

# ***Mallik 2002 Gas Hydrate Production Research Well Program***

**S. Dallimore, T. Collett, T. Uchida, M. Weber**



# 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**



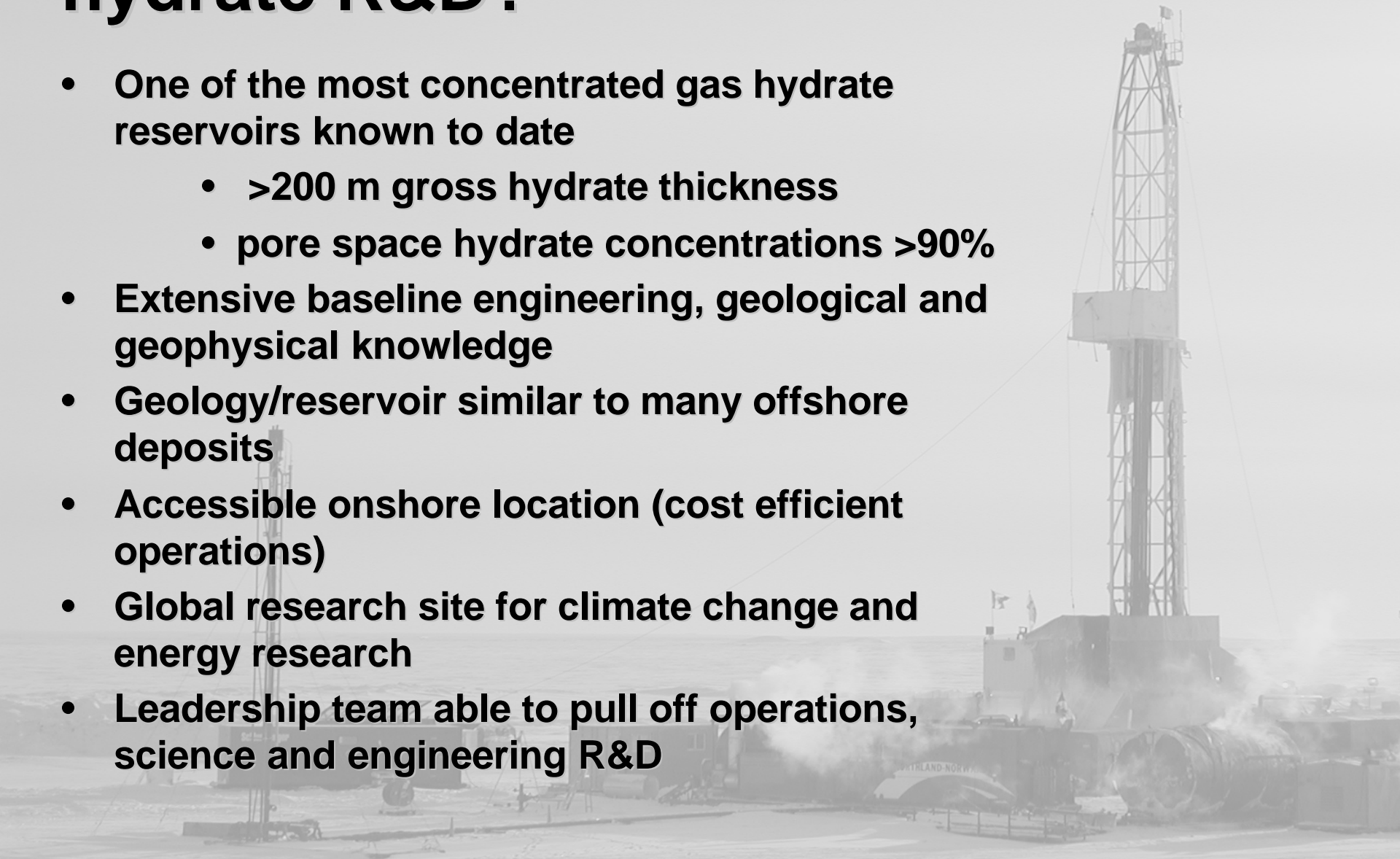
# Mallik 2002 Gas Hydrate Production Research Well

