Resource Characterization and Quantification of Natural Gas-Hydrate and Associated Free-Gas Accumulations in the Prudhoe Bay – Kuparuk River Area on the North Slope of Alaska

March 2003 Quarterly Technical Report
Second Quarterly Report: January 2003 – March 2003
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by
BP Exploration (Alaska), Inc.
Robert Hunter (Principal Investigator)
P.O. Box 196612
Anchorage, Alaska 99519-6612
Email: hunterrb@bp.com
Tel: (907)-696-2124, (907)-564-5733

with
University of Alaska Fairbanks
Shirish Patil (Principal Investigator)
425 Duckering Building
P.O. Box 755880
Fairbanks, Alaska 99775-5880

and
University of Arizona, Tucson
Robert Casavant (Principal Investigator)
Dept. Mining and Geological Engineering
Rm. 245, Mines and Metallurgy Bldg. #12
1235 E. North Campus Dr., POB 210012
Tucson, AZ 85721-0012

in collaboration with
United States Geological Survey
Tim Collett (Principal Investigator)
Denver Federal Center
Box 25046, MS939
Denver, CO 80225

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ABSTRACT

Interim results are presented from the project designed to characterize, quantify, and determine the commercial feasibility of Alaska North Slope (ANS) gas-hydrate and associated free-gas resources in the Prudhoe Bay Unit, Kuparuk River Unit, and Milne Point Unit areas. This collaborative research will provide practical input to reservoir and economic models, determine the technical feasibility of gas hydrate production, and influence future exploration and field extension of this potential ANS resource.

The large magnitude of unconventional in-place gas (40 – 100 TCF) and conventional ANS gas commercialization evaluation creates industry-DOE alignment to assess this resource. This region exclusively combines known gas hydrate resource presence and existing production infrastructure. Many technical, economical, environmental, and safety issues require resolution before enabling gas hydrate commercial production.

Gas hydrate energy resource potential has been studied for nearly three decades. However, this knowledge has not been applied to practical ANS gas hydrate resource development. ANS gas hydrate and associated free gas reservoirs are being studied to determine reservoir extent, stratigraphy, structure, continuity, quality, variability, and geophysical and petrophysical property distribution. Phase 1 will characterize reservoirs, lead to recoverable reserve and commercial potential estimates, and define procedures for gas hydrate drilling, data acquisition, completion, and production. Phases 2 and 3 will integrate well, core, log, and long-term production test data from additional wells, if justified by results from prior phases. The project could lead to future ANS gas hydrate pilot development.

TABLE OF CONTENTS

1.0 LIST OF FIGURES AND TABLES

2.0 INTRODUCTION

This project will help solve technical and economic issues to enable government and industry to make informed decisions regarding future commercialization of unconventional gas-hydrate resources. The project will characterize and quantify in-place and recoverable gas-hydrate and associated free-gas resources in the Prudhoe Bay Unit (PBU) – Kuparuk River Unit (KRU) – Milne Point Unit (MPU) areas on the Alaska North Slope (ANS).

Successfully unlocking the potential of gas hydrate and associated free gas resources could significantly increase current developable gas reserves available for reservoir energy support and commercial sales on the North Slope of Alaska. Proving technical production feasibility and commerciality of this unconventional gas resource could lead to greater energy independence for the U.S., providing for future gas needs through an abundant, safe, secure, and stable domestic resource.

2.1 Project Reports Summary

(See Section 7.0 list for full associated publications listing)

Current Reports:

1. Quarterly (Yearly) Status report (December, 2002): Quarterly report listing pre-phase 1 accomplishments (October, 2001 – October, 2002) and first Quarter Phase 1 accomplishments (October, 2002 – December, 2002).
2. Quarterly Status report (March, 2003): Quarterly report listing second Quarter Phase 1 accomplishments (January, 2003 – March, 2003).

Future Reports:

3. Quarterly Status report (June, 2003): Quarterly report listing third Quarter Phase 1 accomplishments (April, 2003 – June, 2003).
4. Quarterly Status report (September, 2003): Quarterly report listing fourth Quarter Phase 1 accomplishments (July, 2003 – September, 2003).
5. Quarterly Status report (December, 2003): Quarterly report listing fifth Quarter Phase 1 accomplishments (October, 2003 – December, 2003).
6. Quarterly Status report (March, 2004): Quarterly report listing sixth Quarter Phase 1 accomplishments (January, 2004 – March, 2004).
7. Quarterly Status report (June, 2004): Quarterly report listing seventh Quarter Phase 1 accomplishments (April, 2004 – June, 2004).

8. Quarterly Status report (September, 2004): Quarterly report listing eighth/final Quarter Phase 1 accomplishments (July, 2004 – September, 2004).
9. Phase 1 end report and final decision on progression to Phase 2 (October, 2004).

2.2 Project Open Items

Through 3/31/03, DOE has obligated ~90% of Phase 1 research funds. BP currently accesses these project funds through the U.S. Treasury Department Automated Standard Application for Payments (ASAP) system in accordance with 10 CFR 600.122(b). To fully fund the Phase 1 research through October 2004 will require:

1. Obligation of the remaining 10% ($204,282) Phase 1 research funds into the U.S. Treasury account.
2. Obligation of additional funds ($237,480) used for pre-Phase 1 (October, 2001 through October, 2002) research and project administration before execution of the DOE-BP contract in October 2002. Despite the DOE-BP contract allowing retroactive funding of activities prior to October, 2002, completion of Phase 1 research program will still require 2 years from date of contract execution (October, 2002), since data could not be released for project work prior to contractual definition of data confidentiality. The pre-phase 1 funds requested will enable extension of the Phase 1 contract through October, 2004 will be requested no later than 60 days prior to the end of the current budget period (December 31, 2003) through a continuation application on the SF 424.

2.3 Project Status Assessment and Forecast

Project technical accomplishments between January 2003 inclusive through March 2003 are presented by associated project task. The attached milestone forms present project tasks 1 through 13 with task duration and completion timelines.

2.4 Project Research Collaborations

Progress towards completing project objectives would significantly benefit from continued DOE support and funding of the following associated projects and proposals:

1. **LBNL Reservoir Modeling studies**, including code calibration to data collected during 2002 Mallik gas hydrate test program.
2. **DE-FC26-01NT41248:** UAF/PNNL studies to determine effectiveness of CO_2 as an Enhanced Recovery Mechanism for Gas Dissociation from Methane Hydrate.
3. **UAF/Argonne National Lab proposal:** project to determine efficacy of Ceramicrete cold temperature cement used for new application to future arctic regions gas hydrate drilling and completion operations.

Progress towards completing the objectives of this project are aligned with a collaborative research agreement planned between BP and Japan National Oil Corporation. Execution of the BP-JNOC agreement would allow additional funding for studies and data acquisition. JNOC participation in Phase 1 research would enable JNOC participation in Phase 2 and/or 3 research should industry decide to progress into these operational phases.

2.5 Project Performance Variance

No significant project performance variance is expected at this time.

3.0 EXECUTIVE SUMMARY

This Quarterly report encompasses project work from January 1, 2003, inclusive through March 31, 2003. Sections 4 and 5 provide a detailed project activities report.

- Coordinated project work planning and meetings with USGS, UA, UAF
- Finalized PBU Ballot Agreements for industry review and 3D data release
- Drafted BP – JNOC Collaborative Research Agreement (in legal review)
- Loaded BP Milne Point, KRU and PBU West End well log data
- Correlated 65-70% of 20 Sagavanirktok parasequence units in MPU region
- Completed regional comparison of USGS and UA parasequence picks
- Familiarized team with Landmark software packages and UNIX system
- Completed secure UA hardware, software, and network system
- Created synthetic seismograms for tying wells to seismic data
- Modeled Acoustics of gas/water and hydrate/gas fluid contacts
- Extracted amplitudes on prominent reflections for correlation to fluid contacts
- Delineated possible gas hydrate with associated free gas in MPU S-15i area
- Created shallow fault map from upper 950 ms MPU area 3D seismic data
- Generated MPU-area Isochron maps on marker horizons and unconformities
- Identified key areas to apply neural network and attribute-analysis techniques
- Completed preliminary runs of NN classification for several seismic attributes
- Acquired DBR Phase Behavior apparatus, software, and systems training
- Designed Phase Behavior Experiments and compared results to predictions
- Designed experimental apparatus for two-phase (gas, hydrate-water) relative permeability measurements; equipment ordered and being assembled
- Worked with AETDL and DOE to fund separate UAF/ANL research proposal to study efficacy of Ceramicrete arctic conditions cold drilling cement
- Built economic model (excel based) for the running of project economics
- Planned drilling, completion, data acquisition, and production support work

4.0 EXPERIMENTAL

During the time period from January through end-March 2003 encompassed by this report, primary experimental activities consisted of experiment apparatus design, setup, and execution.

