Oil & Natural Gas Technology

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Semi-Annual Progress Report
(March – September 2007)

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

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"Characterizing Natural Gas Hydrates in the Deep Water Gulf of Mexico: Applications for Safe Exploration and Production Activities Semi-Annual Report"

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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 was 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 April 2007 – September 2007, the JIP concentrated on:

- Conducting experiments on the cores collected;
- Preparing a continuation application for Phase III;
- Began redesigning a new pressure corer;
- Reviewing paper for the special volume on leg 1;
- Studying sites for Phase III drilling seismic analysis.

More information can be found on the JIP website.

https://cpln-www1.chevron.com/cvx/gasjip.nsf

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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.

On the basis of 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 contract on the basis of 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 is 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 will drill at least three data collection wells to improve the technologies required to characterize gas hydrate deposits in the deep water GOM using seismic, core and logging data. **Phase III** of the project began in September of 2007 and will focus 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 September 2007 the members of the JIP were Chevron, Schlumberger, ConocoPhillips, Halliburton, the Minerals Management Service (MMS), Total, JOGMEC, and Reliance Industries Limited. The Korean National Oil Company (KNOC) has signed the necessary contract forms to become a member if the JIP starts work on a Phase III.

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 contract between DOE and Chevron in place. Several Semi-Annual and Topical Reports have been written that cover the activity of the JIP through March 2007.

1.6 Purpose of This Report

The purpose of this report is to document the activities of the JIP during April 2007 – September 2007. It is not possible to put everything into this Semi-Annual report. However, many of the important results are included and references to the JIP website, https://cpln-www1.chevron.com/cvx/gasjip.nsf, are used to point the reader to more detailed information concerning various aspects of the project. The discussion of the work performed during April 2007 – September 2007 is organized by task and subtask for easy reference to the technical proposal and the DOE contract documents.

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 contract on the basis of 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 is 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 will drill at least three data collection wells to improve the technologies required to characterize gas hydrate deposits in the deep water GOM using seismic, core and logging data.

A website has been developed to house the data and information that were collected in the Workshop, as well as other items submitted during the course of this research endeavor. The link to the JIP website is as follows:

https://cpln-www1.chevron.com/cvx/gasjip.nsf.

2.1 Phase III Continuation Application

A continuation application for Phase III was submitted and accepted by the DOE.

2.2 Site Selection

The site selection group selected several drilling locations for AC818 and it also recommend GC955 and WR313 for additional seismic analysis.

2.3 Pressure Corer

Initial analysis of the pressure corer indicates no technical problems with increasing the operating pressure.

2.4 Marine and Petroleum Geology JIP Special Volume

Marine and Petroleum Geology will publish the Scientific Results for the 2005 DOE-Chevron Joint Industry Project Gulf of Mexico methane hydrates drilling. Papers to be included in this publication have been compiled and are in final stages of review. The target date for completion of final review and acceptance of the papers is June 2007 with publication to follow thereafter. All papers have been received and are being reviewed for publication.

3.0 Results and Discussion Phase II

3.1 Task 1.0 – Research Management Plan

The goals of this task are to develop a work breakdown structure and supporting narrative that concisely addresses the overall project as set forth in the agreement. Provide a concise summary of the technical objectives and technical approach for each task and, where appropriate, for each subtask. Provide detailed schedules and planned expenditures for each task including any necessary charts or tables, and all major milestones and decision points.

A Continuation Application for Phase II was submitted to the DOE on 15 May 2003. Additional documentation was supplied to the DOE in November and December of 2003, March, July, and December of 2004, and the research plan was revised again in

January 2005 to allow for the additional cost of the drilling vessel. Several changes were required to the original plan because of delays due to EPA permitting, and drill ship changes. The final Phase II revision was submitted to the DOE in March of 2006 along with a revised budget to complete Phase II and prepare a proposal for Phase III.

3.2 Task 2.0 – Project Management and Oversight

A project manager appointed by the Joint Industry Project (JIP) Recipients will manage the technical teams, contractors, and the day to day operation of the project. Project manager will report, verbally and through required reporting, on the progress of the program to the DOE and the JIP as required.

During the period of the progress report the JIP and DOE project managers were in regular contact discussing progress on the project and changes to the research plan for Phase III.

3.3 Task 3.0 – Validation of New Gas Hydrate Sensors

Review and evaluate new hydrate sensor development (Phase I – Task 4, Subtasks 4.1 – 4.4). Prototype sensors, if available, will be field tested in well bores and protocols for use will be developed and distributed to all entities involved in drilling wells in the Gulf of Mexico.

The pressurized core measurement vessel, developed by Georgia Tech, and transfer vessels were tested during the Leg 1 Cruise. After some initial adjustment, the equipment worked and one pressure core was transferred into the measurement vessel for testing. Georgia Tech’s complete report was presented in previous semiannual reports. The measurement vessel was also used in the fall of 2006 to collect data on cores collected as a part of an expedition led by the Indian Government’s National Gas Hydrate Program.

3.4 Task 4.0 – Validation of the Well Bore Stability Model

The goal of this task is to revise the well bore stability model, developed in Phase I – Task 5.0 – Subtasks 5.1 – 5.4, using laboratory data and to validate the model using all available information. Changes or improvements will be made and the model will be distributed for use by organizations drilling wells in the Deep Water Gulf of Mexico.

The well bore model developed in Phase I was used to predict pore pressure and well bore stability before the Leg 1 Cruise. During the cruise one of the staff responsible for the well bore model collected data necessary to determine the performance of the model. The final report on the well bore stability model was received in October of 2006 and is available on the JIP Web Site. The report's conclusions and recommendations were presented in previous semi-annual reports.

3.5 Task 5.0 – Core and Well Log Data Collection – Area A

In order to develop the necessary ground truth data, twin wells in the most favorable location for gas hydrates identified in Phase I – Tasks 11/12 – Subtasks 11.1 – 11.5 (this will be designated Area A) will be drilled. Well A-1 will be drilled without well control and will gather drilling, MWD and open hole logging information. Well A-2 will be drilled with well control and will gather drilling, MWD, core and open hole logging information. The wells will be surveyed and the core will be sent to laboratories for analyses. An additional well, A-3, will be drilled in the least favorable location for gas hydrates in Area A and appropriate core, logging and drilling data will be obtained.

Leg 1 drilling was conducted at two locations, Atwater Valley and Keathley Canyon, in the GOM. In both locations holes were drilled to collect log and core data. In addition to the two primary wells drilled in Atwater Valley, two short wells were drilled near the center of the mound. A complete operation and drilling summary was presented in previous semiannual reports.

3.6 Task 6.0 – Data Analysis – Initial Cruise

Work under this task will consist of conducting the appropriate analysis of all data obtained during initial field activities (the April—May 2005 activities at the Atwater Valley and Keathley Canyon sites) and provide an initial Scientific Results report that details the following: a) the pre-cruise seismic interpretations and an analysis comparing those interpretations with actual findings; b) the findings of the geochemical surveys; c) the findings of the well logging efforts and analysis; d) the findings of the borehole geophysical surveys; e) the performance of various sampling devices employed; f) as well as any other appropriate results emanating from shipboard or subsequent analysis of data or samples obtained during the cruise.

Leg 1 core and log data was presented in a workshop in April 2006 and in previous semiannual reports. Geotechnical data was received from Rice University and will be reported on at a later time.

One of the objectives of the JIP was to determine if seismic analysis can be used to determine hydrate concentrations and locations. WesternGeco performed pre-cruise seismic analysis and predicted the locations and concentrations of hydrates. During this period they also compared their pre-cruise predictions to log and core data collected during the cruise. The complete report is available on the JIP Web Site and a summary of the comparison was presented in previous semi-annual reports.

3.7 Task 7.0 – Technical Conference

In order to provide the scientific community with current data from the project, a workshop will be conducted to present all information obtained during the course of the project to industry, academic, government and other interested professionals. This workshop will focus on the opportunities for improving the tools and protocols for effective field investigation of hydrates in the Gulf of Mexico. The output of the workshop will be plans for DOE consideration for acting on specific recommendations arising from this workshop.

The workshop was held in Houston on 13 and 14 April 2006. Presentations from the workshop and breakout session discussions will be reported in a DOE Topical Report.

Marine and Petroleum Geology will publish the Scientific Results for the 2005 DOE-Chevron Joint Industry Project Gulf of Mexico methane hydrates drilling. Papers to be included in this publication have been compiled and are in final stages of review. The target date for completion of final review and acceptance of the papers is June 2007 with publication to follow thereafter. All papers for the volume have been received and are being reviewed for publication.

3.8 Task 8.0 – Field Sampling Device Development

In addition to any specific data/tool needs identified in the Task 7 workshop, the acquisition of improved technologies for the acquisition, retrieval and subsequent analysis of samples under in-situ pressure (and possibly temperature) conditions will be pursued. Pressure coring equipment will be evaluated both from the JIP membership and the development of new devices to accomplish these goals (both sample retrieval and extensive analysis of samples in systems capable of minimizing hydrate dissociation and sample alteration from its natural state).

After reviewing the performance of pressure coring devices and factoring in the need to sample sands containing hydrates, it was decided to develop a pressure coring tool based on the design used by Japan in the Artic and offshore Japan. Negotiations are complete and a contract is being completed with the company that owns the rights to produce the Japanese design to determine if the operating pressure can be increased and transfer capability can be added. In this reporting period the contractor began reviewing the various components of the corer for increased pressure operation.

3.9 Task 9.0 – Recommendation for Further Activities

Analysis of initial cruise findings will be used to determine the need for additional field activities to properly characterize the full range of hydrate occurrences in the Gulf. New locations will be selected and evaluation of existing geophysical and well log data will be conducted to evaluate the existence of sites or the location of favorable transects in the Gulf of Mexico that have the best potential to provide the missing data. Recommendations will be prepared for a second phase of field activities, including a description of the sites and a plan for conducting field operations.

A site selection meeting was held on 7 September 2006 in Houston. The meeting followed the April 2006 breakout group's recommendations and reviewed the sites that were pulled from the MMS Data Base. The MMS Data Base was reviewed by MMS, USGS, and DOE personnel and 6 locations were reviewed in the September Meeting. The results of the meeting were presented in previous semiannual reports.

AC 818 and AC 857 were the two locations selected in the meetings and a detailed seismic analysis of these locations is in progress with analysis completion anticipated by late June 2007 and reporting of analysis results in July 2007. Figure 3.1 shows the location of AC 818 and Figure 3.2 is an example of the data being developed for the two locations.

A working group was formed to recommend drilling locations for AC 818 and AC 857 and also to determine if other blocks in the GOM should be considered for additional study. The working group completed its work in October of 2007. Meeting records and the drilling target report for AC818 are presented in Appendix A and B.

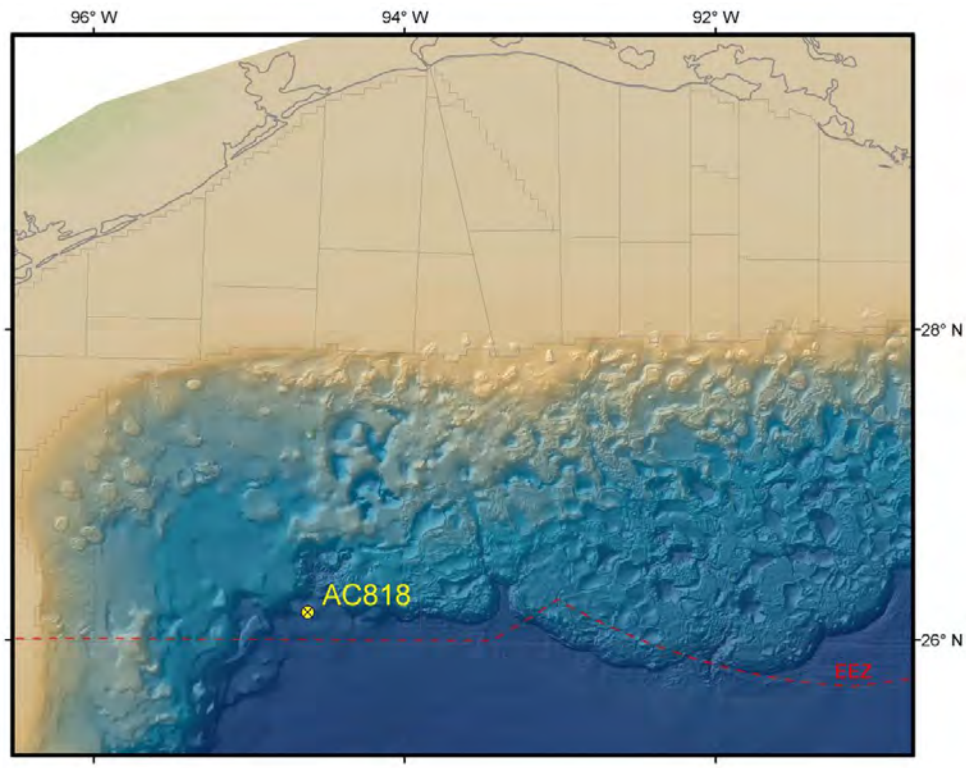

Figure 3.1. Location of AC 818

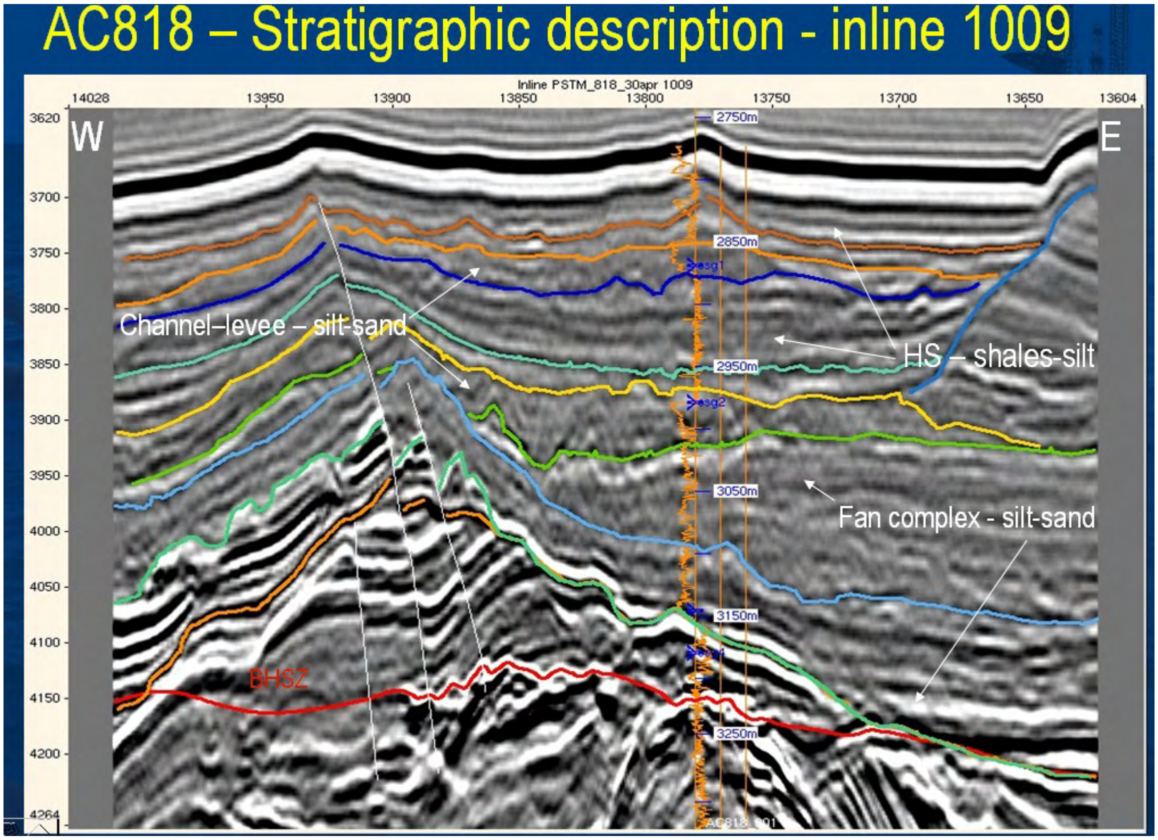

Figure 3.2. AC818 Strategic Description.

4.0 Discussion and Results PHASE III – Follow on Field Activities and Final Reporting

Tentative tasks are provided for Task III activities, which will include the execution of a second field program as identified in Phase II/Task 9.0, and full reporting to both DOE and the broader scientific community.

4.1 Task 1.0 – Research Management Plan

Develop a work breakdown structure and supporting narrative that concisely addresses Phase III activities and includes a concise summary of activities, schedules and costs for each Phase III Task.

A continuation application for Phase III was prepared, submitted, and accepted by the DOE.

4.2 Task 2.0 – Project Management and Oversight

A project manager appointed by the Joint Industry Project (JIP) Recipients will manage the technical teams, contractors, and the day to day operation of the project. Project manager will report, verbally and through required reporting, on the progress of the program to the DOE and the JIP as required.

4.3 Task 3.0 – Field Activities

Conduct field operations as developed in Phase II Task 9.0 and outlined in Phase III Task 1.0.

4.4 Task 4.0 – Data Analysis

Conduct appropriate analysis of all data obtained during the Phase III cruise, integrate these data with those from the Phase II cruise, and provide a detailed Final Report on the findings and their implications. Recommend and pursue options for providing this report as a Special Volume in a manner similar to that provided from other large-scale hydrate research efforts (for example, the special volumes emanating from the Mallik programs).

4.5 Task 5.0 – Technical Conference

Conduct a technical conference to present all information obtained during the course of the project to industry, academic, government and other interested professionals.

5.0 Experimental

Experimental work was conducted during the period of this report. Photos and drawings of some of the experimental equipment that was used on the cruise were presented in previous semiannual reports.

6.0 Conclusions

Several drilling targets were identified for AC818 and will be further analyzed for LWD drilling in 2008.

Two additional blocks, GC955 and WR313, were selected for detailed seismic analysis.

Redesign of the pressure corer so far has not uncovered any technical problems.

7.0 References

No external references were used for this report.

8.0 Appendix A & B

APPENDIX A.

Records of the Site Selection Groups Meetings

Agendas and Summaries

From Site Selection Working Group Discussions

16 August – 19 October, 2007

Compiled by Deborah R. Hutchinson

31 October, 2007

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JIP/DOE Site Survey Conference Call

16 August 2007

Draft Agenda

11:00	**I. Introductions**	
11:05	**II. AC818**	
	Goal: Define Drilling Targets (6-10 holes)	
	a. NRL Cruise • shallow results • implications for occurrence of deeper hydrate	Warren Wood
11:15	b. NE AC818 • *Delineate sands* (Frio? Other sands? Regional distribution, thickness, relations to BGHS, nature of top/bottom reflections, etc.) • *Provide rationale for hydrate* Well log results, saturations from PSWI, saturations from WG inversion, seals, pathways, deposystems, etc. • *Identify locations to test interpretations* Amplitude anomalies c and f (?), other anomalies, transect across anomalies, quantify uncertainty in BGHS, etc.) • Develop site and hole write-ups	Tom Latham Dianna Shelander
11:40	c. Other parts of AC818 (western) • Any targets worth pursuing?	
11:55	**III. AC857** ***Goal: Achieve consensus to abandon this site?***	Ray Boswell Tom Latham
12:00	**IV. GC955** ***Goal: Decide if this a good drilling target.*** a. Geological Indicators • Sand, well logs, petroleum system, geology • BGHSZ, gas occurrence b. Geophysical indicators • Seismic, amplitude anomalies • Well logs – resistivity	Jess Hunt/Bill Shedd Dan McConnell
12:20	**V. Utilizing MMS Assessment Information** ***Goal: For group to understand:*** • ***Information available to help find sites***	Matt Frye

- ***Timeline for getting this information***
- ***Restrictions on what the group can see***

12:30	**VI. Walker Ridge 144 (Choctaw Basin)** ***Goal: Decide if this is a good drilling target.*** a. Geological Indicators • Sand, well logs, petroleum system, geology • BGHSZ, gas occurrence b. Geophysical indicators • Seismic, amplitude anomalies • Well logs – resistivity	Jess Hunt/Bill Shedd
12:40	**VII. Walker Ridge 269 (Terrebonne Basin)** ***Goal: Decide if this is a good drilling target.*** a. Geological Indicators • Sand, well logs, petroleum system, geology • BGHSZ, gas occurrence b. Geophysical indicators • Seismic, amplitude anomalies • Well logs – resistivity	Dan McConnell
12:50	**VIII. AC 819-821** ***Goal: Decide if this is a good drilling target.*** a. Geological Indicators • Sand, well logs, petroleum system, geology • BGHSZ, gas occurrence b. Geophysical indicators • Seismic, amplitude anomalies • Well logs – resistivity	WesternGeco?
12:55	**IX. Next Steps** Conference call - drill holes for other sites Write-up for AC818 Other	Debbie Hutchinson

JIP/DOE Site Survey Conference Call - Summary

16 August 2007

prepared by D. Hutchinson, 20 August, 2007

Participating:

Niranjan Banik, Ray Boswell, Timothy Collett, Ann Cook, Brandon Dugan, Matt Frye, Jesse Hunt, Debbie Hutchinson, Emrys Jones, Toms Latham, Dan McConnell, Kelly Rose, Carolyn Ruppel, William Shedd, Dianna Shelander, Warren Wood,

I. AC818

Summary:

This site is a high priority for drilling because of the existence of a well (AC818 #1) in which a high resistivity anomaly exists in an Oligocene sand unit above the inferred base of hydrate stability (i.e., a 50' interval that is interpreted to contain high saturations of gas hydrate in sand, just above the base of hydrate stability). The gas-hydrate-bearing section is the top of a 300' thick Frio sand. The sand beneath the hydrate at the well site is interpreted to perhaps contain low saturations of gas. Tom Latham (mapping geology and seismic anomalies) and Dianna Shelander (mapping gas hydrate saturations from seismic inversion) are both in general agreement about the location of gas hydrate around the drill hole – associated with a NE-SW trending anticline. Tom Latham interprets the crest of the anticline to be formed by an unconformity separating the Oligocene sand from younger Plio-Pleistocene shales; Dianna Shelander interprets an unconformity higher in the section, probably within Plio-Pleistocene shales. The inferred largest concentrations of gas hydrate are to the northeast of AC818 #1.

NRL provided information from their site survey piston-coring and heat-flow cruise to AC818. The primary result is lateral consistency in thermal gradients and pore-water chemistry, except where punctuated by more focused advection along the SSW-NNE trending anticline referred to above. NRL did not sample the deep, hydrate-laden formation directly. The preliminary conclusion is that the laterally extensive and continuous bottom simulating reflection (BSR) at a depth consistent with measured thermal gradients, combined with the relatively consistent depth to the sulfate-methane transition (~7 – 10 m) suggests that the flux of fluids responsible for methane hydrate emplacement is largely diffuse, and is only mildly focused along the apex of the anticline. One of the implications of this is that the consistent diffuse flux should result in more laterally continuous gas hydrate accumulations in the area, although important outstanding questions are the thickness and lateral extent of sand penetrated by the AC818 well.

Drilling targets (see Figure 1):

- Three sites for maximum hydrate concentrations (peak over trough signature), T. Latham, slide 11 of ppt. Comments: This peak in hydrate concentration needs to be related to thickness of the Frio sand to further refine targets.
- Three sites for thin or no hydrate, but underlying gas (strong trough without overlying peak), T. Latham, slide 12 of ppt. Comments: This interpretation needs to be related to the thickness of the Frio sand to see the extent that changes in the thickness of the sand versus changes in hydrate concentration control the seismic signature. These other sites might also be used to enable delineation of the extent of the deposit.
- Control site, for full thickness of Frio sand body outside of region of underlying gas (well off structure), T. Latham, slide 13 of ppt.
- Anomaly “n,” along strike to SW of AC818. Comment: probably a lower priority until better characterized.
- Anomaly “a” along strike to NE of AC818, targeting specifically the orange/red anomaly in the southwest corner. Comment: probably a lower priority until better characterized.

Action Items:

1. Consensus on drilling targets northeast of AC818 #1 for highest saturations of hydrate. Reconcile Latham and Shelander interpretations. Cross check location of Oligocene/Plio-Plestocene unconformity and base of hydrate stability zone. Are differences in Shelander/Latham maps because of seismic processing, migration, etc?	Tom Latham and Dianna Shelander
2. Better definition and justification of drilling target for anomaly n (where is sand? where is base of gh stability? thickness of hydrate?)	Dianna Shelander
3. Better definition and justification of drilling target for saturation anomaly at southwest part of anomaly a (where is sand? where is base of gh stability? thickness of hydrate?)	Dianna Shelander
4. Other targets around anomalies c and f to map extent of hydrate deposit:	Unassigned
5. Identify whether younger (Oligocene? Plio-Pleistocene?) sands exist above base of hydrate stability in western part of AC818. This will be very difficult as the seismic seems clear that the objective section to the west is not present in the #1 well and not penetrated for miles around.	Matt Frye, Bill Shedd, Jess Hunt

II. AC857

Summary:

This site is back under consideration after being dismissed because of lack of hydrate in the AC857 #5 well. Apparently the AC857 #5 well was a geotechnical well drilled to show no hazards, and therefore did not specifically target gas hydrate. This differs from other knowledge in which we were told that the #5 tested for hydrates, i.e., it was logged for hydrate, with nothing during the drilling or on the logs indicating the presence of hydrate.

According to the WesternGeco analysis, the best potential for hydrate is in the southwest quadrant of AC857, away from the AC857 #5 well. There are two issues that continue to be outstanding with this site: (a) are there good sands in the section within the hydrate stability zone? and (b) do the seismic data give good evidence for hydrate? The inversion results from WG show promising hydrate saturation anomalies, but the inversions contain uncertainty because of lack of logs for good calibration. Perhaps we need to see a display running from the #5 well to the WG amplitudes in the SW corner so we can see what the #5 was testing in relation to the proposed test targets. Analysis of the other wells (#1-#4 is also needed).

Drilling Targets (Figure 2):

These are identified as the anomalies to the southwest of the AC857 #5 well. Specific targets were not presented.

Action Items:

1.	Circulate Shell report to MMS on AC857 #5 to the site selection group.	Bill Shedd
2.	Detailed analysis of section above base of hydrate stability and below the unconformity that truncates the top of Oligocene to identify sands.	Matt Frye, Bill Shedd, and Jess Hunt.
3.	Analysis of #1 - #4 well logs, if available, with detailed correlation to seismics.	Kelly Rose, MMS, and WG

III. GC955

Summary:

This site is extremely attractive because of the penetration of levee sands in the GC955 well, above inferred base of gas hydrate stability. There is a small resistivity anomaly in the logging data, although it was off structure (i.e., away from hydrate occurrence) or it may be an effect of the change in casing. Statoil conducted surveys around this block and the results are shown in the paper by Heggland (2004), showing gas chimneys and faults. Hence this site appears to have the lithology, structure, and gas source necessary for formation of high saturations of gas hydrate. It also has anomalous peak amplitudes within the closure and conforming with the closure as per Dan McConnell. This site still needs work to map the sands and the base of gas hydrate stability, although it would appear in general that there are enough sands shallow in the section to be well above the uncertainties in the depth to the base of hydrate stability.

Drilling targets:

None specifically identified.

Action Items:

1. Develop contract for Dan McConnell to work on seismic data to do mapping	Matt Frye/MMS
2. Check whether Chevron has spec data that Dan could work on.	Tom Latham

IV. MMS Assessment Results

Summary:

This discussion involved a discussion of how the MMS assessment results might best be used in site selection for the DOE/JIP project. The two choices here are (a) using the MMS analysis, database, and personnel to refine the sites already selected for drilling, and (b) exploring for new prospects to drill. After hearing about the MMS model results for the most likely areas to have high saturations of hydrate, the consensus of the group seemed to be that the limited time and resources available would be best spent refining the sites already selected for drilling, i.e., looking in detail at proposed sites AC818, AC857, and GC955. There was also discussion of whether any of the existing sites would provide a validation (test or calibration) of the assessment model (GC955 might).

Action Items:

1.	Contact Art Johnson about the gas sand site he had identified for its location (and have him contact Emrys).	Warren Wood
2.	Develop a strategy for working on the proposed sites.	Matt Frye, Bill Shedd, and Jess Hunt.
3.	Consider what sites will best validate/calibrate the MMS assessment model	Matt Frye/MMS

III. Other Sites

Summary: Discussion on these sites deferred until next conference call.

Preliminary Agenda

DOE/JIP Site Selection Working Group Conference Call

23 August 2007

11:00	**I. General Update**	Debbie Hutchinson
11:05 (20 min)	**II. AC818** ***Goal: Define Drilling Targets (6-10 holes)*** a. AC818 • *Update on Chevron/WG merged interpretation* Primarily, discuss relationship between seismic anomalies mapped by Tom and inversion results from WG. Does this modify drilling targets? • *Drilling targets to identify extent of hydrate deposit?* • Develop site and hole write-ups b. New information on AC819-821??	Tom Latham Dianna Shelander
11:25 (15 min)	**III. AC857** ***Goal: Are we on again or off again with this site?*** *Bill Shedd Comments*: I found out that the report Mike Smith gave me about the #5 well is confidential until April of next year, so I can't distribute it. If Chevron was a partner, can they distribute it? One question about last week's discussion of this well - didn't Tom mention that Shell circulated glycol to try to get any hydrate to flow? Our database does not refer to any test of that kind. The well was drilled riserless and the deepest casing was set ~9100 feet. An MDT test was run, but I'm not aware that glycol could have been circulated that way or without casing or riser. Any thoughts?	Kelly Rose and Group Discussion
11:40 (30 min)	**IV. GC955** ***Goal: Can we identify drilling targets?*** a. Any work done on this since last week? What needs to be done? • Discuss likely drilling targets.	Jess Hunt/Bill Shedd Dan McConnell
12:10 (15 min)	**V. Walker Ridge 269 (Terrebonne Basin)** ***Goal: Decide if this is a good drilling target.*** *Bill Shedd comments:* WR269 is interesting (good BSR's, good sand in the area from a well one block to the south, and active seepage confirmed by ALVIN/JASON this year and last), but with it's negatives (the well has a thick (~860 ft) sand above the BSR with only a hint of resistivity - 1.6-1.8	Dan McConnell/Bill Shedd

ohms – in the bottom 50 feet). The BSR drapes over a turtle (inverted) structure, implying good sand in the prospective section.

- What needs to be done to define drilling targets?

12:25 (15 min) — **VI. Walker Ridge 144 (Choctaw Basin)** — Bill Shedd/Jess Hunt

Goal: Decide if this is a good drilling target.

Bill Shedd comments: WR144 is in an area of little well control (closest well is the one close to WR269, 38 km away), so I have less confidence in my sand
interp. The BSR is excellent and extends well out into the minibasin, so if there is good sand in the area, we should be OK. Thinning of the section onto the adjacent salt high occurs very close to salt and does
not affect the section where the BSR is prominent. A series of radial faults terminate within the HSZ and could act as conduits (the BSR crosses the faults without being displaced).

- Is it worth going forward with this site without well control nearby?

12:40 (15 min) — **VII. MC373/374** — Bill Shedd

Goal: Decide if this is a good drilling target.

Bill Shedd comments: I've looked at our survey (Western data) that covers this area - an old 1988 survey, not the best data, but good enough to do an evaluation. I see Art's play - a very bright negative amplitude dipping to the northwest that terminates abruptly near the north-south boundary of MC 373 and 374. There is no discernible BSR associated with the termination of the amplitude. The area should have decent sand since it is along depositional strike with a well in the block to the north with ~22% sand in the shallow section. The concern I have with this prospect is it's depth - it is ~480m below mudline and I estimate the BHSZ is ~354m (using Maekawa et al, 1995, algorithm, a modification of the 1992 algorithm from the DSDP from the ODP/JOIDES safety manual - assuming a seafloor temp of 5 degree C and geothermal gradient of .025 degree C/m). If the two depths were closer and it had a good BSR I might feel better about this area.

- Is it worth going forward with this site without well control nearby?

12:55 — **IX. Next Steps** — Debbie Hutchinson

Next Conference call
Assignments? Other?

JIP/DOE Site Survey Conference Call - Summary

23 August 2007

D. Hutchinson, 07 September, 2007

Participating:

Niranjan Banik, Timothy Collett, Ann Cook, Matt Frye, Jesse Hunt, Debbie Hutchinson, Emrys Jones, Tom Latham, Dan McConnell, Kelly Rose, Carolyn Ruppel, William Shedd, Dianna Shelander, Warren Wood

I. AC818

Summary:

Dianna Shelander and Tom Latham integrated their respective interpretations of the geology and geophysics of the potential hydrate deposit at site 818 and proposed 8 drilling targets that provide information that tests their models of hydrate occurrence (Table 1, Figure 1).

Table 1: Summary of AC818 proposed drilling locations.

Hole	Inline	Crossline	Thickness (m)	Sgh (%)	Objective
1	1035	13754	11	95	Maximum saturation and best location for high peak over trough anomaly in Frio sand
2	1022	13768	14	91	Similar to site 1, thicker section and slightly lower gh saturation
3	1001	13782	10	91	Along strike of anticline with slightly different amplitudes and saturations, in Frio sand
4	1001	13790	10	87	Similar to 3, but has slightly higher amplitudes that could be gh in a second layer (Pleistocene?) or an effect of tuning at the unconformity
5	1041	13720		20/40	Control location for properties of Frio reservoir below hydrate in fizz gas zone
6	1013	13686	30	35	Complete section of Frio sand (not eroded), possible gh anomaly above Frio in Pleistocene unit that was not sampled (i.e., pinches out towards) AC818
7	1055	13683	28	43	Gas hydrate in Pleistocene above Oligocene unconformity but unconformity is steeply dipping, may be Miocene present, (nb at edge of charge region)
8	939	13828	18	53	Pleistocene gas hydrate deposit, above Frio, strong peak at top of anomaly.

The consensus of the group was that these are well defined targets that test both the inversion analysis done by WesternGeco and the seismic amplitude analysis done by Chevron. The only substantive recommendation was to consider drilling a duplicate hole near hole 1 to test for small scale lateral continuity of the deposit and have confidence in extrapolating information away from the hole (recommendation from T. Collett).

Action Items:

1.	Clean up details of holes (correct lease block numbers etc.)	Tom Latham and Dianna Shelander
2.	Draft document giving justifications and objectives of each hole proposed.	Dianna Shelander, to be circulated to the group.

II. AC857

Summary:

After considerable confusion about whether the drilling results from this site make for a compelling target, the group felt that it would be best to let the MMS group (Eric Hawkins, Bill Shedd, etc.) complete their analysis of the correlation between AC818 and AC857 and work with WesternGeco (Dianna Shelander) to resolve the interpretation of whether the Miocene Big Mac formation was above or below the base of the hydrate stability zone.