- **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

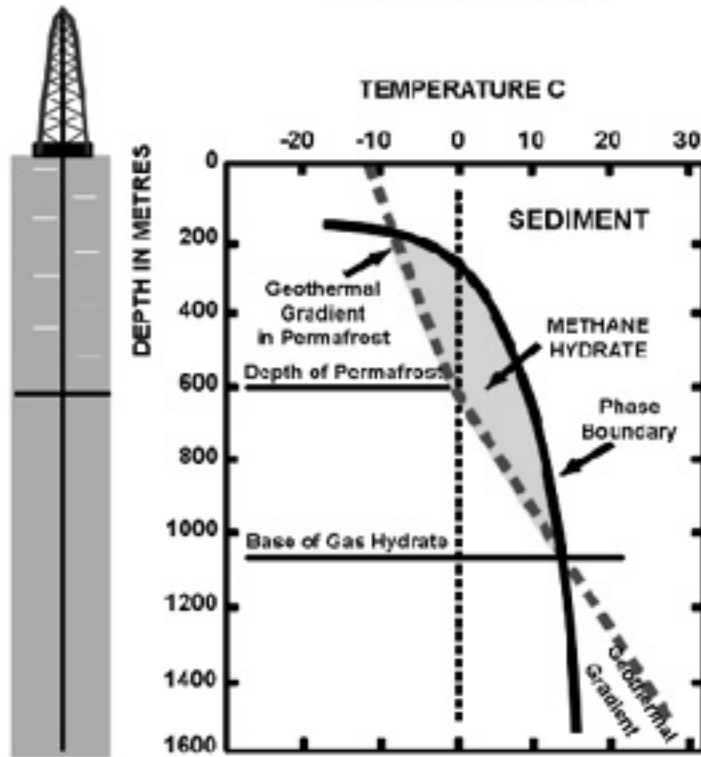


# Why Mallik as the site for gas hydrate R&D?

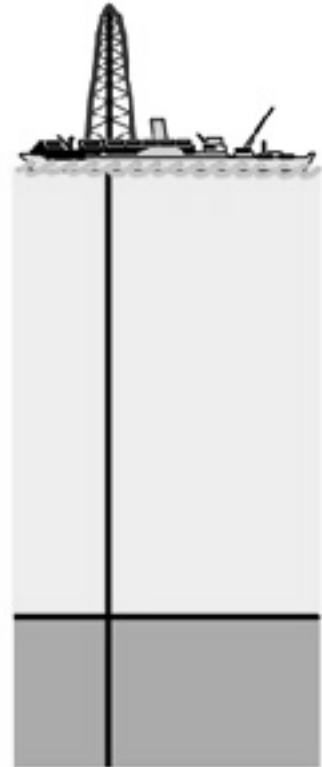
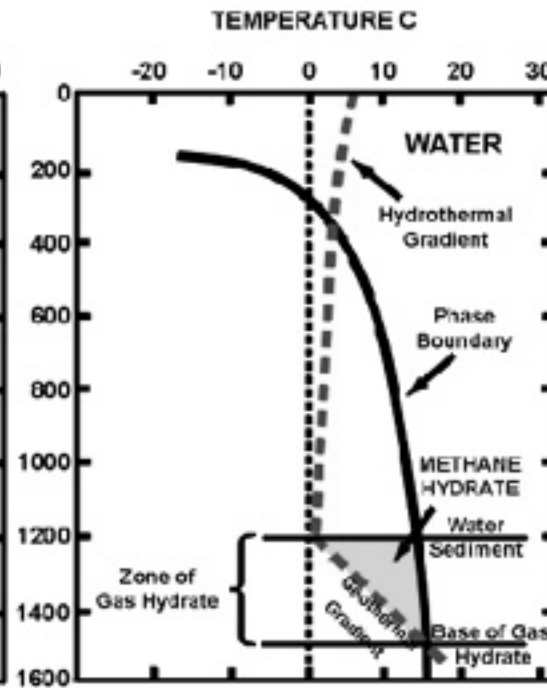
- One of the most concentrated gas hydrate reservoirs known to date
  - >200 m gross hydrate thickness
  - pore space hydrate concentrations >90%
- Extensive baseline engineering, geological and geophysical knowledge
- Geology/reservoir similar to many offshore deposits
- Accessible onshore location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



