Documentation of the Results from the (1) DOE Methane Hydrates R&D Conference, and (2) The ChevronTexaco JIP Workshop Held in Denver, Colorado September 29 – October 1, 2003

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Edited by: **Stephen A. Holditch**
Schlumberger Fellow

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Submitting Organization:
ChevronTexaco Energy Technology Company
2811 Hayes Road
Houston, TX 77082

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ABSTRACT

In 2000, Chevron (now ChevronTexaco) 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 Project (JIP) was organized in 2001, and the 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 deepwater Gulf of Mexico. 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.

As part of the project, three workshops were held in 2002. The first was a data collection workshop, held in Houston during March 14-15, 2002. The purpose of this workshop was to find out what data exist on gas hydrates and to begin making that data available to the JIP. The second and third workshop, on Geoscience and Reservoir Modeling, and Drilling and Coring Methods, respectively, were held simultaneously in Houston during May 9-10, 2002. The Modeling Workshop was conducted to find out what data the various engineers, scientists and geoscientists want the JIP to collect in both the field and the laboratory. The Drilling and Coring workshop was to begin making plans on how we can collect the data required by the project's principal investigators. A report describing the results from the 3 workshops held in 2002 can be found on the JIP website.

http://bobqpext.chevrontexaco.com/wwuexpl_gashydrates

Phase I of the JIP project is almost completed and Phase II is beginning. During Phase II, the JIP will be drilling, coring and logging shallow formations in the Deep Water portion of the Gulf of Mexico that are thought to contain natural gas hydrates. As part of the planning process, the DOE and the JIP held a 2 ½ day conference and workshop September 29 – October 1, 2003 in Denver to present results from current R&D efforts. The workshop also presented tentative plans for the JIP Phase II work, and offered these plans for critique by industry and academic experts.

The purpose of this report is to document the presentations and the results of the 2-½ day conference and workshop recently held in Denver. All of the presentations can be found on either the DOE National Energy Technology Laboratory web site or on the JIP web site.

http://www.netl.doe.gov/

By combining the DOE R&D Conference with the JIP workshop, the combined meeting attracted 101 international hydrate experts, scholars and scientists from academia, industry, research institutes, national laboratories and government organizations. Virtually all of the attendees commented on the high quality of the technical materials presented and discussed at this meeting. All technical materials are included in this report or can be obtained from either of the two web sites listed above.

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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 has been an active explorer and operator in the Gulf of Mexico, and is aware that natural gas hydrates must be better understood to operate safely in deepwater. 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 deepwater.

On the basis of the workshop held in August 2000, Chevron formed a Joint Industry Project (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 Deepwater Gulf of Mexico: Applications for Safe Exploration and Production Activities".

1.1 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 deepwater Gulf of Mexico. 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.

1.2 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. Phase I will be coming to a close in 2003. During **Phase II** of the project, Chevron will drill several data collection wells to improve the technologies required to characterize gas hydrate deposits in the deepwater Gulf of Mexico using seismic, core and logging data. Phase II will begin in late 2003 and the first wells will be drilled in Q2 of 2004. A second round of drilling will occur in Q2 of 2005.

1.3 Research Participants

In 2001, Chevron (now ChevronTexaco) organized a Joint Industry Project (JIP) group to plan and conduct the tasks necessary for accomplishing the objectives of this research project. The original members of the JIP were Chevron, Schlumberger, Phillips, Conoco, and Halliburton. Subsequently, the Minerals Management Service (MMS), TotalFinaElf. Japan National Oil Corporation and Reliance Ltd. have joined the JIP.

1.4 Purpose of This Report

The purpose of this technical report is to present the results from the workshop held in Denver from September 29 – October 1, 2003. This workshop was used to present **the status of the Phase I work and plans for Phase II**, as well as to inform all workshop participants of R&D results from other DOE projects in the Arctic and in other Deep Water projects.

By combining the DOE R&D Conference with the JIP workshop, the combined meeting attracted 101 international hydrate experts, scholars and scientists from academia, industry, research institutes, national laboratories and government organizations. Virtually all of the attendees commented on the high quality of the technical materials presented and discussed at this meeting. All technical materials are included in this report or can be obtained from either of the two web sites listed above.

2.0 EXECUTIVE SUMMARY

Chevron formed a Joint Industry Project (JIP) group to conduct a research project called

"Characterizing Natural Gas Hydrates in the Deepwater 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 deepwater Gulf of Mexico. **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 3 data collection wells to improve the technologies required to characterize gas hydrate deposits in the deepwater Gulf of Mexico using seismic, core and logging data.

Three workshops were held in 2002 to (1) inventory the data currently available on naturally occurring gas hydrates in the deepwater Gulf of Mexico, (2) determine what additional data needs to be collected for the modelers and scientists, and (3) determine how to collect the data.

The 2003 Workshop was held to review R&D results from various DOE projects, to review research results from Phase I of the JIP project and to critique plans for Phase II of the JIP project.

The USDOE hydrate conference was held for the first one and one-half days (Sept 29-30) and GOM hydrate workshop was held for the next one and one-half days (Sept. 30-Oct.1). Both of these events were well attended with total attendance of over hundred plus. The amalgamation of these two resulted in presence of international hydrate experts, scholars and scientists from academia, industry, research institutes, national laboratories and government organizations at one place.

2.1 DOE Methane Hydrates R&D Conference

The Department of Energy held a Research and Development Conference to review many of the gas hydrate projects that they are funding. The combined meeting generated significant interest in the gas hydrates technical community.

William F. Lawson, Associate Director, NETL, US DOE provided introductory remarks and welcomed the participants.

Edith Allison, Program Manager, Exploration, US DOE Office of Fossil Energy, provided a brief overview of DOE's Methane Hydrate R & D Program. She also announced that the DOE's Hydrate R&D budget for FY 2004 is still being discussed in Congress.

KEYNOTE ADDRESS- Professor Dendy Sloan, Weaver Distinguished Professor of Chemical Engineering, Colorado School of Mines, provided the overview of how knowledge is developed in the field of hydrates in his keynote address. He stated that S-II hydrates (thermogenic) are found in the GOM and Caspian Sea. S-I hydrates have been found in the pipelines of GOM (Kenyon Express). He gave 2 examples of hydrate plugs formed in deepwater pipelines (Norsk Hydro and Petrobras). Dr. Sloan said that it took 5 days for the hydrate plug to form, and 2-months to melt it.

The remainder of the DOE R&D conference was divided into two parts. The first part addressed the research that is being conducted in the Arctic regions in Canada and Alaska. Presentations were made by Tom Williams with Maurer Technology, Bill Liddell with Anadarko, Richard Sigal with APC, Tim Collett with USGS, Robert Hunter with bp Exploration Alaska, Scott Dallimore with Geological Survey of Canada, and George Moridis with LBL.

The second part addressed the research that is being conducted in Deep Water environments. Presentations were made by Emrys Jones with ChevronTexaco, Deborah Hutchinson with USGS, Joseph Gettrust with NRL, James Woolsey with the University of Mississippi, Thomas McGee with the University of Mississippi, Frank Rack with JOI, Pulak Ray with MMS, and Andrew Shepard with NOAA.

Details of all presentations are presented in this report and on the JIP and DOE websites.

2.2 ChevronTexaco JIP Workshop

Following the conclusion of the DOE R&D Conference, the ChevronTexaco JIP workshop was begun. The purpose of the JIP workshop was to present the results of Phase I and to ask for comments on the JIP's plans for Phase II.

2.2.1 Presentations

Steve Holditch, Schlumberger provided an introduction and talked about the objectives of the ChevronTexaco JIP, and past JIP workshops on data collection, model requirements, and drilling, logging and coring procedures required to collect the data needed by the JIP scientists and engineers. Dr. Holditch explained the main objectives of the current workshop, which are to discuss the results of Phase I, and obtain the input from the hydrate community on the Phase II drilling, logging and coring plans. He explained that we will divide into 4 breakout sessions tomorrow, following the formal presentations. The breakout sessions will be as follows:

- Drilling and Coring Procedures
- Core Handling and Core Analyses Procedures
- LWD and Wireline Logging Requirements

Site Selection Criteria, Remote Sensing & Permanent Monitoring

Additional presentations were made by Nadar Dutta, Fred Snyder and Jianchun Dai with WesternGeco, Sheila Noeth, Richard Birchwood, and Pat Hoyman with Schlumberger, Carolyn

Ruppel with Georgia Tech, Frank Rack with JOI, Phil Long with Pacific Northwest National Laboratory, and Tim Collett with USGS.

Details of all presentations are presented in this report and on the JIP and DOE websites.

2.2.2 Breakout Sessions

Drilling and Coring

The Fugro Explorer has been chosen as the vessel for conducting Phase II of the JIP research project. Drilling will be done riserless. At the KC-195 sites, total depth (TD) of the drill hole is expected to be 2000 ft below the mud line. At the AT-14 sites, TD is expected to be 1000 ft below mud line. The participants are concerned that if we drill below the BSR into one of the high amplitude anomaly zones, we could hit free gas and could have both drilling and plugging problems. Typically MMS does not allow someone to drill below a BSR without using a riser. Some of the participants stated that we should drill through the BSR at least at one site so we can obtain logging and coring data through a BSR. The downside is that if any gas influx occurs, the hole will have to be plugged with 10-ppg-cement and abandoned, which will add days and significant dollars to the cost of the wells. Otherwise, holes will be left open after logging or coring operation is completed and the holes allowed to close naturally.

At each site, twin holes will be considered. One of the holes will be used for logging and the other hole will be used for coring. The hole drilled for LWD will be an 8 ½ " hole and a 10" hole will be drilled for coring and wireline logging. The drill pipe will be a combination 5" and 5 ½" string for all operations. Fishing tools will be available if needed. The drilling fluid will be 8.6 ppg seawater. The expected fracture gradient is 10.4 ppg. Drilling fluid circulation will be kept at 350 gpm or less in an effort to keep the hole as cool as possible so that no hydrates will melt. The drilling fluid will not be chilled. Drilling fluid mixing capacity is not a problem on the Fugro Explorer. Seawater will also be used as coring fluid.

The Fugro Hydraulic Piston Corer (FHPC) design that will be used on the Fugro Explorer is identical to one used in ODP operation. We expect that 800-1000 ft of core will be cut and collected during the first phase of field operations in Q2 of 2004. The derrick is not capable of handling a core barrel of greater than 30 ft. The Fugro Pressure Corer (FPC) and FHPC coring systems use the same bottom hole assemblies (BHA). Some participants raised concern that for contingency, the Hyace Rotary Corer (HRC) needs to be present at the rig site. Furthermore, some participants stated that the HRC system has a better success ratio than the FPC system.

It was stated that continuous coring was better for gathering the most complete data set. Several concerns were raised, such as core recovery, and hole stability during drilling, coring and /or logging. There will be 2 to 3 pressure-coring samples per hole. Once to the surface, each core sample will be cut into 1m samples.