Action Items:

1.	MMS to continue correlation of stratigraphy between AC818 and AC857	Bill Shedd, Eric Hawkins
2.	MMS and WG to resolve discrepancy in depth to Big Mac relative to the base of hydrate stability	Bill Shedd, and Dianna Shelander
3.	Comparison of amplitudes at #5 well with those to the southwest (where hydrate appears to be most concentrated), and complete integrated log/seismic study.	Recommended by Ray Boswell post-meeting.

III. GC955

Summary:

This site satisfies one of the major objectives of drilling gas hydrate, to test the model used in the MMS assessment. It combines elements of direct detection (yet to be done) with integration of seismic interpretations of lithology. It is therefore an attractive target for gas hydrate drilling and needs to have the analysis completed for choosing drilling targets. Dan McConnell is willing to do this pending approval of his contract with either JIP or MMS to gain access to the data. This should be resolved within the next few days. MMS will not work further on these data unless Dan cannot get access to them. Decision about completing an inversion analysis of the data at this site will be deferred until the drilling targets and their objectives are completed.

Action Items:

1.	Finalize contract for Dan McConnell and let rest of group know status.	Emrys Jones
2.	Complete analysis and suggest drilling targets.	Dan McConnell
3.	Report back to group with drilling targets at next conference call.	Dan McConnell

IV. Walker Ridge

Summary:

Because the closest drill hole data to WR 144 is the hole near WR269, because the analysis of WR269 is more complete than at WR144, and because WR144 is less complete in its analysis compared to WR269, site WR144 was abandoned in favor of site WR269. The strength of this site is the sand channel that runs through the minibasin and appears to intersect the base of the hydrate stability zone. This site satisfies both JIP objectives of drilling a sand-bearing hydrate and testing the MMS assessment model. The target is hydrate in the sand that lies directly above base of hydrate stability. MMS has begun analysis of this site, and will continue to characterize the basin and contained hydrate, recognizing the detailed work done already by Dan McConnell. Dan will be included to the extent that contracts can be worked out (similar to GC955).

Action Items:

1.	MMS to continue characterizing the basin around WR269	Bill Shedd
2.	Check for permit number of WG data around WR269	Dianna Shelander
3.	Discuss in detail at the next meeting.	TBD

V. Other Sites

Summary:

Because the three sites AC818, GC955, and WR269 appear to be strong candidates for gas hydrate drilling with reasonably mature (although at differing levels of) analysis, the group felt that consideration of other sites would be done by a proponent who would prepare a summary (either document, ppt or other means) to provide the justification for considering the site. This will probably be done for MC118.

VI. Other

- Next conference call will be Monday, 10 September, 11:00 – 1:00 EDT
- Need to decide via email whether we need 2 face to face meetings (one at MMS to review data; one with the JIP after finalizing drilling targets).
- Need to schedule conference call with JIP for an update

Preliminary Agenda
DOE/JIP Site Selection Working Group Conference Call
10 September 2007

11:00	**I. General Update**	Debbie Hutchinson
11:05	**II. AC818 Update**	Tom Latham
(10 min)	***Goal: Define Drilling Targets (6-10 holes)***	Dianna Shelander
	a. Update on write up (Tom/Dianna)	
	b. Need for more holes?? (Ray Boswell)	
11:15	**III. Walker Ridge 269 (Terrebonne Basin)**	Bill Shedd
(20 min)	***Goal: Decide if this is a good drilling target.***	
	Presentation on latest interpretation	
	Bill's comments: "I have done extensive mapping around WR 269/270 and concluded it is a very interesting site and should stay on the A-list. I mapped on 3 sand intervals from the WR 313 well and isochroned the intervals between them to study growth history - there's minimal thinning coming up structure (late salt uplift), thus a good chance of sand above the BSR (it's very large and well developed over much of the area)."	
11:35	**IV. GC955**	Dan McConnell
(30 min)	Update on drilling targets	
	Presentation	
12:05	**V. AC857**	Bill Shedd
(10 min)	Update from Bill Shedd on whether to proceed. *Bill's comments:* "We've done some correlating at AC 857 from AC818 and looked at the position of the elevated resistivities zones in the wells relative to the BSR and conclude that the so-called Big Mac section is probably free gas just below the BHS - there's not much sand above, so the probability of finding hydrate in sand isn't too good. We'll talk more about it on Monday."	
12:15	**VI. MC118**	Jess Hunt
(25 min)	Update from Jess Hunt.	
	Discussion of what is new to consider this now.	
12:40	**VII. Other sites**	Bill Shedd
(10 min)	Consensus on not doing any more work on MC373/374 and WR144	
12:50	**VII. Next Steps/Logistics**	Debbie Hutchinson
	Next Conference call, assignments, Call with JIP, Face to face meeting (scheduling)	

JIP/DOE Site Survey Conference Call - Summary

10 September 2007

D. Hutchinson, 24 September, 2007

Participating:
Timothy Collett, Myung Lee, Matt Frye, Jesse Hunt, Brandon Dugan, Debbie Hutchinson, Emrys Jones, Dan McConnell, Ray Boswell, Kelly Rose, Carolyn Ruppel, William Shedd, Dianna Shelander, Warren Wood, Brenda Monsalve

I. AC818

AC818 is very close to being complete for identifying and documenting drilling targets. Dianna Shelander showed the group her spread sheet summary of the wells and a Word file for one of the sites giving details about the drilling targets. Some of the thicknesses and depths have uncertainties because of uncertainties in estimated or assumed velocities. Three additional sites were proposed: two between sites 3-4 and site 8, to show the extent of the hydrate deposit, and a third approximately 10 m from site 1 to test for small scale heterogeneity of the deposit.

Action Items:

1. Updated text in Word templates for sites 1-8.	Debbie Hutchinson with Tom Latham and Dianna Shelander
2. Check depths with check shot information from AC818.	Bill Shedd and Jess Hunt
3. Identify source of and uncertainties in velocities used in depth and thickness information	Dianna Shelander??
4. Add additional locations throughout the site area, including southern extent of hydrate deposit and testing predictions of lower gas-hydrate saturations.	Dianna Shelander
5. Add drilling target location ~10 m from site 1 to test for small scale heterogeneity of hydrate saturations	Dianna Shelander

II. GC955

Dan McConnell showed the perspective and visualization slides he prepared for GC955, pointing out faults, thickness of the gas hydrate anomaly zone, and other geologic features of the area (mud volcano, gas zone, land slides, incipient seep features etc.). Well logs need reanalysis to understand the quality of the log and whether the lack of large resistivity anomaly is due to the quality of the log or the absence of resistive materials. Discussions covered whether this site was ready for full inversion analysis similar to AC818.

Action Items:

1. Continue analysis and interpretation of GC955	Dan McConnell
2. Check quality of log information	Bill Shedd and Jess Hunt

III. WR269/270

Bill Shedd presented slices across WR269/270 showing mud volcanoes, faults, BSR, deep salt, and interpreted sand units. The well through the area shows sand units although there is some question as to where the casing was set (just before the base of the gas-hydrate stability zone??). This site was recently dove on by Alvin and is shown in the August, 2007 EOS article by Harry Roberts and others.

Action Items:

1. Need to integrate Dan McConnell and Bill Shedd interpretation	Dan McConnell and Bill Shedd

IV. MC118

Jess Hunt showed UMiss summaries and data from across MC118 illustrating the BSR at ~250 m depth, the active craters and seeps, and the similarities that this site shares with many of the minibasin sites that the MMS assessment covers (i.e., it is a good test of the MMS assessment). The well information showing the existence of sands around MC118 is new evidence compared to the analysis done in September, 2006, and is the reason for bringing this site back into consideration for drilling.

Action Items:

1. Need to generate maps showing locations of hydrate anomalies so that drilling targets can be picked.	Jess Hunt and Bill Shedd

V. Other Information

No conference call week of 17 September because of DOE review in Golden, CO.
Participants in the DOE review will try to meet in Golden to discuss site selection issues.
Next conference call is scheduled for Monday, 24 September, 11:00 – 1:00 EDT. This may conflict with SEG, but we will proceed as best we can.
Emrys Jones is unavailable for next conference call due to other commitments.
Still need overview of GC160/161.

Chevron Gas Hydrates JIP Site Selection Informal Meeting
Golden, Colorado, 19 September, 2007

Participants: *Ray Boswell, Rick Baker (DOE), Tim Collett, Emrys Jones, Dan McConnell, Kelly Rose, Carolyn Ruppel*

These notes were formalized by Carolyn Ruppel (USGS) based on a real-time record of our meeting. Deborah Hutchinson, the USGS head of the site selection group, was not present at the Golden CO DOE review panel. Ruppel assumes responsibility for any inaccuracies herein.

Overview of Meeting Goals and Context

Several members of the JIP site selection group met while in Golden, CO during the DOE NETL Methane Hydrates program review. The tasks for the meeting were set in advance by Deborah Hutchinson, who was unable to attend:

1. Review new information, particularly GC955 analyses completed by McConnell
2. Discuss categorization of sites
   A. Top group
   B. Potentially viable, but requires more investigation
   C. No further consideration
3. Within Groups A and B, prioritize sites for forwarding to JIP
4. Any additional business

The following notes do not represent the lengthy discussion of logistics and related matters that occurred during the meeting, but do reflect the components of the discussion directly relevant to the site selection tasks outlined above.

Agenda Item 1: Review new information

a. GC955

The group first reviewed new information from Dan McConnell, who has been working up seismic data at GC955 (~6000 ft water depth) to further define the potential hydrates play. The primary hydrates targets are within a sand unit in a 4-way closure although the sand channel thalweg is not directly over the closure. A well in this area penetrates the inferred sand unit, and the logs can only be reasonably interpreted as a sand-rich lithology. The total play covers about a quarter of the block. In stepping through the seismic data, a BSR is visible on some lines, but not all. Seismic signatures are dominated by the gas, with no clear signal associated with possible hydrate charge. Faults are present throughout the deep section and cut into the gas-charged strata at depth, providing confidence that there are both sources of and pathways for charge. McConnell has informally noted 4 or more places that would be good targets for drilling within the play, including one wedge of sand located between the BSR/free gas signature and an overlying seal and characterized by anomalously high amplitude internal reflections.

McConnell has previously completed hazards analyses in this area. Anecdotal information from an operator who has drilled there indicates that there were problems with borehole stability, possibly due to a less than adequate well plan. The site selection group informally discussed the potential for Phase III JIP drilling to also encounter borehole instability. While our site selection group is in no position to make a formal hazards determination from a technical perspective, we believed that the borehole instability issues actually were a good sign from the standpoint of possibly encountering the desired target lithologies and could probably be circumvented through design of an appropriate well plan.

Additional note: McConnell roughly estimates thermal gradient of 32°C/km in this area.

b. Review of GC160/161

GC160/161 is a site put forth by the JIP members in response to Emrys Jones' request for additional nominations of potential Phase III drilling sites. This site has not yet been fully reviewed during the site selection web/audio conferences held over the past 2 months. We therefore took the opportunity in Golden to discuss the slides Emrys circulated for this site several weeks ago. One motivation for this site's having been proposed by a JIP member was the thought that drilling there might constitute a good test for the MMS assessment.

GC160/161 is north of the Sigsbee Escarpment in 3000-4000 ft of water and the near several major developed fields, including Typhoon and Popeye. There are mud volcanoes in the immediate area and potentially some issues with gas hazards. The site is close to the area of the 4C-OBC work being conducted by Bob Hardage and colleagues. One factor that led to this site's identification for evaluation by the site selection group is the inferred presence of channel sands intersecting the hydrate stability zone. Shallow water flows nearby have at times been interpreted as possibly linked to gas hydrate dissociation. Nonetheless, there are no wells intersecting the presumed sand unit, which does not have a clearcut channel morphology in any case. There is even a remote chance that the fill in the channel-like feature could be finer-grained clastics (e.g., mudflows). Another important point that emerged from the discussion was that the structural characteristics at some of the other sites being considered for Phase III drilling mean that the target sands are coming up into the hydrate stability zone, instead of diving out of the stability zone as they do at GC160.

c. Update on status of WR269/270

Dan McConnell, who has previously conducted extensive analyses of this area, has been working with Bill Shedd to help the MMS identify the channel sands intersecting the stability zone in this area. McConnell noted that the promising features he has previously seen at WR269/270 really can't be anything other than channel sands and that these are structurally coming up into the hydrate stability zone, as they are also at GC955. The entire site selection committee has earlier seen an extensive MMS presentation on WR, in addition to hearing comments from McConnell and others with experience in that area.

Agenda Item 2: Categorization of Sites

During this part of the discussion, we reviewed each site on the basis of its own (not relative) merits and determined whether we would recommend placing it in Category A, B, or C. As a reminder, the categorization scheme is:

A. Top group: Mature site(s), clear targets for Phase III drilling objectives, and already thoroughly investigated geophysically and geologically **B.** Potentially viable sites, but require more investigation to mature the scientific data sets, interpretations, and arguments and/or to identify individual drilling targets **C.** No further consideration.

The following sites were considered in the discussion:

Alaminos Canyon: AC818, AC857
Green Canyon: GC160, GC955
Mississippi Canyon: MC118, MC373
Walker Ridge: WR144, WR270

When only one lease block number is given above, it is assumed that we are considering the plays that have been discussed since July 2007 and that may be in adjacent lease blocks (e.g., MC373/374, WR269/270, GC160/161)..

Because the site selection group that met in Golden included the Chevron JIP program manager, the DOE program managers, and the federal agency that has taken the leadership role on the site selection group (USGS), we felt it worthwhile to complete this categorization and come up with the following consensus agreements/recommendations for discussion by the entire site selection group during the 24 September, 2007 conference call.

At the outset, we confirmed the following recommendations previously discussed by the site selection group:

MC373/374: Category C
WR144: Category C
AC857: Category C

MC118: Category C
There was then considerable discussion of MC118. MC118 had been formally proposed to the site selection group by MMS personnel and is the focus of the long-running University of Mississippi Consortium effort. In the course of preparing for and participating in the DOE review meeting, all members of the site selection group that met in Golden had had an opportunity to learn more about MC118. It is the unanimous recommendation of the subgroup that met in Golden that MC118 should be assigned Category C. This recommendation is based on the following:

- There is currently no evidence for deeper gas hydrates at this site.

- The high-quality geophysical data required to support the type of independent assessment of the site like that underway for/completed at other sites is lacking.
- The geologic information and interpretation to characterize the site to the extent of other sites already in Categories A or B are lacking.
- Drilling into a hydrate-associated cold seep is not judged to be consistent with the goals of Phase III of the JIP or DOE's objectives in assessing marine hydrate resources.

Note on Category C Sites: It was the consensus of the group and is our recommendation that no further effort be expended to attempt to bring Category C sites up into Categories B or A. This was based on our judgment that all of the Category B sites have intrinsic value or some potential promise and that the sites that remain in Categories A and B combined are sufficient to go forward to the JIP members. We also make this recommendation based on the tight timeline for finalizing our recommendations.

GC160, GC955, WR270: Category B

Based on discussions documented in the earlier parts of these notes, we unanimously recommend assigning these sites to Category B. All of these sites have geologic evidence and sometimes even log evidence for the occurrence of sands within the hydrate stability zone and geophysical data consistent with gas below the hydrate stability zone (source of charge) and pathways for migration of gas into the stability zone.

AC818: Category A

Based on information currently in hand, we unanimously recommend that only AC818 be placed in Category A at present. Of the sites we have considered, AC818 is the only one for which enough high-quality data and robust geophysical and geological analyses are currently available to merit a Category A designation.

Agenda Item 3: Prioritization of Sites within Category B

Only Category B contains multiple sites that could potentially be carried forward for consideration by the JIP. By unanimous consensus, we recommend that the prioritization of sites within Category B, based on currently available information, be:

1. GC955
2. WR269.270
3. GC160/161

SUMMARY OF SITE CATEGORIZATION AND PRIORITIES RECOMMENDATIONS

Category A: AC818
Category B (Ordered list from top to lowest priority): GC955, WR269/270, GC160/161
Category C (No further consideration, alphabetical list): AC857, MC118, MC373, WR144

Agenda Item 4: Other Business

Emrys Jones reported that he has identified several potential platforms for the LWD cruise that will start the Phase III field-based research. The target timeframe for LWD expedition is spring 2008, between the end of winter storm season and the onset of hurricane season. LWD holes will most likely be done in groups of 3 due to logistical limitations (e.g., battery life). Emrys is working closely with DOE to address issues related to obtaining DOE funding and contracting a vessel.

Issues related to the required additional analyses for the Category B sites were discussed.

Permitting issues related to the 2005 drilling and anticipated Phase III drilling were discussed, including potential timeframes for NEPA and MMS approvals.

Dan McConnell believes he can come up with some potential specific drilling sites at GC955 in relatively short order. This should be keyed as an action item coming out of our 24 September call.

Preliminary Agenda

DOE/JIP Site Selection Working Group Conference Call

24 September 2007

11:00	**I. General Update**	Debbie Hutchinson
11:05 (30 min)	**II. Review/Discussion of Golden Mtg Summary** *Goal: Consensus on Recommendations in C. Ruppel email of 9/21/2007* Category A: *Mature site, Drilling Priority* AC818 Category B: *Viable, needs more work* GC955 WR270 GC160 Category C: *No further consideration* MC373/374: not enough characterization done WR144: WR 270 is better constrained site of the two minibasin sites. AC857: No deep sand identified MC118: Convincing evidence for deep hydrate is weak, seep site not a priority for JIP/DOE objectives	Carolyn Ruppel
11:35 (20 min)	**III. GC955** *Goal: Progress on identifying drilling targets*	Dan McConnell
11:55 (30 min)	**IV. Walker Ridge 270** *Goals:* *(a) Progress on identifying drilling targets?* *(b) Aspects of site that fulfill MMS desire to test assessment methodology.*	Bill Shedd
12:25 (30 min)	**VI. GC160** *Goals:* *(a) Should this site be considered further?* *(b) Concrete evidence for deeper hydrate – wells?*	Dan McConnell
12:55 (10 min)	**VII. AC818** *How much work is needed to finalize documentation?*	Debbie Hutchinson/Dianna Shelander
1:05 (10 min)	**VII. Next Steps/Logistics** Next Conference call, assignments, Face to face meeting (scheduling)	Debbie Hutchinson

Site Selection Conference Call

24 September 2007

Participants:

Debbie Hutchinson
Carolyn Ruppel
Brandon Dugan
Dianna Shelander
Kelly Rose
Matt Frye
Tim Collett
Warren Wood
Bill Shedd
Dan McConnell

Note: A number of members of the Site Selection Group were unable to attend because of the SEG meeting.

Agenda Item I. General Update

Debbie provided overview of this meeting and discussed 19 October meeting in Houston with JIP Executive Board.

Agenda Item II. Recommendations of Golden meeting

(Defer Category B sites to Agenda items III-VI).

Category A—AC818: Yes, there is consensus that this is a mature site, drilling priority.

Category C--AC857: Problem here according to MMS is that sand is deeper than BGHZ.

Category C--MC118: Several intervals mapped by MMS. No structural closure in any of the mapping horizons. Sand in the area (e.g., MC119). Some type of closure directly under seep site, but that is a no-drill area anyway. Outside of that, there is a nose, some flattening, from a petroleum systems standpoint this is not a reasonable area. No indication of a good BSR. Gassy 1 horizon that is gassy from place to place that might be BGHZ or free gas, but no real indicator that we should be seeing any hydrate. Several hundred feet of sand at top of log in MC119 (starts deep in section) does not cross above the base of the stability zone and no indication from the log that there is any hydrate or even hydrocarbon to speak of. MC119 log is about 5 miles from the target drill location. Very little change between MC119 and MC118 that would make one believe that the sand present in MC119 log is not present in MC118. Only the seep provides indication of hydrocarbons there, a bypass in a reservoir dynamics sense.

Agenda Item III. GC 955

Category B—GC955 (Led by Dan McConnell):

In the last two weeks, McConnell has only done a little in identifying drilling targets. He noted 3 or 4 distinct types of targets:

1. On crossline 3290, channel levee system with closure on both sides. Blue to cyan is peak, and yellow is the extreme trough. BSR cut through this section. No particular reflector to identify with hydrate. This channel levee system is fractured and faulted from the salt underneath. This is not exactly on the crest of the regional closure.

2. Another type of play is directly underneath the channel, high amplitude peak-dominant wedge over a BSR-like feature. Stratigraphically, underneath the thalweg on the eastern side. Fluid moved into the closure from the mound and seaboard of that.

3. Also another type of play directly over the 4-way closure where much of the gas is focused. There are a couple of good potential drilling targets here. More than 500 total feet of sand here, and the reservoir is very fractured reservoir (pathways for gas). Note that the section may be more sandy away from the center of the channel levee system than right over it. The seismic data have a leading trough and peak pair, with peak-dominated targets. Some versions of these data look different from the Chevron version. Believes these features reflect hydrate phenomena. Not that concerned that there is no strong amplitude above the BSR associated with the hydrate charge. (Crossline 3077)

4. Crossline 3120: Here there may be more direct gas hydrate indicators, with a dominant peak and a flat reflector that seems to imply fluid flow. Approaching the 4-way closure but also a site closer to the thalweg, where there is some amplitude anomaly. Bill Shedd ran the blue reflector above the base of the stability line through to the well, and it came very close to the water-wet sand interface, perhaps at the base of a hydrate-bearing sand. Bill Shedd says this is clearly a fining upward sequence as would be expected. Resistivity goes as high as 2 ohms directly at base of sand to 0.25 ohms beneath the sand.

What are the direct indicators for the presence of hydrate? To avoid drilling over a seismic feature indicating gas and just finding fine-grained material devoid of hydrate, find sands. Now that they've drilled the area, we know it is sand, and we were already aware that there is gas in the area and a means to migrate the gas into the sand. We can only go on the fact that the channel levee system is sandy, that there are BSR like features, and that there is gas there that can migrate up the faults. Sand intersects BSR in some places according to Dan, but Bill Shedd says that the sand is entirely within the stability zone.

Tim's comments are based on Indian experience and drilling very bright reflectors that ended up being related to complex channel systems. He points out that it is important to remember to use caution in interpreting these systems and what we base our inferences on.

Geometry of this system and BSR migration through the sand section are reasonable arguments for these being hydrate features, so this is not as robust a site as AC818, but still very good.

Action Item: Dan McConnell will come up with 6-9 or so locations as a start, then we could always winnow down to fewer. Mapview with locations, potential coordinates and reasons for targets, depth-converted information, and some supporting data (e.g., tielines). Should have an update ready in about a week and then won't take much longer after that to finalize. Dianna will go to AOA on Friday of this week, and Bill Shedd will forward to Dan his suggestions.

Agenda Item IV. WR269/270

Category B—WR269/270 (Led by Bill Shedd, who has been working with McConnell)

WR313 well #1 in the area, Bill Shedd hasn't come up with exact drilling targets, but gave an overview.

This area has been investigated quite a bit based on seafloor bathymetry and amplitude and has large carbonate mounds and also mud volcanoes. Alvin and Jason have both been down on these sites. Active flux in really discrete locations, but the drilling would be outside of those areas. On the NESW traverse B-B', the well is off to the SW of the surface high. 850 ft section of sand in the well, and there is a faint BSR below the base of the sand (although no good expression of it right at the well). Base of the sand work is going on now. It has elevated resistivity. Sand is a fairly consistent 1 to 1.2 ohms and probably has low hydrate saturation. However, there seems to be good charge deeper down based on sonic (3 ohms, real gas charge). BSR is very clear on the NE flank, seems to continue under a mud volcano visible on the surface. Sands mapped from the 313 well do not thin dramatically on flank of salt structure, which formed late (well after deposition). Sands have no structural reason for them not to be there. 6300 ft water depth. Based on the BSR, this is over 1000 m thick gas hydrate stability zone on the flank.   In some intervals, even see thickening coming up onto the structure. This part used to be the middle of the minibasin.   Thinning on the other side is not caused by truncation. Have lost the top of the sand units, not the base. Inverted structure. Good sand from 313 well runs up into GC area. Late salt movement and withdrawal and late vertical salt movement allowing the thick sed section to remain thick on top. Seafloor seep/volcano features very closely tied to the faults. In seismic lines, these features do not seem to be deeply rooted, rather fed more by lateral migration of gas along fault systems. On the north side, it seems to be a good area for ponding of sands derived from the north. BSR is shoaling upwards right at the crest of the feature. Would require thermogenic gas for this BSR to be so deep. Kerr McGee had thermogenic gas in the well. Some percent of ethane (19.5 % tied all the discontinuous BSRs together in Dan's analysis). Gas charged sands define the BSR in some places (e.g., Dan's WR269 play). Unconformity trap on the west flank of the feature. Similar good sandy section up to the north and northeast. If the downdip limit of the gas-charged sands conform to structure, then there should be full-saturated hydrate sands above.

Compared to KC151, this location has the advantage of having a well and evidence for sand.

Dan asked how sandy this section is on the reflectors, not a big thick sandy section in his recollection. Bill believes the section between the yellow and dark green on his slides is 85% sand, then a section of lower sand percent (quite shaly), then increases again beneath that. Above the unconformity, rather shaly. Shale strings within the sand throughout.

Matt discussed looking at the area under the unconformity to see if that is a top-seal on the reservoir. Dan has previously done work here and can say that this reflector under the unconformity does switch polarity as it crosses the base of gas hydrate stability.

Looked at the well log Shedd marked up in terms of stratigraphic units and ties to seismics.

Action Item: Bill and Dan continue working together to identify channels and possibly getting closer to refining where the targets should be.

Agenda Item V. GC160/161
<u>Category B—GC160</u>: (McConnell takes the lead on this)

Dan had earlier done some work on this and thus knew the area a little. Main issues related to this prospect will be explored here.

3000 ft of water. Channel system (not as well developed as others). Shallow water flow issues.

Slide 2 in presentation: High amplitude extraction on channel body. Probably these data are not completely 0 phase. Leading trough over the strong peaks as the data are presently processed. 1000 ft below mudline to top of channel unit. Cartoon on this slide is just generic. Probably the channel feature is a mixture of sand and clay. Charge here comes from migration of fluids up the faults. Questions are whether the fluids do charge the channel and whether the channel is in the hydrate stability zone.

Skipped to slide 11: Mapped high amplitudes and then depth-converted. Figure out how close the high amplitudes are to the base of gas hydrate stability. Followed high amplitudes where he found them. Not as good as GC955, but is a pattern that the high amplitudes. Is there enough room within the stability zone for the sands? Generally these higher amplitudes dive down along the sand channel, not come up into the stability zone.

Now back to Slide 10: Nearest log is from GC205 with a sand at depth, but this is not the same sand that we see at GC160. No constraints on whether there is sand in the large channel at GC160.

Now to slide 9: At GC161 #1, had a gassy water flow at 3717 ft below seafloor. Probably there are sand and gas hydrate in this area. Drilled open hole and no problems at all. Only when they cemented it and changed temperature in the well, they had a gassy shallow water flow. Dan has seen films of these, and they show a lot of hydrate forming.

No clear indication of a BSR feature here. The high amplitudes do go deeper in the sandy faces, and they do cut a little deeper when they go into deeper water. But not clearcut whether these are hydrate related or not.

Chevron analysis talks about thermo vs biogenic gas hydrate. May be some hydrate over the deeper channel and then possibly some thermogenic hydrate near the channel at deeper levels.

This channel here is more of an infill, a bit mounded, but not the typical channel. There has been compaction around it. Dimensions and size of channel are about the same as some of the others we've looked at (e.g., GC955), but its origin/structure are different.

Going back to 955, one interpretation could be that this is a shale filled channel according to Bill, based on the reasoning outlined by Dan for composition of the channel at GC160, but Dan thinks the log at 955 is critical for showing there is a good bit of sand. At GC160, the channel fill is probably more mixed, yet the extent of the charge is very large. The charge might be lighting up silty (not sandy) layers. At GC955, no major flux through the system, but do have a fractured reservoir with gas migrating into zone and stopping.

Targets would be locations within the channel itself. If the channel is sandy, this will be a very heterogeneous hydrate reservoir.

Water depth gives us less room for error here because hydrate stability zone shouldn't be very thick here. Hydrate target is only a few hundred feet, and some of these high amplitudes may be gas.

No real concern about charging the sands…Seems to be enough charge. Compelling reasons to believe that there is charge. Active seeps mean that migration is very fresh. Drilling history of #1 well is pretty compelling as well.

Dan will not spend time on this site right now and will instead work on others.

We will spend time on GC955 and WR269/270 for now and defer all work on GC160 until we get guidance from Emrys.

Another site-- AC557: New site, gamma ray and resistivity, resistivity up to 5 ohm, gamma ray is highly suppressed, but think this is Oligocene and the suppression of gamma ray is probably not that significant and probably related to K-spar in that section. This was not on the highest list from MMS because they had 818 with full log suite nearby. We wouldn't learn as much there because this is merely a 2nd good site in Alaminos Canyon.

Dan finds the sites we have on the list now to be pretty compelling for the US GoMex for looking for gas hydrates.

Important to document why we aren't looking at other sites.

Agenda Item VI. AC818 (Dianna Shelander takes the lead)
Debbie and Dianna will work on filling in the chart for AC818in terms of potential sites.

Dianna has been looking at the compartmentalization of the hydrate region. AC819-Site 2 probably has the thickest/higher concentration of gas hydrate. May add some more sites to nail down the edge in anomaly C and anomaly F, particularly sites to the east/near the edge.

Trying to choose sites based on both high Shyd and high "integrated" analyses.

Extent of anomaly f and also testing lower saturations.

Don't feel limited as long as there is scientific justification for the sites that are chosen.

Action Item: Diana will define new sites.

Action Item: Uncertainties on velocities at 818--Bill was going to look at check shots and Dianna was going to review velocities as used for conversion. Remains an action item.

Agenda Item VII. Next Steps/Logistics

Next web meeting on 9 October, 11:00 – 1:00 EDT.

Preliminary Agenda

DOE/JIP Site Selection Working Group Conference Call

09 October 2007

1. Information on 19 October JIP site selection mtg in Houston (Emrys)

2. Overview of GC955 proposed drilling targets and justification (Dan McConnell), with an initial attempt at rough prioritization if we get far enough along (All).

3. Update on progress on WR269/270 (will not be ready to pick drilling targets by Tuesday; Matt Frye).

4. Discussion of need for a brief call to follow up on #2 and particularly #3 in early morning of 16 October (Carolyn)

5. AC818 new drilling targets (Dianna and Tom) and (if time) start of our group's rough prioritization of all the AC818 targets (all).

JIP Site Selection Web/Teleconference 9 October, 2007

Participants: Ray Boswell, Tim Collett, Brandon Dugan (partial), Rebecca Dufrene (MMS New Orleans), Matt Frye, Emrys Jones, Tom Latham, Dan McConnell, Carolyn Ruppel, Dianna Shelander, Warren Wood

(Notes from C. Ruppel. Please contact me with any changes)

Overview

The primary purpose of this meeting was to further advance the state of preparation for GC955 and WR sites. The planned agenda was:

1. Plans for the JIP Site Selection Committee meeting at WesternGeco on 19 October (Emrys Jones)
2. Preliminary target identification at GC955 (Dan McConnell)
3. Progress on Walker Ridge sites (Matt Frye)
4. Plan for web/teleconference on afternoon of 17 October
5. Discussion of AC818 sites (Dianna Shelander)

#1: JIP Site Selection Meeting on 19 October (Emrys Jones)

The meeting to report the outcome of the site selection process will be held at WesternGeco's headquarters in Houston starting at 9 a.m. on 19 October. Those who plan to attend should notify Niranjan Banik (*nbanik@houston.oilfield.slb.com*). The JIP site selection group will be in charge of the agenda for the meeting. Debbie Hutchinson will assume responsibility for organizing most of the agenda and determining how and by whom material will be presented. The only person from outside the site selection group or the JIP who will attend is George Hirasaki from Rice University.

#2: Target Identification at GC955 (Dan McConnell)

Prior to the meeting, Dan McConnell distributed two sets of new slides describing progress on identifying potential targets at GC955. Dan first reminded us of the general geologic setting, which is dominated by a sand channel crossing the area from NNW to SSE and moving over uplifted and faulted salt. Sand occurs both above and below the gas hydrate stability zone, and the fact that there is subsalt hydrocarbon extraction (sidetracking from an Anadarko-Kerr McGee discovery well in the adjacent block) in this area (not certain whether gas or oil) argues for the potential for charge.

The GC955 sand channel is large and highly faulted, with the faults coming together along the central axis of the channel, which lies at the 4-way closure. The axis of the channel is coarse sand, the proximal levees are sandy, and the near-proximal levees are sand-prone. About 400 ft of fining-upward sand straddles the BSR near the closure, and the BSR moves up through the facies, but remains within the sand, on top of uplifted sections.

There are two wells in the area, dubbed GC955 #1 (within the proximal levee to the west of the main channel) and GC955 #2 (~500 ft off the east side of the block, drilled in support of the discovery in the adjacent block). The drilling engineers reported encountering no problems in the #2 well.

A new piece of information is the existence of a derived log (attenuation derived resistivity) that shows a 4.2Ω anomaly below the bottom of casing, well above the base of gas hydrate stability, and within the sand channel levee deposit in GC955#1. While the log is provocative, the real significance is not certain. Becky Dufrene has looked at this information and said that these are pseudologs, not true resistivity logs, calculated from other log data. She said that they would loosely indicate the top of hydrate at ~8200 ft below sea surface, but emphasized (as did Matt) that the meaning of these logs was not clear.

Tim confirmed this interpretation and advised returning to the original data, paying particular attention to whether acoustic, porosity, and resistivity logs were available. He cautioned that 4.2 Ω was not indicative of a substantial concentration of hydrate and suggested that another approach is to use the logs to estimate the amount of free gas, since that is usually a solid indicator of the potential for hydrate to be present nearby.

Dan then proceeded to discuss some of the specifics regarding potential targets. On composite line AOBPRJE across the 4-way closure (AOBP), Dan noted some high impedance (although these are not inverted data) or at least high peak features that could be interpreted as concentration hydrate. Ray noted that the strong peaks were right near the BSR and asked whether such peaks were truly indicators for hydrate. Dan replied that he expected the peaks to be near the BSR because this is where hydrate was most likely to be concentrated based on charge from below and added that he didn't necessarily expect to find good "hydrate reflectors" within sand units. A later comment also addressed Ray's point, noting that a hydrate-bearing sandy section that gets cleaner with depth might have a sharp base but not a sharp top, thereby producing no hydrate reflectors other than those near the base.

Dianna raised concerns about the far left side of this composite figure, where the sense of polarity is leading trough over peak near location A. There was some discussion, but no resolution, of the significance of this reflection pattern, which Dan had already highlighted on his slides as a potential "problem."

