Oil & Natural Gas Technology

DOE Award No.: DE-NT0005666

Microbial Ecological Work on the "Methane in the Arctic Shelf/Slope (MITAS)" Expedition

September 15-25, 2009

Submitted by:
School of Marine Science and Policy
University of Delaware
Lewes, Delaware 19958

Principal Investigator: David L. Kirchman

Prepared for:
United States Department of Energy
National Energy Technology Laboratory

October 30, 2009

Office of Fossil Energy

TABLE OF CONTENTS

EXECUTIVE SUMMARY 1
OVERVIEW OF THE EXPEDITION 1
SAMPLING EFFORT 2
PROBLEMS 3
CONCLUSION 3

EXECUTIVE SUMMARY

As part of a National Energy Technology Laboratory (NETL) project, "Characterization of Methane Degradation and Methane-Degrading Microbes in Alaska Coastal Water", University of Delaware personnel participated on the "Methane in the Arctic Shelf/Slope (MITAS)" expedition in the Beaufort Sea, September 15-25, 2009. We collected samples for various analyses in both the water column and sediments. About as many samples were collected as planned for some of the microscopic analysis but more samples were collected (272 in total) than planned for molecular analyses of genes and mRNA for methane degradation and other microbial processes. As usual for a field program in a remote location, there were problems and delays, but these did not prevent us from collecting the samples needed for this project to move forward.

Overview of the expedition

The overall purpose of this expedition was to obtain a better understanding of methane and methane hydrates in the Arctic by examining microbiological, geochemical, and geological parameters in the water column and sediments of the Beaufort Sea. The focus of this NETL-supported project is to examine the microbial communities potentially involved in methane degradation in this Arctic system. The main activity during the expedition itself was the collection of samples for a variety of analyses (see below) back in the lab on land.

Figure 1 is a map of the cruise track where sampling took place. The work was done on the USCGC *Polar Sea*, starting late in the day on September 15, 2009, after leaving Barrow, Alaska. Over 30 stations were occupied over the next 10 days before returning to Barrow on the morning of September 26. Samples for the NETL-supported project were offloaded and successfully expressed shipped back to Delaware.

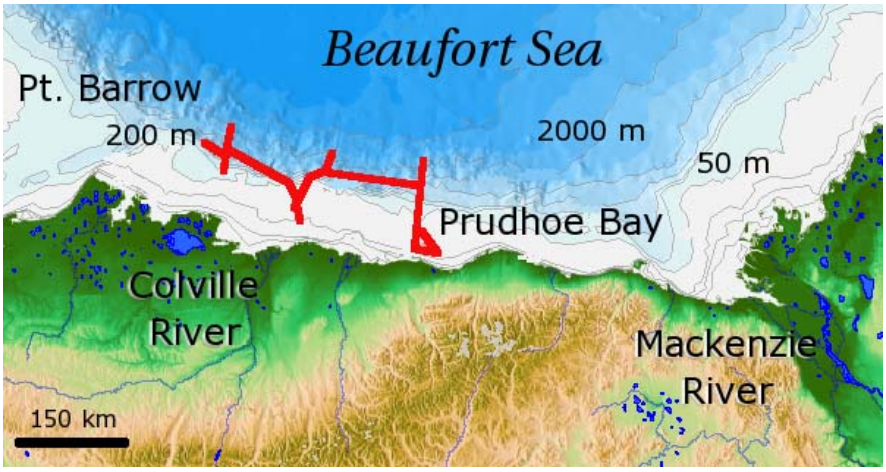

Figure 1. Sampling line for the MITAS Beaufort Sea cruise of September 2009

Sampling effort

We collected samples for various analyses in both the water column and sediments. We sampled two depths (surface and 100 m) at 11 stations for various water column properties (Table 1), but most of our work was focused on sediments where methane concentrations are high and potential methane degraders (methanotrophs) are abundant. We took samples at several depths in sediment cores at 11 stations. These stations were sampled by a multi-corer (five times), which is best for the sediment surface layer, and by vibracoring (once) and piston coring (five times). Three of these sediment cores had high methane concentrations based on visual inspection and shipboard gas analyses.

Table 1. Water column and sediment samples collected during the MITAS expedition

Parameter	**Water column**	**Sediments**
Microbial abundance	58	214
CARD-FISH* analysis	24	214
Chlorophyll a	60	0
Leucine incorporation	8	5
Acetate uptake and respiration	0	3
DNA samples	58	214

*CARD-FISH= Catalyzed reporter deposition fluorescence in situ hybridization. CARD-FISH is a microscopic approach for identifying microbes.

Problems

As is the case with virtually all field programs, this one had a few problems, but none prevented us from collecting the samples and data necessary for meeting the objectives of the project. One of the first problems was a delay in the departure date for the expedition, due to the late arrival of the *Polar Sea* in Barrow. The ship was late because she had to turn back in Seattle to fix a mechanical problem. This delay meant that we lost a couple days from the expedition. We discovered another problem with the scintillation counter when we arrived on the ship in Barrow. The counter and associated computer (the source of the problem) were in the radioactive work van provided by the UNOLS facilities at Oregon State University. This instrument is used to radioassay samples for examining microbial activity in sediments and the water column. The scintillation counter computer would not boot up, and we could not install the software on another computer. In spite of many phone calls and emails to the scintillation counter company and others, we were unsuccessful to fix the problem, and lost time in the process. Consequently, fewer samples than planned were taken for rate measurements, but we were able to preserve some samples for analyses back in the lab. A small, single sample counter, which we arranged to be shipped from Delaware to Barrow, was used to survey the radioactive van after the cruise in compliance with Nuclear Regulatory Commission regulations.

Conclusion

In spite of the problems, many potentially interesting samples were collected from the Beaufort Sea and will allow this project to move forward. These samples are likely to yield new insights into methane degradation and other microbial processes in this important Arctic region. The data we collect will be analyzed in conjunction with other data on several biogeochemical and geological properties of the systems in order to understand methane dynamics in the Beaufort Sea.

National Energy Technology Laboratory

626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940

3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880

One West Third Street, Suite 1400
Tulsa, OK 74103-3519

1450 Queen Avenue SW
Albany, OR 97321-2198

2175 University Ave. South
Suite 201
Fairbanks, AK 99709

Visit the NETL website at:
www.netl.doe.gov

Customer Service:
1-800-553-7681