4.1 TASK 6.0, Reservoir and Fluids Characterization

The University of Arizona (UA) loaded MPU, PBU, and KRU well data onto computing and mapping systems and continued data interpretation in association with seismic interpretation studies. Section 5.6 provides additional details, results, and recommendations.

4.1.1 Subtask 6.1: Reservoir and Fluid Characterization and Visualization

Continued seismic and well log interpretation for reservoir and fluid characterization studies.

4.1.2 Subtask 6.2: Seismic Attributes and Calibration

Created Synthetic seismograms for tying well logs to seismic data, calculated initial attribute-cubes on original stacked data, and modeled acoustic properties of gas/water and hydrate/gas contacts to confirm seismic response to gas hydrate-gas fluid contact.

4.1.3 Subtask 6.3: Petrophysics and Artificial Neural Net

Completed Preliminary runs of NN classification for several seismic attributes in the vicinity of well West Sak 25

4.2 TASK 7.0: Laboratory Studies for Drilling, Completion, and Production Support

The University of Alaska Fairbanks (UAF) setup experimental apparatus and designed experiments for gas hydrate phase equilibrium and relative permeability studies. Sections 5.7 through 5.12 provide additional details, results, and recommendations.

4.2.1 Subtask 7.1: Characterize Gas Hydrate Equilibrium

Setup experimental apparatus, designed phase behavior experiments, and conducted initial experiments.

4.2.2 Subtask 7.2: Measure Gas-Water Relative Permeabilities

Designed experimental apparatus set-up for measurement of gas-water relative permeability.

5.0 RESULTS AND DISCUSSION

Project technical accomplishments from January 2003 through March 2003 are presented in chronological order by associated project task.

5.1 TASK 1.0: Research Management Plan – BP and Project Team

Task schedules are presented in the attached milestones forms. Expenditures by budget category and associated tasks are attached in Table 1.

- Coordinated, compiled, and fulfilled project reporting requirements
- Completed and distributed project staff organization chart
- Coordinated project work planning meetings at UAF with UAF and USGS
  - Included Mallik-related results in work plans
  - Documented meeting actions and distributed to team
- Coordinated project work planning meetings at UA with UA and USGS
  - Included Mallik-related results in work plans
  - Documented meeting actions and distributed to team
- Reviewed, processed, and ensured budget-consistency of subcontractor invoices
- Coordinated project work plan meetings at BP with LBNL and USGS
  - Discussed scope-of-work requirements for BP project support
  - Discussed incorporation of Mallik data to model code calibration
- Coordinated project update meetings at BP with DOE and USGS
  - Presented project update
  - Discussed and agreed to high level project support within BP and DOE
  - Coordinated ANS site visit and toured MPU and PBU facilities with DOE
  - Coordinated UAF site visit and discussed UAF project work with DOE

TABLE 1: Expenditures, DE-FC-26-01NT41332, March 2003 Quarterly Report

BUDGET PERIOD 1 (2 year) COSTS SUMMARY

BP AFE #	Cost Category	% Obligated	NET COSTS	Budget Period 1	GROSS COSTS	SPENT COSTS	BALANCE FUNDS	REMAINING
GS2420H01	U. Arizona, Labor	90.168%	$779,125	$864,077	$779,125	$169,796	$609,328	78%
GS2420H02	U. Arizona, Travel	90.168%	$43,473	$48,213	$43,473	$7,515	$35,958	83%
GS2420H03	U. Arizona, Third Party	90.168%	$55,735	$61,812	$55,735	$39,047	$16,688	30%
GS2420H04	U. Arizona, Operations	90.168%	$155,311	$172,245	$155,311	$39,305	$116,006	75%
GS2420H05	U. AK Fairbanks, Labor	90.168%	$414,007	$459,148	$414,007	$0	$414,007	100%
GS2420H06	U. AK Fairbanks, Travel	90.168%	$26,528	$29,420	$26,528	$0	$26,528	100%
GS2420H07	U. AK Fairbanks, Third Party	90.168%	$39,791	$44,130	$39,791	$0	$39,791	100%
GS2420H08	U. AK Fairbanks, Operations	90.168%	$89,029	$98,736	$89,029	$0	$89,029	100%
GS2420H09	BPXA, Third Party Labor*	90.168%	$236,284	$262,047	$236,284	$111,612	$124,672	53%
GS2420H10	BPXA, Travel	90.168%	$25,247	$28,000	$25,247	$3,146	$22,101	88%
GS2420H11	BPXA, Operations	90.168%	$9,017	$10,000	$9,017	$438	$8,579	95%
	*TOTAL**	90.168%	$1,873,546	$2,077,828	$1,873,546	$370,860	$1,502,687	80%

* Only includes DOE funds (If include BP funds, add $84,063)

BP AFE #	Cost Category	Project Tasks**
GS2420H01	U. Arizona, Labor	Task 6.0, 6.1, 6.2, 6.3
GS2420H02	U. Arizona, Travel	Task 6.0, 6.1, 6.2, 6.3
GS2420H03	U. Arizona, Third Party	Task 6.0, 6.1, 6.2, 6.3
GS2420H04	U. Arizona, Operations	Task 6.0, 6.1, 6.2, 6.3
GS2420H05	U. AK Fairbanks, Labor	Tasks 7, 8, 9, 10, 11, 13
GS2420H06	U. AK Fairbanks, Travel	Tasks 7, 8, 9, 10, 11, 13
GS2420H07	U. AK Fairbanks, Third Party	Tasks 7, 8, 9, 10, 11, 13
GS2420H08	U. AK Fairbanks, Operations	Tasks 7, 8, 9, 10, 11, 13
GS2420H09	BPXA, Third Party Labor	Tasks 1, 2, 3, 4, 11, 12, 13
GS2420H10	BPXA, Travel	Tasks 1, 2, 3, 4, 11, 12, 13
GS2420H11	BPXA, Operations	Tasks 1, 2, 3, 4, 11, 12, 13

** Project Task 5.0 performed by USGS under separate funding

5.2 TASK 2.0: Provide Technical Data and Expertise – BP, USGS

- Finalized PBU Ballot Agreement for industry partner review
  - PBU Ballot Agreement will permit release of shallow portions of 3D seismic data within PBU to project (within confidentiality constraints)
  - Ballot Agreement in review by BP PBU Commercial Manager
  - Agreements to be discussed with industry partners in April WIO meetings
- Released MPU area velocity survey data and VSP's to UA

5.3 TASK 3.0: Wells of Opportunity, Data Acquisition – BP

- Planned Well-of-Opportunity approach with USGS
- Accounted for additional data acquisition potential within BP-JNOC Agreement
  - Implementation agreement can fund justified open hole and/or cased hole log data in wells of opportunity
- Maintained communications with BP development planning teams
- New area shallow log data acquired in 2002 at PBU L-106 and V-107
  - This log data included in PBU Ballot Agreement for release to project

5.4 TASK 4.0: Research Collaboration Link – BP, USGS, Project team

- Drafted and Finalized BP – JNOC Collaborative Research Agreement
  - Agreement will set foundation for BP – JNOC methane hydrate research collaborations
  - Agreement will enable additional funding source for Phases 1, 2, and 3
  - Ensured agreement aligned with BP-DOE Collaborative Agreement
  - Planned budget and studies for BP-JNOC Agreement implementation
  - Conducted BP – JNOC video conference for Agreement status update
  - Agreement in legal review by BP Chicago IP group
  - Agreement in legal review by BP Alaska
- Represented BP-DOE Alaska methane hydrate program at Mallik program consortium meetings in Canada
  - Participation enabled by BP Canada
  - Documented Mallik actions relevant to Alaska research program
  - Transferred relevant non-confidential information to Alaska project
- Planned April 2003 UAF Energy Conference presentation
- Coordinated and planned project AAPG poster presentation for May 2003

USGS Research Collaboration Meetings and Activities:

- 1/5-1/11: Prepared and presented talk to the Fifth International Petroleum Conference and Exhibition (Petrotech-2003), (Titled: *Gas hydrate energy resource potential*) in New Delhi, India.
- 1/12-1/16: Participated in project planning meetings with representatives of the Japan National Oil Corporation (in Chiba, Japan) to discuss the status of the Mallik-2002 project (included for informational purposes, no USDOE funds were used to support this effort).