Due to the size of the Fugro Explorer, there will be approximately 50 persons on ship. To run the ship, a total of 38 persons will be needed, of which 22 will work for the drilling contractor. That means there is space for 12 persons associated with the JIP. Chevron Texaco (operator) will have 2-3 slots, the JIP will have 1 slot, and Scripps Oceanographic Institute will have 2-5 slots. That leaves room for 6 to 7 slots for persons to do the core handling and science related program (well loggers / LWD / scientists / engineers). It was mentioned that an additional supply boat could provide room for core handling.

Another issue discussed was handling of cores on the rig floor. Most likely the core will be placed into an ice bath to keep the core cold while other rig floor operations are ongoing. Core cycle time was estimated to be around 1 to 1.5 hours. This would entail ½ ton of ice per day. It was mentioned that making that much ice available would not be problem. IR imaging will be used to locate gas hydrates inside the core barrel.

The need to use a seabed frame was discussed. A seabed frame is 10x10x10 ft^3 steel frame that weighs around13 tons. There will be cameras on the seabed frame to monitor shallow water or gas flows. Twin holes would be about 20-30 m apart.

H_2S safety was discussed. It was mentioned that on mounds, H_2S might be possible. JOI will be providing an H_2S training manual. It was also mentioned that a detailed well plan is to be prepared and circulated. Site specific hazards and mitigation /rig management plans will be addressed.

Core Handling and Core Analyses

The objectives of the coring program were summarized as follows by the breakout group.

- What is the nature and distribution of GOM gas hydrate (at range of scales)?
- Why do gas hydrates occur where they do?
- What are the properties of the sediments and the hydrates?
- Investigations must be conducted with appropriate attention to safety.

The next step was to outline the general scope of the coring program, given the stated operational constraints. The constraints of the coring program were defined as follows:

- 2 general coring locations
- 100 piston cores (9m)
- 60 cores at 2m
- 15 pressure cores (Fugro)
- 15 pressure cores (HYACE)
- 9 science berths on ship

A cumulative timeline and flow of operations for a typical wireline piston core was then defined.

- (0 min) Drop core barrel
- (0-15 min) Monitor T, P, conductivity in core barrel as a function of time
- (15 min) Retrieve core or deck, monitor H_2S
- (20 min) Place core in chilled mousehole
- (25 min) Open core barrel, scan IR while removing to refrigerated work environment
- (30 min) Take whole core samples where IR indicates hydrate occurrence
- (32 min) Puncture core liner to take gas samples and relieve pressure
- (35 min) Mark sections for core curation (ODP conventions)
- (40 min) Repeat IR scan
- (45 min) Section core and sample for subsequent analyses
- (50-60 min) Place core in refrigerated storage

The next topic discussed was the various analyses to be performed on the core samples. Rather than list all the possible analyses, it was decided to focus only on those that were required or highly desirable to be done at sea during the cruise.

Required shipboard analyses

- Gas analyses (headspace and core void gases), store gas samples for shore based work
- Pore waters (1-2 per section in first core, less frequent in deeper cores)
    - squeeze whole round samples
    - subsample and preserve
    - measure salinity, dissolved sulfide, alkalinity
- Microbial sampling and preservation
- Physical properties samples (whole round, pressurized?)
    - Multisensor track (Vs/Vp, NMR, density, etc?)

The general procedure for handling pressure cores was outlined as shown below.

Pressure Cores—shipboard procedures and tests

- Transfer pressure cores to mated storage chambers (need total of 30 storage chambers).
- Quantitatively degas on ship/supply boat for methane concentration, recover gas for shorebased analyses.
- Consider rapid depressurization and core transfer to retain some hydrate and to make apparatus available to enable more frequent deployment of pressure coring apparatus.

A brief discussion of general tasks associated with core handling and analyses is summarized below.

General Tasks

- Establish safety procedures
- Adopt optimal sample storage and hydrate preservation methods
- Outline type of measurements to be made on core samples
    - Seismic/geophysical calibration
    - Borehole/mechanical properties
    - Geochemistry/ microbiology studies
    - Core description/sedimentology
    - Petrophysical properties

In the time remaining, members of the breakout group tried to cover some of the remaining aspects of possible shore based investigations and how these should be carried out.

Onshore Lab/JIP Investigator Lab Capabilities

- All work not done at sea for this program must be done in onshore labs—either a central facility for the JIP or in labs of cooperating investigators
- Examples of shorebased work:
- Biostratigraphy
- Sedimentology
- Mineralogy
- Grain Size

- Etc.
- Recommend that required Leg II data be developed

Logging

The prioritized program for LWD and wireline logging is as follows:

- MWD / LWD, Density Neutron, Resistivity, GR with Pulsing;
- Wireline Dipole Sonic (DSI);
- LWD NMR;
- Zero offset VSP related to seismic program. Consider evaluation of seismic vision while drilling (SVWD) which would replace ZOVSP;
- LWD X-Sonic. This does not replace wireline Sonic since there is concern how it works; and
- Mud logging for methane detection at the seafloor.

Site Selection

Assumptions were as follows: There will be 3-4 sites in KC-195 region and 3-4 sites in AT-14 region. Twin holes at each site. AT-14 is a high flux area. KC-195 is a low-flux area.

Three types of sites are prioritized for AT-14 area:

- Near mound site (Offset not center of mound)
- Baseline site
- One with BSR with bright amplitude below BSR.

The prioritized sites for KC-195 area are as follows:

- Above BSR
- Above & Below BSR
- Baseline
- Mound –offset
- Sites 5 & 6 backup of 1 & 2.

3.0 Presentations

All presentations can be found on both the JIP and the NETL Web sites.

http://bobqpext.chevrontexaco.com/wwuexpl_gashydrates

http://www.netl.doe.gov/

3.1 Department of Energy Project Review

William F. Lawson, Associate Director, NETL, US DOE provided introductory remarks and welcomed the participants.

Edith Allison, Program Manager, Exploration, US DOE Office of Fossil Energy, provided a brief overview of DOE's Methane Hydrate R & D Program. She also announced that the DOE's Hydrate R & D budget for FY 2004 is still being discussed in Congress. The US House of Representatives had approved the budget of US$ 5.5 million; whereas, the US Senate had approved the budget of US$ 9.5 million. The actual budget is expected to fall in between these two numbers. She also stated that Formal International Cooperation would be announced at the 3rd International Hydrate Workshop in Chili in November 2003.

KEYNOTE ADDRESS- Professor Dendy Sloan, Weaver Distinguished Professor of Chemical Engineering, Colorado School of Mines, provided the overview of how knowledge is developed in the field of hydrates in his keynote address. He stated that S-II hydrates (thermogenic) are found in the GOM and Caspian Sea. S-I hydrates have been found in the pipelines of GOM (Kenyon Express). He gave 2 examples of hydrate plugs formed in deepwater pipelines (Norsk Hydro and Petrobras). Dr. Sloan said that it took 5 days for the hydrate plug to form, and 2-months to melt it. The good news is that the plug melts radially inwards. Dr. Sloan provided a CD on his hydrate literature database to the attendees, which contains over 10,000 articles. He also emphasized how the new equipments such as RAMAN+NMR+XRD have improved the speed and accuracy of obtaining hydrate phase equilibrium measurements. Dr. Sloan next reviewed various hydrate phase behavior prediction software such as CSMHYD-II, CSMHYD, DBR, WHYP, and AQUILIBRIUM and stated that most software have accuracy of $\pm$ 0.5 ^{0}C in temperature. He emphasized use of INFRA-RED sensing device for detecting amount and type of hydrate in hydrate cores. Dr. Sloan provided a new phase diagram for a Methane-Water hydrate system based on new equipment and measurements. Finally, Dr. Sloan reminded the attendees about the hydrate conference in Chiba, Japan, in December 2003 where the results of Malik production testing will be made public.

HOT ICE # 1 Well (APC) Presentations

One of the two arctic gas hydrate projects currently funded by the US DOE is the Anadarko-Maurer Technology-Noble Drilling Project. Anadarko is the operator.

Overview by Tom Williams, Maurer Technology*:* The objectives of this project are to drill and core gas hydrates that are located to the south of the Kuparuk River Unit on the North Slope of

Alaska. The gas hydrate zones will be characterized using the data from logs and core analysis. Anadarko is using a Dynatec 1500 UDR slim hole drilling rig, a rig normally use in mining operations. The drilling effort has been monitored via a live data feed. Continuous coring of the gas hydrates (3.25" diameter) is planned. Chilled drilling and coring fluid (-5 ^{0}C) will be used to help preserve the gas hydrate in the cores.

Lessons Learned & Future Well Plans by Bill Liddell, Anadarko Pet. Corp.: To conduct this project and to test out new technology, Anadarko designed an arctic drilling platform, where the entire operation is conducted 12 feet above ground level. This new platform was designed in the Summer of 2002, constructed and was installed in February 2003. The first well was spud on March 31, 2003. Drilling was suspended on April 21, 2003 because the weather had warmed and the tundra was beginning to thaw. Casing was set near the top of the gas hydrate zone, and the location was temporarily abandoned. Drilling activity is planned to resume in January 2004, and Anadarko expects to be coring and logging the gas hydrate zones soon after operations are restarted.

Update on Remote Lab & Equipment by Richard Sigal, APC: A remote core analysis laboratory was set up on the arctic platform. All cores are cut with chilled mud and brought to the surface, where the core handling procedures are carried out at sub-zero temperatures to avoid hydrate melting. In the work done during 2003, the entire hole through the permafrost was cored and tests were run on the core to gather data and to evaluate the laboratory equipment. The following core logging and measurements have been made on prior cores and are planned for the gas hydrate cores that will be cut in 2004:

- Compressional Velocity
- Shear Velocity (for shallow seismic calibration)
- Dynamic Elastic Modulus
- Resistivity (for log calibration)
- NMR (for hydrate saturation)
- Dissociation (for dissociation rate)
- Pore volume compressibility
- Effect of pressure on porosity & permeability
- Infra Red Imaging
- Temperature Scanning
- White Light Photography
- Geologic Description
- High Res. CATSCAN

It was stated that because of corrosion caused by the high salinity of the drilling fluid used in the 2003 field work, much of the laboratory equipment has been redesigned and rebuilt in preparation for the 2004 work.

Timothy S. Collett, Geologist, USGS provided a geological characterization of the Eileen and Tarn Gas Hydrate Accumulations on the North Slope of Alaska. The Eileen hydrate accumulation has 60+ TCF of free gas below formations containing gas hydrate;whereas, the Tarn accumulation has 40 TCF of free gas below hydrates. Both of these accumulations contain natural gas of thermogenic origin. These accumulations have been well studied and significant information is available in the literature. Dr. Collett stated that P-T conditions within these two accumulations are very similar to those from the ODP Leg-204 sites. Dr. Collett also discussed his Gas Hydrate Energy Resource Flow Chart.

