figure 1-1b). The rise in K_0 occurs earlier in the model than the pressure core data.
- Our experimental results show that the presence of load-bearing hydrate in porous media imposes viscous effects. The significant deformation during the stress holds and the near isotropic stress conditions are examples of this visco-plastic behavior. Moreover, the time scales for stress relaxation and creep are within one day, which suggests that on the time scale of hydrate production (days to months), the viscous nature of the hydrate will impact reservoir compression.
- High hydrate saturation sediments that are loaded as a result of geological sedimentation will relax over these long time-scales; thus, these strata will record isotropic stresses. This unusual stress state will impact our ability to fracture the reservoir, whether for leak off tests during drilling or hydraulic fractures for stimulation.
- The mechanisms triggering submarine landslides associated to gas hydrates remain unclear. Hydrate dissociation and the loss of strength has been widely attributed as a precursor for slope failure (Sultan et

al., 2004). However, recent studies have suggested that submarine landslides occur as a slow creeping process (Mountjoy et al., 2014). Mountjoy et al. (2014) proposed that the visco-plastic nature of hydrate-bearing sediments enables a glacial-like deformation. Our experimentally observed time-dependent behavior supports this hypothesis, where the presence of hydrate facilitates long-term deformation under sustained load.

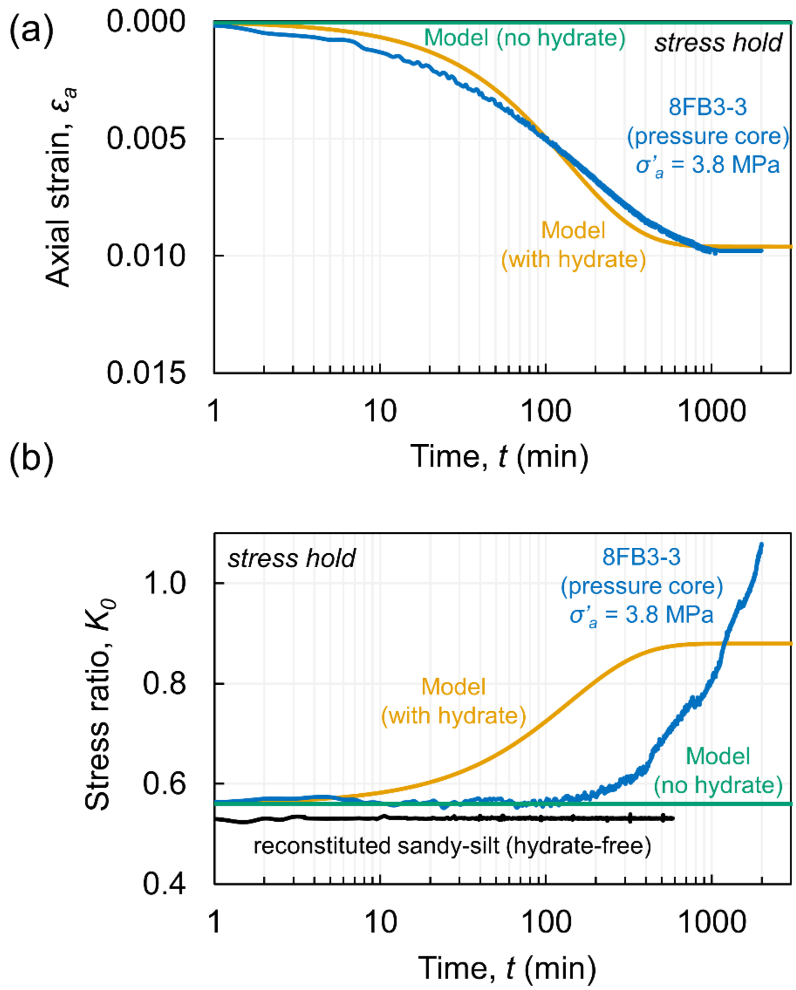

Figure 1-1: Time-dependent evolution of the (a) axial strain and (b) stress ratio K0 during the second stress holds at σ'_a = 3.8 MPa for the sample 8FB3-3 (blue line). The initial time corresponds to the beginning to the stress hold. The standard linear solid model predictions are superimposed (yellow line), together with model results with no hydrate (green line).

