Fall 2001

Fire in the Ice

THE NATIONAL ENERGY TECHNOLOGY LABORATORY METHANE HYDRATE NEWSLETTER

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INTENT

Fire in the Ice is published by the National Energy Technology Laboratory to promote the exchange of information among those involved in the research and development of gas hydrates as a resource.

WELCOME TO THE *FIRE IN THE ICE* NEWSLETTER!

Brad Tomer

This is the first issue of a periodic newsletter from the Strategic Center for Natural Gas (SCNG) at the National Energy Technology Laboratory (NETL). In it, we hope to convey information about the latest developments in DOE's methane hydrate research and development program. By sharing information about ongoing research on methane hydrate, we hope to advance the state of knowledge on hydrate-related issues. At the SCNG, we have just concluded two of our most interesting years in hydrate research to date. For example, in May of 2000, the Methane Hydrate Research and Development Act of 2000 was signed into law establishing a National Methane Hydrate R&D Program. In August 2000, SCNG and the Chevron Petroleum Technology Company hosted a Gulf of Mexico Hydrates R&D workshop in Houston, which resulted in a path forward and led to a significant increase in industry participation and interest in the program.

We are looking forward to another exciting year ahead. This issue highlights significant new research initiatives that the SCNG has with industry, academia, and other national laboratories. In addition, this issue introduces the new methane hydrate R&D website. The site is a repository of information dealing with methane hydrate issues and will foster communication among partnering organizations and others involved in methane hydrate research and development. We invite you to visit the website at www.netl.doe.gov/scng/hydrate.

In future issues, we plan to do special feature articles on current research efforts, including spotlights on the scientists involved. This will keep you up-to-date on current developments and introduce you to the ideas of those working in the area of methane hydrate research.

We invite comments and suggestions about this quarterly newsletter to make it more useful for you. We also welcome short summaries of your research so that we may include it in the newsletter.

Please note that each article includes a point of contact to obtain more information about a specific product or narrative. If you have general questions about the hydrate program, you may contact Brad Tomer, Product Manager, Gas Exploration, Production and Storage. Thank you for your time and contribution to the program. We hope you find the newsletter useful and we look forward to hearing from you in the future.

SIX INDUSTRY/ ACADEMIA PROPOSALS

SCNG Begins Fiscal Year 2002 with Significant New Hydrate Research and Development Projects

In Fiscal Year 2001, SCNG asked industry, academia, and other national labs to provide proposals in the area of methane hydrate research in two separate solicitations. As a result, we selected six industry/academia proposals and five national laboratory proposals.

Industry Takes Lead in Methane Hydrate Research

The industry/academia solicitation was the larger of the two solicitations. The six selected projects, which will help bring methane hydrate into the natural gas resource base and ensure safe drilling operations, are valued at $48 million. The majority of the work will be conducted in the Gulf of Mexico and the Alaska Northern Slope.

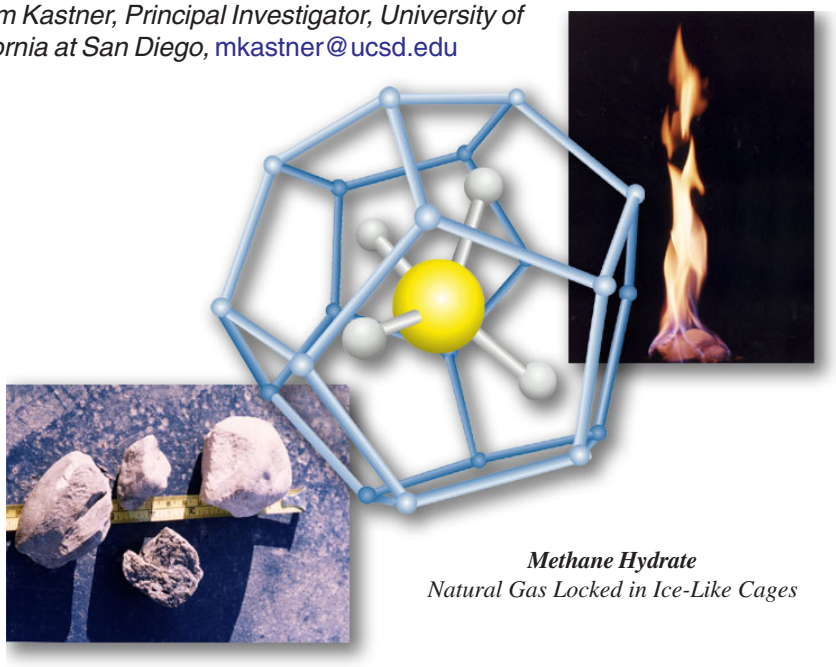
University of California at San Diego, Scripps Institute of Oceanography, San Diego, CA

