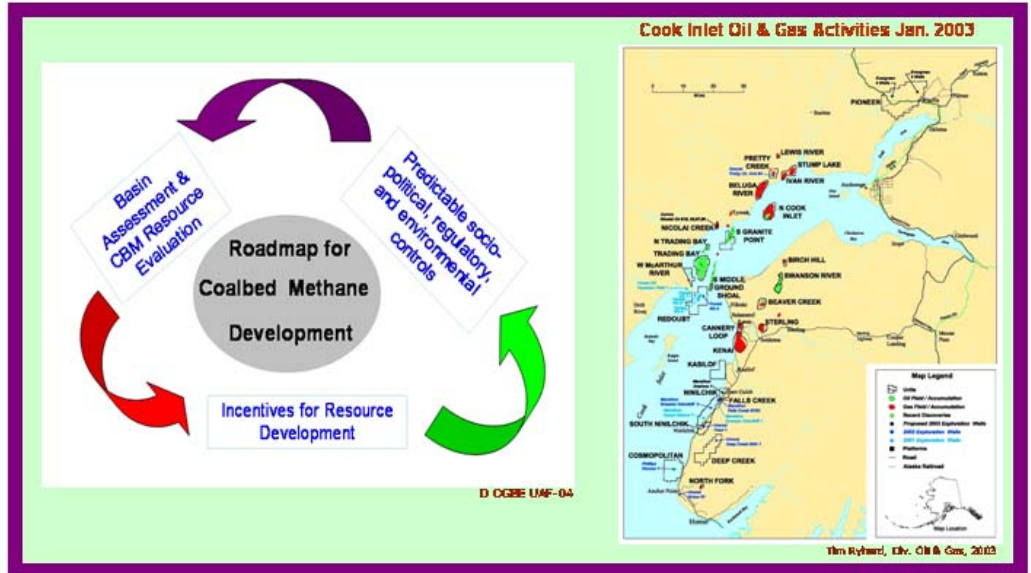


ROADMAP FOR PRODUCING ALASKA'S COALBED & TIGHT SAND GAS

Final Project Report

Prepared for



RESEARCH PARTNERSHIP TO SECURE ENERGY FOR AMERICA
 RPSEA Subcontract No. R-513

RPSEA Project Manager
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ROADMAP FOR PRODUCING ALASKA'S COALBED & TIGHT SAND GAS

EXECUTIVE SUMMARY

INTRODUCTION

Current estimates of the conventional gas reserves remaining in the Cook Inlet Basin vary from 1,000 to 2,000 billion cubic feet (bcf). Cook Inlet has provided low-cost gas for heating and electricity to residents in south-central Alaska since the late 1960s. Natural gas consumption in the region has varied between 210 and 220 bcf per year for the past 20 years, with power generation and utilities consuming 30 percent and industrial users--primarily ConocoPhillips-Marathon liquefied natural gas (LNG) and Agrium fertilizer plants in the Kenai Peninsula Borough--accounting for about 61 percent. Near the middle of this decade, the region needs to develop new gas supplies to meet demands. Limited supply of low-cost gas may jeopardize continued fertilizer production at the Agrium plant beginning in late 2005. The economic impacts of closing the fertilizer plant on Kenai Peninsula Borough alone are significant, including loss of about 250 jobs and substantial tax-revenues from Agrium--the second highest tax payer in the Borough (Thomas et al, 2004). Renewal of contracts and federal export license for LNG beyond 2009 is at risk unless significant new sources of gas can be online by 2009.

The solution to meeting the gas demand-supply imbalance in the region lies in the development of unconventional gas resources to support aggressive exploration for conventional gas. Total future discoveries of conventional gas in the Cook Inlet may range from 1,000 to 3,560 bcf, if higher gas prices support exploration. Cook Inlet basin contains vast quantities of unconventional gas resources in coal beds and tight sands. Estimates of tight gas resource-in-place and producible gas reserves are unknown. Coalbed methane (CBM) resource estimates stand at 250,000 bcf for the entire basin, with 8,000 bcf technically recoverable coalbed gas near existing pipeline infrastructure in the upper Cook Inlet (Clough et al, 2000). Development of the huge volumes of unconventional gas resources may hold the key to meeting both export and local demands in south-central Alaska.

