U.S. DEPARTMENT OF ENERGY

Fiscal Year 2012 Methane Hydrate Program

Report to Congress
August 2013

United States Department of Energy
Washington, DC 20585

Message from the Secretary

Section 968 of the Energy Policy Act of 2005 requires the Department of Energy to submit to Congress an annual report on the actions taken to carry out methane hydrate research.

I am pleased to submit the enclosed report, entitled U.S. Department of Energy *Fiscal Year 2012 Methane Hydrate Program Report to Congress*. The report was prepared by the Department of Energy's Office of Fossil Energy and summarizes the progress being made in this important area of research. This report is being provided to the following Members of Congress:

- **The Honorable Joseph R. Biden**
  President of the Senate

- **The Honorable John Boehner**
  Speaker of the House of Representatives

- **The Honorable Ron Wyden**
  Chairman, Senate Committee on Energy and Natural Resources

- **The Honorable Lisa Murkowski**
  Ranking Member, Senate Committee on Energy and Natural Resources

- **The Honorable Lamar Smith**
  Chairman, House Committee on Science, Space and Technology

- **The Honorable Eddie Bernice Johnson**
  Ranking Member, House Committee on Science, Space and Technology

- **The Honorable Fred Upton**
  Chairman, House Committee on Energy and Commerce

- **The Honorable Henry A. Waxman**
  Ranking Member, House Committee on Energy and Commerce

If you need additional information, please contact me or Mr. Brad Crowell, Acting Assistant Secretary, Office of Congressional and Intergovernmental Affairs, at (202) 586-5450.

Sincerely,

Ernest J. Moniz

Executive Summary

This report describes actions taken in Fiscal Year (FY) 2012 to implement the Methane Hydrate Program (Program), authorized by the Methane Hydrate Research and Development Act of 2000, as amended by the Energy Policy Act of 2005 (EPAct). EPAct requires that the Secretary of Energy provide this report to Congress annually.

In FY 2012, the Department of Energy (DOE), in partnership with ConocoPhillips and the Japan Oil, Gas, and Metals National Corporation, conducted the most extensive scientific field evaluation of gas hydrate reservoir response yet accomplished. In the Gulf of Mexico, the Program continued the development of necessary marine sampling devices and awarded two new projects designed to assess the feasibility of marine gas hydrate investigations using established scientific and service industry drill ships. New interagency efforts were also initiated to gather and evaluate advanced geophysical data at sites discovered by the Program in prior collaborative exploration programs with industry. The Program also maintained active international R&D collaborations with Japan, India, and Korea throughout FY 2012.

In FY 2012, the Office of Fossil Energy continued its cooperative efforts with industry and international partners, and revitalized its R&D portfolio through the award of 14 new agreements with private partners. The fundamental goals of the Program remained unchanged: to advance the science and technology associated with both the energy resource and environmental implications of naturally-occurring methane hydrate.

The effort to evaluate gas hydrate as a resource will be aided by eight new projects initiated in FY 2012. These projects include work to improve technologies for delineating and characterizing the most promising accumulations, improved modeling tools to predict reservoir response to production, and efforts to determine further opportunities to characterize the scale of potential resource in U.S. waters through marine drilling and coring programs. Ultimate determination of the resource potential of gas hydrate will also require additional field production testing programs. The highest priority for additional field work is an onshore extended-duration test of the most promising production concepts, and the Program continues to evaluate options for conducting such a test given future budget expectations and current conditions within industry.

With respect to gas hydrate and its role in the global environment, DOE continues to support a range of studies designed to determine the sources, sinks, and fluxes of methane in arctic and marine methane hydrate-bearing environments. The goal is to understand what role methane hydrate may play in the global cycling of carbon, and more specifically, the response of the natural environment to warming climates. To further this line of study, the Program awarded six new projects with academic and interagency partners in FY 2012.

This report outlines key accomplishments of the Program during FY 2012, and provides a bibliography of peer-reviewed papers, articles, and conference presentations that appeared during the year.