Controls on gas hydrate formation and dissociation, Gulf of Mexico: in-situ field study with laboratory characterizations of exposed and buried gas hydrates

These field and laboratory studies will help scientists better understand the formation and dissociation of exposed gas hydrates and gas hydrate-rich sediments in the northern Gulf of Mexico. The work will characterize the chemistry and structure of the hydrates; the composition of overlying seawater; and the chemistry, mineralogy, and hydrology of associated sediments and pore waters. Samples will be collected with a submersible vehicle and specially designed pressure chambers and sampling equipment. Methane release and its effect on the immediate environment will be monitored with a yearlong seafloor installation of specialized sampling equipment and time-lapse camera surveillance.

Gary Sames, Project Manager, NETL, sames@netl.doe.gov

Miriam Kastner, Principal Investigator, University of California at San Diego, mkastner@ucsd.edu



Methane Hydrate
Natural Gas Locked in Ice-Like Cages

Joint Oceanographic Institutions, Washington, D.C.

In-situ sampling and characterization of naturally occurring marine methane hydrate using the D/V JOIDES Resolution

This research project is designed to develop and test tools to sample and characterize methane hydrates using the systems and capabilities of the D/V JOIDES Resolution. The Hydrate Ridge, located off the Oregon coast, will be the site of future testing. The project's funds will benefit the Ocean Drilling Program, which seeks to improve in-situ core-recovery systems used to better characterize gas hydrates in the seafloor.

William Gwilliam, Project Manager, NETL, william.gwilliam@netl.doe.gov

Frank Rack, Principal Investigator, JOIDES, frack@brook.edu

Chevron Petroleum Technology, Co., Houston, TX

Characterizing natural gas hydrates in the deep water Gulf of Mexico: applications for safe exploration and production activities

This two-phase study is designed to drill for gas hydrates in the Gulf of Mexico at depths of 1,000 feet or more. After collecting and analyzing data from workshops and other sources, Chevron will devise a strategy to drill through hydrates, core them, and transport and test the samples. Three wells will be drilled; two wells in areas rich in gas hydrate and a third well in an adjacent area without hydrates. Drilling data, seismic response, and the cores will help determine the effects of hydrates in the pore space of rocks. Depending on the results, a third phase involving the drilling of seven boreholes will be proposed.

Dan Driscoll, Project Manager, NETL, daniel.driscoll@netl.doe.gov

Emrys Jones, Principal Investigator, Chevron Petroleum Technology Company, emry@chevron.com

Westport Technology Center International, a subsidiary of Halliburton Energy Services Inc., Houston, TX

Petrophysical characterization and reservoir simulator for methane gas production from Gulf of Mexico hydrate

This work proposed to investigate gas hydrate through lab experiments and analytical modeling. Specifically, the project will 1) identify and measure properties to characterize methane production from a reservoir typical to the Gulf of Mexico, 2) quantify the effects that sediments have on these properties, 3) develop a reservoir model that integrates data from steps 1 and 2 to assess well productivity, and 4) develop a hydrate reservoir simulator by combining the reservoir model and geophysical properties models from the project with an in-house model.

John Rogers, Project Manager, NETL, john.rogers@netl.doe.gov

Kehawa Shukla, Westport Technology Center International, Principal Investigator via Dan Gleitman, dan.gleitman@westport1.com

Maurer Technology Inc., Houston, TX

Methane hydrate production from Alaskan permafrost: what, when, where, why, and how?

This two-phase project will evaluate existing best technologies to drill, complete, and produce methane from hydrates, and to drill, core, test, and instrument three gas hydrate wells south and west of the Kuparuk River area of Northern Alaska. The project will obtain the field data required to verify geological, geophysical, and geochemical models of hydrates and to plan and implement a program that safely and economically drills and produces gas from Arctic hydrates. Anadarko Petroleum Corporation and Noble Engineering and Development will assist Maurer.