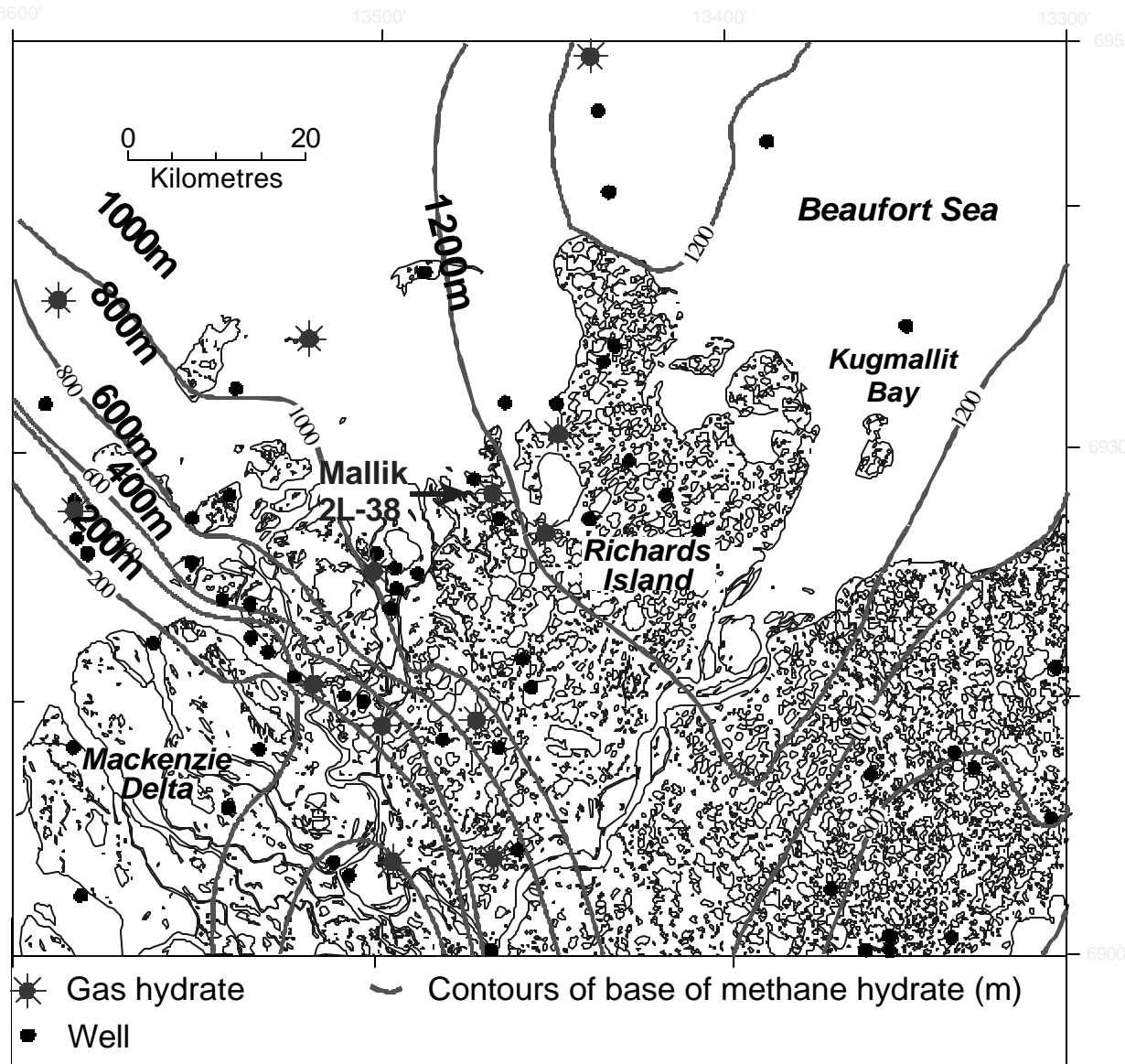
## PERMAFROST



## MARINE



# Gas Hydrates in the Mackenzie Delta



**>600m permafrost**

**>1200m to base of methane hydrate stability field**

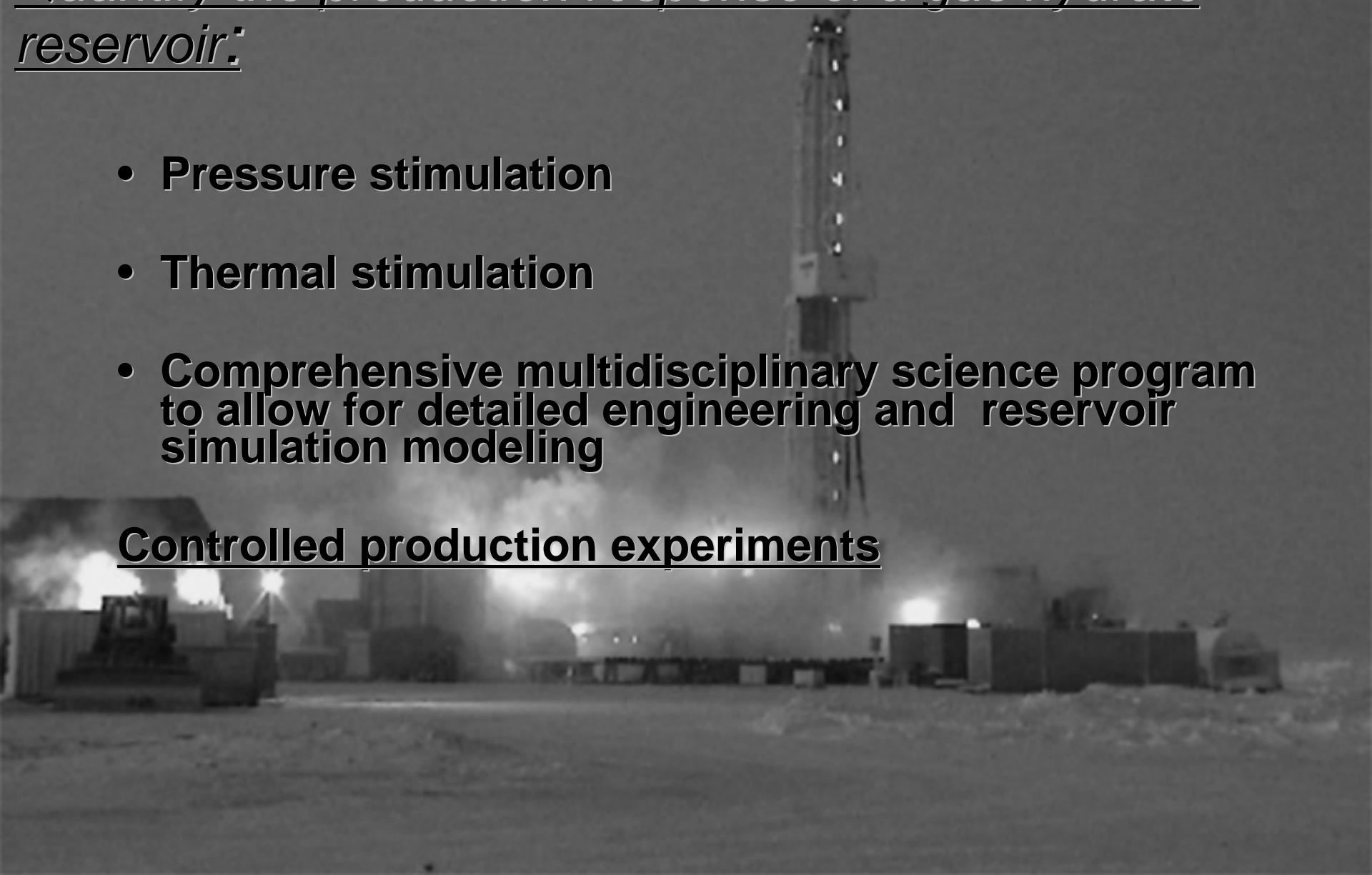
**>20% of onshore wells drilled in 70's / 80's encountered hydrates**

# **Mallik 2002 Objectives:**

*Quantify the production response of a gas hydrate reservoir.*

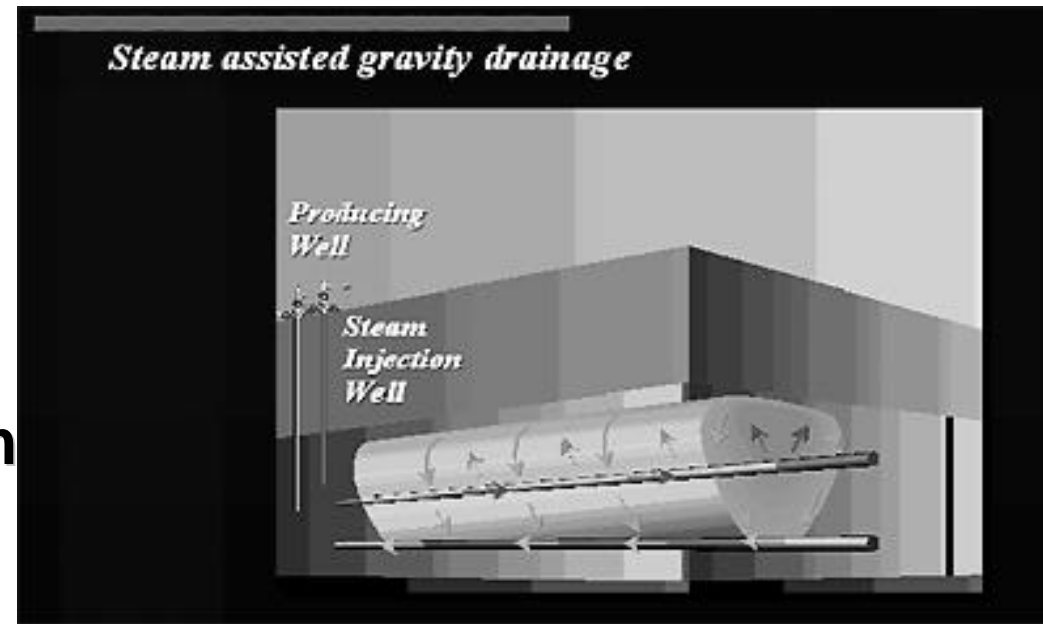
- **Pressure stimulation**
- **Thermal stimulation**
- **Comprehensive multidisciplinary science program to allow for detailed engineering and reservoir simulation modeling**

