Oil & Natural Gas Technology

DOE Award No.: DE-FE0009949

Quarterly Research Performance Progress Report (Period ending 12/31/2013)

A new approach to understanding the occurrence and volume of natural gas hydrate in the northern Gulf of Mexico using petroleum industry well logs

10/1/2012-9/30/2015

Submitted by:
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National Energy Technology Laboratory

Office of Fossil Energy

EXECUTIVE SUMMARY

The main objective of the project is to significantly increase our understanding of the occurrence, volume and fine scale distribution of natural gas hydrate in the northern Gulf of Mexico using petroleum industry and Gulf of Mexico Gas Hydrate Joint Industry Project (JIP) well logs.

First Year

In the first quarter (October 1, 2012-December 13, 2012), the initial steps were to establish an estimate for the base of gas hydrate stability zone (GHSZ) for each industry well in the Gulf of Mexico and begin ordering industry well data. For the modeling side of the project, student Brian Tost completed a formation model for JIP2 wells in Alaminos Canyon, Gulf of Mexico. Ann Cook and Barbara Anderson began constructing formation models for the sand reservoir in Green Canyon, Gulf of Mexico.

In the second quarter (January 1, 2013-March 31, 2013) well orders were completed for each block in the Gulf of Mexico, by Cook, Urmi Majumdar (PhD student), Abby Crock (undergraduate hourly) and Samyra Ismail (undergraduate hourly). Eleven total DVDs were ordered from the Bureau of Safety and Environment Enforcement (BSEE). Student Brian Tost defended his master's thesis on the JIP Alaminos Canyon wells. Undergraduate senior Abby Crock completed her thesis on Alaminos Canyon industry wells in Block 857.

In the third quarter (April 1, 2013 – June 30, 2013) Urmi Majumdar and Samyra Ismail began working on well assessments by Gulf of Mexico Block. This involved opening each well log, noting the types of logs available in the GHSZ and analyzing the log for any signs of natural gas hydrate By the end of June, Majumdar completed initial reports on all of the wells in East Breaks and Keathley Canyon. The plan is to produce reports of this type for all assessed Gulf of Mexico Blocks. At the end of May, Tost and Cook submitted a conference article entitled, 'Do Gas Hydrates Occur in Alaminos Canyon, Gulf of Mexico?' the Unconventional Resources Technology Conference, which will be presented in August 2013. Tost was moved to a part time hourly worker for the summer (June 1-August 16) so he can complete the manuscript on Alaminos Canyon for the Journal of Geophysical Research. Cook and Anderson worked on resistivity formation models for JIP2 Hole GC955-H. Unfortunately, some of the Schlumberger proprietary models have changed and do not match the well conditions in Hole GC955-H. Anderson is working on having Schlumberger reinstate the old models.

In the fourth quarter (July 1 – September 30, 2013) Majumdar continued working on assessments in the Gulf of Mexico, specifically focusing on Alaminos Canyon and Mississippi Canyon. The report for Alaminos Canyon can be found on pages 7-13 of this quarterly report. Tost presented his work at the Unconvetional Resources technology conference. Tost and Cook continued to work on to work on the Alaminos Canyon Block 21 manuscript for submission to JGR. Anderson was able to fix the Schlumberger proprietary models, but we were not able to complete the resistivity formation models for GC955-H and WR313-G because of the delay.

The target completion date for the resistivity models was moved to December 31, 2013.

Second Year

In the first quarter of year two (October 1, 2013-December 13, 2013), Majumdar and Cook continued working on the Gulf of Mexico assessments. Over half of the large protraction areas have now been completed (see Figures 1 & 2); including East Breaks, Alaminos Canyon, Keathley Canyon and Garden Banks. The northern section of Mississippi Canyon has also been completed. Majumdar and Cook submitted abstracts to ICGH and the GRC. The ICGH abstract was accepted with an Oral presentation. Cook and Tost submitted the manuscript on Alaminos Canyon to JGR. In December, Cook and Majumdar held a phone conference with Matt Frye and Bill Shedd and discussed several of the prospects. We planned to meet sometime this spring to go over seismics from several of the sites together.

Resistivity models for GC 955 and WR 313 are still behind. Anderson now needs a new computer from Schlumberger (her computer failed at the begining of November), but she has still not received a new one.