Fiscal Year 2012 METHANE HYDRATE PROGRAM REPORT TO CONGRESS

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I. Legislative Action

This report describes actions taken in Fiscal Year (FY) 2012 to implement the Methane Hydrate Research and Development Act of 2000, as amended by Section 968 of the Energy Policy Act of 2005 (EPAct). EPAct requires that the Secretary of Energy provide this report to Congress annually.

II. Summary of Accomplishments in FY 2012

FY 2012 funding enabled the Department of Energy (DOE) to solicit, evaluate, and award 14 new projects and supporting national lab and interagency Research and Development (R&D) efforts (see Appendix A) that will be largely performed in FY 2013 and subsequent years. The Methane Hydrates Program (Program) achieved substantial technical accomplishments during FY 2012, primarily through the continuation of an array of projects that were forward-funded in FY 2010. Most notably, the National Energy Technology Laboratory's (NETL) successful application through development of a Field Work Proposal (FWP) to DOE's Office of Science, combined with expanded partner cost-share (through agreement with the Japan Oil, Gas, and Metals National Corporation) that provided $7.7 million, enabled the ongoing Alaska gas hydrate testing program to progress to the production testing phase in FY 2012. The following sections describe the key technical accomplishments for the Program during FY 2012, organized by research topic area.

Gas Hydrate Characterization and Exploration Technologies

Chevron-led Gulf of Mexico Joint Industry Project

The Gulf of Mexico Gas Hydrates Joint Industry Project (JIP) is a cooperative research program between the DOE (in coordination with the U.S. Geological Survey (USGS) and the Bureau of Ocean Energy Management (BOEM)) and an international consortium of industry partners under the leadership of Chevron, through which DOE has a cooperative agreement. The overall objectives of the JIP are to understand the nature of gas hydrate occurrence in the deepwater Gulf of Mexico, to assess its potential risks to the drilling of deepwater wells, to develop exploration technologies to improve the detection, delineation, and characterization of marine methane hydrate accumulations, and to develop tools for deepwater gas hydrate sample acquisition and analysis. The JIP has provided the Program with the means to stage major deepwater field expeditions guided by broad participation from numerous U.S. federal agencies, private companies, and academic institutions.

The 2005 "Leg 1" expedition and associated studies (full peer-reviewed scientific results volume published in FY 2009) developed standard protocols for drilling through the most typical gas hydrate bearing sediments, thereby resolving the issue of drilling safety. The project's 2009 "Leg 2" expedition (full peer-reviewed scientific results volume published in FY 2012) proved the Program's gas hydrate marine exploration method through drilling and logging programs that discovered resource-grade gas hydrates at two of three sites studied. It also provided initial confirmation of the BOEM's 2008 gas hydrate resource assessment, which had attributed more than 6,000 trillion cubic feet (Tcf) of potentially-recoverable gas hydrate in the Gulf of Mexico. In 2012, the JIP, reflecting a growing tendency to reduce risk, announced that they would be unable to facilitate further marine exploration field work programs with the DOE.

Ongoing efforts within the DOE-Chevron cooperative agreement outside of the field work aspect of the JIP are focused on completing tool development activities; in particular the designing, building, and testing of deepwater pressure-coring tools and compatible pressure-core analyses devices. During FY 2012, the JIP project team developed synergies with ongoing pressure-core development within Japan's MH21 Methane Hydrate R&D Program and is progressing on a design that meets DOE's goals of 1) robust performance; 2) flexibility to successfully retrieve samples from both gas hydrate seals (softer sediments) and gas hydrate-bearing sands (much harder); 3) appropriate design (size, etc.) to be deployed from the range of potential drill ships that are the most likely platforms for future operations, including scientific and service industry vessels; and 4) compatibility with new and existing pressure-core analysis devices that will enable scientific measurements to be taken on cores without removing them from gas hydrate stability conditions. Japan shares these goals, and has enabled JIP members to participate in Japan's initial testing of new devices and to review select performance data acquired from Japanese coring programs in FY 2012. Japan is continuing to share insight, expertise, and testing opportunities to guide the final design of the DOE-JIP pressure corer and associated tools.