**Controlled production experiments**



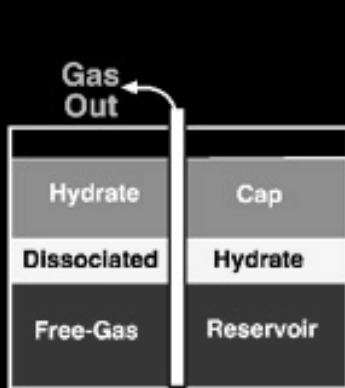
# Gas hydrates as a energy resource

- R&D goals to move from cartoons to concept

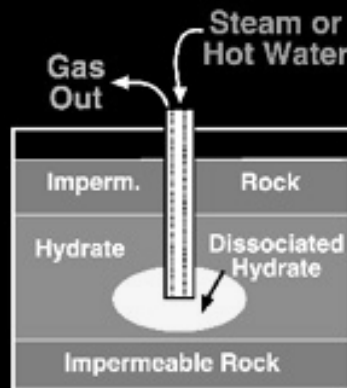


## Gas Hydrate Production Methods

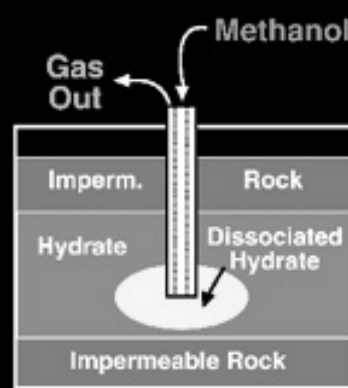
### Depressurization



### Thermal Injection



### Inhibitor Injection



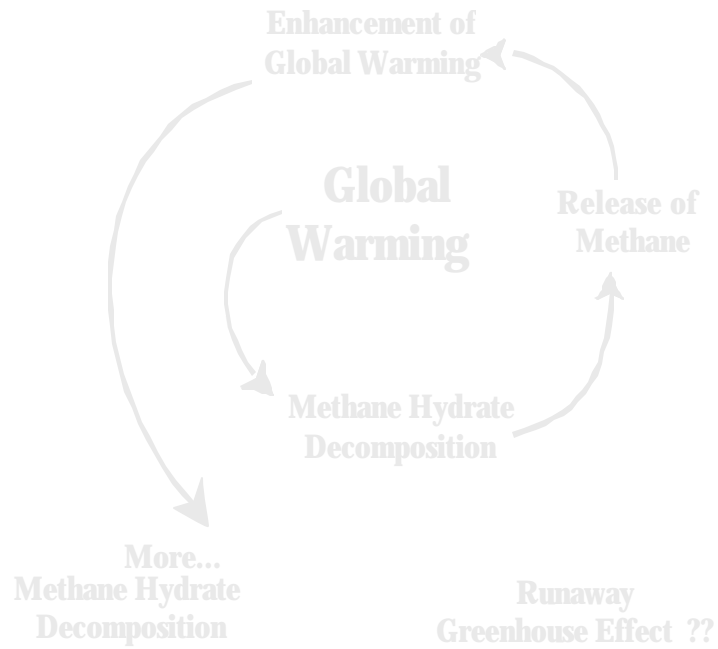


# Mallik 2002 Objectives:

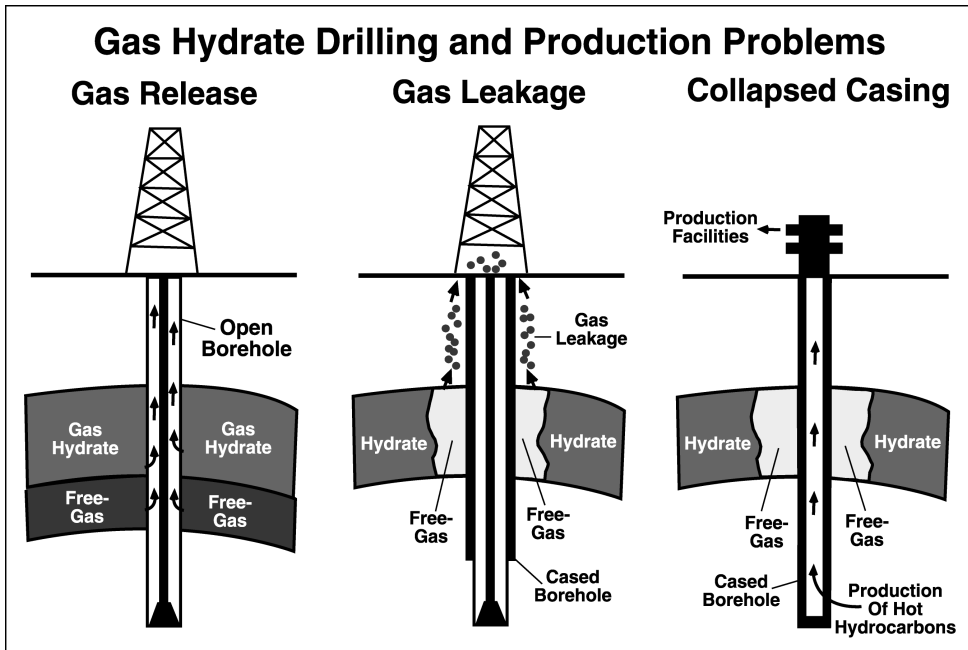
## Climate change, environmental and geohazard studies

- 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**

# Mallik 2002

**Credit due to many..**

**Japex Canada Ltd./Canadian  
Petroleum Engineering,**

**APA Engineering,**

**Akita Drilling,**

**Advanced Geotechnology**

**Northern contractors**

## **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**

# 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

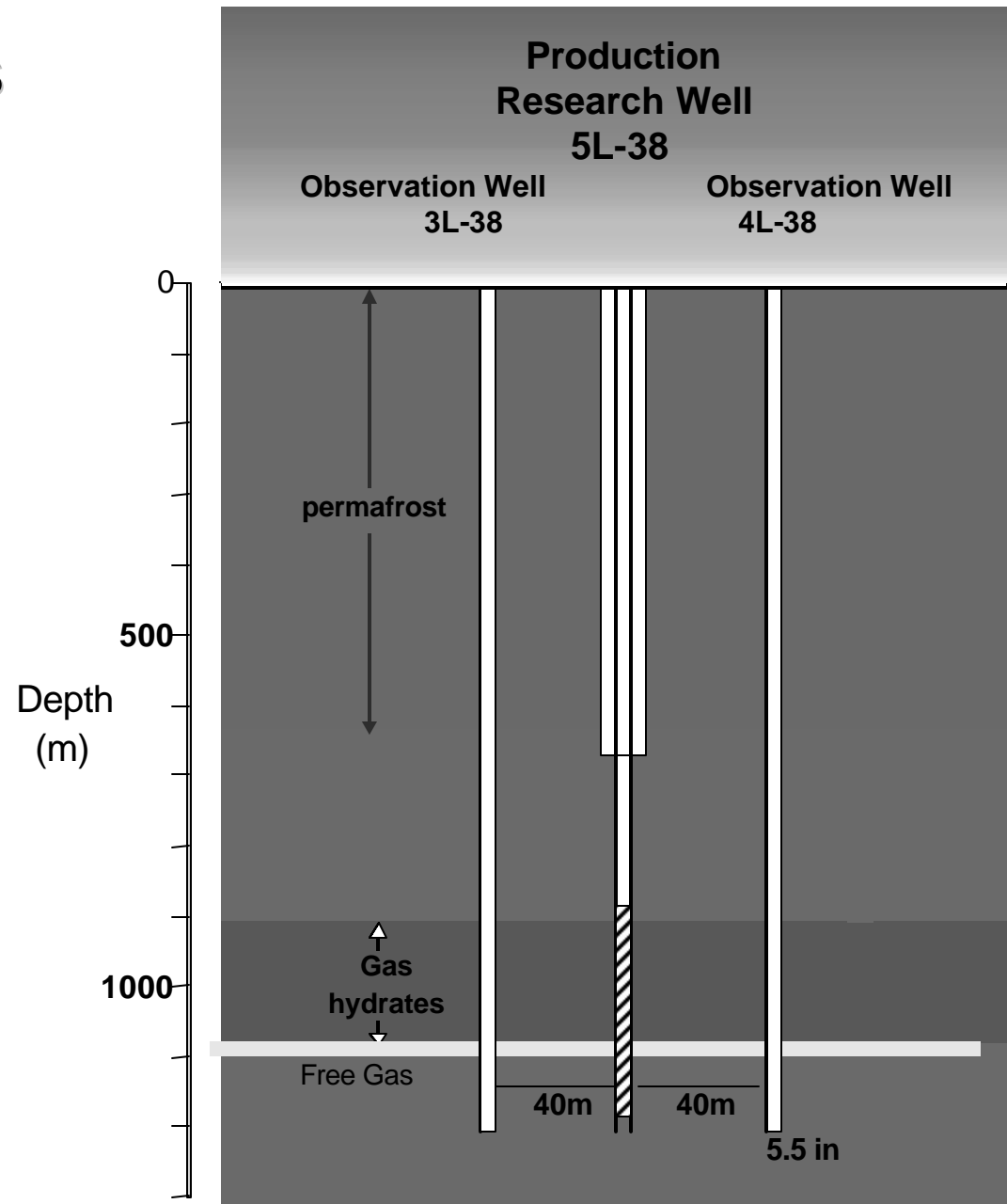
- cross hole seismic tomography
- DTS temperature monitoring