Frances Toro, Project Manager, NETL, frances.toro@netl.doe.gov

Tom Williams, Principal Investigator, Maurer Technology, t.williams@maurertechnology.com

BP Exploration Inc., Anchorage, AK

Resource characterization and quantification of natural gas hydrate and associated free-gas accumulations in the Prudhoe Bay - Kuparuk River area on the North Slope of Alaska

This project will characterize, quantify, and determine the commercial viability of in situ, recoverable gas hydrates and associated free-gas resources in three areas of the Alaska North Slope: Prudhoe Bay, Kuparuk River, and Milne Point units. The project will provide practical data for input into reservoir and economic models. It will also help determine the feasibility of gas hydrate production and provide leverage for exploration and field extension of hydrates in the three ANS areas being studied. The University of Alaska in Fairbanks, the University of Arizona in Tucson, and the U.S. Geological Survey will assist BP.

Daniel Driscoll, Project Manager, NETL, daniel.driscoll@netl.doe.gov

Robert B. Hunter, Principal Investigator, BP Exploration Inc., hunterrb@bp.com

Methane Hydrate Worldwide

FIVE NATIONAL LABORATORY PROPOSALS

National Labs Unlocking the Energy in Methane Hydrate

Five laboratory projects, valued at $1.8 million, have been awarded to four national laboratories to develop tools and standardize measurements of hydrate properties. These lab studies are designed to help us better understand the nature of methane gas in hydrate form. The research is directed toward developing cost-effective methods and technologies to acquire and measure the physical and chemical characteristics of gas hydrates in sediments. Specific areas of interest include seismic/acoustic measurements, thermal conductivity, formation and dissociation kinetics, mechanical strength, and material characteristic values. The goal of these projects is to provide technical expertise to private oil and gas companies who may, in the future, use this knowledge to safely drill through and produce the methane from gas hydrate deposits.

Lawrence Berkeley National Laboratory, Berkeley, CA.

This research will develop new numerical simulation capabilities and laboratory measurements to characterize the recoverable resources and stability parameters associated with methane hydrate deposits. The simulation will be based on an integrated approach involving geology, geophysics, and reservoir simulation.

John Rogers, Project Manager, NETL, john.rogers@netl.doe.gov

George J. Moridis, Principal Investigator, Lawrence Berkeley National Laboratory, gjmoridis@lbl.gov.

Pacific Northwest National Laboratory, Richland, WA

This project will measure methane hydrate dissociation and will investigate the effects of dissociation on flow and transport properties in hydrate-bearing sediments. The relationship between rate of hydrate dissociation and sediment properties will be useful in predicting the response of a hydrate reservoir to pressure and temperature changes.

John Rogers, Project Manager, NETL, john.rogers@netl.doe.gov

Bernard P. McGrail, Principal Investigator, Pacific Northwest National Laboratory, pete.mcgrail@pnl.gov

Pacific Northwest National Laboratory, Richland, WA

In cooperation with NETL and participating industries, this project will analyze and integrate data from a wide variety of sources, including laboratory measurements, well logs, surface and volumetric data, and three-dimensional seismic data. The goal is to derive velocity, density, and structure characteristics to enhance seismic interpretations. The Hawaii Geophysical Institute and PNNL will work together to develop a prototype in-situ logging device with Raman capability (laser technology) to image hydrates below the seafloor and in well bores. The goal of this research is to use this new tool in combination with nuclear magnetic resonance imaging to increase our understanding of the microscopic physical characteristics, composition, structure, and volume of in-situ hydrates.

John Rogers, Project Manager, NETL, john.rogers@netl.doe.gov

George He, Principal Investigator, Pacific Northwest National Laboratory, George.He@pnl.gov

Oak Ridge National Laboratory, Oak Ridge, TN

This project will devise experimental methods to characterize the physical and chemical properties of natural and synthetic methane hydrates in pure form and in sediments. Of particular interest are thermal transport properties because they play an important role in models that simulate and predict hydrate behavior in natural environments. Raman and X-ray diffraction studies will be used to study the structure and phase transformation of mixed-gas hydrate, analogous to natural hydrate composition, at varying pressures and temperatures. This research will improve our ability to analyze core samples, evaluate proposed recovery techniques, and assess and predict seafloor stability.