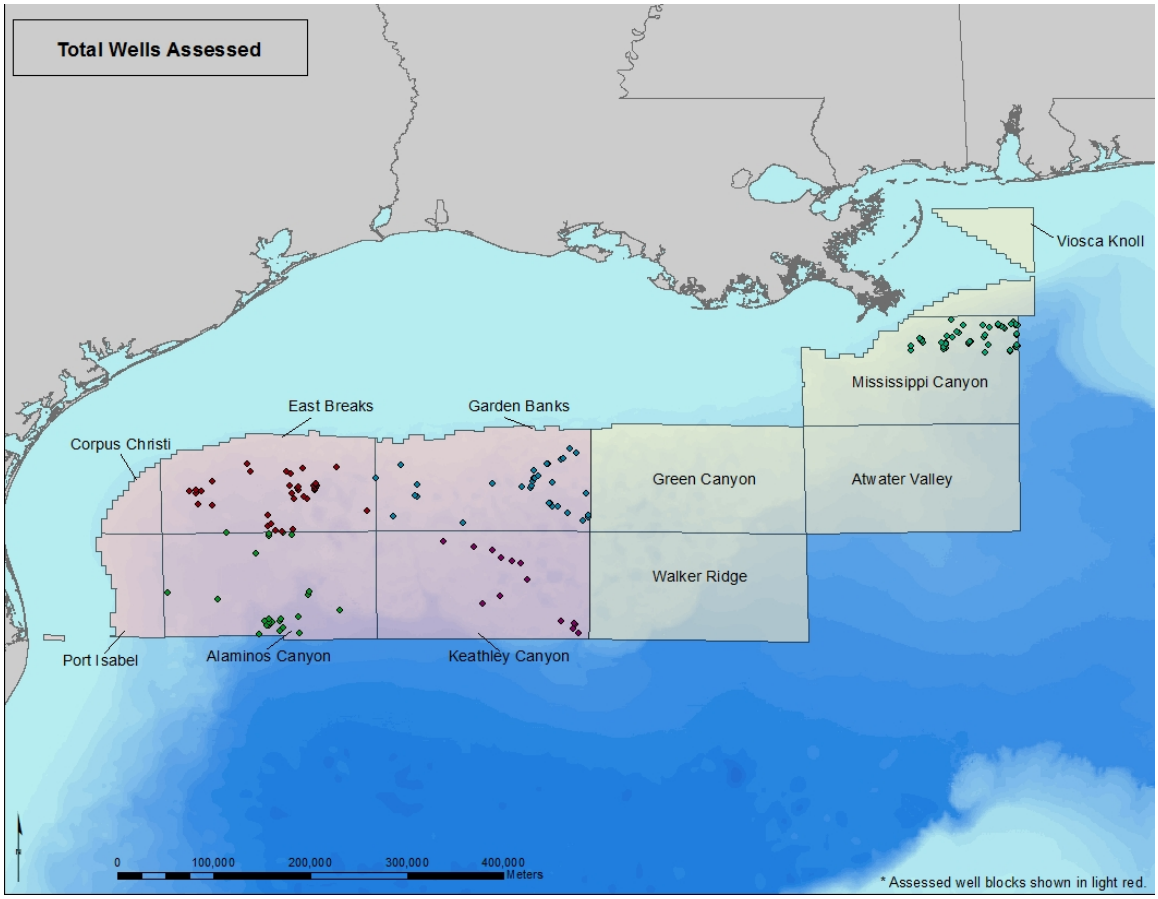

Figure 1. Wells with complete initial assessments as of 12/01/2013. The map only includes wells with 50 ft or greater of data within the gas hydrate stability zone.

Protraction areas East Breaks, Garden Banks, Alaminos Canyon and Keathley Canyon are complete. Mississippi Canyon is currently in progress.

PROGRESS, RESULTS AND DISCUSSION

See Table 1 for Project Timeline on each task and subtask.

Task 1.0 – Project Management Plan

During October and November, the Cook worked with Skip Pratt to develop the PMP for the project. It was completed on November 27, 2012.

Cook participated in a project kickoff conference call with DOE on November 7, 2012.

