NATIONAL ENERGY TECHNOLOGY LABORATORY

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Quarterly Research Performance Progress Report

(Period Ending 03/31/20)

Deepwater Methane Hydrate Characterization & Scientific Assessment

Project Period 4: 10/01/19 - 09/30/20

Submitted by:

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Office of Fossil Energy

DISCLAIMER

1 ACCOMPLISHMENTS

This report outlines the progress of the second quarter of the sixth fiscal year of the project (Budget Period 4, Year 1). Highlights from this period include:

- **AAPG Volume 1 Publication in final phases:** A dedicated volume will be published in 2020 that captures the initial results from the UT-GOM2-1 expedition with 6 papers. This is the start of a multi-volume commitment by AAPG to this project. It will be an exciting demonstration of the project's achievements.

- **PCTB Modifications**: In January, 2020, Geotek completed upgrading the PCTB to "PCTB4" specifications. Five modifications were permanently incorporated in to the PCTB design, based on outcomes of the PCTB bench tests completed in 2019

- **PCTB Bench Test II**: Geotek conducted pressure actuation testing (Bench Test II) of the PCTB to test the PCTB4-upgrades prior to the Land Test. There were 9 successful tests using both water and mud. There were 2 failed tests due to operator error. Both instances of operator error were documented and procedurally corrected. Overall the PCTB functioned extremely well with 100% success rate when properly deployed.

- **PCTB Land Test**: In March, 2020, UT, Geotek, and Pettigrew Engineering performed a Land Test of the PCTB at the Schlumberger Cameron Test and Training Facility (CTTF). Seven tests of the PCTB were performed and the Probe Deployment Tool (PDT) was deployed. Core recovery and core quality was excellent with both the PCTB-CS and the PCTB-FB. In 6 out of 7 cases, the ball only partially closed and no increase in pressure was recorded. We interpret that drilling fluid and entrained cuttings are wedging between the outer housing and the seal carrier jamming the seal carrier which drives the ball.

- **Pressure Core Transfer:** UT completed the transfer of all pressure core sections per the recommended allocation from the Science and Sample Distribution Technical Advisory group.

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

Table 1-2: Current Milestones

Budget Period	Milestone	Milestone Description	Estimated Completion	Actual Completion	Verification Method
4	M4A	Document results of BP3 Activities	Jan-20	In progress	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 1-3: Future Milestones

Budget Period	Milestone	Milestone Description	Estimated Completion	Actual Completion	Verification Method
5	M5A	Document Results of BP4 Activities	Dec-20	-	Phase 4 Report
	M5B	Complete Contracting of UT-GOM2-2 with Drilling Vessel	May-21	-	QRPPR
	M5C	Complete Project Sample and Data Distribution Plan	Jul-22	-	Report directly to DOE PM
	M5D	Complete Pre-Expedition Permitting Requirements for UT-GOM2-2	Dec-21	-	QRPPR
	M5E	Complete UT-GOM2-2 Operational Plan Report	May-21	-	QRPPR
	M5F	Complete UT-GOM2-2 Field Operations	Jul-22	-	QRPPR
6	M6A	Document Results of BP5 Activities	Dec-22	-	Phase 5 Report
	M6B	Complete Preliminary Expedition Summary	Dec-22	-	Report directly to DOE PM
	M6C	Initiate comprehensive Scientific Results Volume	Jun-23	-	Report directly to DOE PM
	M6D	Submit set of manuscripts for comprehensive Scientific Results Volume	Sep-24	-	Report directly to DOE PM

1.2 What Was Accomplishments Under These Goals

1.2.1 Previous Project Periods

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

Table 1-4: Tasks Accomplished in Phase 1

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

Table 1-5: Tasks Accomplished in Phase 2

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

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

Table 1-6: Tasks Accomplished in Phase 3

PHASE 3/BUDGET PERIOD 3	
Task 1.0	**Project Management and Planning**
Task 6.0	**Technical and Operational Support of CPP Proposal**
Task 9.0	**Develop Pressure Core Transport, Storage, and Manipulation Capability**
Subtask 9.8	*X-ray Computed Tomography*
Subtask 9.9	*Pre-Consolidation System*
Task 10.0	**Core Analysis**
Subtask 10.4	*Continued Pressure Core Analysis (UT-GOM2-1)*
Subtask 10.5	*Continued Hydrate Core-Log-Seismic Synthesis (UT-GOM2-1)*
Subtask 10.6	*Additional Core Analysis Capabilities*
Task 11.0	**Update Operational Plan 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*

1.2.2 Current Project Period

Current project period tasks are shown in Table 1-7.

Table 1-7: Current Project Tasks

PHASE 4/BUDGET PERIOD 4	
Task 1.0	**Project Management and Planning**
Task 10.0	**Core Analysis**
Subtask 10.4	*Continued Pressure Core Analysis (GOM2-1)*
Subtask 10.5	*Continued Hydrate Core-Log-Seismic Synthesis (UT-GOM2-1)*
Subtask 10.6	*Additional Core Analysis Capabilities*
Subtask 10.7	*Hydrate Modeling*
Task 11.0	**Update Operational Plan 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*

1.2.2.1 Task 1.0 – Project Management & Planning

Status: Ongoing

1. **Coordinate the overall scientific progress, administration and finances of the project:**
    - Monitored and controlled project scope, costs, and schedule.

2. **Communicated with project team and sponsors:**
    - Presented at the Methane Hydrate Advisory Committee Meeting on February 26, 2020 in Galveston, TX.
    - Organized and coordinated project team and stakeholder meetings.
    - Organized task-specific team working meetings to plan and execute project tasks (e.g. AAPG Volume On-line Workshops and GRC discussion, PCTB development, PCTB Bench Test, PCTB Land Test, UT-GOM2-2 Operations Plan, UT-GOM2-2 Science Plan, and UT-GOM2-2 permitting).
    - Organized sponsor meetings.
    - Managed SharePoint sites, email lists, and archive/website.

3. **Coordinated and supervised subcontractors and service agreements:**
    - Actively managed subcontractors.
    - Monitored schedules and ensured that contractual obligations were met.
    - Held a 1-day, in-person meeting with Peter Schultheiss, Melanie Holland, and Mike Mimitz of Geotek on March 2, 2020 at the University of Texas at Austin. We discussed the following issues:
        - UT pressure core center equipment performance, issues, and potential modifications
        - Pressure core degradation
        - Pressure vessel recertification
        - UT-GOM2-2 Scientific Drilling Program vessel requirements
        - UT-GOM2-2 science program (onboard and shore-based)
        - PCTB modifications, bench test results, and land test planning
        - UT-Geotek service agreements

1.2.2.2 Task 10.0 – Core Analysis

Status: Ongoing

1.2.2.2.1 Subtask 10.4 – Continued Pressure Core Analysis

A. Pressurized Core Analysis

- One sample of pressure core (H005-7FB-3 adjacent to the permeability sample) was cut in PCATS and transferred to a storage chamber for quantitative degassing near the end of Q2 and will be quantitatively degassed in Q3.
- Ohio State presented a new interpretation of the gas geochemistry results from gases collected during quantitative degassing.

  Hydrocarbon molecular C_1/C_2+, where C_1 represents methane concentration and C_2+ represents the summed concentration of ethane and longer chained hydrocarbons, and isotopic compositions ($\delta^{13}C$-CH_4, $\delta^{2}H$-CH_4, and $\delta^{13}C$-CO_2) are very useful tools to delineate the processes forming natural gas within subsurface hydrates from Green Canyon 955. Natural gas formed by thermogenic processes is most easily distinguished from microbial sources by the presence of ethane and heavier aliphatic hydrocarbons ([C_2+]) (Jackson et al., 2013). The C_1/C_2+ of oil-associated natural gas can be as low as 0.1 and increases up to ~100 as thermal maturity increases (Bernard et al., 1976). Regardless of the specific pathway, methanogens produce almost exclusively methane, leading to high C_1/C_2+ (up to 1×10^4 for CO_2 reduction or 2×10^3 for acetate fermentation) and isotopically-light $\delta^{13}C$ signatures of methane (Bernard et al., 1976) (Etiope, 2017) (Milkov, 2011) (Whiticar et al., 1986). Increasing thermal maturity also leads to a progressive increase in the stable isotopic composition of carbon and hydrogen in methane and heavier hydrocarbons (Figure 1-1). The $\delta^{13}C$-CH_4 and $\delta^{2}H$-CH_4 of immature oil-associated natural gas is initially approximately -55‰ and -300‰, respectively (Figure 1-2). As temperature increases, the stable isotopic values of carbon and hydrogen continue to increase and can range up to $\delta^{13}C$-CH_4 ~ -25‰ and $\delta^{2}H$-CH_4 ~ -160‰ in post-mature natural gas (Schoell, 1980).

  Mixing models (black and grey lines in Figure 1-1) can be used to determine the proportion of microbial or thermogenic natural gas contained within hydrates. Below are the two formulas used to determine the proportion of microbial gas present in our system (Jenden et al., 1993):

  Eq. 1. $(C_1/C_2+)_{Mixture} = ((f_{Mic}*[CH_4]_{Mic} + (1-f_{Mic}) * [CH_4]_{Therm})) / ((f_{Mic} * [C_2+]_{Mic} + (1-f_{Mic}) * [C_2+]_{Therm})$

  Eq. 2. $(\delta^{13}C\text{-}CH_4)_{Mixture} = ((f_{Mic}*[CH_4]_{Mic}*(\delta^{13}C\text{-}CH_4)_{Mic}) + ((1- f_{Mic}) * [CH_4]_{Therm}* (\delta^{13}C\text{-}CH_4)_{Therm})) / (f_{Mic}*[CH_4]_{Mic} + (1-f_{Mic}) * [CH_4]_{Therm})$

Where, f_{Mic} is the proportion of microbial gas in the mixture and $[CH_4]_{Mic}$, $[C_2+]_{Mic}$ and $(\delta^{13}C\text{-}CH_4)_{Mic}$ represent the methane and ethane concentrations and carbon isotopic composition of the microbial endmember, respectively. The $[CH_4]_{Therm}$, $[C_2+]_{Therm}$, and $(\delta^{13}C\text{-}CH_4)_{Therm}$) represent the methane and ethane concentrations and carbon isotopic composition of the thermogenic endmember, respectively.

Based upon the three figures below and the two equations above, we can determine that natural gas was formed predominantly by primary microbial processes (>76.1 %). This is determined by using a hydrogenotrophic methanogenesis endmember ($d^{13}C\text{-}CH_4$= -75‰ and C_1/C_2+= 10,000) and the previously published geochemical data (Sassen et al., 2003) from the underlying Genesis oil and gas field ($d^{13}C\text{-}CH_4$= -55.3‰ and C_1/C_2+= 10.7).

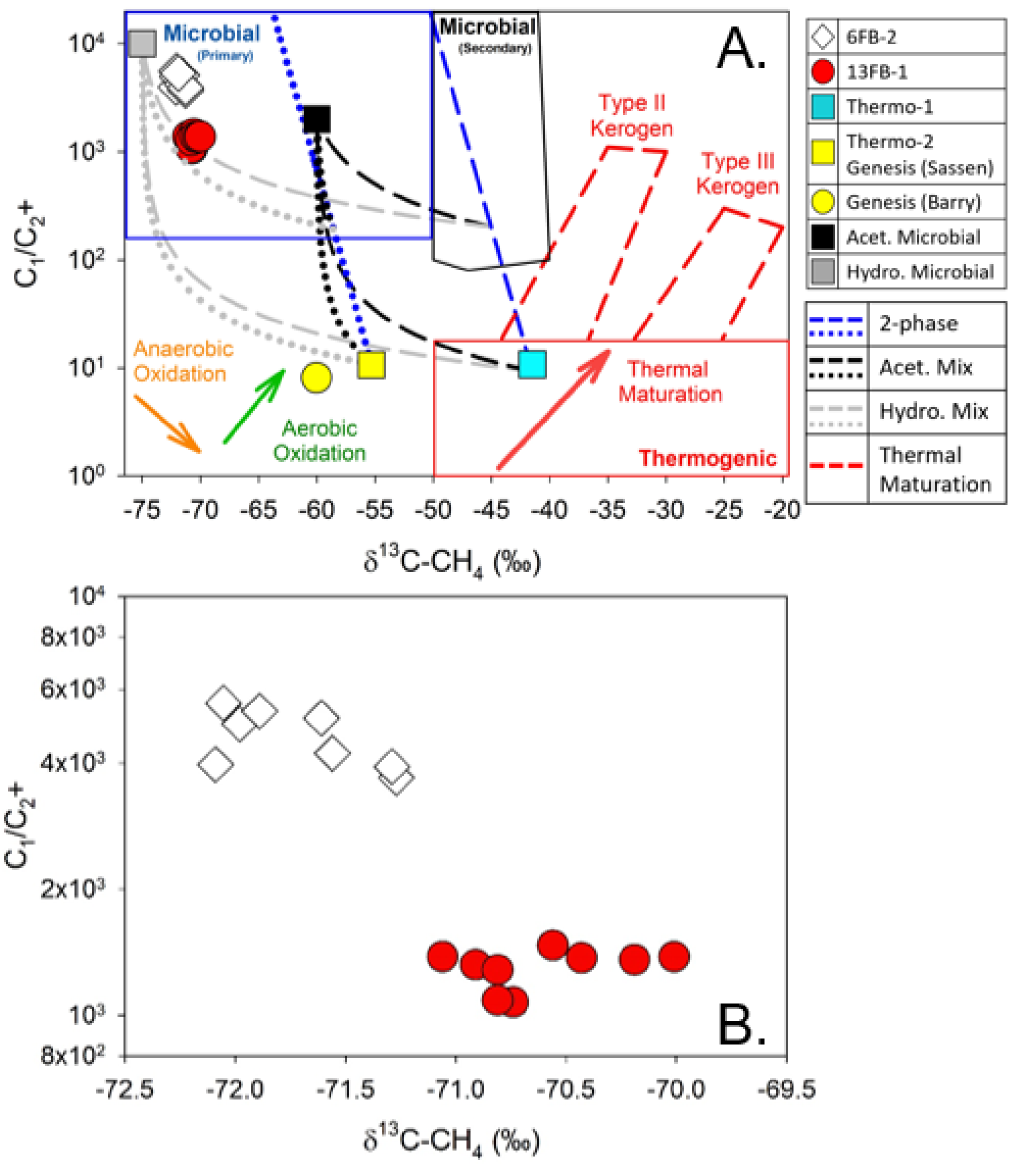

Figure 1-1: Scatter plots of C_1/C_2+ versus $\delta^{13}C$-CH_4 (top, A) and a zoomed in plot of just UT-GOM2-1 samples (bottom, B). A. Measured gas samples collected in the present study are shown in the upper left (white diamonds for section 6FB-2 and red circles for section 13FB-1) and are compared to samples from previously published data from the Genesis Oil and Gas Field (yellow square, (Sassen et al., 2003); yellow circle,(Barry et al., 2018). The blue box represents the ranges of typical primary microbial methane generation. The black box represents secondary microbial methane. The red box represents thermogenic methane and the red arrow and dashed boxes are the trends of thermogenic natural gas maturation based on a Type II or Type III kerogen source rock (Schoell, 1980) (Bernard et al., 1976) (Milkov and Etiope, 2018). Paths of possible post-genetic modification of Thermo-1 (calculated based on R_o,) (McBride et al., 1998) (Schoell, 1983) start at the cyan square and move along the dashed lines. Paths of possible post-genetic modification of Thermo-2 (Genesis gas) start at the yellow square and move along the dotted lines. Modification from 2-phase solubility fractionation is shown in blue (Darrah et al., 2015) (Harkness et al., 2017) (Moore et al., 2018). Modification from thermogenic endmembers mixing with hydrogenotrophic is shown in the lower grey lines. Acetoclastic biogenic modification endmembers are shown in the lower black lines (Jenden et al., 1993). Modification by mixing between migrated thermogenic natural gas that already experienced some post-genetic fractionation and biogenic methane endmembers is represented by the upper black and grey lines. Trends for aerobic oxidation and anaerobic oxidation of methane are shown for comparison by the green arrow and orange arrow, respectively. B. A zoomed-in view of the measured gas samples collected in the present study (white diamonds for section 6FB-2 and red circles for section 13FB-1).

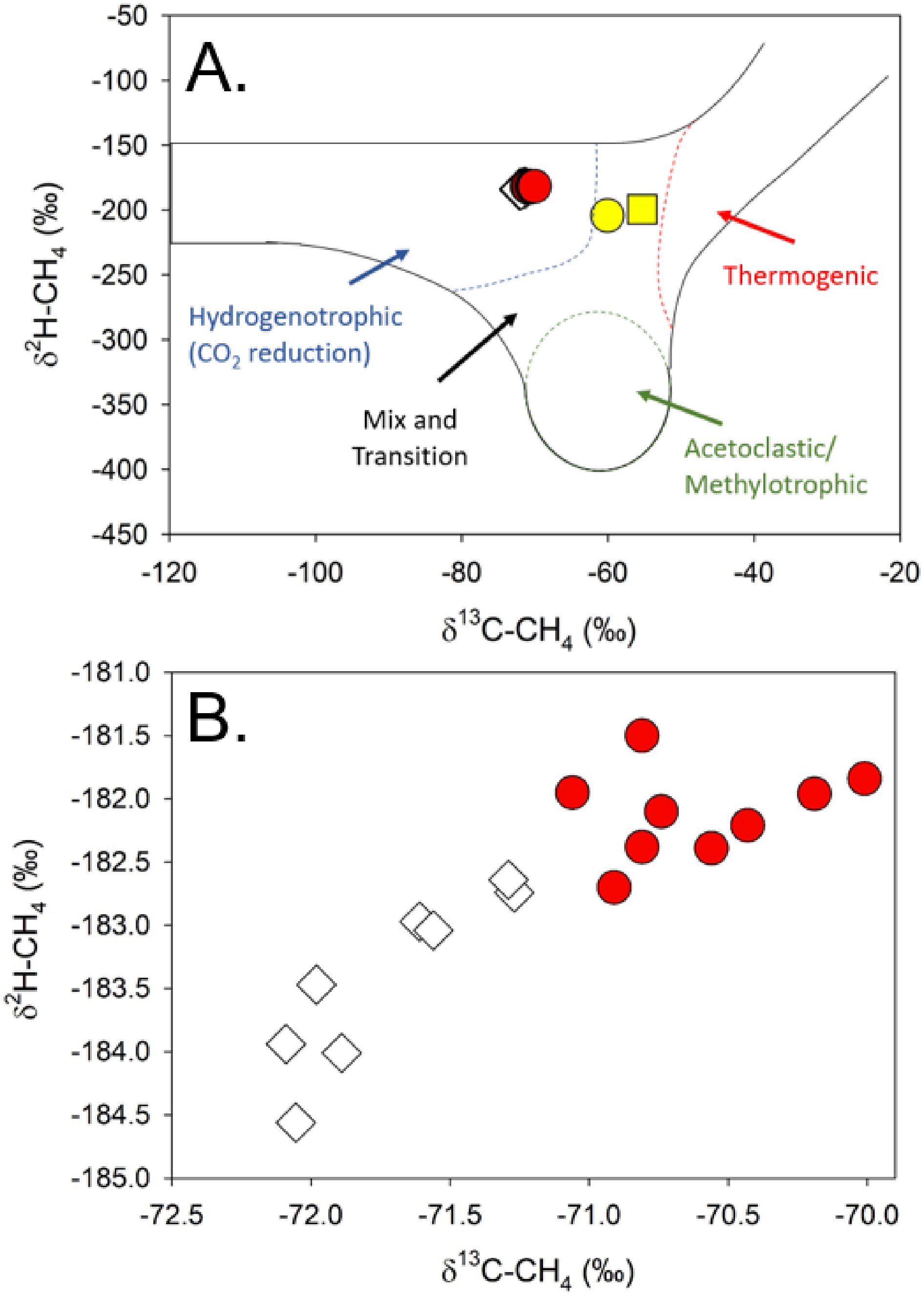

Figure 1-2: Scatter plot of δ²H-CH₄ vs. δ¹³C-CH₄ (top, A) and zoomed in (bottom, B) showing data from the present study (white diamonds for section 6FB-2 and red circles for section 13FB-1) in comparison to previously published data from the Genesis Oil and Gas Field (yellow box,(Sassen et al., 2003);and yellow circle, (Barry et al., 2018). In Figure 1-3A, zones for methane formed by hydrogenotrophic (blue) and acetoclastic (green) methanogenesis, thermogenic (red) natural gas are shown for comparison (Vinson et al., 2017).

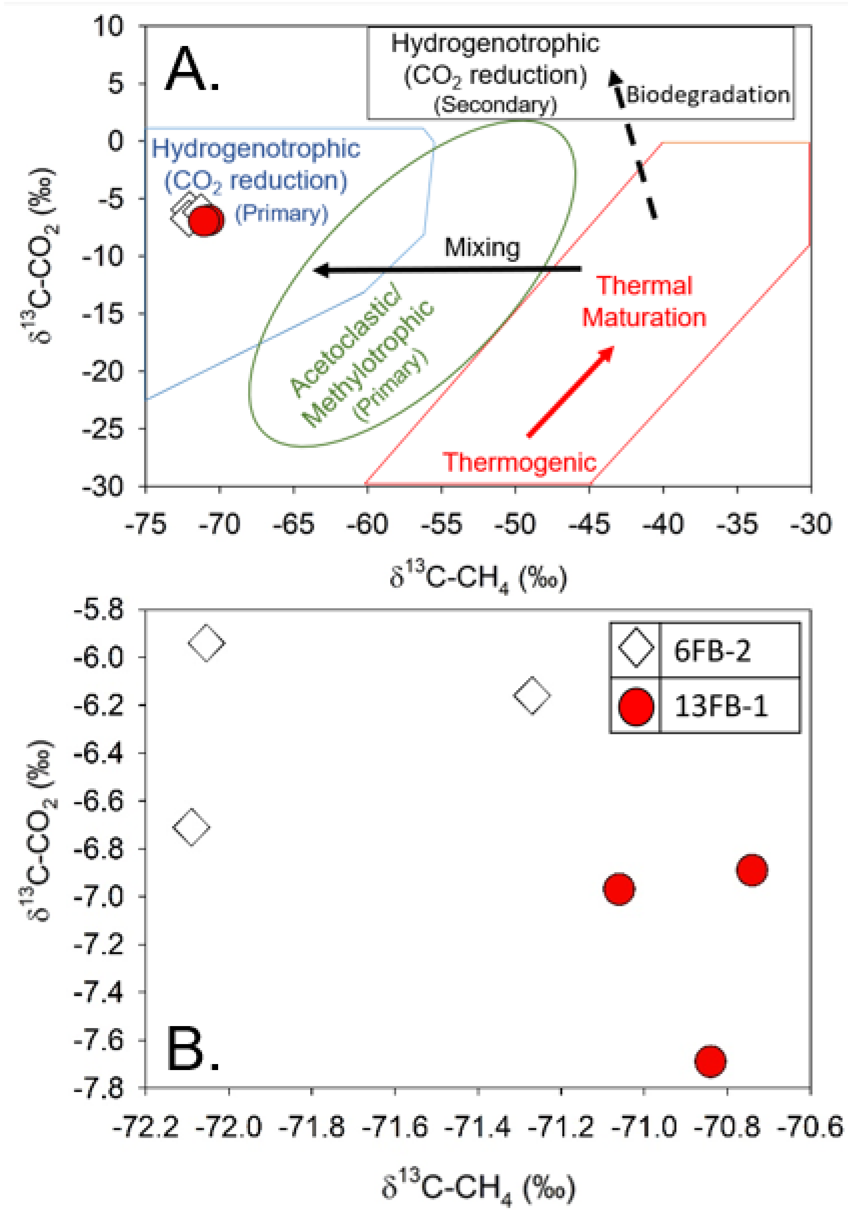

Figure 1-3: Scatter plot of $\delta^{13}C$-CO_2 vs. $\delta^{13}C$-CH_4 (top, A) and zoomed in (bottom, B) showing data from the present study (white diamonds for section 6FB-2 and red circles for section 13FB-1). In Figure A, zones for methane formed by primary hydrogenotrophic (blue) and acetoclastic (green) methanogenesis, secondary hydrogenotrophic methanogenesis (black), thermogenic (red) natural gas are shown for comparison along with trends for mixing (black arrow), thermal maturation (red arrow), and biodegradation of hydrocarbons (black dashed arrow) (endmembers reproduced from (Milkov, 2011; Milkov and Etiope, 2018).

