CO_2-CH_4 Exchange Field Trial North Slope, Alaska Kickoff Meeting

January 22, 2009

National Energy Technologies Laboratory

Morgantown, West Virginia

Agenda

Introductions & ConocoPhillips Overview	Helen Farrell	10min
Award Status	Robert Miller	15min
Experimental basis for CO_2-CH_4 exchange	James Howard	20min
Field Trial Overview & Status of Initial Deliverables	David Schoderbek	10min
Subtask 2.7: Pioneer #1 Logging While Drilling	David Schoderbek	10min
Site Selection status & Project Timeline	David Schoderbek	15min

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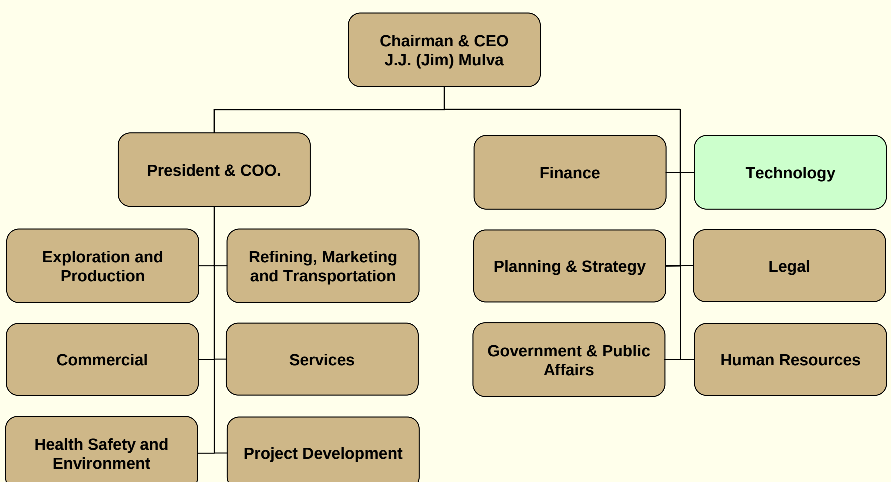
ConocoPhillips

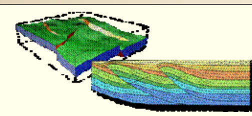


As of 1/January/2009

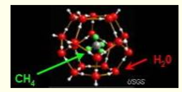
ConocoPhillips
Restricted to ConocoPhillips & NETL/DOE use

The Role of Technology

Improve recovery for conventional resources →



Unlock value in alternative & non-conventional resources →

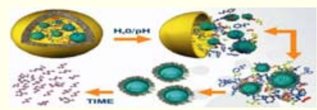


Increase energy efficiency →

Reduce environmental footprint & anticipate new fuel requirements →

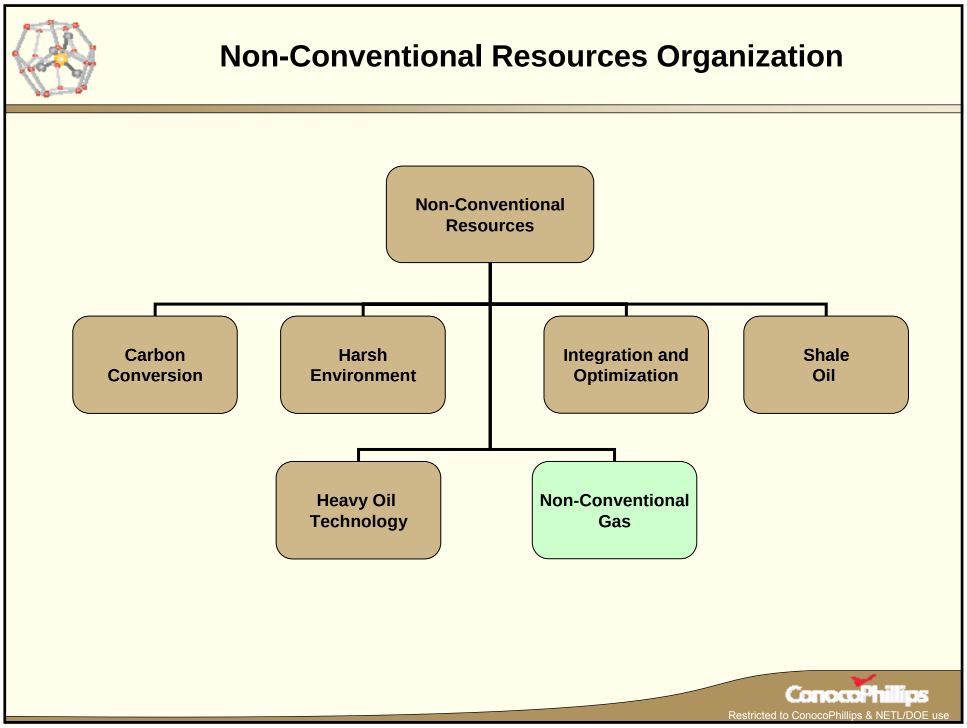
Future innovations →

Nano, Bio, Catalysis



Technology Organization

- **SVP, Technology**
  S. R. (Stephen) Brand
  - Subsurface Technology
  - Non-Conventional Resources
  - Research & Development
  - Biofuels
  - Finance
  - Technology Planning & Strategy
  - Abu Dhabi Technology Center
  - Human Resources
  - Doha Water Sustainability Center


