

# Oil & Natural Gas Technology

DOE Award No.: DE-FC26-01NT41330

## Semi-Annual Progress Report #41330R18 (October 2009 – March 2010)

### Characterizing Natural Gas Hydrates in the Deep Water Gulf of Mexico: Applications for Safe Exploration and Production Activities

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Prepared for:  
United States Department of Energy  
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June 2010



Office of Fossil Energy

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## **ABSTRACT**

In 2000, Chevron began a project to learn how to characterize the natural gas hydrate deposits in the deepwater portions of the Gulf of Mexico. A Joint Industry Participation (JIP) group formed in 2001, and a project partially funded by the U.S. Department of Energy (DOE) began in October 2001. The **primary objective** of this project is to develop technology and data to assist in the characterization of naturally occurring gas hydrates in the deep water Gulf of Mexico (GOM). These naturally occurring gas hydrates can cause problems relating to drilling and production of oil and gas, as well as building and operating pipelines. Other objectives of this project are to better understand how natural gas hydrates can affect seafloor stability, to gather data that can be used to study climate change, and to determine how the results of this project can be used to assess if, and how gas hydrates act as a trapping mechanism for shallow oil, or gas reservoirs.

### **During October 2009 – March 2010 JIP activities included:**

- **Continuing to analyze data from the Leg II (2009 LWD) cruise**
- **Preparing papers to present Leg II initial results at the 2010 Offshore Technology Conference**
- **Commencing formation of the Leg III (Coring) science team organization**
- **Commencing Leg III engineering and operations planning including evaluation of drill pipe options to accommodate the prototype HPTC coring device**
- **Commencing contracting for equipment needed for Leg III**
- **Commencing turnover planning for the JIP Program Manager position**
- **Presentation of update on the JIP at the DOE Hydrate Advisory Committee meeting in Atlanta, Georgia the week of 25-29 January**

More information is available on the JIP website: <http://gomhydratejip.ucsd.edu/>

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## 1.0 Introduction

In 2000, Chevron Petroleum Technology Company began a project to learn how to characterize the natural gas hydrate deposits in the deepwater portion of the Gulf of Mexico. Chevron is an active explorer and operator in the Gulf of Mexico, and is aware that natural gas hydrates need to be understood to operate safely in deep water. In August 2000, Chevron working closely with the National Energy Technology Laboratory (NETL) of the United States Department of Energy (DOE) held a workshop in Houston, Texas, to define issues concerning the characterization of natural gas hydrate deposits. Specifically, the workshop was meant to clearly show where research, the development of new technologies, and new information sources would be of benefit to the DOE and to the oil and gas industry in defining issues and solving gas hydrate problems in deep water.

Based on the workshop held in August 2000, Chevron formed a Joint Industry Project (JIP) to write a proposal and conduct research concerning natural gas hydrate deposits in the deepwater portion of the Gulf of Mexico. The proposal was submitted to NETL on April 24, 2001, and Chevron was awarded a cooperative research agreement based on the proposal.

The title of the project is **“Characterizing Natural Gas Hydrates in the Deep Water Gulf of Mexico: Applications for Safe Exploration and Production Activities”**.

### 1.2 Objectives

The **primary objective** of this project is to develop technology and data to assist in the characterization of naturally occurring gas hydrates in the deep water Gulf of Mexico (GOM). These naturally occurring gas hydrates can cause problems relating to drilling and production of oil and gas, as well as building and operating pipelines. Other objectives of this project are to better understand how natural gas hydrates can affect seafloor stability, to gather data that can be used to study climate change, and to

determine how the results of this project can be used to assess if and how gas hydrates act as a trapping mechanism for shallow oil or gas reservoirs.

### ***1.3 Project Phases***

The project is divided into phases. **Phase I** of the project was devoted to gathering existing data, generating new data, and writing protocols that will help the research team determine the location of existing gas hydrate deposits. During **Phase II** of the project, Chevron was to drill at least three data collection wells to improve the technologies required to characterize gas hydrate deposits in the deepwater GOM using seismic, core and logging data. **Phase III** of the project began in September of 2007 and is focused on obtaining logs and cores of hydrate bearing sands in the GOM.

### ***1.4 Research Participants***

In 2001, Chevron organized a Joint Industry Participation (JIP) group to plan and conduct the tasks necessary for accomplishing the objectives of this research project. As of March 2010, the members of the JIP were Chevron, Schlumberger, ConocoPhillips, Halliburton, the Minerals Management Service (MMS), Total, JOGMEC, Reliance Industries Limited, The Korean National Oil Company (KNOC), and Statoil.

