



Natural Gas Hydrates: Technology Development, Opportunities and Challenges

Alaska Hydrate Planning Workshop
Anchorage, Alaska
August 17, 2005

Outline

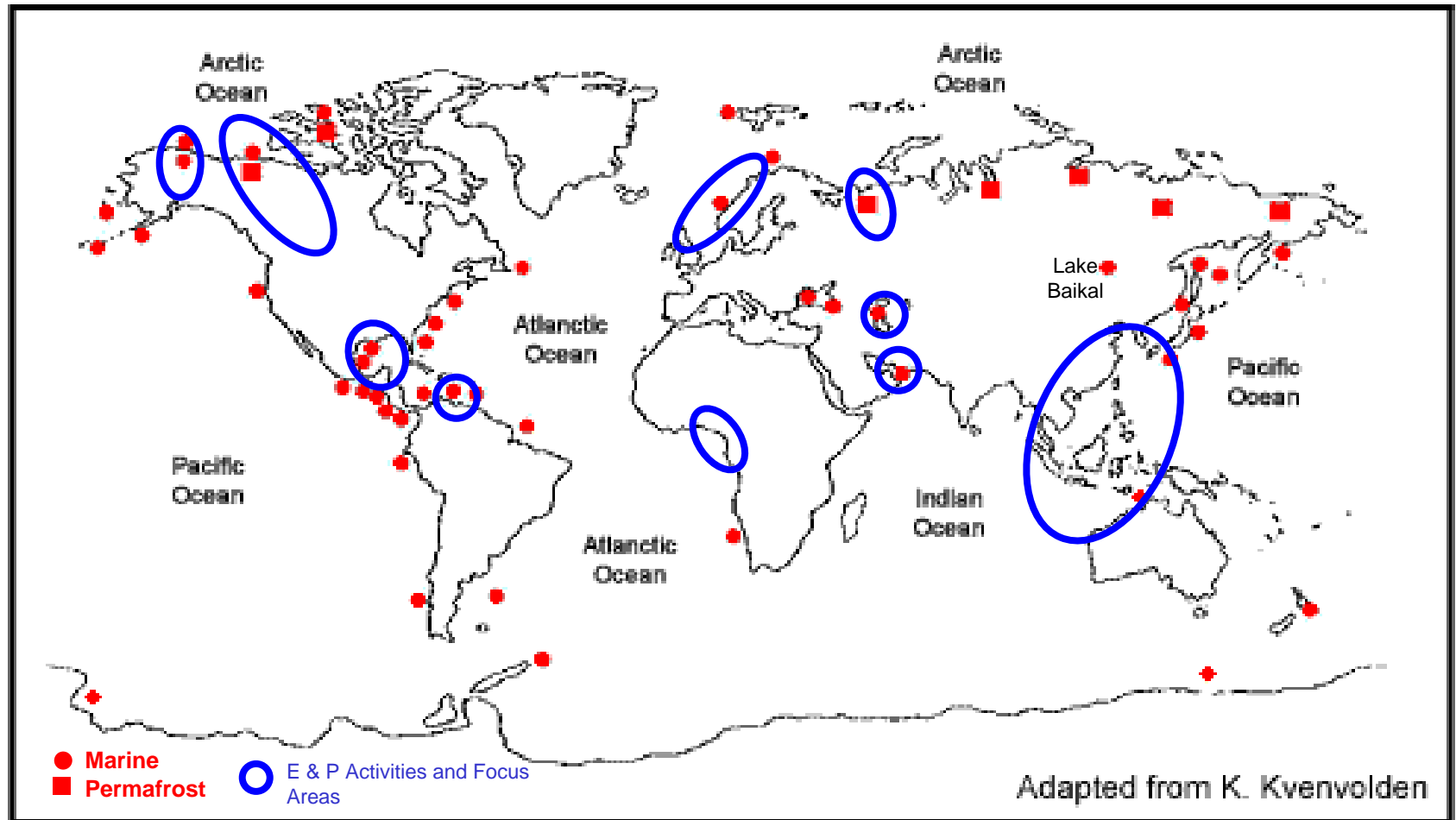
- **Strategic Fit**
- **Technology Development**
- **Key Challenges**
- **Future**