Non-Conventional Resources Organization
Non-Conventional Resources
Carbon Conversion
Harsh Environment
Integration and Optimization
Shale Oil
Heavy Oil Technology
Non-Conventional Gas
ConocoPhillips
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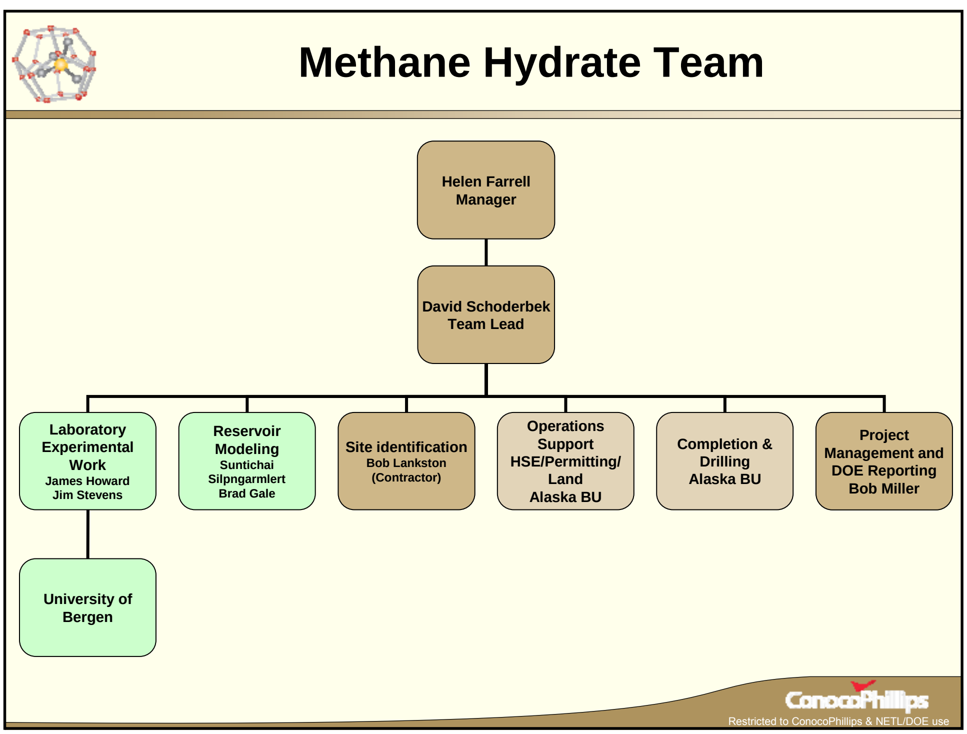
Methane Hydrate Team
Helen Farrell Manager
David Schoderbek Team Lead
Laboratory Experimental Work James Howard Jim Stevens
Reservoir Modeling Suntichai Silpngarmlert Brad Gale
Site identification Bob Lankston (Contractor)
Operations Support HSE/Permitting/ Land Alaska BU
Completion & Drilling Alaska BU
Project Management and DOE Reporting Bob Miller
University of Bergen
ConocoPhillips
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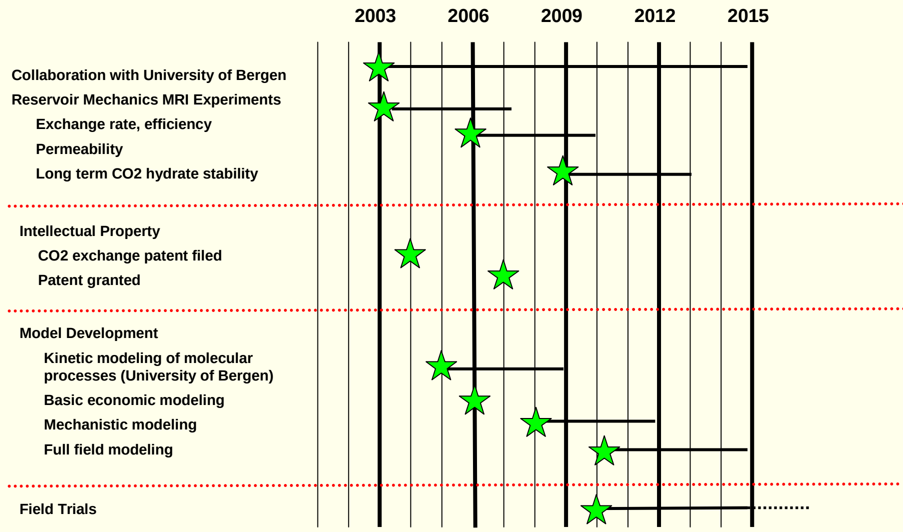
Exchange Technology Development



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Award Status

2008 Activity:

Description	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Proposal Submitted	■						
Notification of Award		■					
Revisions Requested			■				
Revisions Submitted				■			
Notice of Financial Asst. Award				■			
First Contact from DCAA					■		
Limited Rights Draft Submitted					■		
DCAA Visit to COP					■		
Project Management Plan Complete						■	
Petition for Advance Waiver Submitted						■	
DCAA Audit Complete							■

Current Status:

Await NETL Proposal(s) to Resolve Conditional Status

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Natural Gas Hydrates in Lab

Previous Work by Others

- Extensive Fundamental Properties of Bulk Hydrates – Flow Assurance.
- P-T Conditions for Hydrate Formation Well Established.
  - Sand Size Pores ~ Bulk Properties
- Porous Media Studies.
  - CH_4 vs. THF – Inc. Pressure Requirements.
  - Emphasis on Sand Packs.
- Limited Work on Production Scenarios.