New FY 2012 Projects in Gas Hydrate Characterization and Exploration

In order to develop new opportunities for field characterization projects, the Program awarded new projects in FY 2012 to the Consortium for Ocean Leadership and to Fugro GeoConsulting to develop plans for marine scientific drilling programs that are consistent with geotechnical and/or academic drill ships. In addition, the Program developed several new projects that will address the issue of gas hydrate exploration through seismic data interpretation. Two projects, with Oklahoma State University and Fugro GeoConsulting, will leverage log suites acquired during the DOE-JIP 2009 expedition to further the calibration of seismic data and enhance the ability to determine the fine-scale occurrence and variation in concentration of gas hydrates, as well as further delineate areas of potential free gas that may be masked by association with overlying gas hydrates.

A collaborative effort between DOE, the USGS, and BOEM will enable USGS scientists to acquire new ocean-bottom-seismic data over those same, well-characterized Gulf of Mexico gas hydrate accumulations. In addition, the Colorado School of Mines will conduct a series of laboratory experiments to determine how methane hydrate can be detected using advanced seismic methods. The final new project in exploration technologies in FY 2012 is with the Ohio State University. It will enable a comprehensive evaluation of potential gas hydrate occurrence in more than 1,700 industry well logs from the deepwater Gulf of Mexico.

Gas Hydrate Production Technologies

CO_2-CH_4 Exchange Field Trial

In FY 2012, NETL's ongoing project with ConocoPhillips, Alaska, progressed to the field trial phase. The field operations were conducted from December 16, 2011 to May 7, 2012. The field team, despite abnormally harsh conditions, achieved incident- and injury-free operations. Using prior year DOE funding, augmented by the financial support provided via the FWP with DOE's Office of Science, and cost-share from both ConocoPhillips and new project partner Japan Oil, Gas, and Metals National Corporation (JOGMEC), the project fully met its primary goal of conducting a safe and controlled scientific experiment in a field setting to further our understanding of the response of gas hydrate reservoirs to gas injection and pressure-induced flow.

In summary, the project 1) rebuilt an ice-pad and established a test site around the Ignik Sikumi well, which the Program had drilled and evaluated in FY 2011; 2) confirmed well-bore integrity, re-entered, and successfully directionally perforated the casing over the target interval; 3) injected 210,000 standard cubic feet (scf) of mixed, gas-phase, Nitrogen (77%) and CO_2 (23%); 4) flow-tested the well through pressure reduction; and 5) fully abandoned and remediated the site. During the course of the testing program, NETL maintained a real-time log of operations which can be viewed at http://www.netl.doe.gov/technologies/oil-gas/FutureSupply/MethaneHydrates/rd-program/ANSWell/co2_ch4exchange.html.