Upstream Strategy



- **Become a major supplier of global gas to key markets**
North America & Asia
- **Maintain leadership position in heavy oil**
- **Develop competitive positions in giant reserve basins**
- **Optimize legacy assets**

Known or Inferred Hydrate Occurrences



Emerging Technology

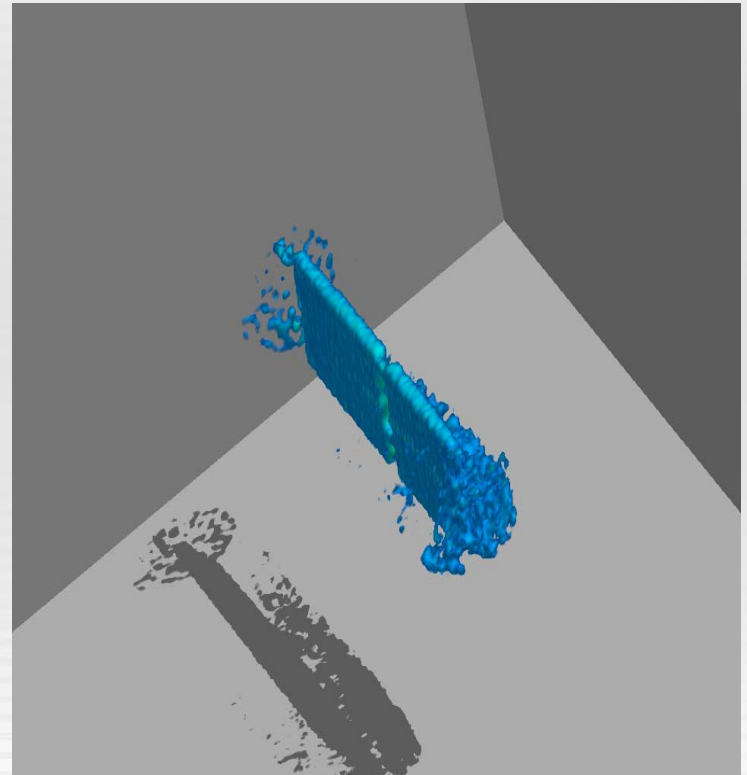
- Themes
 - Increase profits from hydrocarbons
 - Extend the longevity of hydrocarbons
 - Position ConocoPhillips for an alternative future
- Methane recovery from gas hydrates
 - Expand resource potential
 - Sequester greenhouse gas (CO₂)