## 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

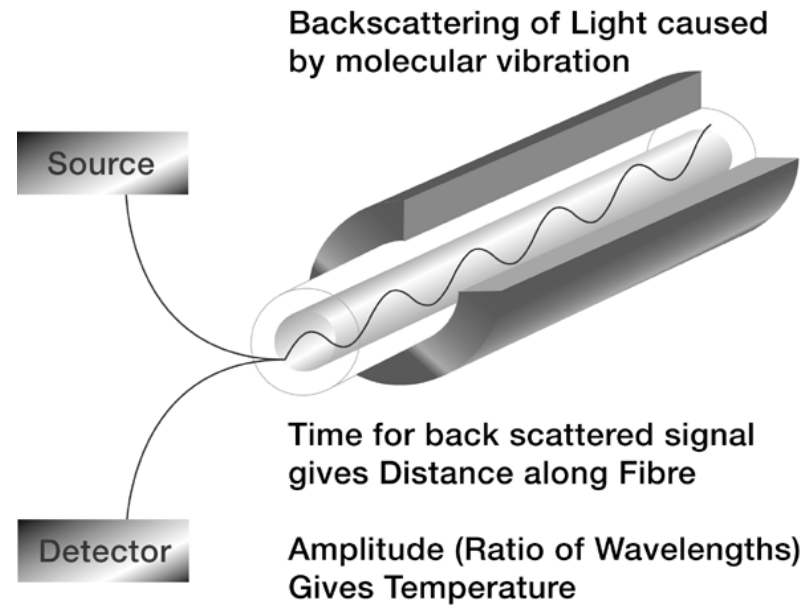
## 3D Seismic Experiment

## Passive Monitoring

## Industry 3 D seismic survey



# Distributed Temperature Sensors



# CORING

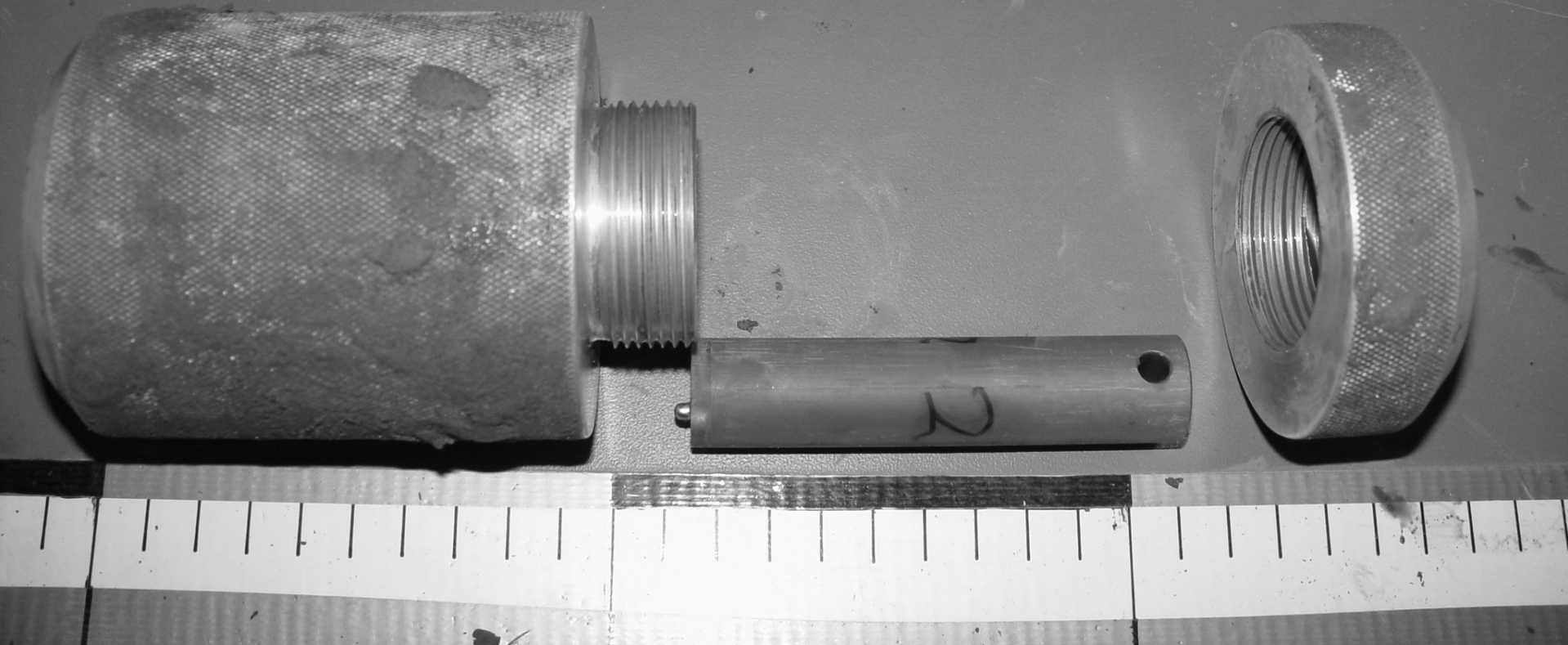
- 3-inch wireline coring system
- Excellent hydrate recovery
- Transitions from hydrate to water/gas saturated intervals