Robert Hunter, Geoscience / Project Manager, BP Exploration (Alaska), Inc. provided an overview of the BPX Alaska Gas Hydrate Project. This project is focused on developing gas hydrate and free gas underneath hydrates through production testing. Mr. Hunter described various petroleum system components within the Eileen gas hydrate /free gas accumulation such as source, migration paths, reservoir rock, trapping mechanisms, seals, and the stability conditions. He also described prospect requirements for drilling and production testing, and the components for commercial exploitation of gas hydrates such as the presence of industry infra-structure, access to the acreage, availability of production technology, economics and risk assessment, ultimate recovery potential, daily production rate potential, operating costs, profitability, and research support in aligned areas. Phase-I of the BPX project will be from October 2002 to September 2005, and will cost about US$2 million. During Phase I, BPX will conduct reservoir characterization studies, reservoir engineering studies, reservoir simulation and economic analysis. Phase-II starts in October 2005 (US$3.6 million) and covers production testing and reserve calculation.

Scott Dallimore, Research Scientist, Geological Survey of Canada provided an overview of the Malik 5-L-38 hydrate production research well project. This is an international collaborative field research project sponsored by 8 partners at a cost of US$17 million. The main features of this project include DTS-long-term-temperature monitoring, dedicated wireline coring, open hole logging (NMR, EPT, DSI, FMI, PEX), cased hole (CHFR-RST), cross-hole tomography, zero offset and walk-away VSP, Production testing by pressure draw-down and thermal stimulation. 3” wireline coring (CORION) resulted in 80% core recovery. NMR / Density logs were used to determine the gas hydrate saturation values. DTS was used for long-term temperature measurement at every meter interval with $\pm 0.1^0$C accuracy. MDT flow tests were conducted on 6 intervals. The detailed results of this project will be released to public at the December 8-10, 2003, hydrate conference in Chiba, Japan.

George Moridis, Lawrence Berkeley National Laboratory discussed strategies for gas production from hydrates. He classified strategies based on resource type such as Class-I: hydrate interval + free gas zone; Class-II: hydrate interval + water; Class III: hydrate only. Dr. Moridis also discussed parameters, which increase the production potential of gas hydrates. He concluded that the best chances of producing gas at commercial flow rates and volumes will be from the free gas zones in Class-I hydrate deposits.

Emrys Jones, Chevron Texaco, Project Manager, Gulf of Mexico-Hydrate JIP: Emrys Jones provided an overview of the Gulf of Mexico (GOM) gas hydrate Joint Industry Project (JIP) which is focused on characterizing the shallow hydrates in the deepwater Gulf of Mexico. He discussed the overall objectives of the project, provided a brief description of activities during Phase-I of the project. Phase I is drawing to a close and the drilling, logging and coring plans for the Phase II of the project will be one of the subjects of the JIP 2003 Workshop. The initial area evaluated by the JIP included 28 blocks, each of which was a 3 mile by 3 mile square. Of these 28 blocks, 6 blocks were selected for more detailed evaluation. Eventually, two blocks, the Keathley Canyon - KC195 and the Atwater Valley – AT14 were selected for even more detailed evaluation. Dr. Jones briefly discussed the laboratory studies conducted by Georgia Tech, the Japan National Oil Company, and the USGS; seismic modeling studies conducted by WesternGeco, USGS and the Naval Research Laboratory; wellbore stability modeling study conducted by Schlumberger, heat flow measurements conducted by Georgia Tech; high resolution seismic studies conducted by USGS, DTAGS / SS-DR studies conducted by NRL, and long-term monitoring stations proposed by the University of Mississippi. The JIP's planning process for Phase II is being assisted by JOI / TAMU and the USGS. Scripps Institute of Oceanography will be the science provider and the JIP will use the Fugro Explorer to conduct field operations.

Deborah Hutchinson, Coastal & Marine Geology, Woods Hole, USGS provided an overview of geological evidence for sub-surface gas hydrates in the GOM, and she discussed the results of various cruises. She discussed various areas of GOM that are well known for gas hydrate evidences through mounds, mud volcanoes and bottom seismic reflectors (BSRs). The evidence presented included seismics records, heat flow data, and geochemistry information in areas such Bush Hill, Mississippi Canyon, Green Canyon, Garden Banks, Atwater Valley & Keathley Canyon. Four (4) out of 18 cores had hydrates in them, mostly in the disseminated form.

Joseph Gettrust, Geophysicist, Naval Research Laboratory presented a geochemical analysis of gas hydrate distribution. The NRL cruise equipment consisted of a methane sniffer, DTAGS (200m WD, 1.6 Km streamer, 10-200 HZ), heat flow measurements, MCS, TEAMS (mass spectrometer). He stated that most gas hydrates in the GOM are of thermogenic origin except in the Cascadia margin. He described a BULLSEYE feature representing erosion of seafloor, and gas chimneys in the Cascadia margin. He briefly discussed a shallow water flow study conducted by BP / Shell in the MARS / URSA area. Dr. Gettrust stated that due to weather problems during the coring and heat flow measurement cruise in the Atwater Valley site, no data were taken. However, the Keathley Canyon site cruise was successfully completed and piston cores were taken and heat flow measurements were completed.

James Woolsey, Director, MMRI, CMRET, University of Mississippi described the status of GOM seafloor monitoring station. This station was envisioned due to concern of gas seepage from hydrate dissociation in the GOM. He showed Bush Hill site pictures with gas seepage and hydrate mounds. A temperature probe was placed in one of the mounds, and the Johnson sea link was used for data transmission. The two recording thermistors showed dramatic temperature effects in the mound versus time. The mean temperature in water was 7.87^{o}C, and the mean temperature in the hydrate was 7.81^{o}C. A doppler current meter was used for measuring the amount of gas seepage through the loop currents. The gas activity correlated with water temperature eddies. Dr. Woolsey described a device to analyze pore water samples at 10 locations in the upper few meters of the seafloor sediments. He described the Raman Spectrometer of Wood Hole Oceanographic Institute, and laboratory studies concerning the effects of biosurfactants on hydrate formation rate. Dr. Woolsey also described shear wave studies using hydrophones and 3-component accelerometers. The equipment is located on a multi-purpose, towed sled, rigged for single point deployment. He described how it operates (direct S-wave, converted S-wave, reflected and incident P-wave). Dr. Woolsey then described how to help the JIP through use of low cost linear array of P-T and ground (VSP) monitoring sensors (borehole vertical line array). He discussed how to deploy it and how to get the data to shore (NOAA Unit).

Thomas McGee, Research Associate Professor, MMRI, Univ. of Mississippi described the USGS seismic data gathered at the AT-14 site (line 9979) and the variable line array (VLA). The heat flow in the hydrate mound was found to be 10 times higher than other areas in the vicinity. A seismic cruise is planned in Mid-October 2003 in the AT Valley-14 to collect additional data.

Frank Rack, Associate Director, Joint Oceanographic Institute provided an overview of the hydrate drilling and coring study conducted at ODP Leg-204 at Hydrate Ridge, Oregon. During Leg-204, they cored and logged 9 sites in the Cascadia Continental margin to determine the distribution and concentration of gas hydrates in the ridge and adjacent slope basin. They also investigated the mechanisms that transport methane and other gases into the gas hydrate stability zone, in order to obtain constraints on the physical properties of gas hydrates in-situ. Leg-204 was the first time in the history of the ODP project that extensive data had been gathered to characterize a large gas hydrate deposit. The project features include a 3-D seismic survey / DTAG survey, MWD /LWD (RAB, VDN, NMR Provision, Power Pulse MWD) measurements, VSP surveys, Piezoprobe temperature surveys, pressure coring systems (PCS, FPC, HRC, PTCS) and geriatric studies onboard. During the cruise, over 3600 m of core was recovered (80% recovery). Several reports concerning Leg-204 are available on the ODP Web site.

Pulak Ray, Mineral Management Service discussed MMS philosophy on accessing technically recoverable amounts of gas hydrates in offshore areas. He referred to a 1995 USGS Resource Assessment of 200,000 Tcf of gas in hydrate deposits of USA.

Andrew Shepard, NOAA Undersea Research Center, UNC @ Wilmington provided an update on the hydrate research activities at NOAA. He discussed gas flux measurements from bubblometers, high-resolution digital imaging systems, HC sensors and gas hydrate cores. Dr. Shepard presented the concept of a hydrate observatory, and new NOAA initiatives for determination of methane input to atmosphere from ocean sources through mapping AUV (deep LEO type station) and devise sampling program.

3.2 JIP Workshop

Steve Holditch, Schlumberger provided an introduction and talked about the objectives of the ChevronTexaco JIP, and past JIP workshops on data collection, model requirements, and drilling, logging and coring procedures required to collect the data needed by the JIP scientists and engineers. Dr. Holditch explained the main objectives of the current workshop, which are to discuss the results of Phase I, and obtain the input from the hydrate community on the Phase II drilling, logging and coring plans. He explained that we will divide into 4 breakout sessions tomorrow, following the formal presentations. The breakout sessions will be as follows:

- Drilling and Coring Procedures
- Core Handling and Core Analyses Procedures

- LWD and Wireline Logging Requirements
- Site Selection Criteria , Remote Sensing & Permanent Monitoring

Western Geco Team (Nader Dutta, Fred Snyder and Jianchun Dai) made presentations on "Seismic interpretation, analysis and modeling for gas hydrate detection in deepwater Gulf of Mexico". The major objectives of their study are as follows:

- To establish a geologic framework for gas hydrate detection;
- To show whether available seismic data are adequate for gas hydrate detection and quantification;
- To define a processing flow for seismic data; and
- To develop a procedure for gas hydrate characterization.

Steps involved in gas hydrate characterization include the following:

- Reprocessing / acquisition of high-resolution 3-D seismic data at 2ms;
- Stratigraphic evaluation;
- Seismic attribute analysis (AVO analysis);
- Rock property inversion (pre-stack fully elastic waveform inversion); and
- Hydrate mapping (Quantification).

The seismic data for two blocks, the Keathley Canyon (KC-195) and Atwater Valley (AT-14), were reprocessed at 2ms and the resolution was improved considerably.

A regional BSR was interpreted in the KC195 region, and the BSR was found to extend west from a regional growth fault and deepens westward as the mini-basin sediments thicken. Isolated, high-reflectivity zones beneath portions of the BSR were interpreted to possibly be free gas in sand layers.

In AT-14 region, a northwest-southeast transect across the data show several hydrate mounds. The height of the mounds vary from 9-22 m, and the widths ranged from 450-600 m. Seismic data (2D and 3D) have a reflection that was interpreted to be an anomalously shallow BSR beneath Mound. It was pointed out that shear wave data are needed to further characterize the mounds and p-wave data are not sufficient.

Schlumberger Team (Sheila Noeth, Richard Birchwood, Pat Hooyman) made presentations on wellbore stability modeling (WBS). Their study involved the following steps:

Phase-I - To identify and evaluate existing WBS models and to determine hydrate modeling requirements.

Phase-II - To build a prototype WBS model that includes the effects of gas hydrates.

Phase-III - To validate / calibrate the prototype WBS model for hydrates with Q2 2004 well data and laboratory data from Georgia Tech.

The wellbore stability problems related to gas hydrates include hole washouts, cementing heat of hydration causing hydrate melting problems, poor cement bonding which can lead to behind pipe gas migration, sloughing, stuck tools and casing collapse.