<u>A2. Permeability measurement of pressure core</u>

- UT continued permeability measurement of UT-GOM2-1 pressure cores. During this quarter, we cut two pressure core sections from UT-GOM2-1-H005-7FB-3. We finish the measurements of effective permeability of 7FB-3 core (7FB-3-03) with brine.

- We also measured the effective permeability of 7FB-3-03 core with freshwater to examine the effect of clay swelling on the permeability result. We found that the measured effective permeability did not decrease. Instead, the effective permeability under freshwater increased about 2 mD. This permeability increase is possibly caused by the dissolution of hydrate in freshwater that was injected to displace the brine.
- We reconstituted a sample from 7FB-3 parent sediments using the undercompaction technique. We measured its intrinsic permeability (~41 mD) at porosity of 40%.
- Permeability results of 7FB-3 are compared to previous measurements from 4FB-8 and 13FB-1 (Figure 1-4).

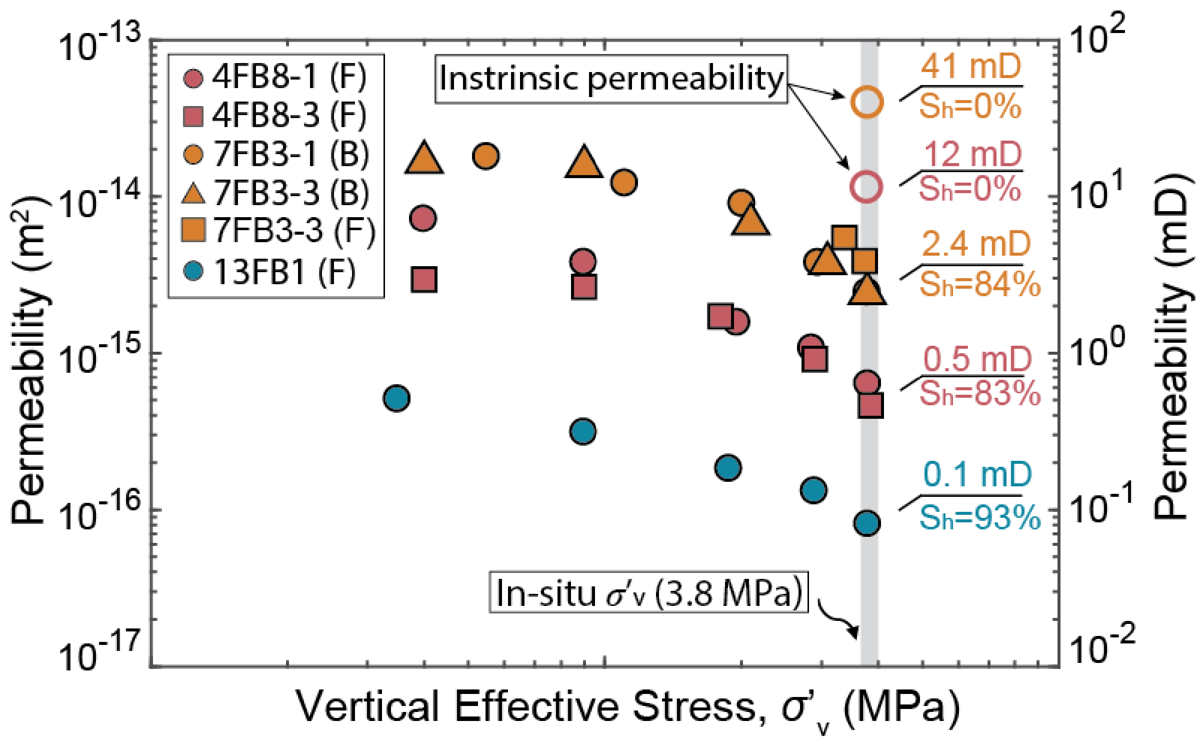

Figure 1-4: Permeability of UT-GOM2-1 Sandy silt sediment from three pressure core sections as a function of vertical effective stress before (effective permeability). The intrinsic permeability is measured by reconstitution approach. B-brine (3.5% salinity), F-freshwater.

A2. Raman measurements of pressure core

Micro-Raman spectroscopy scans of hydrate bearing material under pressure were taken at UT by Professor Lin. A section of pressure core H005-07FB-3 was cut and moved into the micro-Raman high pressure analysis chamber. The chamber was taken out of the cold lab and tilted slightly to allow the sediment to rest right against the chamber sapphire window and Raman scans were taken using a Horiba micro-Raman spectrometer. Raman spectroscopy measures the vibrations and rotations of molecules and can distinguish between free methane molecules and molecules trapped in large or small hydrate cages. Intensity of the Raman spectrum at a given point and wavelength shift is proportional to the local concentration of molecules at that point. Figure 1-5 A shows an image of the Horiba micro-Raman system from Professor Lin's lab in the UT Pressure Core center with the micro-Raman chamber in the background. Figure 1-5 B shows images of the UT-GOM2-1 sediment against the sapphire glass and a photo of the micro-Raman lens next to the sapphire glass during scanning using a blue laser (wavelength 473 nm). Exxon Mobil provided funding for the development of the micro-Raman system and high pressure analysis chamber. Figure 1-6 shows a two-dimensional Raman maps and cage ration results from the first scans of a pressure core from the Gulf of Mexico. Figure 1-6(a) shows the relative positions of testing areas on the sample compared to the full sapphire window. Figure 1-6(b) Mapping results of area 1. (c) Mapping results of area 2. The upper panels in Figure 1-6(b) and Figure 1-6(c) are maps of the ratio of the quantity of methane in large cages (peak Raman shift at 2903 cm-1) versus that of small cages (peak Raman shift at ~2905 cm-1). The ratios were calculated from ration of the peak area of the large cage over that of the small cage. The lower panels in (b) and (c) show the peak area of large cages as a function of that of small cages for each measurement with the area normalized to the maximum peak area of large cages. The ratio of large to small cages is indicative of the hydrate structure, sI or sII.

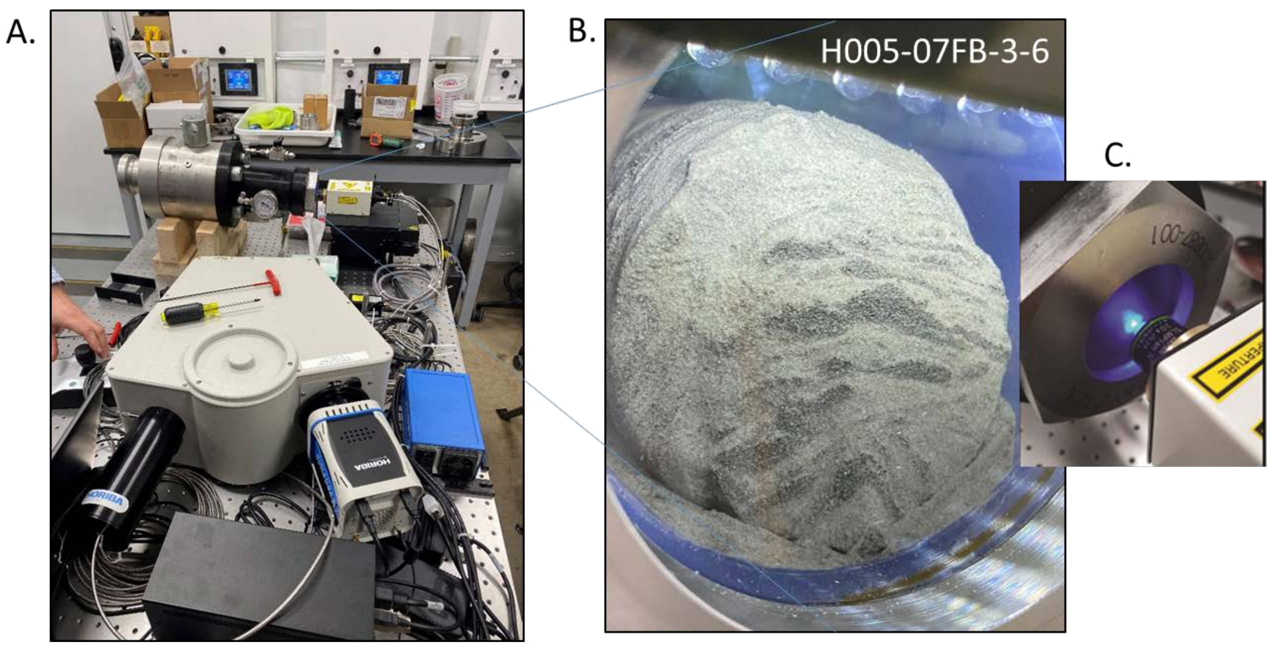

Figure 1-5: micro-Raman spectrometer set up in the UT Pressure Core Center A. micro-Raman Pressure chamber connected to a Horiba Raman system (Lin). B. Hydrate-bearing sediment as seen through sapphire window of micro-Raman Pressure chamber. C. Photo of the Horiba Raman system lens next to the sapphire window during imaging using a blue laser (wavelength 473 nm).

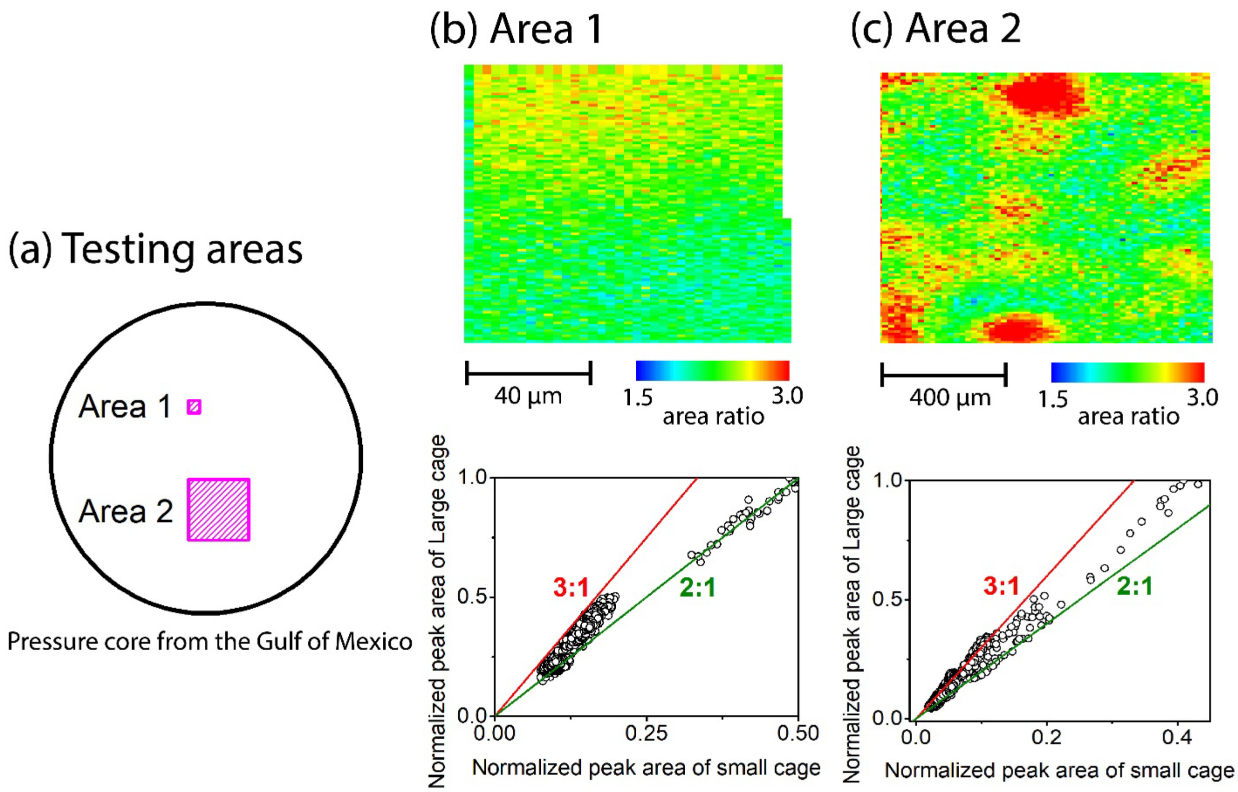

Figure 1-6: Two-dimensional Raman maps of a pressure core from the Gulf of Mexico. (a) Relative positions of testing areas on the sample. (b) Mapping results of area 1. (c) Mapping results of area 2. The upper panels in (b) and (c) are mappings of ratio between the quantity of large cages and that of small cages, which were calculated via peak area of large cage over that of small cage. The lower panels in (b) and (c) show the peak area of large cages as a function of that of small cages for each measurement with the area normalized to the maximum peak area of large cages. Two lines represent 3:1 and 2:1 area ratios are plotted in red and green, respectively.

B. Depressurized Pressure Core Analysis

- The University of New Hampshire continued working on bulk sediment CHNS and bulk sediment TOC, N, and S isotopes. Bulk sediment CHNS elemental analysis allow us to sample and measure at a high down core resolution total carbon (TC), total nitrogen (TN), total sulfur (TS), total organic carbon (TOC) and derived $CaCO_3$, of select samples throughout the records. Bulk sediment TOC, N, and S isotopes allow us to look at the sources of organic carbon and evidence for anaerobic oxidation of methane (AOM) in the records. Coupled with the C/N measurement, the isotopic character of the organic carbon ($\delta^{13}C$) will define relative variations in the source (marine or terrestrial) of the carbon.

  61 non-acid treated sample splits of the TOC samples have been measured for total C, TN, and $\delta^{15}N$ and $\delta^{13}C$ at the stable isotope lab at UNH. The total C results are used with previously measured TOC samples to calculate the $CaCO_3$ wt. % for each sample, whereas the total N will be used with TOC to determiner C/N ratios. In addition, 61 samples were measured for total S and bulk $\delta^{34}S$ at the University of California Berkeley. UNH replicated samples for TOC and $\delta^{13}C$ of the TOC at the stable isotope lab at

UNH. These results yielded greater TOC content and more enriched δ^{13}C TOC signatures than the previous measurements and indicated that not all of the inorganic carbon ($CaCO_3$) had been dissolved prior to TOC measurement. We have modified our acidification method accordingly and are planning to re-measure these samples.

Oregon State with Texas A&M Corpus Christi (TAMU-CC) and ExxonMobil are UT-GOM2-1 pressure cores de-pressurized at UT during the summer of 2019 to determine the microbial community characteristics in the samples that have been stored since 2017. Among the samples collected during summer 2019, one was collected in close physical proximity to a sample taken an analyzed when the cores were originally collected in 2017. The microbial community in the original was characterized at Exxon Research by Zara Summers and Ian Drake and will be used as a point of comparison for communities derived from the core that was de-pressure in 2019. The initial DNA and RNA extraction trials of the 2019 material were unsuccessful. Possible reasons include:

- DNA binding to sediments interfering with extraction efficiency;
- Inhibition of DNA amplification by other materials in the sediments that co-extracted with the DNA;
- Loss of microbial cells that were originally present in the samples (and detected by Drake and Summers) during the 2+ year storage period;
- A combination of the factors noted above

The team confirmed that the samples possess low biomass and furthermore that samples were preserved and apparently sampled during de-pressurization in August 2019 without notable contamination. A separate consideration of pressure and compaction in fine-grain materials such as would occur in the GoM2-1 samples suggests that cells in the GC955 sediments may face a different survival challenge that just pressure alone. In this case, cells appear to exist in the sediments that are compacted to the extent that some of the cells may be physically crushed or pierced by the close contact with sediment grains that are close to the size of the cells themselves. This concept was described by (Rebata-Landa and Santamarina, 2006) and should be a consideration in our study.

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

- No update this period.

1.2.2.2.3 Subtask 10.6 – Additional Analysis Capabilities

- 52 samples for sediment grain size from holes H002 and H005 using the laser particle size analyzer at UNH were measured twice, (bulk sediment and TOC-free sediment) using the UNH Malvern Mastersizer 2000 Laser Particle Size Analyzer. These results were summarized and submitted to the project as a Data Report (Johnson et al., in press).

1.2.2.2.4 Subtask 10.7 – Hydrate Modeling

- No update this period.

1.2.2.2.5 Other – Publications

- UT, Ohio State, University of New Hampshire, Oregon State, Columbia University, and University of Washington all participated in the Gordon Research Seminar and Conference on Gas Hydrates including three invited GRS talks. The GRS presentation titled "Coupled Multiphase Flow and Reactive Transport Processes in Gas Hydrate Systems" by You et al. was one of three selected from GRS for a second presentation at GRC.
- UT, Ohio State, Oregon State, University of Washington, Columbia, and University of New Hampshire all continued 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. 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/).
- UT continued working on contributions to Vol. 1 of the AAPG Bulletin special issue dedicated to UT-GOM2-1. Papers include:
    1. *Fang, Y., Flemings, P. B., Daigle, H., Phillips, S. C., Meazell, P. K., and You, K., in press, Petrophysical properties of the Green Canyon block 955 hydrate reservoir inferred from reconstituted sediments: Implications for hydrate formation and production: American Association of Petroleum Geologist Bulletin. DOI:10.1306/01062019165*
    2. *Flemings, P. B., Phillips, S. C., Boswell, R., Collett, T. S., Cook, A. E., Dong, T., Frye, M., Guerin, G., Goldberg, D. S., Holland, M. E., Jang, J., Meazell, K., Morrison, J., O'Connell, J., Pettigrew, T., Petrou, E., Polito, P. J., Portnov, A., Santra, M., Schultheiss, P. J., Seol, Y., Shedd, W., Solomon, E. A., Thomas, C., Waite, W. F., and You, K., In press, Pressure coring a Gulf of Mexico Deepwater Turbidite Gas Hydrate Reservoir: Initial results from the UT-GOM2-1 hydrate pressure coring expedition: American Association of Petroleum Geologist Bulletin.*
    3. *Meazell, K., Flemings, P., and Santra, M., in press, Silt-rich channel-levee hydrate reservoirs 1of Green Canyon 955: American Association of Petroleum Geologist Bulletin.*
    4. *Phillips, S. C., Flemings, P. B., Holland, M. E., Schultheiss, P. J., Waite, W. F., Jang, J., Petrou, E. G., and H., H., in press, High concentration methane hydrate in a silt reservoir from the deep-water Gulf of Mexico: American Association of Petroleum Geologist Bulletin. DOI:10.1306/01062018280*
    5. *Portnov, A., Cook, A. E., Heidari, M., Sawyer, D. E., Santra, M., and Nikolinakou, M., in press, Salt-driven evolution of a gas hydrate reservoir in Green Canyon, Gulf of Mexico: American Association of Petroleum Geologist Bulletin. DOI: 10.1306/10151818125*

6. *Santra, M., Flemings, P., Meazell, K., and Scott, E., in press, Evolution of Gas Hydrate-bearing Deepwater Channel-Levee System in Abyssal Gulf of Mexico – Levee Growth and Deformation: American Association of Petroleum Geologist Bulletin. DOI: 10.1306/04251918177*
7. *Thomas, C., Phillips, S. C., Flemings, P. B., Santra, M., Hammon, H., Collett, T. S., Cook, A., Pettigrew, T., Mimitz, M., Holland, M., and Schultheiss, P., in press, Pressure-coring operations during the University of Texas Hydrate Pressure Coring Expedition, UT-GOM2-1, in Green Canyon Block 955, northern Gulf of Mexico: American Association of Petroleum Geologist Bulletin. DOI: 10.1306/02262019036*

- Ohio State continued working on three AAPG submissions covering XCT saturation, gas sampling/effects of degassing on gas geochemistry, and gas source.
- AAPG Editors continued working on the AAPG Volumes 1-3. Editors hosted a discussion at the Gordon Research Conference on Gas Hydrates to review the status of all potential papers for Volumes 2 and 3. Each group reviewed their completed or anticipated results and possible submission.

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

Status: Ongoing

- UT completed some updates to the UT-GOM2-2 Science and Sample Distribution Plan after meetings with Geotek. The plan includes detailed science objectives, core types and coring locations, core cutting and preservation, core analyses and methodology, and distribution of cores and other samples.
- UT and Ohio State began to develop an operations plan for the updip drilling locations, F001 and F002.

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

Status: Ongoing

- No update this period.

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

Status: Ongoing

- During this quarter, UT scanned and conducted multiple samplings of core H005-7FB-3. In March, 2020 UT held a meeting with Geotek. In addition to discussing the PCTB Land Test, UT identified several K0 operational deficiencies involving scratches on sealing surfaces, bottom cap seal failures, and reduced axial loading capability. Geotek provided a variety of procedures to remedy these deficiencies including better component alignment to prevent scratches, upgrading seals to provide cleaner surfaces and engagement, and the use of hydraulic pressure to increase axial loading capabilities. Testing of these remedies will occur next quarter.