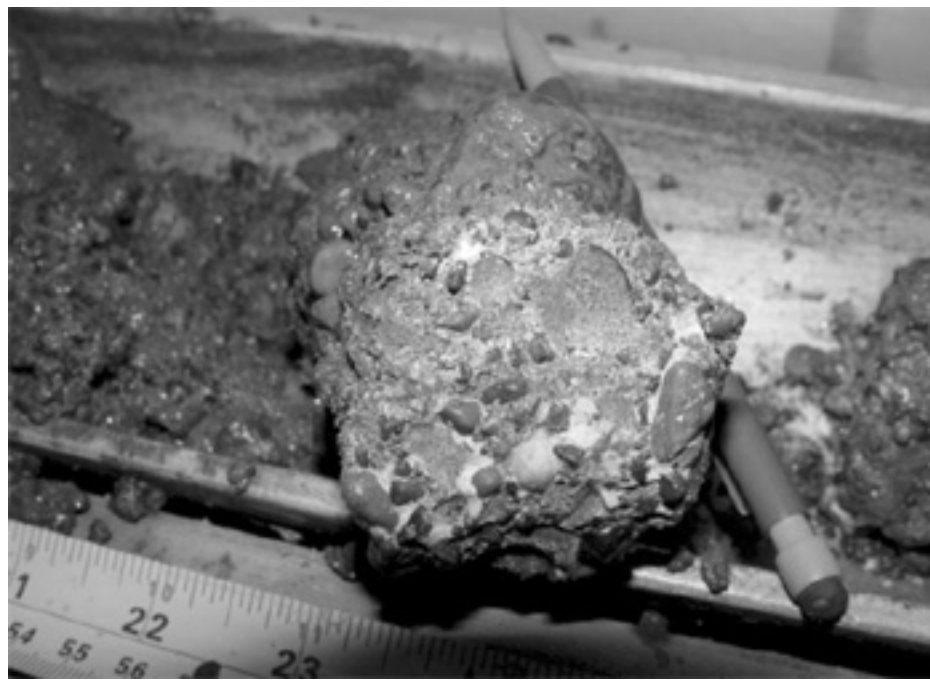
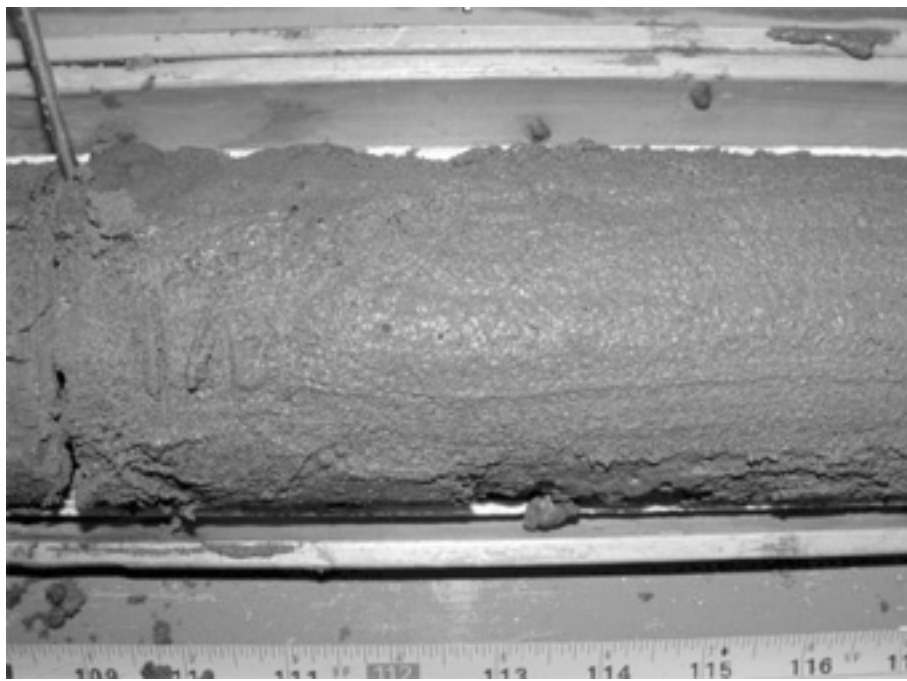
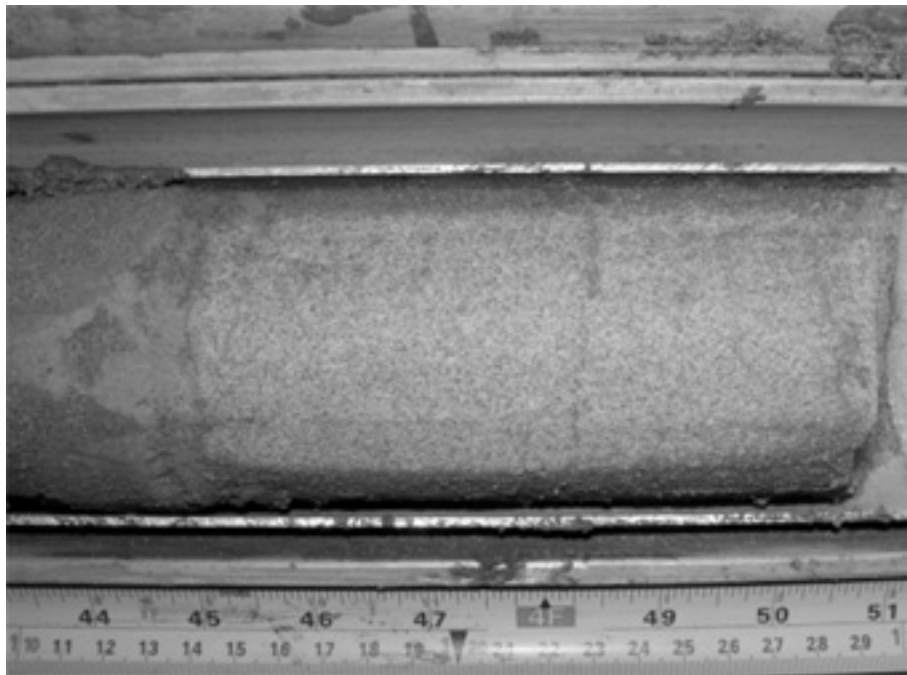