Carolyn Ruppel, Associate Professor, Georgia Tech, presented results of a laboratory study contracted by the JIP for the measurement of various properties of cores containing laboratory generated hydrates. The laboratory hydrates are made with water and tetrahydrofuran (THF). THF was used to decrease the time required to form hydrates in low permeability rocks and to allow the experiments to be run at room temperature. Dr. Ruppel showed the experimental study matrix and stated that roughly 75-80% of experiments are completed. The properties measured by Georgia Tech on laboratory synthesized THF hydrate samples include the following:

- Mechanical Properties;
- Elastic-Plastic Transition;
- Tensile Strength;
- Shear Strength;
- Compressive Strength;
- Failure / Stability Envelopes (Mohr-Coulomb);
- Bulk Moduli – Static (Hydrostatic Compaction Coefficient);
- Young's modulus – static (Strain);
- Triaxial Compaction Coefficient;
- Volume-Pressure Compaction Curves (Uni-axial Volume Compaction);
- Thermal Properties;
- Thermal Conductivity;
- Thermal Diffusivity;
- Heat Capacity;
- Volume Change During Phase Transition;
- Effect of depressurization on acoustic properties of the cores; and
- Effect of estimated temperature cycles on acoustic properties of cores.

There was significant discussion on why THF hydrate was being studied and whether it simulates real hydrate conditions in situ.

Phase-II Drilling & Coring Plans, Frank Rack, JOI, JOI presented generic drilling and coring plans for the JIP Phase II. Their report will be out in December 2003. Two drilling vessels were considered. One vessel was the JOIDES and the other was the Fugro Explorer. Both vessels can operate in 2500 –4000 ft water depth, 0 –2000 ft below seafloor with no riser. Both vessels have wireline retrievable coring systems.

The presentation addressed some of key issues that need to be addressed in the breakout sessions, such as follows:

- Operational sequence to be followed;
- The JOI report that will include all necessary specifications;
- Over-pressured coring (APC);
- Format of the core delivery;
- Rig layout and rig-space management;
- Planning for camera for seafloor monitoring;
- Continuous monitoring of hole conditions for making drilling decisions;
- Need for good safety program;
- LWD / wireline logging to be finalized;
- System for positioning and naming core samples; and
- Safety during core retrieval on the rig floor.

Phase-II Core Handling & Core Analyses Plans, Frank Rack, JOI, Dr. Rack presented generic core handling and core analyses plans for the Phase II. The presentation addressed the following topics to be discussed in the breakout sessions:

- Core testing protocols for data gathering. With the Fugro drill ship, lot of core work will have to be done onshore. ODP core handling and core analyses protocols will be documented;
- Safety during handling of cores containing H_2S (need for area sensors);
- Safety for gas analyses onboard (What backups, what training needed, how it will be managed);
- Infrared thermal imaging of sediment cores (How it was done during ODP 204);
- Need for planning for preservation of hydrate samples in liquid N_2;
- Release of pressure to minimize risk of core liner failure;
- Use of proper gloves and aprons during core handling;
- Proper handling of cores and voids (disturbing core to minimum by processing core as fast as possible);
- Use of styrofoam for core tracking;
- Handling of pressure vessels and maintaining low temperature;
- Manifold system for gas extraction and analysis;
- Filling pressure vessels with methane gas with minimum headspace (Parker Vessels with 5000 psi rating, $700 per piece);
- Core transfer;

- Transporting pressure vessels;
- Geotek logging of hydrate bearing pressure cores;
- X-Ray linear core scanner to conduct hydrate dissociation experiments at ODP Gulf Coast Core Repository;
- Need for certification of aluminum pressure vessels from DOT for international transport – (requires 6 month lead time);
- Extracting pore waters from core samples;
- Plan for using the laboratory space on the Fugro Explorer;
- When to use whole core or split core measurements;
- Microscopic analysis of core samples (onboard or other vessels);
- Core sampling and description procedures / sampling policy / core description methods;
- D-tubes for split core storage and transport;
- Packaging of cores;
- Refrigerated core storage for long term needs;
- Data organization and management; and
- Metadata requirements.

Peter Schultheiss, Geotek Ltd., presented Pressure Coring Sampler (PCS) experience in the GOM. The PCS coring system was used in ODP- Leg 164. In ODP-Leg 204, following coring systems were used:

- The ODP Pressure Core Sampler (PCS) is a wireline-retrievable, top-drive rotary/push system. The tool is 42-mm diameter, up to 86 cm-long core is rated to10,000-psi (690-bar) maximum pressure

- The FUGRO Pressure Corer (FPC) is a wireline-retrievable, percussion/push prototype tool. It is 50-mm diameter, up to 100 cm-long core and is rated for 3625 psi (250 bar) maximum pressure.

- The HYACE Rotary Corer (HRC) is a wireline-retrievable, downhole mud motor rotary / push; prototype tool. It is 58 mm diameter, up to 100 cm-long core and is rated to 3625 psi (250 bar) maximum pressure.

Phil Long, Pacific Northwest National Laboratory gave a presentation on IR imaging of cores. IR imaging of cores has significant advantage over conventional temperature detection methods. IR imaging was initially tried in ODP Leg-201, and in Malik. Full implementation of this method with auto-core tracking was done in OPD Leg 204. IR imaging allows immediate identification of hydrates within sediment while still in the core barrel. Features and advantages of this system include the following:

- This system has 2 cameras. FLIR SC-2000 & AVIO Neo Thermo Model TVS-610;

- It has provision for both track mounted and handheld;
- It can be used for continuous imaging of the core;
- Data reduction and partial analysis can be done on shipboard;
- IR images and data can be linked for observation of hydrates and for making core decisions;
- Gives textural information such as veins, nodules, disseminated etc.;
- Provides IR profile for estimating hydrate volume in the core;
- Statistical analysis of IR data can be useful; and
- IR anomaly can be correlated with other data.

He recommended that following be discussed in the break out sessions:

- Operational issues for the GOM sites;
- Evaluation of imaging priorities;
- Comparison of IR versus other methods; and
- What is the optimal approach for interpretation of IR data.

Timothy Collett, US Geological Survey **gave** a presentation on evaluation of marine gas hydrate accumulations during Leg 204. He compared log evaluation in Malik (coarse-grained), Blake Ridge- Leg 201 (clay-dominated system), and Hydrate Ridge- Leg 204 (fine-grained system). Dr. Collett stated that resolution is important and depends upon the form of hydrates. He also made recommendation of LWD and wireline logs that should be looked at for hydrate evaluation.

JIP Site Selection Presentations: Debby Hutchinson –Seismic data; Karolyn Ruppel – Heat Flow Surveys / Thermal Data; and Richard Coffin – Piston Coring Data

Debby Hutchinson presented the seismic data for two regions namely, Atwater Valley (AT-14) region and Keathley Canyon (KC-195) region.

AT-14 region has four interesting area which were described as (1) a local anomalous shallow BSR below the mound, (2) an area with seismic blanking, (3) possible hydrates at seafloor and (4) a baseline area where no hydrates are thought to exist. Several sites were proposed for further discussion during the breakout sessions. These sites were as follows:

- Site 14a – Center of mound;
- Sites 14b and 14c – At offset of main mound;
- Site 14d – Mound 2 center;
- Site 14e – Background site (no hydrate?);
- Site 14f – transition zone;
- Site 14g – Variability address site;

The KC-195 site also has four areas which were describes as (1) a regional BSR, (2) and area with high amplitudes below BSR, (3) a mini-basin baseline area and (4) several mounds. The following sites were pre-selected for further discussion:

- Site KC195a – Site that encompasses BSR, fault and high amplitude anomaly below BSR;
- Site KC195b – Site at mound center with BSR & high amplitude anomaly below BSR;
- Site KC195c – Baseline step out site with no hydrates;
- Site KC195d – Site with regional deep BSR;
- Site KC195e – Site with blanking / mound but no high amplitude anomaly;
- Site KC195f – Site with regional BSR;
- Site KC195g – Site at mound center; and
- Site KC195h – Site with BSR & high amplitude below BSR.

Carolyn Ruppel mentioned that it was not possible to collect heat flow data at AT-14 due to a hurricane in August 2003. She only presented KC-195 heat flow data. The average measured thermal conductivity was 1.14 W/m/K. The geothermal gradient was obtained using marine heat flow data, downhole temperatures and inferences from BSR depth.

Richard Coffin discussed piston-coring results. Four cores of 7 m in length were obtained. Methane / chloride / sulfate / H_2S concentrations were measured. Methane isotopic analysis indicated that the gas was biogenic.

4.0 ChevronTexaco JIP Breakout Sessions

4.1 Drilling and Coring

It is important to note that the group felt strongly that the <u>detailed planning for the project should begin as soon as possible</u>! There are many competing goals. Priorities must be set, and the plan should be balanced on the basis of cost and time.

General Plan

- Two general areas have been selected which have numerous sites that are likely to yield hydrates – Atwater Valley 14 (AT 14), and Keathley Canyon 195 (KC 195). Both areas have water depths of about 4300'. It was generally felt that the goal of tying seismic data to hydrate location/amount precludes drilling/coring directly into seabed hydrate mounds because the seismic data is so poor below these areas. This is also a lower safety risk.

- The geotechnical ship Fugro Explorer has been chosen to do the riserless drilling/coring/logging work. A work-boat will be supplied for shuttling cores to the beach, extra storage space, re-supply of consumables, etc.

- Jim Niemann (CVX) will coordinate a shallow hazard survey for the sites of interest. CVX drilling in New Orleans will supply drilling planning help and a rig supervisor for the project.

The MMS has tentatively agreed to permit the holes under CFR 251 rules normally meant for science related holes <500' deep. The MMS has also tentatively agreed that our holes (about 1000'-1500') do not have to be cemented as part of the abandonment unless gas flow is observed, or free gas is logged. Cement will probably be a simple 11 ppg slurry. A 150' plug above the gas zone will be needed, with second plug near the mudline.

- The project will be approximately 30 days drilling/LWD logging and coring/wireline logging as many holes as time allows.

- April/May was chosen as the time most likely to give us minimal weather delays.

- At each site a seabed frame will be set, including a camera to watch for well flows.

- The hole sizes will probably be 8-1/2" for LWD, and 10" for coring.

- In each major area, one pair of baseline holes will be drilled/logged and cored to establish "normal" for the area.

- Other targets include BSR's, and sites near mounds

- LWD tools/services are very expensive, so the first 2 weeks are so will be spent quickly drilling and getting LWD logs on a number of sites. The LWD tools will then be back-loaded to the beach and the wireline tools brought onboard. Most of the initial holes should be subsequently "twinned" (10-20 meters away) for coring and wireline logging.

The LWD logs should help identify key spots for taking pressure cores. Also, LWD tools require no/little rathole, and give data starting at the seabed. If hole conditions are terrible in some cases is it possible that a quick/clean hole will be drilled just for wireline logging.

- All cores will be wireline retrieved. The Fugro Hydraulic Piston Corer (FHPC) should be the main tool for unpressured cores down to about 800-1000’ below mud line (BML). In stiffer sediments the Fugro Corer (FC) will be employed. For pressure cores the Fugro Pressure Corer (FPC) and the Hyace Rotary Corer (HRC). Modifications are under way to run at least one of these with the same bottom hole assembly as the FHPC.