The seismic line showing location E highlights a potential hydrate play in a wedge of material on the east side of the sand channel.

Composite line IHDOFGNM crosses the crest of a fluid expulsion feature near IH, and there is far more gas in this section than on the other composite line. There are also strong peaks and troughs throughout the section on this composite line, and gas hydrate might be encountered shallower than the BSR at the positions of G and N, where some reflectivity is seen within the sand unit above the BSR.

The area near P is peak-dominated with reflectors similar to those seen at the AC site.

Dan also presented the seismic lines through other interesting features in the data, including the area below a mud volcano where there are apparent reflectors dipping within the sands above the BSR. Such reflectors could be mere artifacts from processing or might suggest concentration of gas hydrate in the faults.

Matt asked whether we have a location identified close to the #1 well. J is currently fairly close, but Dan agreed that having a potential target very close to the #1 well would be wise.

Action Item 1: MMS (Dufrene) and Tim Collett will review the logs from the GC955 #1 well (to be provided to Tim by Dan) and will provide information to Dan McConnell regarding the interpretation of these logs.

Action Item 2: Dan McConnell will continue with his analysis and identify 6 to 9 targets for drilling, complete a spreadsheet, and have information ready for review during the 17 October conference call. This information does not need to be nearly as complete as that at AC818 since full processing of the data block has not been completed.

#3: Progress on Walker Ridge Sites (Matt Frye)

Bill Shedd has been overseas since shortly after the last site selection meeting, and Jesse Hunt was also unable to participate in this web conference. Matt Frye presented a number of new maps and images, a mixture of material provided by Bill Shedd and new information added by Matt.

Starting with an overview of the general structural features using the map we have seen before, Matt noted that the original discussions led by the MMS arbitrarily proposed two locations NE and SW of the primary structure through the 4-block area (WR269, 270, 313, 314). Matt believes that the depositional histories are probably different on either side of the structure, and the MMS will focus on the SW part of the feature, primarily in the northeastern corner of WR313, for the near future. This decision is based in part on the lack of time to properly process both parts of the data set at this time and in part on the lack of well control to the NE of the structure.

Dan McConnell, who has previously looked at this area in the context of some other projects, believes the area that MMS has chosen to focus on for now is a good choice in terms of finding potential hydrate targets. He has previously identified a channel sand that corresponds to Bill Shedd's #2 or #3 sand and that crosses the base of the hydrate stability zone. The channel feature that Bill/Matt are converging on appears to be at the location previously identified by Dan.

Matt then outlined the work that Bill Shedd has done most recently. Right now, it appears that the prime hydrate drilling targets are likely to be downdip from the WR313 #1 well, where the sands are thicker than up on the crest of the structure. The well log indicates only wet sands, but the presence of a strong BSR reflector in the area of proposed drilling and the polarity change in the reflectors that mark the boundaries of the sand units as they cross the BSR are interpreted as potential evidence for gas hydrate above the BSR. It is postulated that the updip termination of the strong reflectors above the BSR may represent the top of hydrate occurrence.

In contrast to AC818 and GC955, WR313 is not a structural play. The hydrate may accumulate above the BSR with no conventional updip trap. Another distinction between the WR sites and the others we are discussing for Phase III JIP research is that it is probably representative of hydrate occurrences within the salt-dominated minibasin province of the northern Gulf of Mexico.

The MMS plan, if Bill Shedd agrees once he returns, is to extend the existing mapping to better define stratigraphy and facies along the lines of McConnell's previous work; investigate targets in the 3A, 4, and 5 sand units; link seismic lines through potential targets into WR313 #1 well; and justify potential drilling targets in spreadsheet format.

By the time of the web/teleconference on the afternoon of Wednesday, 17 October, the MMS will have relatively final material prepared for this region and will have identified images and written material that can be circulated in (at least) hardcopy format.

Ray asked for a clarification of the spatial scales of some of the features that Matt showed compared to the scale of the channel sand deposits in Dan's analysis. Many of the maps Matt displayed could not be shown with a scaling bar, but a quick comparison confirmed that the features MMS is highlighting in WR313 are approximately coincident with those Dan previously studied. This question also highlighted the difference between the more geological maps Dan has been showing and the sand-time sections the MMS has produced. In the latter, the area of potentially charged sands appears larger, and there is an impression that the sands have spread out and also ponded into lobes.

Brandon asked whether those working on the WR sites had taken a hard look at the KC151 data and processing, even suggesting that they run the same types of analyses on KC151 as have been carried out at the Walker Ridge sites. It was determined that this latter approach is not the best use of MMS time, but MMS can obtain some of the background for KC151 from Emrys or others. There were also key distinctions noted between KC151 and the WR sites, including more sand-dominated lithology at the latter site and an intention to drill away from the top of the structure at WR.

Action Items

The MMS will work on further analysis of WR313 with the goal of producing by 17 October a list of potential drilling targets (general areas) with scientific motivations and justifications. This list does need to have as much ancillary supporting information as is expected for AC818 on the full drilling location forms since complete processing of the seismic block has not been accomplished.

The MMS will also continue working on linking the well log data to the seismic interpretation and on finding a way to present the results to combine the best aspects of a geologic approach (e.g., interaction between depositional features like channels and the base of gas hydrate stability) and a more seismic approach (e.g., sand time maps).

Decision: Henceforth, we will discuss the Walker Ridge sites with this terminology: WR313 refers to the area SW of the structure striking NW-SE across the 4-block area and will be the subject of most of the MMS work in the coming weeks. WR269-270 will be used to refer to the area NE of the structure. The potential for hydrate in that area may be less than, the same as, or greater than at WR313, but we have no basis on which to make such a judgment (and no well control).

The 19 October presentation on Walker Ridge must mention that both locations are potentially viable, but emphasize that resource limitations (time, personnel) prevented complete preliminary analysis of WR269-270 in time for the 19 October meeting. Instead, the site selection group decided that the MMS should continue bringing WR313 to maturity to determine the general viability of the region. If the JIP chooses WR as one of the focus areas, it might later decide to devote its own resources to both WR269-270 and WR313.

#4: Plan for Web/Teleconference Early in Week of 15 October

Based on issues related to the readiness of the WR targets and the desire of the group to review the GC955 and come to some agreement on AC818 sites, we decided to have a conference on the afternoon of Wednesday 17 October. The time will be determined and login information distributed by email based on Debbie Hutchinson's schedule during a conflicting meeting being held in Denver. The rough agenda for this meeting (in order) is:

1) Review AC818 target status, particularly outcome of action item detailed below
2) Discuss and finalize target list for GC955
3) Review status of WR313 (bulk of call)

We expect materials to be distributed by Shelander and McConnell before the call on 15 October (preferably by early next week) and expect MMS to be able to distribute some form of public material before that call as well since they should be well along on preparing hardcopy information for distribution on 19 October.

#5: Progress on Target Identification at AC818 (Shelander)

Dianna Shelander and Tom Latham have been collaborating on the choice of additional targets at AC818. One approach has been to look at the interaction of faults and the structural closure in terms of the potential implications for gas charge, compartmentalization, and hydrate saturations. Tom noted that these faults cut off the unconformity that forms the structural trap and that the faults may in some cases be barriers to flow.

The slides Dianna has prepared have not yet been distributed, but she has put new targets #9 through #16 on the map. Some notes about these locations: At #11 and #12, the sand is probably getting too thin to resolve. #5, a target we had previously discussed, targets fizz sand with potentially 30-50% gas hydrate or a lithologic variation that can explain the seismic characteristics. #2 is proximal to a gas vent, while #6 is designed to get the full section of Frio. A key point about #6, #7, and #8 is that, although they are estimated to have ~40% hydrate saturation, they are located in a different system – the Plesitocene section which unconformably overlies the Oligocene (which includes the Frio sand).

Most of the time spent discussing AC818 focused on the overall strategy for choosing locations. Ray and Emrys both re-emphasized the need for some targets with intermediate predicted saturations (e.g., 30-40%) within the Frio and the main structural closure. A concern was that the first 8 targets didn't provide the range of predicted hydrate saturations needed to fully test seismic calibrations, but the additional targets that had been added might also not be serving that stated need. The group as a whole has been behind the idea of drilling targets with a range of predicted S_{hyd} for awhile now, and this is a valid and obvious scientific strategy. To move this discussion along, we agreed to a compromise solution that should not take up too much of Dianna's time: Dianna (probably with some input from Tom) will move forward with delineating 2 or so more targets subject to the criteria discussed during the call. These sites might possibly be on the western side of the main closure where Western's maps appear to predict intermediate gas hydrate saturations. The group will then have a basis for prioritizing drilling targets within the context of overarching scientific objectives.

Action Item: Dianna Shelander will identify a few new Frio targets within the main closure and with intermediate predicted hydrate saturations.

Preliminary Agenda

DOE/JIP Site Selection Working Group Conference Call

17 October 2007 (all times EDT)

09:00	**I. General Update**	Debbie Hutchinson
09:05	**II. Agenda for Oct. 19 Meeting**	Debbie Hutchinson
(10 min)	*General Categories to cover*	
09:15	**III. AC818**	Dianna Shelander
(30 min)	*Final drilling targets*	
09:45	**IV. WR269**	Bill Shedd
(30 min)	*Status of drilling targets and presentation*	
10:15	**V. GC955**	Dan McConnell
(30 min)	*Status of drilling targets and presentation*	
10:45	**VI. Revisit Agenda and Oct. 19 Meeting**	Debbie Hutchinson
(10 min)	*Topics + documents to submit*	
10:55	**VII. Anything Else**	Debbie Hutchinson
(10 min)	*See you on Friday!*	

Summary
DOE/JIP Site Selection Working Group Conference Call
17 October 2007

Participants: Ray Boswell, Carolyn Ruppel, Dianna Shelander, Bill Shedd, Matt Frye, Tom Latham, Warren Wood, Brandon Dugan, Richard Desell (MMS – head of modeling and methodology), Emrys Jones,

I. Agenda + Deliverables: Overview – will revisit at end of call.

II. AC818 Summary (Dianna)

Dianna provided updates on the work that she has done picking new sites and developing an overview cartoon of the geologic targets:

Geologic cartoon summarizing play types
  Oligocene – more sandy, more consolidated, western source
  Plio-Pleistocene – more shaly, less known, less consolidated, distal from Miss R. source (less study), Started with Tom's geological concept slide from July. Took representative section, added all concepts in.
Site U – unconformity cuts down (one Tom has been mapping – cuts top of Frio sand)
  Frio sand may not be present (eroded away), Plio-Pleistocene reservoir
  Saturation section – low anomalies
  Downthrown block on south side of anomaly f
Site S – to west of anomaly f,
  anomaly about 200 ms above BSR showing increased saturation
  Testing section to west – may be a gas source to charge the strate
  Migration pathway not obvious,
  Big unconformity coming through the section
*Site T – BSR right at unconformity at top of Frio.
  Anticlinal structure right at top of section, maybe three layers of gas hydrate,
  Probably Plio-Pleistocene, saturation numbers not calibrated to Plio Pleistocene – therefore more uncertainty.
  West side of anomaly S.
*Site Q – strata west of Frio structure (similar to S)
  Obvious faults from gas charge into area with amplitude
  Miocene or Plio Pleistocene reservoir?? (two unconformities to west, merge at AC818, so Miocene is not present).
* *Most interesting sites – include in final drilling targets.*
18 Targets total. A question remains of how deep to show drilling.

Potential targets to show in Presentation.
Site 2 – thick section, best looking saturation
Site 1 – moderate – variation in Frio saturation, upper fault block, higher saturations,
  [3 – similar to 1 thickness, but in different fault blocks] – maybe show because it would be similar to the well.

Site 18 = on list because so different (stratigraphy, other reservoir).
Site 6 = important for stratigraphy, control well.
Site 12 = no amplitude on anomaly, below seismic resolution, test predictive capability
Ste 5 = place where no hydrates but fizz gas charge to Frio

III. WR 269 Bill Shedd Terrebonne Basin

Matt Frye and Bill Shedd provided a summary of the impressive amount of work they contributed to interpreting WR313 in the last few days.

The site should be Walker Ridge 313 since there is no time to analyze the 269 location.
Geology: Gas mounds. BSR discontinuous, sometimes connecting the dots, Structure NNW-SSE plunges NW, separates two basins, Investigated with Alvin, Depositional system unimpeded from north to south. Continues to SE to 271 and 315. Edge of salt body – to east there is a leak point – sediments have a way to get out. No way out on western side. Therefore opportunity to pond sediment. Therefore this is a low risk site.
seep sites and well. Active charge, mud volcano, active hydrocarbon flux
Structure map on sand 3 – plunging anticline, eastern flank
Still much work to be done to develop this site into a prospect
Mapped channel – cut into section, unconformity,
Some of more detailed features – 3 targets mapped, all within sand 1 with nice gamma ray response. Other sands make it into stability zone (2/3 through 6), but have not done detailed mapping on these sands. 9400 feet – just below base of sand 1, discoaster??, therefore sand 3 up is lower to middle Pleistocene. Well was middle Miocene test.
Isopach from sea floor to BSR – About as thick as see anywhere in Gulf of Mexico, > 1000 m in middle of mini basin.
Seismic section – may be phase reversals, targets are where phase reversal is largest – higher gas charge and highest saturation.
5 Sand units – maps on three of them.
Unconformity (brown) moves up and cuts into overall section of sands – channel downcut and truncated – forming ultimate updip trap. Thrust fault showing very late movement (happening today).
Target 1 – no phase reversal, heart of amplitude,
Target 2 – very good example of phase reversal, from trough into peak, an excellent example – don't usually see this very often, very unusual signature in Gulf. (Hydrate tapers off updip, either because away from gas charge or sand thins).
1200-1500 acres accumulation, down dip edge follows structure very well. Therefore accumulation of gas, not fizz water, i.e., have gas water contact
Channel climbing up structure, meets salt barrier, turns more into a sheet sand.
Also see target sand 3.
Identify channels moving with salt movement. Pre tectonic to syn tectonic and axes of channels move, then post tectonic section buries entire section.
WR269 and 313 are both unleased. 270 – Devon. Generally unimpeded in leasing.

To do list:

Progress to facies analysis
Have more seismic included + justification,

8 targets – these are justified
Block size area – 1 block – 9 square miles.

IV. GC955 Dan McConnell

Dan gave an update on his work – the analysis is essentially completed. He needs to finalize the targets and develop the spread sheet and figures to support the interpretations and recommendations.

Will work out favorite sites later today.
Justification for why 955 – quantitative delineation of sand units relative to BSR. Range of estimates for base of BSR.
Need to get map of these
Should have a good test of sand within base of hydrate stability.
How much hydrate above the gas.
Targets are all justified, though final targets might end up being different.
Sand near stability zone. Fractured and faulted with uplift – how is hydrate distributed.
Identify a block size for inversion – shift slightly south of 955 boundaries.
We need to give JIP an idea that there are good targets.

V. Summary

Analysis of WR313 + GC955 shows where to focus our effort. JIP will probably require WesternGeco to conduct inversion on the data. For the Friday meeting, we should be thinking of the areas where the inversion would best be done. It is perhaps best to wait on prioritizing targets in the WR313 and GC955 areas until we get the inversions done and targets are refined based on the inversions.

Site selection meeting in Houston, 19 October, 2007

Present: Emrys Jones, Brandon Dugan, Niranjan Banik, Ray Boswell, George Hirasaki, Bill Shedd, Debbie Hutchinson, Dan McConnell, Warren Wood, James Howard, Tom Latham, Richard Birchwood, Matt Frye, Carolyn Ruppel, Chang Jeong, Pat Hooyman, Karen Glaser

Webex: Tim Collett and Myung Lee

Introduction (Emrys)

3-4 members of the JIP here to listen to discussion regarding outcome of small group working on JIP site selection
Safety moment
Introductions of attendees

Introduction to Process (Hutchinson)

15 members of the group participating in the process
Final recommendations: AC818 (18 targets, mostly in Oligocene sand, existing well); GC955 (9 targets, Pleistocene sand, GC955 well), WR313 (8 targets, Lower Pleistocene sand, also well in the lease block)

At first reviewed JIP objectives: Direct detection of hydrate, calibrate geologic/geophysical interpretations, determine best locations for coring cruise that will follow LWD cruise, test MMS assessment

JIP guidance to working group: Develop drilling targets (12-18 holes, probably 6-9 at AC818 and 3-6 at two other sites)

Additional guidance is detailed in words on the slide presented at the meeting

Recap: considered 7 sites—AC24, **AC818, AC857**, AT92, EB597, GB460, MC118
These were based on looking at MMS well logs where there might be sands or resistivity anomalies
Some had sands with no resistivity anomaly; others had resistivity anomaly that was deeper than BGHZ

Starting in July 2007 we worked to get to final drilling targets over the course of ~6 conference calls plus the Golden face-to-face meeting getting to this point

July meeting was an open process to identify new sites:
MC118, MC373, GC160, WR144, WR313, GC955, AC818, AC857

Category A: High priority—AC818

Category B: Potentially viable: GC955, WR313, GC160
Category C: No further consideration—AC857, MC118, MC373, WR144

MC118: No indicators of deeper hydrate
MC373: Not enough information
WR144: WR313 has better well control
AC857: no sand in HSZ

NOTE: WE SHOULD MAKE SURE WE CHANGE THIS TO REFLECT THAT WR269/270 REMAIN EQUALLY OR MORE IN PLAY WITHIN CAT B, BUT WE SIMPLY HAVE LITTLE INFO ON WR269/270 AND NO WELL CONTROL

Final focus: AC818—Present potential targets based on full inversion information; GC955 and WR313—Develop geologic interpretations and present targets; GC160—Put on hold, no time to do this right now

Reviewed deliverable products: PowerPoint slides, Excel spreadsheets, word document with geologic framework, table of critical information, site justification, and seismic sections

Geologic Overview

AC818: Seaward of the Sigsbee Escarpment, Tiger Shark petroleum prospect, Perdido fold belt detached above the salt, some of the largest closure structures in GoMex
AC818 sits on Fold 3 in Perdido, target is Frio SS within HSZ
Highest priority site for three reasons: (1) Hydrate very likely based on high resistivity anomaly within the hydrate stability zone (40 Ohm-m) and the only possible interpretation is gas hydrate; (2) coarse-grained sand (Frio SS volcaniclastic), (3) multiple analyses that point in the direction of gas hydrate (WesternGeco inversion, Chevron geologic/geophysical interpretation, USGS well log analysis)

AC818 (Dianna Shelander)

Lots of input from Tom Latham and Ray Boswell

Basic concept is that the Frio crosses the base of the hydrate stability zone on top of the fold structure and that there is a source of charge
At least 3 unconformities: One cuts down into Frio across top of structure (more on W than E), 2 more unconformities higher in the section
The well penetrates 20 m of hydrate that sit very close to the BGHZ and within the Frio
The age is Oligocene for the Frio; above the unconformity that wraps on Frio, it is Plio-Pleistocene
To the west, there might be Miocene between the two unconformities (blue and orange on slide), possibly some hydrates there as well
On the east side, may also be small accumulations of hydrate above and below the unconformity (green)
Strong seismic character develop for hydrate where the Frio is present

Bright spots on the flanks and within Frio sandstone

Look at the 100 ms below the BGHS and check areal distribution of the gas charge from acoustic impedance (density * velocity)

Positive event at the top of hydrates, negative at the base of the hydrates
Seismic resolution is down to 10-15 m
In the inversion, took the data that they processed and focused on stability zone and inverted to a saturation of gas hydrate
Only one calibration site at well
Good value in the prediction where the conditions are similar
The more the seal and/or reservoir change, the less useful the absolute values of Sgh in the inversion; the relative values will still be useful

Max Amp Sat map is done by windowing throughout the stability zone to map out the anomalies
Anomalies c and f are most prominent, with Sgh in excess of 60%
This is precisely where the Frio is coming up into the stability zone and acts as a good reservoir
The high points are definitely within the gas charge area; other anomalies only touch the area of high gas charge
Possibility of compartmentalization of the reservoir, so put some points within the miniblocks
18 nominal drill targets

Gas charge
Emrys asked about the gas charge and whether we can calibrate well using seismic (can't)
At the well there is no resistivity anomaly below the hydrate, so maybe not a lot of gas (3-5%)
Emrys is asking this mostly b/c of the safety issues

Zone is not overpressured
Migrated section on right and saturation section on the left in each diagram

Sample targets
Target 2: Higher saturation than well location, thicker accumulation, dent on the seafloor and then more seafloor disturbance to the right (gas vent coming up)
Targets 1, 9: Two different little mini-blocks; Target 9 has potentially thicker section
Targets 3,4,11,12: Transect across the anomaly, test the degree to which the seismic can resolve the hydrate (go off the edge of the anomaly); target 4 may be multilayered reservoir

Summary (using composite slide)
Target 6: geophysical parameters for the calibration off structure; Frio ss wet, something interesting in Pleistocene above BGHS, maybe saturations at relatively "low" values (~40%)
Target 7: another Pleist section with gas charge (not Frio) beneath
Target 5: Frio not in stability zone, but there is gas charge
Targets 8, 17: Plio or Mio above BGHS on top of nice charge in Frio
Target 18: pick up section (Mio?) not present in other targets

Targets 4, 15, 13 have potential multiple layers with hydrates

On top of Frio, most Sgh are very high; off Frio, much lower saturations
Plio-Pleistocene is much shalier, not as much high quality pore space for hydrate

Potential issues for drilling
Seafloor channel just to west of small crater (NRL piston coring focused on the channel)
The well was quite close to channel (just to the east of it) and the channel is probably controlled by a fault
Some chemos along seafloor ridge (so this will be a concern re drilling locations)

Emrys: return to the seafloor map
500 ft radius from chemos, then special care from 250-500 ft
Shedd—can't get amplitude response from these chemos, have to get away from other sources of high amplitude (e.g., a big fan); within 100 m of the well there is a healthy chemo close to well
Has to be some sort of meeting to determine what the final ruling will be on distance from chemos
Quite a bit of overlap in target objectives or targets can be moved very slightly to accommodate chemos

Group should come up with some sort of idea about a good strategy so that we can drill 9-12 of them

Debbie: Can we truly find Frio with not much saturation
Tom: Control well should be far enough outside
Ray: Low amplitudes on the map are not the Frio, but do give a chance to look at what happens when you don't have as good a reservoir at the level of the Frio right above the BGHS
Tom: AVO and polarity of signals is not quite right in some places where non-Frio is above BGHS

Strategy: Test how reservoir quality, nature of charge, and geologic structure control hydrate system

Three types of targets should be tested:

1. Sites with high saturation of gas hydrate, with a trap that is structurally controlled by the 4-way closure, and within high-quality, thick reservoir like the Frio sandstone (Target 2, 1, 9, 14, 16 …)
2. Marginal sites (not high saturations or at the edges of anomalies) that enable comparison among reservoirs of different qualities being placed within the HSZ and near a source of charge (Targets 11, 12, 13, 17?)…e.g. Plio-Pleistocene overlying gas-bearing Frio SS that provides charge
3. Reference sites (off structure, wet / fizz gas in Frio sandstone) that may also test Pleistocene or possibly Miocene as well (Targets 5, 6, 18)

GC955 (Dan McConnell)

Brought targets from data currently in hand (no inversion left)

9 targets
BGHS: ~475 to 600 m depth
Thickness of the potential reservoir is between 129 and 173 m
Most of the locations are within the near proximal sandy levee, others in the proximal levee or the coarse channel lag
In most cases, looking at strong peak at BGHS, but also sands near highest flux/vent or weak peak anomaly in high-mid reservoir
Good source for charge at all sites: faults, subsalt HC
Mostly concentration at base, vertical fracture fill
3.7 sq km of high flux area

Off the edge of the Sigsbee, faulting near aquitard (seep sapping), nearby slope failures
Pleistocene sand fairways
The site is beyond the natural spill point at the edge of the Sigsbee
Heggland, 2004 GC955, salt in blue, gas chimneys moving through the section
Quantitative delineation of sand relative to BSR
What are the estimates for the BGHSZ
Seismic indicators of GH

Geologic setting: sands above, at, and below base of stability zone
Salt uplift has raised and fractured the principal channel
4-way closure intersects prox/near-prox levee sediments
well through proximal section encountered more than 400 feet of sand

gas doesn't rise into the top of the faulted sandy section
BSR seen in seismic data consistent with gradient of 27 to 32 C/km
BSR moves through sandy sedimentary facies as section moves across the local uplift

Source: GC955 #1 had trouble drilling through section and found 400+ feet sand
4.2 Ohm-m anomaly from an interpreted log through section
955#2 is a subsalt discovery by Anadarko

sands persist in levee system in nearly all the block in near-proximal levee system
central uplift where most fractured, uplifted in SW quad of block
Heggland never mentions gas hydrate
4-way closure beneath seafloor uplift, with sand draped over the deep salt
faulted right at closure, but faults don't seem to run to seafloor

mostly peak dominant in the SW corner, which is a high flux area
troughs larger in absolute amplitude

what does gas or the freeze line look like?
Look at the full thickness of material from the top of the unit down through the BGHZ
Neg amplitudes mark the freeze line (troughs over peaks)
Freeze front moves up over the high flux area

Freeze line rises and falls (and also mimics bathymetry)
Faults extend through the top of the reservoir
Channel axis is more coarse grained, proximal levees have more thin sands in them
A through G are within the high flux are in the proximal or channel sand
H is outside within the channel proper
Significant numbers of faults striking ENE in map view through the channel

Transect through some potential targets (arbitrary line)
Statoil well had a lot more sand than they predicted, regular resistivity logs were not so good, but the derived attenuation derived resistivity is provocative

Strong peaks at A,E in thick potential reservoir
Potential reservoir is quite large, sandy facies with lots of faults through it
A,E,G highest flux
H is in channel levee system near well, leading peak in some sandier facies
I location has wedge of sandy sediments
Far off to right, reflection is dimming within reservoir unit
F is over the high peak, but unknown how much hydrate in reservoir unit above the BGHS
H to well#1 is ~2000 ft, could move as close to 1000 to 1200 ft
B, C, D, G small mud volcano, is there hydrate at depth here

No sonic log in top-hole section
Potential reservoir quite thick, but charge is unknown, good play concept b/c following Pleistocene sand as they move through expulsion events and potentially fill with hydrate

Is gas pooling in sand beneath the reservoir unit?
Does all the charge come from the faults?
This levee horizon is not the one creating all the sapping

Emrys: Is it the consensus of the group that it is worthwhile to do the full inversion here?
Dan: definitely something to test
Will the inversion show the hydrate, particularly when we don't have good inputs here
Bill: Try to get some pseudo-logs to start with, still be a valuable tool, particularly if you can do 2 ms processing
Niranjan: can get better stack sections than we have now
Warren: fairly compelling as is already, even without any reprocessing
Dan: High res lines by KC Offshore (relatively old), not very well processed
Emrys: Maybe the real question is whether this is an area worth prospecting in for at least LWD wells

Should a new high res 3D survey be done or should we process existing data?
Process lines at 50 m distance, hazard type survey, just process as conventional 3D
Possibly could be done by spring

GC955 of "intermediate" value in terms of gas hydrates, partially comes out that way b/c of positive structural features (salt); additional data here would be beneficial to the assessment

Dianna: If looking at pre-stack data, always helpful to see what type of offset response to define lithology, saturations, pore fill; reprocessing or new high resolution will greatly benefit us in terms of quality of the data; reprocessing improved frequency content of existing data quite a bit;

Tom: may be useful to do a post-stack inversion on the data to clean up some of the wavelet mess

Not sure which way to go forward here (new data, reprocessing, etc.), but we all seem to agree that this should fit into the program

If we don't find hydrate there, then we have to explain why, so this is a good place to go to test that idea

WR313 (Matt Frye and Bill Shedd)

Well north of the Sigsbee, within the minibasin province
Terrabonne basin, long N-S basin with 2 lobes on the S
High Plio-Pleistocene sed rates and accompanying salt movements
Age of sed, sedimentation rate, structural style all make it attractive
Any info from this province will go a long way to refine assessment

Compelling evidence on both a gross and fine-scale to be looking at this area
BSR (not continuous), in excess of 20,000 acres, covers parts of 9 OCS blocks
Structural feature centered in WR270, and BSR wraps around texture of that feature
4-way dipping anticline, excellent feature to help focus gas migration to shallow system
Active seeps, carbonate hardgrounds, chemo communities
Well in the NE corner of WR313
Sand delivery system comes in at single entry point to north then splits into 2, with damming/ponding on the West side but exit point on the east side;
We are focusing on the west side (ponding area) in WR313
Age of structure uncertain, so interaction with sedimentation also uncertain

Seafloor to BSR isopach map **(truly in meters, not in feet**)**—**IMPORTANT POINT TO BE MADE SOMEWHERE, PERHAPS ON SLIDE ITSELF

BSR is only good where gas saturation events terminating into a feature, like "connecting the dots" among strata
Salt highest beneath shallowest BSR where it doesn't mimic seafloor well
Green features are mud volcanoes, high flux sites
Red features are other flux indicators

Not a lot of thinning coming upstructure, in some cases seeing thickening
Very late salt movement
Sands both above and below hydrate stability zone
Look at the thick sand with discrete shale breaks within the section that is in well

Target 2 and 3 intersect the well, very slight increase in resistivity from 1 Ohm-m to 1.5 Ohm-m, consistent with shale break right at top of sand
Yellow, blue, orange sand "objectives"—change in polarity of signal across BGHS
Yellow shows bright amplitude diminishing abruptly upward across BSR, truncated by unconformity (not much room above it), no phase reversal or change from trough to peak
Blue objective has excellent phase reversal; below BSR seeing peak-trough-peak; above BSR it is trough-peak-trough; probably free gas below and hydrate above
Target 7 would provide a lot of information about differences between blue target in NE and SW of the peak amplitude map

Real free gas reservoir in discrete (blue) channel sand providing good charge into overlying sand
Downdip from dry hole, so this is probably a reasonable thing to do
2 is closest to edge, 7 is in deepest trough (thick sand unit)
8 is down near BSR, 2 is away from BSR, thinner and possibly less concentration
Orange objective is next one down, clear phase reversal
On amplitude map, can clearly see channel
Thick channel complex, know there are sands in wells, long-lived delivery system
Probably go from a confined system on this line to an unconfined system

8 locations, most in clue, but 3, 4, 5 in orange and blue
WD are mostly 1940 to 2000 m, BHSZ depth 2789 2919 m, all Lower Pleistocene

Where would be the best place to concentrate?
Much discussion of which blocks to reprocess, whether this will tell us much, what can MMS do (15 hours to do some work on WR270)
Everyone would be fine if we could just do WR313, but if could do some extra work and get some of 269/270 would people be more content with that?
If we can't swing it, we'll just go back to WR313
Very new wide-aperture Q data in the area, run in NE/SW direction
Can Western take a quick look at the data?
Size/orientation of the block with Dianna

269/313 open
WR270 is to Devon Energy

There is one target over in 269, could be brought back over to 313 if necessary

BSR here is much deeper than at other sites, > 800 m from mudline

Summary slide:

Two objectives (blue and orange) demonstrate phase reversal
Low sand risk due to seismic facies analysis and nearby well control
Opportunity to test several facies
Highest risk is % hydrate saturation
Nonstructural test will provide GoMex minibasin province analog

Significant areal extent and projected reservoir thickness

To do: Reprocess seismic data, using WR313 well data
Refine and prioritize proposed drilling locations

"Frye, Matt" <Matt.Frye@mms.gov>
10/25/2007 08:35 AM

To
"Emrys Jones" <ejones@chevron.com>
cc
"Ray Boswell" <RAY.BOSWELL@netl.doe.gov>, "Hutchinson, Deborah" <dhutchinson@usgs.gov>
Subject
WR 313 / 270

Emrys --
Bill Shedd has completed his 15 hour evaluation of the north and north east flanks of the WR 270 structure. He has reported finding no geophysical targets of interest that he would recommend pursuing at this time. He and I feel that at this point, our time would be best spent refining the interpretation over the well-defined objective at 313 rather than to continue looking for something that might not be there.

Furthermore, we don't believe that reprocessing or inverting the data on the N/NE flank would increase our confidence in the geologic objectives.

As you recall, the areally expansive BSR attracted us to this area initially. However, prospect-level "reservoir" mapping suggests that all parts of this 20,000+ acre area are not of equal attractiveness. On the NE flank, Bill is seeing limited to no signs of: phase reversals; strong peak amplitudes in the HSZ; "free gas" below the HSZ; widespread sand deposition. We see all of these in 313, and interpret these findings to present the best location for an exploratory well(s).

As for 313, Bill has started to delineate the (slightly) deeper objectives (targets 3A and 4), and reports that the early interps are yielding good returns (these are the events we identified earlier and had not yet had the time to define). I'm confident that this prospect and the story tying it all together will get better yet.

Expect that we will identify several new drilling locations to test horizons 3A and 4 (all in the 313 vicinity) within the next few days/weeks, and that these data will all be used to define the reprocessing grid for WG, should we go that route.

Thanks, M. Frye

Matt Frye
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APPENDIX B

Report on Gas-Hydrate Drilling Targets Near the AC818#1 Well

Gulf of Mexico JIP Site Selection Working Group[1]
October 31, 2007

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Ray Boswell, DOE/NETL
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Brandon Dugan, Rice University
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Dan McConnell, AOA Geophysics
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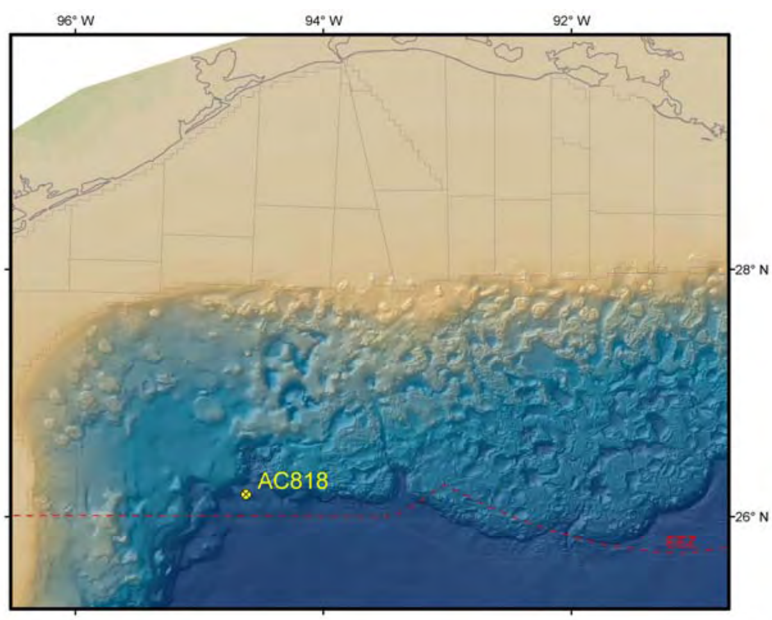
Carolyn Ruppel, USGS
Bill Shedd, MMS
Dianna Shelander, Schlumberger, Inc.
Warren Wood, NRL



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Introduction

Identifying high saturations of gas hydrate in sandy marine sediments is one of the primary objectives of the Phase III drilling program of the Gulf of Mexico Gas Hydrates Joint Industry Project. Based on geophysical logs, a drill hole referred to as the Alaminos Canyon 818 well #1 (AC818#1) in the deep-water western Gulf appears to have penetrated a 17-m-thick section of volcaniclastic sand containing potentially high saturations of gas hydrate (Smith et al., 2006).

