Oil & Natural Gas Technology

DOE Award No.: DE-FE0010180

Quarterly Progress Report
(Period ending December 31st , 2016)

Gas Hydrate Dynamics on the Alaskan Beaufort Continental Slope: Modeling and Field Characterization
Project Period: October 1, 2012 –March 31st, 2017

Submitted by:

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Prepared for:
United States Department of Energy
National Energy Technology Laboratory

January 31st, 2017

Office of Fossil Energy

ABSTRACT
The first quarter of FY 2017 (Oct – Dec, 2016) was spent primarily analyzing heat flow and thermal conductivity data collected on the US Beaufort Margin during the fall of 2016. After spending the months of October and November processing data, SMU and OSU researchers met in San Francisco (AGU and Menlo Park) to discuss preliminary results from the initial measurements and to begin writing papers related to this work. One manuscript demonstrates clear evidence in the heat flow data for major swings in ocean bottom temperature along the feather-edge of hydrate stability, indicating that hydrate is highly unstable along the margin. The second manuscript, a longer study, assesses the broad-scale heat flow across the Beaufort Margin (with special focus on areas where anomalously high heat flow appear to exist along the margin).

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EXECUTIVE SUMMARY

In October 2012, Southern Methodist University in close partnership with The United State Geological Survey at Woods Hole and Oregon State University, began investigating methane hydrate stability in deep water (>100 mbsf) environments below Alaskan Beaufort Sea. In late 2014, the project was further expanded to include analysis of methane hydrates and slope stability off the US east coast. This research is part of a now 4.5 year study funded by the Department of Energy's (DOE) National Energy Technology Laboratory (NETL) that analyzes methane hydrate stability on both the Atlantic and Beaufort Margin. Key goals of this study include integrating and processing marine seismic data collected at the USGS as well as other publically available data with dynamic 2D/3D/4D heat flow models developed at SMU to determining the depth, location, and dynamics of methane hydrate stability along the Alaskan Beaufort Margin and similar environments. A major component of this study is to constrain how the methane hydrate stability zone is changing with time. Additional goals of this study include determining areas where concentrated methane hydrate might exist in the subsurface and to understand the role methane hydrate plays in slope stability along continental margins. To accomplish these goals, researchers use geophysical (seismic, heat flow, CTD/XBT) data combined with numerical models to assess methane hydrate stability in space and time. Researchers also integrate regional coring and biological data with methane hydrate stability models to place further constraints on hydrate dynamics.

PROGRESS AND RESULTS

After spending two months analyzing the data, SMU and OSU researcher met in mid-December at AGU to assess of results from the project and plan future directions. Below, I outline the main conclusions drawn from discussions at this meeting, and from it, what manuscripts we have begun writing:

Upper Margin/Shelf Heat Flow Analysis and Hydrate Stability (manuscript 1): we have completed a preliminary analysis of the heat flow and thermal conductivity measurements made on the upper US Beaufort Margin. Our results indicate highly erratic ocean temperature swings occur along the margin edge on an annual basis. We have used these data to constrain both the timing and location of warm-water ocean currents traversing the margin, and show that these currently likely cause large-scale (hundreds of meters up and down slope) annual variations in hydrate stability along the feather edge of hydrate stability. Results are currently be written-up in journal format for submission.

Margin-wide Heat Flow Analysis (focus of manuscript 2): We have merged measured heat flow values along the entire margin to generate a more complete, basin-wide picture of heat flow for the US Beaufort Margin. The analysis indicates that systematically higher heat flow values exist in the western third of the margin. The cause of these high heat flow values (which are more than three times higher than background values at some locations) remains unclear, however, our draft manuscript provides three hypotheses for why these heat flow anomalous exist. The study will be very valuable in assessing hydrocarbon maturation and evolution along the Beaufort Margin and will likely lead to further study of the margin.

Thermal Conductivity Measurements: We have now made a series of thermal conductivity measurements on sample collected during the fall expedition. During this process, however, we have noted some systematic errors in the needle-probe readings that are likely due to a poor heating element in the sensor (we discovered this by comparing it to measurements on several standards). As a result, we have ordered a new needle probe that generates higher accuracy and higher precision results for thermal conductivity. We will re-measure several of our samples when this new probe arrives in early February.

COST STATUS

Below we outline the current cost status for the project as we near project completion.
This month, Skip raised concerns about cost-sharing figures—specifically, he was concerned that we appeared to have a lot of unspent cost-share in our latest Q-drive numbers. Upon further review, this is no longer a concern, as the primary source of confusion regarding cost share is that SMU had not yet accounted for Bremen and UCLA reporting their cost share. Emails between SMU, Bremen, UCLA, and DOE have helped clarify this problem, and our discussions indicate these institutions have contributed a significant amount of cost share that has not yet been booked to the project, but will be properly booked at project closeout. Below, I outline the current state of the budget and the expected cost-share from each institution.

	Federal Funds	Recipient Funds*	Total Project Funds
Total Award Authorized 10/01/2012 - 03/31/2017	$ 1,330,615.00	$ 387,716.00	$ 1,718,331.00
Cumulative Expended 10/01/2012 - 09/30/2016	$ (895,796.84)	$ (139,427.19)	$ (1,035,224.03)
Remaining Balance As of 09/30/2016	$ 434,818.16	$ 248,288.81	$ 683,106.97
Expended 10/01/206 - 12/31/206	$ (297,634.00)	$ -	$ (297,634.00)
Remaining Balance Available for 03/31/2017	$ 137,184.16	$ 248,288.81	$ 385,472.97

* Note: Recipient cost share allocations may not be reported in the month in which they are incurred.

Anticipated distribution of remaining cost share (subject to reallocation upon final certifications from particpants):

	Allocation	Allocated As of 12/31/16	Remaining
Total Cost Share	$ 387,716.00	$ (139,427.19)	$ 248,288.81
SMU Cost Share	$ 157,004.00	$ (86,575.93)	$ 70,428.07
OSU Cost Share	$ 96,931.00	$ (52,851.26)	$ 44,079.74

U of Bremen	$ 61,200.00	$ -	$ 61,200.00
UCLA	$ 72,581.00	$ -	$ 72,581.00

PROBLEMS OR DELAYS

There were no significant problems or delays. As noted above, we did find a problem with some of the thermal conductivity measurements that we traced to a faulty heater in the conductivity probe. We have since ordered a replacement that will improve these measurements significantly. Otherwise, we are on track to submit two manuscripts outlining our most significant results later this year.

CONCLUSIONS AND FUTURE DIRECTIONS

We remain on schedule with research and reporting requirements. We remain confident that two manuscripts will be submitted within the next few months related to this work, the first assocatied with methane hydrate stability and ocean temperatures on the upper US Beaufort Margin; the second outlining heat flow and implications for hydrocarbon potential in the Beaufort.

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