



the **ENERGY** lab

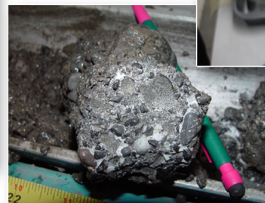
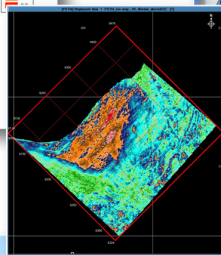
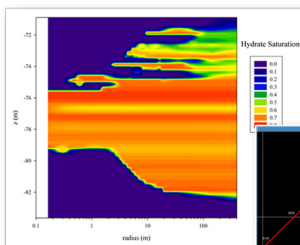
PROGRAM FACTS

Strategic Center for
Natural Gas & Oil

Methane Hydrates R&D Program: Today and Tomorrow

Gas hydrates are a naturally-occurring combination of methane gas and water that form under specific conditions of low temperature and high pressure. Once thought to be rare in nature, gas hydrates are now known to occur in great abundance in association with arctic permafrost and in the shallow sediments of the deep-water continental shelves. The most recent estimates of gas hydrate abundance suggest that they contain perhaps more organic carbon than all the world's oil, gas, and coal combined.

The primary mission of the Methane Hydrates Program is to advance the scientific understanding of gas hydrates as they occur in nature such that their full resource potential can be fully understood and realized. In pursuit of this primary mission, the program is pursuing three parallel paths. The first path is to confirm the scale and nature of the potentially recoverable resource through drilling and coring programs. The second is to develop the technologies to safely and efficiently find, characterize, and recover methane from hydrates through a combination of field testing, numerical simulation, and controlled laboratory experimentation. The third is to better understand gas hydrate's role in the natural environment, including its linkages to global climate change.



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U.S. DEPARTMENT OF
ENERGY

The Issues

It was only recently that gas hydrates were recognized to exist at a massive scale in the natural environment. This finding leads to a number of important scientific issues:

- Gas hydrates are potentially a source of significant supplies of methane gas for meeting future energy needs. Large resources are available in Alaska (the Department of Interior's US Geological Survey (USGS) in 2008 reported a mean estimate of 85 trillion cubic feet or more, technically recoverable) that can have real implications for native communities, can broaden U.S. gas supplies, and enable access to other Arctic resources—including viscous oil and stranded conventional gas. In the Gulf of Mexico, marine in-place gas hydrate resources in the most favorable reservoir settings have recently been assessed by the Department of the Interior's Minerals Management Service (MMS) at more than 6,000 trillion cubic feet.
- International interest and investment is high, as gas hydrates have the promise of providing supplemental energy resources to a number of critical and growing economies that are largely and increasingly reliant on energy imports.
- The role of gas hydrates in mediating the movement of carbon in the geosphere is not well known but could have major implications on both long- and short-term environmental processes, particularly climate change. This issue is most acute in Arctic regions where climate change is most pronounced and where gas hydrate deposits are common and least effectively buffered from environmental change.

- Unintended dissociation of gas hydrates while drilling to, or producing from, deeper targets can threaten the integrity of wells and destabilize surface structures. To address these hazards, industry has historically opted for simple avoidance, and only recently has this issue begun to be studied.

The need for scientific data collection and technology development is being driven by the following:

- Resource volumes, particularly those resources in the marine setting that are the most prospective for production, remain poorly defined. Large areas of the U.S. outer continental shelf are virtually unexplored, with only a handful of wells having been drilled for hydrate evaluation in the Gulf of Mexico and the Pacific and Atlantic seaboard.
- The commercial viability of gas hydrate reservoirs is not yet known. Only a very limited number of production tests have been conducted to date, though these have shown positive results. A series of long-term, scientific production test wells, leading to commercial-scale multi-well demonstrations, are needed to determine the rates and volumes at which methane can be extracted, and to assess the potential environmental impacts.
- Multiple gas hydrate production scenarios are under evaluation. Simple depressurization seems to hold the most promise in terms of potential rates; however, methane production via carbon dioxide (CO₂) injection (and sequestration) has shown great potential in the lab and requires evaluation at a field scale.

INTERAGENCY COORDINATION TEAM

DOE-NETL

U.S. Geological Survey

Minerals Management Service

National Oceanic & Atmospheric Administration

Naval Research Laboratory

Bureau of Land Management

National Science Foundation

RELEVANT LINKS

NETL home page: [http://www.netl.doe.gov/methane hydrates](http://www.netl.doe.gov/methane%20hydrates)

Fire in the Ice: A quarterly publication highlighting the National Methane Hydrate R&D Program

<http://www.netl.doe.gov/technologies/oil-gas/FutureSupply/MethaneHydrates/newsletter/newsletter.htm>

FE web page: <http://www.fe.doe.gov/programs/oilgas/hydrates/index.html>



- The environmental impacts of potential gas hydrate production scenarios (such as movement of liberated methane and geomechanical stability of produced reservoirs) must be closely studied in the lab through modeling and by being closely monitored during field tests
- A need for a fuller understanding of gas hydrate's role in the potential release of methane (a powerful greenhouse gas) into the natural environment, including its impacts on the health of the oceans and as a potential near-term feedback to climate change.

Project Portfolio Overview

Over the last two years, 34 different projects under the Methane Hydrates Program have received funding. The efforts represent a total potential value of roughly \$141 million, including both government and non-government costs. The bulk of the funding supports large field programs being conducted through partnerships with industry and academia and comes directly through cooperative agreements and supporting work enabled by agreements with DOE's national laboratories and other federal agencies. A 2010 review of the gas hydrate program, conducted by the National Research Council, can be found at http://www.nap.edu/catalog.php?record_id=12831.

Investigations of the production potential of gas hydrates are currently utilizing the natural laboratory of the North Slope of Alaska to pursue a range of field test options. The current portfolio includes the following:

- BP Exploration Alaska is continuing to pursue options to conduct a long-term scientific test of the response of gas hydrate systems to depressurization in the Prudhoe Bay region of Alaska. Previous work conducted at the Mount Elbert site in the Milne Point unit in 2007 has

successfully demonstrated arctic gas hydrate assessment technologies, provided critical reservoir data that enable advances in international modeling capabilities, and confirmed that methane can be produced from gas hydrates via depressurization.

- ConocoPhillips will conduct a field trial in the Prudhoe Bay region to assess the potential for injecting CO₂ into a gas hydrate reservoir where it will be sequestered while releasing the methane (CH₄) for use as an energy resource.

Investigations of the nature and occurrence of marine gas hydrate resources include the following:

- Chevron, through its leadership of an international industry consortium (Joint Industry Partnership), is conducting field and lab studies to assess gas hydrate occurrence in the Gulf of Mexico. A 2005 expedition provided major advances in gas hydrate remote detection and an analysis of drilling hazards. A 2009 expedition confirmed gas hydrate prospecting methodologies, provided initial validation of very promising Department of Interior gas hydrate resource estimates, and confirmed the existence of resource-quality gas hydrate accumulations in the Gulf of Mexico. A FY 2012 expedition to collect and gather scientific measurements on cores held under natural pressure conditions is being planned.
- Scripps Institute of Oceanography is advancing the science of controlled-source electromagnetic imaging to complement existing seismic technologies in the remote detection and characterization of gas hydrate occurrences.
- Bilateral agreements with Korea, India, Japan, and potentially others have enabled DOE participation in international field studies of gas hydrates, in India (2006), China (2007), and Korea (2007 and 2010).