Four independent analyses of data from the AC818 site support confidence in the existence of this high-saturation gas-hydrate zone: (1) Well log data that are explained by the presence of gas hydrate: gas release, higher than expected velocities, and high resistivities in the inferred gas-hydrate interval (Smith et al., 2006); (2) Inversion of seismic data calibrated at the AC818#1 well site that show gas hydrate accumulations in the lease blocks north and east of the well site (WesternGeco analysis presented at the 26 July, 2007 Site Selection meeting, Houston, TX); (3) Seismic-stratigraphic and geological interpretation of seismic data (initially presented by Tom Latham at the 26 July, 2007 Site Selection meeting, Houston, TX, and subsequently refined in discussions with Dianna Shelander and used in this report); and (4) analyses conducted by M.W. Lee at USGS estimating gas hydrate saturations in the AC818#1 well (Appendix 1) and identifying likely gas hydrate targets near the AC818#1 well using seismic data (Appendix 2).

This report summarizes the geologic framework in this area and information about eighteen potential drilling targets identified near the AC818#1 well (Appendix 3). The drilling targets were chosen to 1) delineate potential gas hydrate accumulations, thus providing guidance for a later phase of planned coring; and 2) yield data for calibration of geophysical data across the range of interpreted gas hydrate saturations, thicknesses, and lithologies. To provide these recommendations, a geologic interpretation has been merged with the quantitative estimates of gas hydrate saturations from analysis of seismic data to identify the conditions under which gas hydrate might be found in both the Oligocene Frio sand and younger (mostly Pleistocene) shale-prone units.

Geologic Setting of AC818

The AC 818 block is just north of the U.S.-Mexico border in the northwestern Gulf of Mexico (*Figure 1*) in water depths of about 2700 m. The area lies about 13 km seaward of the Sigsbee Escarpment within the Perdido foldbelt, a buried set of subparallel folds that were formed during Oligocene time (Fiduk et al., 1999). The large concentric box folds comprising the fold belt form some of the largest structural closures in the Gulf of Mexico (Fiduk et al., 1999). Because of their subparallel aspect, the folds have been numbered 1 (east) to 5 (west). The sites around AC818 are near the crest of fold 3 (*Figure 2A*). A published regional seismic profile (Fiduk et al., 1999) shows the deeper stratigraphy and structure across fold 3, with younger units onlapping the fold structure (*Figure 2B*).

Although the Perdido fold belt affects units from Mesozoic to Oligocene age, it is only the uppermost Oligocene Frio strata that have been uplifted into the GHSZ in this area. At the crest of fold 3, this volcaniclastic sand was logged during drilling of AC818#1 and contained resistivity anomalies of 30-40 Ω-m (*Figure 3*). Sampling gas hydrate was not an objective of the drilling, but the show of gas during drilling and the combination of elevated seismic velocities and high formation resistivities are interpreted to indicate high saturations of gas hydrate. At the crest of the structure, the Frio sandstone is truncated at an unconformity. Away from the fold axis, the full Frio section is preserved, and the unconformity is overlain by younger onlapping fine-grained turbidite deposits. At the location of the AC818#1 well, this overlying unit consists of about 450 m of Plio-Pleistocene fine grained muds.

A possible Bottom-Simulating Reflection (BSR) identified in AC818 (*Figure 4*) places the base of the hydrate stability zone within the Frio sandstone unit at the crest of the structure. The gas-hydrate-bearing (Frio) sand encountered by the AC818#1 well is immediately below the unconformity marking the top of the #3 fold. The highest preserved occurrence of Frio sand in the immediate area occurs north of the AC818#1 well on the up-thrown side of a minor fault, providing possibly a thicker gas hydrate section than seen at the well.

From a petroleum systems perspective, the Frio sandstone forms the gas-hydrate reservoir, which is capped by fine-grained Plio-Pleistocene shale-prone deposits of the Alaminos Fan (Morton and Weimer, 2000). The AC818#1 well encountered a high gas-oil ratio oil in the deeper Eocene section, demonstrating the presence of a methane-rich petroleum system (Latham, T., personal communication). Excellent indicators of gas in parts of the system exist in the seismic data, including strong reflectors (bright spots) consistent with gas-charging of units below the base of the GHSZ in some locations and the loss of high frequency content beneath and west of the fold axis at about 4.2 s twtt (*Figure 5*). This loss of high-frequency information is generally associated with attenuation caused by small amounts of free gas in the system. Spatially, this gassy zone does not appear to extend any appreciable distance east of the edge of the fold. Faults are evident in the seismic data (*Figure 2*) suggesting that transport pathways exist to move gas-rich fluids into the gas hydrate stability zone. The reprocessed seismic data reveal minor faulting through the Frio indicating possible compartmentalization of the gas-hydrate reservoir (*Figures 6B and 6C*).

Although the primary drilling target is the high-saturation portions of the Frio sand, we here recommend several additional targets that could provide important rock properties and physical parameters for sediments not tested in the existing well and that could enable the testing of seismic amplitude anomalies suggestive of low-to moderate gas hydrate saturations in the younger Plio-Pleistocene section.

Pressure-Temperature Conditions

Assuming pure methane as the hydrate former and hydrostatic pressure, the regional depth to the base of the GHSZ at 3197 m corresponds to a temperature of 23.8^{o}C (pressure of ~33 MPa, Table 1). For an average sea-floor temperature of 3 ^{o}C, the estimated thermal gradient is ~44 mK/m, which is consistent with known thermal gradient measurements in this part of the Gulf

(Forrest et al., 2005). During drilling, gas began to flow from the formation at depths corrected to sea level of 3184 m (10,445 ft), which is less than 4 m (10 ft) below the top of the inferred gas hydrate-saturated zone (Smith et al., 2006).

Table 1: Selected Parameters for AC818#1 Well

Parameter	Value	Source[1]
Latitude	26d 10' 47.3" N	Operator
Longitude	94d 37' 22.4" W	Operator
Water Depth (ft)	9004	DS spread sheet
Water Depth (m)	2744.42	Conversion
Top of GHSZ (ft)	10,435	DS spread sheet
Top of GHSZ (m)	3180.59	Conversion
Depth to BGHS (seismic - ms)	4154	DS spread sheet
Depth to BGHS (ft)	10,488	DS spread sheet
Depth to BGHS (m)	3196.74	Converson
Seafloor to BGHS (m)	452.32	Subtraction
Hydrostatic pressure at BGHS (MPa)	32.93	CR spread sheet
Temp (equilibrium) for 3.3 wt % salt, pure CH4	23.77	CR spread sheet
Thermal Gradient (mK/m)	43.97	CR spread sheet

[1]Source: DS = Dianna Shelander, CR = Carolyn Ruppel

Drilling Targets

Initial guidance from the JIP was that 6 to 9 logging-while-drilling (LWD) holes might be drilled around the AC818 well. Based on this, the working group decided to identify up to twice as many potential targets in case some would be disallowed for safety or other reasons. Therefore, 18 targets were selected for possible LWD around the AC818#1 well (*Figure 6*). These targets are located in AC818, AC819, AC774, and AC775. The attached tables (Appendix 1) provide specific objectives for each hole. Broadly, the targets fall into three categories:

(1) Targets with interpreted high saturations of gas hydrate within Frio sand: *Targets 1, 2, 9, 14, 16 and 3, 4, 10, 15.*

(2) Targets with moderate to low estimated gas-hydrate saturations and with generally lower-confidence estimates of gas hydrate occurrence and concentration. These targets include structural and/or stratigraphic complexities that interfere with charge to the Frio, lower quality reservoir units present near the BGHS such as fine-grained Plio-Pleistocene turbidites presumably charged by the same source, thinning of the Frio reservoir below the resolution of seismic methods, and stronger seismic indications of gas hydrate in adjacent structures or units leading to little gas hydrate being predicted in the Frio itself): *Targets 11, 12, 13, 17.*

(3) Reference sites to provide constraints on the characteristics of the Frio sand when it contains only fizz gas or water and to study stratigraphic units that are not penetrated

elsewhere (e.g., by AC818#1 or JIP LWD sites) or that are missing due to erosion across the primary structures *Targets 5, 6, 7, 8, 18.*

In attempting to identify sites with low to moderate gas hydrate saturations (category 2 above), it became clear that most such targets were anomalies within the Plio-Pleistocene shales or at the very thin edges of the Frio Formation. This observation is clear on the inferred gas-hydrate saturation map, which reveals that the highest gas-hydrate saturations coincide with the thickest occurrences of the Frio sandstone (*Figure 6B*). Hence, the Frio formation may contain high saturations of gas hydrate wherever it occurs within the gas-hydrate stability zone. The drilling targets identified in categories (1) and (2) should test this hypothesis.

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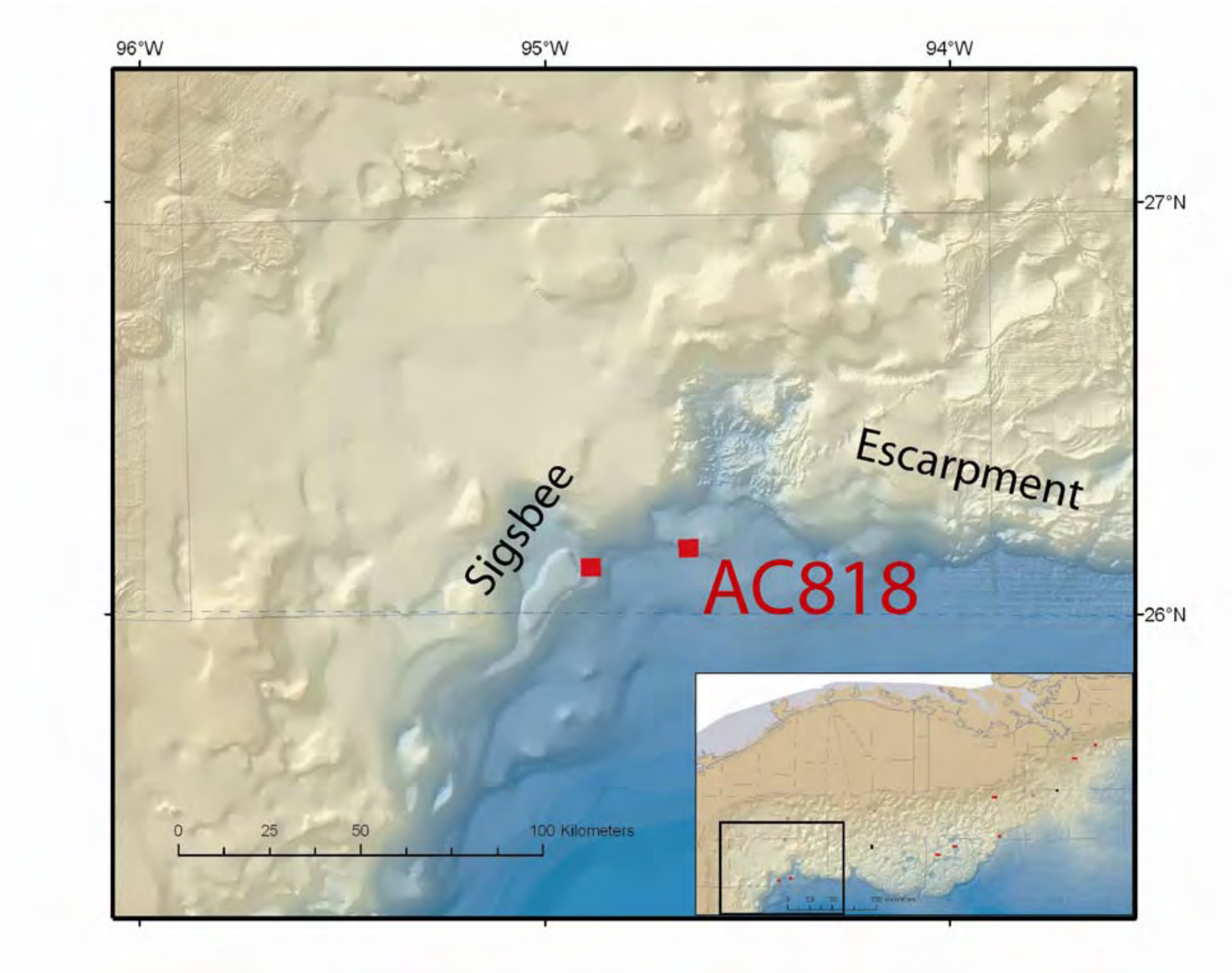
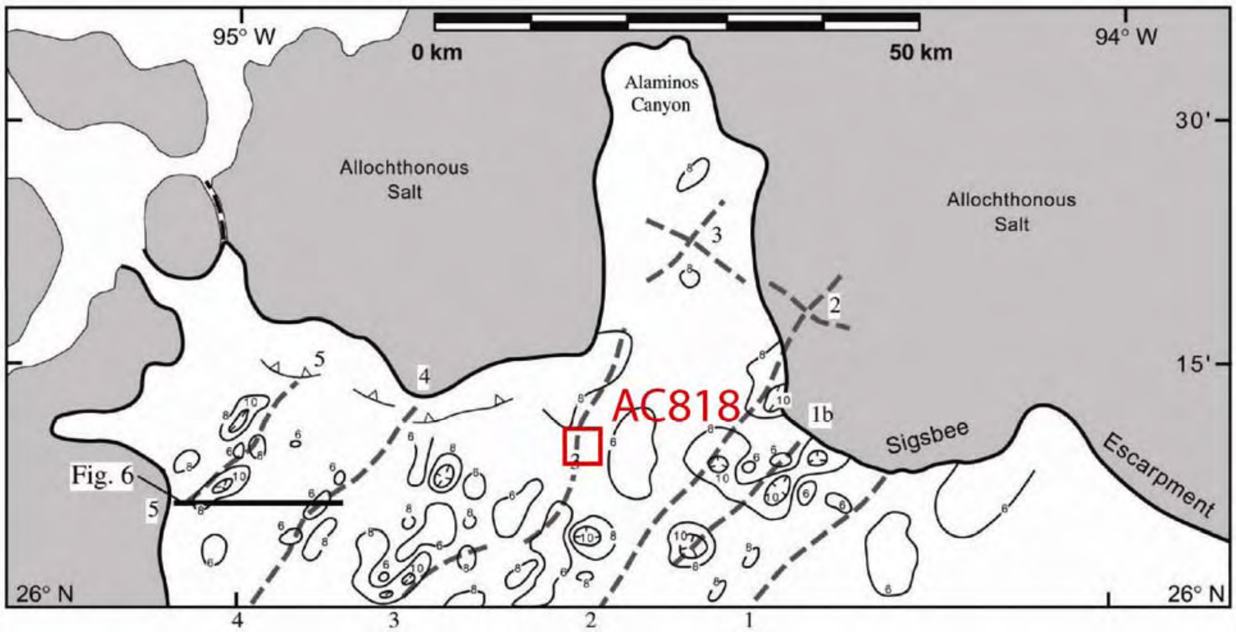


Figure 1: Location map showing regional morphology and location of AC818.

A.



B.

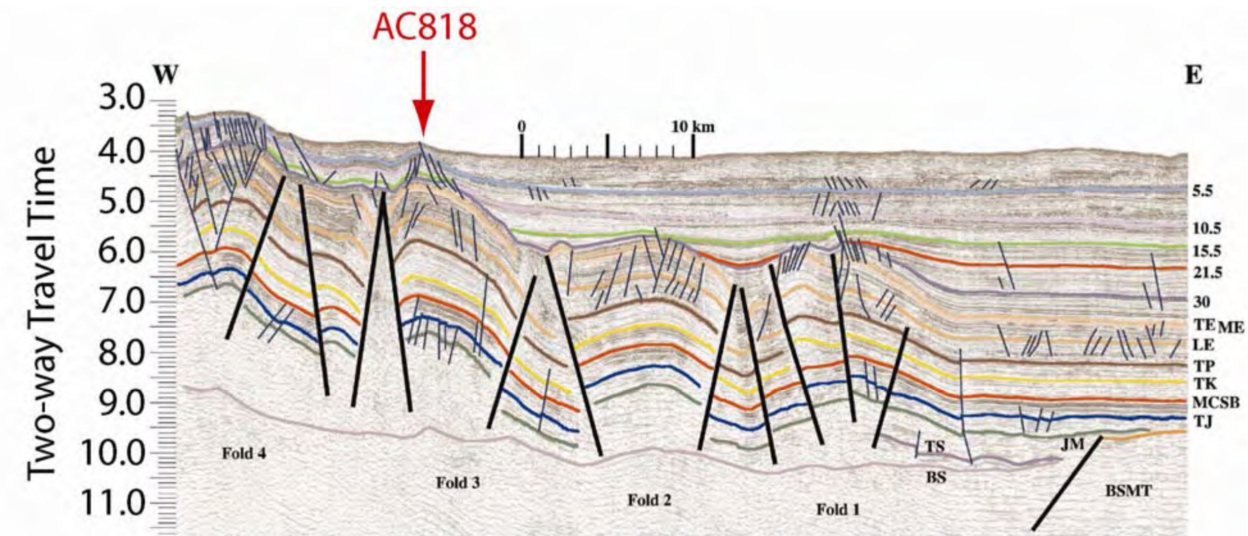


Figure 2: (A) Map of the Perdido Fold Belt seaward of the Sigsbee Escarpment in the western Gulf of Mexico showing the location of the AC818 lease block on the crest of fold 3.

(B) Seismic profile showing the geometry of units in fold 3 of the Perdido Fold belt. Units are labeled according to inferred age (After figures 9 and 10 of Fiduk et al., 1999).

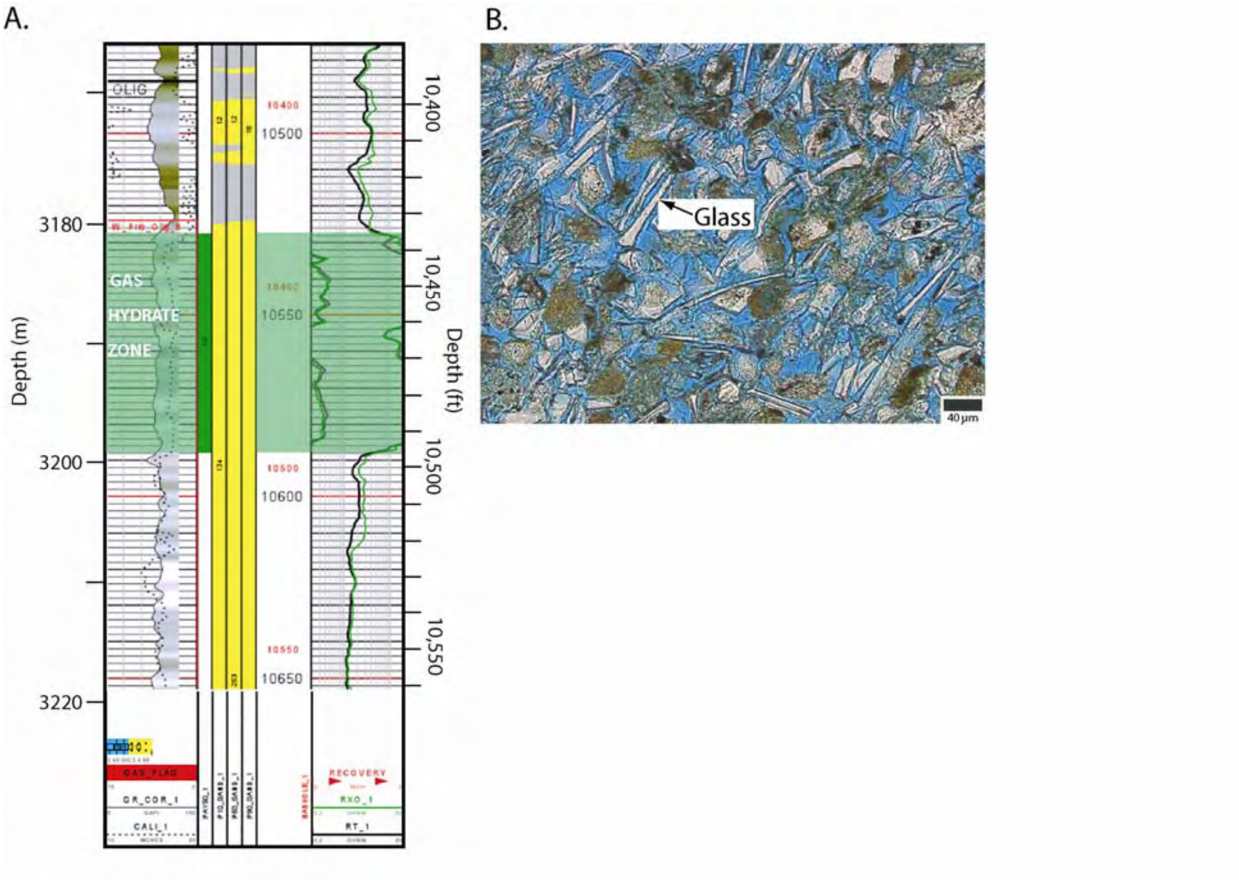


Figure 3: AC818#1 Well. (A) Well log data from AC818#1 showing gamma ray response (left) and high resistivities (right) with the interval of inferred gas hydrate saturation shaded green (3181 – 3197 m). From Smith et al., 2006. (B) Photomicrograph from a sidewall core of the Frio sandstone in AC818#1 showing an immature lithic sandstone with high concentrations of volcanic glass. Elevated radioactivity caused by volcanic glass and potassium-feldspar bearing rock fragments explains the muted gamma ray response for these sands. Photo courtesy of Chevron, Inc.

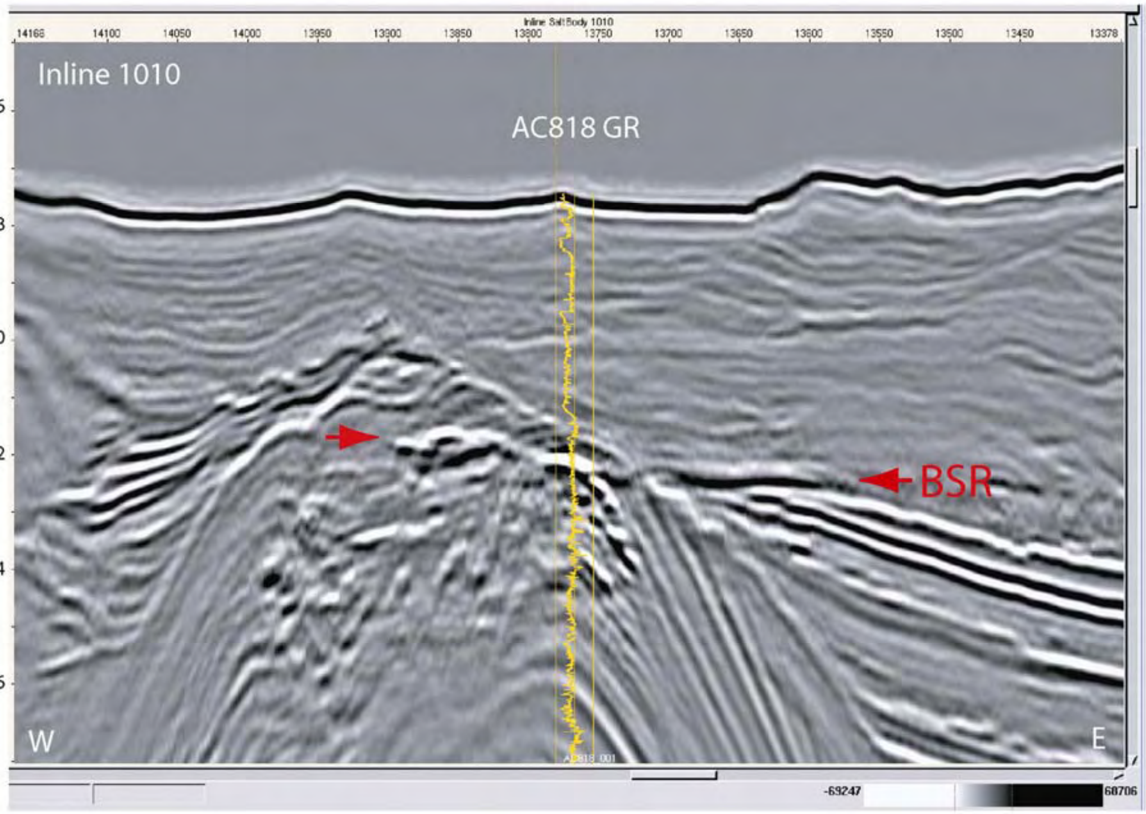


Figure 4: Depth-converted seismic profile showing inferred BSR at the location of AC818#1. The well log projected onto the seismic profile is gamma ray (GR).

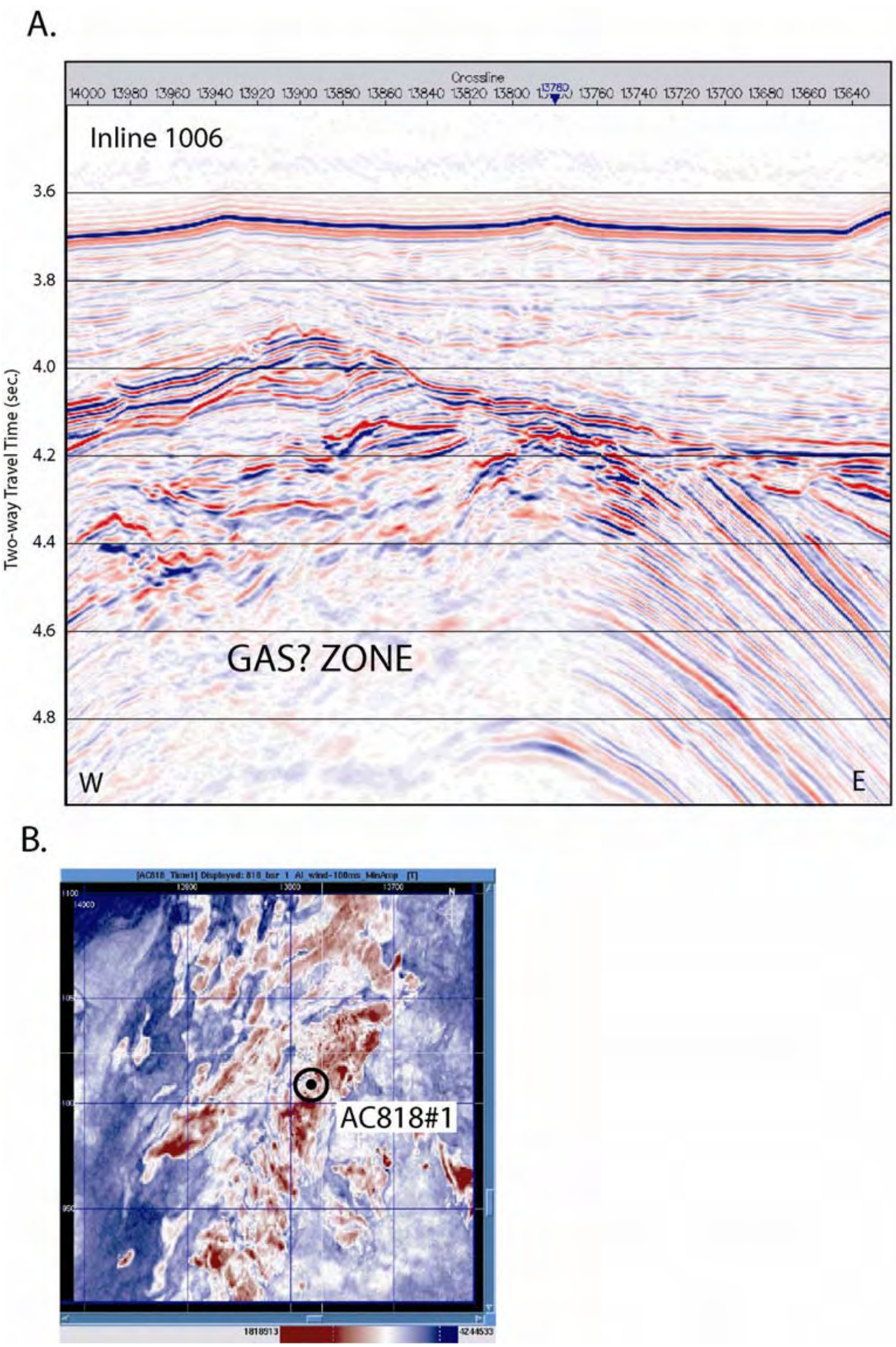


Figure 5: Evidence for gas charge at AC818#1. (A) Seismic profile near AC818#1 showing attenuation of the seismic signal beneath and west of the major structural anticline. Continuous reflectors east of the anticline are interpreted to not contain significant gas charge. (B) Map of P-impedance in a 100-ms window beneath the BSR. Low impedance (red) indicates source of gas beneath the base of the hydrate stability zone.

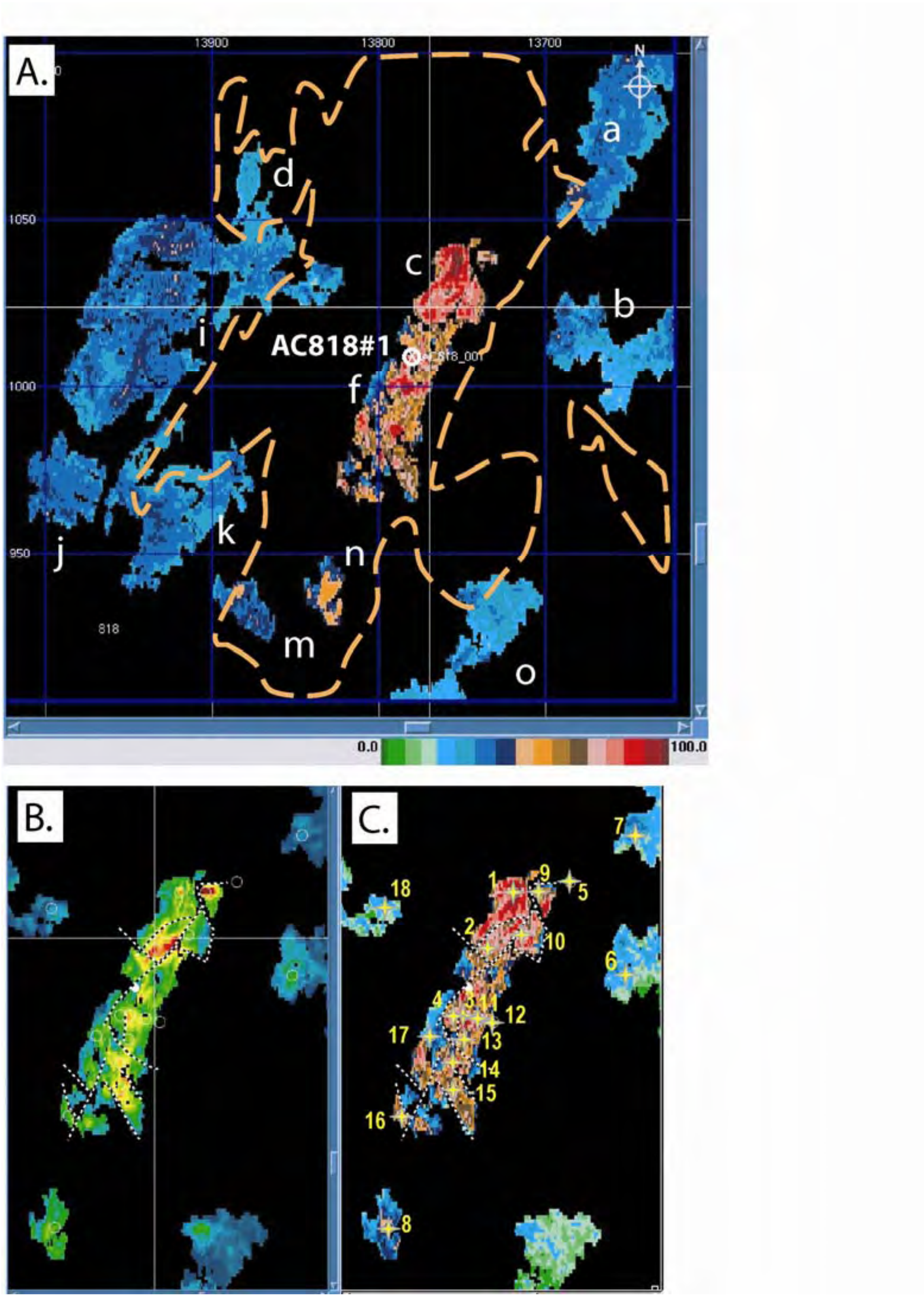


Figure 6: Maps showing drilling targets. (A). Maximum amplitude saturation of gas hydrates (blue is low, red is high). The location of the AC818 well is shown together with the outline of the highest likelihood of gas beneath the base of gas hydrate stability zone (from Figure 5B). Letters refer to potential individual gas hydrate accumulations. (B). Integrated map showing where maximum (red) and minimum (blue) thicknesses of Frio sandstone and gas-hydrate saturations occur. Faults are shown as white dashed lines. (C). Map showing locations of drilling targets 1-18 superimposed on the maximum saturation map shown in (A).

APPENDIX B-1

Analysis of Well Log at Tiger Shark AC 818#1, Gulf of Mexico

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LOG ANALYSIS

Resistivity Log

The amount of gas hydrate is estimated from the resistivity log. The formation resistivity of gas hydrate-bearing sediment (GHBS), R_t, is given by

$$R_t = \frac{aR_w}{\phi^l S_w^j} \tag{1}$$

where a and j are constants, R_w is the resistivity of connate water, l is the cementation factor, and S_w is the water saturation. The saturation of gas hydrate (S) can be estimated from the resistivity using the following equation (Collett and Ladd, 2000) with j = 1.9386:

$$S = 1 - \left(\frac{aR_w}{\phi^l \; R_t} \right)^{1/1.9386} \tag{2}$$

When R_w is available, fluid saturations can be estimated from equation (2) with Archie parameters a and m. When R_w is not available, a quick look method (Collett, 2000) can be applied to estimate saturations and apparent resistivity R_a ($R_a = a\ R_w$).