1.2.2.2.2 *Subtask 10.5 – Continued Core-Log-Seismic Synthesis (UT-GOM2-1)*

- No updates.

1.2.2.2.3 *Subtask 10.6 – Additional Core Analysis Capabilities*

- No updates

1.2.2.2.4 *Subtask 10.7 – Hydrate Modeling*

Columbia University continues work on reaction-transport modeling of microbial methanogenesis with a 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 related to the objectives of the drilling expedition.

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

Status: Complete (Milestones 5C, 5E)

- UT-GOM2-2 Operations Plan Rev. 2.2. was completed and submitted in the previous performance period, reflecting changes made as a result of the September 2022 BP5 Budget Period Continuation. Further revisions will be made only if required, based on the outcome of the FY23 Federal budget appropriation.
- See notes in Section 1.2.2.7.4 Subtask 15.5 – Finalize Operational Plan for UT-GOM2-2 Scientific Drilling Program for additional information.

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

Status: Complete (Milestone 5B)

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

Status: Ongoing

1.2.2.5.1 *Long-Term Pressure Core Storage Optimization*

- UT conducted a new core degradation simulation on pressure core 8FB-1, and collected new pore water samples for chemical analysis in the previous quarter. UT is now analyzing core volume loss by comparing the CT images collected in 2017 and 2019 in ImageJ.
- UT continues to quantify the dissolution of methane hydrate in our pressure cores to gain a better understanding of the mechanism driving degradation of our pressure cores. UT is exploring a potential remedial action to mitigate methane hydrate dissolution by saturating the pressure core storage system water with methane.
- UT has assembled all the components to create methane-saturated water in a pressurized vessel. UT is now pursuing the construction of a mobile operations stand to contain the methane-saturation system. UT will pursue pressurized testing of the system to quantify and stop system leaks once the stand has been assembled and the components installed.

(Flemings, 2021a, b)

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

- UT manufactured and tested a sediment trap that was designed in the previous quarter. The sediment trap was designed to collect debris generated during cutting and transfer from mini-PACTS to the Effective Stress Chamber, thereby preventing the actuator in the Effective Stress Chamber from jamming.
- The mini-PCATS system underwent a full maintenance teardown. Seals and bearings were replaced and mini-PCATS sediment traps were cleaned. The power balance drive underwent a full maintenance teardown with full seal replacements. The X-ray system underwent quarterly calibration.
- The P-wave Velocity system underwent a calibration.

1.2.2.5.3 *Subtask 13.2 – Hydrate Core Effective Stress Chamber*

- Core H005-08FB-01 underwent cutting/subsampling.
    - Two sub-samples were cut from the core. The remainder of core H005-08FB-01 was returned to storage vessel with solid spacers to occupy open volume.
    - 8FB-01-K02 testing is being conducted in this quarter.
- The Effective Stress Chamber underwent a general cleaning and sediment flush between pressure core samples.
- We have refined our experimental approach to studying permeability and compression behavior under uniaxial strain over the last year. This resulted in successful geomechanical measurements in sample 8FB3-3. However, there are pending issues we addressed during this quarter. These are summarized below:
    - We focus on whether system compressibility is causing an overestimation of the vertical displacement. UT conducted multiple calibration tests at high stresses using a steel sample. Results revelated significant equipment deformation that can cause errors of up to 10%. UT has implemented and tested a new pump protocol that will correct for these effects.
    - We focused on making a 'production test' on a hydrate-bearing sample, where we monitor the geomechanical behavior during hydrate dissociation. A key variable for our effort is the temperature of the sample. Using a pressure core sample, UT successfully tested the custom-made temperature monitoring system and sensors from Geotek to measure the temperature directly in the sample and confining fluid. We have added thermal isolation foams to reduce the background thermal noise caused by the cooling system of the room.