# Vemco Temperature-Pressure logger

-Continuous temperature-pressure data  
inside inner tube and to surface







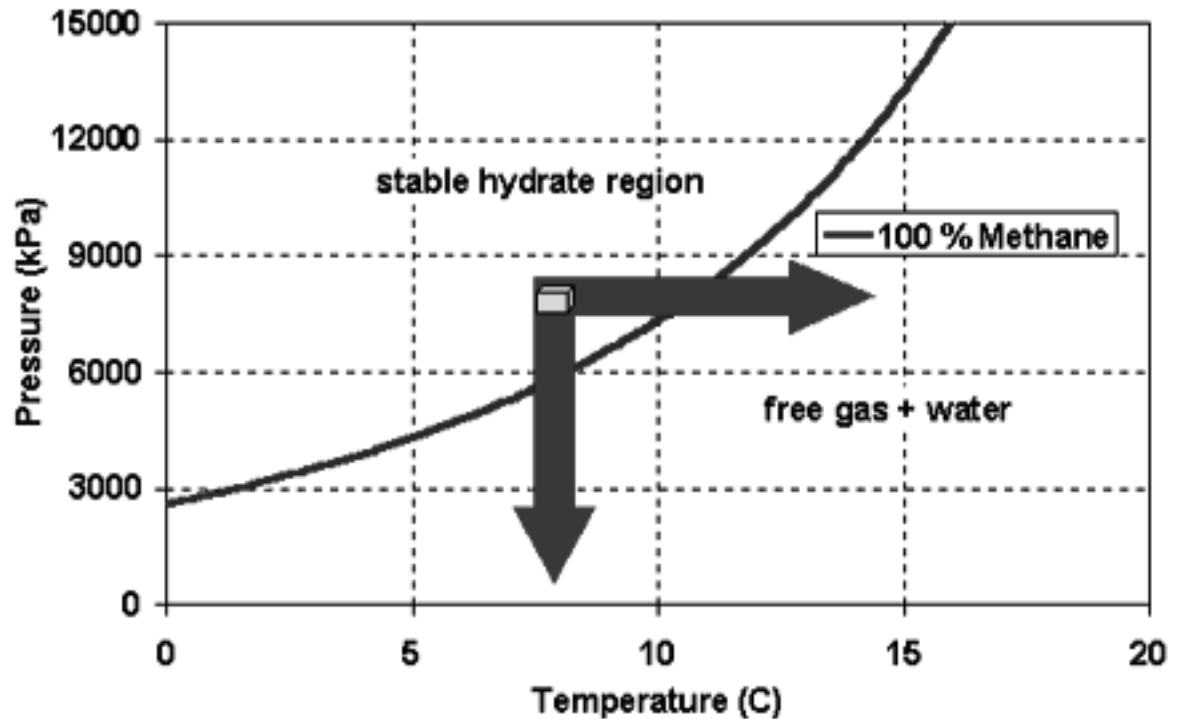


↑  
Hydrate  
Water

1108

# Production Testing

Gas hydrate dissociation induced by pressure and thermal change

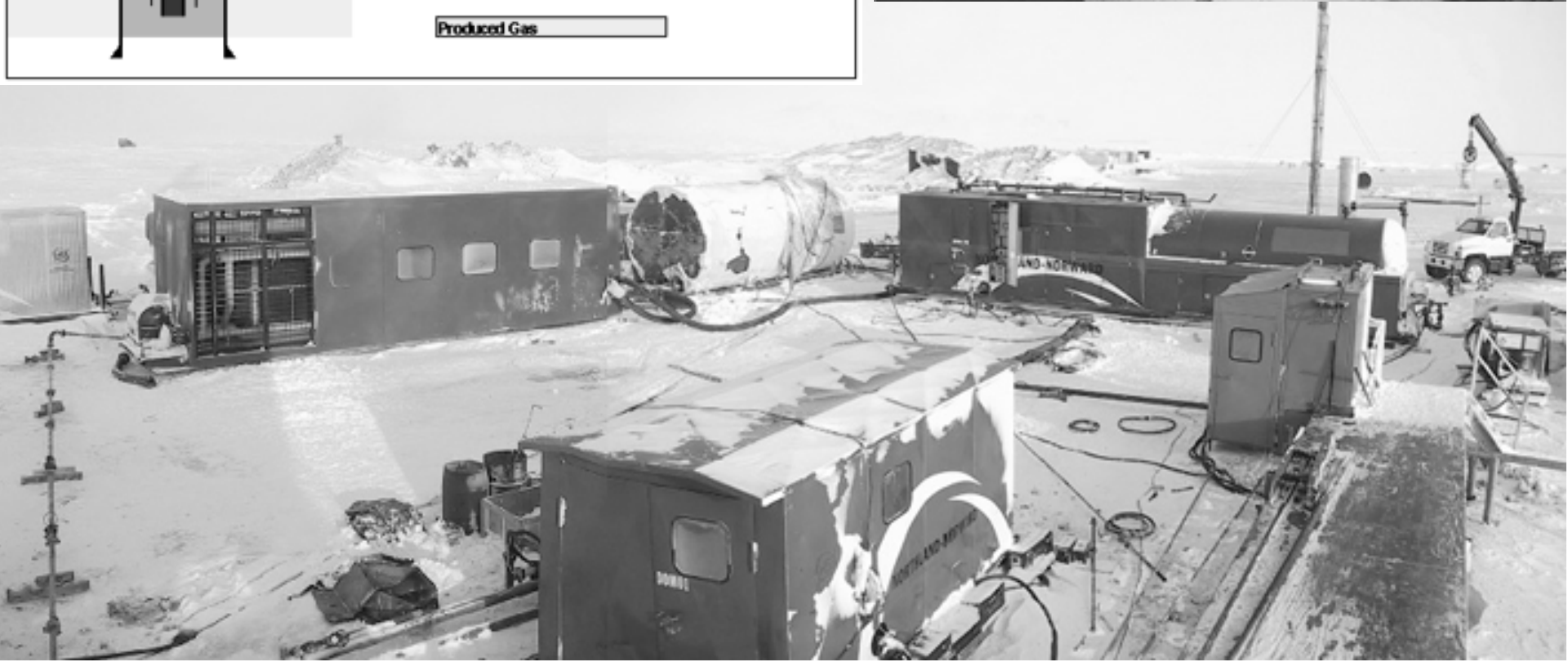
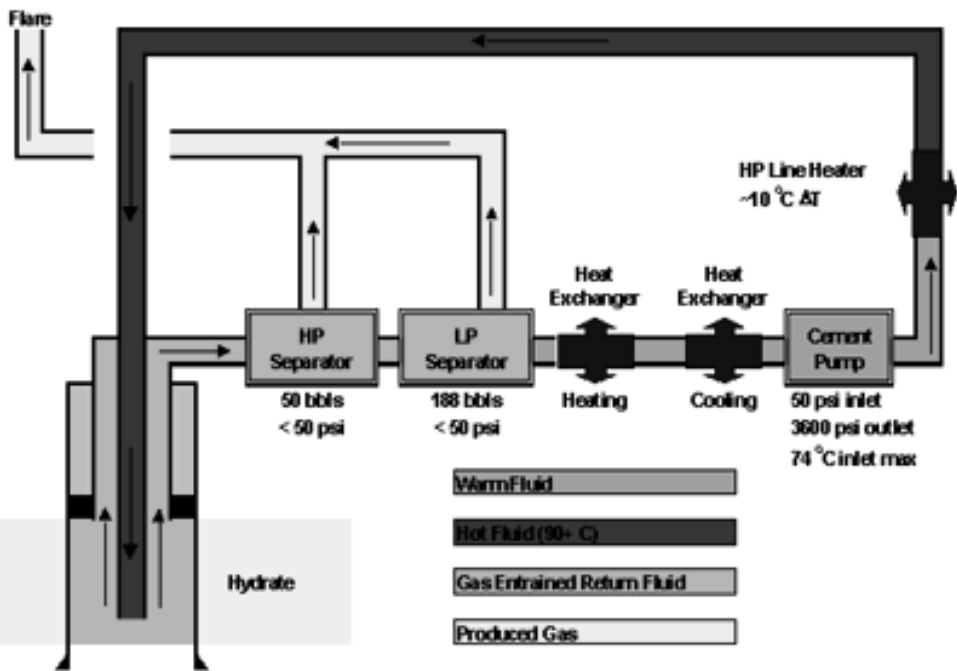