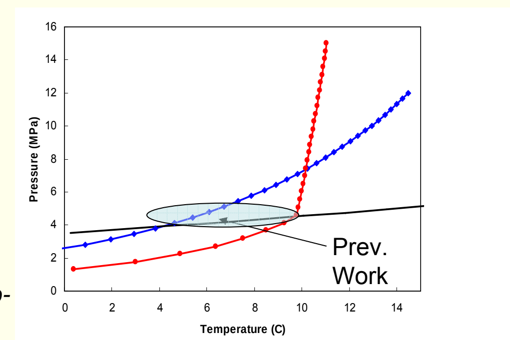
Early Thoughts on CO_2 Exchange

Thermodynamics of CO_2 Exchange Recognized.

Assumptions:

Slow Kinetics (*Based on Bulk, Solids*)

Free Water Released (*Dissociation/Reformation at Macro-Scale*).



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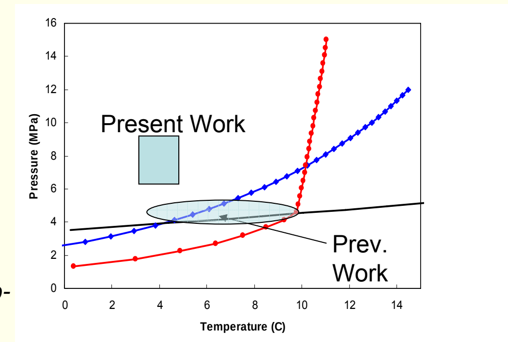
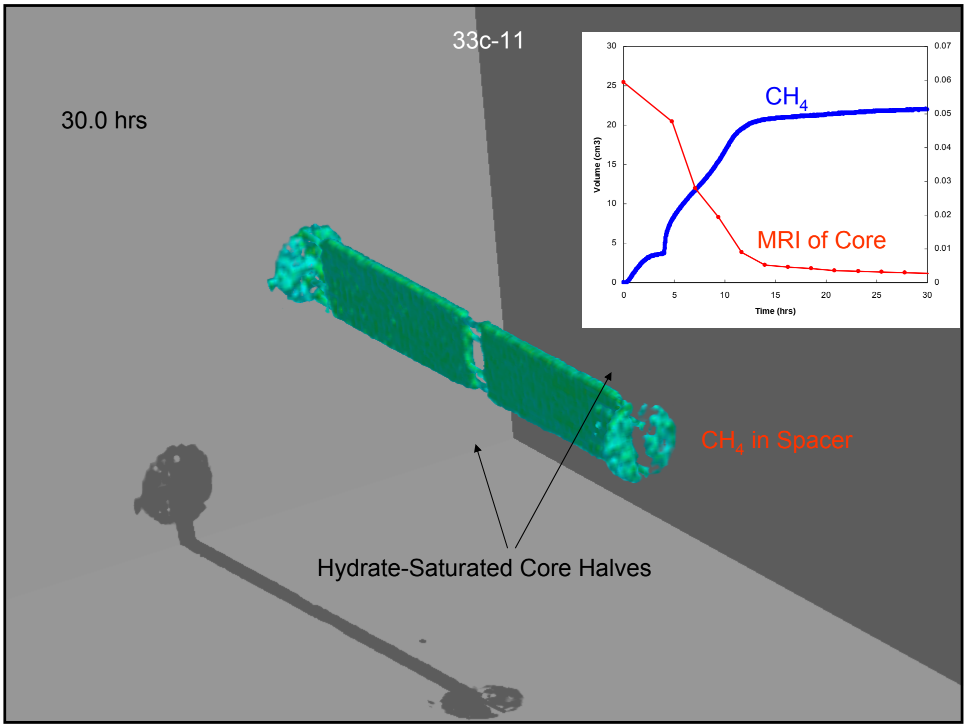


- Current Experiments Run at Elevated T-P Conditions Relative to Earlier CH_4-CO_2 Exchange Studies and Are Comparable to North Slope Reservoir Conditions.

Summary of COP Experiments

- Hydrate Formation – CO_2-CH_4 Exchange and CH_4 Production Experiments Completed at Series of P-T Conditions, Initial Water Saturation and Water Composition.
- Most Experiments Monitored with MRI – Additional Information Beyond PVT.



CH_4 - CO_2 Production Scenario

- Replace CH_4 in Hydrate Structure with CO_2.
- COP Patent **(*US 7,222,673*)** Based on the Absence of Produced Free Water.
- Keys are Understanding of Rates of Exchange and Recovery Efficiency.

