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Quarterly Progress Report
(October – December 2007)

Characterization and Quantification of the Methane Hydrate Resource Potential Associated with the Barrow Gas Fields

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Prepared for:
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FIFTH QUARTERLY PROGRESS REPORT

OCTOBER – DECEMBER, 2007

CHARACTERIZATION AND QUANTIFICATION OF THE METHANE HYDRATE RESOURCE POTENTIAL ASSOCIATED WITH THE BARROW GAS FIELDS

DOE Project Number: DE-FC26-06NT42962

Awarded to

North Slope Borough, Alaska

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DISCLAIMER

EXECUTIVE SUMMARY

Phase 1B of the project commenced August 1, 2007, with the initial task of revising the Research Management Plan to incorporate changes suggested by technical advisory group (TAG) feedback on Phase 1A results. The revised RMP was submitted on September 5, 2007.

Comparative analysis of the recent E.B. #14 well produced water sample against earlier East Barrow well samples was completed, and samples will continue to be collected periodically from E.B. #14 to track any compositional changes over time. The recent sample analysis reflects an increase in total dissolved solids in the formation water from past samples, which was contrary to our expectations.

Seismic interpretation and mapping of the Barrow Gas Fields was completed this quarter, and a core-log model was developed to facilitate reservoir characterization for volumetric calculation and dynamic reservoir modeling. The seismic and well log interpretation results will be loaded to the Roxar RMS 3D modeling application during the next quarter to build an integrated reservoir characterization.

Seismic and well log correlation indicates that the Walakpa Sands extend updip from the Walakpa #1 well and into the South and East Barrow Fields. This finding is very significant in supporting the presence of reservoir sands updip of the free gas in the Walakpa Gas Field, and well into the hydrate stability window.

Two locations were identified as potential hydrate test well targets, based on geoscience, reservoir, and logistical considerations. One location is in the updip extent of the East Barrow Gas Field, and the other is updip of the main Walakpa Gas Field.

An intermediate modeling step was added to the project scope to determine if we could explain the production history performance results for the East Barrow Field with either volumetric gas expansion, volumetric gas expansion coupled with aquifer support, or hydrate dissociation, gas expansion and aquifer support. The "tank" modeling results indicated that volumetric expansion and aquifer support combined could not explain the pressure response of the reservoir, and that hydrate dissociation must be a factor. This was a valuable step that supports the full dynamic reservoir modeling effort.

SUMMARY OF PROJECT

The North Slope Borough (NSB) has established a team to characterize and quantify the methane hydrate resource potential associated with the Barrow Gas Fields (BGF), which are owned and operated by the NSB in a permafrost region of arctic Alaska. Currently, gas from these three producing fields provides heating and electricity for Barrow, which is the economic, transportation, and administrative center of the NSB. Other commercially-operated producing oil and gas fields within the NSB include Prudhoe Bay, Milne Point, Kuparuk, Alpine and Endicott. The results of this project will enhance the understanding of the nature and occurrence of methane hydrates in the arctic environment, and specifically in the Barrow Gas Fields, and will server to evaluate the potential influence of gas hydrates on gas supply and production from producing gas fields. Findings of this project will contribute significantly to understanding the role of gas hydrate as a recharge mechanism in a producing gas field, and provide substantial commercial and social benefits for the NSB.

The characterization and quantification of methane hydrate resources in the Barrow Gas Fields (BGF) will be completed in three phases: IA, IB, and II. This approach will allow for timely evaluation and adjustment of methods and objectives as new findings are obtained. The Research Management Plan (RMP) lays the framework for all three phases, and it has been revised for Phase 1B based on input from the TAG.

Phase 1A concluded that methane hydrate stability zones exist in association with two of the BGF (Walakpa and East Barrow), validating the postulate that the gas fields in question are potentially being recharged by dissociation of adjacent methane hydrates. Based on these results, funding was approved for Phase 1B of the study.

In Phase 1B, the NSB will a) determine probability that the reservoir is continuous up-dip into the methane hydrate stability zone, and contained sufficient water to combine with available gas to form gas hydrate; b) determine the optimum well location for a dedicated methane hydrate well; and c) quantify reserves, expected production rates and depletion mechanisms for methane hydrate production.

The Project has been funded for $609,859 for Phase 1B to accomplish the following four tasks:

Task 5 —	Revise RMP, Map Barrow Area and Walakpa Gas Fields
Task 6 —	Reservoir Characterization and Selection of Optimum Test Well Location
Task 7 —	Build methane hydrate reservoir simulator to model methane hydrate test well production
Task 8—	Phase I Final Report

The results of Phase 1B will determine whether or not funding will be requested for Phase 2.