Task 2.0: Evaluation of gas hydrate occurrence in petroleum industry well logs

Subtask 2.1: **Calculate the depth of the GHSZ depth in the Gulf of Mexico using ArcGIS.**

Gas hydrate stability zone models for the Gulf of Mexico were received from Matt Frye, BOEM. These models contain minimum, mean and maximum estimates as well as breakdowns from P10-P90. The Frye models were assessed and by Cook and students, and compared to a blanket GIS calculation based only on bathymetric depth. We decided Frye models were likely more accurate, and decided to use the P90 gas hydrate stability zone depth as a cutoff for the log order. Thus, wells that contains only logs depths deeper than P90 will not be ordered.

Students Tost and Ismail worked on outputting spreadsheet data from the GIS to make the industry well log orders. Some GIS issues, including missing wells, were encountered and hopefully fixed.

The first well data order from BSEE was on December 7, 2012 and ordering continued through he end of Q2. Two undergraduate students, Crock and Ismail, PhD student Majumdar, and Cook ordered well data and compiled spreadsheets on each well (Subtask 2.2). In total, 11 DVDs were ordered full of logging data from the Gulf of Mexico. This task was completed at the end of Q2.

Subtask 2.2: **Well log evaluation and database development.**

Spreadsheets were developed for each block in the Gulf of Mexico for wells drilled in water column greater than 1400 ft. Orders were then compiled on the BSEE website using their well query system. Each well was queried using the API number. The BSEE seafloor depth at each well was crosschecked with GIS bathymetry data to make sure hydrate stability zone calculations were reasonably valid. Well logs that were above the P90 cutoff were ordered in each well, including (but not limited to) gamma ray, resistivity, velocity, density, neutron porosity and caliper. Most frequently, wells only contained resistivity and gamma ray logs. Additionally, we will not know how shallow

some of the logs were recorded until the log data is analyzed. Typically the top of logged interval is only reported for the top of any log and typically does not represent the top of logged interval for all logs.

Each well that was ordered will be analyzed completely through the Mean GHSZ estimate and anything of interest was noted through the P90 GHSZ estimate. We note year of logging and operator for each well. Logs available through the Mean GHSZ are noted, as well as mud type in the Mean GHSZ, and any well deviation in the GHSZ. Initial well assessment spreadsheets and reports were completed for East Breaks and Keathley Canyon in Q3, and Alaminos Canyon in Q4. Garden Banks was completed in Q1 of the second year. Green Canyon is also close to completion (Figure 1). This subtask is on track to be completed in Q2 of this year.

Task 3.0: Modeling of resistivity measurements from JIP Leg 2

Subtask 3.1: **Develop true resistivity models for sand reservoirs for JIP Leg 2 Holes**

A resistivity model that incorporates the measured resistivity and the seismic trace in for JIP2 Holes AC-21A and AC-21B has been developed by Tost and Cook.

An initial model for JIP2 Hole GC-955H was completed in December 2012. Anderson and Cook are collaborating to produce more accurate models, unfortunately, some of the Schlumberger proprietary codes were changed since our first model run, and the newer models were mismatched. Anderson is working on trying to get these models revered back to the original. The completion date for this task was moved to December 31, 2013 due to problems with the proprietary Schlumberger code.

UPDATE: The Schlumberger codes were fixed and another model iteration was run. But shortly after the new iteration was completed, Anderson's computer failed. She is working with Schlumberger to obtain a new computer that can run proprietary code.

Subtask 3.2: **Determine hydrate saturation using best-fit ANISBED models.**

This task will begin once task 3.1 is complete.

Task 4.0: Determining volume of methane in gas hydrate in the northern Gulf of Mexico

This task and associated subtasks are on track to begin in Phase II.

Task 5.0: Publication, presentation and dissemination of results.

- A conference paper was submitted for the Unconventional Resources Technology Conference, 'Do Gas Hydrates Occur in Alaminos Canyon,

Gulf of Mexico?' with authors Tost and Cook. Tost presented this work in August 2013.

- Majumdar submitted abstracts on the project to ICGH and the Gordon Research Conference. The ICGH conference abstract was accepted with oral presentation.
- A significantly edited version of the URTEC manuscript was submitted to JGR in November and is currently in review.