- 1/21-1/26: Participated in project planning and review meetings with representatives of the Mallik-2002 partner group (in Whistler, B.C., Canada) to discuss the status of the Mallik-2002 project (included for informational purposes, no USDOE funds were used to support this effort).
- 1/27: Participated in project planning meetings with representatives from BP and JNOC (in Vancouver, B.C., Canada) to discuss potential cooperative research opportunities within the BPXA-USDOE funded Alaska gas hydrate research project.
- 2/26: Participated in project planning meetings with representatives from USBLM (in Fairbanks, Alaska) to discuss potential cooperative gas hydrate research opportunities in northern Alaska (included for informational purposes, no USDOE funds were used to support this effort).
- 2/27: Participated in project planning meetings with representatives from BP and UAF (in Fairbanks, Alaska) to review project goals, accomplishments, and work plans within the BPXA-USDOE funded Alaska gas hydrate research project.
- 2/28: Prepared and gave a talk at the Ninth Annual RMAG-DGS 3D Seismic Symposium, (Titled: Imaging gas-hydrate-bearing zones using 3-D seismic data, Milne Point, North Slope, Alaska) in Denver, Colorado.
- 3/13-3/14: Participated in project planning meetings with representatives from BP and UA (in Tucson, Arizona) to review project goals, accomplishments, and work plans within the BPXA-USDOE funded Alaska gas hydrate research project. Presented original work illustrating seismic modeling and attribute analyses for fluid contact delineation (gas – gas hydrate – water). Transferred concepts from analysis of the Milne Point 3D seismic survey data to UA for detailed analysis.
- 3/20: Participated in project planning meetings with representatives from the MBARI, GSC, and the USGS (in Moss Landing, California) to discuss potential cooperative climate change gas hydrate research opportunities in the Arctic (included for informational purposes, no USDOE funds were used to support this effort).
- 3/24-3/26: Participated in project planning meetings with representatives from BP and the USDOE (in Anchorage, Alaska) to review project goals and accomplishments within the BPXA-USDOE funded Alaska gas hydrate research project.
- 3/24-3/25: Participated in project planning meetings with representatives from Anadarko Petroleum, Maurer Technology and the USDOE (in Anchorage, Alaska) to review project goals and accomplishments within the Anadarko Petroleum, Maurer Technology and the USDOE funded Alaska gas hydrate research project.
- 3/26: Participated in project planning meetings with representatives from BP and LBNL (in Anchorage, Alaska) to review project goals, accomplishments, and work plans within the BPXA-USDOE funded Alaska gas hydrate research project.
- 3/26: Participated in project planning meetings with representatives from BP and JNOC (in BP video conference between Anchorage, Alaska and Chiba, Japan) to discuss potential cooperative research opportunities associated with the BPXA-USDOE funded Alaska gas hydrate research project.

5.5 TASK 5.0: Logging and Seismic Technology Advances – USGS, BP

- Maintained linkages to Schlumberger and logging technology advances

5.6 TASK 6.0: Reservoir and Fluids Characterization – UA

- Literary research and team discussions regarding the stratigraphy and structural elements of the gas hydrate-bearing Sagavanirktok formation and the regional geology of the central North Slope of Alaska.
- Compilation and preliminary evaluation of previous studies and local geology, focusing principally on a review of USGS work done by Collett and others.
- Met with project Team Bob Hunter (BP), Tim Collett and Dave Taylor (USGS) to discuss project status, develop project work plans, provide update on geological background, and plan future integration of efforts (March 13-14). Exchanged ideas, developed action items for follow-up and continuing work, and reviewed Collett's and Taylor's (USGS) work on well logs and seismic attributes, respectively.
- UA Gas Hydrate Research Team Meetings and work sessions

5.6.1 Subtask 6.1: Reservoir and Fluid Characterization and Visualization – UA

5.6.1.1 Products, Preliminary Findings

- Successfully loaded BP Milne Point, KRU and PBU West End well log data
- Assessed available well log database for analysis and correlation work.
- Produced a working base map of ANS wells showing presence/absence of the different log data within the Sagavanirktok Formation. Less than 67 out of 90 wells provided to UA contain suitable GR information for correlation and comprehensive petrophysical interpretation within the Sagavanirktok
- Developed independent UA stratigraphic naming scheme (stratigraphic column) for the Sagavanirktok. Integrated USGS framework into stratigraphic column.
- Correlated 65-70% of approximately 20 independent parasequence units and genetically related succession of beds, bed sets and correlative marine-flooding surfaces within the Sagavanirktok.
- Identified a significant degree of lateral and vertical variability in Sagavanirktok reservoir quality in preliminary analyses.
- Completed regional comparison between USGS and UA parasequence picks within the Sagavanirktok. Contrast between these independent stratigraphic frameworks appears negligible at this time.
- Confirmed seismic-to-well-log ties for gas-hydrate occurrences in MP18-01 and WSAK-25 in preliminary analysis.
- Confirmed correlative mid-Tertiary marker bed with seismic horizon and completed correlation for MPU B-01, MPU D-01, and MPU 18-01 wells.
- Identifying Sagavanirktok faulted intervals in well logs (in progress).
- Entered available inferred USGS gas-hydrate picks into StratWorks database.
- Collaborated with UA GEOS team members to select areas with adequate seismic coverage and quality to apply neural network and well-log attribute-analyses techniques.
- Familiarized team with Landmark software packages: StratWorks (Correlation, Cross-section, Map View, etc.), SeisWorks, PetroWorks, Data Import/Export, Data Management modules.
- Familiarized team with basic UNIX startup and data management commands

- Tested third-party software that converts Landmark CGM output files into common graphic image formats (e.g. TIFF, PICT, JPEG)
- Held general discussions with BP geoscientists, Josef Chmielowski (Milne Point group) and Jason Lore (Houston), during UA GeoDaze Symposium.
    - Discussed training students for petroleum industry work and non-proprietary interpretations of North Slope geology (April 10-11).

5.6.1.2 Other Project Activities

- Successfully loaded Landmark and Oracle software, all functional in MGE.
- Installed all hardware; maintained by IT staff.
- Completed set up of MGE large format printer in Subsurface Characterization and Imaging Lab (SCIL)
- Completed 100MB network connectivity in MGE
- Approved users authenticated in both GEOS and MGE labs.
- Ensured security access required for Labs, dedicated project servers and databases
- Acquired and setup 40/80 GB DLT in-lab backup system in MGE in addition to multiple server backups
- Networked all computers with appropriate security switches employed.
- Apply latest software patches on weekly basis
- Set up all printers and completed secure printer network connectivity
- Trained student researchers on well and seismic data import, export, and on generation and display and format of professional graphics using lab software (e.g. Landmark, Petra, Adobe Illustrator, Photoshop, PowerPoint, etc.)
    - Configured, generated and printed cross-sections, posters and other products on all printers.
    - Produced several posters for 2003 UA GeoDaze Conference to gain experience and to serve as test runs for the hydrate research.
- Cross-trained students on GeoPlus Petra/PetraSeis 3D workstations (e.g. duplicating well log templates, cross section and map generation, etc.)
- Presented DOE Gas-Hydrate Project at UA Geoscience Dept. Colloquium
- Reviewed and submitted Department of Geoscience Alumni Newsletter article on the gas-hydrate project.
- Prepared project graphics for May, 2003 AAPG poster in Salt Lake City

5.6.1.3 Work in Progress

- Assessing reservoir heterogeneity and interpretation of faulted intervals based on well log correlations.
- Correlating and regionally tying parasequence units and associated beds, bed sets and correlative marine-flooding surfaces within the Sagavanirktok
- Beginning integration and correlation of gas hydrate, permafrost and free-gas zones (inferred from log response; Collett, 1993) with new parasequences and well log character
- Analyzing reported distribution of log-based inferred gas hydrate occurrences within UA stratigraphic framework

- Training students in the classification of well log patterns and interpretation of sand body facies types and depositional environments from well logs.
  - Preparing gross sand map for May, 2003 AAPG poster.
  - Preparing representative cross section for the AAPG poster illustrating correlation of sequences, parasequences, regional correlation markers within the Sagavanirktok and vertical and lateral reservoir heterogeneity
- Developing more detailed stratigraphic and structural geologic model based on findings from the geophysical and geological work
- Integrating the USGS log inferred hydrate picks within the UA stratigraphic framework. Will analyze their distribution in relationship to structure and facies changes.
- Developing an oral presentation on the role of non-conventional energy sources for UA Speakers Series in Green Valley, AZ
- Continuing training on Landmark Stratworks and GeoPlus Petra in log correlation, cross-section and map generation.
- Security and nightly backup of database, project files and software system files.

