Metadata Citation Information

Title:	**Mallik Gas Hydrate Production Research Program Weekly Science Report #1 January 21-28, 2008**
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Status:	**Final report**
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Prepared for:	**General distribution**
Submission date:	**January 28, 2008**
Review status:	**R. Bowen/S. Dallimore Unedited technical report as provided by lead NRCan scientist. It is included here as background program documentation only.**
Distribution:	**Public**

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MALLIK GAS HYDRATE PRODUCTION RESEARCH PROGRAM

WEEKLY SCIENCE REPORT # 1
JANUARY 21-28, 2008

AURORA RESEARCH INSTITUTE

INTRODUCTION:

Welcome to the start of the Mallik 2008 field program and the first of our weekly science reports! The expectations are high for this winter as we strive for the elusive 'proof of concept' that gas hydrates can be produced by reducing the pressure regime, and changing their in situ state from the solid to the gaseous form. We hope by early March we will be flowing gas to surface and collecting a wealth of technical data. The challenges however are significant as we deal with complex logistics, weather, untried technology and overcoming the science and technical unknowns incumbent with undertaking activities for the first time. The investment to date in Mallik R&D has been quite astounding both in terms intellectual effort, hard labor and financial investment. This will be the fourth field season at Mallik (1998; 2002; 2007 and 2008) and for some us nearly a year of field time has been invested in a place that many newcomers see as the end of the world. We have published more than 100 scientific papers and we have arguably led the world in gas hydrate R&D. Our goal for this year will be to deliver the goods…the harsh reality is we have never faced more severe limitations in terms of budget and time.

The weekly Science report series is meant to be an informal, high level chronicle of events. I hope to give you some simple insights on field activities, a honest weekly update on our progress, and to provide a forum to connect scientist, engineer, manager and administrator. My apologies in advance, as on occasion the report may contain some inaccuracies and some stumbling English. SRD.

PROJECT STAFF ON SITE

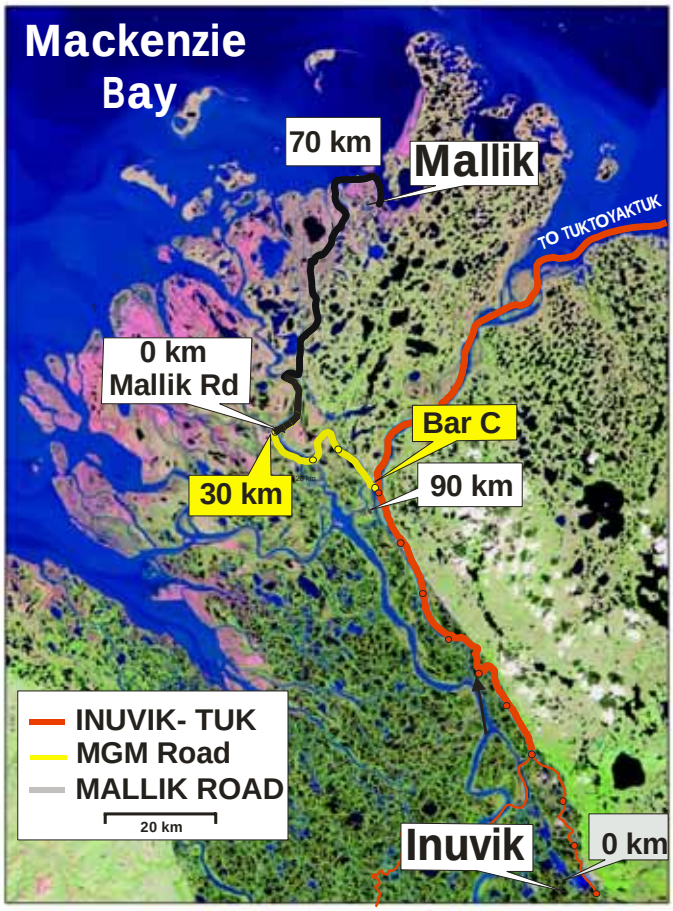
INUVIK

NRCAN- S. Dallmore

AURORA- A. Applejohn, A. Taylor, A. Jenks
D. Ashford, G. Serrano, L. Bueno

WEEKLY WEATHER- In a word the weather in Inuvik and at the Mallik site was **'extreme'** this week. Extremely warm (to +2°C) early in the week, extremely windy most of the week, extremely white and extremely cold (to -36°C). Whereas the entire operational season last year was carried out without a significant weather event impeding operations, the first week of Mallik activities in 2008 has been marked by strong northerly winds causing blizzard conditions for much of the week. The Dempster highway servicing Inuvik was closed intermittently and the Government ice road between Inuvik and Tuktoyaktuk has been closed now for 4 days.

FIELD OPERATIONS



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ITS ALL ABOUT LOGISTICS!