### ***1.5 Research Activities***

The research activities began officially on October 1, 2001. However, very little activity occurred during 2001 because of the paperwork involved in getting the JIP formed and the cooperative research agreement between DOE and Chevron in place. Several previous Semi-Annual and Topical Reports have been written, and are available, that cover the activity of the JIP through March 2010.

### ***1.6 Purpose of This Report***

The purpose of this report is to synopsise the activities of the JIP during the six month period between October 2009 – March 2010. It is not possible to fully capture the extent of all activities and results in this Semi-Annual report, therefore, references within this report point the reader to more detailed information concerning various aspects of the

project contained within the JIP website (<http://gomhydratejip.ucsd.edu/>) which serves as a repository for documentation of important project results. The discussion of the work performed during October 2009 – March 2010 is broken out by activities being performed in association with project Phase IIIA and Phase IIIB ease of reference

## **2.0 Executive Summary**

Chevron formed a Joint Industry Participation (JIP) group to write a proposal and conduct research concerning natural gas hydrate deposits in the deepwater portion of the Gulf of Mexico. The proposal was submitted to NETL on April 24, 2001, and Chevron was awarded a cooperative research agreement based on the proposal.

The title of the project is **“Characterizing Natural Gas Hydrates in the Deep Water Gulf of Mexico: Applications for Safe Exploration and Production Activities”**.

The **primary objective** of this project is to develop technology and data to assist in the characterization of naturally occurring gas hydrates in the deep water Gulf of Mexico (GOM). **Other objectives** of this project are to better understand how natural gas hydrates can affect seafloor stability, to gather data that can be used to study climate change, and to determine how the results of this project can be used to assess if and how gas hydrates act as a trapping mechanism for shallow oil or gas reservoirs.

The project is divided into phases. **Phase I** of the project was devoted to gathering existing data, generating new data, and writing protocols that will help the research team determine the location of existing gas hydrate deposits. During **Phase II** of the project, Chevron drilled seven wells at two locations (Atwater Valley 13/14, Keathley Canyon 151) to obtain data for improving technologies required to characterize gas hydrate deposits in the deepwater GOM using seismic, core and logging data. **Phase III** of the project (the current phase) has an objective of collecting and analyzing data on hydrate bearing sands. Both logging and coring operations are planned in Phase III.

Phase III is roughly divided into two parts. Phase IIIA centered on a LWD drilling expedition (Leg II) completed in 2009, to test methodologies to predict the locations and hydrate saturations of large, coarse-grained deepwater geobodies located in the hydrate stability zone. Phase IIIB is focusing on additional LWD of promising location(s), retrieval and analysis of pressure cores from hydrate containing coarse grained deepwater geobodies, as well as wireline logging and (if possible) wireline formation testing of those geobodies. The end of Phase IIIB will also include analysis and synthesis of cores and data collected as a part of Phase III as well as preparation and release of Final Integrated Reporting for the entire project.

### **3.0 Phase III A (Leg II) Activities (during period: 10/09 – 3/10)**

During the 2009 LWD leg, ongoing third party operations at one of the target drilling locations required that the Leg II expedition shift to an alternative site at a nearby block (AC21) which had not undergone full pre-drill seismic inversion work to predict hydrate saturations as had been done for other Leg II locations. LWD data at AC21 was successfully retrieved, and subsequent to completion of Leg II the JIP science team recommended that (for the sake of completeness) a pre-drill estimate should be made of this location. The estimate would be done the same way as the pre-drill estimates at GC 955 and WR 313. Seismic inversion work in support of this objective continued during this reporting period. Unfortunately reading in the pre-stack seismic data took more time than anticipated because the tapes containing the seismic gathers are fairly old and problematic. Approximately 95% of the data had been retrieved by February. By March this was increased to 99.5% coverage. The largest gap was about 160ft (or 4 in-lines) which fortunately did not cross any of the well locations. The science team decided that the best option was to interpolate through these zones and proceed with the inversion analysis, keeping track of where the gaps were on all subsequent products, so as not to misinterpret them. The affect on our timeline is such that the pre-drill inversion and Sgh quantification will likely proceed through the summer.



The original and fully processed GOM JIP Leg II well log database was loaded onto the Lamont-Doherty Earth Observatory web site: <http://brg.ldeo.columbia.edu/ghp/>. The web site includes original and processed data, in the same formats as GOM JIP Leg I. LDEO will add the processed MP3 shear-wave and PeriScope data when it is received from Schlumberger. The JIP board voted to release the leg II LWD data collected to the public (i.e. not to fully invoke their approved option to apply EPACT protection of data first generated under the project). This data release is to be done on a controlled basis so that reservoir modelers could use the data for a comparison of models, for graduate student and research staff studies, etc. Any requests for access should be directed to the JIP Program Manager ([jbalczewski@chevron.com](mailto:jbalczewski@chevron.com)).