Figure 1A shows measured resistivity with an assumed base line resistivity (R_o) for a quick look method (Collett, 2000). In estimating gas hydrate saturations, resistivities higher than base line resistivities or R_o are assumed to be due to gas hydrate. The gas hydrate saturations calculated using the quick look method is shown in figure 1B with a red solid line. The gas hydrate saturations reach about 80% near depth of 10,550 ft.

Apparent resistivity R_a calculated using Ro shown in figure 1A using the quick look method is shown in figure 1A as a green line. Saturations estimated from the full Archie equation using equation 2 with *l* = 2.15 and R_a shown in figure 1a are shown in figure 1B as a blue solid line and similar to those estimated using the quick look method. Because the full Archie method uses porosity in estimating saturations, saturations are generally more accurate than those estimated from the quick look method. Also note that the base line resistivities for full Archie analysis are shown as a red line in figure 1A and similar to those for quick look method.

DSI Sonic Logs

Figure 2A shows measured P- and S-wave velocities at AC 818#1 well with predicted velocities for water-saturated sediments using the modified Biot-Gassmann theory by Lee (2002, 2005), hereafter referred to as the BGTL, in order to estimate the gas hydrate saturation. On the basis of figure 2A, the BGTL parameter *m* = 1.8 is determined to be appropriate for modeling velocities at this well site. The sediments having higher than the predicted velocities are assumed to be gas hydrate-bearing sediments.

The gas hydrate saturation estimated from the P-wave velocities are shown as a dotted line in figure 1B. The overall saturations estimated from the P-wave velocities agree well with those estimated from the resistivity, although the gas hydrate saturations estimated from the P-wave has a higher spatial resolution than that from the resistivity. Similar to saturations estimated from the resistivity, the gas hydrate estimation reaches about 80% near the depth of 10,530 ft.

Figure 2B shows the relationship between the measured P- and S-wave velocities. For comparison, the relationship for gas hydrate-bearing sediments (GHBS) at the Mallik 5L-38, western Canada and for mid rock by Castagna et al. (1985) are shown. The P- and S-wave relationship at the AC 818#1 well agrees with that at the Mallik 5L-38 well. When S-wave velocities are less than about 1 km/s, the P-wave velocities for mud rock are slightly larger than those for gas hydrate-bearing sediments at Mallik 5L-38 and AC818#1 wells, whereas when S-wave velocities are less are greater about 1.0 km/s, the opposite is true, although the S-wave velocities at AC 818# 1 well are slightly smaller than those at Mallik 5L-38 well. The smaller S-wave velocities at AC 818#1 well are possibly caused by poor well log quality. Note that the general behavior of the P- and S-wave relationship at AC 818#1 well follows the relationship for the GHBS at the Mallik 5L-38 than that for the mud rock.

Predicting Elastic Velocities from Resistivity

One way of checking the internal consistency and accuracy of well logs is to compare measured velocities to predicted velocities derived from the resistivity log. Figure 3A shows the measured and predicted velocities at the AC 818#1 well. The P- and S-wave velocities are predicted using the BGTTL with m = 1.8, clay volume content calculated from the gamma log, differential pressure depending on depth, and gas hydrate saturations estimated from the full Archie analysis. The variation and magnitude of predicted P- and S-wave velocities using the resistivity log are similar to those of measured P-wave velocities. However, measured velocities show more details than predicted velocities.

Measured velocity indicates that there are two highly gas hydrate saturated intervals, namely one is between 10,530 to 10,550 ft and the other is 10,560 to 10,582 ft. Also the width of anomalous interval inferred from the measured velocity is smaller than that inferred from the predicted velocity or resistivity. This will be discussed later in detail.

DISCUSSION

Evidence for High Gas Hydrate Saturations at AC818#1 Well

High velocities associated with high resistivities do not necessarily indicate the presence of high gas hydrate saturations in the pore. Evidences that gas hydrate is responsible for well log responses at the AC 818#1 well include:

1) Logs indicate that high resistivity intervals correspond to high P-wave velocity intervals with high density porosities. The density porosities corresponding to high P-wave velocities range from 43% to 58% (fig. 2A). High velocity and high resistivity coupled

with high density porosity is only possible for sediments filled with a pore saturant having high intrinsic acoustic velocity and density close to water. The possible saturants are gas hydrate and ice. On the basis of temperature, therefore, the pore saturant is gas hydrate

2) The predicted P- and S-wave velocities using the saturations estimated from the resistivity supports the assumption of gas hydrates in the pore space (fig. 3A).
3) The relationship between gas hydrate saturation and shale volume or porosity agrees with the natural gas hydrate habitats. Namely, the present data indicate that more gas hydrates accumulate in more cleaner (low gamma) and in higher porosity intervals of the sediments (fig. 4).
4) The relationship between P- and S-wave velocities shown in figure 2B agrees better with the relationship for GHBS at the Mallik 5L-38.
5) Anomalous high velocity and resistivity intervals are within the methane gas hydrate stability zone at this well.

It is noted that logs at the Nankai Trough indicate that the P-wave velocity of 2.5-2.7 km/s and resistivity of about 30 ohm-m characterize the high saturated proven GHBS (60-70% saturations) (Tsuji et al., 2004). These values are similar to those at AC 818#1 well.

Difference Between Predicted and Measured Velocities.

Figure 3A indicates that the difference between predicted and measured velocities is greater for depths between 10,590 and 10,600 ft compared to other interval. As mentioned previously, the measured low S-wave velocity may be caused by the poor quality of S-wave log. However, difference and shape between measured and predicted P-wave velocity are very similar to those for S-wave velocities.

The shaded region in figure 3B shows detailed velocities for this interval. Velocities predicted assuming gas hydrate below 10,582 ft (red dotted line, which is the same as those in figure 3A) are higher than those measured velocities, velocities predicted assuming free gas below (blue line) are smaller for P-wave velocity and larger for S-wave velocity than measured velocities, and velocities assuming water (circle) are similar to measured velocities. The results shown in figure 3B indicate that the gas hydrate /free gas saturations estimated from the resistivities are erroneous in the shade region. Comparison of velocities and saturations near 10,525 ft also indicate the same erroneous gas hydrate saturations from the resistivity. This discrepancy appears to be caused by difference in vertical tool resolutions; the DSI tool had higher vertical resolution than the resistivity tool. Consequently, the thickness of anomalous zone inferred from the resistivity is larger than the thickness inferred from the velocity log.

On the basis of this depth-limited and fair quality velocity log, it is difficult to determine whether the underlying sediments below the anomalous zone contain some free gas or not. As opposed to the low-frequency surface seismic, detecting free gas from the sonic log is difficult, because velocities of partially gas saturated sediments with low saturation in the logging frequency are similar to those of water saturated sediments.

Synthetic Waveforms

The seismic response generated from the measured P-wave velocities is shown in figure 5A using 25 and 70 Hz Ricker wavelets. The seismic response using 25 Hz Ricker wavelet indicates that two high gas hydrate saturated intervals manifest themselves as a single large peak-trough combination, whereas each intervals are shown as a separate peak-trough combinations for the 70 Hz Ricker wavelet. Even at 50 Hz Ricker wavelet, the seismic response is basically a peak-trough combination. A seismic profile crossing the well shows a large peak-trough reflection event for this anomalous interval, indicated with an arrow in figure 5B, and agrees with the synthetic seismogram.

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Collett, T.S., 2000, Quantitative well-log analysis of in-situ natural gas hydrates: Colorado School of Mines, Ph.D. Thesis, Golden, Colorado, 535 p.

Collett, T.S., and Ladd, J., 2000,Detection of gas hydrate with downhole logs and assessment of gas hydrate concentrations (saturations) and gas volumes on the Blake Ridge with electrical resistivity log data, *in* Paull, C.K., Matsumoto, R., Wallace, P.J., and Dillon, W.P., eds., Proceedings of the Ocean Drilling Program, Scientific results, v. 164: College Station, TX, p. 179-191.

Lee, M.W., 2002, Biot-Gassmann theory for velocities of gas hydrate-bearing sediments: Geophysics, v. 67, p. 1711−1719.

Lee, M.W., 2005, Well log analysis to assist the interpretation of 3-D seismic data at Milne Point, North Slope of Alaska: U.S. Geological Survey Scientific Investigations Report 2005-5048, 18 p. http://pubs.usgs.gov/sir/2005/5048.

Tsuji, Yoshihiro, Ishida Hisashi, Nakamizu Masaru, Matsumoto Ryo, and Shimizu, Satoshi, 2004, Overview of the MITI Nankai Trough Wells: A milestone in the evaluation of methane hydrate resources: Resource Geology, v. 54, p. 3-10.

Figure 1

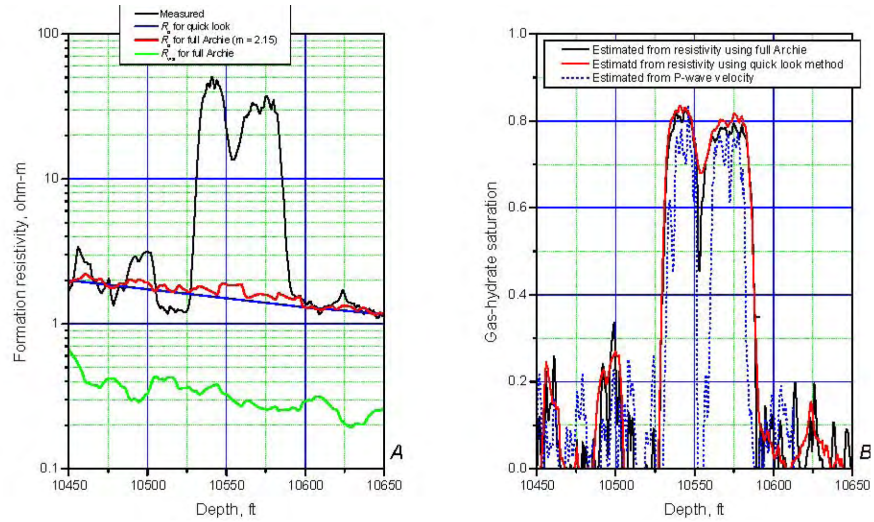


Figure 1. Resistivity and saturations at the AC 818#1 well, Gulf of Mexico. A, Measured resistivity, assumed base line resistivity for the quick look method (solid blue line), estimated Ra from the quick look method (solid green line), and calculated resistivity of water-saturated sediment using the full Archie equation with apparent resistivity given in figure 1A (solid red line). B, Gas hydrate saturations estimated from the quick look method (solid red), from the full Archie equation (solid black line), and from the P-wave velocity (dotted blue line).

Figure 2

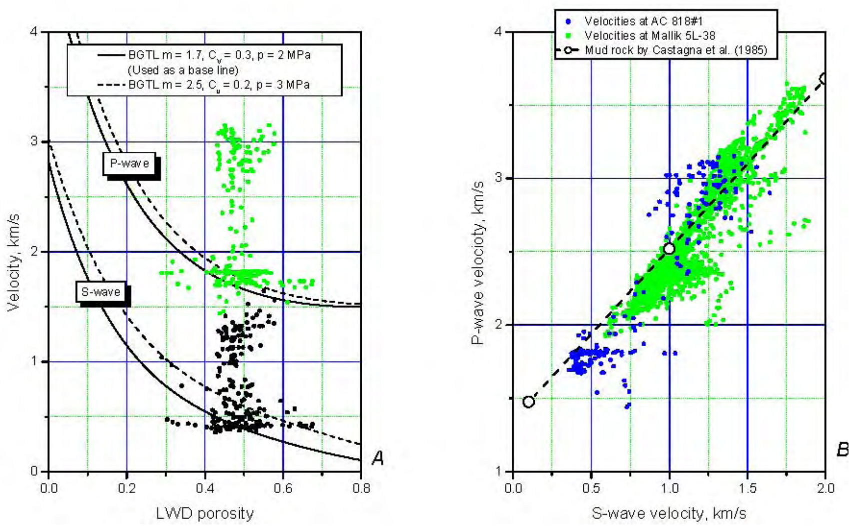


Figure 2. Well log velocities at the AC 818#1 well, Gulf of Mexico. A) Measured P-and S-wave velocities with modeled velocities using the modified Biot-Gassmann theory, the BGTL. B. Relationship between P- and S-wave velocities.

Figure 3

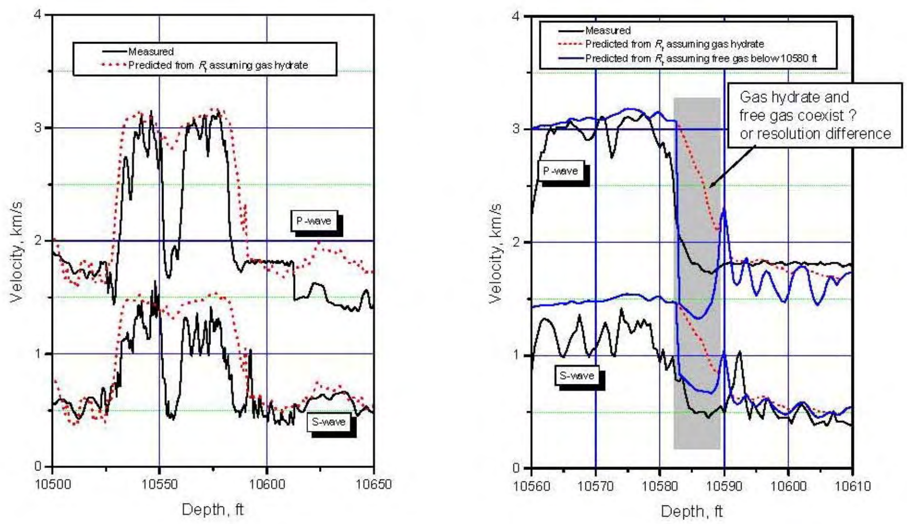


Figure 3. Velocities at the AC 818#1 well, Gulf of Mexico. A) Measured and predicted velocities from the resistivity log.

Figure 4

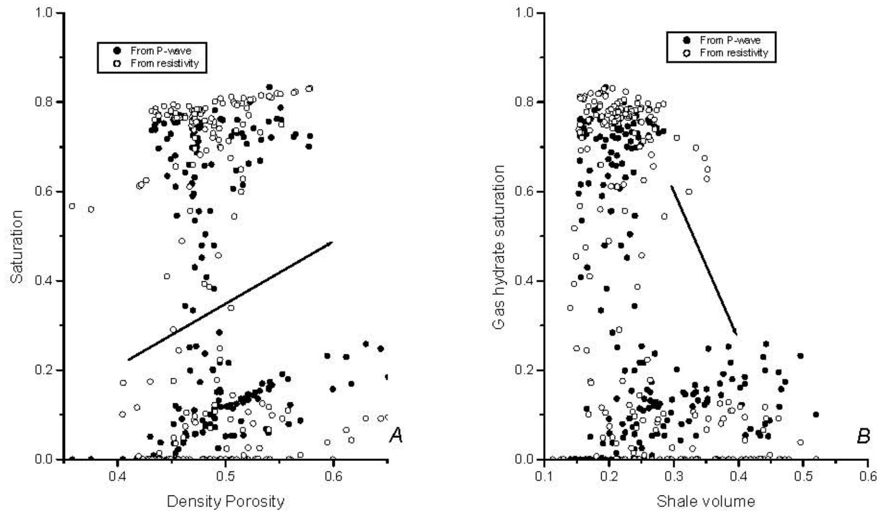


Figure 4. A) Relationship between porosity and gas hydrate saturations estimated from the full Archie equation. B) Relationship between clay volume and gas hydrate saturations estimated from the full Archie equation.

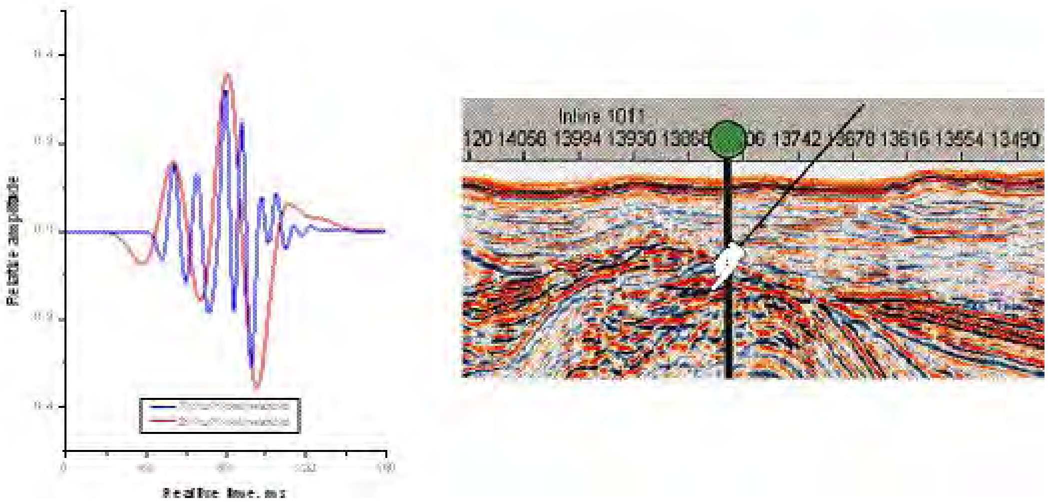


Figure 5. A) Synthetic seismogram generated from the measured P-wave velocities with 25 and 70 Hz Ricker wavelets. B) A seismic profile crossing the AC 818#1 well. The arrow indicates the surface seismic response corresponding to the synthetic seismogram.

APPENDIX 2

Interpretation of seismic profiles near Tiger Shark 818 well

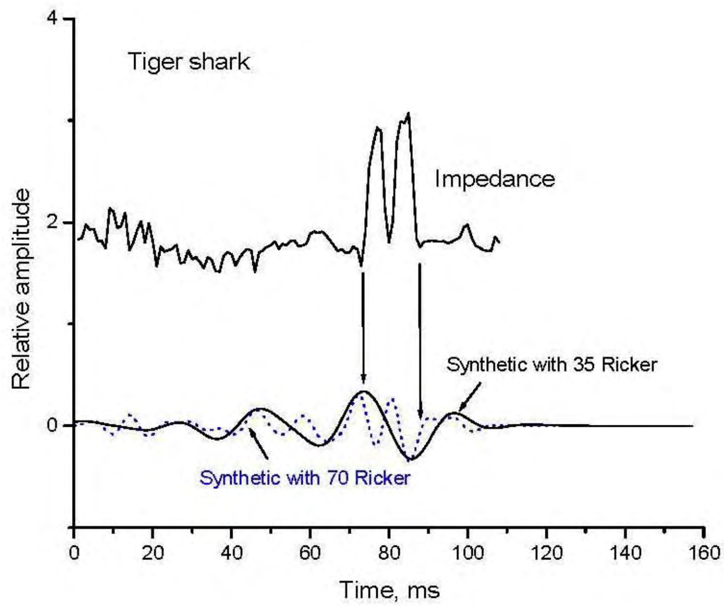
M.W. Lee

The impedance calculated from the log in time domain is plotted in the top part of figure 1. The two-way time of the velocity log given to us is about 100 ms. In the same figure, synthetic seismograms using 35 and 70 Hz Ricker wavelet are also shown. The gas hydrate-bearing sediments (GHBS) inferred from the well log analysis is manifested as a peak–trough combination in 35Hz Ricker wavelet, whereas two separate peak-trough combinations are shown for 70 Hz Ricker wavelet.

The bottom part of figure 1 shows the seismic trace crossing the Tiger Shark 818 well (Inline number is 1009 and the crossline number is 13780) with the shifted synthetic trace using 35 Hz Ricker wavelet. The real seismic data indicate that a strong peak-trough combination represent the GHBS at the Tiger Shark 818#1 well as shown in the synthetic with 35Hz Ricker wavelet.

Figure 2 show an example of seismic profile (X-line 13750) for an interpreted GH prospect. Figure 3 shows a time slice at 4136 ms (top) and amplitude map of prospect (bottom). The slides Emery sent us contain 7 mapped amplitude anomalies and potential prospects. Prospect C by Schlumberger is similar (same) to our prospect.

Schlumberger's interpretation is based on picking strong peaks for the potential gas hydrate prospects above the BHSZ. I don't know whether the local geology played a part in choosing the prospects or any inversion results have been incorporated into the interpretation. I agree with their picking peaks for the gas hydrate prospect. However, without any other information, I cannot assess their interpretation.


Tiger shark
Impedance
Synthetic with 35 Ricker
Synthetic with 70 Ricker
Relative amplitude
Time, ms
4
2
0
0
20
40
60
80
100
120
140
160

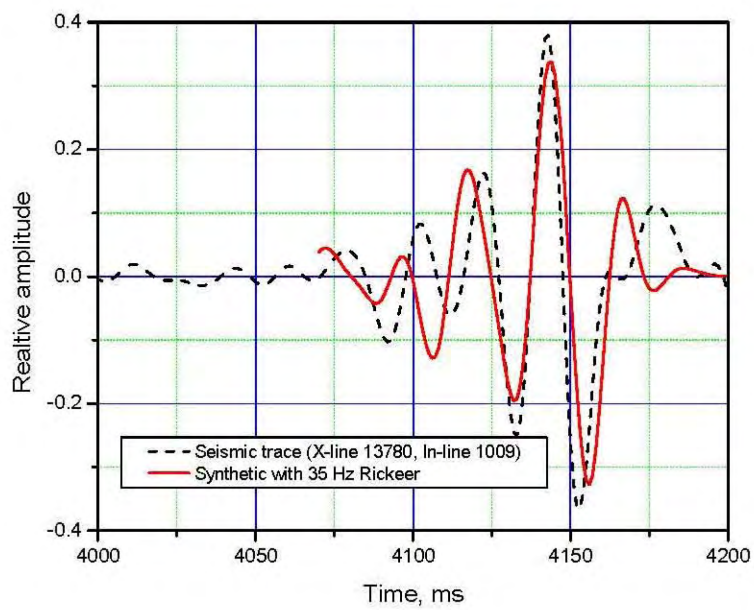

Realtive amplitude
Time, ms
Seismic trace (X-line 13780, In-line 1009)
Synthetic with 35 Hz Rickeer
0.4
0.2
0.0
-0.2
-0.4
4000
4050
4100
4150
4200

Figure 1.

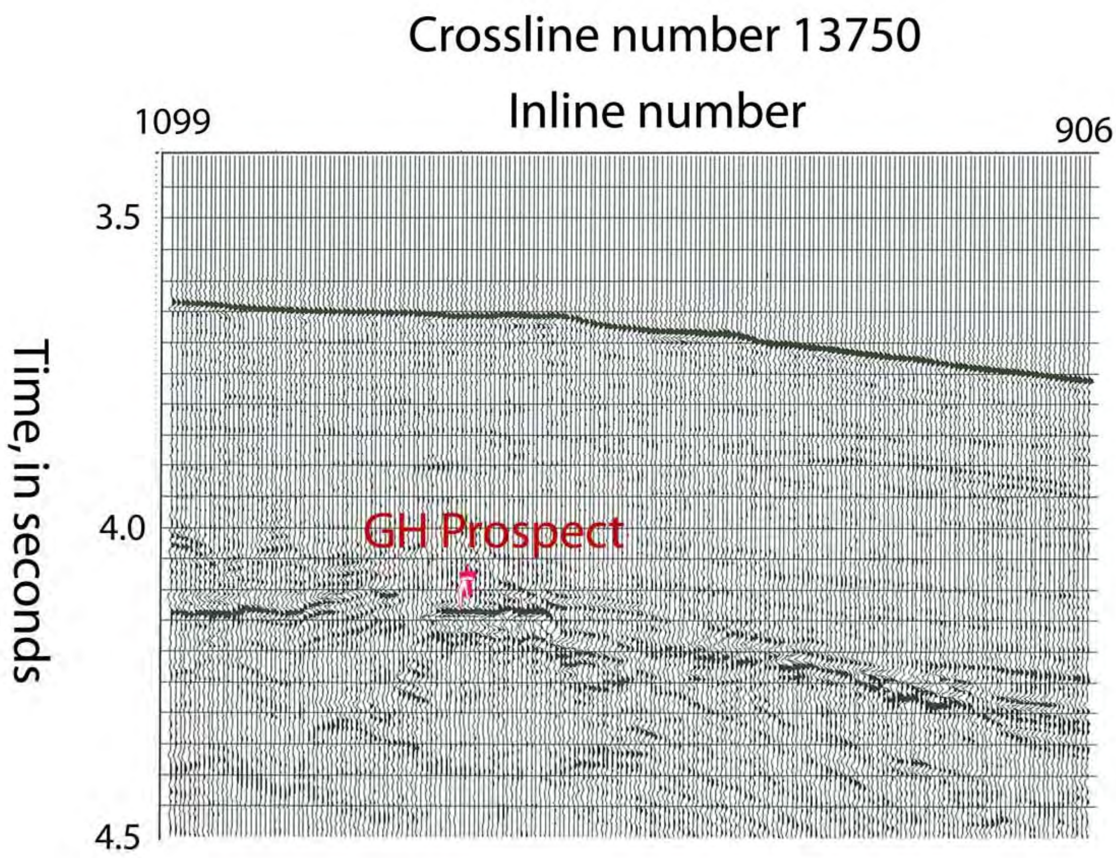
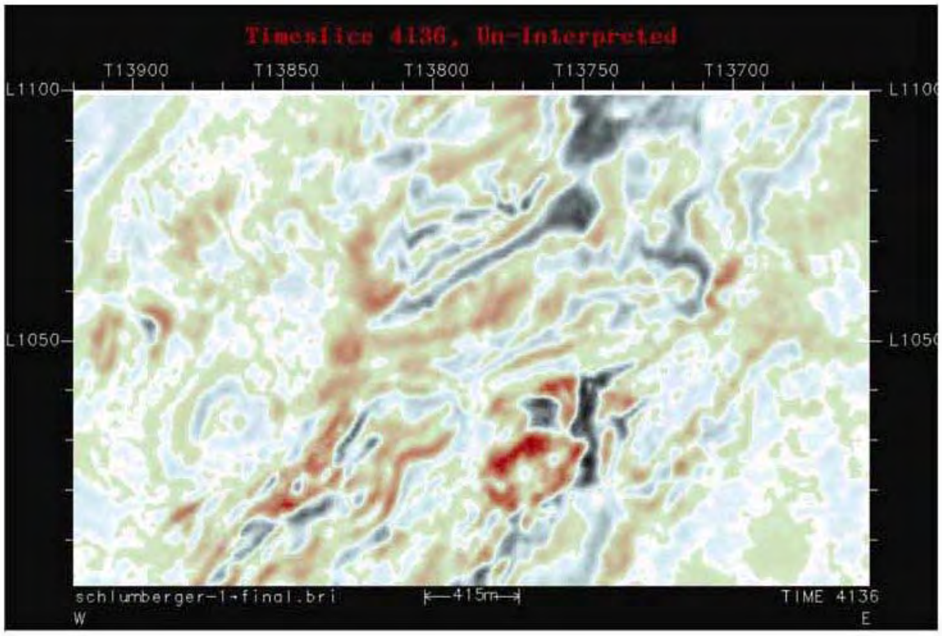

Crossline number 13750
Inline number
1099
906
3.5
4.0
4.5
Time, in seconds
GH Prospect

Figure 2.


Timeslice 4136, Un-Interpreted
T13900
T13850
T13800
T13750
T13700
L1100
L1050
schlumberger-1-final.bri
415m
TIME 4136
W
E

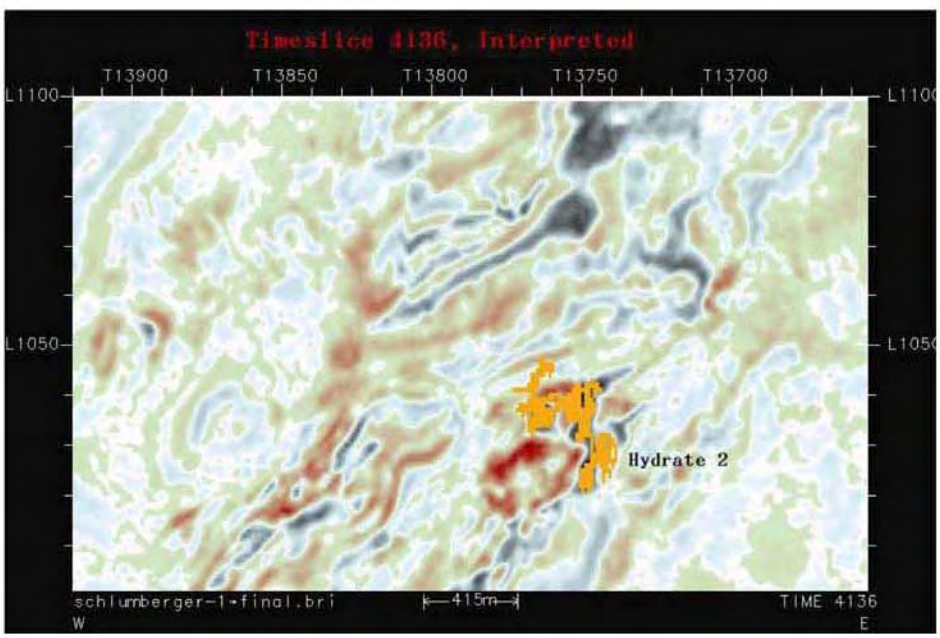

Timeslice 4136, Interpreted
T13900
T13850
T13800
T13750
T13700
L1100
L1050
Hydrate 2
schlumberger-1-final.bri
415m
TIME 4136
W
E

Figure 3

APPENDIX 3

Hydrates JIP Phase III: Alaminos Canyon

Drilling Target Documentation

The following pages provide three tables of tabulated information, seismic cross sections and a location map for each of the 18 sites.

Hydrates JIP Phase III: Alaminos Canyon (AC775) Target 1

Table 1: Background Information

Date of Information	*31 October 2007*
General Site Objective	Testing WG inversions of saturation and thickness of gas hydrate system
Drilling target and Specific Hole Objective	*Gas Hydrate saturated Frio Sand.* *Test area of maximum predicted saturation and best location for high peak over trough anomaly. Test seismic prediction at north end of mapped anomaly*
Other Drilling in Vicinity	AC818#1

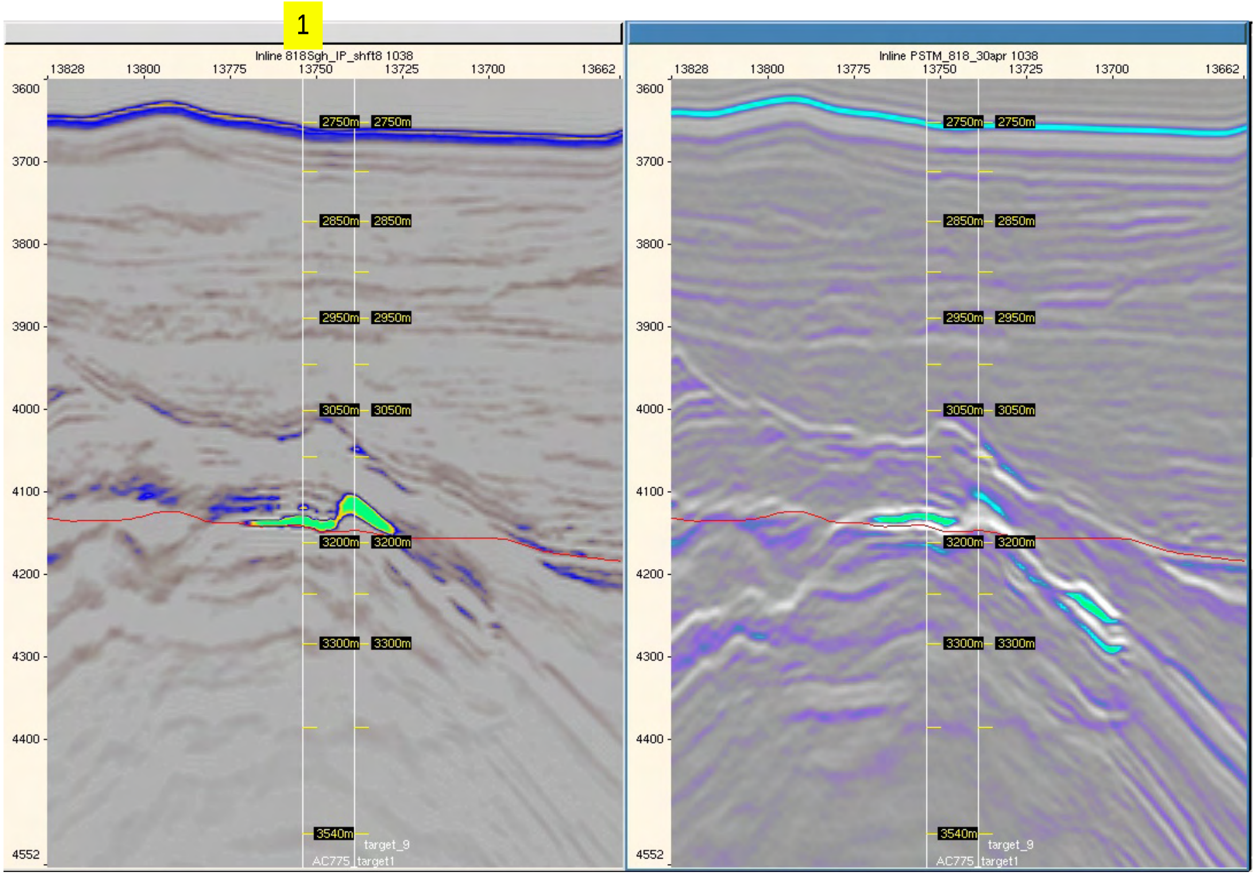
Table 2: Proposed Hole General Information

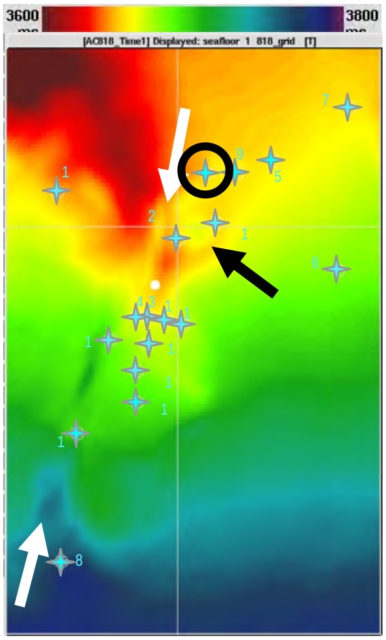
Site Name	AC775 Target-1
General Area	Tiger Shark, seaward of Sigsbee escarpment, 20 km north of Mexico/U.S. boundary
Location	Latitude: 26d 11' 11.0" N Longitude: 94d 37' 10.8" W
Coordinate Datum	*NAD27*
Water Depth	9004 ft
OPD/Lease Block	AC775
Seismic line showing hole	ACA1 – inline1038 crossline 13754

Table 3: Proposed Hole Drilling Information

Proposed penetration	>1456 ft (1456' = sea floor to base of gh interval)
Expected lithologies	Muds, silts, volcanic sand at GH interval
Expected sediment ages/section	PlioPleistocene, then unconformity and Oligocene Frio Sand
Estimated depth to BGHS	10,460 ft (within Frio SS)
Base of Frio SS	10870 ft
Estimated GH interval	10,414 – 10,460 ft. (Frio SS)
Estimated GH saturation	max.Sgh=95%, ProbSS=95%,ProbCharge=95% (Frio SS)
Anomalous condns?	
Other relevant information	Seeps occur in the area. This tests the "c" anomaly (~70 acres, strong amplitudes). Among the highest predicted Sgh.