- The group expressed a desire for at least part of the holes to be continuously cored from the seabed, while recognizing that the time/budget limits of the project may make it advantageous to spot core some holes.

- Logistical limits mean the drilling fluid will be mostly seawater and high viscosity sweeps, with some heavier pills spotted for logging. Hole closure with time may be an issue in the lower sections of each hole. Mud compatibility issue was raised – is freshwater gel ok to use or is seawater gel (attapulgite or sepiolite) more suitable for our application. Seawater gel is preferred.

- A team of scientists from Scripps Institute will put together a detailed science plan for the project. They will engage a Lead Scientist to oversee the planning and operations.

- Safety will be a central issue. H2S is a possibility, which will call for self contained air packs, training, handheld sensors, area sensors, etc. Protocols for dealing with pressured samples will be developed. We will have copies of the ODP protocols in these areas as a starting point.

Fugro Explorer

The Explorer is considerably smaller than the Joides Resolution, but is fully adequate for the JIP project. Some key features are as follows:

- 261’ long;
- Max water depth – 3000m;
- Heli-deck;
- Dynamically positioned with differential GPS and location pinger on seabed frame;
- 50 bunks (38 accounted for by Fugro crews – boat, drilling, coring/handling). About half of remaining bunks will be taken by CVX personnel, lead scientist, etc.;
- 90’, 150 ton derrick – only trips singles – slow pipe tripping – 350-400’/hr;
- Wireline retrieval rates about 300-400’/min (limited by swabbing);
- 10’ passive heave compensator for drill string;
- wireline has in-line tensioner for heave compensation;

- Drill string – 5-1/2” S-135 below mud line, 5” aluminum above mud line;
- 8’ x 10’ core storage cooler on upper deck;
- 1300 sq. ft. of lab space;
- Can handle approximately 1 meter heave at mid-ship – about 2 meter seas;
- Cores probably processed on back deck with one pipe rack removed;
- Deck crane is 6-ton. 20 ton hydraulic A-frame;
- 2 liquid mud tanks – 333 bbls each. 3 mixing tanks – 134 bbls each;
- Dry bulk tanks – 4 @1500 cubic ft. each;
- Drill water – 47K gallons;
- Mud pumps – 2 Wirth triplex. 600 gpm at 290 psi with 5 1/2” liners, 230 gpm at 925 psi with 3” liners;
- Small cement unit;
- VSAT for communications – 3 voice lines, 1 fax/email. INMARSAT if needed; and
- Ship computer networked.

Logging and Downhole Tools

The logging vendor approval process is almost complete. Fugro bit will be modified to 3.76” ID to allow passage of all wireline tools.

Key LWD logs include the following:

- Resistivity at Bit (RAB);
- Gamma Ray (GR);
- Neutron Density (VDN);
- Seismic while drilling was discussed but thought to be a poor option due to the verticality of the holes; and
- The need for real-time data was discussed.

Key Wireline Log

- Dipole sonic

Other logs may be added (particularly NMR) if budget allows, and the technical reasons are strong enough (VSP, FMS/dipmeter, APWD).

Piezoprobe for Temperature and Pressure Measurements

- Push about 3’ into bottom of hole and wait for equilibration
- Real time data on e-line

- How often? ODP does every 50 m
- Can take up to 6-8 hours for pressure to equilibrate; however, since measurements can be viewed in real time, the experiment can be completed whenever pressure equilibrates.

Coring Equipment

- Fugro Hydraulic Piston Corer (FHPC) – 30' cores, usually goes to 800-1000' below mudline until sediments are harder
- Fugro Corer (FC) – for stiffer sediments, up to 4 meter cores, push and/or mud hammer
- Fugro Pressure Corer (FPC) – 1m core, 58 mm diameter, chamber has 3600 psi pressure limit
- Hyace Rotary Corer (HRC)
- Flow rates will be kept low to keep hole as gauge as possible

Core Handling

The topic of core handling was mostly covered by another breakout session, but the following comments were generated in the drilling and coring breakout session.

- The infra-red (IR) camera system is a very good way of spotting hydrates for sub-sampling. Frank Rack will loan us 1-2 cameras. We probably won't set up to "log" the cores with IR in detail.
- An ice-trough will be fabricated so that pressure coring assemblies can be chilled immediately upon arrival on the drilling floor. They will have warmed up while being wirelined out and the pressure will be rising. Once the cores are cooled there will be more time to safely move the assembly for core transfer, etc. Numerous ice machines will be added to the Explorer to cover these activities.
- A 10' cold room will be on the deck to house the Fugro core logging frame.
- In general, only immediately necessary analyses will be done on board. The emphasis will be on stabilizing the core and getting to a land-based lab.

4.2 Core Handling and Analyses

George Claypool opened the breakout session by stating the objectives and the fact that we would be expected to report back a summary of at 3:30 PM in the afternoon.

Peter Schultheiss provided some basic background. The JIP will be drilling at two locations, and currently plans to talk 160 9-m cores, 60 specialized 2-m cores, and 15 HYACE pressure cores. Peter stated emphatically that we need to state the objectives clearly or we will not be able to figure out what we need to do.

The primary objective: **Determine the nature and distribution of gas hydrate in core**.

Richard Sigal emphasized the need for complete information from core, not just the data required to calibrate the seismic (by this he meant, a full suite of physical properties, gamma density, NMR, etc).

George pointed out that a key objective is **to figure out where the hydrate came from** (Objective 2). Objective 3 was **to determine key properties, particularly seismic properties** to enable remote detection of hydrate in the GOM in the future.

It was noted that macroscopic and microscopic (pore filling) hydrate may be different (in origin?).

The question was asked, "How do we preserve the cores and what do we preserve?" The answer to this question is different for pressure cores than for non-pressure cores.

Scott Dallimore felt strongly that we needed a scheme to describe what he referred to as "exotic" textures like Phil Long showed from Leg 204. Scott was in favor of splitting cores and IR imaging core surfaces or otherwise systematically describing hydrate textures at the next level of detail below that available from IR imaging of core liners.

Phil Long seconded Scott's idea and noted that while the textures observed on leg 204 seem exotic, they may be quite common in hemipelagic sediments.

A couple of individuals noted the importance of getting the enhanced, rapid IR imaging on the full circumference of the core liner as suggested by Phil Long in his presentation earlier in the day. It would be particularly valuable for obtaining dip measurements on layers and lenses, something particularly important to structural interpretations.

It was next decided to list the times and what happens (or needs to happen) to the core, starting at the sea floor and going through to activities that occur in a shore-based laboratory. As part of this discussion, George Claypool noted that we needed to decide (1) what had to be done on board ship and (2) what could be postponed until the cores were delivered to the beach. This timeline was put down on the flip charts. For example, sedimentology and other description of core can almost certainly be done on the beach, presumably after the core is split. However it was noted that this does not provide a real-time feedback on the stratigraphy. One means of dealing with this problem would be to do a limited, quick description through the liner and based on cut core ends (e.g. section ends) before the core is sent to beach.

Jonathan Kwan pointed out that engineering and borehole mechanical parameters are needed from the core materials. It would be ideal to get as much of this information shipboard, while the hydrate is still present in the cores. However, everyone recognized that the laboratory space limitation on the Fugro Explorer means that tradeoffs will have to be made. Specific information recommended by J. Kwan includes: geophysics (Vs, Vp), petrophysical data, such as core porosity, water content, etc., geochemistry, microbiology, and hydrologic (flow) properties.

Richard Sigal followed up on Kwan's comments by asking the question of how we preserve gas hydrate, such as by using liquid N_2, or by pressurization with methane. The participants also discussed issues with methane pressurization, such as the creation of new hydrate while in storage.

The group also discussed the importance of monitoring temperature, pressure, and conductivity in cores from the time they are collected to the time they are placed on deck (e.g. the ODP APC methane tool). Phil Long pointed out that ODP is actively developing the next step here that would also provide data on temperature of the inside of the core barrel at spacing of approximately 1.5 to 2.0 m.

It was agreed that a key goal is to get the core on deck ASAP. On ODP Leg 204, this required modification and streamlining of drilling protocols. There was considerable discussion of the desirability of a cold room. It was not known if creating a cold room is feasible, but it was clear that a refrigerated working environment was needed to slow the loss of hydrate during core processing. It was recognized that this only buys some (unknown amount) time. It does not replace the need to preserve core in liquid N_2 and/or methane under pressure. It was also suggested that we needed to collect samples that will enable us to determine the concentration of methane dissolved in the pore water. There clearly will be uncertainty in determining methane from hydrate vs. methane dissolved in pore water, but collection of samples with different amounts of hydrate needs to be done to attempt to resolve this question.

It was also suggested that visible light images be collected at the same time IR images are taken. While the liner sometimes may limit the value of the visible images, the instances where gas cracks or changes in sediment color can be seen will make it worthwhile. Of course, the visible light images will need to be taken in such a way to enable precise depth alignment with the IR images.

Dendy Sloan pointed out that we have an ethical and moral responsibility to ensure that core handling and sampling is done in a safe way. Otherwise, someone could be injured. Dr. Sloan felt that the video footage shown by Frank Rack was a significant concern and indicated a need for a thorough safety analysis to increase the level of assurance that they project can be conducted in a safe manner. It was pointed out that the operator has the primary responsibility for safe drilling and core handling. However, it has been well established that safety in general is greatly enhanced when individuals all take responsibility for safety, establishing a culture of safe operations.

Mike Du asked the question of pressure preservation of cores, including the possibility of pressurizing the core barrel to “buy time”. It was pointed out that the standard APC type core barrel is not designed for or capable of maintaining pressure that would preserve hydrate. Dendy Sloan then pointed out that the GAC Bulletin 544 addresses gas hydrate core preservation methods and includes a significant amount of data to back up their recommendations.

At this point, information was provided on the number of berths available for scientists and engineers. Nine individuals could be accommodated, but they will need to cover 24-hour operations. It is possible that one to two people would be available from the Fugro crew to assist with core handling work. This needs to be sorted out soon, because the number of individuals available to help cores will be a critical determining factor limiting what can be done shipboard.

Discussion then returned to core processing and making sure that we focus on doing the time critical sampling and preservation shipboard and all other activities a shore-based labs. To that end, it was reiterated that we need to preserve whole round cores effectively for a range of activities. For example, for deformation properties of sediment without hydrate, it is necessary to maintain moisture content by waxing and then storing in seawater (Bill Winters). Sediment with hydrate needs to be stored in pressure vessels for testing of strength and deformation properties in the stability range of gas hydrate. Similar approach will be needed for Vs, Vp measurements if those measurement cannot be done shipboard prior to loss of gas hydrate by dissociation.

The possibility of doing some simple experiments shipboard to (semi) quantify the amount of gas hydrate in both sediments with disseminated hydrate and in sample with abundant, visible gas hydrate was discussed further by Scott Dallimore. It was noted that this was done and the data are available for earlier ODP gas hydrate drilling. Apparently little has been done with this information, possibly because of uncertainty about how much methane was lost en route to the surface. Another approach is to do similar, but more controlled experiments on pressure cores that are rapidly removed from pressurization, logged, and parts of the core with different gas hydrate abundances placed in pressure vessels or other controlled chambers for measurement of methane content.