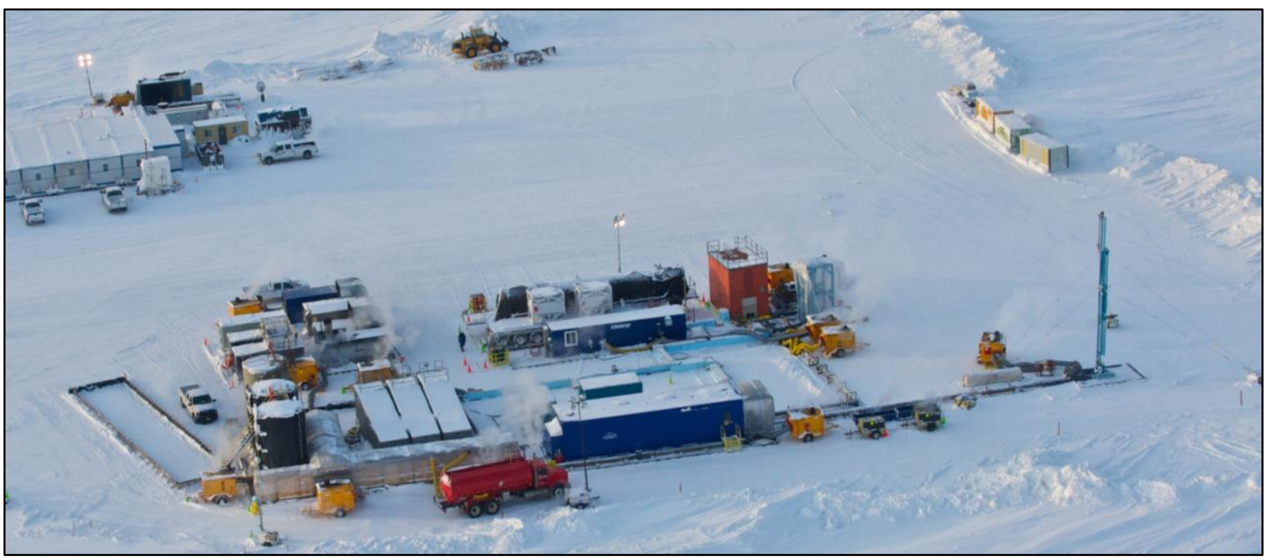

__Figure 1__ -The Ignik Sikumi well site, Prudhoe Bay Unit, Alaska North Slope, February, 2012 (Courtesy ConocoPhillips)

Operations on the winter 2012 gas injection and production phase of the Ignik Sikumi field trial began in December, 2011, with the reconstruction of the ice pad around the well head established the prior winter. Throughout January and February, ConocoPhillips assembled the various equipment (much of it custom designed and built) required to conduct the trial at the field site, connected the various pumps, tanks, and meters to one another and to the well head, and reopened and confirmed the well's physical and mechanical integrity. The well was then filled with a mixture of CO_2 (23%) and nitrogen gas (77%). An oriented perforation gun was lowered and a 30-ft interval of casing was perforated with no damage to the downhole pressure-temperature gauges or the fibre-optic cables. A sand screen designed to control sand production was then set across the perforated interval.

Figure 2-*Flared methane gas during the production phase of the 2012 DOE-ConocoPhillips-JOGMEC gas hydrate production trial (courtesy ConocoPhillips).*

From February 15th to 28th, approximately 210,000 scf of blended CO_2 and N_2, along with minute volumes of chemical tracer were successfully injected into the formation. The goal of the gas mixture was to enhance the opportunities for the CO_2 to interact with native methane hydrate by controlling formation temperature and inhibiting ice formation, and by inhibiting direct formation of CO_2-gas hydrate. The gas mixture accomplishes this by displacing formation water and by changing the chemical conditions in the near well-bore environment. These objectives were achieved and the injection phase proceeded according to plan, with no indication of formation fracturing and with slowly, but steadily, improving injectivity. Once the planned gas volumes had been injected, the well was shut-in and reconfigured for flow-back.

On March 5, the well was re-opened and produced a mixture of gases under its own energy for roughly one day, before the well was shut-in and a down-hole jet pump installed. For approximately eight days, the well was produced by pumping fluids from the well-bore, thereby lowering pressure at the level of the perforations to a point sufficient to draw fluids from the formation, but insufficient to destabilize any native CH_4-hydrate. This phase of production featured a wide range of gas and water flow rates, the intermittent production of fine solids, and the successful negotiation of several minor operational issues.

During the last three days of this initial period, pressures were reduced to approximately the dissociation pressure of native gas hydrate, and production rates climbed to greater than 100,000 scf per day (scf/d) for the period. Following a four day shut-in from March 19 to 22 that was necessitated by the formation of ice in the line to the gas flare, the well was re-opened, hydrate that formed within the wellbore was remediated, and flow was restarted. The well then produced continuously for the next 19 days, before it was shut-in on April 10. During this final production period, well-bore pressures were lowered below that required to initiate dissociation of native gas hydrate and production rates were stable and climbing from 20,000 to 45,000 scf/d, with the rates being highly responsive to induced pressure changes.

Chemical analysis of the recovered gas was progressively dominated by CH_4 (typically greater than 95%), with the bulk of the injected N_2 recovered, and with the CO_2 preferentially retained within the reservoir. Overall, the well flowed for 30 days during the 36-day flow-back period, with cumulative gas production of approximately 1,000,000 scf. Once the field project was completed, the Ignik Sikumi research well was plugged and abandoned in accordance with the regulations of the Alaska Oil and Gas Conservation Commission, including filling the wellbore to the surface with cement, capping the well, cutting the well off below ground surface, then progressively remediating the site to the pre-existing tundra landscape.