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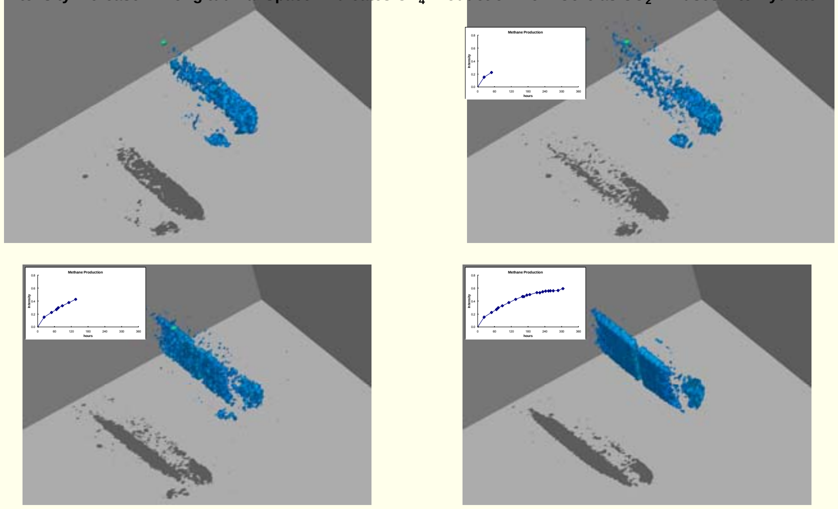
CH_4-CO_2 Exchange

MRI Intensity Increase in Longitudinal Spacer Indicates CH_4 Production from Core as CO_2 Diffuses into Hydrate.



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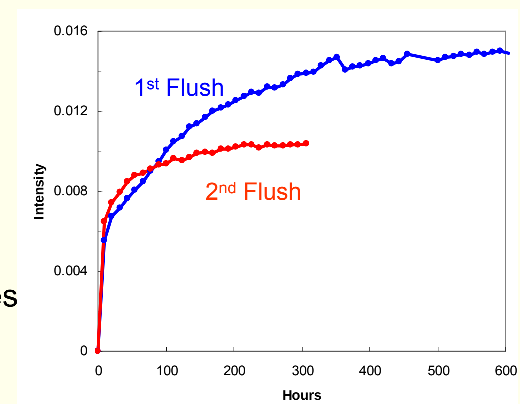
Methane Production

- Monitor MRI Intensity In Spacer.
  - Longitudinal
  - Transverse at Outlet.
- CO_2 "Soak" vs. Active Injection.
- Reproducible Rates.
- CH_4 Recovery Approaches Theoretical Limit.



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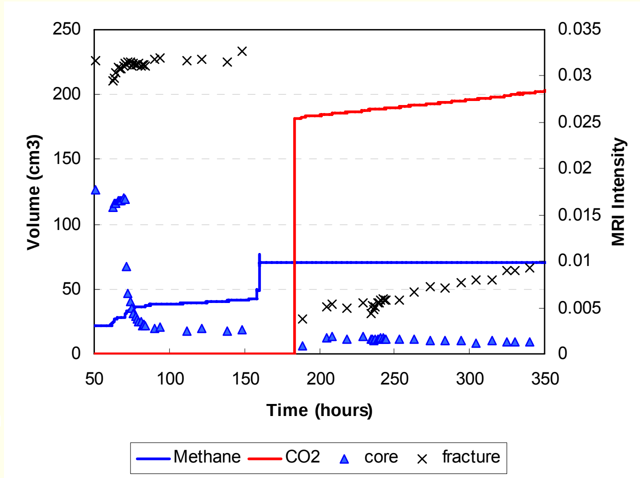
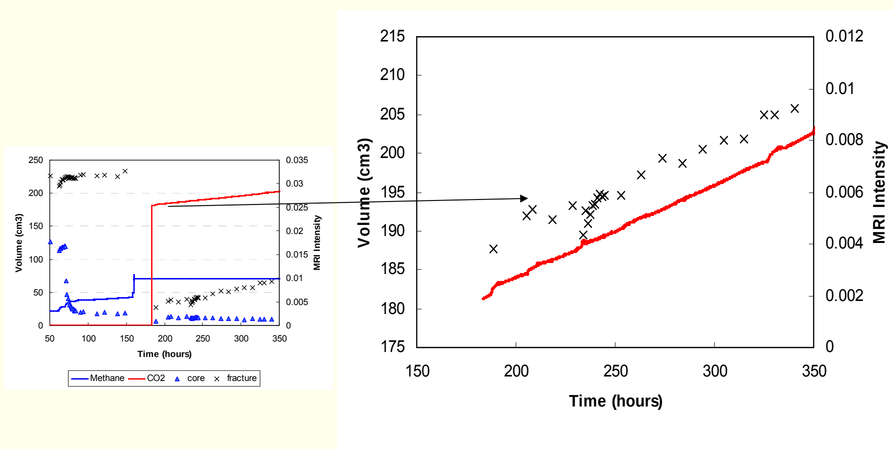
Volumetrics and MRI Results



Methane is Consumed as Core is Cooled and Hydrate Forms in Core (Dec. MRI Intensity. After CO_2 Flush Methane is Produced in Fracture (Inc MRI Intensity) as CO_2 is Consumed. No Change in MRI Intensity in Core.