PROJECT TASKS COMPLETED LAST QUARTER

TASK 5a: Revise Research Management Plan (RMP)

The RMP was revised to incorporate input from the Technical Advisory Group (TAG). Changes included: updating the project schedule to reflect the two no-cost extensions approved in Phase 1A; addition of a seismic reprocessing step to evaluate the use of AVO techniques to determine reservoir presence or absence; expansion of Task 5 to include produced water sampling and

analysis from the E.B. #14 well; and greater emphasis on the production history information to assess the importance of unusual material balance modeling results.

TASK 5b: Map Barrow and Walakpa Gas Fields

All available seismic and well data associated with the Barrow Gas Fields was loaded to the interpretation workstation, and seismic survey wavelet and datum balancing were performed to match the various surveys during the fourth quarter of the project. Synthetic seismograms were generated to tie wells to seismic for horizon identification, and wavelet extraction. Seismic interpretation and mapping was initiated.

One-dimensional and two-dimensional seismic modeling was initiated to understand the effects of reservoir pore-fluid saturations (free gas vs. hydrate) on the seismic response, and wedge modeling to assess the impact of thinning reservoir section. This work is ongoing.

Core analysis for wells cored over the Walakpa and Barrow Sandstones were loaded to the interpretation workstation, and a core-log model was developed to facilitate poro-perm and saturation characterization.

PROJECT TASKS COMPLETED THIS QUARTER

TASK 5b: Map Barrow and Walakpa Gas Fields

During this fifth quarter of the project, additional 1970's vintage seismic data was identified and acquired from the USGS for integration into the reservoir characterization. Some of the USGS data was not available digitally, and hardcopies of the stacked lines had to be scanned and migrated. The additional seismic data provided more structural detail, particularly in the East Barrow area.

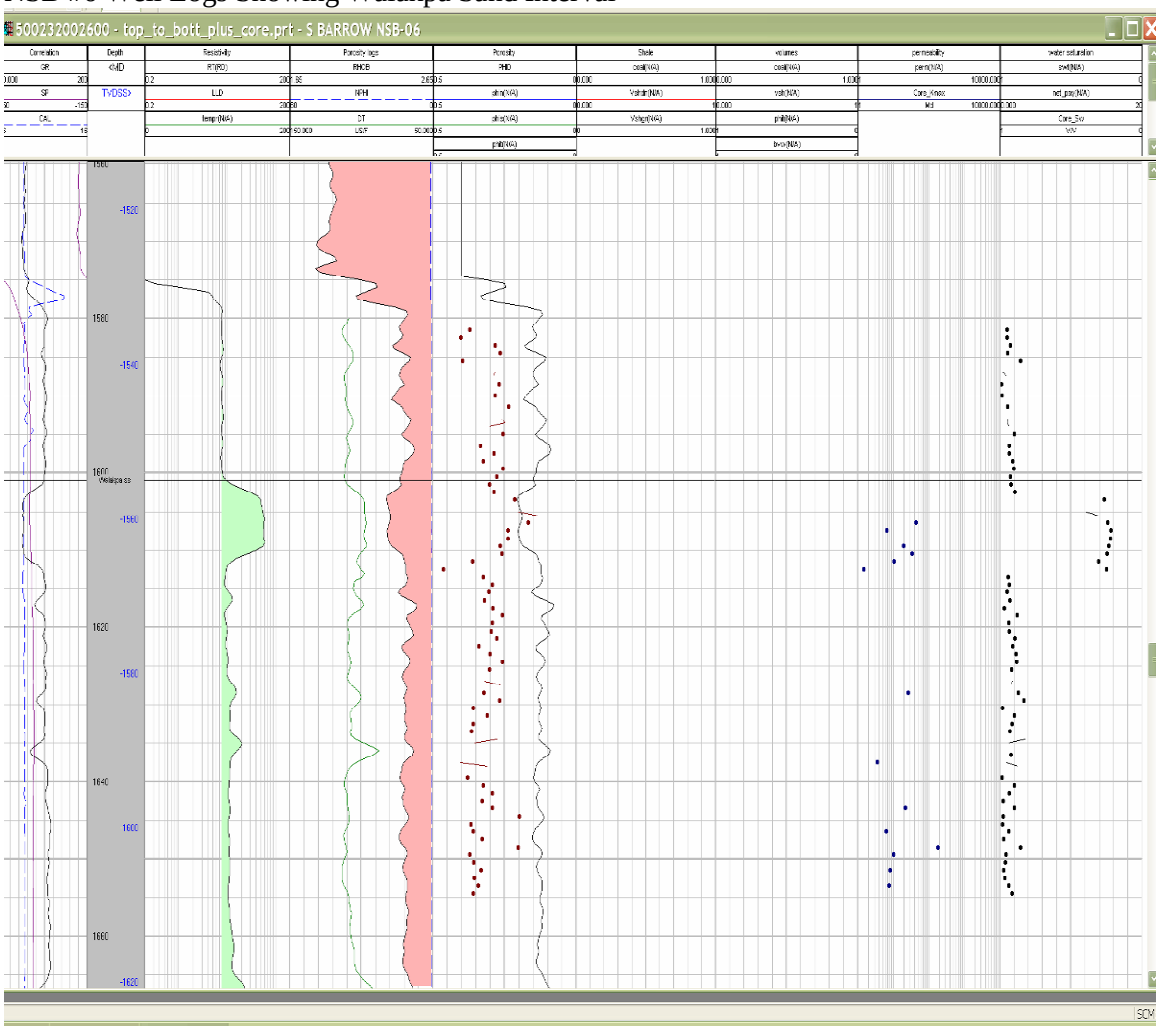
One-dimensional and two-dimensional seismic modeling is still ongoing, with the objective of quantifying the effects of reservoir pore-fluid saturations (free gas vs. hydrate) on the seismic response, and wedge modeling to assess the impact of thinning reservoir section. This modeling was temporarily put on hold to allow for completion of the seismic interpretation and mapping.