Gas Hydrate Technology Development

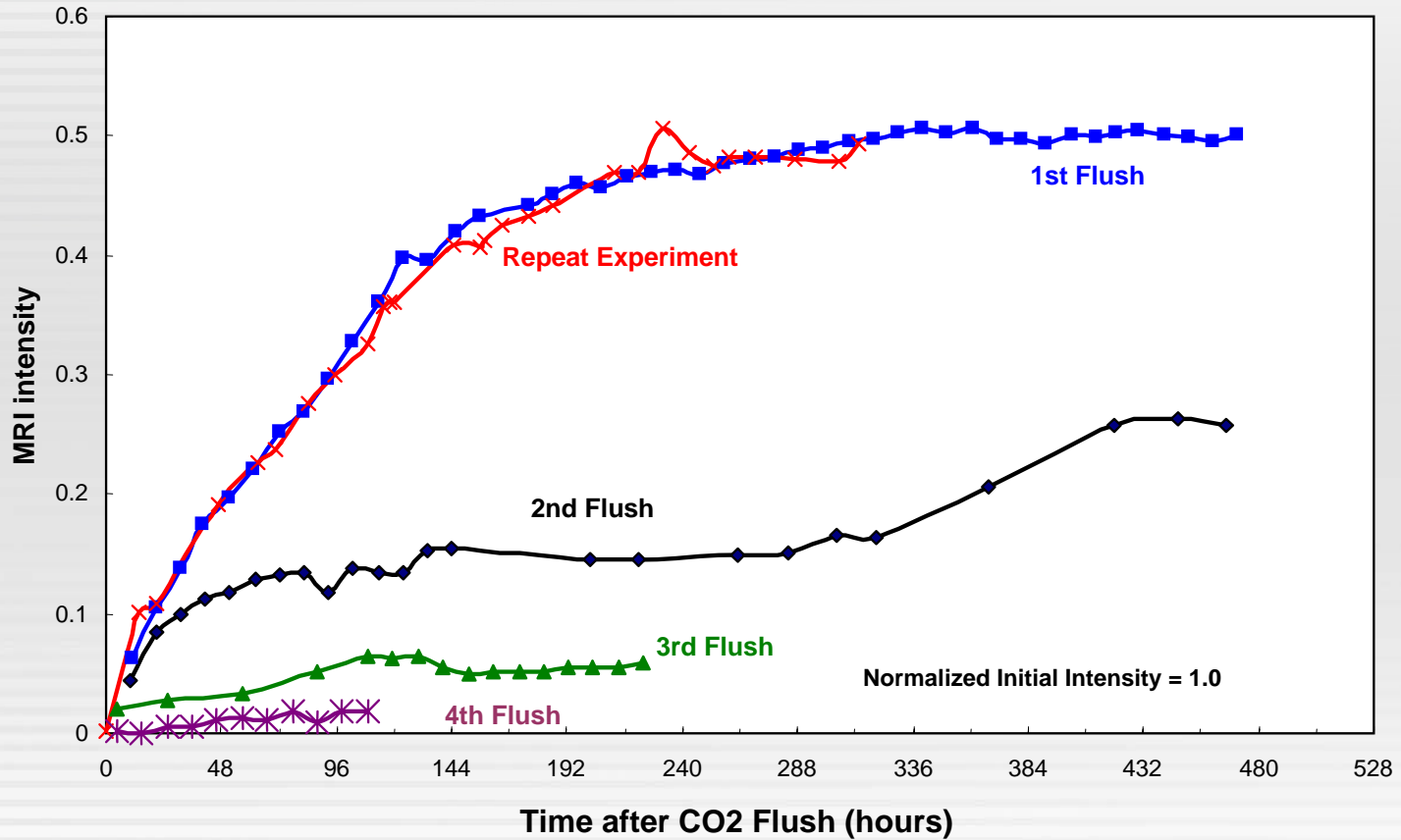
- Focus:
 - Laboratory experiments
 - CO₂-CH₄ exchange
 - Mechanistic and reservoir modeling of recovery processes

Summary of COP Lab Results

- Formation and measurement of gas hydrate in the core at variable initial conditions.
 - Confirmed repeatability
- Demonstrated ability to monitor with MRI CH_4 production during CO_2 injection.
 - No evidence of melting
 - Finite gas permeability observed throughout the core
 - Rate and mass balance information obtained for reservoir models



Characteristic CH₄ Production



Objectives of Numerical Simulation

- Quantify and evaluate field-scale gas production from the CO₂ - Hydrate exchange process.
- Determine sensitivity of process to key variables
- Provide design and operations guidance for a pilot study phase.

Characterization Issues w.r.t Simulation

- Shortage of reliable experimental data for parameters needed in hydrate production model simulations.
 - Kinetics and thermodynamics
 - Rate of CO_2 - CH_4 Exchange in Hydrate
 - Fluid flow
 - How Much CH_4 in Gas Hydrate
 - Controls on CH_4 Production
 - Heat transfer

Technology Development Path Forward

- Expand series of experiments to broaden understanding of exchange mechanism, rates and efficiency
- Calibrate reservoir simulation tools with lab results, scaling to field-scale
- Establish technical feasibility of pilot

Key Challenges

- Developing a recovery scheme compatible with a permafrost environment
- Continuity of resource (i.e., effective net pay)
- Demonstration of commercial rates
- Development with a limited infrastructure footprint
- Drilling and completion (stimulation) technology development
- Economic competitiveness with conventional resources

Future

- Vast resource potential
- Considerable technology development is required
- Economic viability may take many years
 - Delineation
 - Piloting
 - Infrastructure and market timing
- Taking a paced approach