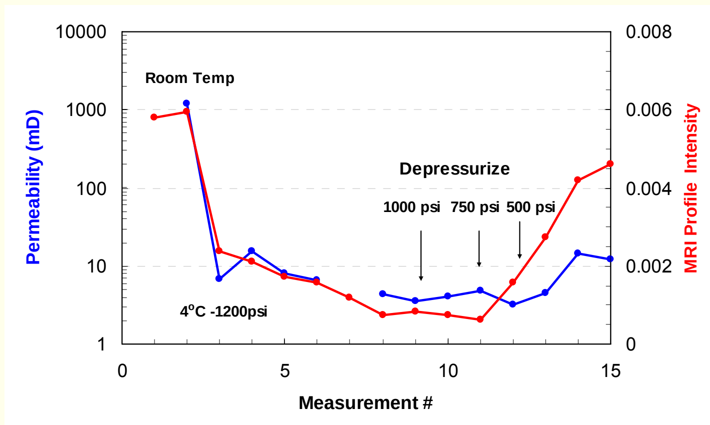
Volumetrics and MRI Results



MRI Intensity in Fracture (CH_4) and CO_2 Volume Consumption

Permeability in Hydrates

- MRI Intensity Loss Indicates Hydrate Formation. Correlates with Permeability Decrease.
- Permeability Remains Constant During CO_2 Exchange.



CO_2-CH_4 Exchange Observations

- Demonstrate that CO_2-CH_4 Exchange Does NOT Involve Free Water.
- Produced CH_4 is Greater Than Free Gas in Pores.
- Mass Balance Calculations Indicate That ~70% of Original CH_4 in Hydrate is Exchanged.
  - *~ Theoretical Limit for Structure I Hydrates.*
- Exchange Rates are Fast.
  - *First-Order Kinetics*
- Permeability Remains Constant During Exchange.

Accomplishments

- Reproducible Hydrate Formation in Sandstone Pores.
  - *Monitor with ΔV_{gas} and MRI.*
- Measure Permeability During Hydrate Formation
  - *K vs. S_{hy} / S_w.*
- Determine CH_4 "Filling Factor" in Formed Hydrates.
  - *~ Theoretical Limit*
- Produced CH_4 from Hydrate Through CO_2 Exchange.

2009 Experiment Goals

Support for Field Trial

- Evaluate Role of Free Water on Hydrate Reformation and Permeability.
- Determine Effect of N_2 Injection on CO_2 Exchange.
- Collect Additional Experimental Depressurization Data for Simulation Model Input / Validation.

COP 2009 Experiments

- CO_2 Injectivity / Permeability in Samples with Free Water (Mt. Elbert Analogue).
- Form Hydrates and Run CO_2 Exchange in Sand Packs – N. Slope Analogue.
- N_2 Injectivity Test – Effect of Diluting CO_2 Stream on Kinetics and Thermodynamics of Exchange Mechanism.

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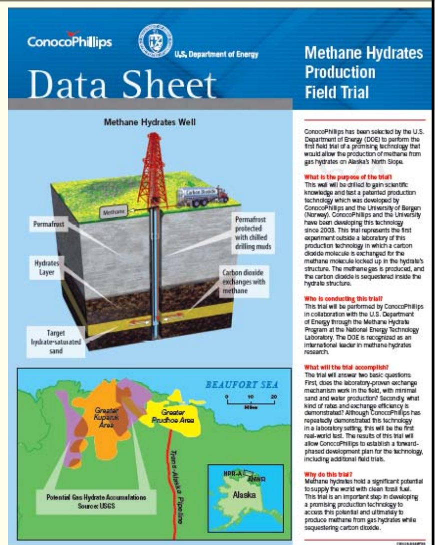
Field Trial Overview

Goal: reservoir-scale trial

Alaska North Slope

CO_2-CH_4 exchange


ConocoPhillips
U.S. Department of Energy
Data Sheet

Methane Hydrates Production Field Trial

ConocoPhillips has been selected by the U.S. Department of Energy (DOE) to perform the first field trial of a promising technology that would allow the production of methane from gas hydrates on Alaska's North Slope.

What is the purpose of the trial?
This well will be drilled to gain scientific knowledge and test a patented production technology which was developed by ConocoPhillips and the University of Bergen (Norway). ConocoPhillips and the University have been developing this technology since 2003. This trial represents the first experiment outside a laboratory of this production technology in which a carbon dioxide molecule is exchanged for the methane molecule locked up in the hydrate's structure. The methane gas is produced, and the carbon dioxide is sequestered inside the hydrate structure.