5.6.1.4 Continuing needs and data

- Normalization of well log data will be required for accurate quantitative petrophysical analysis (e.g. net pay determinations and volumetric estimation) and to more accurately develop neural net classification
- Obtain all the well log information used by USGS for regional cross sections
- Obtain mud and drilling logs for aiding in the identification of coal-bearing zones within the highly variable Sagavanirktok
- Obtain all/any caliper, mudlog and drilling log information related to significant Sagavanirktok borehole washouts, gas shows, and penetration rate anomalies
- Obtain available cased-hole gamma ray logs from a list of wells designated by UA within the study area.
  - Confirm preliminary correlations and assess reservoir variability at a variety of scales.
- Continue collaborations with UA geophysical group to ensure linkage of deep well log data with seismic data
- Obtain a full set of GIS geological and other pertinent cartographic data for the general study area. This will include all thaw lake, river and shoreline features across and adjacent to the study area.
- Host general work/training sessions with BP Landmark representative for variety of software, when possible
- Obtain fault maps at the Kuparuk formation level

5.6.2 **Subtask 6.2: Seismic Attributes and Calibration – UA**

5.6.2.1 Products

- Created synthetic seismograms for tying wells MP18-01, WSAK-25, MPS-15, MPA-01, MPB-01, MPC-01, and MPD-01 to seismic data.
- Calculated initial attribute-cube on original stacked data, including Instantaneous Phase, Instantaneous Frequency, Instantaneous Reflection Strength, Instantaneous Quality

Factor, Instantaneous Amplitude Acceleration, Instantaneous Dominant Frequency, Event Similarity Prediction, Trace Balancing, and Image Enhancement.

- Modeled Acoustics of gas/water and gas-hydrate/gas fluid contacts
  - Confirmed characteristic polarity reversal along reservoir horizon at fluid contacts and possible frequency response for gas contacts.
- Ran predictive deconvolution to eliminate peg-leg multiples.
- Completed preliminary seismic-to-well-log ties for gas-hydrate occurrences in MP18-01 and WSAK-25.
- Delineated possible free gas in the MPS-15 area.
- Created shallow fault map from upper 950 ms seismic data in Milne Point 3D survey and overlapping area of Northwest Eileen 3D survey.
- Mapped marker horizons for determination of fault offsets.
- Extracted Amplitude along prominent reflections for possible correlation with gas hydrate and gas occurrences.
- Generated Isochron maps for Milne Point area on marker horizons and unconformities.
- Created Gas-Hydrate Project poster for U of A GeoDaze Student Symposium.
- Presented Gas-Hydrate Project for U of A GeoDaze Student Symposium.
- Calculated initial volumetrics of free gas in one fault-delimited reservoir using EarthCube.
- Developed digital physiographic and other maps from USGS Digital Elevation Models (DEM files) using GMT (Generalized Mapping Tools) software.
  - Completed maps (to date) include various projections of regional topography (~1 km grid spacing) of Alaska with coastline/waterway information, which have been used in regional index maps for publication and poster and PowerPoint presentations.
- Wrote Department of Geoscience Alumni Newsletter article on Gas-Hydrate Project. The article, written for non-specialists in the geosciences, is distributed widely to former students, administrators, and other universities, and serves as a tool for outreach about the project.

5.6.2.2 Other Project Activities

- Evaluated availability and applicability of high-resolution borehole temperature data from North Slope.
- Entered all available USGS gas-hydrate, hydrate-stability-field and permafrost picks into Landmark database system.
- Worked with team members from MGE to identify key areas with project seismic data for application of neural network and other attribute-analysis techniques.

5.6.2.3 Work in Progress

- Interpreting horizons and faults.
- Creating wavelet deconvolution of Predictive Deconvolution data for increased resolution of seismic data and more accurate depiction of subsurface geology.
- Creating advanced wave-equation modeling of gas hydrate and gas occurrences.
- Beginning to calibrate seismic response from gas hydrate, permafrost and free-gas
- Developing more robust geologic models for elastic modeling.

- Investigating seismic attributes for potential direct gas hydrate and associated free gas indicators and fluid characterization.
- Continuing to tie USGS gas hydrate picks to seismic data.
- Evaluating track lines for data request to facilitate AVO analyses.

5.6.2.4 Continuing Needs

- Normalization of well log data for quantitative petrophysical analysis and accurate neural net modeling and volumetric estimations
- 3-D stacking velocity model for shallow section (above 950 ms) for more accurate depth conversions.
- 3-D migration velocity model for shallow section (above 950 ms) for more accurate migrations and depth conversions.
- Near-, intermediate- and far-offset stack volumes for AVO analyses for fluid characterization and hydrate identification.
- Ties from well logs to seismic data based on deeper correlations where data quality is better and where sufficient signal length for accurate correlations is available.
- Detailed processing history for assembled data sets.
- GIS geological data for region; other pertinent geological and cartographic data.

5.6.3 Subtask 6.3: Petrophysics and Neural Network Attribute Analysis – UA

5.6.3.1 Activities and Products

- Completed Preliminary runs of NN classification for several seismic attributes in the vicinity of well West Sak 25. The latter include amplitude, instantaneous frequency, dominant frequency, and amplitude acceleration.
- Supervised training of ANN algorithms (in progress).

5.6.3.2 Work in Progress

- Learning and coding Matlab and Artificial Neural Network (ANN) Toolbox software for the transferring of seismic data into Matlab.
- Establishing a Self-Organizing Map (SOM) network
- Assessing of various visualizations of the NN classification results (in progress)
- Preparing preliminary classifications using instantaneous frequency, dominant frequency, and amplitude acceleration suggest a potential linkage to gas hydrate zones as inferred from log responses published by the USGS.
- Commencing to investigate a new model that can predict gas hydrate concentrations using sonic and bulk density logs in conjunction with seismic attributes such as compressional wave velocity.

5.6.4 Names and Addresses of UA research team

Dr. Robert Casavant (PI)
University of Arizona
Dept. Mining and Geological Engineering
Rm. 245, Mines and Metallurgy Bldg. #12
1235 E. North Campus Dr., POB 210012
Tucson, AZ 85721-0012

(520) 626-3785 casavant@geo.arizona.edu

Dr. Mary Poulton (Co-PI)
University of Arizona
Dept. Mining and Geological Engineering
1235 E. North Campus Dr., POB 210012
Tucson, AZ 85721-0012

(520) 621-8391 mpoulton@u.arizona.edu

Dr. Roy Johnson (Co-PI)
Department of Geosciences
1040 East 4th St.
University of Arizona
Tucson, Arizona 95721

(520) 621-4890 johnson@geo.arizona.edu

Dr. Charles Glass (Co-PI)
University of Arizona
Dept. Mining and Geological Engineering
1235 E. North Campus Dr., POB 210012
Tucson, AZ 85721-0012