At this stage in a field program it is about getting there and preparing the site for full mobilization of equipment. Some of us who have done it before tend to forget just how unique this part of the program is. Scott and Doug Ashford met with the Vice President of the History Channel in Inuvik this week about filming our ice road construction and transportation. It was interesting to hear from her just how fascinating Arctic logistics are to the average southerner. Apparently the History Channels 'Ice Road Trucker' series is their most popular show and those heroic truckers on the show routinely get wedding proposals by email! But the reality is that these truckers are soft compared those hardy folks who actually have to find the route and build the ice road. In our case route finding of the Mallik Road was completed on January 17/18 by Garfield Meisner and his crew from E. Gruben's Transport based in Tuktoyaktuk. As shown on our location map, Mallik is about 190 km from both Tuktoyaktuk and Inuvik. The first 90 km is maintained by the Government of NWT, the next 30 km was constructed earlier in the season by an exploration company called MGM, and the last 70 km is our Mallik road. Garfield and crew began their work on snow machines, navigating to the site and measuring ice thickness with a ground probing radar. After confirming that there was 28 to 44" of ice (these folks don't naturally do not work in metric units) the next stage was to begin plowing snow with a loader, two graders and a plow tuck. All of this work had to be done unsupported from Tuk in the dark and in the case of last week with temperatures near -40°C.

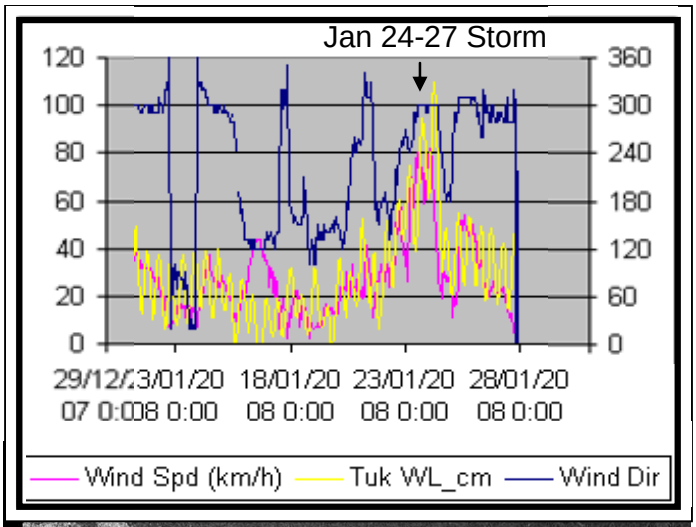
Aurora/JOGMEC/NRCan all agreed that starting ice road construction at just the right time was critical to keep costs down this year and undertake efficient operations. Our ice road to Mallik was officially opened on January 23rd ahead of schedule!

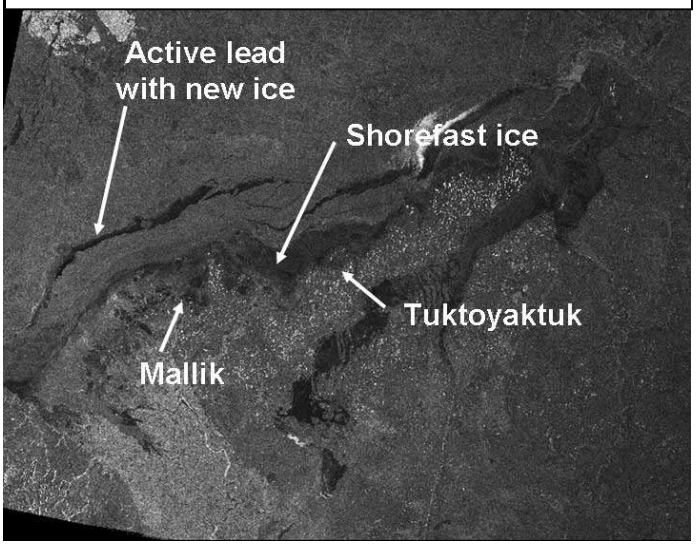
WEATHER, PREPARTIONS AND LUCK

Well folks, while things were going along great to January 23rd, the rest of the week has been an eye opener. Frankly within 12 hours of declaring our road open, it was blown in by a major blizzard. As described above in the weather report, for much of the January 24-27th strong winds blew from the north. This had the effect of causing white out conditions, filling our newly plowed road with snow and perhaps of most concern, causing heaving and buckling of the sea ice with local overflow . Our equipment was stranded out on the Mallik road for more than 40 hrs as the Government ice road was closed and visibility was limited. As a testament to the tenacity of our contractors however, even though conditions remained impassible to the public, Gruben's was able to service their equipment in the last several days and have re-plowed the road again.

There are a few lessons for us in this experience. First we have to remember that this is a new field season. Last year we had problems with operations but we encountered no lost time due to severe weather. This is a brand new season however, and within 24 hrs of beginning operations we have encountered a 4 day storm. The second lesson is that good planning is critical and that a little luck is helpful too. Good planning has helped us in that we did get the road in early and before the storm, saving some time in route finding and plowing. The luck comes into play as frankly as at this stage of our field work we can endure weather problems with almost no cost implications (we had no people at Mallik and only limited equipment on the road). Let's all hope we do not have a similar weather event during the production testing!.

