Gas Hydrate: Future Ocean Resource

United Nations Open-ended Consultative Process on Law of the Sea – 2004

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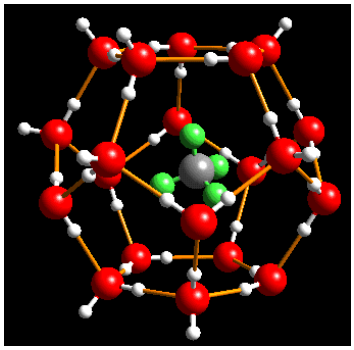
Introduction to Gas Hydrates

- **What are they and how are they formed?**
- **Where are they found?**
- **How much may exist?**
- **Why hydrate is significant**
  - Energy Resource
  - Seafloor Stability
  - Specialized Biota
  - Global Climate Change
  - Fresh Water
- **Next Steps**

What is Gas Hydrate?

Hydrate is a crystalline solid consisting of gas molecules, usually methane, each surrounded by a cage of water molecules

Each volume of hydrate contains up to 160 volumes of methane (natural gas)



Where does the gas come from?

Biogenic Hydrate ~99 %

Microbial activity in the upper several hundred meters of shelf sediment

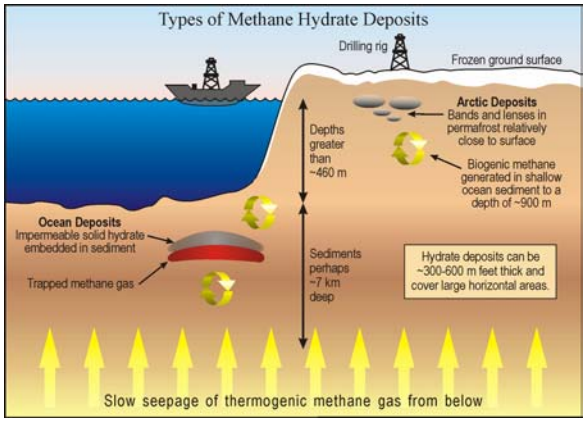
Thermogenic Hydrate

Thermal breakdown of organic material at greater depths, similar to conventional oil and gas.

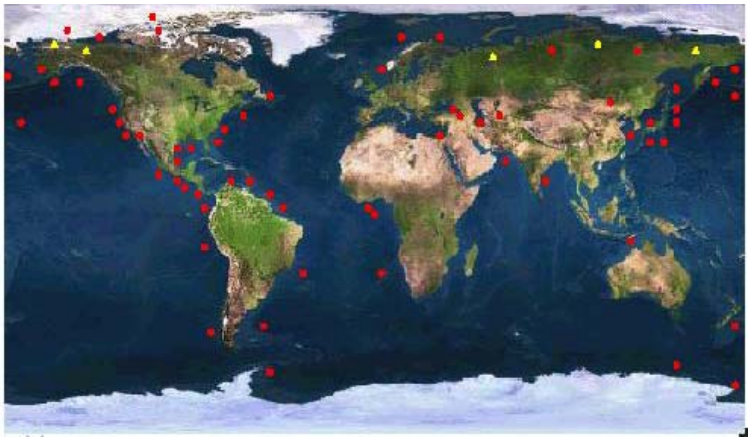
Where does gas hydrate exist?

Where gas and water are present at:

- Moderately low temperatures and Moderately high pressures



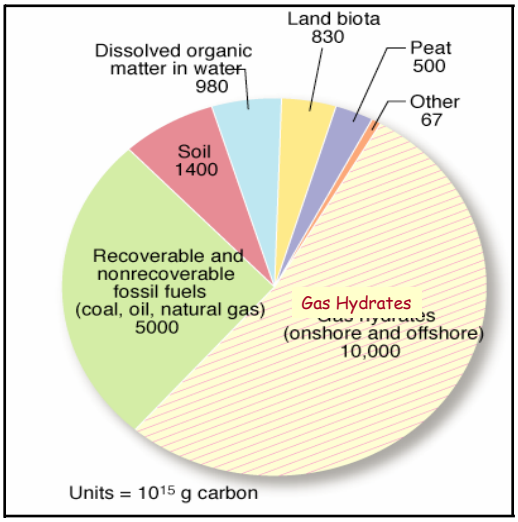
Where are hydrates found on Earth?