Considerable discussion occurred around the need for additional pressure storage chambers for HYACE pressure cores. At the present time, 7 are available. The discussion can be summarized as follows: 7 additional chambers are an approximate minimum number needed for effective operations. As many as 30 could be effectively used for Legs 1 and 2 of the JIP. These pressure storage chambers can be gamma density scanned to produce 3-D images of the interior of the vessel at approximately 5 mm/voxel resolution. It would also be possible to transfer to Al pressure vessels (pressurized up to 900 PSI) that could be X-ray scanned at higher resolution. No decision was made on the need for Al pressure storage chambers.

A related issue is the use of LBNL’s X-ray CT scanner for scanning non-pressurized cores. The scanner could be used on board ship (space and personnel permitting) before gas hydrate dissociates or it could be used on shore to scan both un-pressurized cores after dissociation of gas hydrate and pressurized cores, if transferred to Al pressure storage chambers. Operational constraints probably mean that the X-ray CT scanner is best used in an on shore lab, but this was not discussed or decided by the group and Barry Freifield needed to leave before the session was concluded.

The session wrapped up with further discussion by Mike Du on the importance of a wide range of core data. George Claypool closed the session by asking for any final comments or discussion. The group acknowledged that George did an excellent job of guiding the discussion of a diverse group of scientists and engineers.

4.3 Logging

Aaron Conte presented the following JIP plans for logging in outline form.

Current JIP Plans

- Logging While Drilling (LWD).
    - The LWD phase is planned for the first half of the drilling & coring operations in the spring of 2003. Approximately 15 days.

- Plan is to drill 2 or 3 well bores in each block (based on budgetary constraints) with LWD prior to commencing the coring operations with the goal of obtaining some definition of where the hydrate zone is.
- Formation Evaluation tools planned to be run as LWD:
  - Resistivity at bit with imaging
  - Density-Neutron (with stabilizer)
  - Gamma Ray
- Benefits of LWD
  - Real-time data acquisition. Allows information that future decisions may be based on to be gained early.
  - Hole condition (washout, closure) is not an issue for LWD logs as the data is obtained as the hole is drilled – i.e. prior to significant wash out. This is especially important for the Density Neutron readings, as on wireline the tool has a pad that needs to contact the side of the well bore.

- Wireline Logging
  - Wireline logs will be run through the drill pipe in one or two cored bore holes in each block. Expect approximately 21 days of tool rental time including transit. Entire coring & logging expected to be approximately 15 days.
  - Wireline acquisition will consist of Dipole Sonic data only. The Dipole Sonic is considered reliable data based on previous tool runs on ODP Leg 204
  - Wireline logging strategy still needs to be determined due to core assembly restriction.
  - Necessity to have on back up even if LWD sonic tools are run.

Other Possibilities Worthy of Discussion

- LWD
  - Nuclear Magnetic Resonance
    - Uncertainty values may be within the range of the actual saturations expected.
    - Low end of sensitivity range may be near expected saturations.

        - Debate on amount of uncertainty in the readings & low end values – they may be within acceptable range.
        - Must determine value added as the data comes with an increase in cost.
    - Quadra pole Sonic
        - Can be run in lieu of wireline Dipole Sonic
        - Has risk involved in data acquisition as the tools are not proven in shallow/soft formations. Only modeling has proven to be successful.
        - No wireline drift restrictions.
        - Utilizing this tool has incremental costs.
- Wireline Logging
    - No wireline tools for back up. Depend solely on Quadra pole sonic. No contingency. Eliminates the cost of wireline, but risk of data failure goes up.
    - Other wireline tools. None currently under consideration.
- Logging While Coring
    - Can only utilize resistivity-at-bit with modeling tool.
    - Must run Density Neutron on wireline. Additional cost and increased risk for poor data due to hole quality after coring, circulating, reaming, etc.
    - Can only be used with wireline rotary coring tools.

Constraints Affecting the Logging Program

After discussing the outline of the logging plan, the participants decided to address the topic of what are the constraints affecting the logging plans. What are the hole and pipe constraints and other constraints? Below are the constraints that were agreed upon by the work group.

- It will take 1 day to trip pipe (round trip)
- 8 ½" hole for LWD
- 10" hole for core
- 3.76" ID for logging tools
- Size of Fugro Explorer – Limits the number of tools on board
- It will take1 day travel time between Atwater & Keathley

- Do not have to trip pipe if we stay at one site
- Length of LWD tool string is approximately 130 ft.

General Considerations

Current plans call for drilling 4-8 holes at each site. One-half of the holes will be drilled and logged, and a twin hole will then be drilled and cored. Bob Kleinberg mentioned that logging well coring worked well on ODP Leg 204 and wondered if the JIP was planning to include logging while coring. Aaron Conte said it was not in the current plans due to added cost for coring program. Will have RAB from twin holes, and you can only get resistivity while coring. Bob Kleinberg said that the observed lateral variability can be quite significant and getting RAB with core might be a plus, but it was thought that this tool was not able to be run where real-time data was acquired – only memory data after the fact. This means that no core point decisions could be based on the RAB-C tool and it would likely not justify its cost for this program.

Tim Collett agreed that getting the resistivity at the bit while coring would be desirable, but you get other measurements. The system was designed for the ODP coring system, and would not work with the Fugro drill string. A new tool would have to be custom built for this project. Aaron will consult with Fugro, ODP, and Scripps to see if it is desirable and practical.

The Fugro explorer will drill with LWD first then offload the LWD equipment, and load the core and wireline tools to drill the twin wells. As of now, the exact number of holes at each site have yet to be determined. Once a detailed budget has been obtained, the number of holes can be estimated. However, it a gas or water flow occurs, time and money will have to be devoted to plugging the problem hole, and the total number of experimental holes will be reduced.

Emrys Jones said the number of sites for the project is still on the table. The JIP will plan an aggressive program that will ensure that we have plenty of places to drill and test during the 30 days of the field effort. During the first 15 days of the cruise, we will make LWD measurements only (4-8 holes). During the second 15 days, we will core and, perhaps, run wireline logs in the twin wells.

During the drilling and LWD work, all of the down hole data is not generally pulsed to the surface. However, some of the data should be pulsed to be sure the tools are working properly. Most of the data can be recorded downhole and retrieved when the LWD equipment is pulled.

As a result of the above discussions, the following are general considerations that must be evaluated by the JIP and the contractors.

- Should we consider using RAB while coring?
- Should we drill 2-3 well pairs at 2 locations or 6-8 well pairs at one site?
- There will be a workboat w/possible laboratory space, space for storing logging tools, ROV, and other items that will not fit on Fugro Explorer.
- VSP check shot. Do we need this?

- During the first 15 days, we will drill and log with LWD 4-8 holes
- During the second 15 days, we will coring and log with wireline 4-8 holes
- LWD must have
  - Density – Neutron,
  - RAB/Image,
  - Gamma Ray
  - MWD – Drilling Parameters
- Some of the data should be pulsed to the surface to be sure tools working, but most data should be recorded downhole

LWD Nuclear Magnetic Resonance

- The discussion of the participants moved to the Logging While Drilling Nuclear Magnetic Resonance tool. The NMR LWD was run on leg 204. One of the participants asked the question "What is the Benefit of the NMR log?". The advantage of the NRM is that it tells you about the total water, which is very important, not just the gas hydrate saturation. The ODP data shows the water is all bound water in the hydrates. Bob Kleinberg stated that the NMR tool gives you information about both the free and bound water. The wireline NMR tool has worked extremely well, specifically at Mallik. If you compare the LWD NMR and the Wireline NMR, the LWD measures a narrower range. There are things that the LWD will not find, but these are not the things that we are not interested in for the JIP in the GOM. Based on the wireline tool, the LWD tool should work just fine. As it turns out, the wireline NMR is too big and cannot be run in the JIP holes that will be drilled by the Fugro Explorer. So if we are to get NMR data, it must be with the MWD tool set. The consensus of the participants was that the LWD NMR should be run.

LWD – Sonic – Quadrapole

The participants next discussed the need for sonic information.

Discussion moved to the Sonic Requirements: This whole project is to find where and what characteristics of the gas hydrates from seismic data. When the industry goes to deep water they can identify the hydrates in advance for safe development. The sonic information is very important to understand the acoustic properties. We need to get acoustic information.

All participants agreed that the JIP needs both compressional and shear sonic data. The question is should we try to get sonic data using LWD tools or wireline tools. There is an LWD sonic tool that can measure shear data; however, that tool has not been tested in soft, slow formations. Also, if the LWD sonic is added to the tool string, will it make the tool string so long it can not be handled by the Fugro Explorer. Also, as the tool string gets longer, more rat hole has to be drilled to get a full logging suite. Therefore, it is advisable to determine the tool length and cost, before deciding on the Sonic-Quad MWD.

As far as a wireline sonic is concerned, we know it will work, but there is an ID restriction problem in the Fugro bottom hole assembly. There is also a rig time concern on wireline sonic.

JNOC found out that to get good wireline logging data, you need to drill a hole dedicated to obtaining only wireline logging data. Trying to wireline log a well after coring, does not seem to produce acceptable data in soft sediments.

In summary, if the MWD acoustic-quadrapole works with then we don't need the wireline sonic. The tool will be about 140 feet long. Would be good to test or prove this tool so it can or can not be considered for future research.

Thus, concerning the LWD Sonic tool, we can summarize the discussion as

- If it works – do not need wireline sonic log
- Wireline dipole sonic tool will definitely give us the data we need
- What are issued with tool length?
- Look at tool length and cost to decide on this one
- Would be good to test or prove this tool.

Some Comments by Various Participants

JNOC	–	We will need a dedicated hole for wireline logs
	–	Generally, it is not good to log holes with wireline after coring
Leg 204	–	Good holes after coring in older, more compacted sediments
	–	Poor holes in younger, less consolidated sediments
	–	may see breakouts

Alternate Ways to Get Vp + Vs

- Vertical Seismic Profile (VSP) – Walkaway (wireline)
- Seismic Vision While Drilling – LWD – Look interesting; need to investigate
- VSP – Zero Offset (wireline)

There are other ways to obtain Vp and Vs data, such as zero offset VSP with the source at the ship, a walk away VSP where another boat records the data as it moves away from the source. Another method is seismic vision while drilling (SVWD). Bob Kleinberg mentioned that we will not do the VSP if you don't do the wireline logging, because you need the same equipment. If the JIP is serious about getting mechanical information then the VSP is recommended.

Tim Collett suggested that there are simple tools that can be used, and there will be no problems with the ID of the downhole assembly. At least one or two days, say a day for zero offset, will be required to do a VSP survey. Normally, in the GOM you run it in cased hole. The JIP would only need one VSP per site. Tool has to clamped in a competent part of the open hole and the cable is slacked off. If the ship heaves you can loose the tool, and it can be easily damaged.