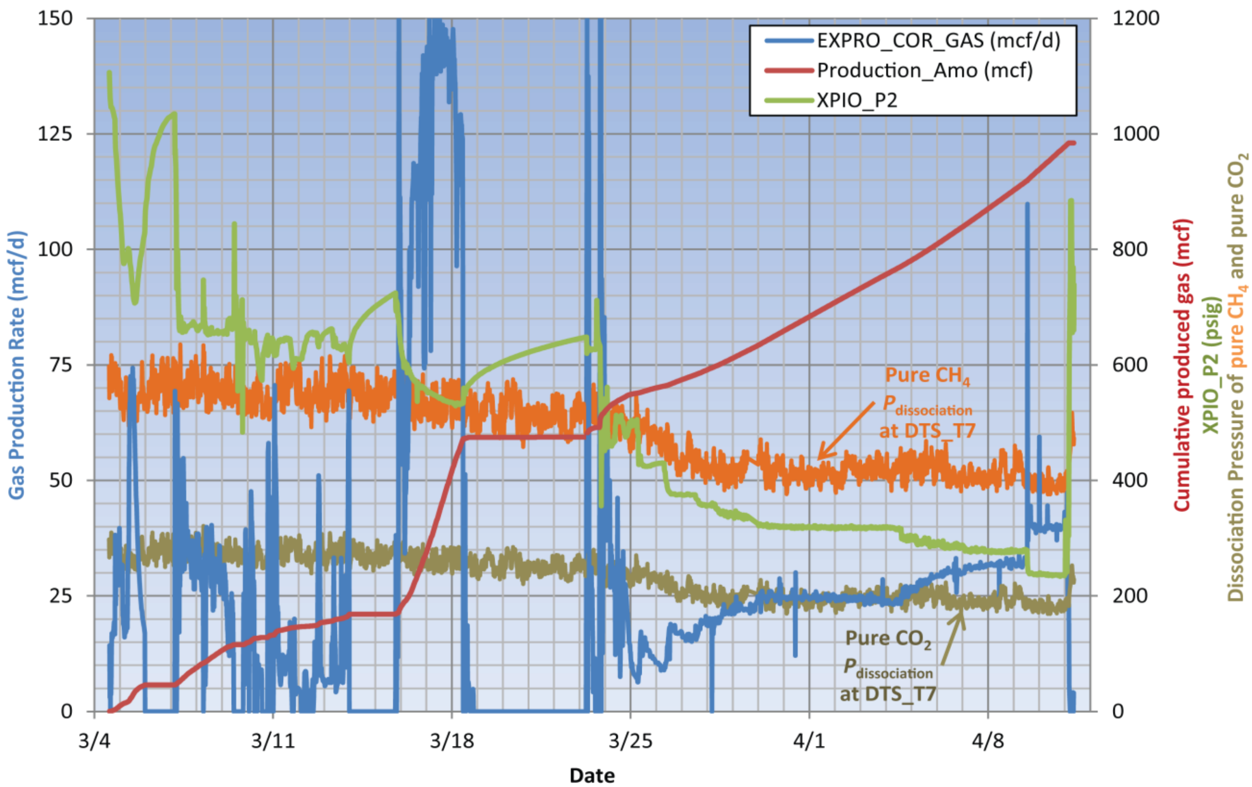

Figure 3-*Summary of final field test data from the flow-back phase of the Ignik Sikumi test. Curves are as follows: rate of gas release from gas hydrate (blue); cumulative gas released (red), reservoir pressure (green), pressure of CH4-hydrate dissociation (orange), pressure of CO_2-hydrate dissociation (olive).*

The Ignik Sikumi field trial overcame a number of challenges to enable a successful short-term production test:

- Careful program planning and management enabled a complex scientific field experiment to be conducted within the highly-active Prudhoe Bay Unit with no disruption to ongoing industry oil and gas operations.
- The field team successfully managed the oriented perforation of the target zone with no damage to the well's extensive downhole monitoring equipment, enabling full collection of desired data throughout the duration of the test.
- Precise engineering of the gas injection phase enabled the precise mixing and control of injectant components, as well as the management of injection pressure such that the target 210,000 scf of gas was injected within the allotted time and without fracturing the

formation, an event that would have negated much of the scientific value of the experiment.
- The team addressed the potential for rapid loss of injectivity due to direct CO_2-hydrate formation through the use of a N_2-CO_2 gas mixture. This gas mixture met the program goals of modifying the near well-bore physical and chemical environment in such a way that injection could occur.
- The well was successfully transitioned from injection to production, in which downhole pressure was lowered in a controlled manner, enabling the measurement and management of produced gases, fluids, and solids, at pressures both above and below the dissociation pressure of native CH_4-hydrate.