# Production Testing

## Thermal Stimulation Production Testing

- Reservoir response to temperature stimulation
- 13 m test zone with high hydrate saturation











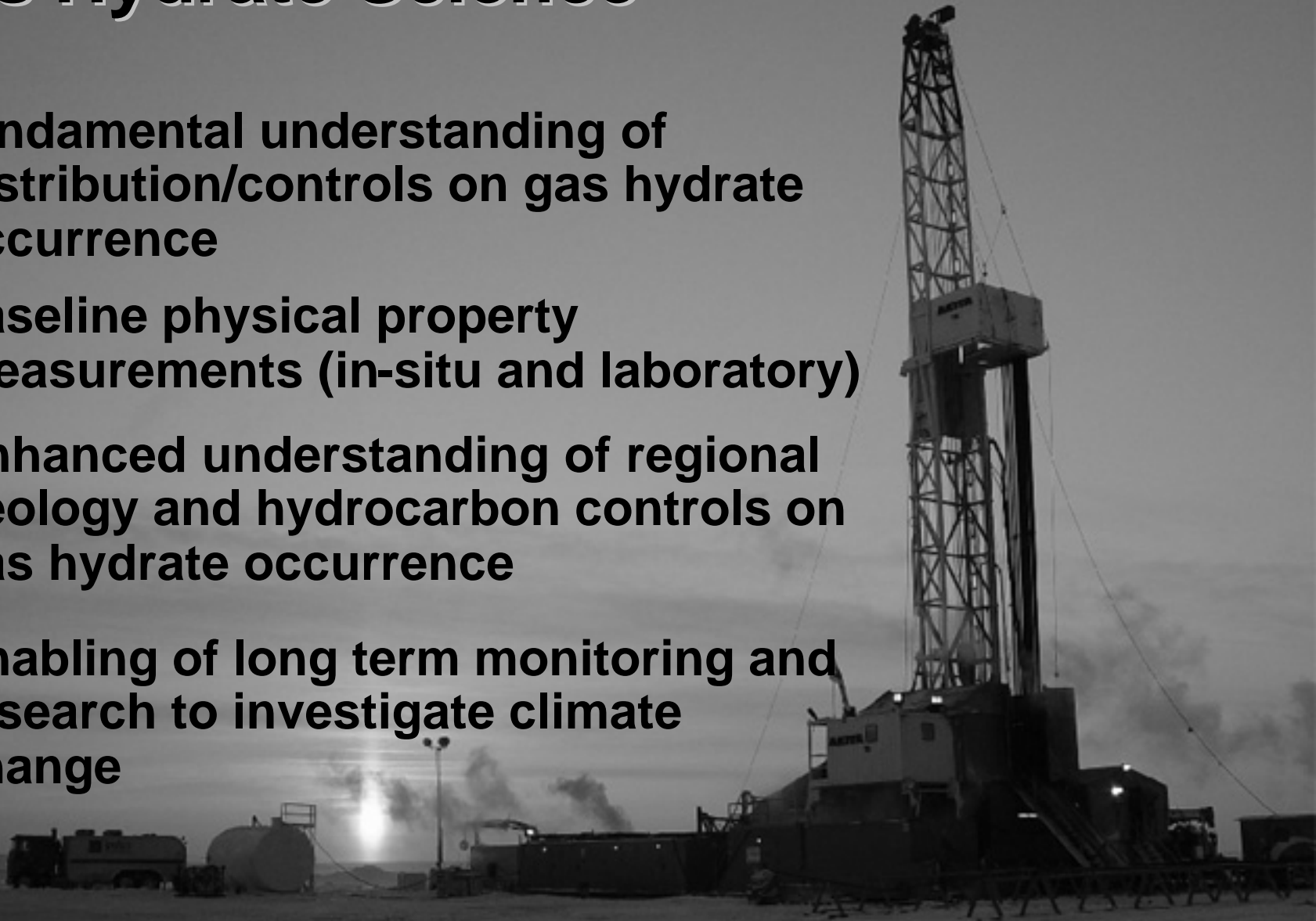
# Gas Hydrate Production



- 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





***From Mallik to the Future  
International Gas Hydrate  
Symposium***

**December 8 to 10, 2003**

**Hotel New Otani Makuhari  
Chiba (Tokyo area), Japan**



Geological Survey of Canada

Bulletin 544

**Scientific Results from  
Mallik 2002 Gas Hydrate Production  
Research Well Program,  
Mackenzie Delta,  
Northwest Territories, Canada**

2004



Natural Resources  
Canada

Ressources naturelles  
Canada

Canada