Target 1 (AC775)





Upper: Seismic data processed by WesternGeco. Vertical axis is two way travel time in milliseconds. Horizontal axes are trace numbers, with nominal spacing of 12.5 m. Left (saturation section), Right (pre-stack time migration).
Lower: Bathymetric map showing target location (circled). Color bar in two way travel time (milliseconds). A narrow channel runs south, southwest to north, northeast (white arrows). A small circular sea-floor depression (crater) exists south of target 1 (black arrow).

Hydrates JIP Phase III: Alaminos Canyon (AC819) Target 2

Table 1: Background Information

Date of Information	*31 October 2007*
General Site Objective	Testing WG inversions of saturation and thickness of gas hydrate system
Drilling target and Specific Hole Objective	Gas Hydrate saturated Frio Sand. Test similar to AC775-site 1, but with thicker section and slightly lower gas hydrate saturation
Other Drilling in Vicinity	AC818#1

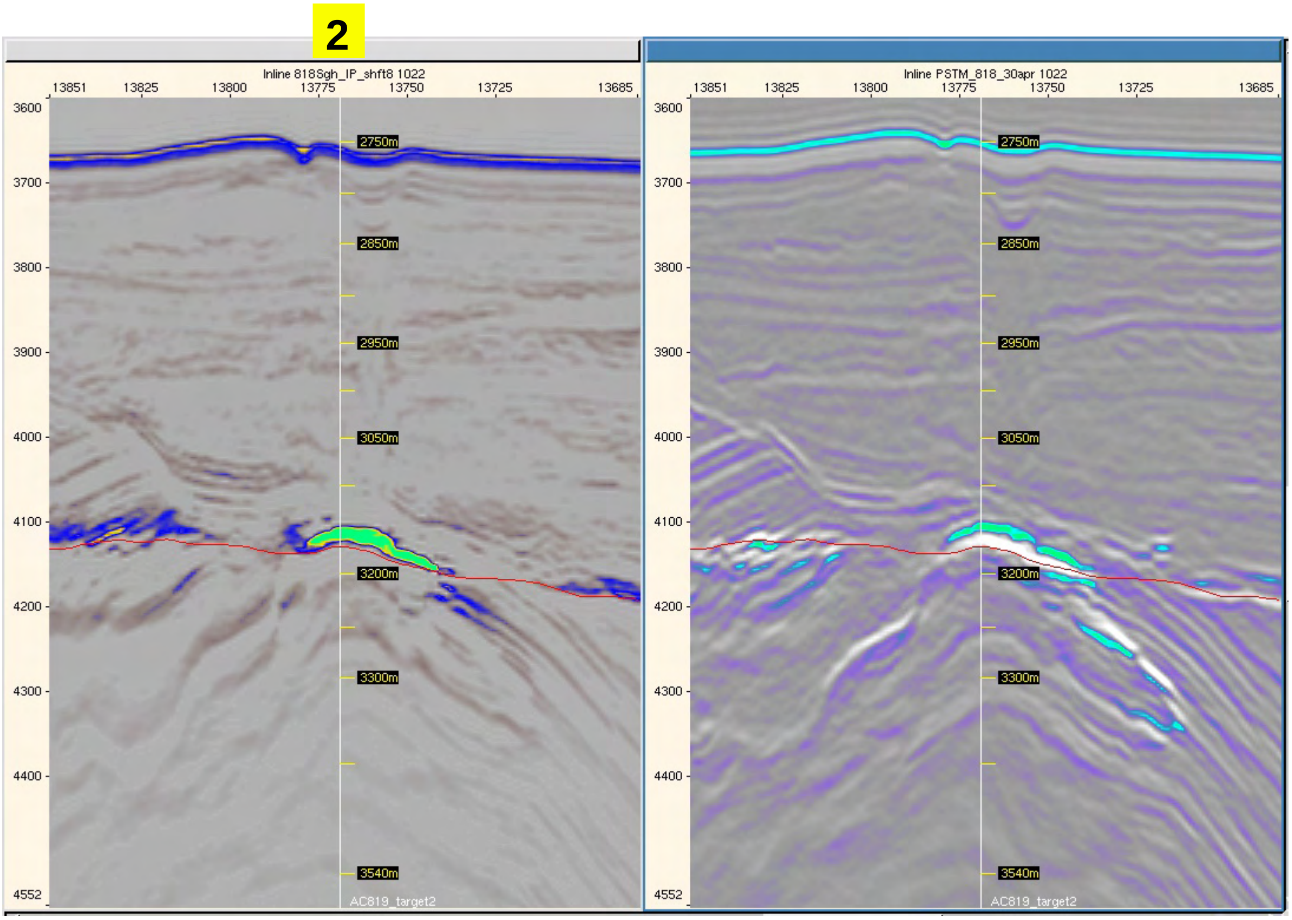
Table 2: Proposed Hole General Information

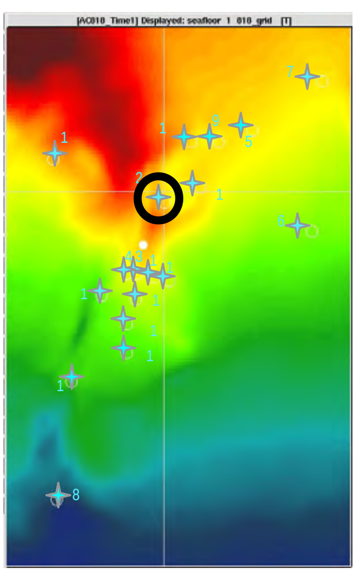
Site Name	AC819 Target-2
General Area	Tiger Shark, seaward of Sigsbee escarpment, 20 km north of Mexico/U.S. boundary
Location	Latitude: 26d 10' 58.0" N Longitude: 94d 37' 17.3" W
Coordinate Datum	*NAD27*
Water Depth	9004 ft.
OPD/Lease Block	AC819
Seismic line showing hole	ACA1 – inline1022 crossline 13769

Table 3: Proposed Hole Drilling Information

Proposed penetration	>1436 ft (1485' = sea floor to estimated BGHS)
Expected lithologies	muds, silts, volcanic sand at GH interval
Expected sediment ages/section	PlioPleistocene, then unconformity and Oligocene
Estimated depth to BGHS	10,440 ft. (within Frio SS)
Estimated GH interval	10,332 – 10,411 ft (Frio SS)
Base of Frio SS	10675 ft
Estimated GH saturation	max.Sgh=91%, ProbSS=95%,ProbCharge=95% (Frio SS)
Anomalous conditions?	Near crater in seafloor and apparent gas chimney in the subsurface.
Other relevant information	This tests the "c" anomaly (~70 acres, strong amplitudes).

Target 2 (AC819)





Upper: Seismic data processed by WesternGeco. Vertical axis is two way travel time in milliseconds. Horizontal axes are trace numbers, with nominal spacing of 12.5 m. Left (saturation section), Right (pre-stack time migration).
Lower: Bathymetric map showing target location (circled). See Target 1 for color bar.

Hydrates JIP Phase III: Alaminos Canyon (AC818) Target 3

Table 1: Background Information

Date of Information	*31 October 2007*
General Site Objective	Testing WG inversions of saturation and thickness of gas hydrate system
Drilling target and Specific Hole Objective	Gas hydrate saturated Frio Sand. To test variation in reservoir quality along strike of anticline with slightly different amplitudes and saturations. To provide close offset of existing well to test for short-distance heterogeneities
Other Drilling in Vicinity	AC818#1

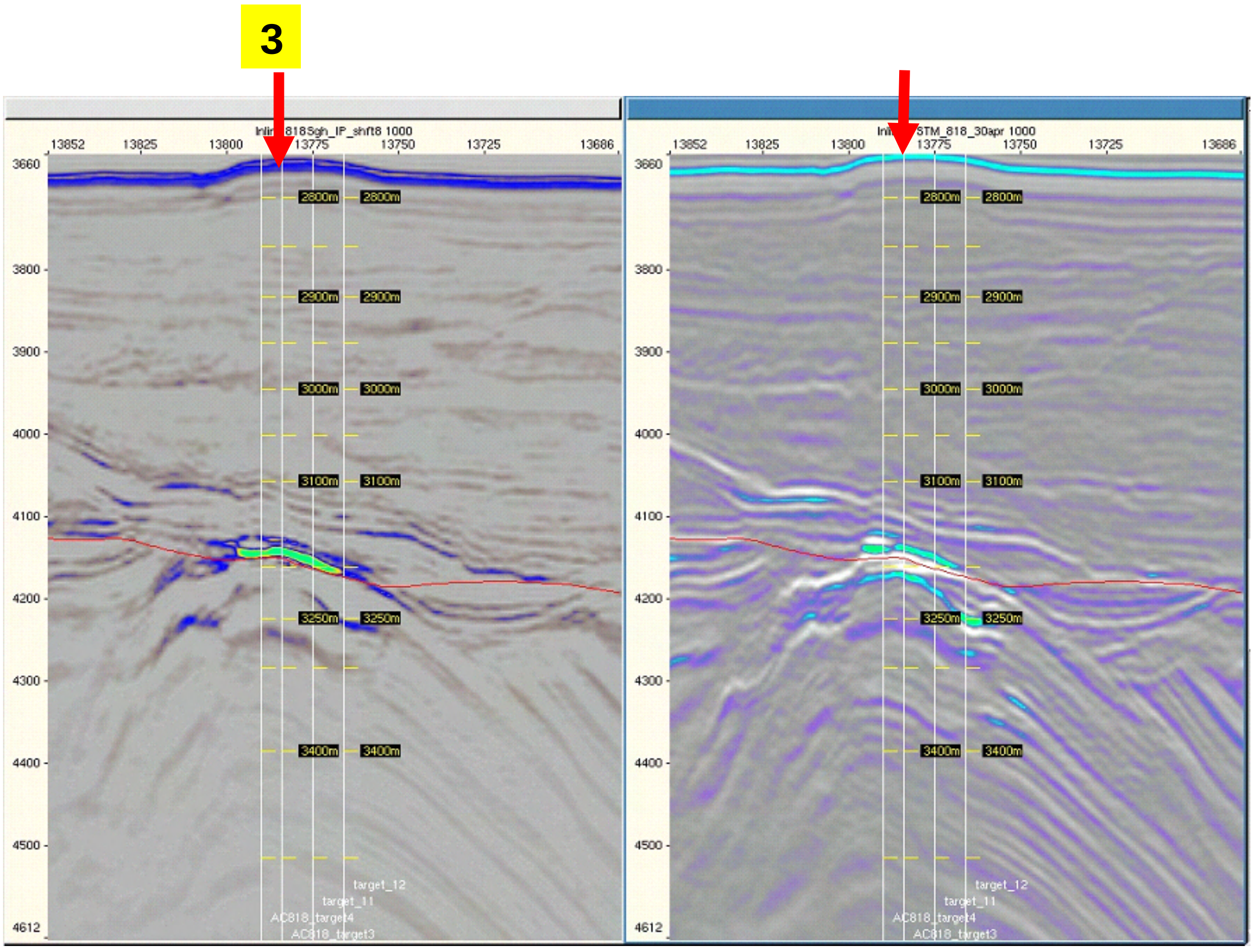
Table 2: Proposed Hole General Information

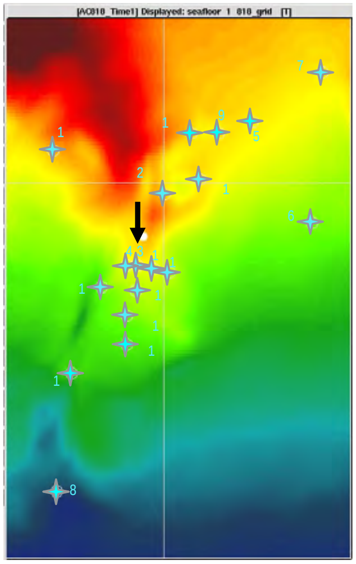
Site Name	AC818 Target-3
General Area	Tiger Shark, seaward of Sigsbee escarpment, 20 km north of Mexico/U.S. boundary
Location	Latitude: 26d 10' 40.8" N Longitude: 94d 37' 23.9" W
Coordinate Datum	*NAD27*
Water Depth	9019 ft
OPD/Lease Block	AC818
Seismic line showing hole	ACA1 – inline1000 crossline 13784

Table 3: Proposed Hole Drilling Information

Proposed penetration	>1484 ft (1484' = sea floor to estimated BGHS)
Expected lithologies	Muds, silts, volcanic sand at GH interval
Expected sediment ages/section	PlioPleistocene, then unconformity and Oligocene
Estimated depth to BGHS	10,503 ft
Base Frio SS	10754 ft
Estimated GH interval	10,435 – 10479 ft (Frio SS)
Estimated GH saturation	max.Sgh=91%, ProbSS=99%,ProbCharge=98% (Frio SS)
Anomalous conditions?	
Other relevant information	Site selected was based on Sgh inversion results. This site is similar to AC818 site-4. This tests the "f" anomaly (~65 acres, patchy amplitudes). Potentially a thin, overlying Pleistocene GH occurs here.

Target 3 (AC818)





Upper: Seismic data processed by WesternGeco. Vertical axis is two way travel time in milliseconds. Horizontal axes are trace numbers, with nominal spacing of 12.5 m. Left (saturation section), Right (pre-stack time migration).
Lower: Bathymetric map showing target location (arrow). See Target 1 for color bar.

Hydrates JIP Phase III: Alaminos Canyon (AC818) Target 4

Table 1: Background Information

Date of Information	*31 October 2007*
General Site Objective	Testing WG inversions of saturation and thickness of gas hydrate system
Drilling target and Specific Hole Objective	Gas hydrate saturated Frio Sand Close offset to 3, but to test nature of unique seismic response (multiple prospective layers that could be gh in a second layer (Pleistocene) or an effect of tuning at the unconformity)
Other Drilling in Vicinity	AC818#1

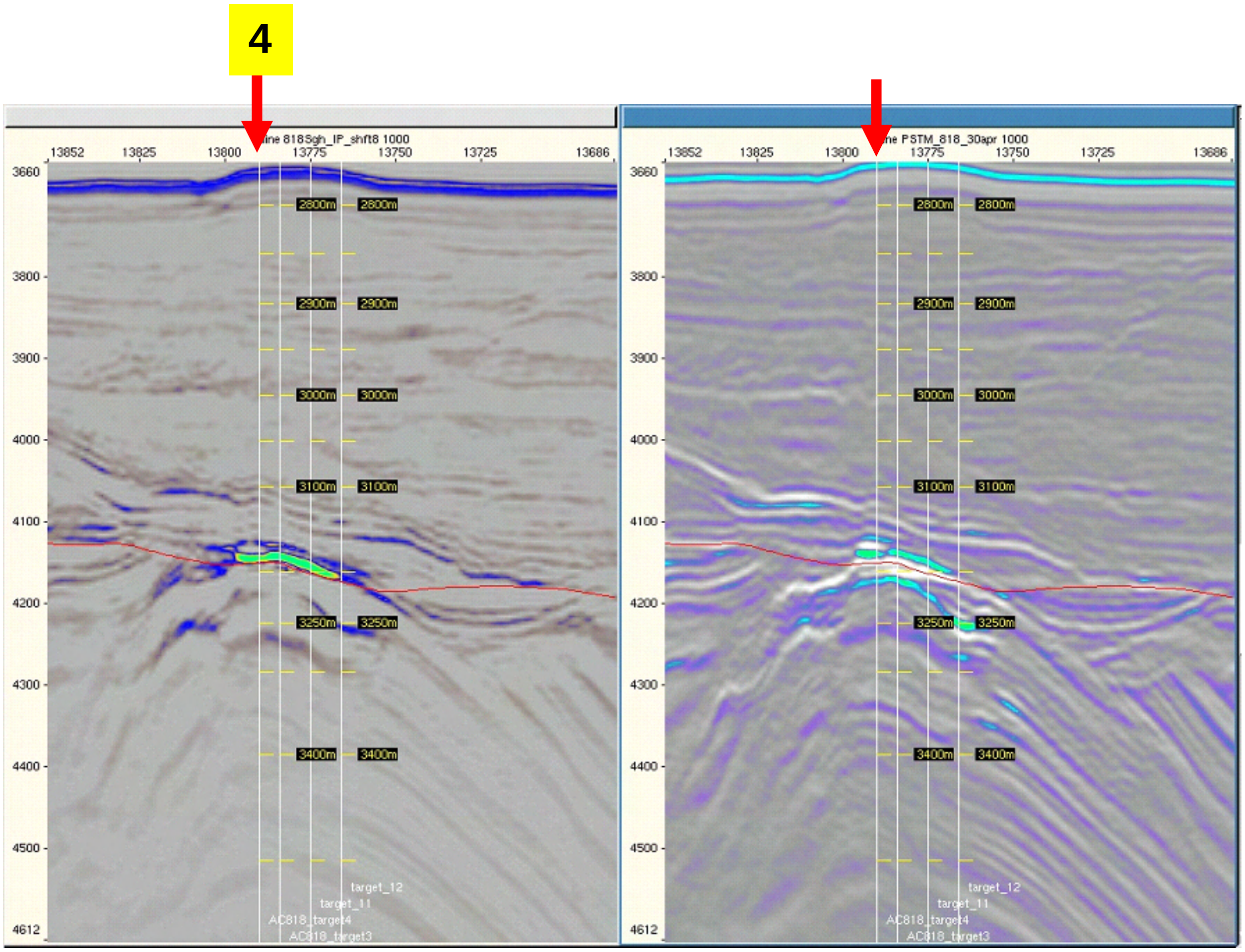
Table 2: Proposed Hole General Information

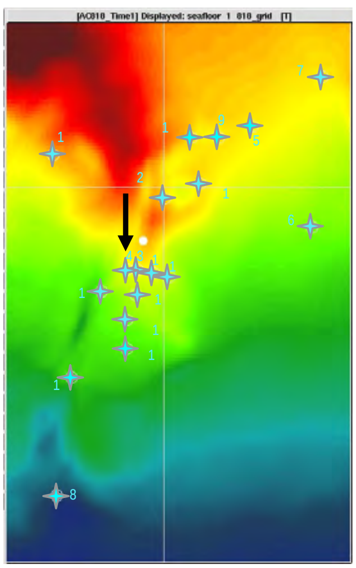
Site Name	AC818 Target-4
General Area	Tiger Shark, seaward of Sigsbee escarpment, 20 km north of Mexico/U.S. boundary
Location	Latitude: 26d 10' 40.8" N Longitude: 94d 37' 26.5" W
Coordinate Datum	*NAD27*
Water Depth	9026 ft
OPD/Lease Block	AC818
Seismic line showing hole	ACA1 – inline1000 crossline 13790

Table 3: Proposed Hole Drilling Information

Proposed penetration	>1475 ft (1475' = sea floor to estimated BGHS)
Expected lithologies	Muds, silts, volcanic sand at GH interval
Expected sediment ages/section	PlioPleistocene, then unconformity and Oligocene
Estimated depth to BGHS	10,501 ft
Base Frio SS	10,742 ft
Estimated GH interval	10,436 – 10,480 ft. (Frio SS)
Estimated GH saturation	max.Sgh=87%, ProbSS=99%,ProbCharge=98% (Frio SS)
Other Anomalous?	
Other relevant information	Site selected was based on seismic migration amplitudes. This is similar to AC818 site-3. This tests the "f" anomaly (~65 acres, patchy amplitudes). Potentially a thin, overlying Pleistocene GH occurs here.

Target 4 (AC818)





Upper: Seismic data processed by WesternGeco. Vertical axis is two way travel time in milliseconds. Horizontal axes are trace numbers, with nominal spacing of 12.5 m. Left (saturation section), Right (pre-stack time migration). Moved annotation over to the leftmost well.
Lower: Bathymetric map showing target location (arrow). See Target 1 for color bar.

Hydrates JIP Phase III: Alaminos Canyon (AC775) Target 5

Table 1: Background Information

Date of Information	*31 October 2007*
General Site Objective	Testing WG inversions of saturation and thickness of gas hydrate system
Drilling target and Specific Hole Objective	Reference sit of partially truncated section of Frio ss. To test Frio section in area with strong seismic amplitudes (fizz-gas) in order to delineate physical properties of the reservoir outside of the hydrate stability zone.
Other Drilling in Vicinity	AC818#1

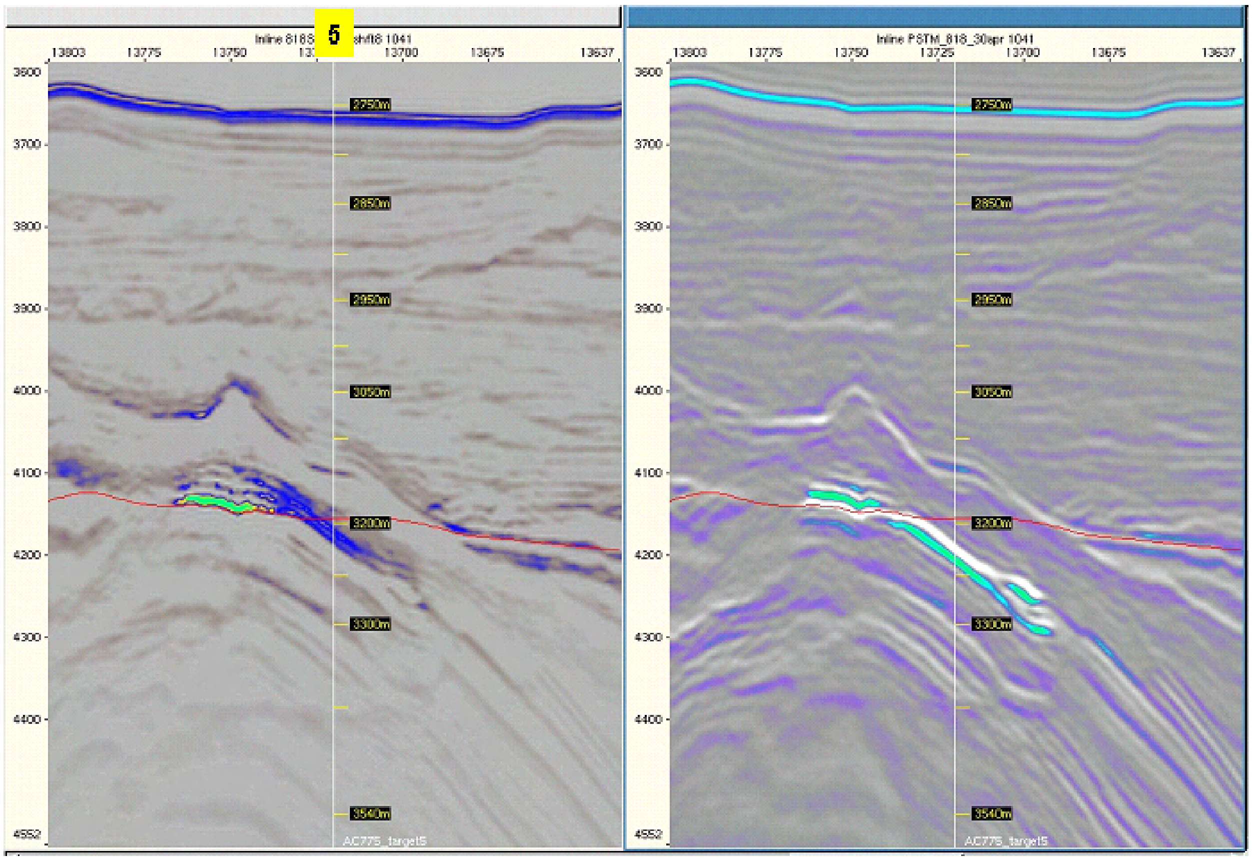
Table 2: Proposed Hole General Information

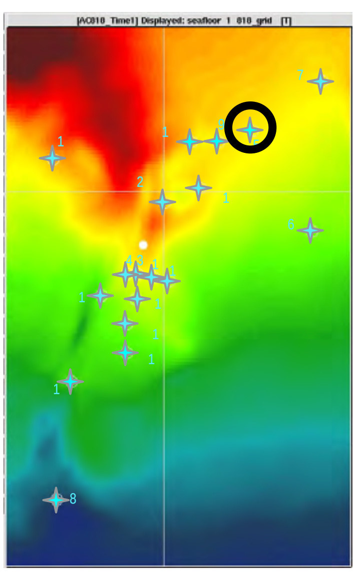
Site Name	AC775 Target-5
General Area	Tiger Shark, seaward of Sigsbee escarpment, 20 km north of Mexico/U.S. boundary
Location	Latitude: 26d 11' 13.6" N Longitude: 94d 36' 55.5" W
Coordinate Datum	*NAD27*
Water Depth	9011 ft.
OPD/Lease Block	AC775
Seismic line showing hole	ACA1 – inline1041 crossline 13720

Table 3: Proposed Hole Drilling Information

Proposed penetration	>1538 ft (sea floor to estimated BGHS)
Expected lithologies	Muds, silts ,volcanic sand
Expected sediment ages/section	PlioPleistocene, then unconformity and Oligocene
Estimated depth to BGHS	10,549 ft
Base of Frio SS	11,500 ft
Estimated GH interval	10,327 – 10376 ft (Pleistocene)
Estimated GH saturation	max.Sgh=20%, ProbSS=50%,ProbCharge=90% (Pleistocene)
Anomalous conditions?	
Other relevant information	Frio is on flank of structure but partially truncated by unconformity. It is expected to contain fizz-gas. There is low potential for overlying GH in Pleistocene section.

Target 5 (AC775)





Upper: Seismic data processed by WesternGeco. Vertical axis is two way travel time in milliseconds. Horizontal axes are trace numbers, with nominal spacing of 12.5 m. Left (saturation section), Right (pre-stack time migration).

Lower: Bathymetric map showing target location (circled). See Target 1 for color bar.

Hydrates JIP Phase III: Alaminos Canyon (AC819) Target 6

Table 1: Background Information

Date of Information	*31 October 2007*
General Site Objective	Delineate rock properties of primary reservoir (Frio SS) in the area, and secondarily, delineate extent and thickness of gas hydrate in Pleistocene section
Drilling target and Specific Hole Objective	Uneroded, water-bearing Frio ss. To delineate physical properties of the reservoir without hydrocarbons. Also to provide test anomalous responses in overlying Pleistocene (possible low saturations of gas hydrate).
Other Drilling in Vicinity	AC818#1

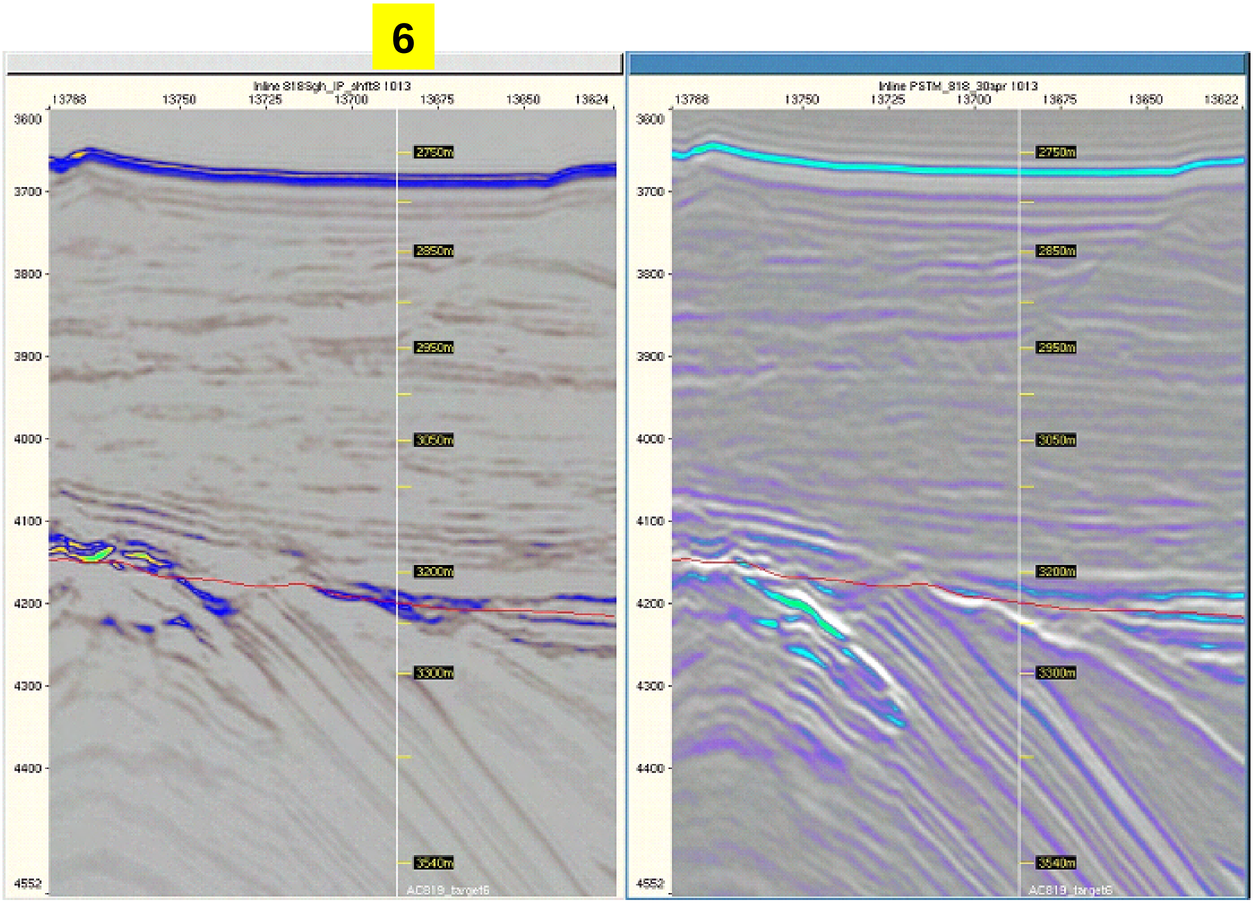
Table 2: Proposed Hole General Information

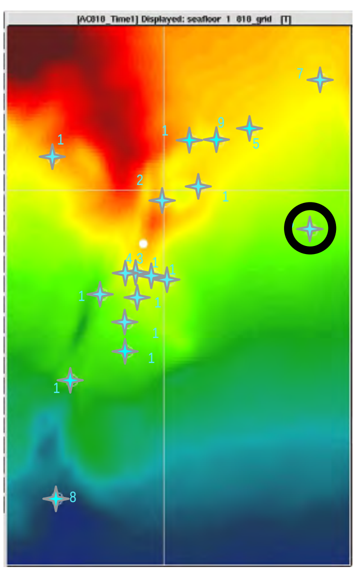
Site Name	AC819 Target-6
General Area	Tiger Shark, seaward of Sigsbee escarpment, 20 km north of Mexico/U.S. boundary
Location	Latitude: 26d 10' 51.1" N Longitude: 94d 36' 40.3" W
Coordinate Datum	*NAD27*
Water Depth	9058 ft
OPD/Lease Block	AC819
Seismic line showing hole	ACA1 – inline 1013 crossline 13687

Table 3: Proposed Hole Drilling Information

Proposed penetration	>2442 ft (2442' = sea floor to base Frio, which is below BGHS)
Expected lithologies	Muds, silts, sand at GH interval
Expected sediment ages/section	PlioPleistocene, then unconformity and Oligocene (including Frio SS)
Estimated depth to BGHS	10,673 ft (Pleistocene) (note this is less than estimated depth to base of GH interval)
Base Frio SS	11500 ft
Estimated GH interval	10568 – 10701 ft (Pleistocene)
Estimated GH saturation	max.Sgh=35%, ProbSS=50%,ProbCharge=50% (Pleistocene)
Anomalous conditions?	
Other relevant information	Frio is on flank of structure and not truncated by unconformity allowing a complete section of this reservoir to be tested for rock properties. It is expected to be wet.

Target 6 (AC819)





Upper: Seismic data processed by WesternGeco. Vertical axis is two way travel time in milliseconds. Horizontal axes are trace numbers, with nominal spacing of 12.5 m. Left (saturation section), Right (pre-stack time migration).
Lower: Bathymetric map showing target location (circled). See Target 1 for color bar.