Ultimately, the well substantially exceeded the duration and cumulative gas volumes of prior field testing programs. Both water production and production of solids (i.e., sand grains) were readily managed during the test.

At FY 2012 end, the project team was continuing the effort to gather, integrate, validate, and quality check the field data. Final datasets, such as records of downhole pressures and temperatures synchronized to gas and fluid flow rates and chemistries, have been compiled. Going forward, these data will be examined to interpret the nature of the various processes that occurred during the test. In March 2013, these data were made public via the NETL website for the use of all research groups with an interest in studying the in situ behavior of gas hydrate reservoirs.

Extended-duration Depressurization Testing Program

DOE has maintained a cooperative agreement with BP Exploration-Alaska (BPXA) since 2001 with the goal of characterizing the nature and commercial implications of methane hydrate resources on the Alaska North Slope through an extended-duration field production test based on the concept of reservoir depressurization. This project, which completed a major field program (the "Mt. Elbert" test well) in FY 2007 (with a volume containing peer-reviewed, scientific results published in FY 2011), has been hindered by the ongoing EPA-imposed debarment of BPXA's Prudhoe Bay element from participation in federal contracts. The DOE continues to explore options to facilitate cooperative research among BPXA, other partners in the Prudhoe Bay Unit, and our international collaborators who have expressed great interest in a potential field test. Initial steps would include the development of a feasible project structure and rigorous scientific design for the testing program, as well as the evaluation of other potential options to advance gas hydrate research.

Gas Hydrate Environmental and Global Climate Studies

DOE continues to support a range of studies designed to determine the sources, sinks, and fluxes of methane in arctic and marine gas-hydrate-bearing environments. The goal is to understand what role gas hydrate may play in the global cycling of carbon, and more specifically, the response of the natural environment to warming climates. This effort reflects DOE's continuing effort to be responsive to the intent of the original Methane Hydrate Research and Development

Act, which directs the DOE to work with our interagency partners to enable research across a broad range of gas hydrate issues, including the impacts of natural degassing from hydrates. In addition, DOE considers the effort fundamental to developing the sound understanding of the nature of gas hydrates, which could facilitate the eventual public acceptance as an energy source. This goal is also supported by DOE's participation in key outreach activities, such as the United Nations Environmental Programme's (UNEP) ongoing gas hydrate assessment, that will be released in CY 2013. As of July 1, 2013, the assessment is on schedule.

To address gas hydrate's role and behavior in nature, NETL developed a portfolio of projects which have concluded in FY 2012 and have been reported in a large number of high-impact publications (see Appendix A). These studies included field work in a range of geologic settings, as well as laboratory-based analyses and initial attempts to incorporate gas hydrate into global climate and environmental process models. New projects selected in FY 2012 are designed to strengthen this effort.

Mississippi Canyon 118 Seafloor Observatory

The University of Mississippi continues to lead a consortium working to establish and maintain a seafloor observatory for long-term monitoring of gas hydrate occurrences in Mississippi Canyon Block 118 (MC118) in the Gulf of Mexico and their response to ongoing environmental changes. This project is conducted in conjunction with the National Oceanic and Atmospheric Administration (NOAA) and BOEM. In March 2012, University of Mississippi researchers successfully collected heat flow data from 15 targeted sites at MC118; and researchers from the University of Mississippi and the USGS successfully recovered data from a seafloor instrument via optic modem, marking the first such occurrence in marine science and a breakthrough in marine data-recovery technologies.