1.2.2.5.4 *Subtask 13.3 – Hydrate Core Depressurization Chamber*

- The system is in standby mode and ready to be used as needed.

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

Status: Complete

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

- UT has developed an enlarged base design and has pursued quotes to manufacture that design for expansion of core storage capabilities. UT is continuing to evaluate manufacturing options and quotes to control costs for the storage bases.
- Expansion of pressure maintenance system is required to increase storage capability sufficient to receive UT-GOM2-2 cores. 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 is being assessed.

1.2.2.5.7 *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.

1.2.2.5.8 *Subtask 13.7 – Maintain X-ray Computed Tomography*

- The X-Ray CT continues to operate as designed.
- The Dell Image Reconstruction computer continues to operate properly.

1.2.2.5.9 *Subtask 13.8 – Maintain Pre-Consolidation System*

- The system will continue to be evaluated to ensure proper pressure maintenance to generate effective stresses in pressure cores. With continued success in nitrogen gas retention, the Pre-Consolidation system can be used to store pressure cores with effective stresses applied in both axial and confining directions.

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

Future Task.

1.2.2.5.11 *Subtask 13.10 – Storage of Hydrate Cores from UT-GOM2-2 Scientific Drilling Program*

Future Task.

1.2.2.5.12 *Subtask 13.11 – Hydrate Core Distribution*

Future Task.

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

Status: Complete

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

Status: In Progress

1.2.2.7.1 *Continued Development of Terrebonne Basin Geology and Geophysics*

- We explored the mechanisms driving overpressure and low temperature in rapidly formed sedimentary basins in respect to gas hydrate stability. Typically, an 'equilibrium model' is applied to estimate the base of methane hydrate stability zone (the depth above which the temperature and pressure are favorable to form methane hydrate). Equilibrium model assumes constant conductive heat flow and hydrostatic pore pressure. We showed that in rapidly formed basins, such as the Terrebonne Basin, this model does not work; the thickness of the methane hydrate stability can at least double relative to its equilibrium depth due to both low temperatures and elevated pressures. This is an important result because under rapid burial, microbial methane can be hydrate-trapped within a significantly wider depth interval. Furthermore, low temperature deepens and widens the thermal window for enhanced microbial methane production.
- We used PetroMod™ software to conduct finite-element numerical simulations that solve time dependent equations of heat transfer, fluid flow and sediment compaction under different sedimentation rates. We then used depth-migrated 2D and 3D seismic reflection data to characterize the Terrebonne basin. We used well log data, mud logs and biostratigraphy reports from WR225 well (API 608124010000) drilled by Marathon Oil Company for facies interpretation and age-dating of seismic stratigraphic units. To reconstruct the evolution of the Terrebonne basin, we used palinspastic restoration using Lithotect® software.
- Our 1D numerical modeling showed that rapidly buried low-permeability marine mud cannot efficiently drain pore water, which leads to significant overpressure (Figure 1-2A). We also showed that due to rapid burial of cold sediment, there is not sufficient heat flow to keep the sediment at its steady state conductive equilibrium, and the thermal depression is developed (Figure 1-2B). The combined effect is that the sedimentary basin is colder and has higher pressure relative to its equilibrium steady state. As a result, the base of GHSZ can be several times deeper than its equilibrium depth (Figure 1-2C).
- We further demonstrated this effect in the Terrebonne Basin, where sedimentation rates range between ~0.2 and ~12 mm yr^{-1}. The model showed strong thermal depression in the central Terrebonne Basin where sedimentation rates are highest (Figure 1-2D). Similarly, pore overpressure within the upper several kilometers of sediments reaches 20-25 Mpa. As a result, the modern GHSZ in the

Terrebonne Basin gradually thickens from ~600 mbsf (its equilibrium depth) to as much as 2000 mbsf responding to the basin-ward increasing sedimentation rates (Figure 1-2D).