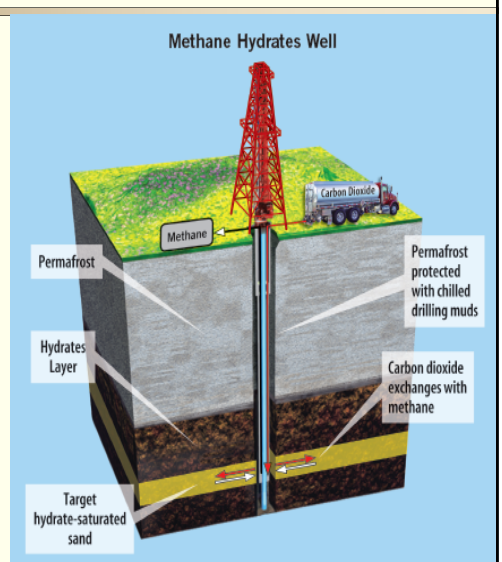
Who is conducting this trial?
This trial will be performed by ConocoPhillips in collaboration with the U.S. Department of Energy through the Methane Hydrate Program at the National Energy Technology Laboratory. The DOE is recognized as an international leader in methane hydrates research.

What will the trial accomplish?
The trial will answer two basic questions. First, does the laboratory-proven exchange mechanism work in the field, with minimal sand and water production? Secondly, what kind of rates and exchange efficiency is demonstrated? Although ConocoPhillips has repeatedly demonstrated this technology in a laboratory setting, this will be the first real-world test. The results of this trial will allow ConocoPhillips to establish a forward-phased development plan for the technology, including additional field trials.

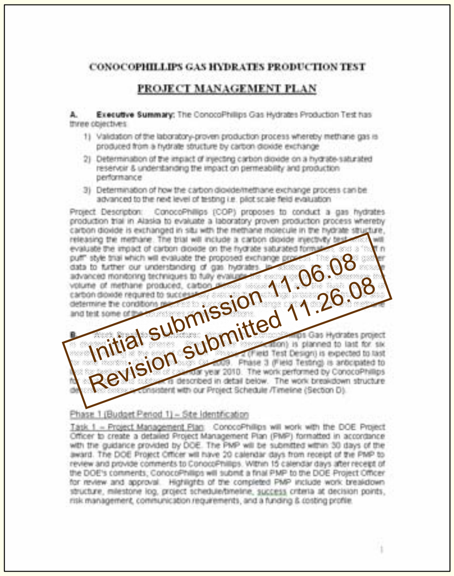
Why do this trial?
Methane hydrates hold a significant potential to supply the world with clean fossil fuel. This trial is an important step in developing a promising production technology to access this potential and ultimately to produce methane from gas hydrates while sequestering carbon dioxide.

Field Trial Overview: Plan

- Existing gravel or ice pad
- Chilled-mud drilling system
- Pre-test formation evaluation (coring/LWD optional)
- Low-temperature casing cementing
- Rigless (coiled tubing) completion
- Perforation & N2 injection to confirm perm
- Downhole real-time monitoring (p & T)
- Injection of CO2 followed by shut-in
- Flowback & metering thru test separator
- Post-test formation evaluation
- Rigless plug & abandon



Status of Initial Deliverables



CONOCOPHILLIPS GAS HYDRATES PRODUCTION TEST

PROJECT MANAGEMENT PLAN

A. **Executive Summary:** The ConocoPhillips Gas Hydrates Production Test has three objectives

1) Validation of the laboratory-proven production process whereby methane gas is produced from a hydrate structure by carbon dioxide exchange
2) Determination of the impact of injecting carbon dioxide on a hydrate-saturated reservoir & understanding the impact on permeability and production performance
3) Determination of how the carbon dioxide/methane exchange process can be advanced to the next level of testing i.e. pilot scale field evaluation

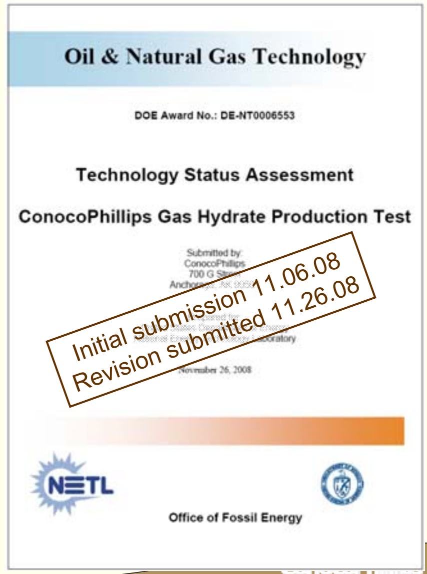
Project Description: ConocoPhillips (COP) proposes to conduct a gas hydrates production trial in Alaska to evaluate a laboratory proven production process whereby carbon dioxide is exchanged in situ with the methane molecule in the hydrate structure, releasing the methane. The trial will include a carbon dioxide injectivity test [illegible] will evaluate the impact of carbon dioxide on the hydrate saturated formation [illegible] puff" style trial which will evaluate the proposed exchange process. [illegible] data to further our understanding of gas hydrates. [illegible] advanced monitoring techniques to fully evaluate [illegible] volume of methane produced, carbon [illegible] carbon dioxide required to success[illegible] determine the conditions [illegible] and test some of the [illegible]

B. [illegible] Gas Hydrates project [illegible] is planned to last for six [illegible] (Field Test Design) is expected to last [illegible] 2009. Phase 3 (Field Testing) is anticipated to [illegible] calendar year 2010. The work performed by ConocoPhillips [illegible] is described in detail below. The work breakdown structure [illegible] consistent with our Project Schedule /Timeline (Section D).