UA Graduate Students:
Casey Hagbo, Bo (Alex) Zhao, Andrew Hennes, Justin Manuel

5.7 TASK 7.0: Lab Studies for Drilling, Completion, and Production Support – UAF

5.7.1 Subtask 7.1: Characterize Gas Hydrate Equilibrium

5.7.1.1 Activities and Products

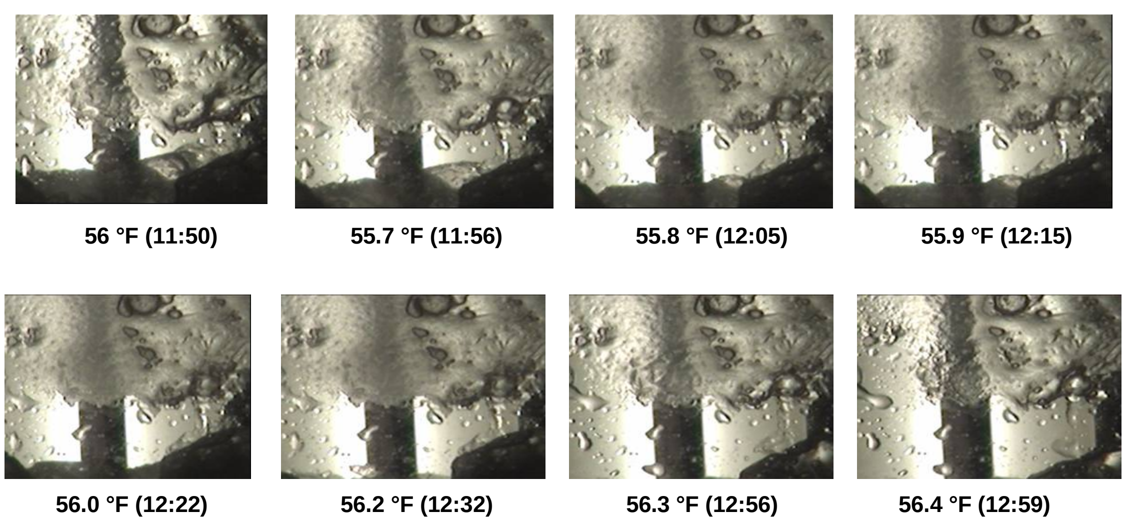
- Acquired DBR Phase Behavior apparatus (ordered in June, 2002)
    - Trained with DBR professional staff in apparatus usage

- Acquired and learned DBR-Oil Phase software "HYDRATE 5.1"
  - Software allows user to model phase equilibriums for varied compositions of gases, pressures, inhibitors, temperatures, and brine concentrations
- Designed initial test Phase Behavior Experiments using ANS pressure-temperature conditions and ANS Gas Compositions and compared results to software predictions
  - Conducted experiment using CP grade methane (99.9% pure) and distilled water. At a pressure of 1500 psia, the formation/dissociation of methane hydrates was in the range of 55.5° F to 56.3° F. The software predicted a formation/dissociation temperature of 56.1° F. Figure 1 shows visual observations of the hydrates forming and dissociating over time
  - Conducted other minor experiments to confirm apparatus capabilities
  - Conducted experiment using CO_2 and a brine concentration of 3.5% by weight. Compared results to predicted models. Figures 2 and 3, respectively, show the predicted and experimental P-T condition results for the pure methane and pure carbon dioxide system with distilled water and brine

5.7.1.2 Future Work (May through December 2003)

- Conduct experiments using CP grade methane with different brine concentrations
  - Vary brine concentrations from 2 -10% by weight and/or 0-20 ppt
- Perform similar experiments using industrial grade methane, which may represent the composition of actual field ANS gas from gas hydrate with associated free gas
- Analyze hydrate formation/dissociation in sediments (if available)
  - Analysis may require several modifications to existing apparatus setup
- Utilize information obtained from these experiments with known geothermal gradient to estimate the depth of the PBU-KRU-MPU region hydrate stability field

Figure 1: Visual Observations of Methane Hydrate Formation and Dissociation



Experimental 55.5 - 56.3 °F Predicted 56.1 °F

Figure 2: Comparison of experimental and predicted PT conditions for pure methane and distilled water system.

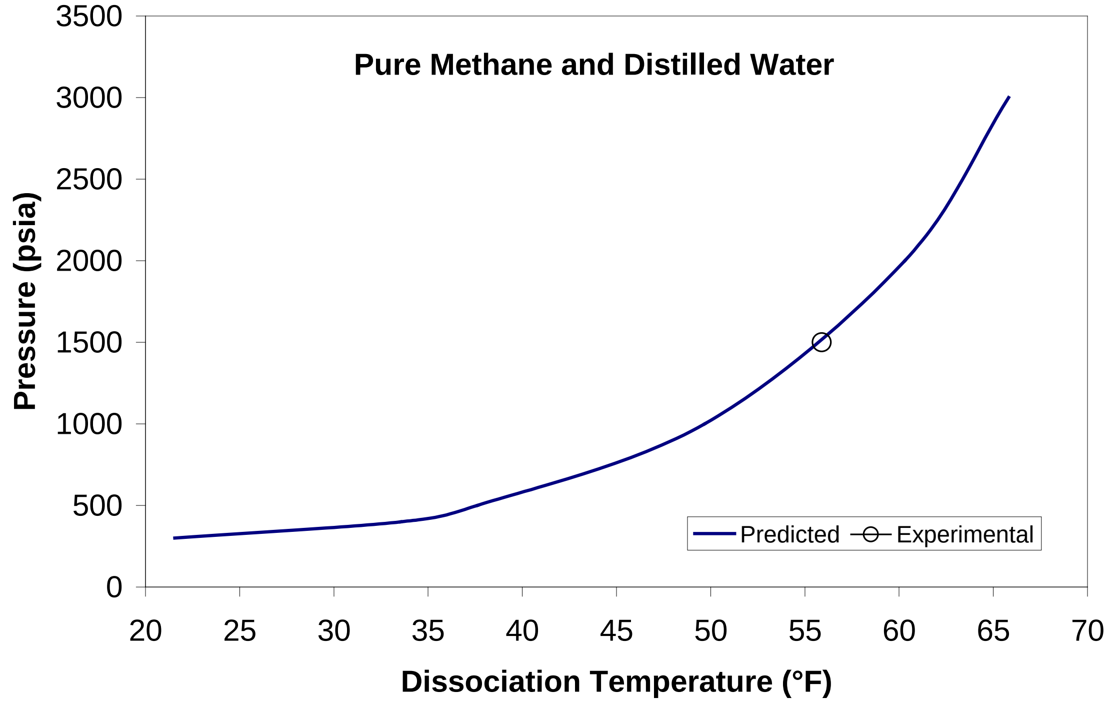
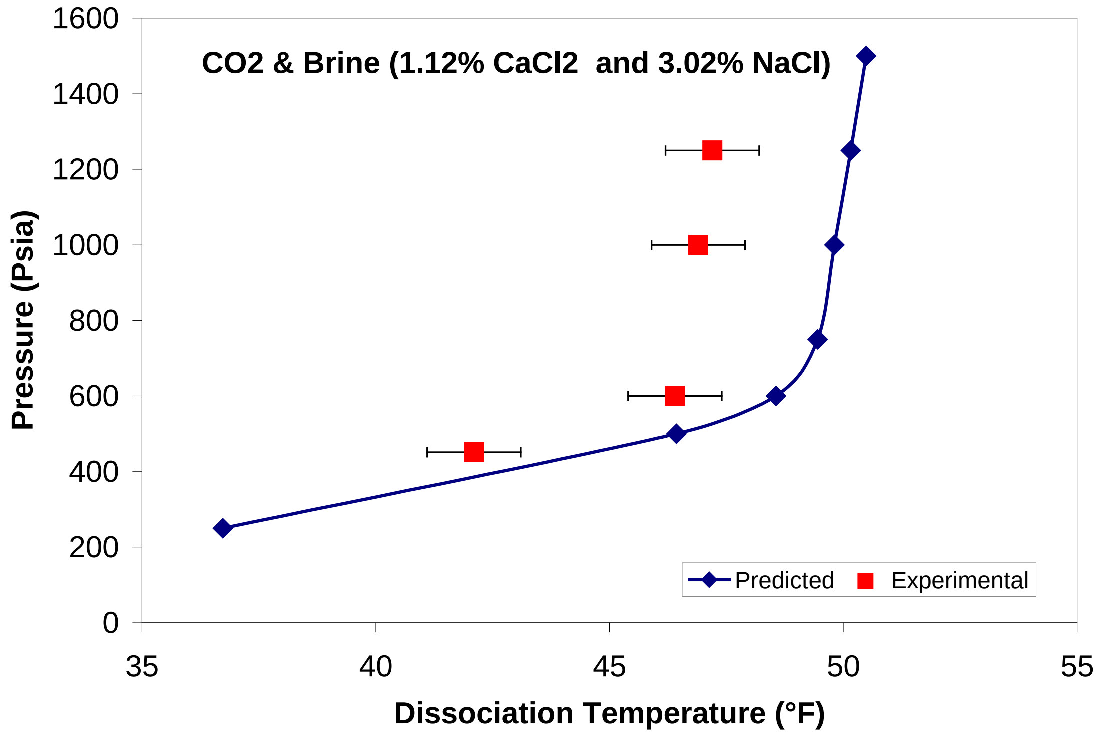


Figure 3: Comparison of experimental and predicted PT conditions for pure carbon dioxide and brine system.