1.2.2.5.1 Subtask 13.1 – Hydrate Core Manipulator and Cutter Tool

- One core scanned and subsampled with the aid of the new CT scanner system:
    - Core H005-7FB-3 – Two K0 samples
    - Core H005-7FB-3 – Natural Hydrate Raman Spectroscopy Chamber sample
        - March 12, 2020 - First micro-Raman scanning conducted on GOM methane hydrate sample. Raman spectra was obtained.
    - Core H005-7FB-3 - Degas sample

1.2.2.5.2 Subtask 13.2 – Hydrate Core Effective Stress Chamber

- Two pressure core samples underwent K0 testing:
    - H005-7FB-3-3 – Completed
    - H005-7FB-3-4 – In process
- System underwent cleaning between tests. All seals were replaced.

1.2.2.5.3 Subtask 13.3 – Hydrate Core Depressurization Chamber

- UT prepared one core sample for a degassing test during this period:
    - H005-7FB-3-6 - Placed in storage chamber, readied for degassing in April, 2020.
- The system underwent maintenance and cleaning.

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

- No update this period.

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

- New core chamber orientation supports are undergoing design refinement. UT is obtaining quotes to manufacture.
- Expansion of pressure maintenance system is required to increase storage capability sufficient to receive UT-GOM2-2 cores. UT is obtaining quotes for additional pressure lines.
- Expansion of pressure safety venting system will also be required. UT is obtaining quotes for additional venting lines.

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

- Core storage expansion in the PCC is anticipated to accommodate any remaining pressure cores acquired from UT-GOM2-1.

1.2.2.5.7 Subtask 13.7 – X-ray Computed Tomography

- The X-Ray CT continues to operate as designed. No updates this period.

1.2.2.5.8 Subtask 13.8 – Pre-Consolidation System

- The Pre-Consolidation System functions as designed. No updates this period.

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

Status: Ongoing

1.2.2.6.1 Subtask 14.1 – PCTB Lab Test

- Geotek conducted pressure actuation testing (Bench Test II) of the PCTB between January 27-31, 2020 (**Appendix A**). The PCTB Bench Test II accomplished pressure actuation testing (PAT) of the final PCTB design that was later tested during the PCTB Land Test at Schlumberger CTTF, using both seawater and drilling mud. Additionally, Geotek tested the Temperature-2-Pressure Probe (T2P) and Probe Deployment Tool (PDT).
- The PCTB Bench Test II PATs were conducted to assess upgrades that were incorporated into the PCTB design in January, 2020 (Subtask 14.2 – PCTB Modifications/Upgrades).
    - 12 pressure actuation tests were performed, in which the PCTB was actuated at field-like pressures in Geotek's pressure chamber test facility (**Appendix A**).
    - In all but two tests a pressure boost was recorded and maintained until tool recovery.
    - In the two failed tests, operator error caused the PCTB to be assembled incorrectly, resulting in failure to seal. The operator errors were identified, document, and corrected.
- Two PDT deployment tests were performed with the T2P attached.
    - In the second test, the PDT/T2P assembly hung up when it was being pulled out. Eventually hammering and lowering and raising the tool several times freed the tool.
    - Visual inspection of the PDT revealed that all three of the locking dogs were bent and one of the upper latch dogs was missing. It is theorized that the missing latch dog is what was preventing the tool from being pulled out of the test chamber.
    - The latch dogs were refabricated from stronger material in time for the Land Test at CTTF (Subtask 14.3 – PCTB Land Test), where this problem was not observed again.

1.2.2.6.2 Subtask 14.2 – PCTB Modifications/Upgrades

- In January, 2020 Geotek completed upgrading the PCTB to PCTB4 specifications:
    1. Single-Trigger Mechanism
        - The single trigger mechanism replaced the original complex vent port mechanism which relied on an O-ring face seal to complete the autoclave upper sealing mechanism. The original vent port closing actuation timing was controlled by a spring and was very close to that of firing the boost which led to potential loss of the boost pressure. The single

trigger mechanism makes it impossible for the boost to fire prior to closing the vent port while eliminating the O-ring face seal and spring.

2. Low Friction Coatings
    - All sliding parts and the latch mechanism have had a low friction coating applied to them, primarily to reduce the wireline overpull required to release the PCTB latch from the bottom hole assembly (BHA).
3. IT Plug Mandrel Shear Pin
    - With the introduction of the single trigger mechanism the IT plug mandrel locking dogs were replaced by a shear rod. The shear rod shear force must be high enough to ensure the autoclave upper seals are properly engaged while low enough to allow the over travel spring to function without prematurely unlatching the PCTB from the BHA.
4. Flow Diverter Seals
    - Introduction of the single trigger mechanism required the flow diverter to be modified. Part of the diverter modification included replacing the original lip seals with point seals in an effort to increase reliability of the diverter.
5. Regulator Sub
    - The regulator sub was modified so seal cannot cause hydraulic lock.
6. Pressure Section Increase
    - The pressure section length was increased by 24 inches, more than doubling its volume. The increased volume will ensure adequate high pressure gas is available to activate the autoclave boost in high hydrostatic pressure environments.

1.2.2.6.3 Subtask 14.3 – PCTB Land Test

- The UT DOE Hydrates program (DE-FE0023919) performed a field test of the PCTB (Pressure Core Tool with Ball), the Probe Deployment Tool (PDT), and the Temperature-2-Pressure (T2P) probe at the Schlumberger Cameron Test and Training Facility (CTTF). Land Test activities occurred from March 16-20, 2020.
- Seven tests of the Pressure Coring Tool with Ball (PCTB) were performed:
    - 2 coring tests were performed with the face bit version (PCTB-FB), both full-function coring tests.
    - 5 tests were performed with the cutting shoe version (PCTB-CS). 4 were full-function coring tests, the fifth was a ‘water core.’
    - In all full-function tests, coring quality was excellent, core recovery was high (generally 80%+) and core diameter consistent (Figure 1-7).
    - However, in 6 out of 7 full-function tests, the ball valve only partially closed. No boost pressure was recorded, and the autoclave did no seal. The core test in which the PCTB sealed correctly is described in Figure 1-8.

Figure 1-7: Core CTTF-02FB contained 8.9 ft of limestone and shale after recovery (91% recovery).

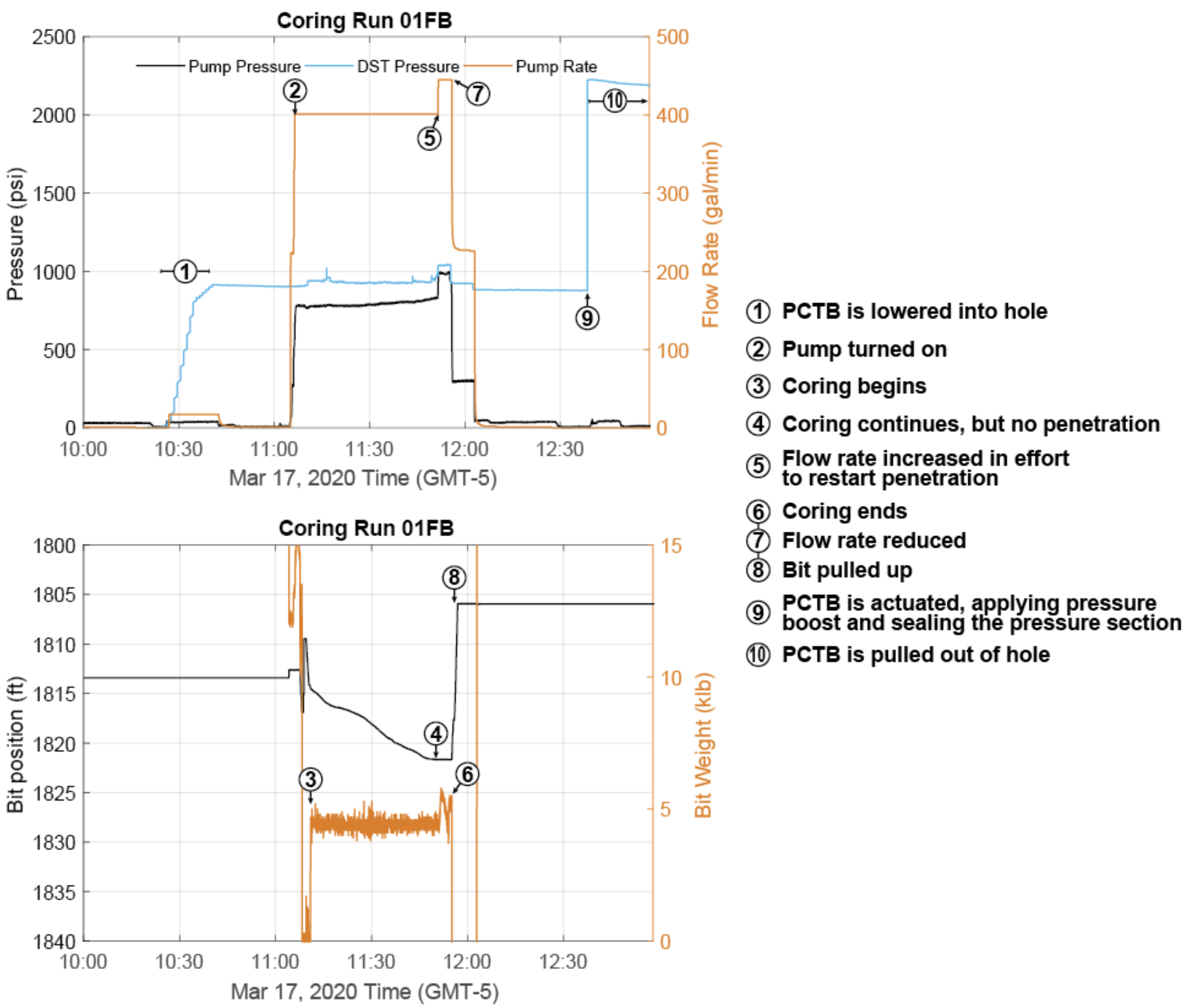

Figure 1-8: Autoclave (DST) pressure plotted alongside several rig parameters for the single core test in which pressure boost was successfully recorded and maintained (CTTF-01FB).

- After the single successful test, the PCTB ball valve was observably partially open upon recovery of the tool in most successive tests (Figure 1-9).
  - We interpret that drilling fluid and entrained cuttings are wedging between the outer housing and the seal carrier around the ball.

- One test failed to seal, as shown by the DST pressure log in the tool. However, the ball valve appeared closed upon recovery. We interpret that the ball is closing at some point on the ascent, and compare the test to several coring runs in the 2017 marine test in which the autoclave sealed late.

Figure 1-9: Illustration of a partially closed ball valve after recovery from the hole. The red object is the seal carrier. A spring to the left of the seal carrier drives the ball downward (to the right). When the ball is forced downwards, it rotates around a pin and seals in place.

- These full-function tests demonstrate that there is a problem with the ball valve sealing, and that this was likely the cause of the late seals or failures to seal in the 2017 UT-GOM2-1 Marine Field Test.
  - During UT-GOM2-1, there was only one core that recorded a boost pressure and this was in lithified marl and mudrock and not in a coarse-grained hydrate bearing interval. In drilling the coarse-grained interval, in all cases, the ball valve sealed as the tool was being raised to the surface and a pressure boost was not recorded.
  - The PCTB-CS and PCTB-FB sealed perfectly during borehole testing in Salt Lake City, January 2020. However, this mud did not have detritus or silt within it. The only change in the ball closure mechanism between the Salt Lake City Bench test and the Cameron test was to put a low friction coating on it. This was fully vetted in the bench test in Salt Lake City with no issues.
- To resolve this issue, it will be necessary to be able to systematically recreate the failure mode where sediments jam the seal carrier.
  - Geotek began to explore this immediately at Salt Lake by adding sediment to mud to simulate the conditions at Cameron, and has been able to reproduce the failure of the ball valve to close under the new conditions.

    - Geotek and Pettigrew Engineering will explore possible design changes to improve sealing in the presence of mud with cuttings.
- At the end of the testing program, the Probe Deployment Tool (PDT) was deployed with the T2P penetrometer.
    - The PDT had not yet been tested in a borehole setting. The T2P's logging electronics have been overhauled since its last deployment.
    - During the descent, the PDT prematurely released from the Running/Pulling Tool (RPT), and the PDT/T2P fell to rest in the BHA.
    - The tool was recovered with an emergency pulling tool.
    - We interpret the detents (catches) on the PDT sheared, causing the PDT to detach from the RPT while still in the locked position.
        - This is attributed to higher than expected impact loading.
        - Upgrades to detent material and the design of surrounding components (latch dogs) are being considered.
    - The T2P tip (2 cm) was sheared off at some point in the fall. The T2P appeared otherwise undamaged.
        - The T2P's pressure and temperature data could not be recovered from the test.
            - The new data acquisition system within the T2P appeared to be undamaged, but no data file was found after the test.
            - The cause of failure to record data during this test is being investigated by UT and Leeman Geophysical.

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

Status: In Progress

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

- The UT-GOM2-2 Permit Team (consisting of UT and Ohio State) continued work on the BOEM Exploration Plan Geology and Geophysical chapter. UT and Ohio State held bi-weekly, or weekly web conferences to work on the G&G for the H002 and G002 that will be drilled as part of the UT-GOM2-2 Scientific Drilling Program. UT and Ohio State also continued work on the G&G for the F001 and F002 wells that will also be permitted, but may only be drilled if additional funding is available. As of the March 30, 2020, the G&G is near final completion.
- UT held a telephone discussion with the Bureau of Ocean Energy Management (BOEM) on May 2020 for informal discussion of the UT-GOM2-2 permit submission schedule. The following plan was agreed upon:
    1. We will send the Exploration Plan (EP), Right-of-Use-and-Easement (RUE), and Geological and Geophysical (G&G) permit documents to BOEM in May, 2020 for informal review.
    2. BOEM and UT will identify potential issues with the permit documents.

3. We will then determine the optimal timing of formal permit submission.

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. 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.

UT will begin work on the Phase 4 to Phase 5 budget period transition.

1.3.2 Task 10.0 – Core Analysis

- Work will continue on measuring the petrophysical and geomechanical properties of pressure core using the UT K0 Permeameter as possible depending on how long labs are shut down. Quantitative degassing will continue as needed in support of the permeability measurements.
- Work will continue on finalizing and posting Data Reports
- UT, Ohio State, University of New Hampshire, and Oregon State continue working on contributions to the AAPG Special Bulletin Volumes (1, 2, and 3).
- UNH plans to finish remeasurement of sediment TOC once their lab reopens.
  Oregon State with Texas A&M Corpus Christi will continue assessing the microbial communities in GC 955 sediment as possible depending on how long labs are shut down. The next steps related to the analysis of microbes in the GC955 cores are summarized below:
    1. The residual de-pressurized core material stored at -80 C at TAMU-CC will be sent to Zara Summers and Ian Drake (Exxon) for DNA extraction and sequencing when work resumes at TAMU-CC and Exxon.
    2. We anticipate DNA extraction, sequencing and data analysis to be complete within 2-3 months after samples are shipped to Exxon.
    3. Considerations as we analyze the molecular data are:
        a) Contamination check to identify any microbial types that are likely contaminants
        b) Assess native microbial diversity and identify cells present
        c) Compare results to diversity and taxa identified in May 2017 samples to determine if changes have occurred as a result of long-term pressure storage
        d) Assess physical and chemical controls (e.g., grain-size, TOC) on the microbial communities present in the sediments
    4. Prepare manuscript for submission in fall 2020

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

- UT and Ohio State will continue to develop an operations plan for the up-dip drilling location (F001 and F002). This will be used for the purpose of permitting.
- UT will continue to develop the UT-GOM2-2 Science and Sample Distribution Plan, which will be reviewed with subcontractors, the Core Analysis Team, and the Technical Advisory Group.
- The UT-GOM2-2 Science and Sample Distribution Plan is scheduled to be distributed to the Technical Advisory Group in June, 2020.

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

- UT will initiate a Vessel Procurement Team to determine strategy and develop plan for UT-GOM2-2 vessel procurement.

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

- The Mini-PCATS, PMRS, analytical equipment, and all storage chambers will undergo continued observation and maintenance at regularly scheduled intervals and on an as-needed basis.
- UT will conduct testing of the Geotek remedies to correct K0 operational deficiencies identified in Q1, 2020.

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

- UT will complete the PCTB Land Test Report.
- UT will engage the PCTB Development Team (including members of DOE and USGS) to review the detailed results of the Land Test and determine next steps.
- UT will continue to coordinate with Geotek in their independent evaluation and post-Land Test testing of the PCTB. UT will monitor the results of Geotek's ongoing evaluation, and report updates immediately to the PCTB Development Team.

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

- The UT-GOM2-2 Permitting Team will continue to hold regular web-conferences to work through permit-related issues.
- The UT-GOM2-2 will continue to develop the permits for the approved 2-well program, as well as for the third, up-dip, location (4-well program). The next steps are to:
    - Finalize G&G permit inputs
    - Prepare time-estimates for the two updip locations

- Finalize preliminary mud programs for H&G wells
    - Commence incremental mud program for F wells
    - Prepare preliminary cement (plug and abandonment) programs
    - Develop science plan permit inputs
    - Continue working on environmental permit inputs
- We are targeting May 2020, to informally submit the EP, RUE, and G&G to BOEM for informal review.

2 PRODUCTS

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

2.1 UT-GOM2-1 Scientific Report

UT and the GOM2 Science Party have created, finalized, and published the UT-GOM2-1 expedition scientific volume. The volume contains preliminary pages, expedition summary, methods, well reports, a digital database of the initial technical findings, and all supporting materials. The volume was modeled after similar IODP volumes. Table 2-1 presents the volume structure with links.

Table 2-1: UT-GOM2-1 Scientific Volume

Expedition Volume Cover / Home	https://ig.utexas.edu/energy/genesis-of-methane-hydrate-in-coarse-grained-systems/expedition-ut-gom2-1/
Expedition Scientists	https://ig.utexas.edu/energy/genesis-of-methane-hydrate-in-coarse-grained-systems/expedition-ut-gom2-1/expedition-scientists/
Preliminary Pages Volume Authorship, Publisher's Notes, Chapter links, Data Report links, Expedition Bibliography	https://ig.utexas.edu/energy/genesis-of-methane-hydrate-in-coarse-grained-systems/expedition-ut-gom2-1/reports/
UT-GOM2-1 Hydrate Pressure Coring Expedition Chapter 1. Expedition Summary 1.1 Background and Objectives 1.2 Pre-Drill Operational Plan 1.3 Operational Overview 1.4 Scientific Results 1.5 Reporting 138 pages, 26 figures, 10 tables, 3 appendices	https://ig.utexas.edu/files/2018/02/1.0-UT-GOM2-1-Expedition-Summary.pdf
UT-GOM2-1 Hydrate Pressure Coring Expedition Chapter 2. Expedition Methods 1.1 Introduction 1.2 Rig Instrumentations 1.3 Pressure Coring 1.4 Physical Properties and Core Transfer 1.5 Quantitative Degassing 1.6 Lithostratigraphy 1.7 Geochemistry and Microbiology 1.8 Wireline Logging 41 pages, 12 figures, 6 tables	http://www-udc.ig.utexas.edu/gom2/Chapter%202%20-%20Methods.pdf

UT-GOM2-1 Hydrate Pressure Coring Expedition Chapter 3. Hole GC 955 H002 1.1 Background and Objectives 1.2 Operations 1.3 Pressure Coring 1.4 Physical Properties and Core Transfer 1.5 Quantitative Degassing 1.6 Lithostratigraphy 1.7 Geochemistry and Microbiology 1.8 Wireline Logging 85 pages, 55 figures, 24 tables	http://www-udc.ig.utexas.edu/gom2/Chapter%203%20-%20H002.pdf
UT-GOM2-1 Hydrate Pressure Coring Expedition Chapter 4. Hole GC 955 H005 1.1 Background and Objectives 1.2 Operations 1.3 Pressure Coring 1.4 Physical Properties and Core Transfer 1.5 Quantitative Degassing 1.6 Lithostratigraphy 1.7 Geochemistry and Microbiology 1.8 Wireline Logging 164 pages,128 figures, 30 tables	http://www-udc.ig.utexas.edu/gom2/Chapter%204%20-%20H005.pdf
Data Directory	http://www-udc.ig.utexas.edu/gom2/

2.2 Publications

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

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

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

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

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

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

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

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

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

Fang, Y., Flemings, P. B., Daigle, H., Phillips, S. C., Meazell, P. K., and You, K., in press, Petrophysical properties of the Green Canyon block 955 hydrate reservoir inferred from reconstituted sediments: Implications for hydrate formation and production: AAPG Bulletin. https://doi.org/10.1306/01062019165

Flemings, P. B., Phillips, S. C., Boswell, R., Collett, T. S., Cook, A. E., Dong, T., Frye, M., Guerin, G., Goldberg, D. S., Holland, M. E., Jang, J., Meazell, K., Morrison, J., O'Connell, J., Pettigrew, T., Petrou, E., Polito, P. J., Portnov, A., Santra, M., Schultheiss, P. J., Seol, Y., Shedd, W., Solomon, E. A., Thomas, C., Waite, W. F., and You, K., In press, Pressure coring a Gulf of Mexico Deepwater Turbidite Gas Hydrate Reservoir: Initial results from the UT-GOM2-1 hydrate pressure coring expedition: American Association of Petroleum Geologist Bulletin.

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

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

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

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

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

Meazell, K., Flemings, P., and Santra, M., in press, Silt-rich channel-levee hydrate reservoirs 1of Green Canyon 955: American Association of Petroleum Geologist Bulletin.