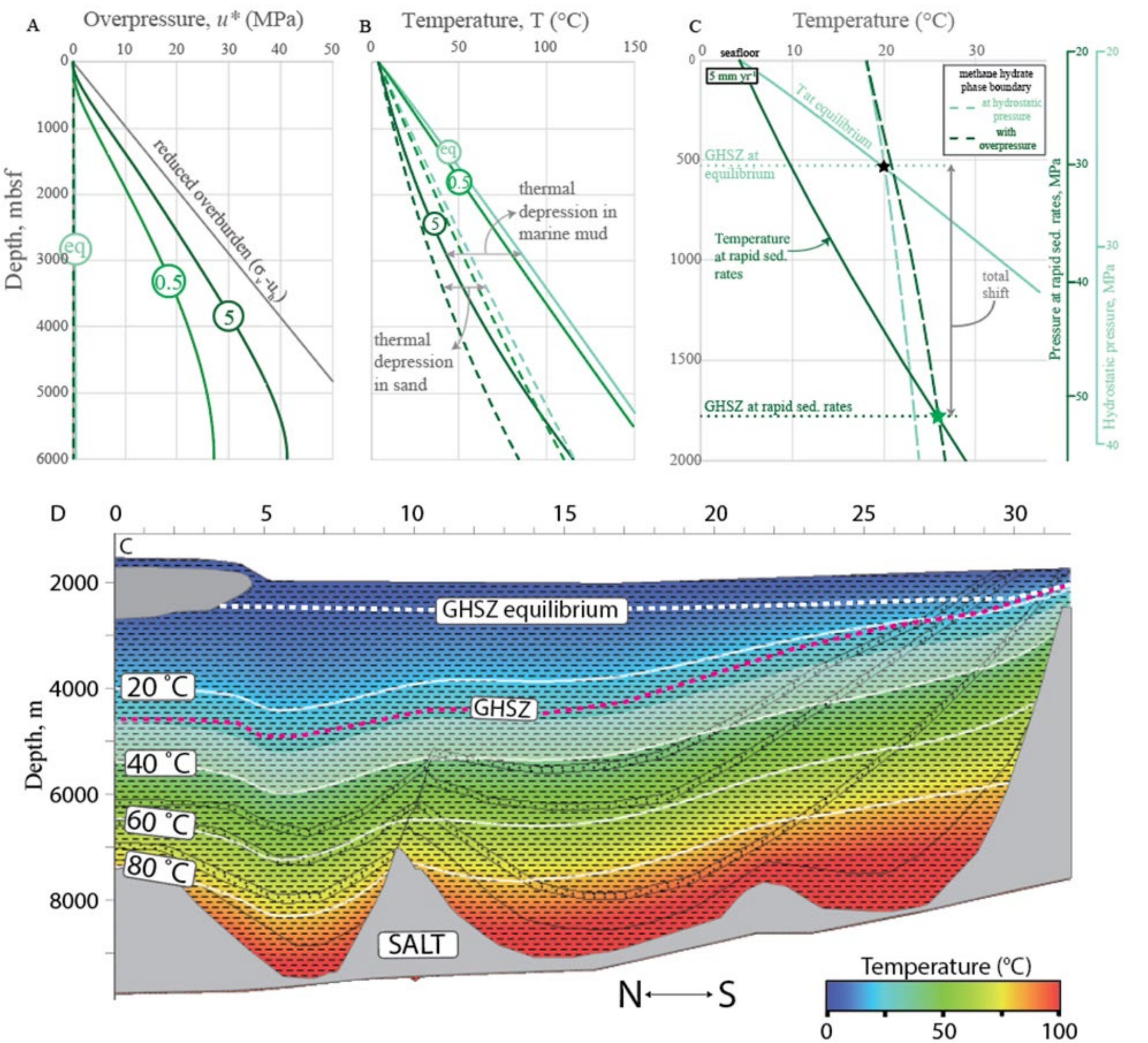

Figure 1-2: Results of 1D numerical modeling showing A) overpressure and B) temperature for 0,5 mm yr^{-1} (light green), 5 mm yr^{-1} (dark green) sedimentation rates and for a depositional system at equilibrium (aquamarine, labeled 'eq'). Solid lines show modeling results for marine mud, dashed lines for sand lithology. C) Temperature vs. depth for the mud deposition simulation at 5 mm yr^{-1} (solid dark green) and equilibrium (solid light green). Methane hydrate phase boundary for hydrostatic and 5 mm yr^{-1} depositional systems are shown with dashed aquamarine and dark green curves respectfully. GHSZ depth at equilibrium temperature and hydrostatic pressure is marked with the black star. Dark green dotted line indicates a 1,250-m downward shift of GHSZ due to overpressure and low temperature at 5 mm yr^{-1} sedimentation rate (intersection marked with the green star). D) Present day temperature distribution in the Terrebonne Basin. Similar to the overpressure, modern sediment temperature shows extremely low values in the area with high sedimentation in the central and northern Terrebonne Basin. Both, pressure and temperature anomalies driven by rapid sedimentation result in extremely deep base of GHSZ (red dashed line).

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

- UT successfully configured UT Austin accounts in BOEM Technical Information Management System (TIMS) and BSEE eWell, both of which are required for permit submittals.
- UT completed a Revised Exploration Plan (EP), updating information on the drilling/activity schedule, well designations, well locations, drilling rig, and air emissions info. The Revised Exploration Plan was submitted to BOEM on October 20, 2022. It was subsequently approved on December 8, 2022.
- A Right-of-Use and Easement (RUE) Amendment was approved by BOEM on December 8, 2022. The RUE amendment corresponds to the changes in the Revised Exploration Plan