5.7.2 **Subtask 7.2: Measure Gas-Water Relative Permeabilities**

5.7.2.1 **Background**

Although the mode of gas hydrate formation in the natural environment is imprecisely known, permeability measurement in the laboratory of sediment samples which contain gas hydrate may help clarify and/or determine some of those natural process. Reliable measurement of gas water relative permeability functions within a gas-hydrate system is of great importance for geothermal reservoir performance simulation. Despite their importance, these functions are poorly known due to the lack of fundamental understanding of gas-water flows, and the difficulty of direct measurements.

5.7.2.2 **Activities and Products**

- Designed experimental apparatus for two-phase (gas, hydrate-water) relative permeability measurements
- Assembling equipment ordered in December, 2002

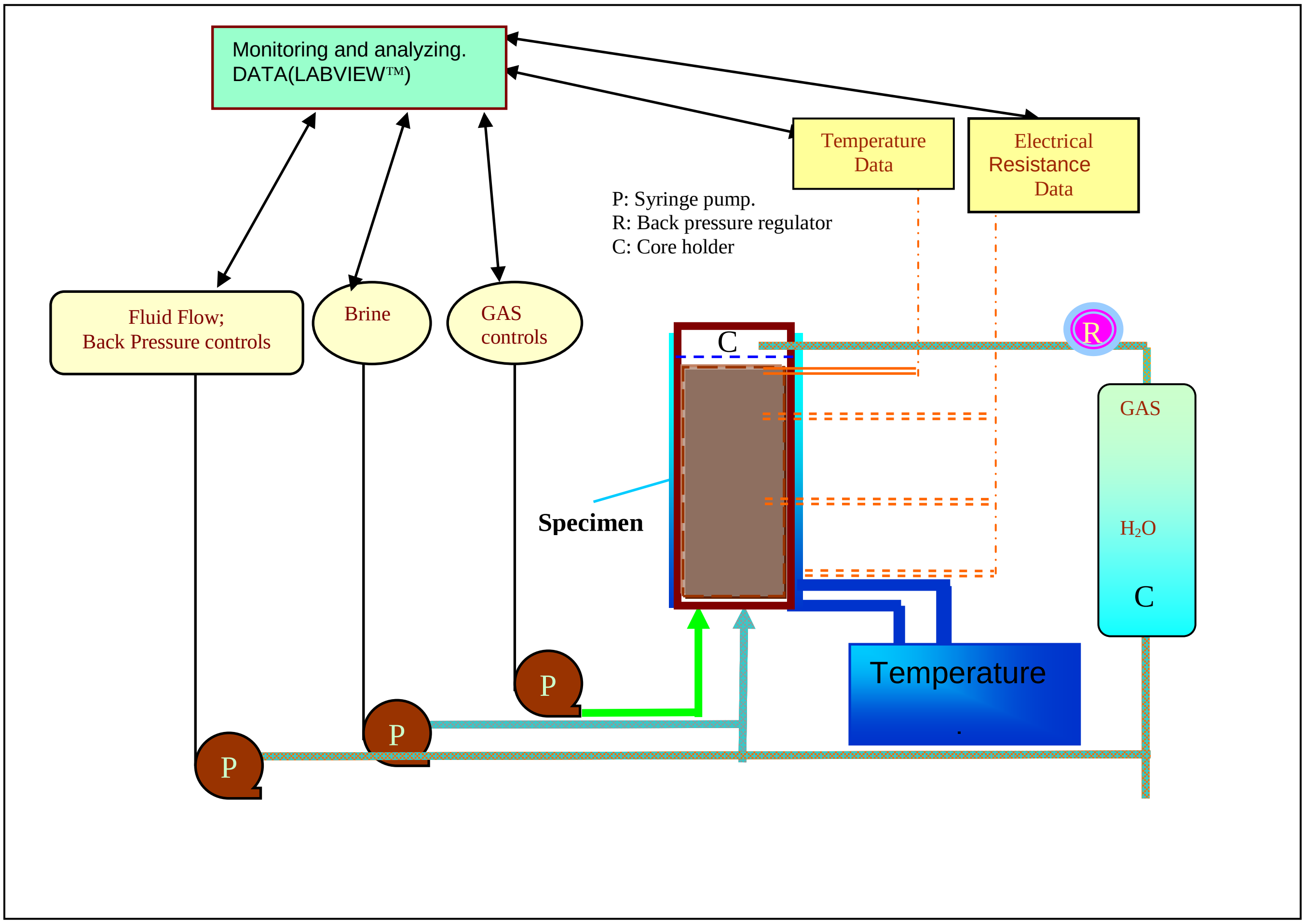
5.7.2.3 Future Work

- Expect to complete experimental apparatus setup by May 2003 for operations by June 2003
- Study multiple sample types
  - o Samples of pure water ice, without sediment present, formed in the test chamber
  - o Frozen sediment formed in the laboratory
  - o Frozen sediment containing laboratory formed gas hydrate
  - o Sediment containing just gas hydrate formed in the laboratory
  - o Reservoir samples containing natural water, ice and gas hydrate (if available)
- Develop Regression based method to estimate in-situ relative permeabilities from experiments
- Design and conduct error analysis for experiments
- Establish functional relationship between permeability, porosity, structure discontinuities, tortuosity and fluid parameters such as viscosity

5.7.2.4 Experimental Setup

Figure 4 shows the schematic of the planned experimental set-up for relative permeability measurements. All measurements will be accomplished using an unsteady-state displacement process. The ISCO Syringe pumps will be used for core saturation with brine, whereas top-down gas injection will be carried out using the gas cylinder pressure. A back pressure regulator maintains a fixed back pressure on the sample downstream end. Nitrogen gas will be used to apply the confining pressure on the test specimen. The production of gas and water from the specimen as a function of time will be monitored using a mass flowmeter and a balance. Cooling fluid will be circulated through the jacket, which encases the TEMCO core holder, to maintain constant test temperatures.

Figure 4: Planned experimental set-up for relative permeability measurements.



5.8 TASK 8.0: Evaluate Drilling Fluids – UAF

- Completed literature survey, emphasizing fluid compositions
- Planned evaluation to determine rheological properties and specific drilling fluids compositions used in Mackenzie Delta and Japan Offshore gas hydrate programs
  - Plan to input suitable modifications or improvements for ANS program

5.8.1 Subtask 8.1: Design Integrated Mud System

- Planning design for fully Integrated Mud System within permafrost and Gas Hydrate bearing section to encourage effective drilling, completion, and production operations
- Determine mud contamination risk
- Evaluate drilling mud chiller systems such as that used in Mackenzie Delta program and/or the recent Anadarko Hot Ice #1
  - Maintain circulation temperature below disassociation point in gas hydrate bearing formations to prevent well control problems

  - o Maintain circulating temperatures below permafrost formation temperature to prevent permafrost thawing and hole sloughing
  - o Maintain circulating temperatures below formation temperature to prevent thermal hole sloughing and to maximize hole stability
- Develop drilling techniques to minimize or prevent gas hydrate dissociation
  - o Reduce the temperature of drilling fluids (with the mud cooler)
  - o Use cement with low heat of hydration
  - o Use small downhole drilling motors to decrease mud temperature
  - o Use mud additives to stabilize gas hydrates and hydrate inhibitors. (e.g. Lecithin enhances the rate of hydrate formation thus reducing the gas-influx into the wells acting somewhat like surfactant)
  - o Increase mud circulation and maintain turbulence to avoid drilling fluid contamination of gas hydrate

5.8.1.1 Drilling and Mud Cooler Specifications

The current commercially available unit is configured for both Arctic winter operation and all season high temperature mud cooling. In cold weather operation the fan coil can dissipate up to 1,800,000 BTU/hr of heat operating at +/- 0^0 C and an ambient air temperature of -30^0 C. In warm weather operation the fan coil can dissipate up to 2,500,000 BTU/hr of heat, depending upon ambient temperature and desired mud temperature. Capacity increases by two or three times if the LMTD is allowed to increase (i.e., increase the temperature difference between the cooling medium and the drilling fluid).