In summary, the following describes the major points concerning a **VSP survey.**

- Contingent on wireline
- Best way to get mechanical properties of formation away from borehole
- Samples large volume of the formation
- Ties better with seismic
- 1-2 days per well for each VSP
- Can damage tool easily
- Soft borehole can be problem
- Very important to reach JIP objectives

Temperature Issues

Tim Collett stated that the JIP should 1) record core barrel temperatures as they did at Mallik. 2) use the logging tool based thermometer data, both Wireline and MWD and 3) look at a fiber optic system DTS system as they did at Mallik.

4.4 Site Selection

General Discussion of Targets

- Goal: Pick 3-4 sites in each of the two areas (Keathley Canyon and Atwater) along with 2 or more back-up sites. Assume each site has 2 wells (twinned)
- Sites will address JIP goal of providing ground truth subsurface data for seismic.
- Because Atwater and Keathley Canyon are quite different geologically, the site selection criteria may be different.

Issues: Should any wells be drilled through surface hydrate mounds and vents?

- If so, an NTL variance will be needed.
- Will drilling through mounds provide data that meets the JIP objectives?

- Can a riserless well be safely drilled through a mound and into an amplitude?
- Wells cannot be drilled within 500 feet of a chemosynthetic community.
- Would it be better to drill all of the wells at either Keathley Canyon or Atwater instead of drilling both sites?
- Does each site need to have a pair of holes, or can some just be logged (or go back and core in 2005)?

Specific Issues for Atwater Site Selection

- Priority is to understand a high-flux area (representation)
- How to tie the well data back to seismics and models?
- How close to a mound can we/should we get?
- How close are known chemosynthetic communities?
- Need for shallow water hazard study

Atwater: Priority Sites

- Site 1: Drill the "perturbed BSR" off mound F, but as close to the mound as possible. This will yield a better tie to seismic than drilling the mound.
- Site 2: Drill a baseline hole between mounds D & F.
- Site 3: Drill between sites 1 & 2. This location will evaluate a chaotic zone. There is a possibility of reservoir sands and perhaps free gas within the hydrate stability zone.

Back-up Sites

- Site 4: Drill a mound D offset, away from the chimney.
- Site 5: Drill on top of mound F (if this can be done safely).
- Site 6: Drill an additional well on the flanks of the mound.

Specific Issues for Keathley Canyon Site Selection

- This area was chosen to represent a low flux region for comparison with Atwater Valley.
- The objective is to target units above and below the BSR.

- Try to target the same sand, where it exists above BSR in one location, and below BSR in another.

- Need to account for uncertainty in seismic data (don't miss the target!)

- terminations of sand bodies

- extent of apparent BSR

- Drilling middle of mounds "not good idea"

    - risk, liability, permitability, etc.

Note: potential value of giant piston cores on mounds.

Keathley Canyon: Priority Sites

- Site 1: Drill through stacked sands above BSR on line WG 5700

- Site 2: Drill through the same sands as at site 1, but below the BSR. This site is relatively close to site 1.

- Site3: Drill a baseline well in the basin, beyond where the BSR has been mapped. (Issue: How deep does the well need to go?)

- Site 4: Drill close to, but not on the WG mound.

  Back-up Sites

- Sites 5 & 6: Similar objectives to Sites 1 & 2, but located on Lines KC 01.

Other Issues/Considerations

- Timetable for JIP for required work

- Getting Hazards Study underway quickly

- Which survey first AV vs KC (probably KC)

- Are other tools viable (e.g., Giant Piston Cores)

- For timing – do we need to stop at/above the BSR in some wells?

- What do we need for the long-term monitoring well at AV? (logistics, monitoring horizons etc.)

- Take into account new data that becomes available before drilling

  DTAGS (NRL) - uncertain

  Coring and Heatflow at AV - uncertain

  Vertical Array (U. Miss.) – certain

  C&C sidescan/chirp/multibeam - uncertain

- Consider other elements of the system

  e.g., charge, trapping mechanisms, etc.

Things that need to be done

- Check lease status (AT 14 may have been leased in the March Sale)
- Map the channel system in upper sections and geohazards
- Depth model for drilling (depth model) – WG data should be good enough
- Extract amplitudes for various horizons
- Amplitude Maps of shallow sands in KC
- Good Depth model on flank of Mound F

5.0 Experimental

No experimental work was performed during this workshop

6.0 Conclusions

1. By combining the DOE R&D Conference with the JIP workshop, the combined meeting attracted 101 international hydrate experts, scholars and scientists from academia, industry, research institutes, national laboratories and government organizations. Virtually all of the attendees commented on the high quality of the technical materials presented and discussed at this meeting.

2. The results from this workshop have been documented in this report, and all the presentations can be found at either the JIP or the DOE web sites.

   http://bobqpext.chevrontexaco.com/wwuexpl_gashydrates

   http://www.netl.doe.gov/

3. The DOE R&D Conference presented a wealth of information that brought the participants in line with the latest technologies and ideas generated from the DOE sponsored gas hydrates research projects. Most of those who participated in the R&D Conference were very interested in the JIP plans for the Deep Water Gulf of Mexico seismic, drilling, logging and coring operations.

4. The results from Phase I of the ChevronTexaco JIP – DOE project were presented to the 101 international experts. Significant feed back and suggestions were obtained that have been used in the detailed planning for Phase II of the project.

5. Significant recommendations were made by the attendees in site selection criteria, coring procedures, core handling procedures, core analyses, and logging procedures.

7.0 References

No references were used to prepare this report.

APPENDIX A

Agendas for the DOE R&D Review and the JIP Workshop

DOE Office of Fossil Energy/

Methane Hydrate R&D Conference

Monday, September 29, 2003

The Westin Westminster Hotel - Westminster, Colorado

DAY ONE

Foyer of Westminster Ballroom IV

11:00 Open Registration Desk

Westminster Ballroom IV

12:30 Introductory Remarks

William F. Lawson, Associate Director, National Energy Technology Laboratory

12:40 DOE Methane Hydrate Program Overview

Edith Allison, Program Manager, Exploration, DOE Office of Fossil Energy

1:00 Keynote Address – How is Knowledge Developed in the Field of Hydrates?

E. Dendy Sloan, Weaver Distinguished Professor of Chemical Engineering Center for Hydrate Research

Colorado School of Mines

1:30 Networking Break

Westminster Ballroom IV

1:45 Arctic Session Moderator: Brad Tomer, U.S. DOE, NETL

Hot Ice #1 Well – Overview Thomas Williams, Maurer Technology, Inc.

Hot Ice #1 Well – Lessons Learned & Future Well Plans Bill Liddell, Anadarko Petroleum Corporation

Hot Ice #1 Well – Update on the Remote Lab & Eqpt. Richard Sigal, Anadarko Petroleum Corporation

3:00 Networking Break

Westminster Ballroom IV

3:15 Geologic Characterization of the Eileen and Tarn Timothy Collett, U.S. Geological Survey

Gas Hydrate Accumulations on the North Slope of Alaska

3:45 Natural Gas Hydrate Characterization Robert Hunter, BP Exploration, Inc.

Prudhoe Bay – Kuparuk River Area, Alaska North Slope

4:15 Review of Mallik 2002 Scott Dallimore, Geological Survey of Canada

Gas Hydrate Production Research Well Program - Mackenzie Delta, Northwest Territory, Canada

4:45 Strategies for Gas Production from Hydrate George Moridis, Lawrence Berkeley National Laboratory

Accumulations Under Various Geological and Reservoir Conditions

5:15 Adjourn

Lakeview Pavilion

5:15 Cocktail Reception with Cash Bar and Buffet

7:00 Day One Concludes

DOE Office of Fossil Energy
Methane Hydrate R&D Conference

Tuesday, September 30, 2003

The Westin Westminster Hotel - Westminster, Colorado

DAY TWO

Westminster Ballroom IV

8:00	**Continental Breakfast**	
8:30	Marine Hydrate Session Moderator:	Edith Allison, U.S. Dept of Energy, Office of Fossil Energy
	Gulf of Mexico (GOM) Joint Industry Project	Emrys Jones, ChevronTexaco
	Geological Evidence for Subsurface Gas Hydrates in the North Gulf of Mexico Woods Hole - USGS	Deborah Hutchinson, Coastal and Marine Geology
	GOM – Geochemical Analysis of Hydrate Distribution	Dr. Joseph F. Gettrust, Head Geology/Geophysics Section, NRL
	Status of GOM Seafloor Monitoring Station	Robert Woolsey and Thomas McGee Center for Marine Resources and Environmental Technology University of Mississippi
10:45	**Networking Break**	

Westminster Ballroom IV

11:00	**In Situ Sampling and Characterization of Naturally-Occurring Marine Methane Hydrate – ODP Leg 204 (Hydrate Ridge)**	Frank Rack, Ocean Drilling Program National Science Foundation
11:30	**Assessing Technically Recoverable Amounts of Gas Hydrates in the Offshore Leased and Leasable Lands**	Pulak Ray, MMS
12:00	**Update on NOAA Hydrate Research Activities**	Andrew Shepard, NOAA Undersea Research Center UNC at Wilmington
12:30	**NETL Event Concludes**	

Gulf of Mexico

Naturally Occurring

Gas Hydrates JIP Workshops

Tuesday, September 30, 2003

The Westin Westminster Hotel - Westminster, Colorado

DAY ONE

Foyer of Westminster Ballroom IV

12:30 Open JIP Registration Desk (For those **ONLY** attending the Hydrates Event)

Westminster Ballroom IV

1:00	**Opening Remarks**	Steve Holditch, Schlumberger
1:30	**Seismic Interpretation, Analysis and Modeling for Gas Hydrate Detection in Deep Water Gulf of Mexico**	Fred Snyder, WesternGeco
2:15	**Presentation by Schlumberger: Wellbore Stability Modelling**	Sheila Noeth, Schlumberger DCS
3:00	**Networking Break**	

Westminster Ballroom IV

3:30	**Laboratory and Numerical Modeling Results on Hydrate-Bearing Sediments and Constraints on Thermal Regimes at Proposed JIP Drilling Sites**	Ruppel, Sanatamarina, and Francisca Georgia Tech University
4:15	**Phase II Drilling and Coring Issue**	Ben Bloys, ChevronTexaco & Frank Rack, JOI
4:45	**Phase II Core Handling and Core Analyses Issues**	Ben Bloys, ChevronTexaco & Frank Rack, JOI Peter Schultheiss, GeoTek & Phil Long, PNNL

5:15 Adjourn

Lakeview Pavilion

5:15 Poster Reception with Cash Bar and Buffet

7:00 Day One Concludes

Gulf of Mexico

Naturally Occurring

Gas Hydrates JIP Workshops

Wednesday, October 1, 2003

The Westin Westminster Hotel - Westminster, Colorado

DAY TWO

Westminster Ballroom IV

7:30 **Continental Breakfast**

8:00 **Recap of Day One** Steve Holditch, Schlumberger

Statement of Objects for Day Two

8:15 **Phase II Logging Issues** Ben Bloys, ChevronTexaco & Tim Collett, USGS

8:45 **Site Survey for JIP Drilling** Deborah Hutchinson, USGS, Carolyn Ruppel, Georgia Tech & Rick Coffin, Naval Research Laboratory