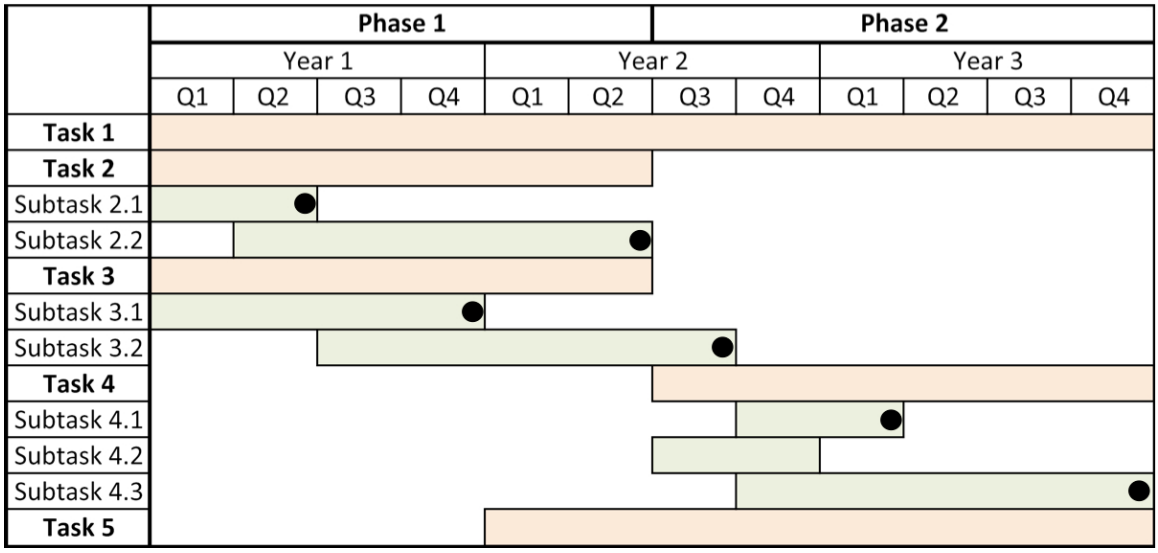

Table 1. Project timeline by task (tan bars) and subtask (green bars). Total project time is 2, 18 month-long phases (3 years). Subtask 2.1 has been completed and the first milestone was met. Milestones are indicated by a black dot.

PARTICIPANTS

Name: Ann Cook
Project Role: PI
Contribution: Managing student time, working on abstracts with Majumdar, submit manuscript to JGR.
Person Months: .5

Name: Urmi Majumdar
Project Roll: Graduate student
Contribution: Assessing wells in the Gulf of Mexico; preparing reports on Alaminos Canyon
Person Months: 3

Name: Sam Ismail
Project Roll: Undergraduate hourly
Contribution: Works on mapping results of assessments

COSTS

During this quarter, charges to the project include graduate student tuition and stipend and hourly pay for undergraduate Ismail.

Department: **06560**
Principal Investigator: **Cook,Ann Elizabeth**
Sponsored Program Officer: **Port,Jared Austin**
Facilities & Administration Rate: **52.50 %**

The Ohio State University - Office of Sponsored Programs
Project Financial Summary
For the Month Ending: **DEC 31, 2013**
Project Period: ***10/01/2012*** to ***03/31/2014***

Project: **60036410**
Award: **GRT00028365**
Sponsor: **US Department of Energy**
Grant/Contract: **DE-FE0009949**

Project/Award Title: **New approach to understanding the occurrence and volume of natural gas hydrate in the northern Gulf of Mexico using petroleum industry well logs**

	Sponsor				
Category	**Budget**	**Expenses This Month**	**Expenses To Date**	**Commitments**	**Balance**
Salaries and Wages	52,030.00	1,910.02	31,204.03	5,481.66	15,344.31
Fringe Benefits	5,888.00	240.66	3,878.93	690.68	1,318.39
GA Tuition and Fees	23,256.00	0.00	12,547.50	3,975.00	6,733.50
Total Personnel Costs	81,174.00	2,150.68	47,630.46	10,147.34	23,396.20
Materials and Supplies	0.00	0.00	1,161.00	0.00	-1,161.00
Domestic Travel	10,000.00	0.00	2,251.92	0.00	7,748.08
Purchased Services	15,000.00	0.00	0.00	0.00	15,000.00
Total Direct Costs	106,174.00	2,150.68	51,043.38	10,147.34	44,983.28
Facilities and Administrative	43,532.00	1,129.11	20,210.38	3,240.48	20,081.14
Total	**149,706.00**	**3,279.79**	**71,253.76**	**13,387.82**	**65,064.42**