Figure 5: Photographs of commercially available mud cooler unit.

5.8.1.2 Plate Type Heat Exchanger

The Canadian Petroleum Engineering (CPE) Mud Cooling System consists of an Alfa Laval "plate type" heat exchanger designed for cooling drilling fluid. The system was originally designed for drilling in permafrost and gas hydrates in the Beaufort Sea and Mackenzie Delta.

The unit is completely self-contained and is designed for extreme cold weather operation. It is mounted on an oilfield skid and enclosed by a heated insulated steel building. The cooler was used in 1998 to maintain drilling fluid temperature in a range of 0^0 C to 3^0 C while drilling and coring In-Situ gas hydrate zones in the Mackenzie Delta, NWT, Canada. The cooler was also used in 2000 to cool drilling fluid on a high temperature well in Western Canada. The application of the mud cooling unit was a major contributor to achieving project objectives for these two projects.

The heat exchanger is an Alfa Laval AM - 20 low LMTD (log mean temperature differential), "two-pass", plate type heat exchanger made of high quality stainless steel and/or titanium alloy to minimize corrosion from entrained oxygen or low pH drilling fluids or brines. The specialty heat exchanger plates are widely spaced to allow for passage of highly viscous fluids with a high content of drilling fines. Cooling is accomplished by circulating ethylene glycol fluid through the coolant side of the heat exchanger. The low LMTD design of the system allows the drilling fluid to be maintained to within 3^0 C to 5^0 C of the cooling medium inlet temperature. The coolant fluid is circulated through a fan coil/ ambient air heat exchanger by a centrifugal pump. A thermostat in the cold drilling fluid stream return line, which modulates a bypass valve on the fan coil/ heat exchanger loop, controls the temperature. The controller is set to maintain the coolant at the appropriate temperature to prevent the drilling mud from freezing in cold weather. In applications where the heat loads are higher than the capacity of the existing fan coil/exchanger and/or during periods where the ambient temperature is higher than the required mud temperature, four alternative methods to provide additional capacity are possible:

- Additional fan coil/ glycol exchanger capacity
- Access to cold water, which can be used in place of the ethylene glycol
- Adding another unit in parallel can increase the existing fan coil/ heat exchanger capacity.
- Installation of a refrigeration unit on the coolant side of the cooler

5.8.2 Subtask 8.2: Assess Formation Damage

- Conduct hole erosion experiments under controlled conditions with chilled and warm drilling fluids.
- Conduct simple spot tests to assess formation damage due to incompatibility between brine and injection water.

5.8.2.1 Subtask 8.2 Future Work

- Continue literature survey
- Design experiments to assess formation damage

5.9 TASK 9.0: Design Cement Program – UAF

5.9.1 Task 9 Future Work

- Continue literature survey; assess current permafrost cements
- Work with AETDL and DOE to fund cooperative research program with Argonne National Lab to study efficacy of Ceramicrete as arctic conditions and chilled mud system drilling cement
  - Proposal submitted in March, 2003
  - Proposal highly ranked, but not funded at this time
  - Project co-funding and participation commitments by Bindan Corporation (Ceramicrete manufacturer) and BJ Drilling (mud company)
- Design experiments to assess cements

5.10 TASK 10.0: Study Coring Technology – UAF

5.10.1 Task 10 Future Work

- Continue literature survey
- Assess coring technologies and recommend best methods for ANS application

5.11 TASK 11.0: Reservoir Modeling - UAF, BP (+LBNL)

- Discussed scope-of-work in March meeting (BP-LBNL-USGS)
- Discussed reservoir model work funding in March meeting (DOE-BP)
- Discussed reservoir model work funding in March meeting (BP-JNOC-USGS)
    - Reservoir Model work group to be part of BP-JNOC associated program
- Acquired a dedicated reservoir simulation workstation for UAF

5.12 TASK 12.0: Select Drilling Location and Candidate – BP, UA

- Discussed criteria for drilling location selection as input to reservoir fluid and characterization studies

5.13 TASK 13.0: Project Commerciality and Progression Assessment – BP, UAF

- Built economic model (excel based) for the running of project economics.
- Research in the public domain (congressional committee reports, lobby group newsletters, industry sources) for economic inputs to use in modeling.
- Data gathered includes gas prices, transportation tariffs, capital expenditure estimates.

5.13.1 Task 13 Future Work

- Create conventional gas simulation for free gas section of reservoir using off the shelf simulator upon delivery of University of Arizona reservoir and fluid characterization data
- Continue to refine economic model, research possible fiscal arrangements for large-scale gas sales. Verify output with BP screening economics
- Work with LNBL to update and improve EOSHYRD module of the TOUGH2 simulator
- Initialize LBNL methane hydrate model and produce production profiles
- Run economics based on production profiles

6.0 CONCLUSION

Interim conclusions only are presented at this stage in the research program. Establishing this collaborative research agreement culminates nearly three decades of hundreds of well penetrations of methane hydrate during oil production operations on ANS following the first dedicated gas hydrate coring and production testing in NW Eileen State – 02, drilled in 1972 within the Eileen gas hydrate trend by Arco and Exxon. During this time, methane hydrates were known primarily as a drilling hazard. Industry has only recently considered the resource potential of conventional ANS gas during industry and government efforts in working toward an ANS gas pipeline. Consideration of the resource potential of conventional ANS gas created the industry – government alignment necessary to also consider the resource potential of the potentially huge (40 – 100 TCF in-place) unconventional ANS methane hydrate accumulations beneath existing production infrastructure. The BPXA – DOE collaborative research project is designed to enable industry and government to make informed decisions regarding the resource potential of this ANS methane hydrate through the first-ever regional shallow reservoir and fluid characterization utilizing 3D seismic data, implementation of methane hydrate experiments, and design of techniques to support potential methane hydrate drilling, completion, and production operations.

The results of the collaborative BPXA-LBNL pre-Phase 1 scoping reservoir model and economics study (presented in the March 2003 Quarterly report) demonstrate first-ever potential commerciality of gas production from gas hydrate across a broad regional contact from adjacent free gas depressurization. This collaborative research project will verify the size of the potential resource, determine the extent of reservoir/fluid compartmentalization, and validate potential production techniques.

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8.0 LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Denotation
2D	Two Dimensional (seismic or reservoir data)
3D	Three Dimensional (seismic or reservoir data)
AAPG	American Association of Petroleum Geologists
AETDL	Alaska Energy Technology Development Laboratory
ANL	Argonne National Laboratory
ANN	Artificial Neural Network
ANS	Alaska North Slope
AOGCC	Alaska Oil and Gas Conservation Commission
AVO	Amplitude versus Offset (seismic data analysis technique)
ASTM	American Society for Testing and Materials
BLM	U.S. Bureau of Land Management
BP	British Petroleum (commonly BP Exploration (Alaska), Inc.)
BPXA	BP Exploration (Alaska), Inc.
DOI	U.S. Department of Interior
DGGS	Alaska Division of Geological and Geophysical Surveys
DNR	Alaska Department of Natural Resources
EM	Electromagnetic (referencing potential in-situ thermal stimulation technology)
GEOS	UA Department of Geology and Geophysics
GOM	Gulf of Mexico (typically referring to Chevron Gas Hydrate project JIP)
GR	Gamma Ray (well log)
GSA	Geophysical Society of Alaska
HP	Hewlett Packard
JBN	Johnson-Bossler-Naumann method (of gas-water relative permeabilities)
JIP	Joint Industry Participating (group/agreement), ex. Chevron GOM project
JNOC	Japan National Oil Corporation
KRU	Kuparuk River Unit
LBNL	Lawrence Berkeley National Laboratory
MGE	UA Department of Mining and Geological Engineering
MPU	Milne Point Unit
NETL	National Energy Technology Laboratory
ONGC	Oil and Natural Gas Corporation Limited (India)
PBU	Prudhoe Bay Unit
PNNL	Pacific Northwest National Laboratory
Sag	Sagavanirktok formation
SPE	Society of Petroleum Engineers
TCF	Trillion Cubic Feet of Gas at Standard Conditions
TCM	Trillion Cubic Meters of Gas at Standard Conditions
UA	University of Arizona (or Arizona Board of Regents)
UAF	University of Alaska, Fairbanks
USGS	United States Geological Survey
USDOE	United States Department of Energy
VSP	Vertical Seismic Profile