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

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

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

Phillips, S. C., Flemings, P. B., Holland, M. E., Schulthiss, P. J., Waite, W. F., Jang, J., Petrou, E. G., and H., H., in press, High concentration methane hydrate in a silt reservoir from the deep-water Gulf of Mexico: American Association of Petroleum Geologist Bulletin. https://doi.org/10.1306/01062018280

Phillips, S. C., Flemings, P. B., You, K., Meyer, D. W., and Dong, T., 2019, Investigation of in situ salinity and methane hydrate dissociation in coarse-grained sediments by slow, stepwise depressurization: Marine and Petroleum Geology, v. 109, p. 128-144. https://doi.org/10.1016/j.marpetgeo.2019.06.015
Portnov, A., Cook, A. E., Heidari, M., Sawyer, D. E., Santra, M., and Nikolinakou, M., in press, Salt-driven evolution of a gas hydrate reservoir in Green Canyon, Gulf of Mexico: American Association of Petroleum Geologist Bulletin. https://doi.org/10.1306/10151818125
Portnov, A., Cook, A. E., Sawyer, D. E., Yang, C., Hillman, J. I. T., and Waite, W. F., 2019, Clustered BSRs: Evidence for gas hydrate-bearing turbidite complexes in folded regions, example from the Perdido Fold Belt, northern Gulf of Mexico: Earth and Planetary Science Letters, v. 528. https://doi.org/10.1016/j.epsl.2019.115843
Santra, M., Flemings, P., Meazell, K., and Scott, E., in press, Evolution of Gas Hydrate-bearing Deepwater Channel-Levee System in Abyssal Gulf of Mexico – Levee Growth and Deformation: American Association of Petroleum Geologist Bulletin. https://doi.org/doi.org/10.1306/04251918177
Sawyer, D. E., Mason, R. A., Cook, A. E., and Portnov, A., 2019, Submarine Landslides Induce Massive Waves in Subsea Brine Pools: Scientific Reports, v. 9, no. 1, p. 128. https://doi.org/10.1038/s41598-018-36781-7
Sheik, C. S., Reese, B. K., Twing, K. I., Sylvan, J. B., Grim, S. L., Schrenk, M. O., Sogin, M. L., and Colwell, F. S., 2018, Identification and Removal of Contaminant Sequences From Ribosomal Gene Databases: Lessons From the Census of Deep Life: Front Microbiol, v. 9, p. 840. https://doi.org/10.3389/fmicb.2018.00840
Smart, K (2018). Modeling Well Log Responses in Hydrate Bearing Silts. Ohio State University. Undergraduate Thesis.
Smith, A. J., Flemings, P. B., Liu, X., and Darnell, K., 2014, The evolution of methane vents that pierce the hydrate stability zone in the world's oceans: Journal of Geophysical Research: Solid Earth, p. 2013JB010686. https://doi.org/10.1002/2013JB010686
Thomas, C., Phillips, S. C., Flemings, P. B., Santra, M., Hammon, H., Collett, T. S., Cook, A., Pettigrew, T., Mimitz, M., Holland, M., and Schultheiss, P., in press, Pressure-coring operations during the University of Texas Hydrate Pressure Coring Expedition, UT-GOM2-1, in Green Canyon Block 955, northern Gulf of Mexico: American Association of Petroleum Geologist Bulletin. https://doi.org/10.1306/02262019036
Wei, L., Cook, A., Daigle, H., Malinverno, A., Nole, M., and You, K., 2019, Factors Controlling Short-Range Methane Migration of Gas Hydrate Accumulations in Thin Coarse-Grained Layers: Geochemistry, Geophysics, Geosystems, v. 20, no. 8, p. 3985-4000. https://doi.org/10.1029/2019gc008405
You, K., and Flemings, P. B., 2018, Methane hydrate formation in thick sandstones by free gas flow: Journal of Geophysical Research: Solid Earth, v. 123, p. 4582-4600. https://doi.org/10.1029/2018JB015683
You, K., Flemings, P. B., Malinverno, A., Collett, T. S., and Darnell, K., 2019, Mechanisms of Methane Hydrate Formation in Geological Systems: Reviews of Geophysics, v. 0, no. ja. https://doi.org/10.1029/2018rg000638
You, K., Kneafsey, T. J., Flemings, P. B., Polito, P., and Bryant, S. L., 2015, Salinity-buffered methane hydrate formation and dissociation in gas-rich systems: Journal of Geophysical Research: Solid Earth, v. 120, no. 2, p. 643-661. https://doi.org/10.1002/2014JB011190

2.3 Conference Presentations/Abstracts

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

2.4 Websites

- 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

2.5 Technologies Or Techniques

Nothing to report.

2.6 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

During the PCTB Land Test at CTTF in March, 2020, the PCTB did not perform satisfactorily. The Purpose of the PCTB Land Test was to verify that the tool was capable of performing in field conditions prior to deploying in the deepwater Gulf of Mexico during the UT-GOM2-2 Scientific Drilling Program.

There is a prevalent consensus between UT, Geotek, and Pettigrew Engineering that the recent modifications and testing of the PCTB have made the tool more reliable. However, problems remain with ball-valve sealing. We think this is caused by grit from cuttings and/or drilling mud that becomes lodged between the outer housing and the seal carrier, jamming the seal carrier or the ball follower. This hypothesis may explain why this failure mode is observed in field conditions, but not in 'bench' conditions.

Geotek is currently conducting independent review and testing of the PCTB performance at the Geotek testing center in Salt Lake City, Utah. Geotek is attempting to re-create the failure the PCTB experienced during the Land Test using 'grit'.

The path forward is to clearly demonstrate the failure mechanism, fix the failure mechanism, and if consistently resolved, determine what further testing is warranted.

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

Task 11.0 – Refined UT-GOM2-2 Scientific Drilling Program Operations Plan

Subtask 14.3 – PCTB Land Test Report

4.2 Future Project Periods

Task 1.0 – Revised Project Management Plan

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

Subtask 17.1 – Project Sample and Data Distribution Plan

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

5 BUDGETARY INFORMATION

The Budget Period 4 cost summary is provided in Table 5-1.

Table 5-1: Phase 4 / Budget Period 4 Cost Profile

Baseline Reporting Quarter	Budget Period 4							
	Y1Q1		Y1Q2		Y1Q3		Y1Q4	
	10/01/19-12/31/19		01/01/20-03/31/20		04/01/20-06/30/20		07/01/20-09/30/20	
	Y1Q1	Cumulative Total	Y1Q2	Cumulative Total	Y1Q3	Cumulative Total	Y1Q4	Cumulative Total
Baseline Cost Plan								
Federal Share	$ 1,087,357	$ 27,293,955	$ 961,357	$ 28,255,312	$ 2,169,274	$ 30,424,587	$ 961,357	$ 31,385,944
Non-Federal Share	$ 307,598	$ 22,798,170	$ 307,598	$ 23,105,767	$ 307,598	$ 23,413,365	$ 307,598	$ 23,720,962
Total Planned	$ 1,394,955	$ 50,092,125	$ 1,268,955	$ 51,361,079	$ 2,476,872	$ 53,837,951	$ 1,268,955	$ 55,106,906
Actual Incurred Cost								
Federal Share	$ 266,282	$ 26,336,093	$ 1,031,076	$ 27,367,169				
Non-Federal Share	$ 61,210	$ 22,577,153	$ 306,656	$ 22,883,809				
Total Incurred Cost	$ 327,492	$ 48,913,245	$ 1,337,732	$ 50,250,977				
Variance								
Federal Share	$ (821,075)	$ (821,075)	$ 69,718	$ (751,357)				
Non-Federal Share	$ (246,388)	$ (246,388)	$ (942)	$ (247,329)				
Total Variance	$ (1,067,463)	$ (1,067,463)	$ 68,777	$ (998,686)				

6 ACRONYMS

Table 6-1: List of Acronyms

ACRONYM	DEFINITION
AAPG	American Association of Petroleum Geologists
AIST	National Institute of Advanced Industrial Science and Technology
AOM	Anaerobic Oxidation of Methane
BHA	Bottom-Hole-Assembly
BOEM	Bureau of Ocean Energy Management
CHNS	Carbon, Hydrogen, Nitrogen, Sulfur
CPP	Complimentary Project Proposal
CRS	Constant Rate Strain
CTTF	Cameron Test Testing Facility
DOE	U.S. Department of Energy
EP	Exploration Plan
G&G	Geologic and Geophysical
GC	Green Canyon
GRC	Gordon Research Conference
IODP	International Ocean Discovery Program
LWD	Logging While Drilling
NEPA	National Environmental Policy Act
NETL	National Energy Technology Laboratory
PCATS	Pressure Core Analysis and Transfer System
PCC	Pressure Core Center
PCTB	Pressure Core Tool with Ball Valve
PCTB-CS	Pressure Core Tool with Ball Valve - Cutting Shoe
PCTB-FB	Pressure Core Tool with Ball Valve - Face Bit
PDT	Probe Deployment Tool
PM	Project Manager
PMP	Project Management Plan
PMRS	Pressure Maintenance and Relief System
QRPPR	Quarterly Research Performance and Progress Report
RPPR	Research Performance and Progress Report
RPT	Running/Pulling Tool
RUE	Right-of-Use-and-Easement
SOPO	Statement of Project Objectives
T2P	Temperature to Pressure Probe
TAMU-CC	Texas A&M University - Corpus Christi
TC	Total Carbon
TN	Total Nitrogen
TOC	Total Organic Carbon
TS	Total Sulfur

TX	Texas
UNH	University of New Hampshire
UT	University of Texas at Austin
UW	University of Washington
XCT	X-ray Computed Tomography

7 BIBLIOGRAPHY

Barry, P. H., Lawson, M., Meurer, W. P., Cheng, A., and Ballentine, C. J., 2018, Noble Gases in Deepwater Oils of the U.S. Gulf of Mexico: Geochemistry, Geophysics, Geosystems, v. 19, no. 11, p. 4218-4235. https://doi.org/10.1029/2018gc007654

Bernard, B. B., Brooks, J. M., and Sackett, W. M., 1976, Natural gas seepage in the Gulf of Mexico: Earth and Planetary Science Letters, v. 31, no. 1, p. 48-54. https://doi.org/10.1016/0012-821X(76)90095-9

Darrah, T. H., Jackson, R. B., Vengosh, A., Warner, N. R., Whyte, C. J., Walsh, T. B., Kondash, A. J., and Poreda, R. J., 2015, The evolution of Devonian hydrocarbon gases in shallow aquifers of the northern Appalachian Basin: Insights from integrating noble gas and hydrocarbon geochemistry: Geochimica et Cosmochimica Acta, v. 170, p. 321-355. https://doi.org/10.1016/j.gca.2015.09.006

Etiope, G., 2017, Natural Gas, *in* White, W. M., ed., Encyclopedia of Geochemistry: A Comprehensive Reference Source on the Chemistry of the Earth: Cham, Springer International Publishing, p. 1-5.

Harkness, J. S., Darrah, T. H., Warner, N. R., Whyte, C. J., Moore, M. T., Millot, R., Kloppmann, W., Jackson, R. B., and Vengosh, A., 2017, The geochemistry of naturally occurring methane and saline groundwater in an area of unconventional shale gas development: Geochimica et Cosmochimica Acta, v. 208, p. 302-334. https://doi.org/10.1016/j.gca.2017.03.039

Jackson, R. B., Vengosh, A., Darrah, T. H., Warner, N. R., Down, A., Poreda, R. J., Osborn, S. G., Zhao, K., and Karr, J. D., 2013, Increased stray gas abundance in a subset of drinking water wells near Marcellus shale gas extraction: Proceedings of the National Academy of Sciences, p. 201221635. https://doi.org/10.1073/pnas.1221635110

Jenden, P. D., Drazan, D. J., and Kaplan, I. R., 1993, Mixing of Thermogenic Natural Gases in Northern Appalachian Basin: American Association of Petroleum Geologists Bulletin, v. 77, p. 980-998.

Johnson, J. E., MacLeod, D. R., and Divins, D. L., in press, Data Report: UT-GOM2-1 Sediment Grain Size Measurements at Site GC 955, Holes H002 and H005, *in* Flemings, P. B., Phillips, S. C., Collett, T., Cook, A., Boswell, R., and Scientists, U.-G.-E., eds., UT-GOM2-1 Hydrate Pressure Coring Expedition Report: Austin, TX, University of Texas Institute for Geophysics, p. 86.

McBride, B. C., Weimer, P., and Rowan, M. G., 1998, The effect of allochthonous salt on the petroleum systems of northern Green Canyon and Ewing Bank (offshore Louisiana), northern Gulf of Mexico: AAPG Bulletin, v. 82, no. 5B, p. 1083-1112.

Milkov, A., 2011, Wordwide distribution and significance of secondary microbial methane formed during petroleum biodegradation in conventional reservoirs: Organic Geochemistry - ORG GEOCHEM, v. 42, p. 184-207. https://doi.org/10.1016/j.orggeochem.2010.12.003

Milkov, A. V., and Etiope, G., 2018, Revised genetic diagrams for natural gases based on a global dataset of >20,000 samples: Organic Geochemistry, v. 125, p. 109-120. https://doi.org/10.1016/j.orggeochem.2018.09.002

Moore, M. T., Vinson, D. S., Whyte, C. J., Eymold, W. K., Walsh, T. B., and Darrah, T. H., 2018, Differentiating between biogenic and thermogenic sources of natural gas in coalbed methane reservoirs from the Illinois Basin using noble gas and hydrocarbon geochemistry: Geological Society, London, Special Publications, v. 468, no. 1, p. 151-188. https://doi.org/10.1144/sp468.8

Rebata-Landa, V., and Santamarina, J. C., 2006, Mechanical limits to microbial activity in deep sediments: Geochemistry, Geophysics, Geosystems, v. 7, no. 11. https://doi.org/10.1029/2006gc001355

Sassen, R., Milkov, A. V., Ozgul, E., Roberts, H. H., Hunt, J. L., Beeunas, M. A., Chanton, J. P., DeFreitas, D. A., and Sweet, S. T., 2003, Gas venting and subsurface charge in the Green Canyon area, Gulf of Mexico continental slope: evidence of a deep bacterial methane source?: Organic Geochemistry, v. 34, no. 10, p. 1455-1464. https://doi.org/10.1016/S0146-6380(03)00135-9

Schoell, M., 1980, The hydrogen and carbon isotopic composition of methane from natural gases of various origins: Geochimica et Cosmochimica Acta, v. 44, no. 5, p. 649-661. https://doi.org/10.1016/0016-7037(80)90155-6
-, 1983, Genetic Characterization of Natural Gases1: AAPG Bulletin, v. 67, no. 12, p. 2225-2238. https://doi.org/10.1306/ad46094a-16f7-11d7-8645000102c1865d
Vinson, D. S., Blair, N. E., Martini, A. M., Larter, S., Orem, W. H., and McIntosh, J. C., 2017, Microbial methane from in situ biodegradation of coal and shale: A review and reevaluation of hydrogen and carbon isotope signatures: Chemical Geology, v. 453, p. 128-145. https://doi.org/10.1016/j.chemgeo.2017.01.027
Whiticar, M. J., Faber, E., and Schoell, M., 1986, Biogenic methane formation in marine and freshwater environments: CO2 reduction vs. acetate fermentation—Isotope evidence: Geochimica et Cosmochimica Acta, v. 50, no. 5, p. 693-709. http://dx.doi.org/10.1016/0016-7037(86)90346-7

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Quarterly Research Performance Progress Report

(Period Ending 03/31/20)

Deepwater Methane Hydrate Characterization & Scientific Assessment

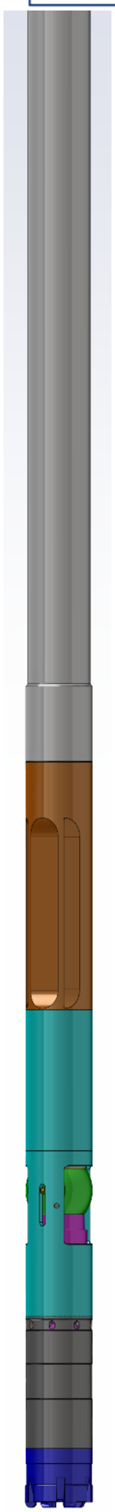
Project Period 4: 10/01/19 - 09/30/20

APPENDIX A

Pressure Coring Tool with Ball Valve (PCTB) UT2020 PCTB4 Lab Testing 2

Geotek Coring Inc.

2020-02-18



PRESSURE CORING TOOL WITH BALL VALVE (PCTB)

UT2020
PCTB4 LAB TESTING 2

GEOTEK CORING INC.

DOCUMENT NO. UT2020 (R1)

PREPARED FOR:

University of Texas

US Department of Energy

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ISSUE	REPORT STATUS	PREPARED	APPROVED	DATE
1	Final	AB/MM	MM/JR	2020-02-18

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1 2020 PCTB 4 TESTING

1.1 PREVIOUS TESTING SUMMARY

1.1.1 *2019 PRE-GOM3 TESTING SUMMARY*

In the spring of 2019, the Geotek Test Facility was used to test a prototype *Single Trigger* pressure section in combination with a *Shear Pin IT (Inner Tube) Plug*. The goal of the testing was to determine if the proposed new *Pressure Section* design was likely to increase the reliability of the boost and improve the likelihood of the tool sealing at low differential pressure. This was done by removing the complicated timing mechanism and replacing it with a sleeve that closes off the controlled leak point and fires the pressure section. Additionally, the shear pin allows the actuation to pause between the closing of the ball and the firing of the pressure section to ensure the ball has enough time to close.

Another major part of the testing was to investigate each step of the unlatching process. On the GOM2 job, there were several instances of the tool being difficult to unlatch from the BHA. During testing the tool unlatched easily each step of the way but can be improved by coating the latch parts with low friction coating.

Overall the testing was successful, showing that the tool worked as designed. There were some new findings and small modifications that were implemented based on collaborative discussion between UT and Geotek as outlined below.

1.2 PCTB4 MODIFICATIONS

1.2.2 *LOW FRICTION COATINGS*

The moving latch parts were coated with a low friction coating to improve unlatching performance.

1.2.3 *SINGLE TRIGGER MECHANISM*

As tested in the 2019 testing but expanded in length as noted below, the *Single Trigger Mechanism* is fully implemented and tested to ensure all part sets fit and interchange correctly.

1.2.4 *IT PLUG MANDREL SHEAR PIN*

In order to eliminate the possibility of unlatching before shearing the pin, a lower force pin was designed and will be implemented in the testing of the final configuration.

1.2.5 *FLOW DIVERTER SEALS*

The current design of the flow diverter is too tight causing difficulties separating the *Upper Assembly* from the *Autoclave Assembly* on the rig floor. This is to be replaced by a lip seal that can handle a larger extrusion gap.

1.2.6 *PRESSURE SECTION INCREASE*

The pressure section length was increased by 24”, more than doubling its volume. This will provide more fluid volume to provide a pressure boost to the tool.

2 2020 TEST GOALS AND PURPOSE

The purpose of this testing is to vet the modifications, as noted above, made to the final PCTB4 specification. Additionally, the parts will be assembled in random sets to ensure compatibility and interchangeability amongst the assemblies, as well as be interchangeable with both *Upper Assemblies*. As it has been theorized that drilling mud can cause tool issues, half of the tests will be done with clean water as in previous tests and the other half with viscous drilling mud. This testing was conducted to ensure that the work that will take place later this year at the *Cameron Test and Training Facility* will be as successful and productive as possible.

3 TEST RESULTS

3.1 TESTING RUN DATA

	NITROGEN (PSI)			
TEST #	SET	FILL	TEST OCEAN (PSI)	PCTB SEAL PRESSURE (PSI)
4kPAT PCTB4 1	4523	7805	3953	4795
4kPAT PCTB4 2	4282	8075	3865	4211
4kPAT PCTB4 3	4197	8031	3782	4350
4kPAT PCTB4 4	4224	8705	3805	4088
4kPAT PCTB4 5	4220	8033	3703	3980
4kPAT PCTB4 6	4290	8063	3785	0
4kPAT PCTB4 7	4196	8256	3863	0
4kPAT PCTB4 8	4290	8063	3784	4249
4kPAT PCTB4 9	4293	8015	3989	3987
4kPAT PCTB4 10	4286	8090	3825	4326
4kPAT PCTB4 11	4275	8050	4027	4102
4kPAT PCTB4 12	4278	8158	3815	4040

Table 1: PAT Summary Data.

3.1.1 *4KPAT PCTB4 1*

While inserting the Wireline Pulling Tool, it was quickly and suddenly dropping in large movements. Upon attempting to remove the Pulling Tool from the Upper it was discovered that the steel shear pin had sheared, and the Pulling Tool was jammed in the upper requiring disassembly of the upper to free.

Upon analysis of the DST data, it was discovered that the boost and seal pressure was higher than the maximum DST pressure. It appears this happened on the previous round of high-pressure testing, but as the autoclave expanded the pressure came back into range so the data looked correct. The larger pressure section has enough volume to keep the pressure above the, it did not drop due to expansion which indicates the larger pressure section is working.

Result: Successful Test

Diagnosis: Broken Pulling Tool Shear Pin, Boosted over maximum DST pressure range.

Corrective Action: Lower the tool in a slower, more controlled manner. Lower atmosphere and set pressure to stay with DST maximum pressure.

3.1.2 *4KPAT PCTB4 2*

Repeat of the previous test. To slowly insert the Pulling Tool backpressure was slowly bled off, which resulted in a controlled insertion.

Result: Successful Test

Diagnosis: None

Corrective Action: None

3.1.3 *4KPAT PCTB4 3*

Repeat of the previous test.

Result: Successful Test

Diagnosis: None

Corrective Action: None

3.1.4 *4KPAT PCTB4 4*

The pressure section was charged to a higher fill pressure to see if the residual nitrogen would similarly increase, which it did.

Result: Successful Test

Diagnosis: None

Corrective Action: None

3.1.5 *4KPAT PCTB4 5*

Repeat of *4kPAT PCTB 3*

Result: Successful Test

Diagnosis: None

Corrective Action: None

3.1.6 *4KPAT PCTB4 6*

Repeat of the previous test, with the second Upper Assembly. The tool failed to actuate fully due to parts that were accidentally left out of the upper. As the PCTB4 is in testing phase, the SOP Technical Animations have not been created yet, causing the build error.

Result: Failed Test

Diagnosis: Parts were left out of the second upper.

Corrective Action: Replace component and complete SOP Technical Animation.

3.1.7 *4KPAT PCTB4 7*

The first Upper Assembly was used again as to not delay testing while rebuilding the second Upper Assembly. The tool came up with no pressure. During diagnosis of the tool, it was discovered that a newly installed SAE plug was put in the tool from the spare part drawer. An obsolete early version of the PCTBII had an SAE plug with a hole drilled in it. As the SAE plug was responsible for sealing the tool, it was a failed run.

Result: Failed Test

Diagnosis: SAE plug used with a hole

Corrective Action: Quarantine and remove all obsolete parts from coring van to prevent accidental use.

3.1.8 *4KPAT PCTB4 8*

The second Upper Assembly was rebuilt and ran again. This was the first test run with drilling mud.

Result: Successful Test

Diagnosis: None

Corrective Action: None

3.1.9 *4KPAT PCTB4 9*

A repeat of the previous test.

Result: Successful Test

Diagnosis: None

Corrective Action: None

3.1.10 *4KPAT PCTB4 10*

A repeat of the previous test.

Result: Successful Test

Diagnosis: This again demonstrates that the differential pressure provided by the boost is required to ensure sealing in situ

Corrective Action: None

3.1.11 *4KPAT PCTB4 11*

A repeat of the previous test.

Result: Successful Test

Diagnosis: None

Corrective Action: None

3.1.12 *4KPAT PCTB4 12*

A repeat of the previous test.