Core analysis and well log interpretation were completed, and maps of reservoir thickness, net-to-gross, porosity, water saturation, and permeability were generated to QC the interpretation. The results of this work will be incorporated in an integrated 3D reservoir model in the next project quarter.

The Walakpa was encountered in several updip wells, where mud logs and wireline logs showed evidence of gas saturated reservoir, although the interval flowed little or no hydrocarbon when tested. In the NSB #6 well, nine feet of Walakpa Sand was cored at a depth of 1603 ft., with an average porosity of 21%. The Walakpa in this well is ten miles updip and 420 ft. shallower than Walakpa #1. The Walakpa sand is a transgressive sand overlying the Lower Cretaceous Unconformity (LCU), and is known to be regionally extensive. The presence of this reservoir interval in the Brontosaurus well fifteen miles southeast of the Walakpa Field, and in East and South Barrow Field wells some fifteen miles updip of Walakpa leads to the postulation that this pool is comprised of a large aquifer, in equilibrium with a several hundred foot high hydrocarbon

column, capped by an extensive hydrate interval. Needless to say, the potential significance of this system could be tremendous.

NSB #6 Well Logs Showing Walakpa Sand Interval



TASK 5c: EB #14 Water Sample Analysis

Comparative analysis of the recent E.B. #14 well produced water sample against earlier East Barrow well samples was completed, and samples will continue to be collected periodically from E.B. #14 to track any compositional changes over time.

As there is very little water produced with the gas in the Barrow Gas Fields, and there is currently no means of separating any produced water at the wellhead, a bailing tool was acquired and utilized to “dip” formation water from the wellbore for analysis.

The recent sample analysis reflects an increase in total dissolved solids in the formation water from past samples, which was contrary to our expectations.

Well East Barrow #14 water sample analysis:

	TDS	Sodium	Calcium	Sulfate	Chloride	NaCl	Comment
SB 14 1977	111662	5108	35600	790	67000	107809	Contaminated
SB 15 DST4 1980	24475	8907	550	1	14400	24300	
SB15 DST4 1980	24120	7804	1465	2	14000	23778	
SB 17 Prod test 1978	21569	7666	620	Tr	13000	21555	
SB 20 Prod test 1980	62931	860	21622	110	40000	61934	
2007 Analytika	34500	3830	6890	ND	20400		