- UT completed an Application for Permit to Conduct Geological or Geophysical Exploration for Mineral Resources for Mineral Resources or Scientific Research on the OCS (G&G Permit). The G&G Permit application was submitted to BOEM through the BOEM Technical Information Management System (TIMS) on December 2, 2022.
- UT published updated ads for public participation in the UT-GOM2-2 drilling program in the Houston Chronicle and the New Orleans Advocate on December 25, 2022, as requested by BOEM, pursuant to 30 CFR 551.7.
- The status of permit submission and approval for the UT-GOM2-2 field program is shown in Table 1-9.

Table 1-9: UT-GOM2-2 Permit Status

AGENCY	PERMIT / REQUIREMENT	STATUS	TRACKING INFO
BOEM	Qualified Operator Certification	Submitted 03/17/17 Approved 03/21/17	No. 3487
BOEM	BOEM Qualification Update (Dr. Daniel Jaffe, VPR)	Submitted 11/10/21 Approved 01/10/22	None
BOEM	Lease Bond	Submitted 07/08/21 Approved 07/19/21	Bond No. ROG000193
BOEM	Right-of-Use and Easement (RUE)	Submitted 04/15/21 Approved 11/12/21 Effective 02/11/22	OCS-G 30392
BOEM	Right-of-Use and Easement (RUE) Amendment	Submitted 10/21/22 Approved 12/08/22	OCS-G 30392
BOEM	Initial Exploration Plan	Submitted 04/16/21 Approved 11/12/21	N-10162
BOEM	Revised Exploration Plan	Submitted 10/20/22 Approved 12/08/22	R-7211
BOEM	Permit to Conduct Geological or Geophysical Exploration… (G&G)	Submitted 12/02/22 Re-submitted 01/04/23	L22-025
BSEE	Application for Permit to Drill (APD)	*In progress*	--
BSEE	Application for Permit to Modify (APM)	--	--
LDNR	CZM Consistency Cert.	Submitted 04/16/21 Approved 11/05/21	C20210156
US CG	Letter of Determination (LOD)	--	--
US DOE	NEPA Environmental Questionnaire (EQ) - UT-GOM2-2	Submitted 02/16/22 Approved 03/10/22	--
US DOE	NEPA Environmental Questionnaire (EQ) - Dockside	*In progress*	
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)