9.0 APPENDICES

9.1 APPENDIX A: Project Task Schedules and Milestones

9.1.1 U.S. Department of Energy Milestone Log, March 2003

Program/Project Title: DE-FC26-01NT41332: Resource Characterization and Quantification of Natural Gas-Hydrate and Associated Free-Gas Accumulations in the Prudhoe Bay - Kuparuk River Area on the North Slope of Alaska

Identification Number	Description	Planned Completion Date	Actual Completion Date	Comments
Task 1.0	Research Management Plan	12/02	12/02	Project Management Ongoing
Task 2.0	Provide Technical Data and Expertise	MPU: 12/02 PBU: 7/03* KRU: unk*	MPU: 12/02 PBU: * KRU: *	Ongoing, See Technical Progress Report Description
Task 3.0	Wells of Opportunity Data Acquisition	Ongoing to 12/03 or beyond**	Ongoing	Ongoing, See Technical Progress Report Description
Task 4.0	Research Collaboration Link	Ongoing to 12/03 or beyond**	Ongoing	Ongoing, See Technical Progress Report Description
Subtask 4.1	Research Continuity	Ongoing	Ongoing	
Task 5.0	Logging and Seismic Technology Advances	Ongoing to 12/03 or beyond**		Ongoing, See Technical Progress Report Description
Task 6.0	Reservoir and Fluids Characterization Study	10/04**		Interim Results to also be presented
Subtask 6.1	Characterization and Visualization	10/04**		Interim Results to also be presented
Subtask 6.2	Seismic Attributes and Calibration	10/04**		Interim Results to also be presented
Subtask 6.3	Petrophysics and Artificial Neural Net	10/04**		Interim Results to also be presented
Task 7.0	Laboratory Studies for Drilling, Completion, Production Support	10/04**		
Subtask 7.1	Characterize Gas Hydrate Equilibrium	10/04**		
Subtask 7.2	Measure Gas-Water Relative Permeabilities	10/04**		
Task 8.0	Evaluate Drilling Fluids	10/04**		
Subtask 8.1	Design Mud System	11/03		
Subtask 8.2	Assess Formation Damage	5/04		

Task 9.0	Design Cement Program	10/04**		
Task 10.0	Study Coring Technology	2/04**		
Task 11.0	Reservoir Modeling	10/04**		Interim Results to also be presented
Task 12.0	Select Drilling Location and Candidate	10/04**		
Task 13.0	Project Commerciality & Progression Assessment	10/04**		Interim Results to also be presented

* Date estimate dependent upon industry partner agreement for seismic data release

** Anticipated completion dates beyond 12/31/03 will require no-cost (and possibly some-cost) time-extension to complete 2-year Phase 1 program

9.1.2 U.S. Department of Energy Milestone Plan

(DOE F4600.3)

(01-93
Replaces EIA-459B
All Other Editions are Obsolete

1910-0400

FEDERAL ASSISTANCE MILESTONE PLAN

1. Program/Project Identification No. DE-FC26-01NT41332

2. Program/Project Title Resource Characterization and Quantification of Natural Gas-Hydrate and Associated Free-Gas Accumulations in the Prudhoe Bay - Kuparuk River Area on the North Slope of Alaska

3. Performer (Name, Address)
BP Exploration (Alaska), Inc., 900 East Benson Blvd, P.O. Box 196612, Anchorage, Alaska 99519-6612

4. Program/Project Start Date 10/22/02*

5. Program/Project Completion Date 12/31/05*

6. Identification Number	7. Planning Category (Work Breakdown Structure Tasks)	8. Program/Project Duration: O N D J F M A M J J A S O N D J* F* M* A* M* J* J* A* S*	9. Comments (Notes, Name of Performer)
Task 1.0	Research Management Plan	>>>>>>>>>>>>>>>!	BPXA
Task 2.0	Technical Data and Expertise	>>>>>>----->>>>------>>>>>>!>>------------>>>>>>>>------>>>>>>>------------	BPXA
Task 3.0	Wells of Opportunity - Data	------>>>>>--------------->>>>!>---------->>>>>>>>>>>>>>---------->>>>>>>>>>>>>>>	BPXA
Task 4.0	Research Collaboration Link	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>!>>>	BPXA, USGS
Task 5.0	Logging/Seismic Technology	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>!>>>	USGS, BPXA
Task 6.0	Characterize Reservoir/Fluid	------->>>>>>>>>>>>>>>>>>>>>>>!>>>	U. Arizona
Task 7.0	Lab Studies: Ph Behav, Rel k	-- ----->>>>>>>>>>>>>>>>>>!>>>	U. Alaska FB
Task 8.0	Evaluate Drilling Fluids	------->>>>>>>>>>>>>>>!>>>>>>>>>>>>>>>--->>>>>>>>>>>>>>>>>>>>>>	UAF
Task 9.0	Design Cementing Program	! ------->>>>>>>>>>>>>>>>>>>>>>>>>	UAF
Task 10.0	Study Coring Techniques	-------->>>>>>>>>>>>>!>>>>>>>>>>>>>>>>>>>	UAF
Task 11.0	Reservoir Modeling	>>>>------------------------>!>>>>>>>>---------------->>>>>>>>>>>>>>>>>>>>>>>>>	UAF
Task 12.0	Drilling Candidate Selection	>>>------- ! ----->>>>>------- ---->>>>>>>>>	BPXA, UAz
Task 13.0	Commerciality Assessment	>>>>>>-----------------------!---------->>>>>>>---------------------------->>>>>>>>>	BPXA, UAF

10. Remarks * Official Contract Date 10/22/02; Funded pre-Phase 1 from 10/01-10/02 at reduced cost levels. Current Phase I project (from 10/01 through 12/03) will require time-extension through 10/04 due to 10/21/02 project contract date and 2-year Phase I research program.
Explanation of Symbols: (> = Major Task Work); (- = Minor Task Work); (! = current time).
Additional significant milestones presented in June 2003 technical progress report and UAF Research Management Plan.

11. Signature of Recipient and Date

12. Signature of U.S. Department of Energy (DOE) Reviewing Representative and Date

9.2 APPENDIX B: UAF Research Management Plan

Research Management Plan and Current Status- University of Alaska Fairbanks

Resource Characterization and Quantification of Natural Gas-Hydrate and Associated Free-Gas Accumulations in the Prudhoe Bay – Kuparuk River Area on the North Slope of Alaska

PHASE I												
				YEAR 1 $350,233				YEAR 2 $281,201				
Task	Subtask	Description	Current Status	October 1, 2002	December 31, 2002	March 31, 2003	June 30, 2003	September 30, 2003	December 31, 2003	March 31, 2004	June 30, 2004	September 30, 2004
7.0		Laboratory Studies in Support of Gas Hydrate Drilling, Completion, and Production										
	7.1	Phase Behavior Experiments (P-T Diagrams for ANS gas compositions)	Deliverables: Hydrate P-T Curves to cover the expected range of compositions and temperatures									
	7.2	Measure Gas-Water Relative Permeabilities in Gas Hydrate Reservoirs	Deliverables: Obtain Relative Permeability functions for use in reservoir simulation,									
8.0		Evaluate Drilling Fluids										
	8.1	Design Integrated Mud System for Effective Drilling, Completion and Production Operations	Deliverables: Conduct literature search, design mud system and test and measure mud properties									
	8.2	Asses Formation Damage Prevention	Deliverables: Spot tests to asses formation damage/erosion									
9.0		Design Cementing Program for Gas Hydrate Test Well	Deliverables: Slurry properties, mechanical testing									
10.0		Study Coring, Core Recovery, Core Preservation, and Core Transportation	Deliverables: Detailed review of coring technologies, core handling and core analysis techniques									
11.0 13.0		Reservoir Modeling & Scoping Economic Analysis	Deliverables: Acquire LBNL models, input UA Characterization data for reserve predictions and productivity considerations									

Task

Proposed Plan

Current Status