PROJECT OBJECTIVES

The primary purpose of this one-year study is to develop a roadmap for producing gas from coal beds and tight sands in order to meet both export and local demands beyond 2009. A secondary objective of this project is to characterize the tight gas sands, and evaluate the amount of resource in-place and producible tight gas reserves. Project objectives were achieved by (1) organizing a workshop that provided a forum for experts and community leaders to interact, identify technological challenges to overcome, and create a roadmap for exploration and production of CBM and tight sand gas in the Cook Inlet; (2) initiating a research program to characterize and assess tight gas resources and their production potential in the basin; and (3)

leveraging the “seed grant” funds by working collaboratively with other related research teams to study methods for water management and disposal suitable for CBM production in Alaska.

WORK COMPLETED AND PROJECT ACCOMPLISHMENTS

The major accomplishment during the one-year period was the organization of the workshop to create a roadmap for producing CBM and tight gas sands. We have also completed a petrographic study of potential tight gas reservoir samples in the Cook Inlet, Alaska.

Unconventional Gas Workshop and Roadmap for Producing Coalbed Methane and Tight Sands

A three day workshop titled “2004 Alaska Unconventional Gas Workshop” was organized in March 2004 in Anchorage, Alaska to bring together community leaders and experts from industry, local, state and federal agencies, native corporations, and academia to create a road map for developing Alaska coalbed methane and tight gas resources. The theme of the workshop was “Road Map for Developing Alaska Coalbed Methane and Shallow Gas Resources.”

The workshop agenda included:

- Day 1: Short Course and Workshop Dinner. The short course provided participants with the knowledge to evaluate coalbed methane potential in a given area and to understand the reservoir and production engineering aspects of CBM production. The evening of the first day featured a guest speaker, Melanie Kenderdine, who talked about natural gas supply-demand trends in the US.
- Day 2: Technical Presentations and Breakout Session I. The technical presentations by representatives from industry and government agencies provided an overview of Alaska’s coalbed methane and shallow gas resources and the challenges and issues involved in the development of those resources; and they were followed by the first round of road mapping breakout session.
- Day 3: Panel Discussion and Breakout Session II. The panel discussion featured speakers from the geological surveys of the state of Alabama, Colorado and Wyoming who shared their experience and discussed how the three states have worked cooperatively with industry to develop commercially viable coalbed methane production in the last decade. The panel discussion was followed by the second round of road mapping breakout session.

The outcome from road-mapping workshop is that there are many barriers and technical areas that limit the development of coalbed methane and shallow gas projects. These challenges include lack of knowledge of the resource base, poor reservoir characterization, time-consuming permitting and environmental issues, complex regulations, lack of infrastructure, and the high cost of development and production in Alaska. The participants recommended that advances in science and technology that reduce the cost and complexity of permitting and environmental compliance, and development of lower cost resource extraction technology for application in Alaska are areas where R & D can help minimize the barriers.

Reservoir Characterization and Assessment of Resources in Tight Gas Sands

Two research studies were initiated to characterize and assess the gas resources in the tight (low Permeability) sandstones in the Cook Inlet Basin. A petrographic study was carried out by the Department of Natural Resources, Division of Geological & Geophysical Surveys (DGGs); and the production rate forecasting is being conducted by the University of Alaska Fairbanks (UAF). The work completed during the past year is described below.

Petrographic Study

Fifty core samples from 25 wells in the Cook Inlet have been examined petrographically as part of an effort to understand the potential for producing tight gas reservoirs in the area. The objectives of this study are to document the composition and burial diagenesis of a range of reservoir sandstones, and to interpret the observed sandstone properties in terms of basin-scale controls on reservoir quality (porosity, permeability, capillarity) of the sandstones that would make up tight gas reservoirs in the Cook Inlet. An understanding of these controls may then be integrated with models of sand depositional facies and basin history (Magoon and Claypool, 1981; Magoon, 1994) to provide critical tools for the exploration for tight gas sandstone reservoirs in the Cook Inlet Basin.