Hydrate forms on continental shelves and in the arctic

How much may exist?

Hydrate binds immense amounts of methane in sediments.



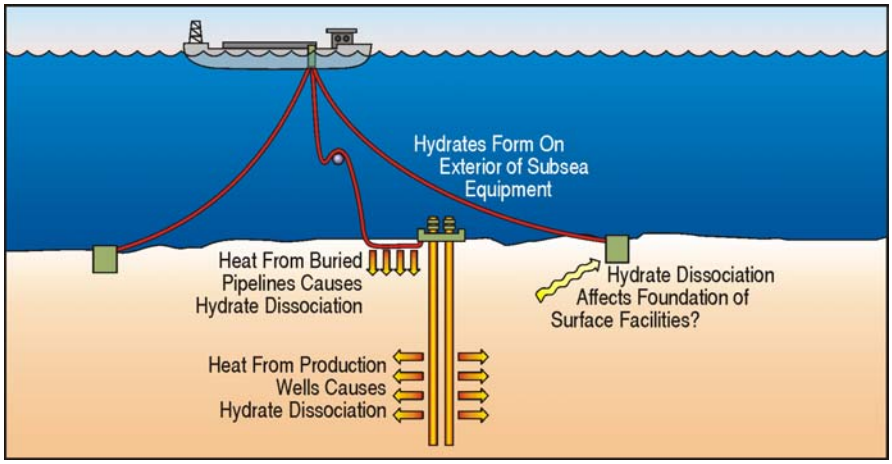
Methane Production from Hydrate
Mackenzie Delta, Canada
Mallik Production Experiment 2002

Well tests prove for the first time that gas production from hydrate is technically feasible

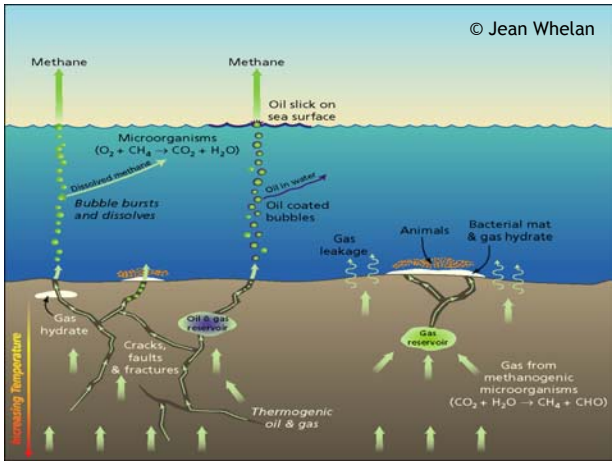
Gas hydrate melted and methane released by heating and/or depressurizing the reservoir

Participants:
Canada, Japan, USA, Germany, India, and ICSDP
International Continental Scientific Drilling Program

Hydrates as a Hazard



Hydrate and Global Climate Change



- Methane is a powerful greenhouse gas
- Hydrates sequester methane in the subsurface
- Hydrate may release methane to the ocean and atmosphere
- Massive releases of methane from hydrates may have occurred in the geologic past

Unique Biological Communities at Hydrate Mounds and Methane Seeps

Community on a hydrate mound.

Mussels at Blake Ridge - the size of American footballs

Multi-national Research

- Demonstrated the feasibility of methane production from hydrate deposits
- Japan, US, Canada, India, EU and others are developing the technology needed for commercial production of methane from hydrate by 2015

  and understanding the role of hydrate deposits in global climate change and seafloor stability

Hydrate as a Fresh Water Resource

- Each volume of gas hydrate contains 0.8 volumes of fresh water
- Massive marine hydrate formations may contain some solids, such as diatoms and clay that would need to be filtered from produced water
- Salts may be trapped in the formations adjacent to hydrates, remixing salts into water during production.

Application of Hydrate for Desalination

- Current technology includes reverse osmosis or distillation
- Worldwide desalination capacity is over 6 billion gallons per day
- Gas Hydrate desalination is being investigated – may have lower energy requirements than other technologies
  - Gas mixed with saline water at depths >100 meters forms hydrate which rises buoyantly. It then separates into fresh water and gas, which can be recycled.

Next Steps

- International Methane Hydrate Research Consortium organizational meeting October 6-7, 2004, San Francisco, California
- U.S. welcomes participation of other Nations in our projects and makes research data publicly available
- For additional information see handout

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