Result: Successful Test

Diagnosis: None

Corrective Action: None

4 CONCLUSION AND RECOMMENDATIONS

The testing performed proves that the PCTB4 functions as designed and shows no obvious operational issues. The larger pressure section can provide enough boost in a wider range of downhole conditions where the rest of the tool functions as designed. The larger pressure section showed its value, as noted in a few DST records where a second boost was observed to make up for compliancy and expansion of the tool coming up the hole. There were a couple issues encountered during testing, but the solutions are both actions items that were going to be performed in the course of transitioning from testing to operational status.

APPENDICES

1 APPENDIX 1: PAT RUN SHEETS AND PRESSURE PLOTS

1.1 4KPAT PCTB4 1

GEOTEK CORING Inc

3350 W Directors Row, Suite 600
Salt Lake City, Utah 84104
1-385-528-2538 info@geotekcoring.com www.geotekcoring.com

TESTING RUN REPORT

GENESIS OF METHANE IN THE GULF OF MEXICO (GoM^3)

DATE:	January 27, 2020	CORE:			4k PAT PCTB4 1
TOOL ASSEMBLY TEAM:		Geotek			
SIMULATED CORE DEPTH:	2,750 m	BOTTOM HOLE PRESSURE:			4,000 psi
PRESSURE SECTION/IT PLUG NUMBER:	3/3	AUTOCLAVE ASSEMBLY NUMBER:			2
UPPER ASSEMBLY NUMBER:	1	CATCHER KIT:	Basket/Rabbit	5" Extension	5" Extension
DST SERIAL NUMBERS: AUTOCLAVE:	L7071	ATMOSPHERE:			C8952
NOTES:					

TEST SETUP

TEST CONFIGURATION:	PCTB CONFIGURATION:
Test Console	AES9001_01 - PCTB4.0 Assembly
GTT1000_00 - Full Vertical Test Assembly	PCTB4 Pressure Section Large
45 gal accumulator, 1x 800 psi, 2x 1800	PCTB4 Shear Pin IT Plug
Slow pull	600# Shear Pin
NOTES:	

TOOL ASSEMBLY

BUILD CHECKLIST				
SAMPLE VALVE CLOSED AND PORT PLUGGED	COMPLETE	PAWL POST HEIGHT (0.095-0.105")		COMPLETE
SHUTOFF VALVE OPEN	COMPLETE	LINER/IT PLUG LENGTH (156.75")		COMPLETE
SUPPLY VALVE OPEN	COMPLETE	SET PRESSURE (CONFIRM WITH 3 TESTS):		4,523 psi
FILL VALVE CLOSED/PORT PLUGGED	COMPLETE	RESERVOIR FILL PRESSURE:		7,805 psi
SET VALVE CLOSED/PORT PLUGGED	COMPLETE	TOOL READY FOR TEST	DATE:	2020-01-27
DRAIN VALVE CLOSED/PORT PLUGGED	COMPLETE		TIME:	09:50
NOTES:				

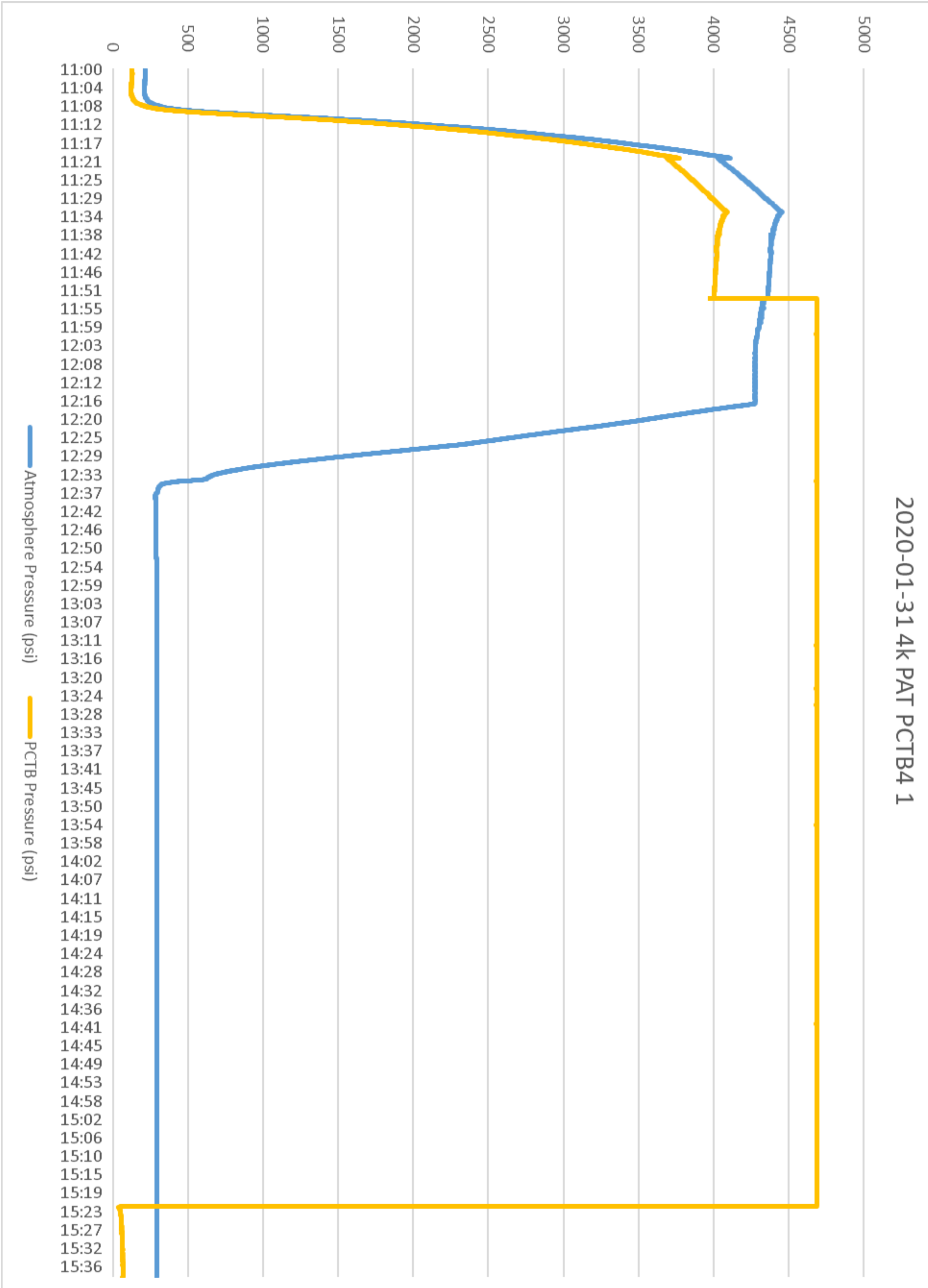
TESTING RUN

TEST DATE:	Jan 27, 2020	TEST START TIME:	10:00
INITIAL LINEAR TRANSDUCER (IN):	N/A	FINAL LINEAR TRANSDUCER (IN):	N/A
INITIAL PCTB PRESSURE (PSI):	N/A	FINAL PCTB PRESSURE (PSI):	N/A
INITIAL ATMOSPHERE PRESSURE (PSI):	N/A	FINAL ATMOSPHERE PRESSURE (PSI):	3953
INITIAL ACTUATION PRESSURE (PSI):	N/A	FINAL ACTUATION PRESSURE (PSI):	N/A
ACCUMULATOR CHARGE (PSI):	N/A	PCTB SEAL PRESSURE (PSI):	4795

NOTES: While inserting W/L Pulling Tool, it actuated faster than normal in large (~2') movements. Upon removal of the W/L tool from the upper, it was discovered that the steel shear pin had sheared and the W/L tool was stuck requiring upper disassembly. In the future, slow down W/L insertion. Upon analysis of the DST data, it was discovered that Boost/seal pressure was higher than maximum DST pressure. Future tests should be run at lower pressure. Even with facility problems, tool test sucessful.

POST-CORING TOOL ANALYSIS & REBUILD

OBSERVATIONS		NOTES	PRESSURE SECTION	
BALL VALVE	CLOSED		RESERVOIR PRESSURE:	5,000 psi
LINER	INTACT		WATER ABOVE PISTON?	NO
PAWLS	INTACT		WATER IN REGULATOR?	NO
PAWL SPRING	INTACT		REBUILD REGULATOR?	NO
NOTES:				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15:27
15:32
15:36
Atmosphere Pressure (psi)
PCTB Pressure (psi)

1.2 4KPAT PCTB4 2

GEOTEK CORING Inc

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TESTING RUN REPORT

GENESIS OF METHANE IN THE GULF OF MEXICO (GoM^3)

DATE:	January 27, 2020	CORE:			4k PAT PCTB4 2
TOOL ASSEMBLY TEAM:		Geotek			
SIMULATED CORE DEPTH:	2,612 m	BOTTOM HOLE PRESSURE:			3,800 psi
PRESSURE SECTION/IT PLUG NUMBER:	1/4	AUTOCLAVE ASSEMBLY NUMBER:			2
UPPER ASSEMBLY NUMBER:	1	CATCHER KIT:	Basket/Rabbit	5" Extension	5" Extension
DST SERIAL NUMBERS: AUTOCLAVE:	L7071	ATMOSPHERE:			C8952
NOTES:					

TEST SETUP

TEST CONFIGURATION:	PCTB CONFIGURATION:
Test Console	AES9001_01 - PCTB4.0 Assembly
GTT1000_00 - Full Vertical Test Assembly	PCTB4 Pressure Section Large
45 gal accumulator, 1x 800 psi, 2x 1800	PCTB4 Shear Pin IT Plug
Slow pull	600# Shear Pin
NOTES:	

TOOL ASSEMBLY

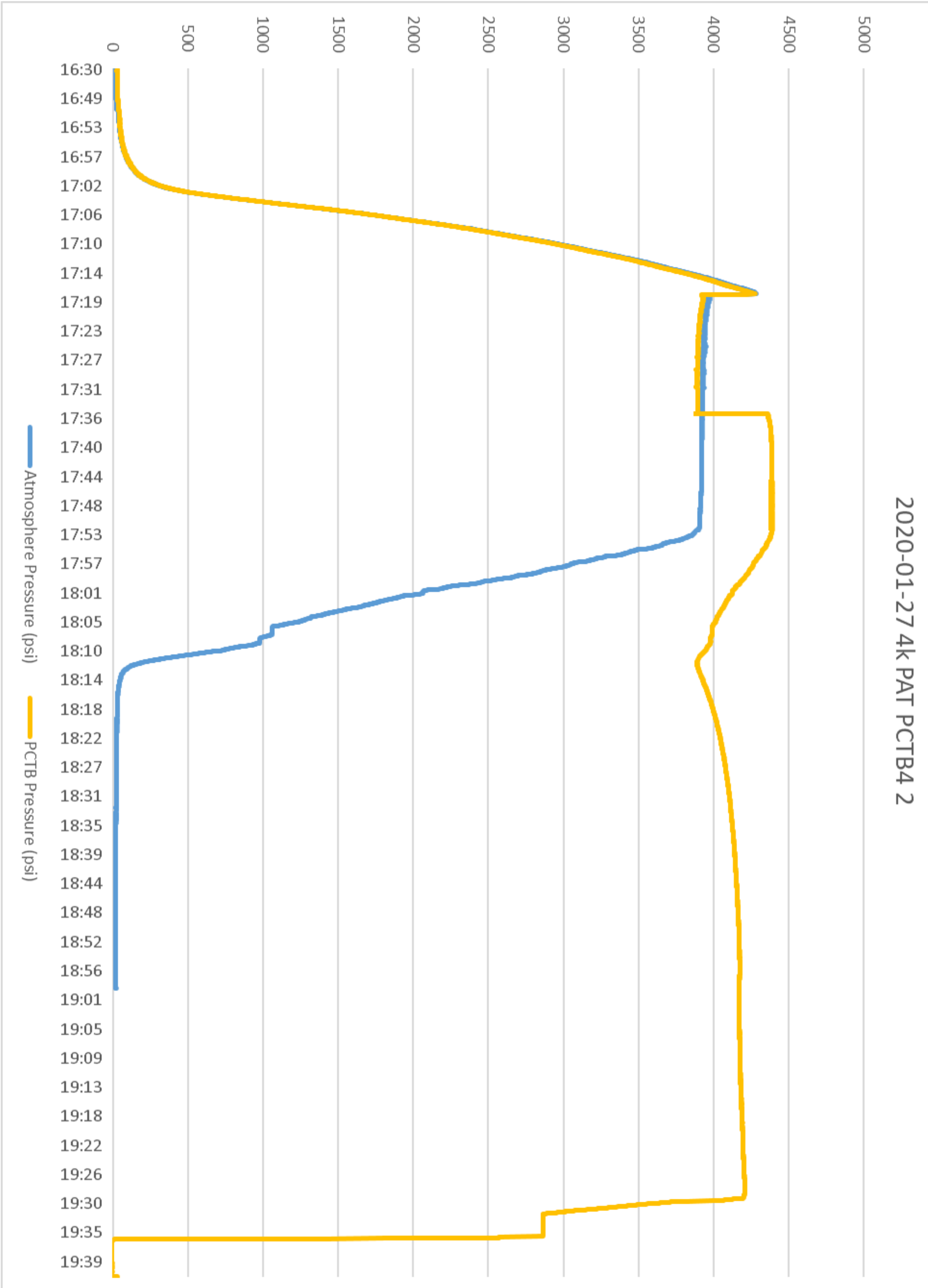
BUILD CHECKLIST				
SAMPLE VALVE CLOSED AND PORT PLUGGED	COMPLETE	PAWL POST HEIGHT (0.095-0.105")		COMPLETE
SHUTOFF VALVE OPEN	COMPLETE	LINER/IT PLUG LENGTH (156.75")		COMPLETE
SUPPLY VALVE OPEN	COMPLETE	SET PRESSURE (CONFIRM WITH 3 TESTS):		4,282 psi
FILL VALVE CLOSED/PORT PLUGGED	COMPLETE	RESERVOIR FILL PRESSURE:		8,075 psi
SET VALVE CLOSED/PORT PLUGGED	COMPLETE	TOOL READY FOR TEST	DATE:	2020-01-27
DRAIN VALVE CLOSED/PORT PLUGGED	COMPLETE		TIME:	16:30
NOTES:				

TESTING RUN

TEST DATE:	Jan 27, 2020	TEST START TIME:	17:30
INITIAL LINEAR TRANSDUCER (IN):	N/A	FINAL LINEAR TRANSDUCER (IN):	N/A
INITIAL PCTB PRESSURE (PSI):	N/A	FINAL PCTB PRESSURE (PSI):	N/A
INITIAL ATMOSPHERE PRESSURE (PSI):	N/A	FINAL ATMOSPHERE PRESSURE (PSI):	3865
INITIAL ACTUATION PRESSURE (PSI):	N/A	FINAL ACTUATION PRESSURE (PSI):	N/A
ACCUMULATOR CHARGE (PSI):	N/A	PCTB SEAL PRESSURE (PSI):	4211
NOTES: Slow insert of pulling tool, good test			

POST-CORING TOOL ANALYSIS & REBUILD

OBSERVATIONS		NOTES	PRESSURE SECTION	
BALL VALVE	CLOSED		RESERVOIR PRESSURE:	4,050 psi
LINER	INTACT		WATER ABOVE PISTON?	NO
PAWLS	INTACT		WATER IN REGULATOR?	NO
PAWL SPRING	INTACT		REBUILD REGULATOR?	NO
NOTES:				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19:30
19:35
19:39
Atmosphere Pressure (psi)
PCTB Pressure (psi)

1.3 4KPAT PCTB4 3

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TESTING RUN REPORT

GENESIS OF METHANE IN THE GULF OF MEXICO (GoM^3)

DATE:	January 28, 2020	CORE:			4k PAT PCTB4 3
TOOL ASSEMBLY TEAM:		Geotek			
SIMULATED CORE DEPTH:	2,612 m	BOTTOM HOLE PRESSURE:			3,800 psi
PRESSURE SECTION/IT PLUG NUMBER:	4/2	AUTOCLAVE ASSEMBLY NUMBER:			1
UPPER ASSEMBLY NUMBER:	1	CATCHER KIT:	Basket/Rabbit	5" Extension	5" Extension
DST SERIAL NUMBERS: AUTOCLAVE:	L7071	ATMOSPHERE:			C8952
NOTES:					

TEST SETUP

TEST CONFIGURATION:	PCTB CONFIGURATION:
Test Console	AES9001_01 - PCTB4.0 Assembly
GTT1000_00 - Full Vertical Test Assembly	PCTB4 Pressure Section Large
45 gal accumulator, 1x 800 psi, 2x 1800	PCTB4 Shear Pin IT Plug
Slow pull	600# Shear Pin
NOTES:	

TOOL ASSEMBLY

BUILD CHECKLIST

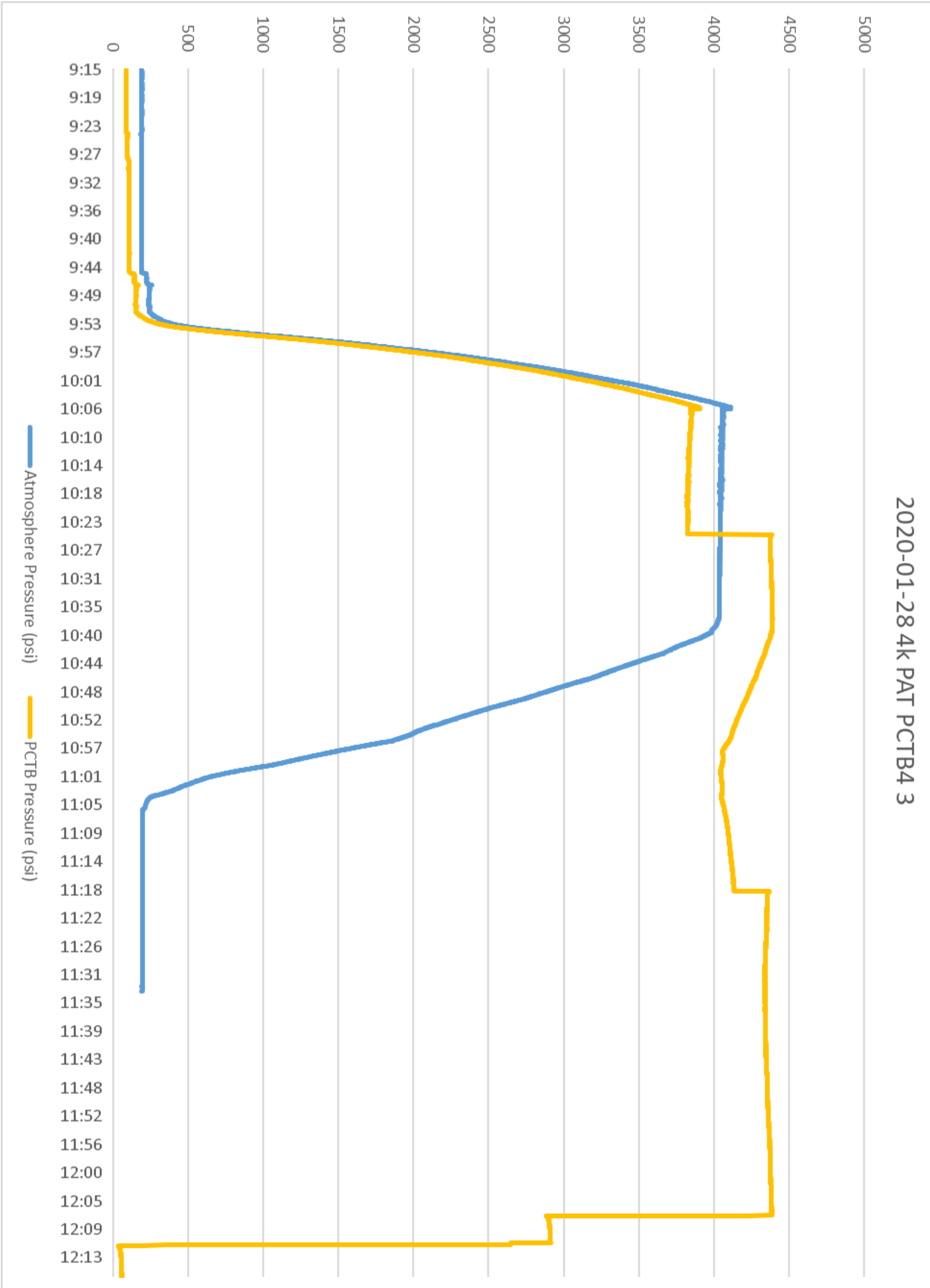
SAMPLE VALVE CLOSED AND PORT PLUGGED	COMPLETE	PAWL POST HEIGHT (0.095-0.105")		COMPLETE
SHUTOFF VALVE OPEN	COMPLETE	LINER/IT PLUG LENGTH (156.75")		COMPLETE
SUPPLY VALVE OPEN	COMPLETE	SET PRESSURE (CONFIRM WITH 3 TESTS):		4,197 psi
FILL VALVE CLOSED/PORT PLUGGED	COMPLETE	RESERVOIR FILL PRESSURE:		8,031 psi
SET VALVE CLOSED/PORT PLUGGED	COMPLETE	TOOL READY FOR TEST	DATE:	2020-01-28
DRAIN VALVE CLOSED/PORT PLUGGED	COMPLETE		TIME:	09:15
NOTES:				

TESTING RUN

TEST DATE:	Jan 28, 2020	TEST START TIME:	09:30
INITIAL LINEAR TRANSDUCER (IN):	N/A	FINAL LINEAR TRANSDUCER (IN):	N/A
INITIAL PCTB PRESSURE (PSI):	N/A	FINAL PCTB PRESSURE (PSI):	N/A
INITIAL ATMOSPHERE PRESSURE (PSI):	N/A	FINAL ATMOSPHERE PRESSURE (PSI):	3782
INITIAL ACTUATION PRESSURE (PSI):	N/A	FINAL ACTUATION PRESSURE (PSI):	N/A
ACCUMULATOR CHARGE (PSI):	N/A	PCTB SEAL PRESSURE (PSI):	4350
NOTES: Good Test			

POST-CORING TOOL ANALYSIS & REBUILD

OBSERVATIONS		NOTES	PRESSURE SECTION	
BALL VALVE	CLOSED		RESERVOIR PRESSURE:	4,425 psi
LINER	INTACT		WATER ABOVE PISTON?	NO
PAWLS	INTACT		WATER IN REGULATOR?	NO
PAWL SPRING	INTACT		REBUILD REGULATOR?	NO
NOTES:				