Current burial depths of the samples range from about 2,500 ft to 13,500 ft. Grain size ranges from silty shales to pebble conglomerates. For the purposes of this study, most attention was focused on sandstone samples (33 of the 50); the remaining shales, conglomerates, and tuffs have been briefly described and photographed, but not otherwise investigated. Twenty-five of the sandstones were selected for detailed point counts and grain size measurements. Of these twenty-five, five samples (of low to moderate permeability) were selected for further capillary pressure analysis. All petrographic examinations, photomicrographs, point counts, and capillary pressure measurements have been completed, and detailed results of this investigation are published in a report by Reifenhstahl and Hickey (2004).

Production Rate Forecasting

At UAF, we are using modern production engineering tools (Rate Transient Analysis) to forecast producible tight gas rates. To analyze gas production rates, we have assumed that the tight (low permeability) sands are co-located in the same neighborhood as the conventional high permeability sands being produced in the Cook Inlet. Consequently, the tight gas zones cannot be produced as stand alone reservoirs at this time. It is likely that these low permeability tight sandstones will be developed as additional reserves following application of appropriate stimulation technology and will be produced along with the high permeability conventional gas reserves in the Cook Inlet basin. The investigation is carried out using the following work plan:

1. Identify gas fields producing from conventional (high permeability) reservoirs and in which the producing wells have been drilled through the tight sands
2. Using analytical tools, forecast baseline production rates of the conventional gas wells
3. Develop suitable stimulation tools to apply to fracture and produce tight sand intervals of the gas wells, and
4. Predict post-stimulation gas production, and estimate incremental production due to the tight zones.

This study is an ongoing project but we have completed Step 1, i.e., identified the candidate wells, and are currently working on the baseline production rate forecasting (Step 2).

RECOMMENDATIONS

The recommendations from the petrographic study are given in the Appendix. The following recommendations were derived from the proceedings of the road mapping sessions during 2004 Alaska Unconventional Gas Workshop. For details, see the section titled “**TASK III: ROADMAP FOR COALBED METHANE PRODUCTION**” in this report or the workshop proceedings by Ogbe et al (2004).

- Cook Inlet Basin is Alaska’s highest priority for coal bed methane (“CBM”) resource assessment and development. The basin has abundant coal, extensive well control, well-developed transportation infrastructure, and market access.
- A rigorous analysis of the resource potential of Cook Inlet Basin CBM identifying areas of high potential may serve as a catalyst for exploration and investment in this play.
- A tax-based drilling credit could be employed to motivate industry to investigate Alaska’s non-conventional gas resources. Tax credits earned from drilling an unconventional gas play regardless of the economic outcome of the well will be a highly effective industry motivation.
- Economic models should be developed to determine the best combination of incentives that will stimulate exploration and minimize costs to the State of Alaska.
- Financial participation of federal or state agencies with an operator in a non-conventional well should also be considered.
- The barriers to exploration and development of tight gas sands in the Cook Inlet are:
 - Commitment of industry leaders to exploration and development;
 - Data confidentiality as barrier to new independent operators who wish to explore for resources
 - Lack of funding of research to carry out basin-scale investigations
 - Difficulty in seismic recognition of reservoir intervals
 - Well completion and stimulation costs
 - Lack of understanding of connectivity/geology/geometry of reservoirs
- Recommendations to overcome the barriers/challenges to tight gas sands exploration and development are
 - Government sponsored basin-scale research to carry out an exhaustive evaluation of the basin in terms of its hydrology, hydrocarbons, depositional history/environment, migration of fluids, chemistry/mineralogy of reservoirs/fluids, and timing of hydrocarbon maturation and migration into traps.
 - Provide tax/royalty incentives to those who possess data for the release of data and reports to the public. This will encourage new entrants to participate in exploration and development.
 - Establish a Cook Inlet industry consortium. The consortium must be supported by the oil and gas industry (maybe required by state for companies looking to explore in Cook Inlet) and its charge is to gather, archive, and analyze data