#### **4.0 Phase III B (Leg III) Activities (during period: 10/09 – 3/10)**

Extensive discussions were held to select optimal drilling pipe for the upcoming Leg III expedition. The JIP prototype Aumann & Associates HPTC pressure corer design (lengthened and up-rated to withstand the higher pressures expected at the relatively deep GOM expedition sites) is based on the original Aumann & Associates PTCS. Both require 5.906" tool joint ID to allow sufficient clearances to pass the core tool ball valve under field conditions. The original PTCS utilized special drilling pipe (currently stored in Japan), but investigations determined that there wasn't enough of this pipe to reach the required GOM depths. The project team considered such options as redesigning the HPTC coring tool to operate in standard API drill pipe and fabricating new special drill pipe. Ultimately the team located standard drilling casing / landing string that is suitable for this application and available for rental in the GOM. Specifications are: LANDING STRING: 7 5/8" .500" WT, (39#), Q-125, HYDRIL 563 T&C CONNS., RANGE 3, INTERNALLY COATED. Once the bottom hole assembly design is formalized, further engineering studies will be done on the proposed drilling casing to confirm suitability.

Planning for the coring expedition was started during this period:

- The drilling rig selection process commenced. Letters of Interest were solicited and several responses received. One of the candidate rigs (the Helix ‘Q4000’) was inspected by the team on February 26<sup>th</sup> at Garden Banks 506. (Note: the ‘Q4000’ is the same rig that was used for the successful 2009 Leg II expedition).
- Work began on forming the Leg III Science Field Organization, with a kickoff meeting in January. In February the project was pleased to name Tim Collett (USGS) and Ray Boswell (NETL) as co-Chief Scientists for Leg III. In addition to their many qualifications, Tim and Ray were co-Chief Scientists for the highly successful 2009 Leg II expedition. A Field Program Advisory Group was also established, and a meeting was set for April to establish science leads and team members.
- A contract was issued by Chevron to Geotek to provide core handling, transfer and analysis technologies/services for use in Leg III, including modifications to the Pressure Core Analysis Transfer System (PCATS) to allow compatibility with the Aumann & Associates HPTC so that cores taken with this system can be analyzed and transferred under pressure.

A presentation was given at the DOE review meeting in Atlanta in January 2010, providing an update of the plans for the JIP.

## **7.0 Conclusions**

Complications with the required drilling pipe for the pressure coring tool were resolved and a design agreed to.

Analysis of the LWD data, collected during Leg II, is complete except for that from the experimental sonic tool tested during the expedition.

Pre-drill estimates of gas hydrate saturation (via seismic inversions) for AC21 are proceeding.

Preparations for the Leg III expedition have commenced.

## **8.0 References**

No external references were used for this report.

## 9.0 Appendix A – Project Timeline

4/18/2010																	
Task	Year	2009				2010				2011				2012			
	Quarter	4	1	2	3	4	1	2	3	4	1	2	3	4			
1.0 Project Management and Planning																	
2.4 Co-Chief Scientists																	
2.4.1 Select			◆														
3.0 Field Coring Program																	
3.0.1 Rig evaluation			↔														
3.0.2 Rig selection				◆													
3.0.3 Letter of Indemnity to secure drilling window					◆												
3.0.4 Drilling window (depending on rig availability)								◀◆---									
4.0 Publication of Initial Results (IR)																	
5.1 Improved Pressure Coring Device																	
5.1.1 Design			↔														
5.1.2 Fabrication					↔												
5.1.3 Onshore Test						◆											
5.1.4 Offshore deployment								◀◆---									
5.1.5 Reconditioning and Storage									↔								
6.0 Detailed Seismic Study of Selected Locations																	
7.0 Well Bore Stability																	
8.0 Data on Lab Samples																	
9.0 Technical Conference														◆			
Project Conclusion														◆			

## 10.0 Appendix B – Phase IIIB Milestones

Milestone	Planned Completion Date	Status	Comments
Appoint Leg III Chief Scientist	Q1 10	Completed on schedule	Tim Collett (USGS) and Ray Boswell (NETL) appointed as co-Chief Scientists. Tim and Ray led the successful 2009 Leg II LWD science field program.
Complete Leg III final science staffing	Q2 10	Completed on schedule	
Develop Leg III scientific targets and objectives	Q2 10		
Finalize Leg III rig selection	Q2 10		
Final design of Pressure Coring Device	Q3 09		
Build and Onshore Test of Pressure Coring Device	Q4 2010		
Conduct Leg III Expedition	Q2 2011		
Access an improved pressure coring device	Q2 2011		
Post Leg III Analyses	Q3 2011		
Publication of Initial Leg III Results	Q4 2011		
Technical Conference	Q4 2011		

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