- Due to unknown amount and distribution schedule of the project's FY23 Federal funding obligation, the UT-GOM2-2 field program scope has been reduced so that it can be accomplished with current funding, under Task 16, 'Phase 5A'. Phase 5A prioritizes pressure coring in the Orange sand in a single well, and is described in the UT-GOM2-2 Operations Plan Rev. 2.2. (submitted as an attachment to the previous quarterly report). The plan includes 'Optional Subtasks' that re-instate components of the original UT-GOM2-2 science objectives if sufficient funding is available in FY23. The expanded program subtasks would be accomplished under 'Phase 5B'. The magnitude of the expanded scope will be adjusted to match the available funding, and will only performed upon formal authorization of Phase 5B by US DOE. Phase 5B prioritizes conventional coring in the shallow section of the hole to allow for characterization of the shallow microbial methane factory, temperature, pressure, and the composition and flux of fluids from the sediments into the ocean, spot pressure coring to characterize dissolved methane concentration with depth and other coarse-grained intervals of interest, and may result in the drilling of a second hole and additional science.

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

1.2.2.8.1 *Subtask 16.1 – Execute UT-GOM2-2 Field Program*
Future task.

1.2.2.8.2 *Optional Subtask 16.2 – Add Conventional Coring (Phase 5B)*
Future task (FY23 budget-contingent).

1.2.2.8.3 *Optional Subtask 16.3 – Add Spot Pressure Coring (Phase 5B)*
Future task (FY23 budget-contingent).

1.2.2.8.4 *Optional Subtask 16.4 – Add Second Hole at H-Location (Phase 5B)*
Future task (FY23 budget-contingent).

1.2.2.8.5 *Optional Subtask 16.5 – Add Additional Cores and Measurements (Phase 5B)*
Future task (FY23 budget-contingent).

1.2.2.9 Task 17.0 – UT-GOM2-2 Core Analysis

1.2.2.9.1 *Subtask 17. 1 – Routine UT-GOM2-2 Core Analysis*
Future Task.

1.2.2.9.2 *Optional Subtask 17.2 – UT-GOM2-2 Expanded Core Analysis*
Future task (FY23 budget-contingent).

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 Project Management Plan (PMP) and Statement of Project Objectives (SOPO).
- 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 PMP.

1.3.2 Task 10.0 – Core Analysis

- UT will use the improved temperature measurement capabilities in the UT Effective Stress Chamber to conduct a gas production test. We will replicate field conditions, where the pore pressure is decreased, the total vertical stress is maintained constant, and the sample undergoes uniaxial strain deformation (i.e., zero lateral strain). We will measure produced gas, lateral stress, compression and temperature throughout the entire test.
- UT, Ohio State, UW, UNH, Oregon State, Colorado School of Mines, and Tufts will continue working on UT-GOM2-2 protocols and supply lists.

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

- The UT-GOM2-2 Operations Plan will be updated if required, based on changes to the program that result from the project's FY23 Federal budget allocation.

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 continue to test the new pump mode that corrects for equipment compressibility effects during uniaxial strain tests. This new version removes the deformation associated to the equipment, and thus, it uses a more accurate measurement of the sample length.

- UT will continue to test and evaluate the sediment trap modification in mPCATS to assist with preventing large quantities of loose sediment being introduced into the Effective Stress Chamber during testing.
- UT will purchase and install the dedicated storage bases, pressure maintenance, and methane safety manifolds necessary for the expansion of the pressure core storage capabilities.
- UT will continue to evaluate and refine the temperature measurement capabilities of the Effective Stress Chamber test section.
- 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 conduct an expedition science workshop in Houston in conjunction with helicopter safety training for all persons possible going off-shore. The workshop will continue UT-GOM2-2 preparations and expose students to the work done to date on understanding the Terrebonne Basin and hydrate-bearing sands at the UT-GOM2-2 drilling location.
- UT will submit an *Application for Permit to Drill* (APD) to BSEE
- UT will submit a notice of intent to comply with the NPDES OCS GMG290000 general discharge permit.
- UT will complete a NEPA Environmental Questionnaire for the dockside science location once it is confirmed by Helix.
- 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.