The science behind our operational problems this week





Poised at the southern edge of the Beaufort Sea and at the edge of the second largest delta in North America, the Mallik site is truly in an extraordinary setting. The factors causing the operational problems over the past week can be observed in the graph above showing wind speed, water level and wind

direction. Prolonged northwest winds averaging >60km/hr created nearly a 1m winter storm surge at Tuktoyaktuk..
The polar pack ice has been extremely dynamic this winter with large open leads observed offshore of Banks Island and the Tuktoyaktuk Penisula. Time series satellite images reveal that the pack ice responded to the weather event this week by moving south, closing up the open leads and causing pressure ridges along the edge of the land fast ice. The landfast ice itself largely remained intact but the 1m storm surge lifted the sea ice from below. In some cases this pressure is relieved in the immediate nearshore area by local heaving and ice ridging. In the case of kilometer 63 on the Mallik road the ice uplifted creating just such a pressure ridge. Pressurized water from the storm surge has also caused some local overflow conditions. The photo below, taken on January 27th, shows a small pressure ridge and overflow. \

PERSONNEL NEWS

During the past week the Inuvik Mallik Operations office has been set up. Activity report follows;

Aurora Research Institute: Andrew Applejohn has been joined this week by Al Taylor (Mallik Operations Manager) and Anick Jenks (Mallik Business Manager) who are working hard to set up office facilities. ARI will be the main hub for managing field work this year. Eventually up to 15 staff from Japan, Canada and many other countries will be meeting and working from here.

Integrated Project Manager: Doug Ashford, Gerardo Serrano Lorena Bueno from Inuvialuit Oilfield Services (AKA Schlumberger). After passing their driving tests IPM staff have settled into their allocated tasks. Gerardo taking care of contracting and costing (in addition to experiencing his first whiteout), Lorena training Gruben's staff on HSE issues, and inspecting equipment, and Doug riding shot gun on everything.

NRCan- Dallimore on site, skiing, working out and writing long Science Reports!

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ADDENDUM:

SUMMARY OF WORK TO DATE AND PLANS FOR 2008 FIELD SEASON

THE ENDURING LEGACY OF 2007- Those involved with the Mallik program last field season will long remember the challenges we faced and overcame. The primary accomplishments of winter 2007 field activities were to prepare facilities for gas hydrate production testing and undertake a number of new 'state of the art' research studies. **Mallik 2L-38,** originally drilled to 1150 m in 1998, was re-drilled and deepened to 1310 m. This well was established as our production testing well by installing production casing. A state of the art well logging program was carried out to measure *in situ* gas hydrate properties such as gas hydrate saturation, permeability and physical properties. This allows us to quantify exactly what it is we are testing. To monitor the change in physical properties in response to testing, five specially designed externally mounted geophysical sensors were installed outside of the production casing. After completion of installations at Mallik 2L-38, a 60-hr pressure draw down production test was completed on a 12-m gas hydrate interval at approximately 1100 m depth to evaluate equipment performance and short-term produceability of gas hydrate. Many of the Mallik 2L activities were undertaken for the first time in the world. The old adage 'if it was easy, someone would have already done it', very much applied. It wasn't easy, but rest assured we did learn a great deal and we intend apply these learning's this winter.

Another major activity undertaken last winter was to establish **Mallik 3L-38** as a water injection well. This well, drilled in 2002, was deepening from 1188 m to 1275 m, logged, perforated and injection tested. Gas hydrates are solid ice-like materials composed of pure methane and water molecules. As we change their phase from a solid to gas during production testing, water will be liberated and brought to the surface with the gas. Mallik 3L-38 becomes much more important this year as we will re-inject the produced water at depth.

WINTER 2008: OPERATIONS

The primary focus of R&D activities for winter 2008 operations will be on production testing. The onsite operations will involve the re-entering of the Mallik 2L-38 production well and installing facilities to undertake the production testing. Mallik 3L-38 will also be re-entered to establish a water injection well. Pressure draw down production testing will take place on the lower gas hydrate intervals tested in 2007. Gas and produced water will be brought to the surface measured, and separated to allow for water re-injection in Mallik 3L-38. At the conclusion of the production test, the wells will be abandoned and all equipment will be moved off location. Abandonment is an absolute requirement and with a reduced budget for 2008 operations it is clear we must proceed efficiently with all activities, on time and on budget. The production testing itself is also under time pressure as the duration is only a 5.5 to 7 days. This is much shorter than originally envisaged, again establishing a requirement for efficient operations.

It wasn't easy, but 2007 included first full scale pressure draw down testing of gas hydrates in the word

ACTIVITIES AND CRITICAL POINTS:

Mobilization

- Start of program Jan 21
- Ice road construction from Inuvik to Mallik
- lease construction complete Feb 14
- Establishment 62-man camp Mobilization of equipment

Field operations to establish wells

- Re-entry of Mallik 3L-38 to establish water injection well complete by Feb 22
- Re-entry of Mallik 2L-38 to establish production test well

Production testing

- Production testing and monitoring begins March 2
- Testing ~March 7 to March 15
- Well Killl

Abandonment of all wells

- Removal of all equipment from site and demobilization by ice road by April 7