Hydrates JIP Phase III: Alaminos Canyon (AC775) Target 7

Table 1: Background Information

Date of Information	*31 October 2007*
General Site Objective	Testing WG inversions of saturation and thickness of gas hydrate system
Drilling target and Specific Hole Objective	Gas hydrate in Pleistocene above Oligocene unconformity. Determine nature of anomalous seismic amplitudes in Pleistocene (?) section above possible gas charge (possible gas hydrate effects with complications due to geometries of unconformities)
Other Drilling in Vicinity	AC818#1

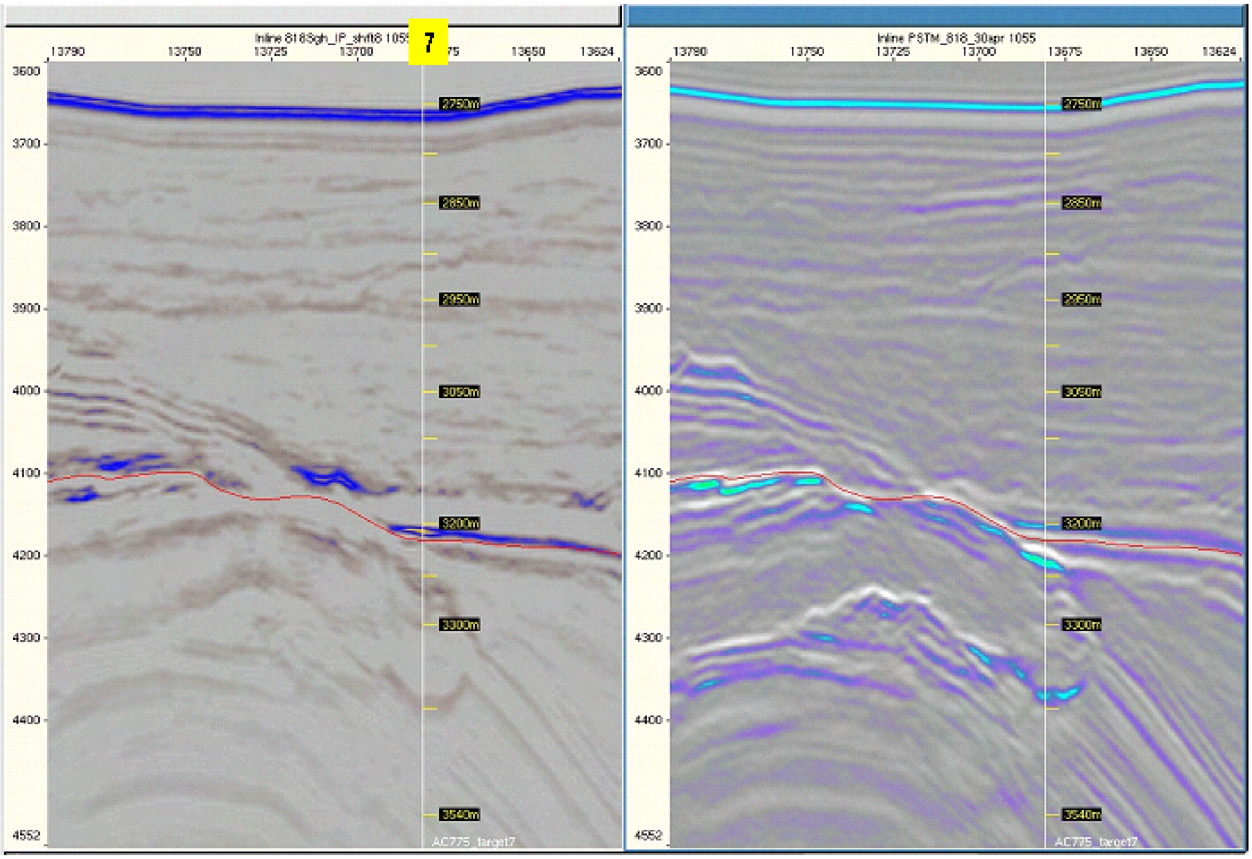
Table 2: Proposed Hole General Information

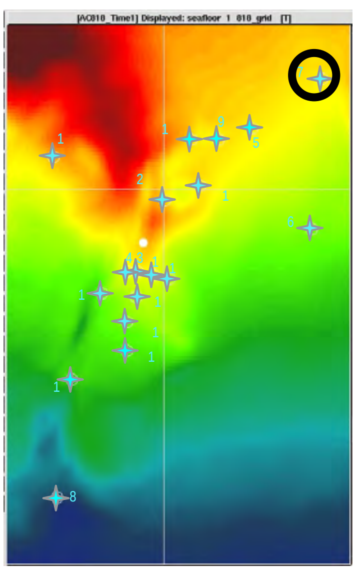
Site Name	AC775 Target-7
General Area	Tiger Shark, seaward of Sigsbee escarpment, 20 km north of Mexico/U.S. boundary
Location	Latitude: 26d 11' 25.2" N Longitude: 94d 36' 38.1" W
Coordinate Datum	*NAD27*
Water Depth	9009 ft
OPD/Lease Block	AC775
Seismic line showing hole	ACA1 – inline1055 crossline 13681

Table 3: Proposed Hole Drilling Information

Proposed penetration	>1628 ft (1628' = sea floor to base GH interval in Pleistocene)
Expected lithologies	Muds, silts,samd??
Expected sediment ages/section	PlioPleistocene, may be Miocenen, then unconformity and Oligocene
Estimated depth to BGHS	10,611 ft (Pleistocene) [note < estimated base of GH interval in Pleistocene]
Base Frio SS	11195 ft
Estimated GH interval	10,513 – 10,637 ft (Pleistocene)
Estimated GH saturation	max.Sgh=43%, ProbSS=50%,ProbCharge= 70% (Pleistocene)
Anomalous conditions?	
Other relevant information	Frio is on flank of structure but partially truncated by unconformity. It is expected to be wet.

Target 7 (AC775)





Upper: Seismic data processed by WesternGeco. Vertical axis is two way travel time in milliseconds. Horizontal axes are trace numbers, with nominal spacing of 12.5 m. Left (saturation section), Right (pre-stack time migration).
Lower: Bathymetric map showing target location (circled). See Target 1 for color bar.

Hydrates JIP Phase III: Alaminos Canyon (AC818) Target 8

Table 1: Background Information

Date of Information	*31 October 2007*
General Site Objective	Testing WG inversions of saturation and thickness of gas hydrate system
Drilling target and Specific Hole Objective	Pleistocene gas hydrate deposit above down-dropped Frio. Test nature of strong peak at top of anomaly and provide test of non-Frio lithologies in optimal structural position for GH formation (actually, not sure I see this peak on the illustration, but it may be there).
Other Drilling in Vicinity	AC818#1

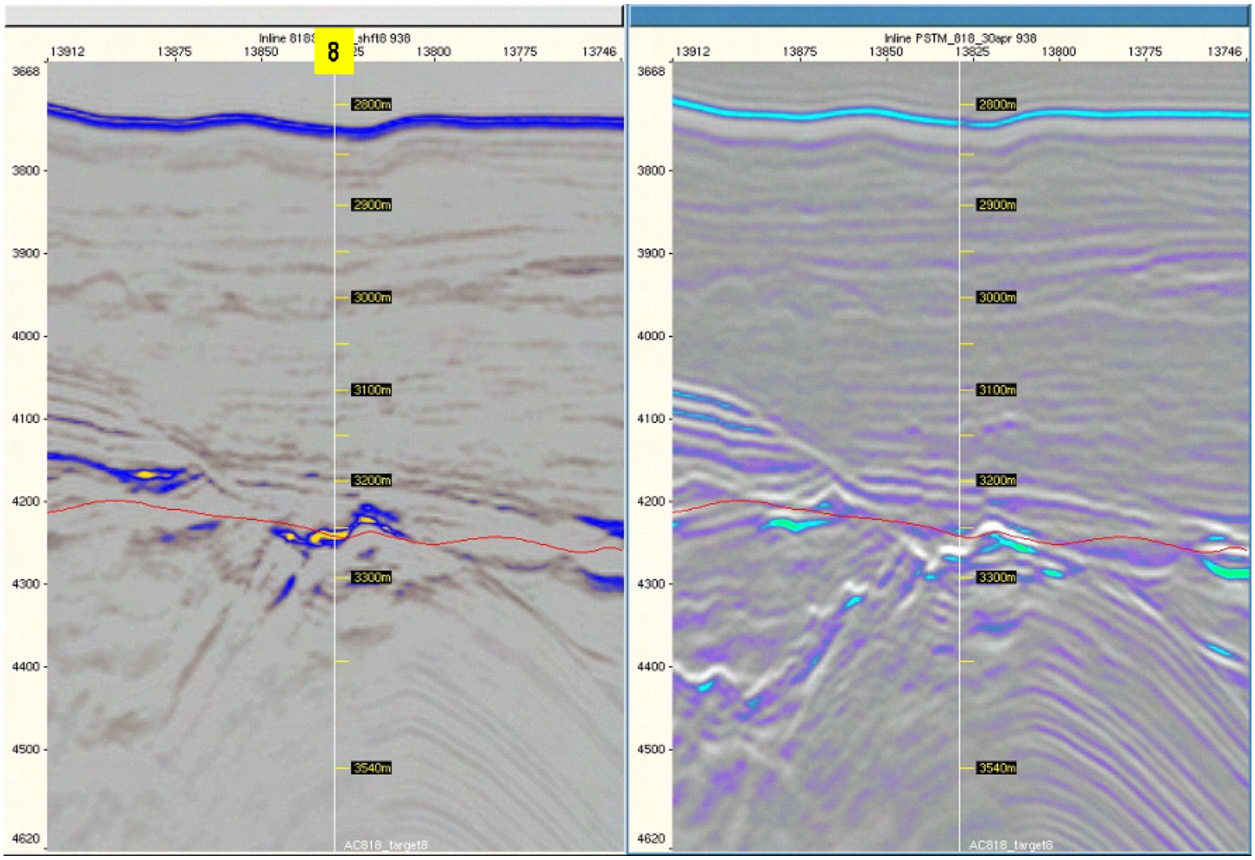
Table 2: Proposed Hole General Information

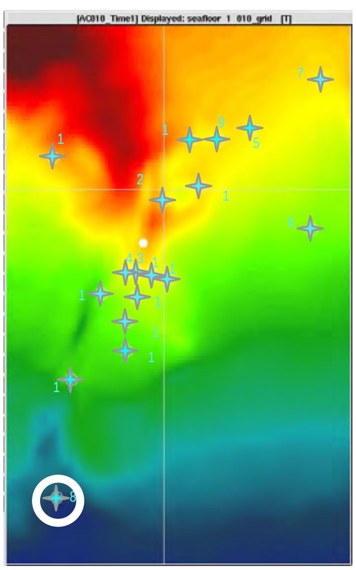
Site Name	AC818 Target-8
General Area	Tiger Shark, seaward of Sigsbee escarpment, 20 km north of Mexico/U.S. boundary
Location	Latitude: 26d 09' 49.4" N Longitude: 94d 37' 43.4" W
Coordinate Datum	*NAD27*
Water Depth	9221 ft
OPD/Lease Block	AC818
Seismic line showing hole	ACA1 – inline938 crossline 13829

Table 3: Proposed Hole Drilling Information

Proposed penetration	>1755 ft (1755' = sea floor to estimated BGHS)
Expected lithologies	For example, muds, silts, sand at GH interval
Expected sediment ages/section	*PlioPleistocene, then unconformity and Oligocene*
Estimated depth to BGHS	10,776 ft
Base Frio SS	10950 ft
Estimated GH interval	10,678 – 10,757 ft (Pleistocene)
Estimated GH saturation	max Sgh=53%, ProbSS=50%, ProbCharge= 75% (Pleistocene)
Anomalous conditions?	
Other relevant information	GH anomaly seems to be Pleistocene directly on top of Frio SS (fiz-gas)

Target 8 (AC818)





Upper: Seismic data processed by WesternGeco. Vertical axis is two way travel time in milliseconds. Horizontal axes are trace numbers, with nominal spacing of 12.5 m. Left (saturation section), Right (pre-stack time migration).
Lower: Bathymetric map showing target location (circled). See Target 1 for color bar.

Hydrates JIP Phase III: Alaminos Canyon (AC775) Target 9

Table 1: Background Information

Date of Information	*31 October 2007*
General Site Objective	Testing WG inversions of saturation and thickness of gas hydrate system
Drilling target and Specific Hole Objective	Frio in anomaly c in an area with the thickest section of gas hydrate. To test area with potentially thick reservoir in possible upthrown fault block with estimated saturations equivalent to that of the existing well.
Other Drilling in Vicinity	AC818#1

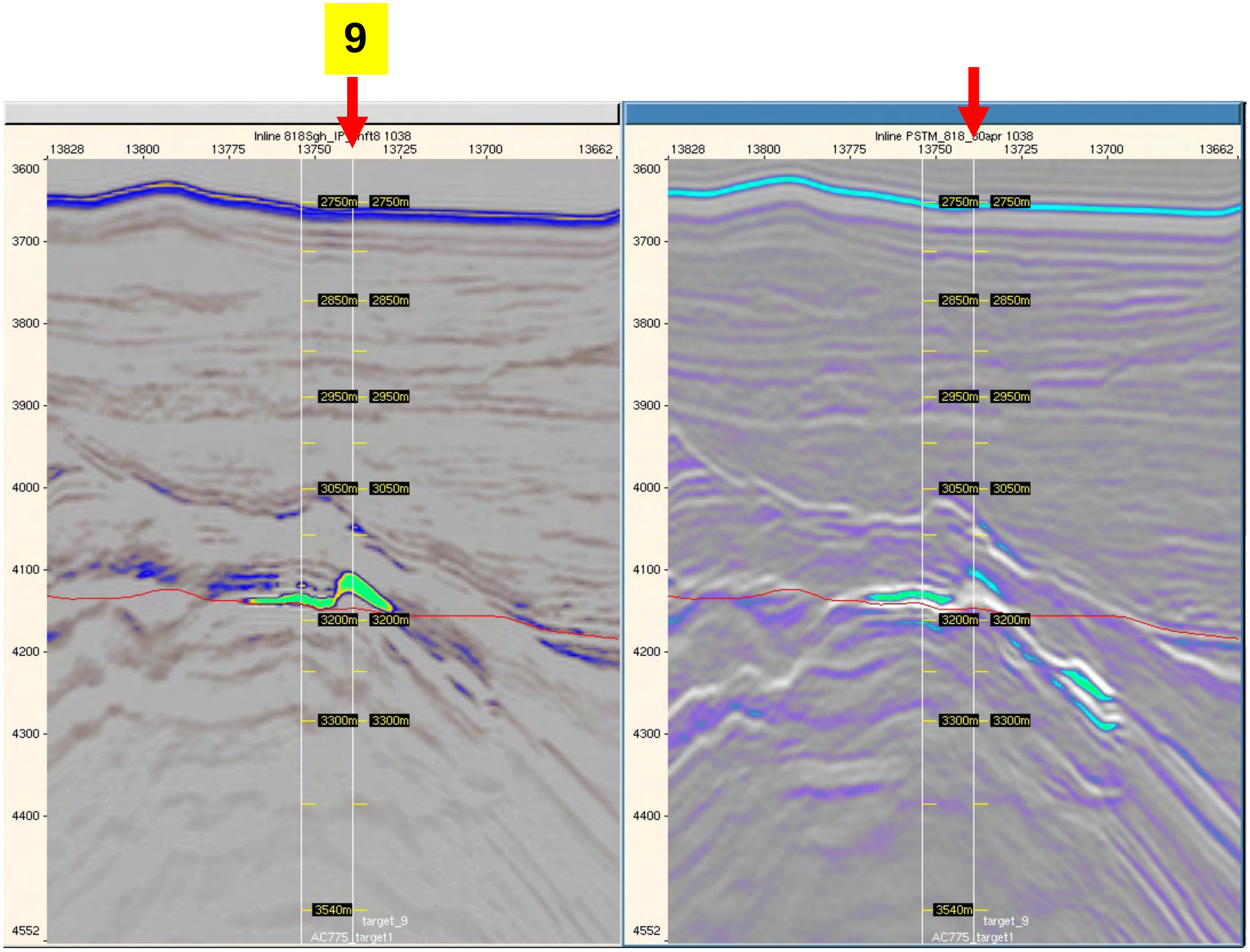
Table 2: Proposed Hole General Information

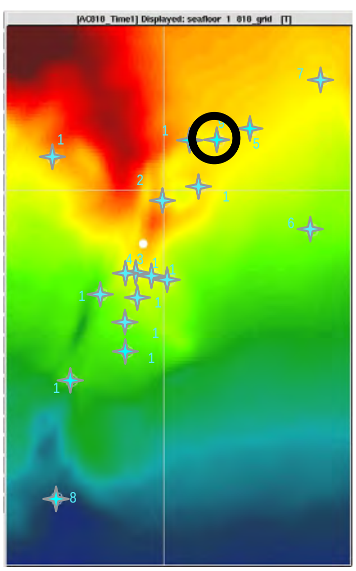
Site Name	AC775 target-9
General Area	Tiger Shark, seaward of Sigsbee escarpment, 20 km north of Mexico/U.S. boundary
Location	Latitude: 26d 11' 11.1" N Longitude: 94d 37' 04.0" W
Coordinate Datum	*NAD27*
Water Depth	9011 ft
OPD/Lease Block	AC775
Seismic line showing hole	ACA1 – inline1038 crossline 13739

Table 3: Proposed Hole Drilling Information

Proposed penetration	>1454 ft (1454' = sea floor to estimated BGHS)
Expected lithologies	For example, muds, silts, sand at GH interval
Expected sediment ages/section	*PlioPleistocene, then unconformity and Oligocene*
Estimated depth to BGHS	10,465 ft
Estimated GH interval	10,330 – 10,427 ft
Estimated GH saturation	max Sgh=76%
Anomalous conditions?	
Other relevant information	Near minor faults

Target 9 (AC775)





Upper: Seismic data processed by WesternGeco. Vertical axis is two way travel time in milliseconds. Horizontal axes are trace numbers, with nominal spacing of 12.5 m. Left (saturation section), Right (pre-stack time migration).
Lower: Bathymetric map showing target location (circled). See Target 1 for color bar.

Hydrates JIP Phase III: Alaminos Canyon (AC775) Target 10

Table 1: Background Information

Date of Information	*31 October 2007*
General Site Objective	Testing WG inversions of saturation and thickness of gas hydrate system
Drilling target and Specific Hole Objective	Gas hydrate bearing Frio SS. To test variation in reservoir properties due potentially to reservoir compartmentalization
Other Drilling in Vicinity	AC818#1

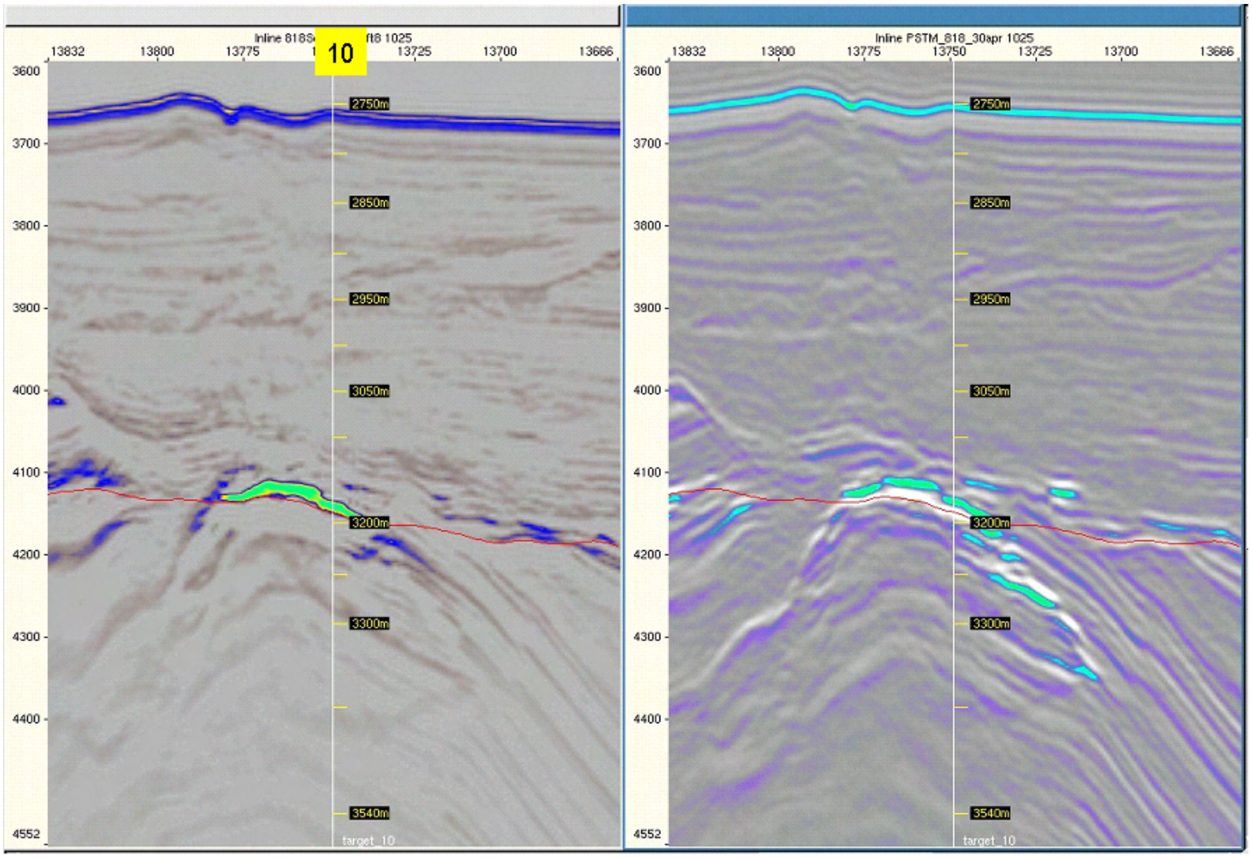
Table 2: Proposed Hole General Information

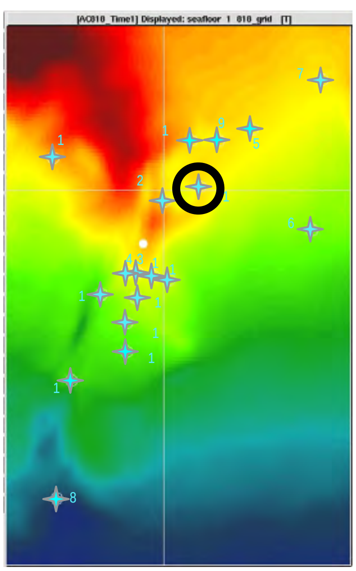
Site Name	AC775 target-10
General Area	Tiger Shark, seaward of Sigsbee escarpment, 20 km north of Mexico/U.S. boundary
Location	Latitude: 26d 11' 00.5" N Longitude: 94d 37' 08.4" W
Coordinate Datum	*NAD27*
Water Depth	9006 ft
OPD/Lease Block	AC775
Seismic line showing hole	ACA1 – inline1025 crossline 13749

Table 3: Proposed Hole Drilling Information

Proposed penetration	>1466 ft (1466' = sea floor to estimated BGHS)
Expected lithologies	For example, muds, silts, sand at GH interval
Expected sediment ages/section	*PlioPleistocene, then unconformity and Oligocene*
Estimated depth to BGHS	10,472 ft
Estimated GH interval	10,416 – 10,469 ft
Estimated GH saturation	max Sgh=76%
Anomalous conditions?	Close to seafloor crater and signatures indicative of subsurface chimney (fluid movement);
Other relevant information	separated from main part of anomaly c by minor faulting

Target 10 (AC775)





Upper: Seismic data processed by WesternGeco. Vertical axis is two way travel time in milliseconds. Horizontal axes are trace numbers, with nominal spacing of 12.5 m. Left (saturation section), Right (pre-stack time migration).
Lower: Bathymetric map showing target location (circled). See Target 1 for color bar.

Hydrates JIP Phase III: Alaminos Canyon (AC818) Target 11

Table 1: Background Information

Date of Information	*31 October 2007*
General Site Objective	Testing WG inversions of saturation and thickness of gas hydrate system
Drilling target and Specific Hole Objective	Gas Hydrate-bearing Frio sand. To test variation in reservoir properties along a potential transect from the center to the edge of anomaly f
Other Drilling in Vicinity	AC818#1

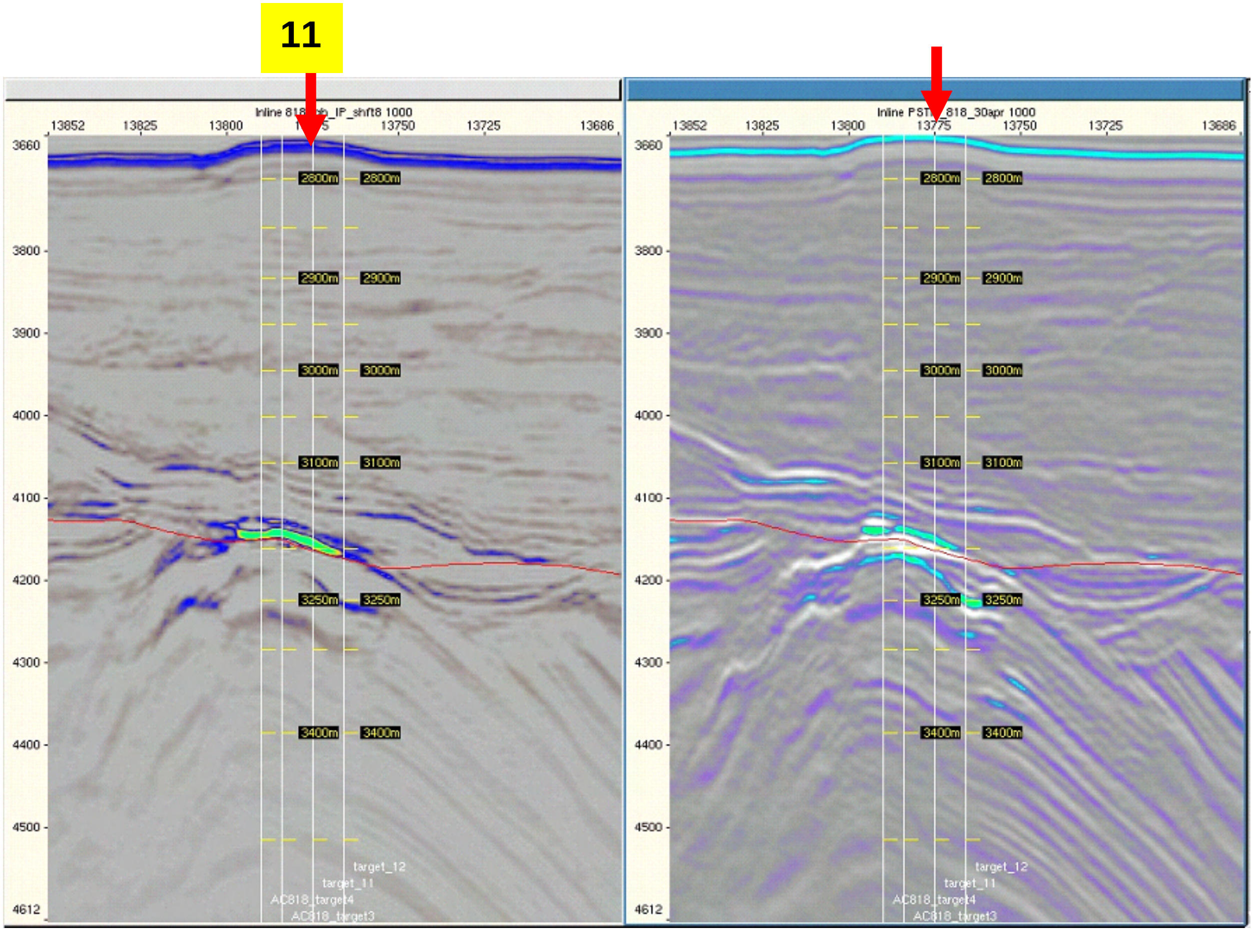
Table 2: Proposed Hole General Information

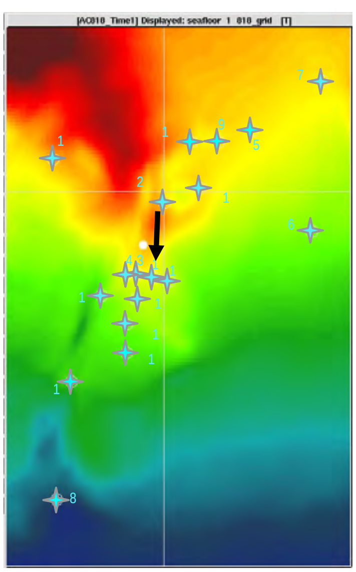
Site Name	AC818 target-11
General Area	Tiger Shark, seaward of Sigsbee escarpment, 20 km north of Mexico/U.S. boundary
Location	Latitude: 26d 10' 40.1" N Longitude: 94d 37' 19.8" W
Coordinate Datum	*NAD27*
Water Depth	9024 ft
OPD/Lease Block	AC818
Seismic line showing hole	ACA1 – inline1000 crossline 13775

Table 3: Proposed Hole Drilling Information

Proposed penetration	>1483 ft (1483' = sea floor to base of GH interval)
Expected lithologies	For example, muds, silts, sand at GH interval
Expected sediment ages/section	*PlioPleistocene, then unconformity and Oligocene*
Estimated depth to BGHS	10,504 ft (note that this is shallower than base of actual GH interval)
Estimated GH interval	10,454 – 10,507 ft
Estimated GH saturation	max Sgh=82%
Anomalous conditions?	
Other relevant information	

Target 11 (AC818)





Upper: Seismic data processed by WesternGeco. Vertical axis is two way travel time in milliseconds. Horizontal axes are trace numbers, with nominal spacing of 12.5 m. Left (saturation section), Right (pre-stack time migration).
Lower: Bathymetric map showing target location (arrow). See Target 1 for color bar.

Hydrates JIP Phase III: Alaminos Canyon (AC819) Target 12

Table 1: Background Information

Date of Information	*31 October 2007*
General Site Objective	Testing WG inversions of saturation and thickness of gas hydrate system
Drilling target and Specific Hole Objective	Gas Hydrate bearing Frio sand. To test variation in reservoir properties along a potential transect from center to edge of accumulation and to test vertical resolution of the predictive seismics at the edge of anomaly f
Other Drilling in Vicinity	AC818#1

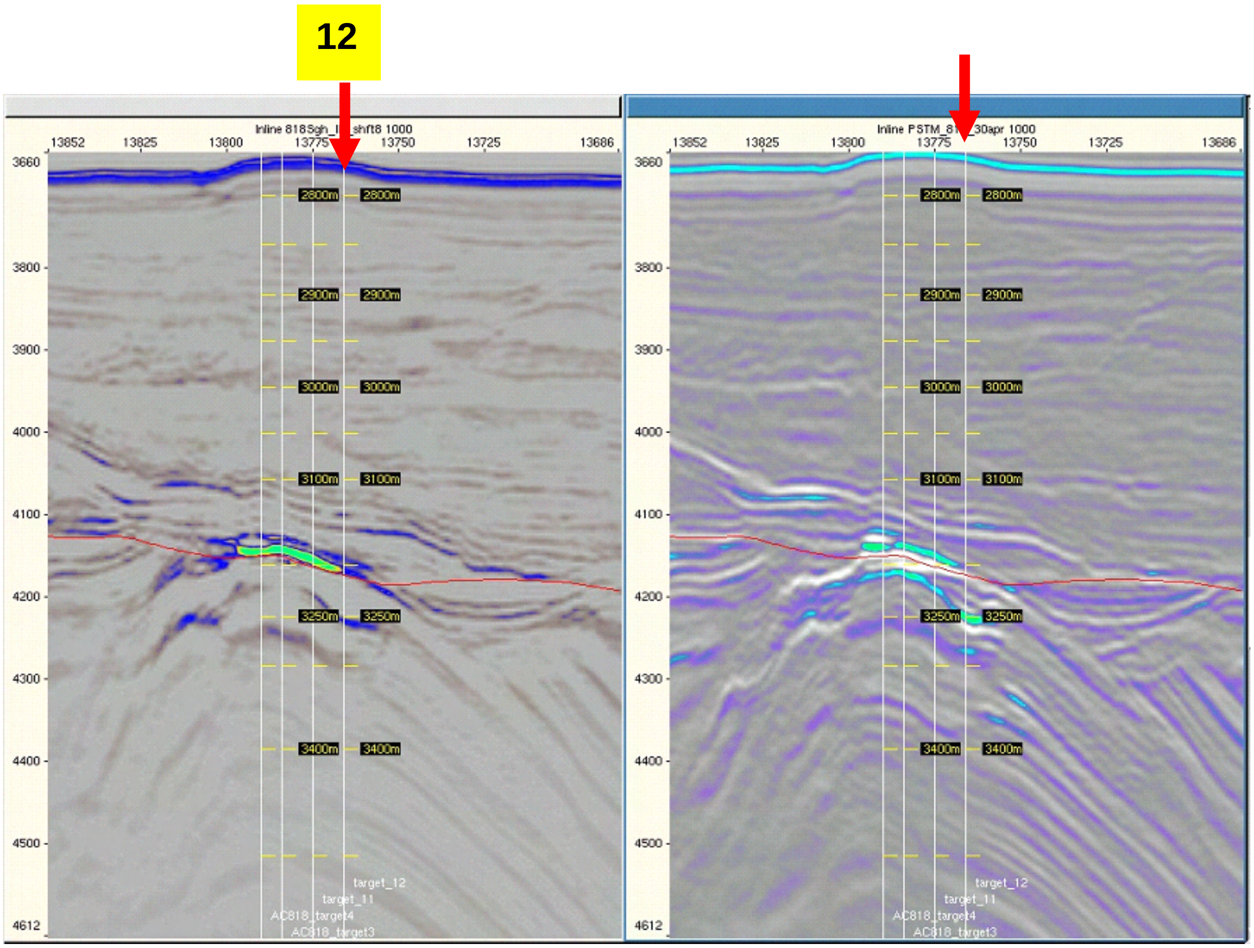
Table 2: Proposed Hole General Information

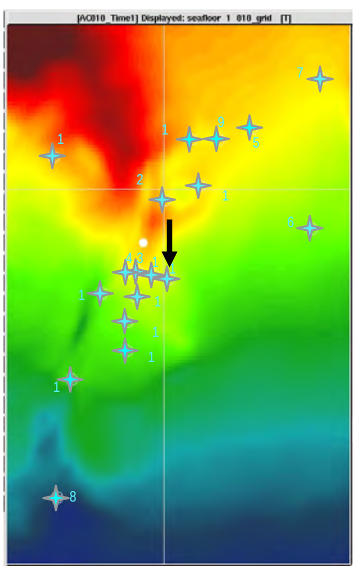
Site Name	AC819 target-12
General Area	Tiger Shark, seaward of Sigsbee escarpment, 20 km north of Mexico/U.S. boundary
Location	Latitude: 26d 10' 39.3" N Longitude: 94d 37' 15.7" W
Coordinate Datum	*NAD27*
Water Depth	9034 ft
OPD/Lease Block	AC819
Seismic line showing hole	ACA1 – inline999 crossline 13766

Table 3: Proposed Hole Drilling Information

Proposed penetration	>1504 ft (1504' = sea floor to estimated BGHS)
Expected lithologies	For example, muds, silts, sand at GH interval
Expected sediment ages/section	*PlioPleistocene, then unconformity and Oligocene*
Estimated depth to BGHS	10,538 ft
Estimated GH interval	10,499– 10,535 ft
Estimated GH saturation	max Sgh=34%
Anomalous conditions?	
Other relevant information	

Target 12 (AC819)





Upper: Seismic data processed by WesternGeco. Vertical axis is two way travel time in milliseconds. Horizontal axes are trace numbers, with nominal spacing of 12.5 m. Left (saturation section), Right (pre-stack time migration).
Lower: Bathymetric map showing target location (arrow). See Target 1 for color bar.