John Rogers, Project Manager, NETL, john.rogers@netl.doe.gov

Claudia Rawn, Principal Investigator, Oak Ridge National Laboratory, rawncj@ornl.gov

Lawrence Livermore National Laboratory, Livermore, CA

This research, a collaborative effort involving five organizations, will concentrate on investigating the properties of laboratory-synthesized gas hydrate in sediments. Hydrate formation, dissociation, dissolution, rheology, elastic properties, and thermal transport properties will be measured at conditions that mimic in-situ pressures and temperatures. A cooperative effort among scientists at LLNL, Stanford University, and the U.S. Geological Survey (USGS) will develop standardized methods for making gas hydrates in sediments in the laboratory and will measure the acoustic velocities of the hydrate/sediment samples. Scientists from Georgia Tech, LLNL, and the USGS will use the laboratory results to work on thermal models of hydrate formation. Collaboration among LLNL, USGS, and Oak Ridge National Lab will analyze thermal expansion properties of hydrates.

John Rogers, Project Manager, NETL, john.rogers@netl.doe.gov

Bill Durham, Principal Investigator, Lawrence Livermore National Laboratory, durham1@llnl.gov

SCNG Launches National Methane Hydrate R&D Website

In an effort to establish a better way to communicate information regarding methane hydrate research at NETL and other government agencies, the SCNG has launched a new website, www.netl.doe.gov/scng/hydrate. This website was developed with input from the U.S. Geological Survey, the Naval Research Laboratory, the National Oceanographic and Atmospheric Agency, the Mineral Management Service, and the National Science Foundation.

The website is a repository of information dealing with methane hydrate issues.

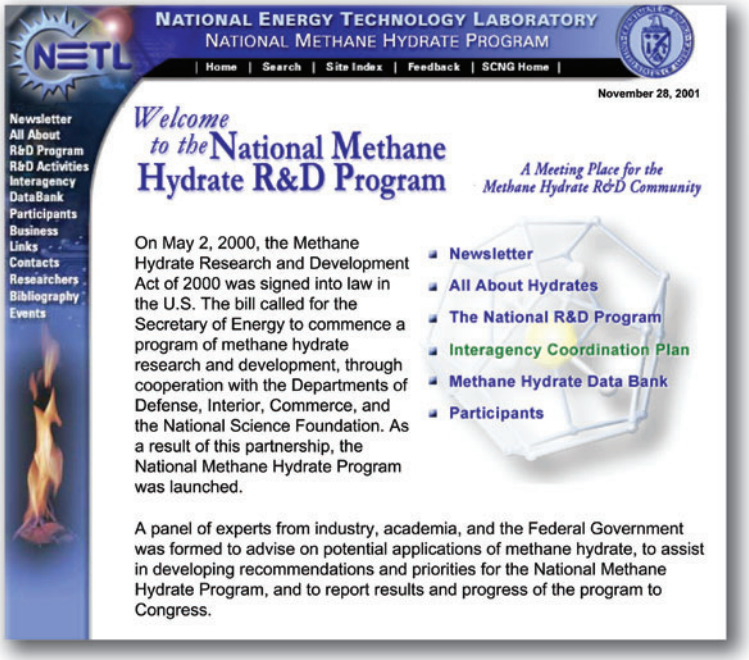
- Resource characterization
- Methane production
- Global carbon cycle and climate change
- Safety and seafloor stability

Featured website topics include:

- This hydrate research newsletter
- All about hydrates
- The National R&D Program—the role of U.S. government in stimulating methane hydrate R&D
- Interagency Coordination—our path to the future
- Methane hydrate data bank—technical information on worldwide resources
- Participants—the people and institutions exploring opportunities

Please visit the site to keep up-to-date on hydrate research.

Heather Quedenfeld, Communications, NETL, heather.quedenfeld@netl.doe.gov



The new SCNG website, www.netl.doe.gov/scng/hydrate, is a cooperative effort to provide current information on methane hydrate research.

Hydrate Cores Recovered with the Hydrate Drill Johnson Sea Link Cruise, July 3-18, 2001

Scientists aboard the research vessel, Seward Johnson, and the four-person submersible, Johnson Sea Link II, have recovered a total of 29 centimeters of gas hydrate in the northern Gulf of Mexico. Cores were taken from a hydrate mound and ledge, 140 kilometers offshore of Louisiana, in approximately 550 meters of water. The newly designed hydrate drill is a significant improvement over earlier crude methods of collecting hydrate. The drill consists of a rotary frame that holds six drill bits. After drilling the hydrate, the drill bit containing the core is placed into a hydrate recovery chamber by a robotic mechanical arm attached to the submersible. The hydrate drill provides researchers with several samples from specific hydrate layers for accurate geochemical and microbiological profiles. The uniform core sample size improves measurements of physical properties, such as shear strength and electrical permeativity, which are important in determining the amount of free water volume. The hydrate drill can also core specific layers within a hydrate deposit, allowing for the study of variations in microbiological communities.