Climate Change-Gas Hydrate Linkages in Past Climates

Two studies to improve the interpretation of gas hydrate response to climate events in the past were initiated in FY 2012. The first study features computer model development at Oregon State University to enable researchers to reconstruct past episodes of methane flux in gas hydrate-bearing regions from shallow geochemical data. In the second study, the University of New Hampshire is reconstructing the history of methane flux at three sites on the Cascadia margin using sedimentological data.

Environmental Change in the Arctic

The release of methane due to increased ocean temperatures, or gas hydrate destabilization, in response to climate change is most likely to be observed first, and proceed more quickly, in the arctic, where cold temperatures and rising sea-levels result in a closer relationship of the atmosphere with the occurrence of sub-sea gas hydrate. DOE is supporting a number of allied efforts to assess the current state and possible future progression of gas hydrate stability on the Beaufort Shelf, offshore northern Alaska.

Southern Methodist University, in collaboration with the USGS, Oregon State, and others, are conducting numerical modeling, field data collection, and experimental studies related to deep water arctic settings. In 2012, the USGS collected approximately 500 km of seismic data from the shelf break down to 1500 to 2000 m water depth. This work is coordinated with ongoing studies by the USGS to assess similar gas hydrate issues on the inner Beaufort Shelf, including the first-ever survey (in August of 2012) of real-time methane fluxes in a subsea permafrost/methane hydrate system. This work produced the first regional map of subsea permafrost on the U.S. Beaufort Sea continental shelf, which approximates the contemporary distribution of "relict" methane hydrate. In a separate, but integrated effort, the University of California at San Diego is developing a new electromagnetic (EM) remote sensing system for very shallow water use to be applied to determine the extent of "relict" permafrost on the Beaufort inner shelf.

Prior DOE projects in the Arctic are now nearing conclusion. Final data reports from the Program's 2009 field study in the eastern Beaufort Sea were published in FY 2012. Another partner in that effort, the University of Delaware, has reported on several genetic sampling techniques that were used to examine the microbial communities in Beaufort sediments cores. This was one of the first research projects to examine the entire microbial assemblage potentially involved in anaerobic methane oxidation.

Onshore, the University of Alaska-Fairbanks has completed a synthesis of all sediment and water column data collected during two summer field seasons sampling arctic thermokarst lakes. The project team developed a 12,000 year paleo-reconstruction of Arctic Alaska wetlands based on estimates of past methane availability.

Gas Hydrate Response to Environmental Change in the Deep Oceans

Key questions for gas hydrate research include the response of deep marine hydrates to environmental change. In the Gulf of Mexico, the University of Texas-Austin has initiated the development of conceptual and numerical models to analyze conditions under which gas may be expelled from existing accumulations of deepwater gas hydrate into the overlying ocean, including the transit of free gas through overlying zones where gas hydrate remains theoretically stable. Similarly, the University of Mississippi has begun a new effort that will investigate the use of time-series, direct current resistivity methods to investigate temporal variations in gas hydrate occurrence at cold vent sites on the continental slope of the northern Gulf of Mexico at the location of the established Mississippi Canyon 818 seafloor observatory.

Methane that escapes the sediment in the deep ocean typically dissolves into the overlying water where it is available to methane-oxidizing (methanotrophic) bacteria. Work nearing conclusion at the University of California-Santa Barbara (UCSB) has provided an increased understanding of the efficiency of this biological methane consumption by studying the distribution of methane oxidation and the disposition of methanotrophs near gas seeps. UCSB scientists succeeded in identifying the bacteria and their distributions in these environments, and in determining the potential physical and chemical controls on this bacteria's activity.

To improve the tools available for modeling the behavior of gas hydrate in nature over longer time frames, researchers at the University of Chicago and the University of California-Berkeley have developed a numerical model of the methane cycle in continental shelf and slope sediments of passive and active margins. The larger-scale formulation of the model, both in space (dimension) and time, offers new insight on the deep sedimentary methane cycle, including the mechanics of methane transport, in particular highlighting the impact of fluid flow heterogeneity on the distribution of methane and gas hydrate.

DOE supports the ongoing effort to assess potential near-term implications of climate-driven destabilization of gas hydrates. The Lawrence Berkeley National Lab (LBNL) and Los Alamos National Lab (LANL) have accessed the World Climate Research Program's latest temperature data (CMIP5) to create a new, more realistic model of temperature change on the global seafloor that includes both historical changes and future temperature scenarios.