Phase 1 (Budget Period 1) – Site Identification

Task 1 – Project Management Plan: ConocoPhillips will work with the DOE Project Officer to create a detailed Project Management Plan (PMP) formatted in accordance with the guidance provided by DOE. The PMP will be submitted within 30 days of the award. The DOE Project Officer will have 20 calendar days from receipt of the PMP to review and provide comments to ConocoPhillips. Within 15 calendar days after receipt of the DOE's comments, ConocoPhillips will submit a final PMP to the DOE Project Officer for review and approval. Highlights of the completed PMP include work breakdown structure, milestone log, project schedule/timeline, success criteria at decision points, risk management, communication requirements, and a funding & costing profile.

1



Oil & Natural Gas Technology

DOE Award No.: DE-NT0006553

Technology Status Assessment

ConocoPhillips Gas Hydrate Production Test

Submitted by:
ConocoPhillips
700 G Street
Anchorage, AK [illegible]

[illegible] National Energy Technology Laboratory

November 26, 2008

NETL

Office of Fossil Energy

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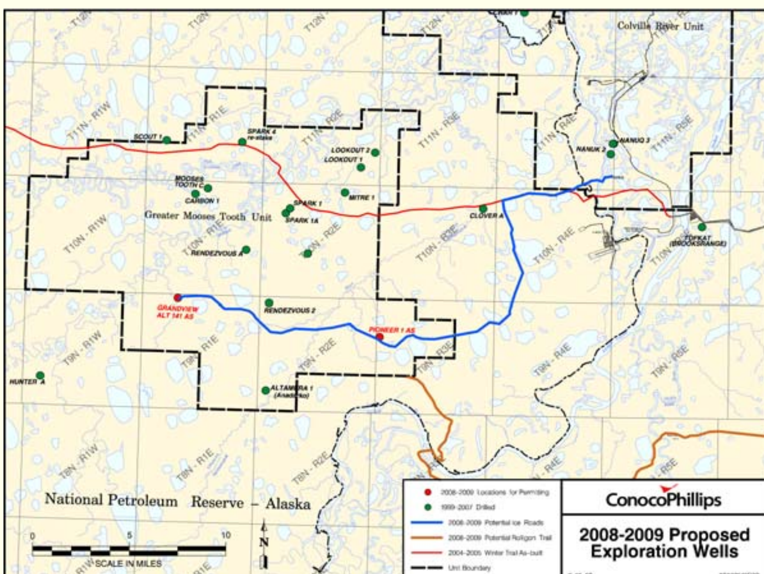
Subtask 2.7: Pioneer #1 Logging While Drilling

Evaluation of Additional Gas Hydrate Identification Technologies

- Q1'09 Pioneer exploratory well in eastern NPR-A
- Acquire LWD log suite (Gamma Ray, Sonic, Resistivity)
- Surface casing to approx 3000ft depth
- Estimated LWD sonic cost: $60k
- Tool charges: $35k
- Data processing: $25k