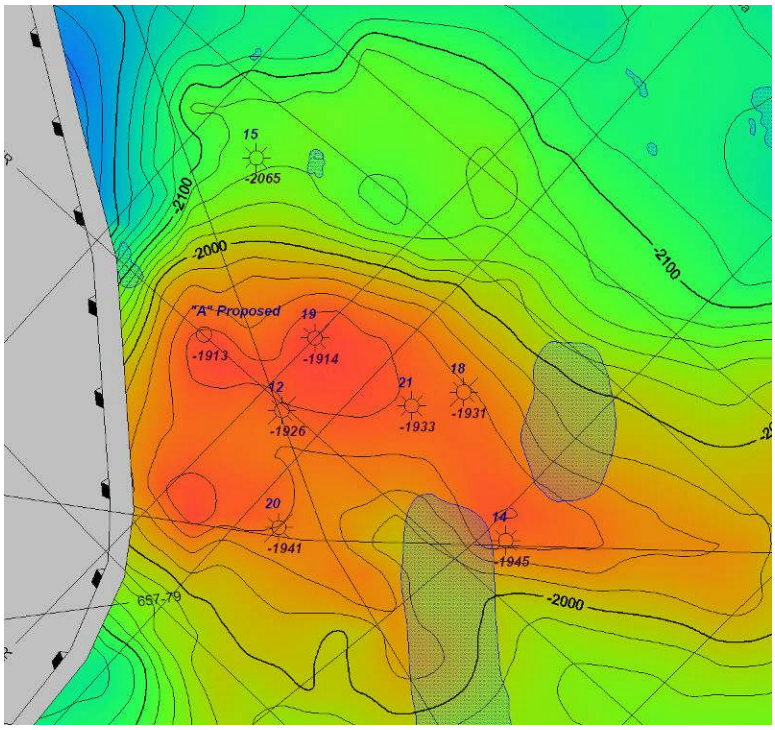
TASK 6: Reservoir Characterization and Selection of Optimum Test Well Location

An intermediate modeling step was added to the project scope to determine if we could explain the production history performance results for the East Barrow Field with either volumetric gas expansion, volumetric gas expansion coupled with aquifer support, or hydrate dissociation, gas expansion and aquifer support. The "tank" modeling results indicated that volumetric expansion and aquifer support combined could not explain the pressure response of the reservoir, and that hydrate dissociation must be a factor. This was a valuable step that supports the full dynamic reservoir modeling effort.

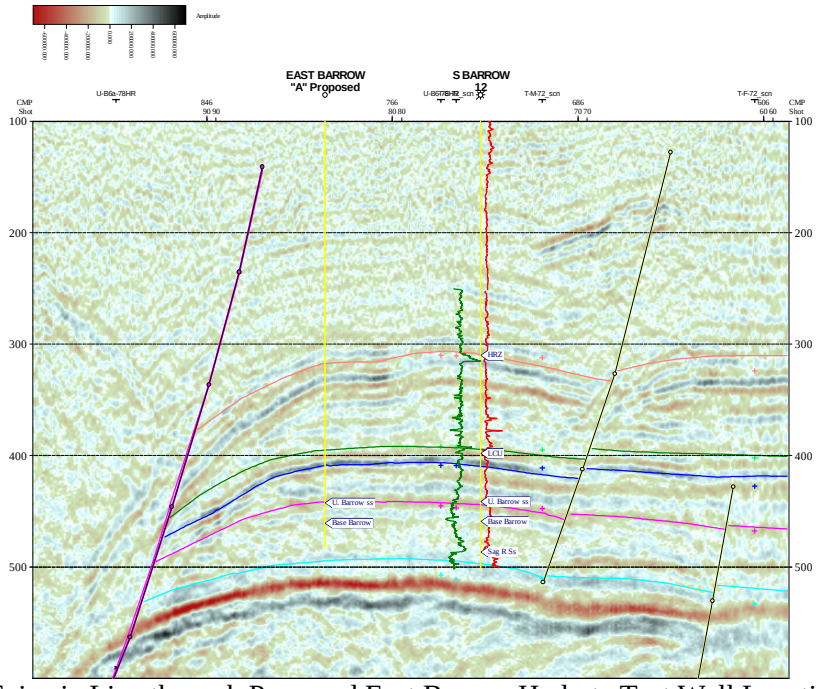
The material balance study confirmed the existence of a thick hydrate layer overlying the free gas zone within East Barrow reservoir. The analysis also shows an association of a weak aquifer providing partial pressure support to the gas reservoir. Results obtained for the hydrate-capped free gas reservoir with weak aquifer support closely matched the production data with a maximum percentage error of 10%.

The full results of this work will be described in a topical report.