2020-01-28 4k PAT PCTB4 3
Atmosphere Pressure (psi)
PCTB Pressure (psi)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
9:15
9:19
9:23
9:27
9:32
9:36
9:40
9:44
9:49
9:53
9:57
10:01
10:06
10:10
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11:01
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11:39
11:43
11:48
11:52
11:56
12:00
12:05
12:09
12:13

1.4 4KPAT PCTB4 4

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TESTING RUN REPORT

GENESIS OF METHANE IN THE GULF OF MEXICO (GoM^3)

DATE:	January 28, 2020	CORE:			4k PAT PCTB4 4
TOOL ASSEMBLY TEAM:		Geotek			
SIMULATED CORE DEPTH:	2,612 m	BOTTOM HOLE PRESSURE:			3,800 psi
PRESSURE SECTION/IT PLUG NUMBER:	2/1	AUTOCLAVE ASSEMBLY NUMBER:			2
UPPER ASSEMBLY NUMBER:	1	CATCHER KIT:	Basket/Rabbit	5" Extension	5" Extension
DST SERIAL NUMBERS: AUTOCLAVE:	C8957	ATMOSPHERE:			C8952
NOTES:					

TEST SETUP

TEST CONFIGURATION:	PCTB CONFIGURATION:
Test Console	AES9001_01 - PCTB4.0 Assembly
GTT1000_00 - Full Vertical Test Assembly	PCTB4 Pressure Section Large
45 gal accumulator, 1x 800 psi, 2x 1800	PCTB4 Shear Pin IT Plug
Slow pull	600# Shear Pin
NOTES:	

TOOL ASSEMBLY

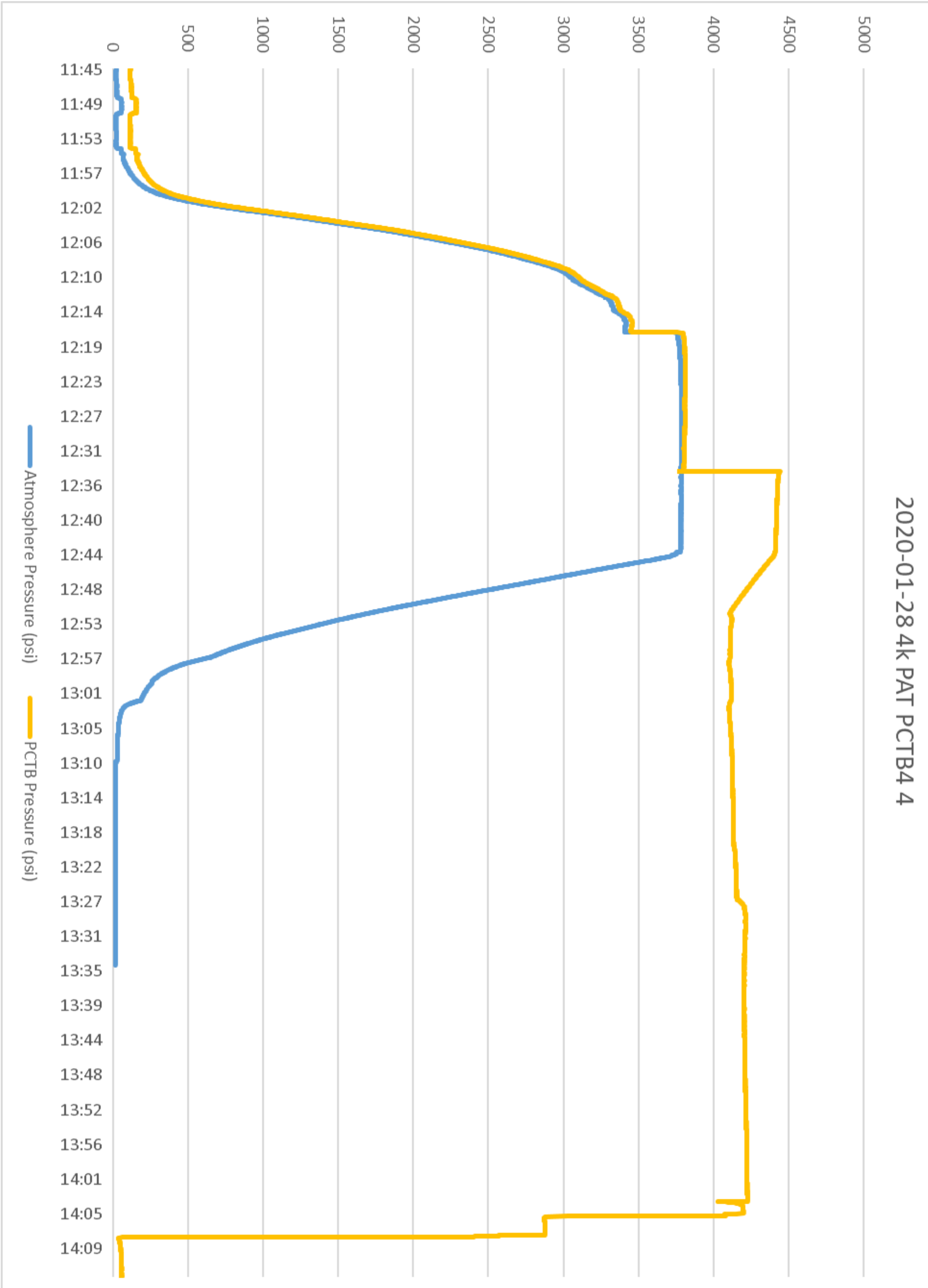
BUILD CHECKLIST				
SAMPLE VALVE CLOSED AND PORT PLUGGED	COMPLETE	PAWL POST HEIGHT (0.095-0.105")		COMPLETE
SHUTOFF VALVE OPEN	COMPLETE	LINER/IT PLUG LENGTH (156.75")		COMPLETE
SUPPLY VALVE OPEN	COMPLETE	SET PRESSURE (CONFIRM WITH 3 TESTS):		4,224 psi
FILL VALVE CLOSED/PORT PLUGGED	COMPLETE	RESERVOIR FILL PRESSURE:		8,705 psi
SET VALVE CLOSED/PORT PLUGGED	COMPLETE	TOOL READY FOR TEST	DATE:	2020-01-28
DRAIN VALVE CLOSED/PORT PLUGGED	COMPLETE		TIME:	11:35
NOTES:				

TESTING RUN

TEST DATE:	Jan 28, 2020	TEST START TIME:	12:00
INITIAL LINEAR TRANSDUCER (IN):	N/A	FINAL LINEAR TRANSDUCER (IN):	N/A
INITIAL PCTB PRESSURE (PSI):	N/A	FINAL PCTB PRESSURE (PSI):	N/A
INITIAL ATMOSPHERE PRESSURE (PSI):	N/A	FINAL ATMOSPHERE PRESSURE (PSI):	3805
INITIAL ACTUATION PRESSURE (PSI):	N/A	FINAL ACTUATION PRESSURE (PSI):	N/A
ACCUMULATOR CHARGE (PSI):	N/A	PCTB SEAL PRESSURE (PSI):	4088
NOTES: Good test			

POST-CORING TOOL ANALYSIS & REBUILD

OBSERVATIONS		NOTES	PRESSURE SECTION	
BALL VALVE	CLOSED		RESERVOIR PRESSURE:	5,374 psi
LINER	INTACT		WATER ABOVE PISTON?	NO
PAWLS	INTACT		WATER IN REGULATOR?	NO
PAWL SPRING	INTACT		REBUILD REGULATOR?	NO
NOTES:				


2020-01-28 4k PAT PCTB4 4
0
500
1000
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2000
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3000
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4000
4500
5000
11:45
11:49
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11:57
12:02
12:06
12:10
12:14
12:19
12:23
12:27
12:31
12:36
12:40
12:44
12:48
12:53
12:57
13:01
13:05
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13:18
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13:27
13:31
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13:39
13:44
13:48
13:52
13:56
14:01
14:05
14:09
Atmosphere Pressure (psi)
PCTB Pressure (psi)

1.5 4KPAT PCTB4 5

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TESTING RUN REPORT

GENESIS OF METHANE IN THE GULF OF MEXICO (GoM^3)

DATE:	January 29, 2020	CORE:			4k PAT PCTB4 5
TOOL ASSEMBLY TEAM:		Geotek			
SIMULATED CORE DEPTH:	2,612 m	BOTTOM HOLE PRESSURE:			3,800 psi
PRESSURE SECTION/IT PLUG NUMBER:	5/5	AUTOCLAVE ASSEMBLY NUMBER:			2
UPPER ASSEMBLY NUMBER:	1	CATCHER KIT:	Basket/Rabbit	5" Extension	5" Extension
DST SERIAL NUMBERS: AUTOCLAVE:	L7071	ATMOSPHERE:			C8952
NOTES:					

TEST SETUP

TEST CONFIGURATION:	PCTB CONFIGURATION:
Test Console	AES9001_01 - PCTB4.0 Assembly
GTT1000_00 - Full Vertical Test Assembly	PCTB4 Pressure Section Large
45 gal accumulator, 1x 800 psi, 2x 1800	PCTB4 Shear Pin IT Plug
Slow pull	600# Shear Pin
NOTES:	

TOOL ASSEMBLY

BUILD CHECKLIST

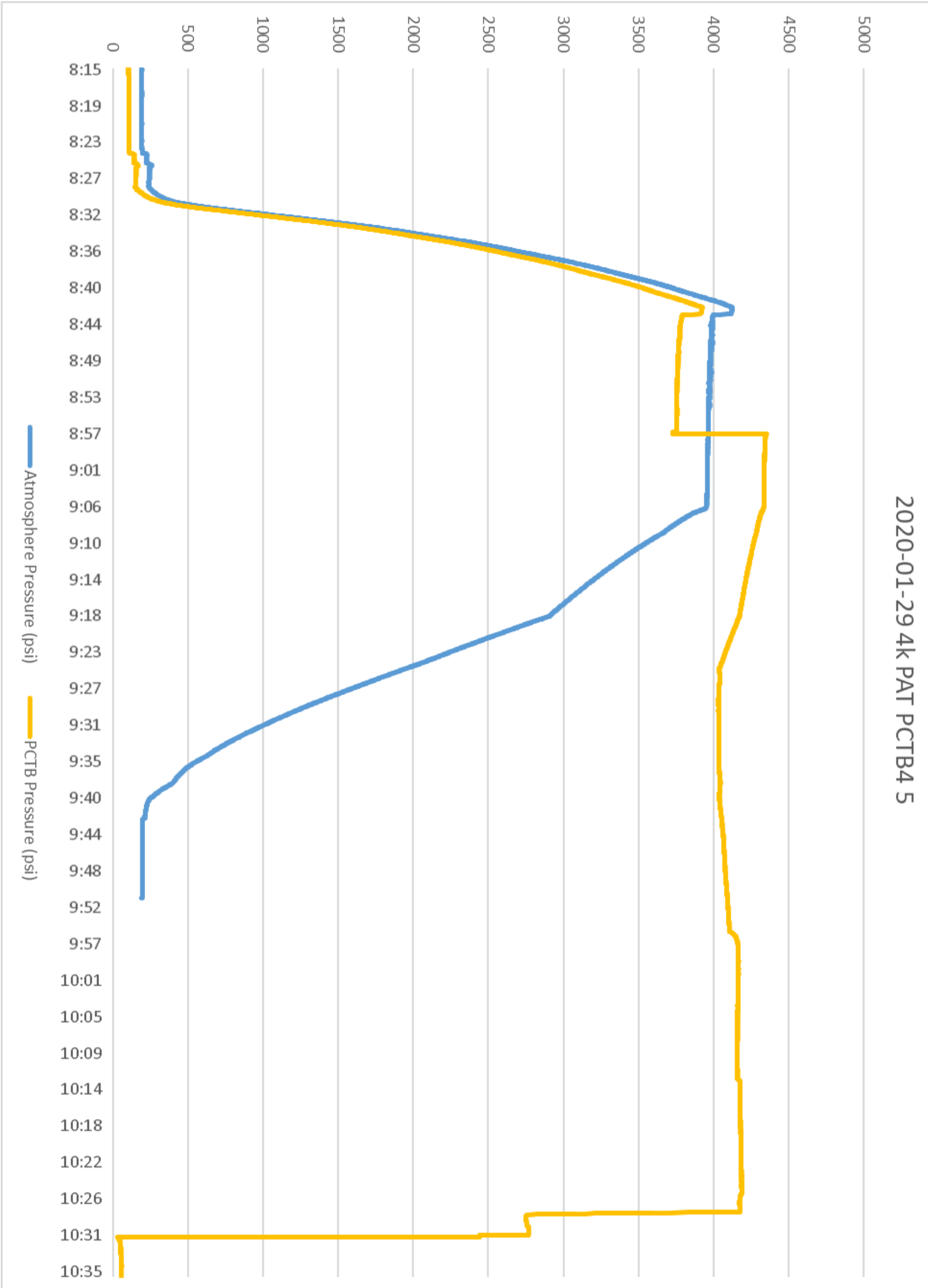
SAMPLE VALVE CLOSED AND PORT PLUGGED	COMPLETE	PAWL POST HEIGHT (0.095-0.105")		COMPLETE
SHUTOFF VALVE OPEN	COMPLETE	LINER/IT PLUG LENGTH (156.75")		COMPLETE
SUPPLY VALVE OPEN	COMPLETE	SET PRESSURE (CONFIRM WITH 3 TESTS):		4,220 psi
FILL VALVE CLOSED/PORT PLUGGED	COMPLETE	RESERVOIR FILL PRESSURE:		8,033 psi
SET VALVE CLOSED/PORT PLUGGED	COMPLETE	TOOL READY FOR TEST	DATE:	2020-01-29
DRAIN VALVE CLOSED/PORT PLUGGED	COMPLETE		TIME:	08:00
NOTES:				

TESTING RUN

TEST DATE:	Jan 29, 2020	TEST START TIME:	08:30
INITIAL LINEAR TRANSDUCER (IN):	N/A	FINAL LINEAR TRANSDUCER (IN):	N/A
INITIAL PCTB PRESSURE (PSI):	N/A	FINAL PCTB PRESSURE (PSI):	N/A
INITIAL ATMOSPHERE PRESSURE (PSI):	N/A	FINAL ATMOSPHERE PRESSURE (PSI):	3703
INITIAL ACTUATION PRESSURE (PSI):	N/A	FINAL ACTUATION PRESSURE (PSI):	N/A
ACCUMULATOR CHARGE (PSI):	N/A	PCTB SEAL PRESSURE (PSI):	3980
NOTES: Good test			

POST-CORING TOOL ANALYSIS & REBUILD

OBSERVATIONS		NOTES	PRESSURE SECTION	
BALL VALVE	CLOSED		RESERVOIR PRESSURE:	5,022 psi
LINER	INTACT		WATER ABOVE PISTON?	NO
PAWLS	INTACT		WATER IN REGULATOR?	NO
PAWL SPRING	INTACT		REBUILD REGULATOR?	NO
NOTES:				


2020-01-29 4k PAT PCTB4 5
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
8:15
8:19
8:23
8:27
8:32
8:36
8:40
8:44
8:49
8:53
8:57
9:01
9:06
9:10
9:14
9:18
9:23
9:27
9:31
9:35
9:40
9:44
9:48
9:52
9:57
10:01
10:05
10:09
10:14
10:18
10:22
10:26
10:31
10:35
Atmosphere Pressure (psi)
PCTB Pressure (psi)

1.6 4KPAT PCTB4 6

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TESTING RUN REPORT

GENESIS OF METHANE IN THE GULF OF MEXICO (GoM^3)

DATE:	January 29, 2020	CORE:			4k PAT PCTB4 6
TOOL ASSEMBLY TEAM:		Geotek			
SIMULATED CORE DEPTH:	2,612 m	BOTTOM HOLE PRESSURE:			3,800 psi
PRESSURE SECTION/IT PLUG NUMBER:	4/1	AUTOCLAVE ASSEMBLY NUMBER:			1
UPPER ASSEMBLY NUMBER:	2	CATCHER KIT: Basket/Rabbit		5" Extension	5" Extension
DST SERIAL NUMBERS: AUTOCLAVE:	C8957	ATMOSPHERE:			C8952
NOTES:					

TEST SETUP

TEST CONFIGURATION:	PCTB CONFIGURATION:
Test Console	AES9001_01 - PCTB4.0 Assembly
GTT1000_00 - Full Vertical Test Assembly	PCTB4 Pressure Section Large
45 gal accumulator, 1x 800 psi, 2x 1800	PCTB4 Shear Pin IT Plug
Slow pull	600# Shear Pin
NOTES:	

TOOL ASSEMBLY

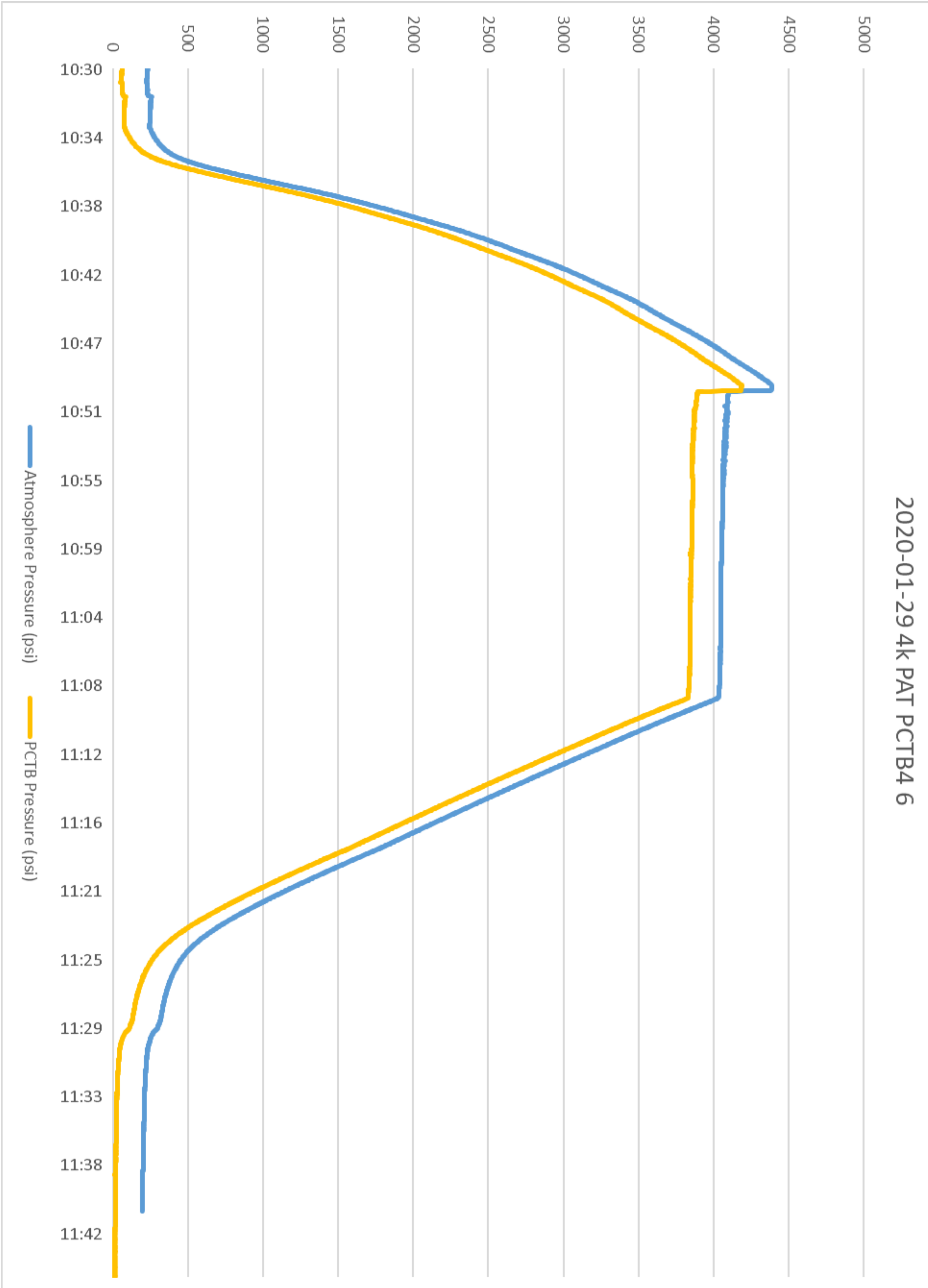
BUILD CHECKLIST				
SAMPLE VALVE CLOSED AND PORT PLUGGED	COMPLETE	PAWL POST HEIGHT (0.095-0.105")		COMPLETE
SHUTOFF VALVE OPEN	COMPLETE	LINER/IT PLUG LENGTH (156.75")		COMPLETE
SUPPLY VALVE OPEN	COMPLETE	SET PRESSURE (CONFIRM WITH 3 TESTS):		4,290 psi
FILL VALVE CLOSED/PORT PLUGGED	COMPLETE	RESERVOIR FILL PRESSURE:		8,063 psi
SET VALVE CLOSED/PORT PLUGGED	COMPLETE	TOOL READY FOR TEST	DATE:	2020-01-29
DRAIN VALVE CLOSED/PORT PLUGGED	COMPLETE		TIME:	08:45
NOTES:				

TESTING RUN

TEST DATE:	Jan 29, 2020	TEST START TIME:	10:15
INITIAL LINEAR TRANSDUCER (IN):	N/A	FINAL LINEAR TRANSDUCER (IN):	N/A
INITIAL PCTB PRESSURE (PSI):	N/A	FINAL PCTB PRESSURE (PSI):	N/A
INITIAL ATMOSPHERE PRESSURE (PSI):	N/A	FINAL ATMOSPHERE PRESSURE (PSI):	3785
INITIAL ACTUATION PRESSURE (PSI):	N/A	FINAL ACTUATION PRESSURE (PSI):	N/A
ACCUMULATOR CHARGE (PSI):	N/A	PCTB SEAL PRESSURE (PSI):	0
NOTES: First run of second upper. Tool failed to actuate fully due to parts left out of upper. SOP build video for new assembly not finished due to testing phase of new design, proper SOP will eliminate build issues.			