Hydrates JIP Phase III: Alaminos Canyon (AC818) Target 13

Table 1: Background Information

Date of Information	*31 October 2007*
General Site Objective	Testing WG inversions of saturation and thickness of gas hydrate system
Drilling target and Specific Hole Objective	Multilayered GH reservoir unit of uncertain age within anomaly f Provide test of alternative lithologies in favorable position directly adjacent to the main Frio accumulation
Other Drilling in Vicinity	AC818#1

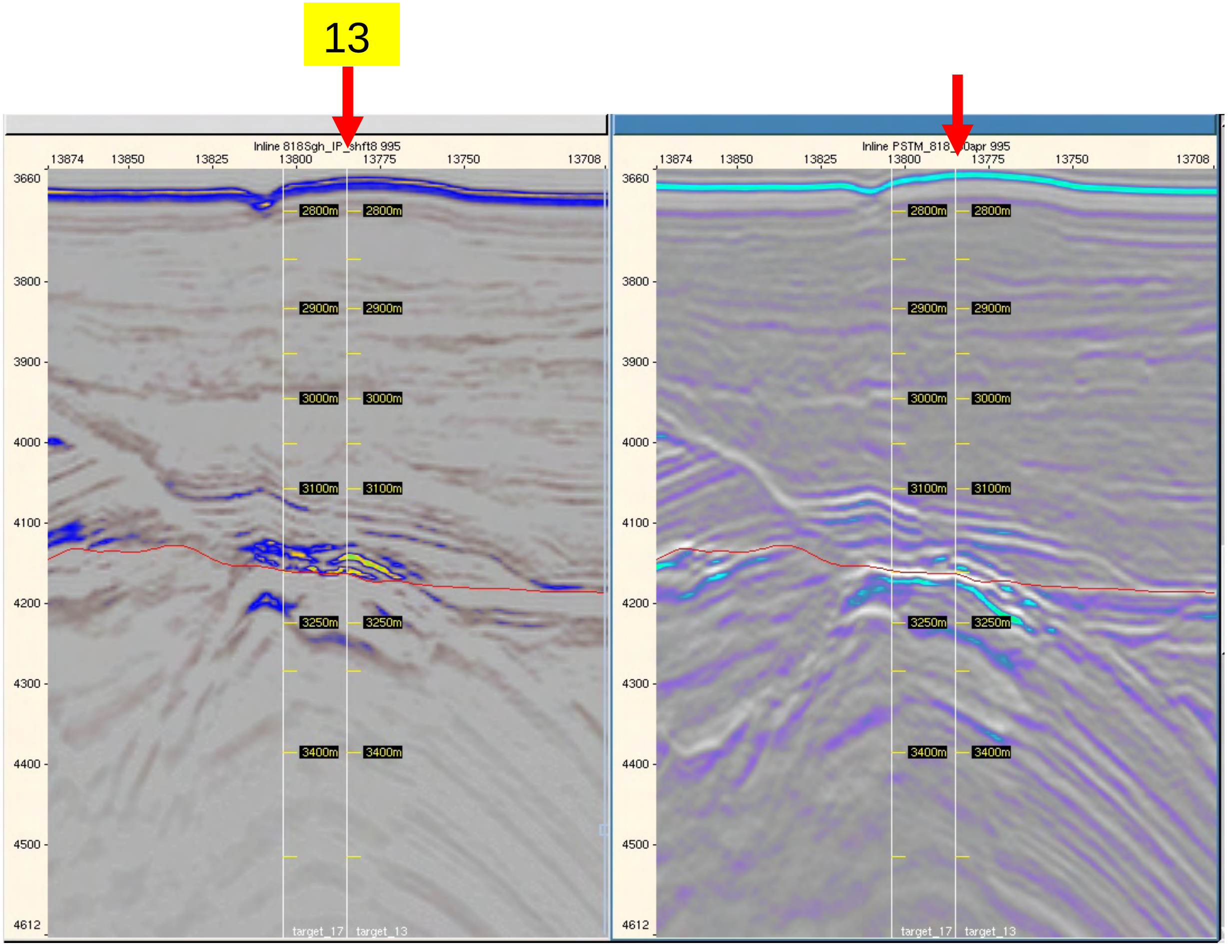
Table 2: Proposed Hole General Information

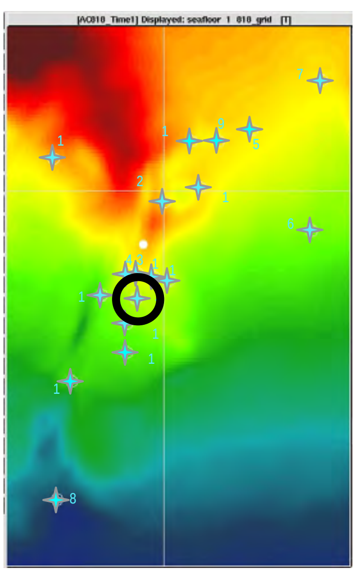
Site Name	AC818 target-13
General Area	Tiger Shark, seaward of Sigsbee escarpment, 20 km north of Mexico/U.S. boundary
Location	Latitude: 26d 10' 35.1" N Longitude: 94d 37' 24.2" W
Coordinate Datum	*NAD27*
Water Depth	9039 ft
OPD/Lease Block	AC818
Seismic line showing hole	ACA1 – inline994 crossline 13785

Table 3: Proposed Hole Drilling Information

Proposed penetration	>1488 ft (1488’ = sea floor to estimated base of gas hydrate interval)
Expected lithologies	For example, muds, silts, sand at GH interval
Expected sediment ages/section	*PlioPleistocene, then unconformity and Oligocene*
Estimated depth to BGHS	10,522 ft (note this is less than estimated depth to base of GH interval)
Estimated GH interval	10,425– 10,527 ft
Estimated GH saturation	max Sgh=64%
Anomalous conditions?	
Other relevant information	Thickest GH zone within anomaly f; lowest Frio Sgh

Target 13 (AC818)





Upper: Seismic data processed by WesternGeco. Vertical axis is two way travel time in milliseconds. Horizontal axes are trace numbers, with nominal spacing of 12.5 m. Left (saturation section), Right (pre-stack time migration).
Lower: Bathymetric map showing target location (circled). See Target 1 for color bar.

Hydrates JIP Phase III: Alaminos Canyon (AC818) Target 14

Table 1: Background Information

Date of Information	*31 October 2007*
General Site Objective	Testing WG inversions of saturation and thickness of gas hydrate system
Drilling target and Specific Hole Objective	Gas Hydrate bearing Frio sand. Test of location with highest predicted Sgh in anomaly f
Other Drilling in Vicinity	AC818#1

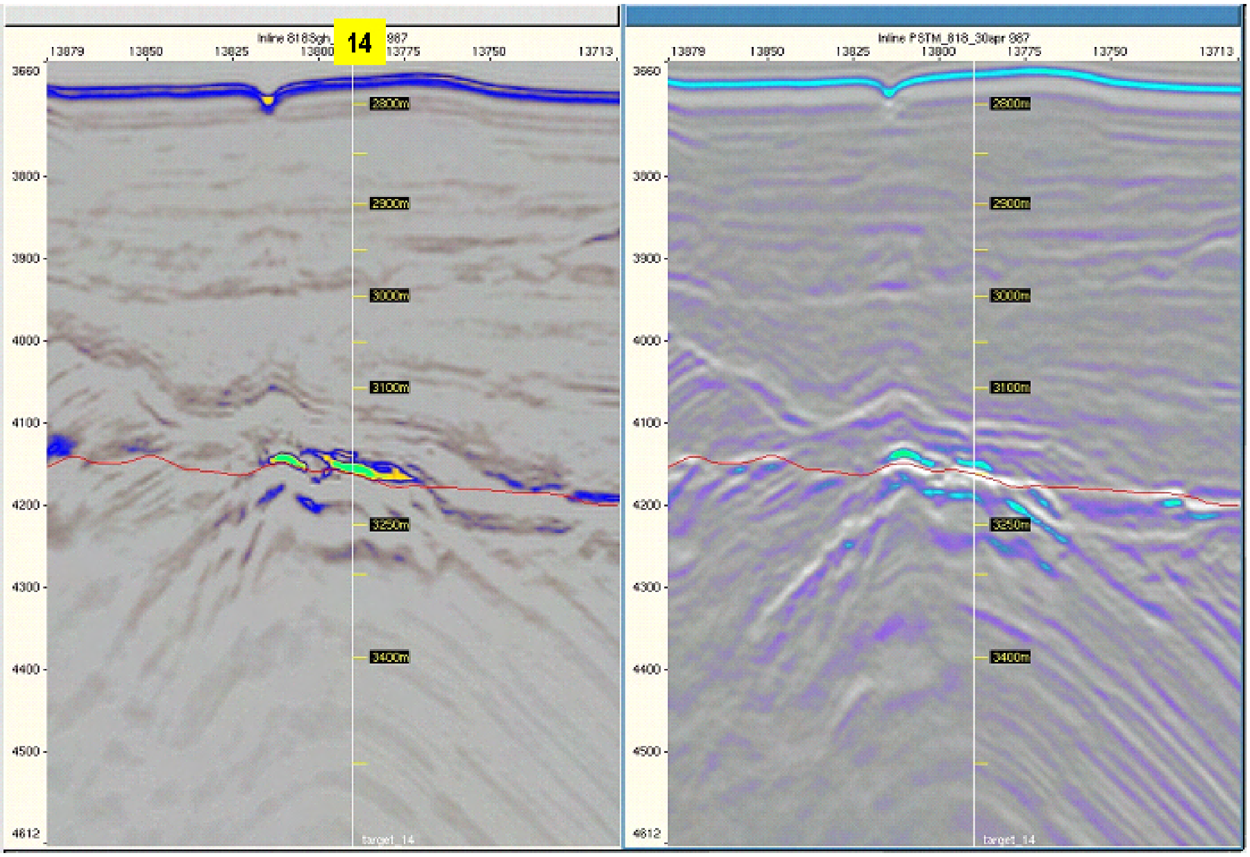
Table 2: Proposed Hole General Information

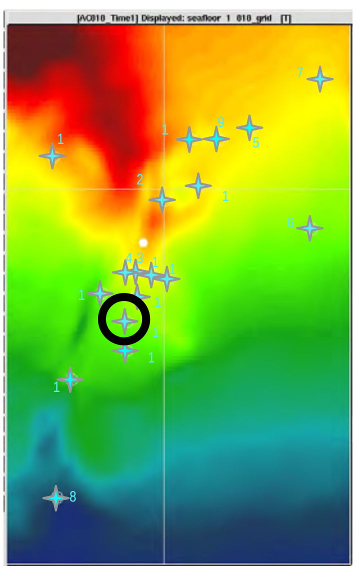
Site Name	AC818 target-14
General Area	Tiger Shark, seaward of Sigsbee escarpment, 20 km north of Mexico/U.S. boundary
Location	Latitude: 26d 10' 29.4" N Longitude: 94d 37' 26.4" W
Coordinate Datum	*NAD27*
Water Depth	9058 ft
OPD/Lease Block	AC818
Seismic line showing hole	ACA1 – inline987 crossline 13790

Table 3: Proposed Hole Drilling Information

Proposed penetration	>1445 ft (1445' = sea floor to estimated BGHS)
Expected lithologies	For example, muds, silts, sand at GH interval
Expected sediment ages/section	*PlioPleistocene, then unconformity and Oligocene*
Estimated depth to BGHS	10,503 ft
Estimated GH interval	10,448-10501 ft
Estimated GH saturation	max Sgh=95%
Anomalous conditions?	
Other relevant information	

Target 14 (AC818)





Upper: Seismic data processed by WesternGeco. Vertical axis is two way travel time in milliseconds. Horizontal axes are trace numbers, with nominal spacing of 12.5 m. Left (saturation section), Right (pre-stack time migration).
Lower: Bathymetric map showing target location (circled). See Target 1 for color bar.

Hydrates JIP Phase III: Alaminos Canyon (AC818) Target 15

Table 1: Background Information

Date of Information	*31 October 2007*
General Site Objective	Testing WG inversions of saturation and thickness of gas hydrate system
Drilling target and Specific Hole Objective	Multilayered, possibly compartmentalized, hydrate-bearing unit (Frio) To determine reservoir properties on far SE side of anomaly f, well away from existing well. To test nature of anomalous multiple reflectors.
Other Drilling in Vicinity	AC818#1

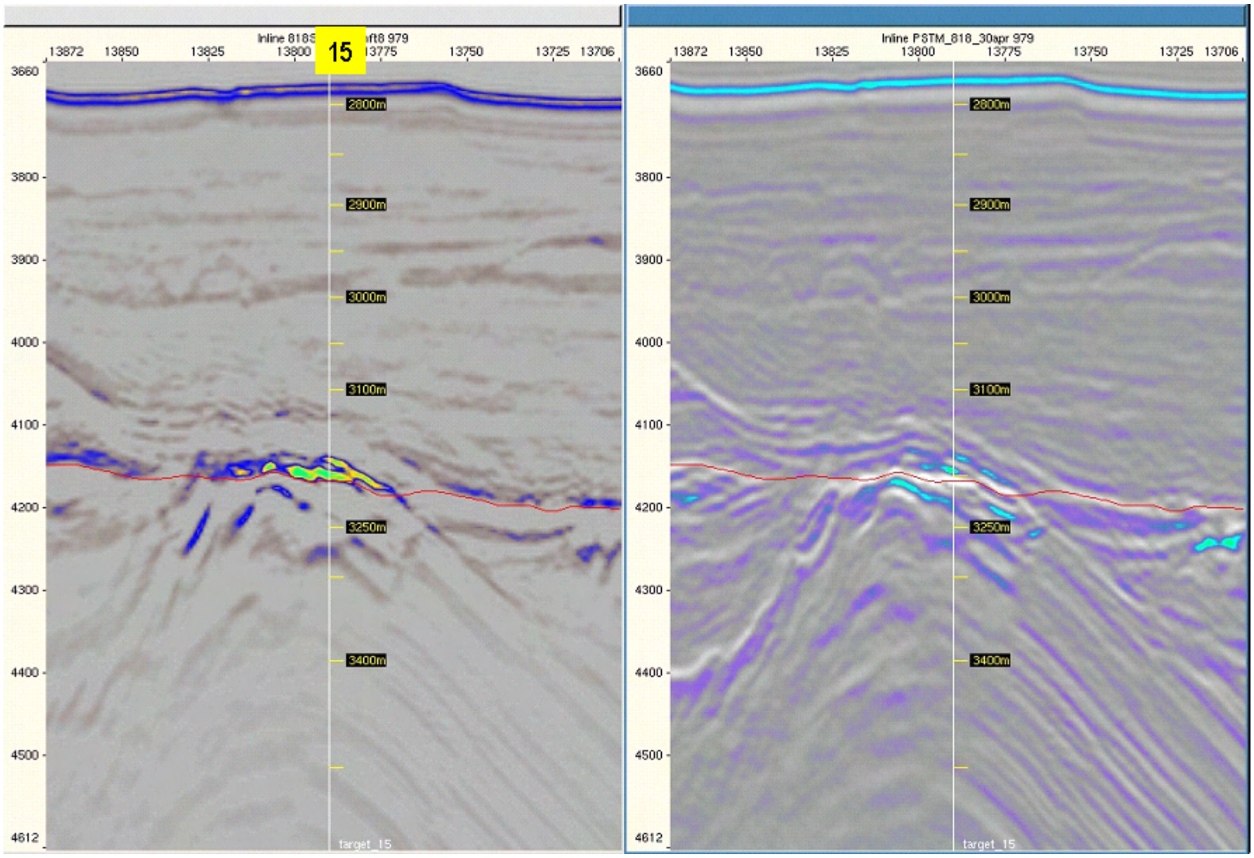
Table 2: Proposed Hole General Information

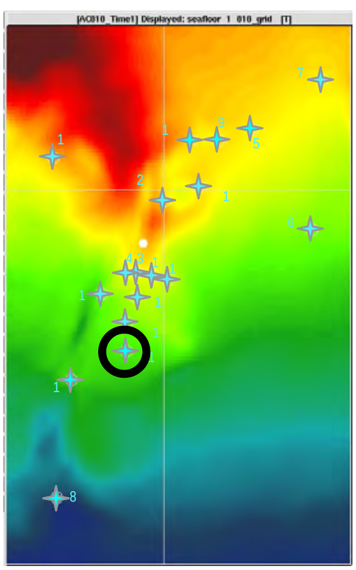
Site Name	AC818 target-15
General Area	Tiger Shark, seaward of Sigsbee escarpment, 20 km north of Mexico/U.S. boundary
Location	Latitude: 26d 10' 22.9" N Longitude: 94d 37' 26.3" W
Coordinate Datum	*NAD27*
Water Depth	9075 ft
OPD/Lease Block	AC818
Seismic line showing hole	ACA1 – inline979 crossline 13790

Table 3: Proposed Hole Drilling Information

Proposed penetration	>1440 ft (1440' = sea floor to estimated BGHS)
Expected lithologies	For example, muds, silts, sand at GH interval
Expected sediment ages/section	*PlioPleistocene, then unconformity and Oligocene*
Estimated depth to BGHS	10,515 ft
Estimated GH interval	10,462-10510 ft
Estimated GH saturation	max Sgh=77%
Anomalous conditions?	
Other relevant information	Lower max Sgh than some of the original anomaly f targets

Target 15 (AC818)





Upper: Seismic data processed by WesternGeco. Vertical axis is two way travel time in milliseconds. Horizontal axes are trace numbers, with nominal spacing of 12.5 m. Left (saturation section), Right (pre-stack time migration).
Lower: Bathymetric map showing target location (circled). See Target 1 for color bar.

Hydrates JIP Phase III: Alaminos Canyon (AC818) Target 16

Table 1: Background Information

Date of Information	*31 October 2007*
General Site Objective	Testing WG inversions of saturation and thickness of gas hydrate system
Drilling target and Specific Hole Objective	Gas Hydrate-bearing Frio sand. To test reservoir properties on far SW edge of anomaly F and possibly separated from main anomaly f by minor faults
Other Drilling in Vicinity	AC818#1

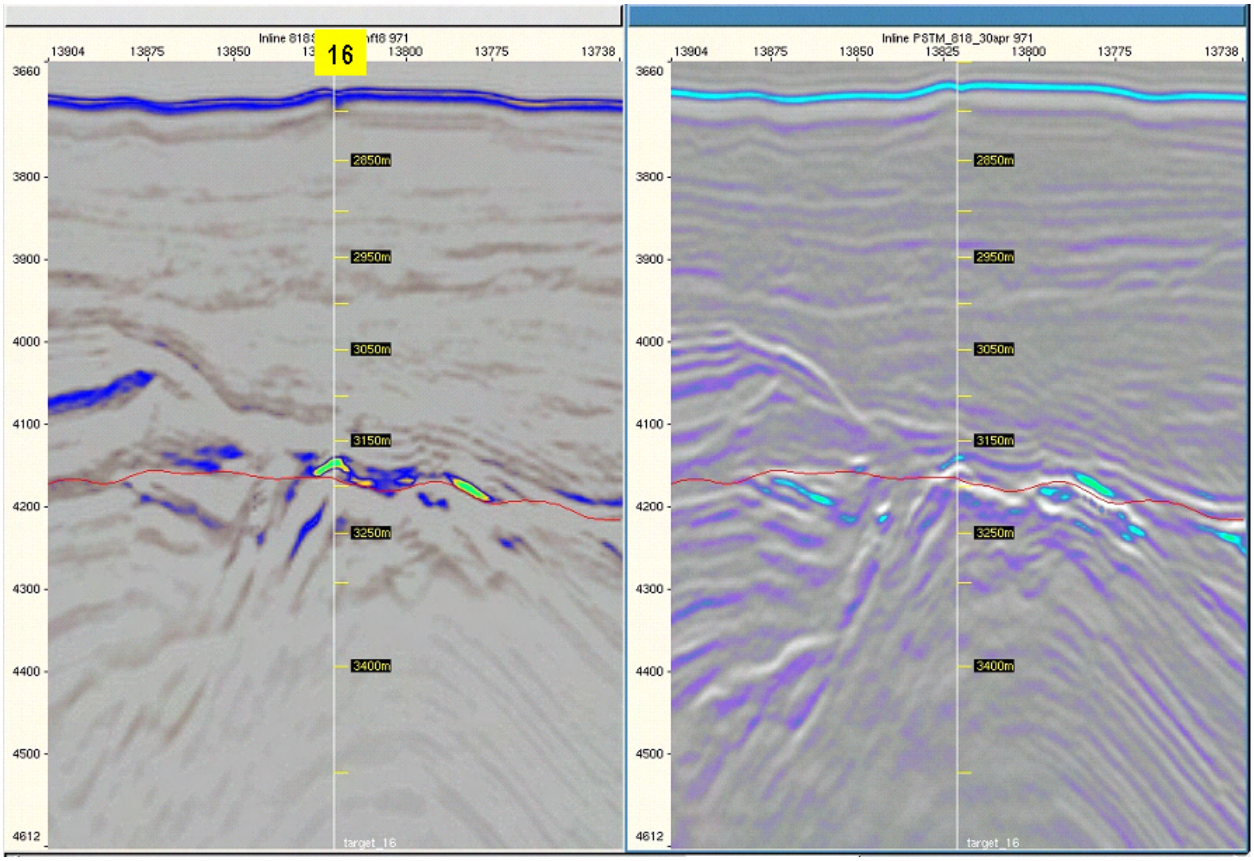
Table 2: Proposed Hole General Information

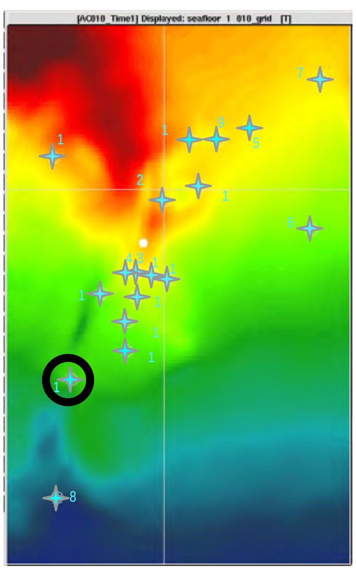
Site Name	AC818 target-16
General Area	Tiger Shark, seaward of Sigsbee escarpment, 20 km north of Mexico/U.S. boundary
Location	Latitude: 26d 10' 16.3" N Longitude: 94d 37' 40.2" W
Coordinate Datum	*NAD27*
Water Depth	9221 ft
OPD/Lease Block	AC818
Seismic line showing hole	ACA1 – inline971 crossline 13821

Table 3: Proposed Hole Drilling Information

Proposed penetration	>1261 ft (1261' = sea floor to estimated BGHS)
Expected lithologies	For example, muds, silts, sand at GH interval
Expected sediment ages/section	*PlioPleistocene, then unconformity and Oligocene*
Estimated depth to BGHS	10,482 ft
Estimated GH interval	10,393-10446 ft
Estimated GH saturation	max Sgh=87%
Anomalous conditions?	
Other relevant information	Lower max Sgh than some of the original anomaly f targets

Target 16 (AC818)





Upper: Seismic data processed by WesternGeco. Vertical axis is two way travel time in milliseconds. Horizontal axes are trace numbers, with nominal spacing of 12.5 m. Left (saturation section), Right (pre-stack time migration).
Lower: Bathymetric map showing target location (circled). See Target 1 for color bar.

Hydrates JIP Phase III: Alaminos Canyon (AC818) Target 17

Table 1: Background Information

Date of Information	*31 October 2007*
General Site Objective	Testing WG inversions of saturation and thickness of gas hydrate system
Drilling target and Specific Hole Objective	Potentially gas hydrate-bearing Plio-Pleistocene section. To test nature of reservoir on top of gas-charged Frio within anomaly f with low to moderate Sgh estimates.
Other Drilling in Vicinity	AC818#1

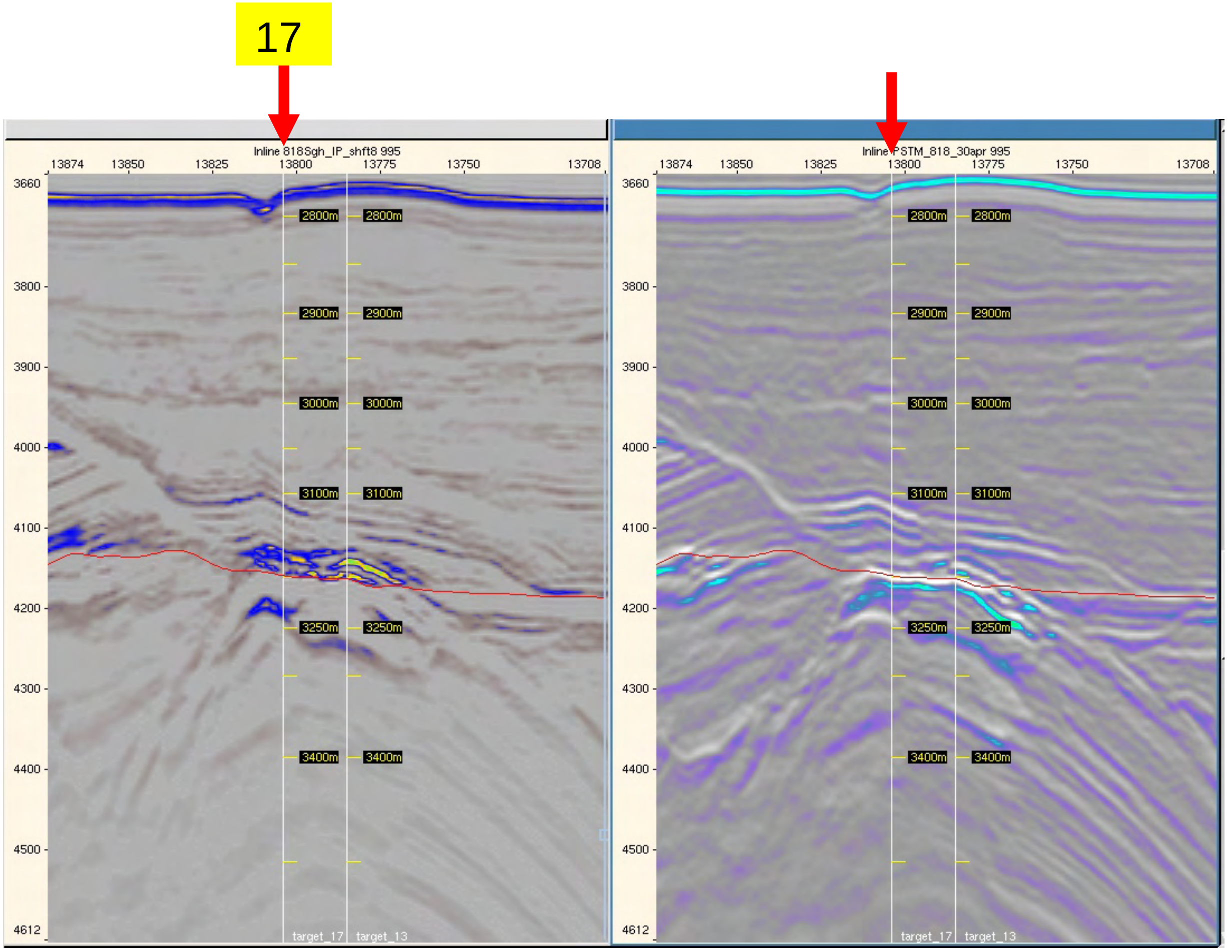
Table 2: Proposed Hole General Information

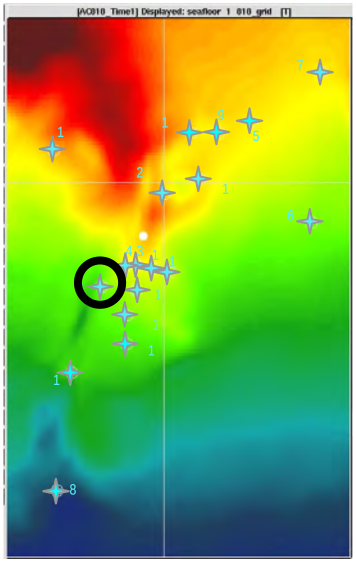
Site Name	AC818 target-17
General Area	Tiger Shark, seaward of Sigsbee escarpment, 20 km north of Mexico/U.S. boundary
Location	Latitude: 26d 10' 35.9" N Longitude: 94d 37' 32.8" W
Coordinate Datum	*NAD27*
Water Depth	9053 ft
OPD/Lease Block	AC818
Seismic line showing hole	ACA1 – inline995 crossline 13804

Table 3: Proposed Hole Drilling Information

Proposed penetration	>1440 ft (1440' = sea floor to estimated BGHS)
Expected lithologies	For example, muds, silts, sand at GH interval
Expected sediment ages/section	*PlioPleistocene, then unconformity and Oligocene*
Estimated depth to BGHS	10,493 ft
Estimated GH interval	10,390-10460 ft
Estimated GH saturation	max Sgh=39%
Anomalous conditions?	
Other relevant information	Lower max Sgh than some of the original anomaly f targets

Target 17 (AC818)





Upper: Seismic data processed by WesternGeco. Vertical axis is two way travel time in milliseconds. Horizontal axes are trace numbers, with nominal spacing of 12.5 m. Left (saturation section), Right (pre-stack time migration).

Lower: Bathymetric map showing target location (circled). See Target 1 for color bar.

Hydrates JIP Phase III: Alaminos Canyon (AC774) Target 18

Table 1: Background Information

Date of Information	*31 October 2007*
General Site Objective	Testing WG inversions of saturation and thickness of gas hydrate system
Drilling target and Specific Hole Objective	Potentially gas-hydrate-bearing Mio to Plio-Pleistocene. To test strata in anomaly d and not present elsewhere in the area and above potentially gas charged section below BGHS
Other Drilling in Vicinity	AC818#1

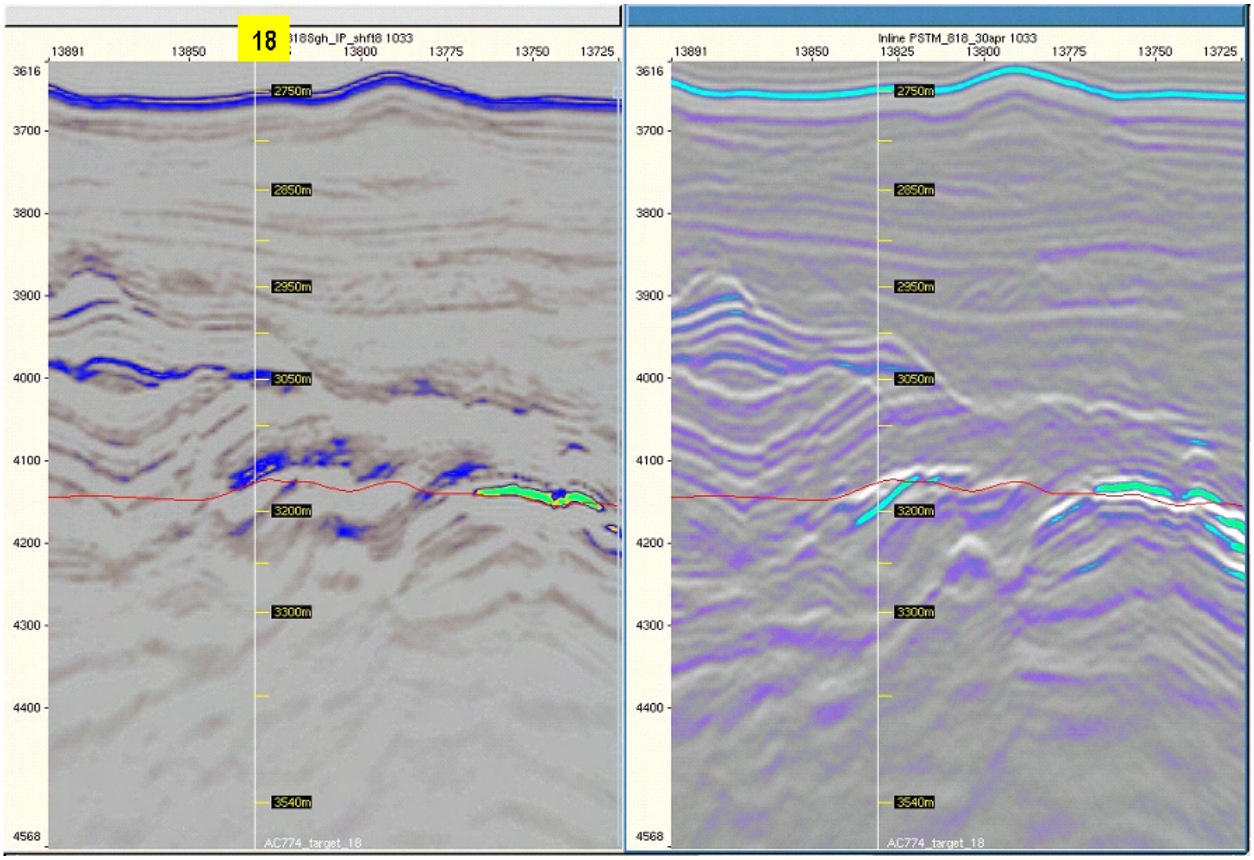
Table 2: Proposed Hole General Information

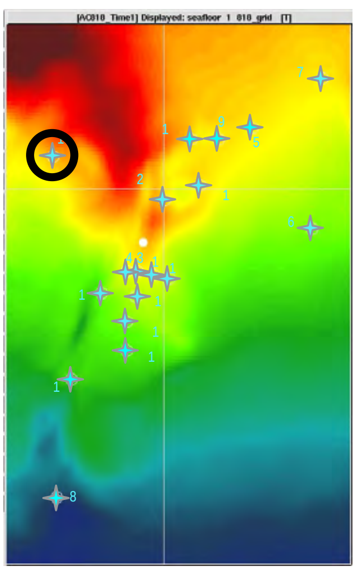
Site Name	AC774 target-18
General Area	Tiger Shark, seaward of Sigsbee escarpment, 20 km north of Mexico/U.S. boundary
Location	Latitude: 26d 11' 06.6" N Longitude: 94d 37' 45.4" W
Coordinate Datum	*NAD27*
Water Depth	8992 ft
OPD/Lease Block	AC774
Seismic line showing hole	ACA1 – inline1033 crossline 13831

Table 3: Proposed Hole Drilling Information

Proposed penetration	>1403 ft (1403' = sea floor to estimated BGHS)
Expected lithologies	For example, muds, silts, sand at GH interval
Expected sediment ages/section	*PlioPleistocene, then unconformity and Oligocene*
Estimated depth to BGHS	10,395 ft
Estimated GH interval	9999-10052 ft
Estimated GH saturation	max Sgh=36%
Anomalous conditions?	
Other relevant information	

Target 18 (AC774)





Upper: Seismic data processed by WesternGeco. Vertical axis is two way travel time in milliseconds. Horizontal axes are trace numbers, with nominal spacing of 12.5 m. Left (saturation section), Right (pre-stack time migration).

Lower: Bathymetric map showing target location (circled). See Target 1 for color bar.

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