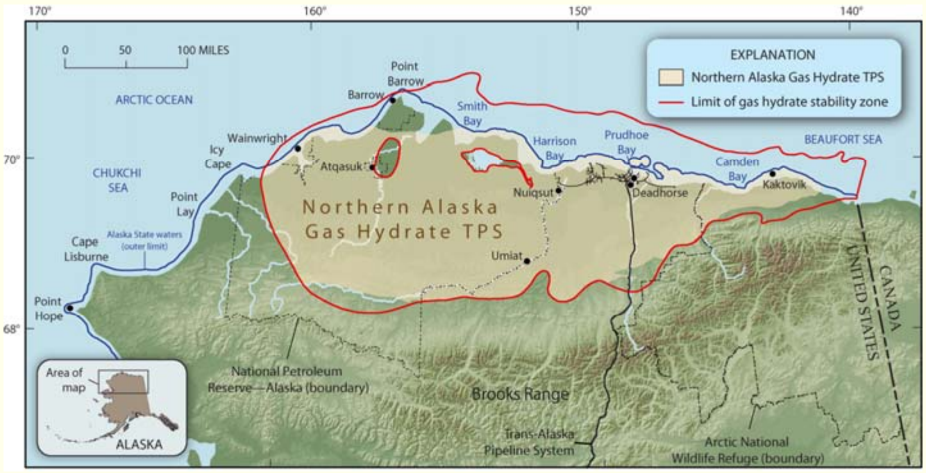
Pioneer #1 Logging While Drilling



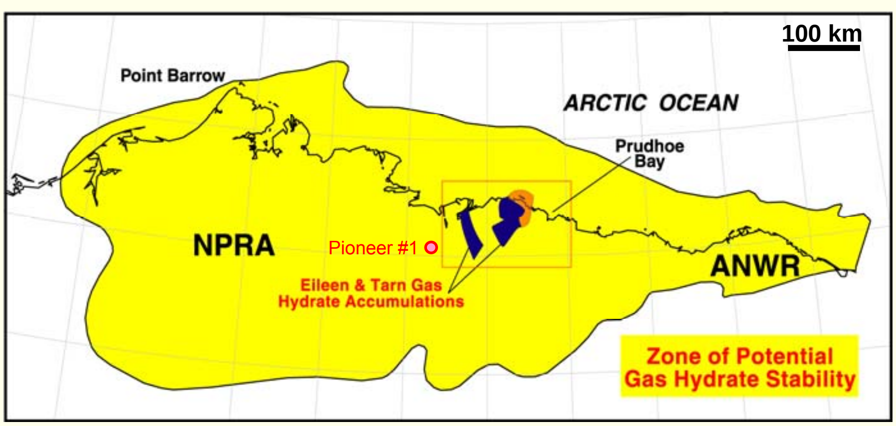
Pioneer #1 ○

25mi WSW of Nuiqsut

USGS Hydrate Petroleum System



USGS Tarn & Eileen Hydrate Accumulations



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Site Selection

- Culled 5700-well database down to 900 wells w/GR/Δt/R_t
- Identified "top 100" plus overlay USGS & in-house studies
- Developing & populating Ranking Matrix

ConocoPhillips

Ranking Criteria

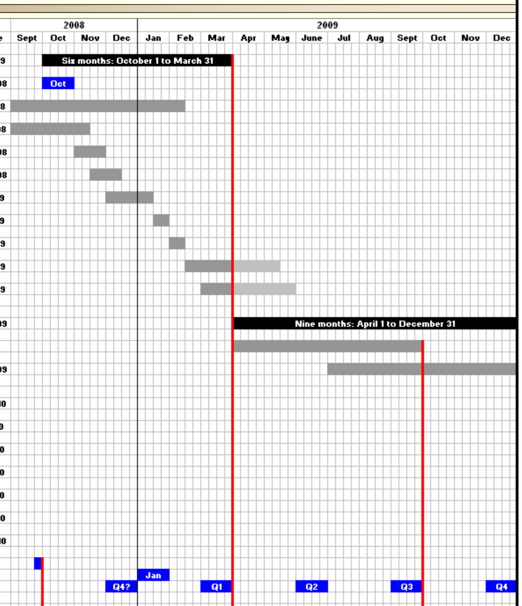
- Hydrate thickness
- Number of sands
- Confidence of occurrence
  - Log coverage
  - Log quality
  - Depth below calc'd PFrost
- Gas hydrate saturation
- Depth/temperature
- Mudlog shows/drilling data
- Seismic quality & character
- Ownership/operatorship
- Access: road & pad
- Historic conventional prod
- Simultaneous Operations

ConocoPhillips

Timeline

ConocoPhillips Gas Hydrate Field Trial: DOE Project Management Plan

	start date	end date
Phase 1: Site Identification	10/1/2008	3/31/2009
Task 1: Project Management Plan	10/1/2008	10/31/2008
Task 2: Site Identification, Evaluation, and Selection	10/1/2008	2/15/2008
Subtask 2.1: Site Identification	10/1/2008	11/15/2008
Subtask 2.2: Identification of Site Ownership Partners	11/1/2008	11/30/2008
Subtask 2.3: Evaluation of Potential Site Ownership Issues	11/15/2008	12/15/2008
Subtask 2.4: Site Evaluation	12/1/2008	1/15/2009
Subtask 2.5: Ranking of Sites	1/15/2009	1/31/2009
Subtask 2.6: Site Selection	2/1/2009	2/15/2009
Task 3: Field Site Ownership Partner Negotiations	2/15/2009	3/31/2009
Task 4: Evaluation of Synergies w/Ongoing DOE-BP Arctic Field Project	3/1/2009	3/31/2009
Phase 2: Field Test Planning	4/1/2009	12/31/2009
Task 5: Detailed Well Planning / Engineering (Production Test Plan)	4/1/2009	9/31/09
Task 6: Pre-Drill Estimation of Reservoir Behavior	7/1/2009	12/31/2009
Phase 3: Field Testing	1/1/2010	12/31/2010
Task 7: Establishment of Test Site Infrastructure	1/1/2010	1/31/2010
Task 8: Drilling of Production Test Well	2/1/2010	3/15/2010
Task 9: Pre-Test Reservoir Characterization (logging)	3/1/2010	3/15/2010
Task 10: Pre-Test Monitoring	3/15/2010	3/31/2010
Task 11: Carbon Dioxide Injection and Gas Production Monitoring	4/1/2010	4/30/2010
Task 12: Post-Injection Monitoring & Evaluation	5/1/2010	12/31/2010
DOE AWARD: Sept 30		
DOE Kickoff Meeting (Morgantown)		
Quarterly Reporting to DOE		
CRITICAL PATH MILESTONES		



Tasks Underway

- Site selection/Laboratory experimentation
- Reservoir Simulation code validation
  - depressurization & CO_2-CH_4 exchange
- Cyclic CO_2 injection/CH_4 flowback test design
- ID & evaluate synergies w/BP-DOE project

Thank you for your attention

Questions?