POST-CORING TOOL ANALYSIS & REBUILD

OBSERVATIONS		NOTES	PRESSURE SECTION	
BALL VALVE	CLOSED		RESERVOIR PRESSURE:	N/A
LINER	INTACT		WATER ABOVE PISTON?	NO
PAWLS	INTACT		WATER IN REGULATOR?	NO
PAWL SPRING	INTACT		REBUILD REGULATOR?	NO
NOTES:				


2020-01-29 4k PAT PCTB4 6
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
10:30
10:34
10:38
10:42
10:47
10:51
10:55
10:59
11:04
11:08
11:12
11:16
11:21
11:25
11:29
11:33
11:38
11:42
Atmosphere Pressure (psi)
PCTB Pressure (psi)

1.7 4KPAT PCTB4 7

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TESTING RUN REPORT
GENESIS OF METHANE IN THE GULF OF MEXICO (GoM^3)

DATE:	January 29, 2020	CORE:			4k PAT PCTB4 7
TOOL ASSEMBLY TEAM:		Geotek			
SIMULATED CORE DEPTH:	2,612 m	BOTTOM HOLE PRESSURE:			3,800 psi
PRESSURE SECTION/IT PLUG NUMBER:	1/2	AUTOCLAVE ASSEMBLY NUMBER:			2
UPPER ASSEMBLY NUMBER:	1	CATCHER KIT:	Basket/Rabbit	5" Extension	5" Extension
DST SERIAL NUMBERS: AUTOCLAVE:		L7071	ATMOSPHERE:		C8952
NOTES:					

TEST SETUP

TEST CONFIGURATION:	PCTB CONFIGURATION:
Test Console	AES9001_01 - PCTB4.0 Assembly
GTT1000_00 - Full Vertical Test Assembly	PCTB4 Pressure Section Large
45 gal accumulator, 1x 800 psi, 2x 1800	PCTB4 Shear Pin IT Plug
Slow pull	600# Shear Pin
NOTES:	

TOOL ASSEMBLY

BUILD CHECKLIST

SAMPLE VALVE CLOSED AND PORT PLUGGED	COMPLETE	PAWL POST HEIGHT (0.095-0.105")		COMPLETE
SHUTOFF VALVE OPEN	COMPLETE	LINER/IT PLUG LENGTH (156.75")		COMPLETE
SUPPLY VALVE OPEN	COMPLETE	SET PRESSURE (CONFIRM WITH 3 TESTS):		4,196 psi
FILL VALVE CLOSED/PORT PLUGGED	COMPLETE	RESERVOIR FILL PRESSURE:		8,256 psi
SET VALVE CLOSED/PORT PLUGGED	COMPLETE	TOOL READY FOR TEST	DATE:	2020-01-29
DRAIN VALVE CLOSED/PORT PLUGGED	COMPLETE		TIME:	11:45
NOTES:				

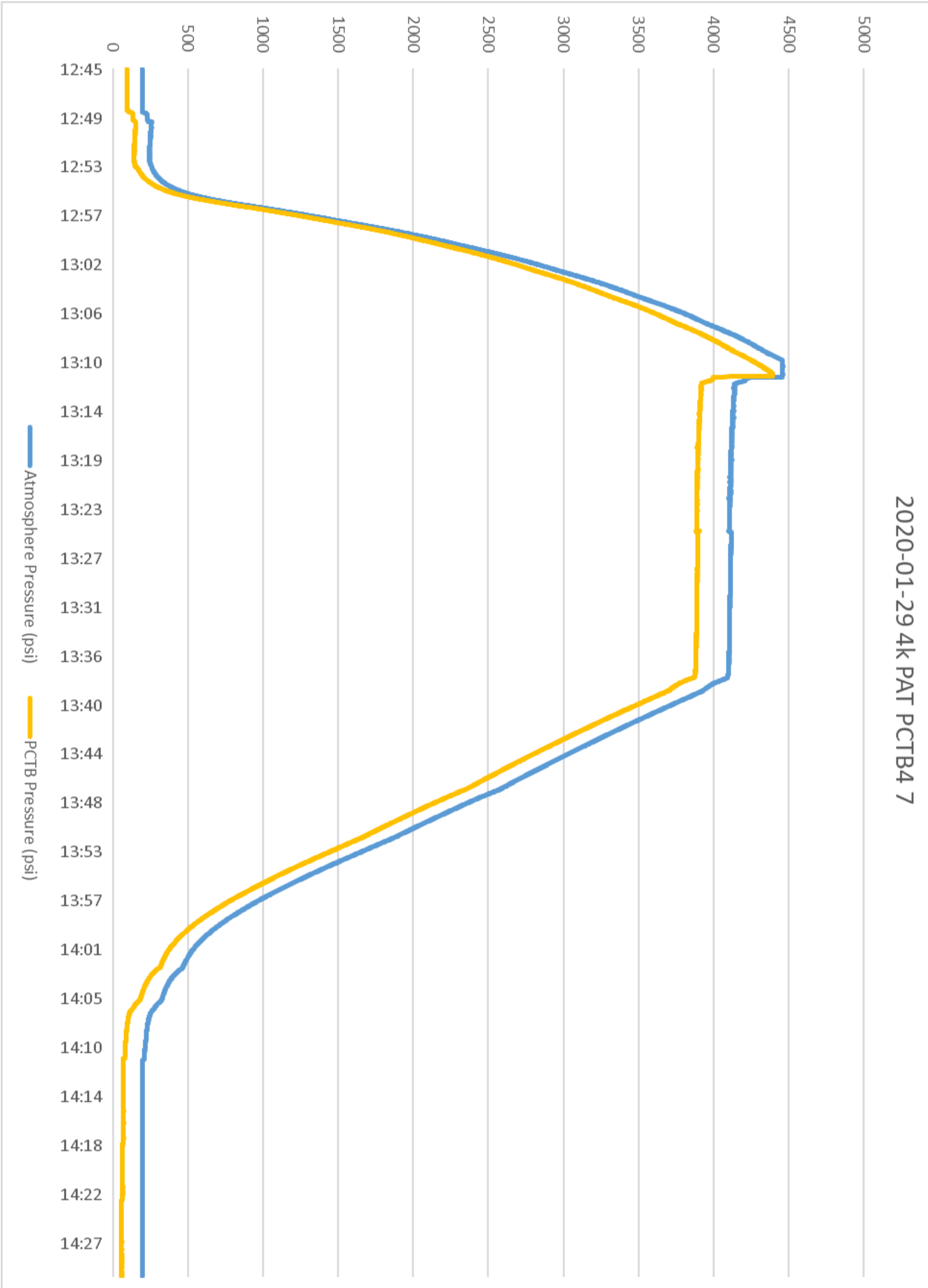
TESTING RUN

TEST DATE:	Jan 29, 2020	TEST START TIME:	12:50
INITIAL LINEAR TRANSDUCER (IN):	N/A	FINAL LINEAR TRANSDUCER (IN):	N/A
INITIAL PCTB PRESSURE (PSI):	N/A	FINAL PCTB PRESSURE (PSI):	N/A
INITIAL ATMOSPHERE PRESSURE (PSI):	N/A	FINAL ATMOSPHERE PRESSURE (PSI):	3863
INITIAL ACTUATION PRESSURE (PSI):	N/A	FINAL ACTUATION PRESSURE (PSI):	N/A
ACCUMULATOR CHARGE (PSI):	N/A	PCTB SEAL PRESSURE (PSI):	0

NOTES: The tool came up with no pressure. Upon diagnosis, it was discovered that one of the newly installed SAE Plugs that was installed during the build for of the pressure section had a hole drilled through it. In an obsolete version of the tool (early PCTBII), there was a Kepner check valve installed under one of these SAE Plugs. As the obsolete parts were still available in the drawers, it was accidentally used. The obsolete parts were removed from the van.

POST-CORING TOOL ANALYSIS & REBUILD

OBSERVATIONS		NOTES	PRESSURE SECTION	
BALL VALVE	CLOSED		RESERVOIR PRESSURE:	N/A
LINER	INTACT		WATER ABOVE PISTON?	NO
PAWLS	INTACT		WATER IN REGULATOR?	NO
PAWL SPRING	INTACT		REBUILD REGULATOR?	NO
NOTES:				


2020-01-29 4k PAT PCTB4 7
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
12:45
12:49
12:53
12:57
13:02
13:06
13:10
13:14
13:19
13:23
13:27
13:31
13:36
13:40
13:44
13:48
13:53
13:57
14:01
14:05
14:10
14:14
14:18
14:22
14:27
Atmosphere Pressure (psi)
PCTB Pressure (psi)

1.8 4KPAT PCTB4 8

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TESTING RUN REPORT

GENESIS OF METHANE IN THE GULF OF MEXICO (GoM^3)

DATE:	January 30, 2020	CORE:			4k PAT PCTB4 8
TOOL ASSEMBLY TEAM:		Geotek			
SIMULATED CORE DEPTH:	2,612 m	BOTTOM HOLE PRESSURE:			3,800 psi
PRESSURE SECTION/IT PLUG NUMBER:	4/1	AUTOCLAVE ASSEMBLY NUMBER:			1
UPPER ASSEMBLY NUMBER:	2	CATCHER KIT:	Basket/Rabbit	5" Extension	5" Extension
DST SERIAL NUMBERS: AUTOCLAVE:	C8957	ATMOSPHERE:			C8952
NOTES:					

TEST SETUP

TEST CONFIGURATION:	PCTB CONFIGURATION:
Test Console	AES9001_01 - PCTB4.0 Assembly
GTT1000_00 - Full Vertical Test Assembly	PCTB4 Pressure Section Large
45 gal accumulator, 1x 800 psi, 2x 1800	PCTB4 Shear Pin IT Plug
Slow pull	600# Shear Pin
Mud	
NOTES:	

TOOL ASSEMBLY

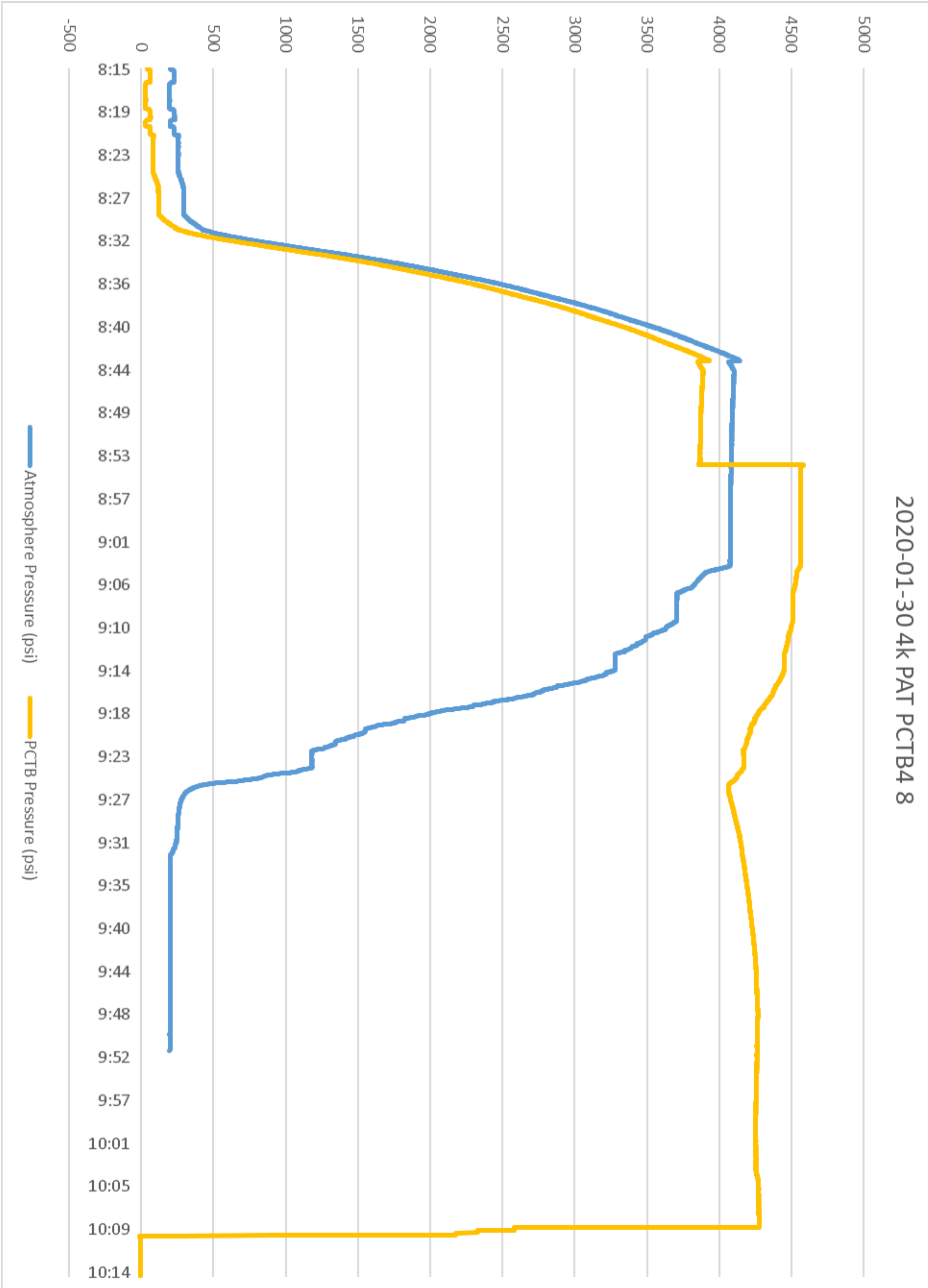
BUILD CHECKLIST				
SAMPLE VALVE CLOSED AND PORT PLUGGED	COMPLETE	PAWL POST HEIGHT (0.095-0.105")		COMPLETE
SHUTOFF VALVE OPEN	COMPLETE	LINER/IT PLUG LENGTH (156.75")		COMPLETE
SUPPLY VALVE OPEN	COMPLETE	SET PRESSURE (CONFIRM WITH 3 TESTS):		4,290 psi
FILL VALVE CLOSED/PORT PLUGGED	COMPLETE	RESERVOIR FILL PRESSURE:		8,063 psi
SET VALVE CLOSED/PORT PLUGGED	COMPLETE	TOOL READY FOR TEST	DATE:	2020-01-29
DRAIN VALVE CLOSED/PORT PLUGGED	COMPLETE		TIME:	14:00
NOTES:				

TESTING RUN

TEST DATE:	Jan 30, 2020	TEST START TIME:	07:50
INITIAL LINEAR TRANSDUCER (IN):	N/A	FINAL LINEAR TRANSDUCER (IN):	N/A
INITIAL PCTB PRESSURE (PSI):	N/A	FINAL PCTB PRESSURE (PSI):	N/A
INITIAL ATMOSPHERE PRESSURE (PSI):	N/A	FINAL ATMOSPHERE PRESSURE (PSI):	3784
INITIAL ACTUATION PRESSURE (PSI):	N/A	FINAL ACTUATION PRESSURE (PSI):	N/A
ACCUMULATOR CHARGE (PSI):	N/A	PCTB SEAL PRESSURE (PSI):	4249
NOTES: Good test, first test with mud			

POST-CORING TOOL ANALYSIS & REBUILD

OBSERVATIONS		NOTES	PRESSURE SECTION	
BALL VALVE	CLOSED		RESERVOIR PRESSURE:	4,578 psi
LINER	INTACT		WATER ABOVE PISTON?	NO
PAWLS	INTACT		WATER IN REGULATOR?	NO
PAWL SPRING	INTACT		REBUILD REGULATOR?	NO
NOTES:				


2020-01-30 4k PAT PCTB4 8
-500
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
8:15
8:19
8:23
8:27
8:32
8:36
8:40
8:44
8:49
8:53
8:57
9:01
9:06
9:10
9:14
9:18
9:23
9:27
9:31
9:35
9:40
9:44
9:48
9:52
9:57
10:01
10:05
10:09
10:14
Atmosphere Pressure (psi)
PCTB Pressure (psi)

1.9 4KPAT PCTB4 9

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TESTING RUN REPORT
GENESIS OF METHANE IN THE GULF OF MEXICO (GoM^3)

DATE:	January 30, 2020	CORE:			4k PAT PCTB4 9
TOOL ASSEMBLY TEAM:		Geotek			
SIMULATED CORE DEPTH:	2,612 m	BOTTOM HOLE PRESSURE:			3,800 psi
PRESSURE SECTION/IT PLUG NUMBER:	1/2	AUTOCLAVE ASSEMBLY NUMBER:			2
UPPER ASSEMBLY NUMBER:	2	CATCHER KIT:	Basket/Rabbit	5" Extension	5" Extension
DST SERIAL NUMBERS: AUTOCLAVE:	L7071	ATMOSPHERE:			C8952
NOTES:					

TEST SETUP

TEST CONFIGURATION:	PCTB CONFIGURATION:
Test Console	AES9001_01 - PCTB4.0 Assembly
GTT1000_00 - Full Vertical Test Assembly	PCTB4 Pressure Section Large
45 gal accumulator, 1x 800 psi, 2x 1800	PCTB4 Shear Pin IT Plug
Slow pull	600# Shear Pin
Mud	
NOTES:	

TOOL ASSEMBLY

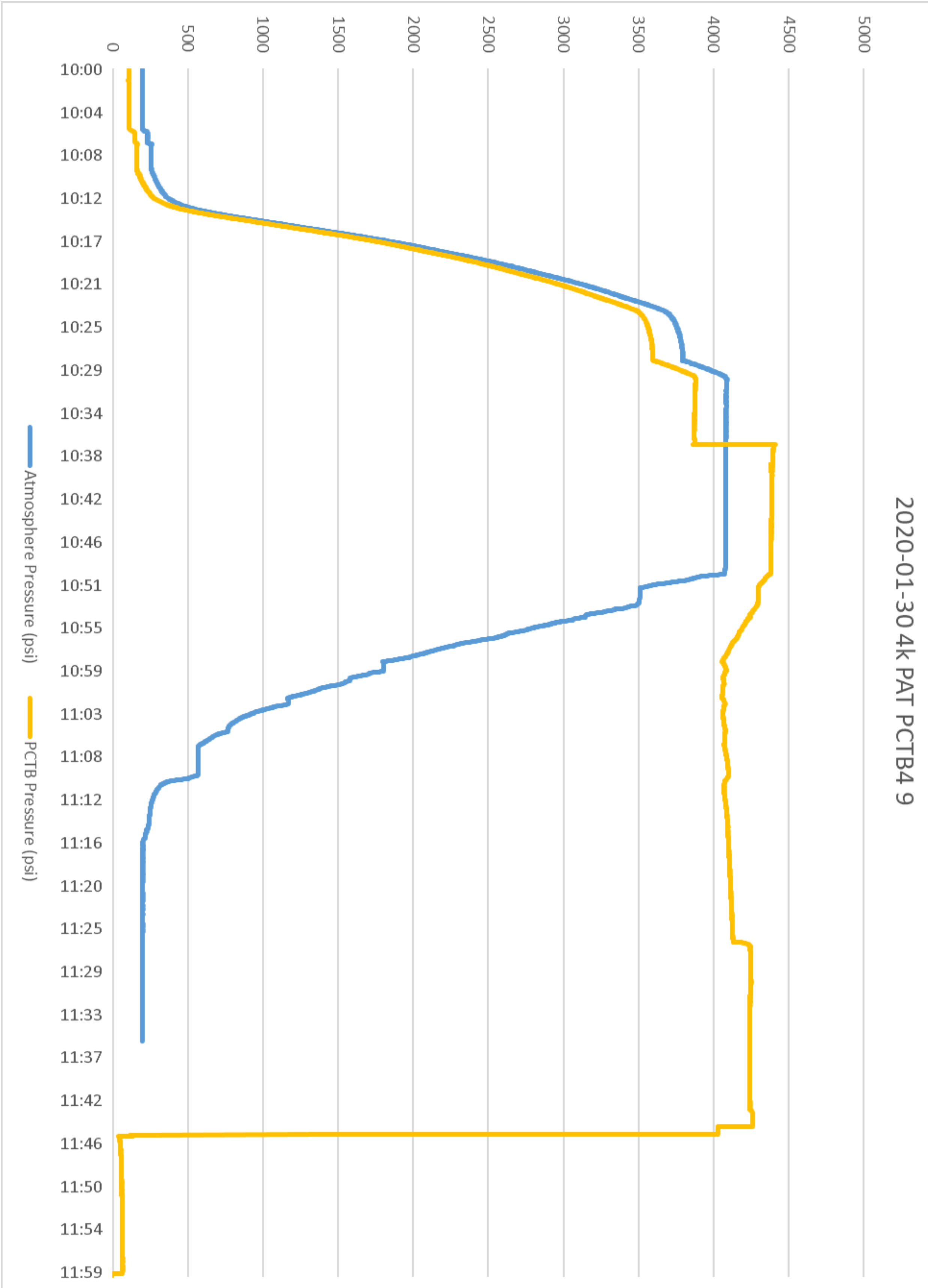
BUILD CHECKLIST				
SAMPLE VALVE CLOSED AND PORT PLUGGED	COMPLETE	PAWL POST HEIGHT (0.095-0.105")		COMPLETE
SHUTOFF VALVE OPEN	COMPLETE	LINER/IT PLUG LENGTH (156.75")		COMPLETE
SUPPLY VALVE OPEN	COMPLETE	SET PRESSURE (CONFIRM WITH 3 TESTS):		4,293 psi
FILL VALVE CLOSED/PORT PLUGGED	COMPLETE	RESERVOIR FILL PRESSURE:		8,015 psi
SET VALVE CLOSED/PORT PLUGGED	COMPLETE	TOOL READY FOR TEST	DATE:	2020-01-29
DRAIN VALVE CLOSED/PORT PLUGGED	COMPLETE		TIME:	18:10
NOTES:				

TESTING RUN

TEST DATE:	Jan 30, 2020	TEST START TIME:	10:10
INITIAL LINEAR TRANSDUCER (IN):	N/A	FINAL LINEAR TRANSDUCER (IN):	N/A
INITIAL PCTB PRESSURE (PSI):	N/A	FINAL PCTB PRESSURE (PSI):	N/A
INITIAL ATMOSPHERE PRESSURE (PSI):	N/A	FINAL ATMOSPHERE PRESSURE (PSI):	3989
INITIAL ACTUATION PRESSURE (PSI):	N/A	FINAL ACTUATION PRESSURE (PSI):	N/A
ACCUMULATOR CHARGE (PSI):	N/A	PCTB SEAL PRESSURE (PSI):	3987
NOTES: Good test			

POST-CORING TOOL ANALYSIS & REBUILD

OBSERVATIONS		NOTES	PRESSURE SECTION	
BALL VALVE	CLOSED		RESERVOIR PRESSURE:	5,265 psi
LINER	INTACT		WATER ABOVE PISTON?	NO
PAWLS	INTACT		WATER IN REGULATOR?	NO
PAWL SPRING	INTACT		REBUILD REGULATOR?	NO
NOTES:				


2020-01-30 4k PAT PCTB4 9
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10:00
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10:08
10:12
10:17
10:21
10:25
10:29
10:34
10:38
10:42
10:46
10:51
10:55
10:59
11:03
11:08
11:12
11:16
11:20
11:25
11:29
11:33
11:37
11:42
11:46
11:50
11:54
11:59
Atmosphere Pressure (psi)
PCTB Pressure (psi)