	Cost Share				
Category	**Budget**	**Expenses This Month**	**Expenses To Date**	**Commitments**	**Balance**
GA Tuition and Fees	0.00	0.00	18,570.00	0.00	-18,570.00
Total Personnel Costs	0.00	0.00	18,570.00	0.00	-18,570.00
Total Direct Costs	0.00	0.00	18,570.00	0.00	-18,570.00
Facilities and Administrative	0.00	21.50	223.81	0.00	-223.81
Total	**0.00**	**21.50**	**18,793.81**	**0.00**	**-18,793.81**

	Third Party				
Category	**Budget**	**Expenses This Month**	**Expenses To Date**	**Commitments**	**Balance**
Other Direct Costs	22,500.00	0.00	0.00	0.00	22,500.00
Purchased Services	52,000.00	0.00	0.00	0.00	52,000.00
Total Direct Costs	74,500.00	0.00	0.00	0.00	74,500.00
Total	**74,500.00**	**0.00**	**0.00**	**0.00**	**74,500.00**

Table 2. Total costs through Year 2, Quarter 1.

Department: **06560**
Principal Investigator: **Cook,Ann Elizabeth**
Sponsored Program Officer: **Port,Jared Austin**

The Ohio State University - Office of Sponsored Programs
Detail of Expenses
For the Month Ending: **DEC 31, 2013**
Project Period: **10/01/2012** to **03/31/2014**

Project: **60036410**
Award: **GRT00028365**
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Account	**Account Description**	**Sponsor Expense**
60092	Graduate Research Associate	1,827.22
60131	Student (non-GA/non-FWSP)	82.80
	Salaries and Wages	1,910.02
60292	Bnft-Graduate Research Assoc	230.23
60331	Bnft-Student (non-GA/non-FWSP)	10.43
	Fringe Benefits	240.66
	Total Personnel Costs	2,150.68
	Total Direct Costs	2,150.68
66701	Indirect Costs	1,129.11
	Facilities and Administrative	1,129.11
	Total F&A Costs	1,129.11
	Total Project Costs This Month	**3,279.79**

Account	**Account Description**	**Cost Share Expense**
66701	Indirect Costs	21.50
	Facilities and Administrative	21.50
	Total F&A Costs	21.50
	Total Project Costs This Month	**21.50**

Table 3. Detail of expenses Year 2, Quarter 1.

Department: **06560**
Principal Investigator: **Cook,Ann Elizabeth**
Sponsored Program Officer: **Port,Jared Austin**

The Ohio State University - Office of Sponsored Programs
Detail of Payroll Expenses
For the Month Ending: **DEC 31, 2013**
Project Period: ***10/01/2012*** to ***03/31/2014***

Project: **60036410**
Award: **GRT00028365**
Sponsor: **US Department of Energy**
Grant/Contract: **DE-FE0009949**

Project/Award Title: **New approach to understanding the occurrence and volume of natural gas hydrate in the northern Gulf of Mexico using petroleum industry well logs**

	Employee						Sponsor Expenses
Account	ID	Name	Journal ID	Journal Date	Pay Type	Description	This Month
60092	200299301	Majumdar,Urmi		12/31/2013	HR Monthly	HR Payroll Expense	1,827.22
						Total for Account	1,827.22
60131	200208533	Ismail,Samrya A		12/27/2013	HR Bi-Weekly	HR Payroll Expense	82.80
						Total for Account	82.80
60292			BNRF700623	12/31/2013	Other	OSURF BENEFIT RATE 5	230.23
						Total for Account	230.23
60331			BNRF500470	12/31/2013	Other	OSURF BENEFIT RATE 5	10.43
						Total for Account	10.43
						Total for Project	**2,150.68**

Table 3. Detail of payroll expenses for Q4.

CONCLUSION

Most tasks are on track, however, the ANISBED modeling was delayed until the end of February. Otherwise, there are no major changes from the PMP at this time.