9:45 **Networking Break**

Westminster Ballroom IV

10:00 **Breakout Session – Drilling and Coring Plans**

Westminster Ballroom III

10:00 **Breakout Session - Core Analysis Plans**

Heritage Suite

10:00 **Breakout Session – Core Handling Plans**

Legacy Ridge Suite

10:00 **Breakout Session – Core Logging Plans**

Lakeview Pavilion

12:00 Seated Luncheon

Westminster Ballroom IV

1:00 Breakout Session Resume – Drilling and Coring Plans

Westminster Ballroom III

1:00 Breakout Session Resume - Core Analysis Plans

Heritage Suite

1:00 Breakout Session Resume – Core Handling Plans

Legacy Ridge Suite

1:00 Breakout Session Resume – Core Logging Plans

3:00 Networking Break

Westminster Ballroom IV

3:15 Report Out by Breakout Session Chair

5:00 Event Concludes

APPENDIX B

List of Attendees

First	Last	Company	Title	email
Goodarz	Ahmadi	Clarkson University	Professor	ahmadi@clarkson.edu
Edith	Allison	US DOE	Program Manager	edith.allison@hq.doe.gov
Roger	Amato	MMS	Geologist	roger.Amato@mms.gov
Ravi	Aurora	ConocoPhillips	Prin. Engineer	ravi.aurora@conocophillips.com
Richard	Birchwood	Schlumberger Oilfield Services	Geomechanics Specialist	rbirchwood@slb.com
Richard	Blake	Lawrence Livermore National Lab.	Associate Program Leader, Fossil Energy	blake2@llnl.gov
Ben	Bloys	ChevronTexaco	Staff Research Scientist	ben.bloys@chevrontexaco.com
Douwe	Bruinsma	Colorado School of Mines	Research Assistant	dbruinsm@mines.edu
Kathy	Bruner	EG&G Technical Services	Research Geologist	kathy.bruner@eg.netl.doe.gov
Eric	Cauquil	TOTAL	Deep Water Survey Engineer	eric.cauquil@total.com
Biswajit	Chakraborty	Reliance Industries Limited	Asst. Vice President	Biswajit_Chakraborty@ril.com
Jen Hwa	Chen	ChevronTexaco	Team Leader- Anchor, Mooring and Risers	jenc@chevrontexaco.com
George	Claypool	Consultant	Geochemist	geclaypool@aol.com
Richard	Coffin	Naval Research Laboratory		rcoffin@css.nrl.navy.mil
Timothy	Collett	US Geological Survey, Dept. of Interior	Geologist	tcollett@usgs.gov
Aaron	Conte	ChevronTexaco	Drilling Engineer	amco@chevrontexaco.com
Rick	Cox	Well Dog Inc.	CTO	rcox@welloginc.com

First	Last	Company	Title	email
Jianchun	Dai	Schlumberger	Geoscientist	jdai@slb.com
Roland	DeBruyn	Clearflame Resources	**	rdebruyn@clearflame.com
Gordon	Deppe	Nexant	Principal	gdeppe@nexant.com
Earl	Doyle	Ocean Studies Board	Member	ehdoyle@alltel.net
Mike	Du	GTI	Petroleum Engineer	mike.du@gastechnology.org
Brandon	Dugan	USGS		bdugan@usgs.gov
Nader	Dutta	Schlumberger	Chief Geoscientist	ndutta@slb.com
Barry	Freifeld	Lawrence Berkley National Lab	Mechanical Engineer	bmfreifeld@lbl.gov
Roger	George	C & C Technologies, Inc.	Geosciences Manager	tony.george@cctechnol.com
Joseph	Gettrust	Naval Research Laboratory	Geophysicist	jGettrust@nrlssc.navy.mil
Michael	Godec	Advanced Resources International	Vice President	mgodec@adv-res.com
Ken	Grabowski	Naval Research Laboratory	Section Head	grabowski@nrl.navy.mil
Arvind	Gupta	Colorado School of Mines	Research Assistant	argupta@mines.edu
William	Gwilliam	USDOE/NETL	Sr. Geologist/PM	william.gwilliam@netl.doe.gov
Patrick	Hart	USGS	Geophysicist	hart@usgs.gov
George	He	Pacific Northwest National Lab	Senior Research Scientist	george.he@pnl.gov
Keith	Hester	Center for Hydrate Research, Colorado School of Mines	Research Assistant	khester@mines.edu
Stephen	Holditch	Schlumberger	Fellow	sholditch@slb.com
James	Howard	ConocoPhillips	Principal Scientist	james.j.howard@conocophillips.com
Gary	Humphrey	Fugro-McClelland Marine Geosciences, Inc.	Sr. Project Mgr., Deepwater Projects	FMMG@fugro.com

First	Last	Company	Title	email
Robert	Hunter	BP Exploration (Alaska), Inc.	Geoscience / Project Manager	hunterrb@bp.com
Dr. Deborah	Hutchinson	USGS		dhutchinson@usgs.gov
Yuichiro	Ichikawa	Japan National Oil Corporation	Senior Drilling Engineer	yuichiro.ichikawa@jdc.co.jp
Takatoshi	Ito	Tohoku Univ.	Professor	ito@ifs.tohoku.ac.jp
Jason	Ivanic	Colorado School of Mines	Research Assistant	Jivanic@mines.edu
Art	Johnson	HEI	President	art_johnson@hydrate-energy.com
Emrys	Jones	ChevronTexaco	Research Consultant	ejones@chevrontexaco.com
Vidyadhar	Kamath	Reliance Industries Limited	Dv. General Mgr.	Vidyadhar_Kamath@ril.com
Bob	Kieckhefer	ChevronTexaco	Staff Geophysicist	rmki@chevrontexaco.com
Derek	Kleehammer	Colorado School of Mines	Research Assistant	dkeehammer@mines.edu
Robert	Kleinberg	Schlumberger	Scientist	kleinberg@slb.com
Jan	Krason	GEOEXPLORERS INTERNATIONAL, INC.	President	geoexpl@eazy.net
Vello	Kuuskraa	Advanced Resources International	President	vkunskraa@adv-res.com
Jonathan	Kwan	University of Oklahoma	Professor	jTKwan@ou.edu
Karl	Lang	SAIC	Sr. Energy Advisor	karl.r.lang@saic.com
Dr. Bill	Lawson	US DOE/NETL-Tulsa	Associate Director	bill.lawson@npto.doe.gov
Bill	Liddell	Anadarko Petroleum Corp	Engineering Supervisor - Ops Technology	bill_liddell@anadarko.com
Phil	Long	Pacific Northwest National Lab	Sr. Program Manager	philip.long@pnl.gov
Devinder	Mahajan	Brookhaven National Laboratory	Scientist	dmahajan@bnl.gov

First	Last	Company	Title	email
Mohit	Mathur	Reliance Industries Limited	Sr. Geoscientist	mohit.mathur@ril.com
Dan	McConnell	AOA Geophysics	Senior Geoscientist	danbeth@sbcglobal.net
Thomas	McGee	MMRI/ University of Mississippi	Research Associate Professor	inst@olemiss.edu
Rex	McKinley	ConocoPhillips	Dir., Business Development	rex.mckinley@conocophillips.com
Jennifer	Merrill	The National Academies	Senior Program Officer	jmerrill@nas.edu
Robert	Moore	Schlumberger	DESC Engineer	mooreb@slb.com
George	Moridis	Lawrence Berkley National Lab		gjmoridis@lbl.gov
Thomas	Mroz	US DOE/NETL	Government Researcher	Thomas.Mroz@netl.doe.gov
Jillian	Nimblett	Shell E&P		jillian.nimblett@shell.com
Lewis	Norman	Halliburton Energy Services	Research Manager	lewis.norman@halliburton.com
Koji	Ochiai	JNOC	Geologist	ochiai-k@jnoc.go.jp
Toshiharu	Okui	Japan National Oil Corporation	Researcher/Methane Hydrate Research Project	okui-t@jnoc.go.jp
Brenda	Pierce	USGS	Energy Program Coordinator	bpierce@usgs.gov
Michael	Pilson	GSO/URI, (NAS/NRC)	Professor Emeritus	pilson@gso.uri.edu
John	Plunkett	EG&G Technical Services	Manager	John.Plunkett@eg.netl.doe.gov
John	Pohlman	NRL	Research Scientist	johnp@ccf.nrl.navy.mil
Dr. John	Pope	Well Dog Inc.	Chair and COO	jpope@welldoginc.com
Frank	Rack	Joint Oceanographic Institutions	Assoc. Director	frack@joiscience.org
Pulak	Ray	MMS	Chief Geologist	pulak.ray@mms.gov
Joseph	Renk III	U.S. Department of Energy	Project Manager	joseph.renk@netl.doe.gov

First	Last	Company	Title	email
Rudy	Rogers	Mississippi State University	Professor	rogers@che.msstate.edu
Martin	Rothfuss	Technical University Clausthal	Petroleum Engineer	martin.rothfuss@tu-clausthal.de
Iraj	Salehi	GTI	Mng. E&P Technologies	iraj.salehi@gastechnology.org
Peter	Schultheiss	Geotek Ltd	Managing Director	peter@geotek.co.uk
Yugdutt	Sharma	Fluid Flow Technologies Inc.	Consultant	yugisharma@aol.com
Bill	Shedd	MMS	Geophysicist	william.shedd@mms.gov
Andrew	Shepard	NOAA/NURP	Associate Director	sheparda@uncw.edu
Richard	Sigal	Anadarko Petroleum Corp	Engineer	richard_sigal@anadarko.com
R.K.	Singh	Reliance Industries Limited	Dv. General Mgr.	Ravindra_K_Singh@ril.com
Dr. Ram	Sivaraman	Gas Technology Institute	Manager, Hydrates Research Facility & Projects	alwarappa.sivaraman@gastechnology.org
Dendy	Sloan	Center for Hydrate Research, Colorado School of Mines	Weaver Distinguished Professor	esloan@mines.edu
Mike	Smith	MMS	Operations Geologist	michael.smith@mms.gov
Fred	Snyder	Schlumberger	Sr. Geophysicist	fsnyder@slb.com
Sivakumar	Subramanian	ChevronTexaco	Research Scientist	sisu@chevrontexaco.com
Charles	Taylor	US DOE/NETL	Leader, Methane Hydrates Group	ctaylor@netl.doe.gov
Charles	Thomas	SAIC		charles.thomas@saic.com
Brad	Tomer	NETL	Product Manager	brad.tomer@netl.doe.gov
Frances	Toro	US DOE/NETL	Project Manager	toro@netl.doe.gov
Yoshihiro	Tsuji	JNOC	Project Director, Hydrate Research	tsuji-y@jnoc.go.jp

First	Last	Company	Title	email
Doug	Turner	Colorado School of Mines	Research Assistant	djturner@mines.edu
Bob	Warzinski	US DOE/NETL	Research Chemist	robert.warzinski@netl.doe.gov
Thomas	Williams	Maurer Technology Inc.	VP Marketing	twilliams@noblecorp.com
William	Winters	USGS	Civil Engineer	bwinters@usgs.gov
James	Woolsey	MMRI/ University of Mississippi	Director	inst@olemiss.edu
Sung-Oh	Yang	Colorado School of Mines	Research Assistant	soyang@mines.edu