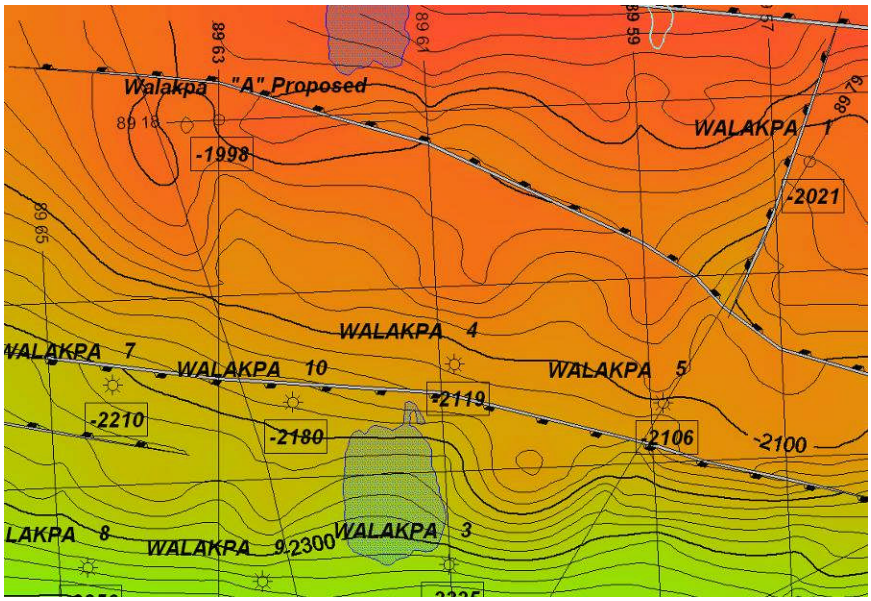
Two potential locations were selected as optimal hydrate test well sites, based on geoscience, reservoir and logistical considerations. The wells are situated near the modeled base of hydrate stability zone, ideally intersecting the hydrate/free-gas interface, and they are both located on seismic lines. The primary candidate is in the updip extent of the East Barrow Gas Field, and is favored due to proximity to road access. The second location is updip of the main Walakpa Gas Field, and while more difficult logistically, it benefits from better seismic and well coverage, and therefore more accurate reservoir characterization.



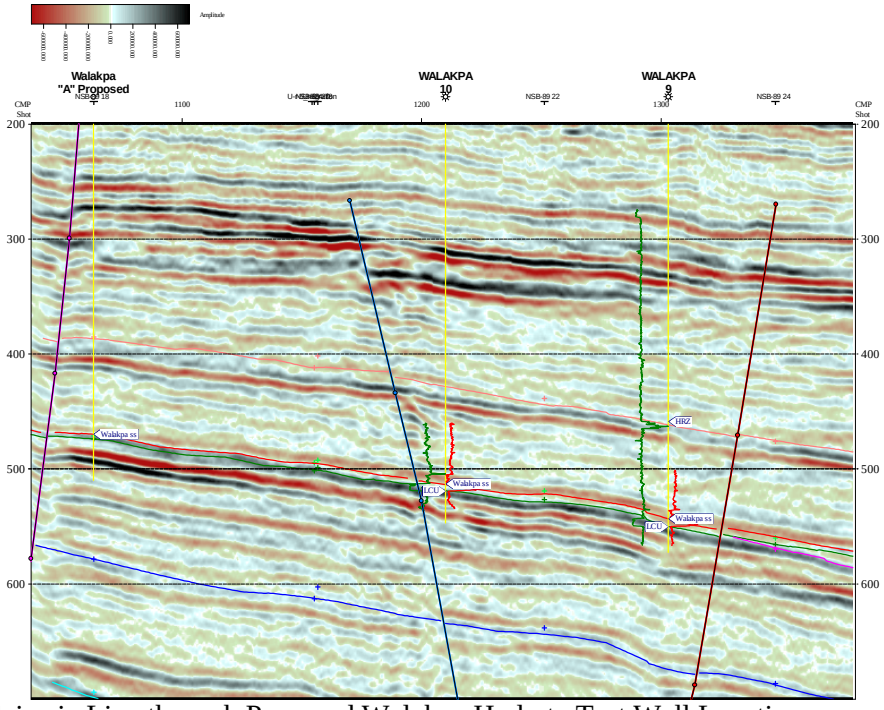
Map of East Barrow Gas Field with Proposed Hydrate Test Well Location



Seismic Line through Proposed East Barrow Hydrate Test Well Location



Map of Walakpa Gas Field with Proposed Hydrate Test Well Location



Seismic Line through Proposed Walakpa Hydrate Test Well Location

A topical report is being written to describe the details of the seismic interpretation and mapping, petrophysical analysis and well log correlation, and hydrate test well location selection.

TECHNOLOGY TRANSFER

- An abstract was submitted to present project findings at the 2008 International Conference on Gas Hydrates, and acceptance of the abstract has been confirmed.

CONCLUSION

Significant progress was made this quarter in characterizing the reservoir, modeling reservoir production history, and selecting optimal locations for a potential hydrate test well. Detailed results of findings will be described in two topical reports, covering the "tank modeling" effort, and the reservoir characterization, respectively.

The next quarter is the final quarter in the project schedule, and objectives for this quarter include building a detailed reservoir model and simulating reservoir performance to understand the depletion mechanisms in play in this system. Documentation of study results will commence in March, and will be submitted in June.

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