Mallik 2002 Gas Hydrate Production Research Well Program
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Outline of Presentation

- Quick overview of goals and objectives of Mallik program
- Update on field, laboratory and modeling research
- Snapshot of scientific highlights
- Schedule for International Symposium and Scientific Results Volume
Mallik 2002 Gas
Hydrate Production
Research Well

- Canada
  - GSC
  - BP/Chevron/Burlington
  - (Japex Canada, Imperial Oil)
- Japan
  - JNOC
- USA
  - USGS
  - USDOE
- Germany
  - GeoForschungsZentrum Potsdam
- India
  - Ministry of Petroleum Geology and Natural Gas
  - Gas Authority India Ltd
- International Continental Scientific Drilling Program
  - Universities and research institutes in Japan, Canada, USA, Germany and China
Why Mallik as the site for gas hydrate R&D?

- One of the most concentrated gas hydrate reservoirs known to date
  - >200 m gross hydrate thickness
  - Pore space hydrate concentrations >90%
- Extensive baseline engineering, geological and geophysical knowledge
- Geology/reservoir similar to many offshore deposits
- Accessible onshore location (cost efficient operations)
- Global research site for climate change and energy research
- Leadership team able to pull off operations, science and engineering R&D
**Gas Hydrates in the Mackenzie Delta**

- >600m permafrost
- >1200m to base of methane hydrate stability field
- >20% of onshore wells drilled in 70’s / 80’s encountered hydrates
Mallik 2002 Objectives:
Quantify the production response of a gas hydrate reservoir:

- Pressure stimulation
- Thermal stimulation
- Comprehensive multidisciplinary science program to allow for detailed engineering and reservoir simulation modeling

Controlled production experiments
Gas hydrates as a energy resource

• R&D goals to move from cartoons to concept
Mallik 2002 Objectives:

- Regional methane flux studies and geothermal modeling considering past geologic events and climate change
- Assessment of in situ geopressure and geothermal regime
- Geomechanical properties and porous media controls over distribution and abundance of gas hydrates
Is the western Arctic a key source of methane?

Reduce risk and development costs related to frontier hydrocarbon development
A to do list from hell!

- Find 8 partners and $17M
- Complete 6 environmental permits
- Stage 760 tons of equipment by barge to Mackenzie Delta in August 2001
- Construct 200km ice road to the site in November and December
- Build a drill rig, camp etc. and complete the engineering to do things that have not been done before
- Spud the first well on Christmas day
- Manage 100 scientist and 100 technical staff
- Get it all done and get out before breakup

Credit due to many..

Japex Canada Ltd./Canadian Petroleum Engineering,
APA Engineering,
Akita Drilling,
Advanced Geotechnology
Northern contractors
Mallik 2002- Operations

Production research well: Mallik 5L-38
- Dedicated wireline coring program through the gas hydrate zones and beneath the free gas zone
- Open hole/cased hole geophysical logging program
- DTS temperature monitoring

2 observation wells Mallik 3L-38 and 4L-38
- Cross hole seismic tomography
- DTS temperature monitoring

Production Testing
- Pressure drawdown, stress testing, in situ gas and water sampling
- Thermal flow testing

Regional Studies
- 3-D Seismic (Industry survey and high resolution survey)
- Long term temperature studies
- Flux measurements
Mallik 3L, 4L, 5L
-Spud December 25
-Completion March 14
Geophysics Program

Open Hole Well Logging
- deployment of advanced tools including NMR log, EPT, DSI, FMI, Pex

Cased Hole Logging
- CHFR-RST

X-hole Seismic Survey

VSP O-Offset and Walk-A-Way

3D Seismic Experiment

Passive Monitoring

Industry 3 D seismic survey
Distributed Temperature Sensors

Backscattering of Light caused by molecular vibration

Time for back scattered signal gives Distance along Fibre

Amplitude (Ratio of Wavelengths) Gives Temperature
CORING

- 3-inch wireline coring system
- Excellent hydrate recovery
- Transitions from hydrate to water/gas saturated intervals
Vemco Temperature-Pressure logger
- Continuous temperature-pressure data inside inner tube and to surface
Production Testing

Gas hydrate dissociation induced by pressure and thermal change
Production Testing

Thermal Stimulation Production Testing

• Reservoir response to temperature stimulation
• 13 m test zone with high hydrate saturation
Gas Hydrate Production

- High quality production data set
  (succeeded in goal to have ‘controlled formation experiments’)
- X-hole tomography surveys- time series data to map migration of dissociation interface
- Surface Seismic Surveys- time series
- DTS- measurement of formation temperature response to production and return to equilibrium after production
- Complimentary post field laboratory studies
Gas Hydrate Science

- fundamental understanding of distribution/controls on gas hydrate occurrence
- baseline physical property measurements (in-situ and laboratory)
- Enhanced understanding of regional geology and hydrocarbon controls on gas hydrate occurrence
- Enabling of long term monitoring and research to investigate climate change
Scientific Results from Mallik 2002 Gas Hydrate Production Research Well Program, Mackenzie Delta, Northwest Territories, Canada

From Mallik to the Future International Gas Hydrate Symposium

December 8 to 10, 2003

Hotel New Otani Makuhari Chiba (Tokyo area), Japan