1.10 4KPAT PCTB4 10

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TESTING RUN REPORT

GENESIS OF METHANE IN THE GULF OF MEXICO (GoM^3)

DATE:	January 30, 2020	CORE:			4k PAT PCTB4 10
TOOL ASSEMBLY TEAM:		Geotek			
SIMULATED CORE DEPTH:	2,612 m	BOTTOM HOLE PRESSURE:			3,800 psi
PRESSURE SECTION/IT PLUG NUMBER:	2/3	AUTOCLAVE ASSEMBLY NUMBER:			1
UPPER ASSEMBLY NUMBER:	2	CATCHER KIT:	Basket/Rabbit	5" Extension	5" Extension
DST SERIAL NUMBERS: AUTOCLAVE:	C8957	ATMOSPHERE:			C8952
NOTES:					

TEST SETUP

TEST CONFIGURATION:	PCTB CONFIGURATION:
Test Console	AES9001_01 - PCTB4.0 Assembly
GTT1000_00 - Full Vertical Test Assembly	PCTB4 Pressure Section Large
45 gal accumulator, 1x 800 psi, 2x 1800	PCTB4 Shear Pin IT Plug
Slow pull	600# Shear Pin
Mud	
NOTES:	

TOOL ASSEMBLY

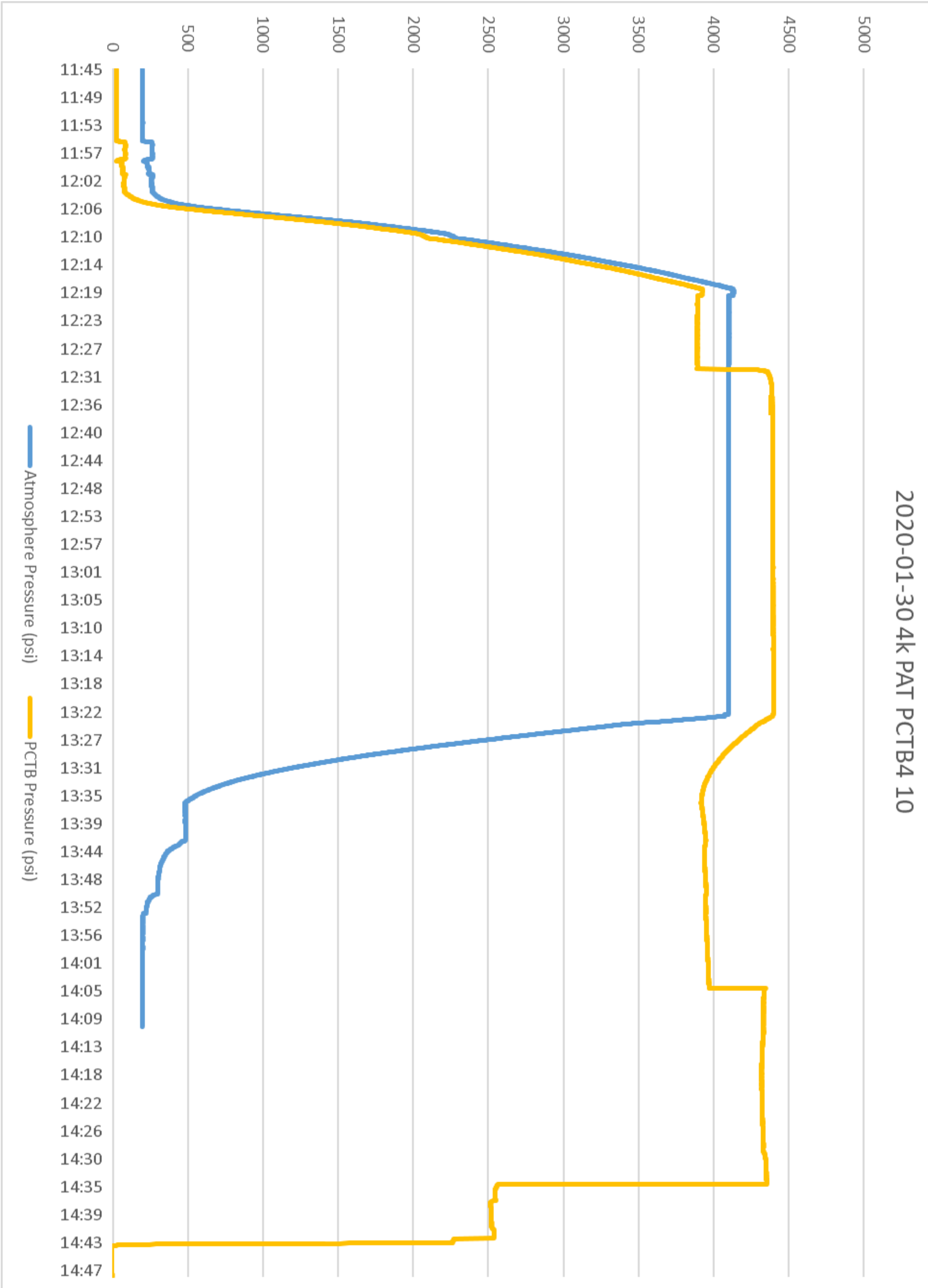
BUILD CHECKLIST				
SAMPLE VALVE CLOSED AND PORT PLUGGED	COMPLETE	PAWL POST HEIGHT (0.095-0.105")		COMPLETE
SHUTOFF VALVE OPEN	COMPLETE	LINER/IT PLUG LENGTH (156.75")		COMPLETE
SUPPLY VALVE OPEN	COMPLETE	SET PRESSURE (CONFIRM WITH 3 TESTS):		4,286 psi
FILL VALVE CLOSED/PORT PLUGGED	COMPLETE	RESERVOIR FILL PRESSURE:		8,090 psi
SET VALVE CLOSED/PORT PLUGGED	COMPLETE	TOOL READY FOR TEST	DATE:	2020-01-30
DRAIN VALVE CLOSED/PORT PLUGGED	COMPLETE		TIME:	11:40
NOTES:				

TESTING RUN

TEST DATE:	Jan 30, 2020	TEST START TIME:	11:50
INITIAL LINEAR TRANSDUCER (IN):	N/A	FINAL LINEAR TRANSDUCER (IN):	N/A
INITIAL PCTB PRESSURE (PSI):	N/A	FINAL PCTB PRESSURE (PSI):	N/A
INITIAL ATMOSPHERE PRESSURE (PSI):	N/A	FINAL ATMOSPHERE PRESSURE (PSI):	3825
INITIAL ACTUATION PRESSURE (PSI):	N/A	FINAL ACTUATION PRESSURE (PSI):	N/A
ACCUMULATOR CHARGE (PSI):	N/A	PCTB SEAL PRESSURE (PSI):	4326
NOTES: Good test			

POST-CORING TOOL ANALYSIS & REBUILD

OBSERVATIONS		NOTES	PRESSURE SECTION	
BALL VALVE	CLOSED		RESERVOIR PRESSURE:	4,751 psi
LINER	INTACT		WATER ABOVE PISTON?	NO
PAWLS	INTACT		WATER IN REGULATOR?	NO
PAWL SPRING	INTACT		REBUILD REGULATOR?	NO
NOTES:				


2020-01-30 4k PAT PCTB4 10
Atmosphere Pressure (psi)
PCTB Pressure (psi)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
11:45
11:49
11:53
11:57
12:02
12:06
12:10
12:14
12:19
12:23
12:27
12:31
12:36
12:40
12:44
12:48
12:53
12:57
13:01
13:05
13:10
13:14
13:18
13:22
13:27
13:31
13:35
13:39
13:44
13:48
13:52
13:56
14:01
14:05
14:09
14:13
14:18
14:22
14:26
14:30
14:35
14:39
14:43
14:47

1.11 4KPAT PCTB4 11

GEOTEK CORING Inc
3350 W Directors Row, Suite 600
Salt Lake City, Utah 84104
1-385-528-2536 info@geotekcoring.com www.geotekcoring.com

TESTING RUN REPORT

GENESIS OF METHANE IN THE GULF OF MEXICO (GoM^3)

DATE:	January 30, 2020	CORE:			4k PAT PCTB4 11
TOOL ASSEMBLY TEAM:		Geotek			
SIMULATED CORE DEPTH:	2,612 m	BOTTOM HOLE PRESSURE:			3,800 psi
PRESSURE SECTION/IT PLUG NUMBER:	5/4	AUTOCLAVE ASSEMBLY NUMBER:			2
UPPER ASSEMBLY NUMBER:	2	CATCHER KIT:	Basket/Rabbit	5" Extension	5" Extension
DST SERIAL NUMBERS: AUTOCLAVE:	L7071	ATMOSPHERE:			C8952
NOTES:					

TEST SETUP

TEST CONFIGURATION:	PCTB CONFIGURATION:
Test Console	AES9001_01 - PCTB4.0 Assembly
GTT1000_00 - Full Vertical Test Assembly	PCTB4 Pressure Section Large
45 gal accumulator, 1x 800 psi, 2x 1800	PCTB4 Shear Pin IT Plug
Slow pull	600# Shear Pin
Mud	
NOTES:	

TOOL ASSEMBLY

BUILD CHECKLIST

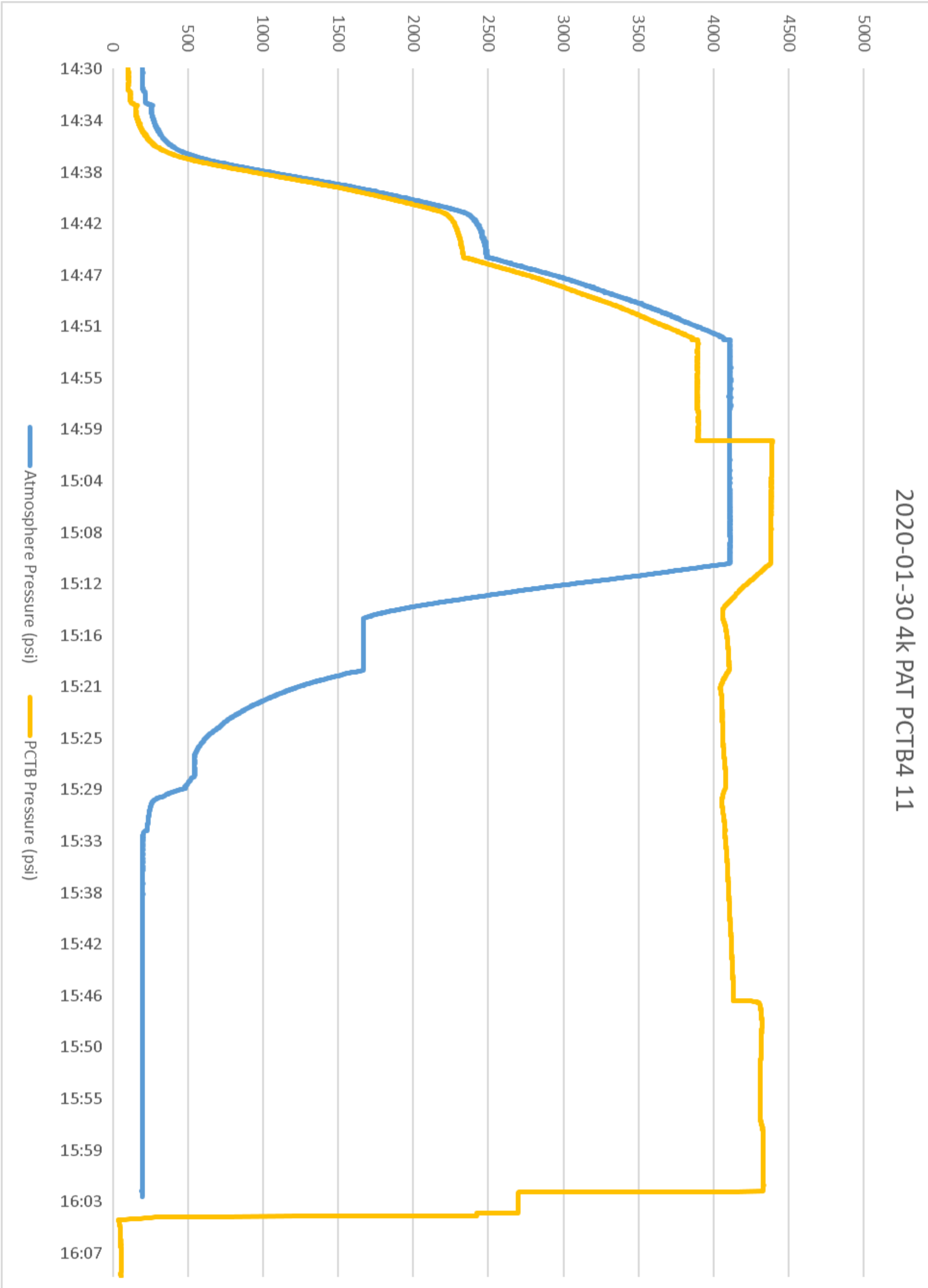
SAMPLE VALVE CLOSED AND PORT PLUGGED	COMPLETE	PAWL POST HEIGHT (0.095-0.105")		COMPLETE
SHUTOFF VALVE OPEN	COMPLETE	LINER/IT PLUG LENGTH (156.75")		COMPLETE
SUPPLY VALVE OPEN	COMPLETE	SET PRESSURE (CONFIRM WITH 3 TESTS):		4,275 psi
FILL VALVE CLOSED/PORT PLUGGED	COMPLETE	RESERVOIR FILL PRESSURE:		8,050 psi
SET VALVE CLOSED/PORT PLUGGED	COMPLETE	TOOL READY FOR TEST	DATE:	2020-01-30
DRAIN VALVE CLOSED/PORT PLUGGED	COMPLETE		TIME:	14:15
NOTES:				

TESTING RUN

TEST DATE:	Jan 30, 2020	TEST START TIME:	14:20
INITIAL LINEAR TRANSDUCER (IN):	N/A	FINAL LINEAR TRANSDUCER (IN):	N/A
INITIAL PCTB PRESSURE (PSI):	N/A	FINAL PCTB PRESSURE (PSI):	N/A
INITIAL ATMOSPHERE PRESSURE (PSI):	N/A	FINAL ATMOSPHERE PRESSURE (PSI):	4027
INITIAL ACTUATION PRESSURE (PSI):	N/A	FINAL ACTUATION PRESSURE (PSI):	N/A
ACCUMULATOR CHARGE (PSI):	N/A	PCTB SEAL PRESSURE (PSI):	4102
NOTES: Good Test			

POST-CORING TOOL ANALYSIS & REBUILD

OBSERVATIONS		NOTES	PRESSURE SECTION	
BALL VALVE	CLOSED		RESERVOIR PRESSURE:	4,977 psi
LINER	INTACT		WATER ABOVE PISTON?	NO
PAWLS	INTACT		WATER IN REGULATOR?	NO
PAWL SPRING	INTACT		REBUILD REGULATOR?	NO
NOTES:				


2020-01-30 4k PAT PCTB4 11
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
14:30
14:34
14:38
14:42
14:47
14:51
14:55
14:59
15:04
15:08
15:12
15:16
15:21
15:25
15:29
15:33
15:38
15:42
15:46
15:50
15:55
15:59
16:03
16:07
Atmosphere Pressure (psi)
PCTB Pressure (psi)

1.12 4KPAT PCTB4 12

GEOTEK CORING Inc

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TESTING RUN REPORT

GENESIS OF METHANE IN THE GULF OF MEXICO (GoM^3)

DATE:	January 31, 2020	CORE:			4k PAT PCTB4 12
TOOL ASSEMBLY TEAM:		Geotek			
SIMULATED CORE DEPTH:	2,612 m	BOTTOM HOLE PRESSURE:			3,800 psi
PRESSURE SECTION/IT PLUG NUMBER:	3/1	AUTOCLAVE ASSEMBLY NUMBER:			1
UPPER ASSEMBLY NUMBER:	2	CATCHER KIT:	Basket/Rabbit	5" Extension	5" Extension
DST SERIAL NUMBERS:	AUTOCLAVE:	C8957	ATMOSPHERE:		C8952
NOTES:					

TEST SETUP

TEST CONFIGURATION:	PCTB CONFIGURATION:
Test Console	AES9001_01 - PCTB4.0 Assembly
GTT1000_00 - Full Vertical Test Assembly	PCTB4 Pressure Section Large
45 gal accumulator, 1x 800 psi, 2x 1800	PCTB4 Shear Pin IT Plug
Slow pull	600# Shear Pin
Mud	
NOTES:	

TOOL ASSEMBLY

BUILD CHECKLIST

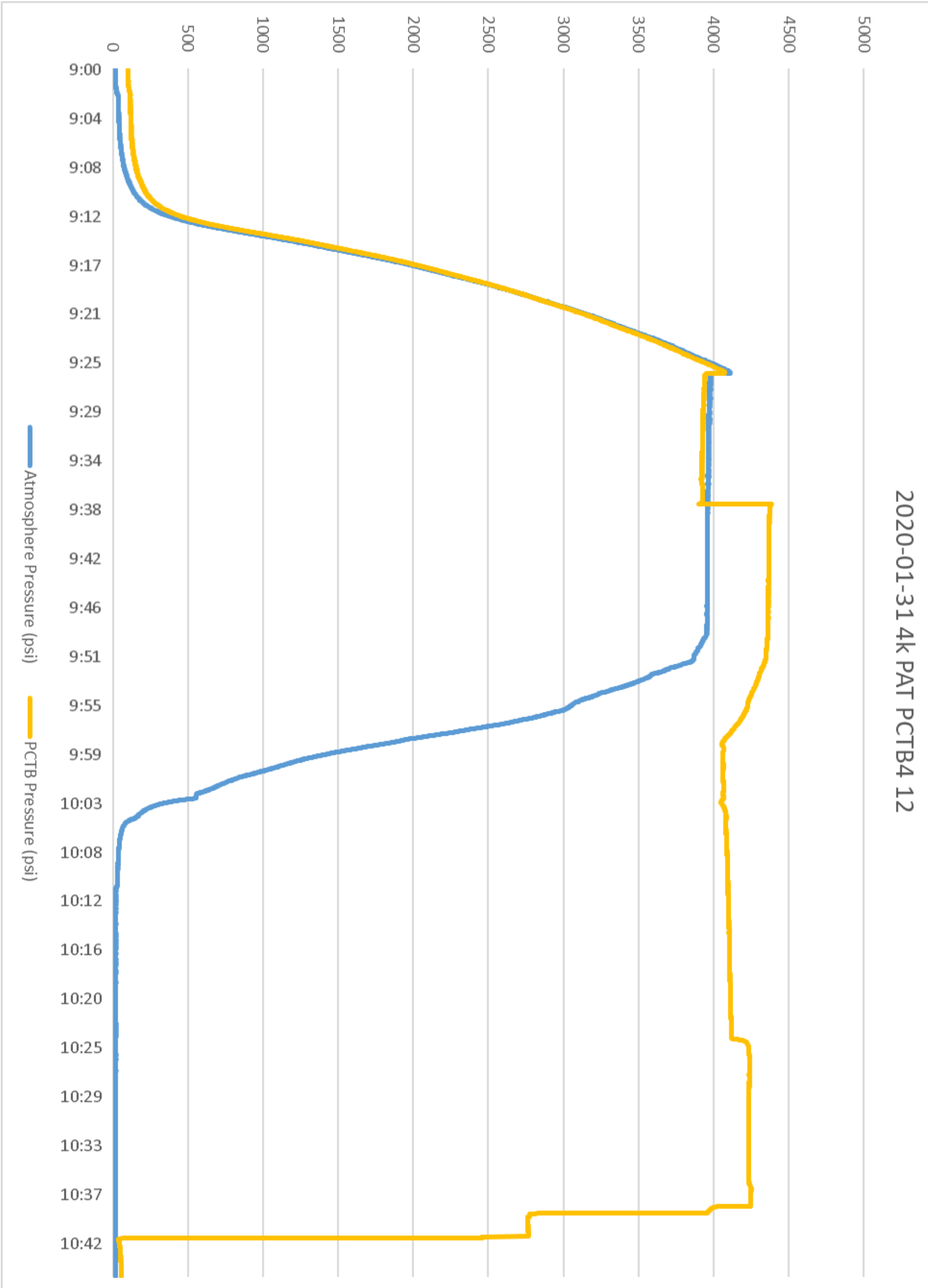
SAMPLE VALVE CLOSED AND PORT PLUGGED	COMPLETE	PAWL POST HEIGHT (0.095-0.105")		COMPLETE
SHUTOFF VALVE OPEN	COMPLETE	LINER/IT PLUG LENGTH (156.75")		COMPLETE
SUPPLY VALVE OPEN	COMPLETE	SET PRESSURE (CONFIRM WITH 3 TESTS):		4,278 psi
FILL VALVE CLOSED/PORT PLUGGED	COMPLETE	RESERVOIR FILL PRESSURE:		8,158 psi
SET VALVE CLOSED/PORT PLUGGED	COMPLETE	TOOL READY FOR TEST	DATE:	2020-01-30
DRAIN VALVE CLOSED/PORT PLUGGED	COMPLETE		TIME:	16:00
NOTES:				

TESTING RUN

TEST DATE:	Jan 31, 2020	TEST START TIME:	08:00
INITIAL LINEAR TRANSDUCER (IN):	N/A	FINAL LINEAR TRANSDUCER (IN):	N/A
INITIAL PCTB PRESSURE (PSI):	N/A	FINAL PCTB PRESSURE (PSI):	N/A
INITIAL ATMOSPHERE PRESSURE (PSI):	N/A	FINAL ATMOSPHERE PRESSURE (PSI):	3815
INITIAL ACTUATION PRESSURE (PSI):	N/A	FINAL ACTUATION PRESSURE (PSI):	N/A
ACCUMULATOR CHARGE (PSI):	N/A	PCTB SEAL PRESSURE (PSI):	4040
NOTES: Good test			

POST-CORING TOOL ANALYSIS & REBUILD

OBSERVATIONS		NOTES	PRESSURE SECTION	
BALL VALVE	CLOSED		RESERVOIR PRESSURE:	n/a
LINER	INTACT		WATER ABOVE PISTON?	NO
PAWLS	INTACT		WATER IN REGULATOR?	NO
PAWL SPRING	INTACT		REBUILD REGULATOR?	NO
NOTES:	Residual not measured due to leaking manifold			


2020-01-31 4k PAT PCTB4 12
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
9:00
9:04
9:08
9:12
9:17
9:21
9:25
9:29
9:34
9:38
9:42
9:46
9:51
9:55
9:59
10:03
10:08
10:12
10:16
10:20
10:25
10:29
10:33
10:37
10:42
Atmosphere Pressure (psi)
PCTB Pressure (psi)