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

- Detailed pre-mobilization planning and preparation activities will commence. Equipment and supplies will be packed and shipped to Helix, Geotek, and Prolog as required.
- Protocols will be developed for UT-GOM2-2 core processing, curation, testing, and analysis.

1.3.9 Task 17.0 – UT-GOM2-2 Core Analysis

- 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

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2.2 Conference Presentations/Abstracts

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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

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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

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2.3.2 Prospectus

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2.3.4 Data Reports

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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

None.

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

None.

3.3 Changes That Have A Significant Impact On Expenditures

The BP5 Budget Period Continuation modified the project cost to reflect UT's best understanding of current offshore drilling costs at this time. Many of UT's service contracts are now locked-in contractually. Unknown variables that are still subject to change include Helix Well Ops third party subcontracts, such as supply vessels, helicopters, mud and drilling fluids, and associated fuel costs.

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 18.1 – Project Sample and Data Distribution Plan

Subtask 18.3 – 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	$ 617,836	$ 33,948,642	$ 543,438	$ 34,492,080	$ 3,743,308	$ 38,235,387
Non-Federal Share	$ 254,642	$ 25,022,184	$ 281,474	$ 25,303,658	$ 258,413	$ 25,562,071	$ 904,873	$ 26,466,945
Total Incurred Cost	$ 721,317	$ 58,352,990	$ 899,310	$ 59,252,300	$ 801,851	$ 60,054,151	$ 4,648,181	$ 64,702,332
Variance								
Federal Share	$ (3,967,208)	$ (9,705,280)	$ (132,137)	$ (9,837,417)	$ (19,730,651)	$ (29,568,068)	$ 3,032,471	$ (26,535,597)
Non-Federal Share	$ (445,590)	$ (1,244,581)	$ 163,033	$ (1,081,548)	$ (2,943,422)	$ (4,024,969)	$ 792,613	$ (3,232,356)
Total Variance	$ (4,412,798)	$ (10,949,860)	$ 30,896	$ (10,918,964)	$ (22,674,073)	$ (33,593,037)	$ 3,825,084	$ (29,767,953)
Baseline Reporting Quarter	Budget Period 5							
	Y3Q1		Y3Q2		Y3Q3		Y3Q4	
	10/01/22-12/31/22		01/01/23-03/31/23		04/01/23-06/30/23		07/01/23-09/30/23	
	Y3Q1	Cumulative Total	Y3Q2	Cumulative Total	Y3Q3	Cumulative Total	Y3Q4	Cumulative Total
Baseline Cost Plan								
Federal Share	$ 1,038,173	$ 36,505,850	$ 19,419,248	$ 55,925,098	$ 19,297,378	$ 75,222,476	$ 609,291	$ 75,831,767
Non-Federal Share	$ 356,923	$ 25,399,611	$ 4,475,093	$ 29,874,704	$ 4,447,789	$ 34,322,493	$ 260,835	$ 34,583,328
Total Planned	$ 1,395,096	$ 61,905,461	$ 23,894,341	$ 85,799,802	$ 23,745,167	$ 109,544,969	$ 870,126	$ 110,415,095
Actual Incurred Cost								
Federal Share	$ 294,544	$ 38,529,931						
Non-Federal Share	$ 207,066	$ 26,674,011						
Total Incurred Cost	$ 501,610	$ 65,203,942						
Variance								
Federal Share	$ (743,629)	$ 2,024,082						
Non-Federal Share	$ (149,857)	$ 1,274,399						
Total Variance	$ (893,486)	$ 3,298,481						

*Note: BP5 rescoped beginning Y3Q1; cumulatives re-set

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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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