The July hydrate drill expedition is the culmination of a joint project involving NETL, the National Science Foundation Life in Extreme Environments program, Texas A&M University—Geochemical and Environmental Research Group, and the Harbor Branch Oceanographic Institute. Dr. Ian MacDonald, from Texas A&M, directed the project and designed the hydrate drilling device. Jerry Neely and Christopher Teitse, from Harbor Branch, drew the plans and fabricated the drill, using MacDonald's specifications. The new hydrate drill is used in conjunction with a gas hydrate recovery chamber designed and owned by Texas A&M. Harbor Branch operates the Seward Johnson research vessel and the Johnson Sea Link submersible.

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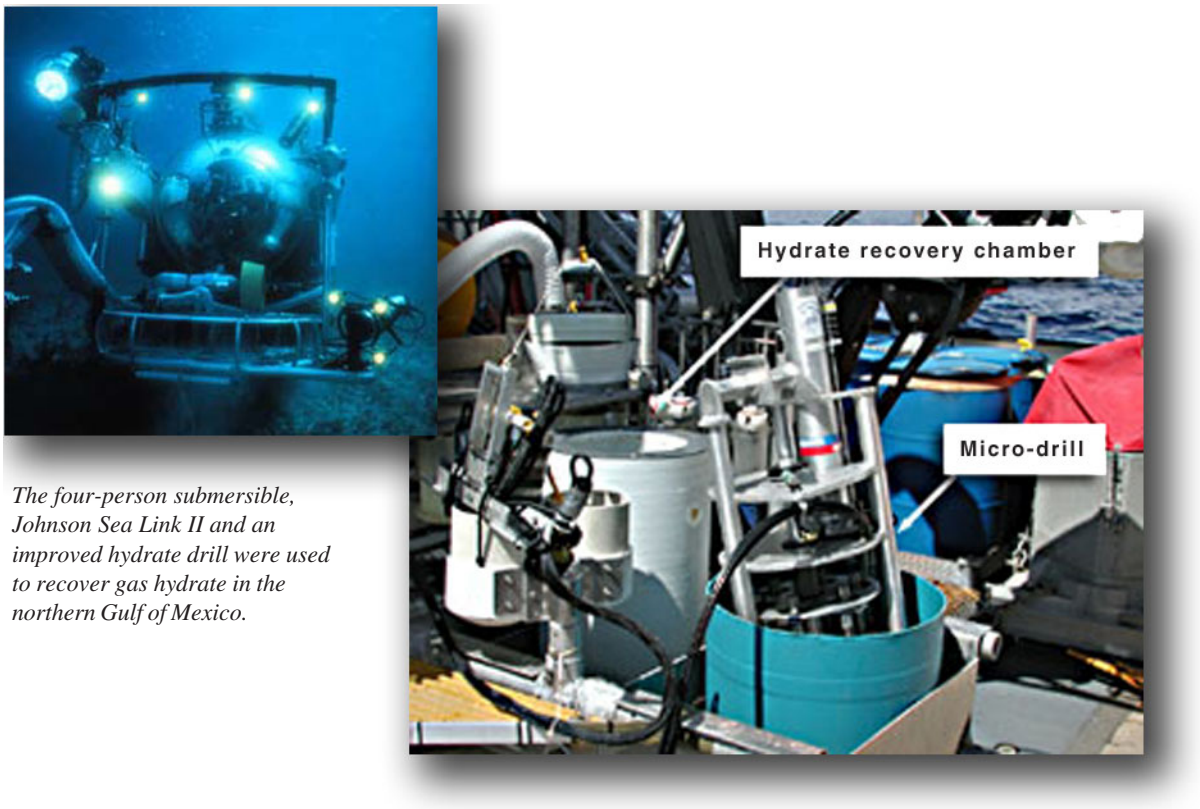

The four-person submersible, Johnson Sea Link II and an improved hydrate drill were used to recover gas hydrate in the northern Gulf of Mexico.