Internationally, the Naval Research Laboratory (NRL) will provide geochemistry expertise in a collaborative field program with New Zealand and Germany to investigate climate-driven changes in gas hydrate stability on the Hikurangi margin, offshore New Zealand.

Fundamental Experimental and Modeling Studies

The Program continues to support focused experimental and numerical modeling studies to provide foundational science regarding the nature of hydrate-bearing sediments and their response to environmental changes, either natural or induced.

FY 2012 research conducted at NETL in partnership with NETL's Regional University Alliance (RUA) was highlighted by the development of fundamental relationships and viable numerical simulations related to CO_2-CH_4-N_2 interactions in nature. These codes will be critical to full evaluation of data acquired from the FY 2012 Iġnik Sikumi hydrate production test. Prior to the Iġnik Sikumi test, the NETL team assisted ConocoPhillips with the simulation of the injection of carbon dioxide and nitrogen into the methane hydrate reservoir and with the design of the test procedures as a mechanism for independent validation.

Improvement of simulation capabilities for evaluating gas hydrate deposits using depressurization continued throughout FY 2012 at LBNL, including improvements to the "Tough+-Hydrate" code's capabilities to assess geomechanics of production. New studies underway at Wayne State University are expected to provide improved definition of capillary pressure and relative permeability phenomena for use in gas hydrate numerical simulation.

Two new laboratory-based efforts were initiated in FY 2012. The first effort, at the Georgia Institute of Technology focuses on experiments to identify, understand, and model processes that occur during methane production that may not be captured in standard reservoir simulation. At present, a general scientific consensus exists that suggests technical recoverability of gas hydrate is limited to sand-hosted occurrences. This effort will focus on evaluating physical processes that may provide avenues for extending recoverability to a broader range of occurrence types. The second laboratory study, at the Colorado School of Mines, will further the ability to interpret seismic data to determine the concentration of gas hydrates in deep sediments.

International Collaboration

DOE maintained active engagement and discussion with the world's leading international gas hydrate R&D programs in FY 2012. Formal departmental-level agreements continued with the governments of Japan (Ministry of Economy, Trade, and Industry), Korea (Ministry of Knowledge Economy), and India (Ministry of Petroleum and Natural Gas). Industry organizations from each of these countries, as well as Norway, are participants in DOE's Gulf of Mexico JIP lead by Chevron, and continue to demonstrate strong interest in future field testing opportunities. In addition to these Departmental-level agreements, NETL maintains active collaborations and communications with gas hydrate efforts in New Zealand, China, Canada, and Taiwan. International collaboration in FY 2012 was highlighted by the cooperation with Japan in both the Ignik Sikumi well testing program in Alaska (to which JOGMEC provided substantial financial support) and in the ongoing development of marine pressure coring tools under the Gulf of Mexico JIP.

Fellowship Programs

NETL, in cooperation with the National Academies, has awarded National Methane Hydrate R&D Program Fellowships since 2007. The sixth fellow in the Program, Dr. Laura Brothers, who received her PhD in Earth Sciences from the University of Maine in 2010, has been a major contributor to the Beaufort Shelf field projects being executed by the USGS.

A seventh fellow, Dr. Rachel Wilson, a Research Associate at Florida State University (FSU), was selected early in FY 2012. Dr. Wilson received her Ph.D. in Chemical Oceanography from FSU in 2010 and her specialties include the formation and stability of gas hydrates. Dr. Wilson will study the nature and rate of dissolution of gas hydrates where it is in contact with water that is not supersaturated with methane. This study has implications to both the environmental and energy resource aspects of methane hydrates.

Program Management and Oversight

Throughout FY 2012, DOE/NETL continued to manage a broad portfolio of R&D projects as specified by EPAct. The Program executed the solicitation, evaluation, award, and negotiation of 14 new cooperative agreements, and continued to manage a range of ongoing projects, field work proposals, and interagency agreements. Program oversight activities in FY 2012 included two meetings of the Program's Federal Advisory Committee and two meetings of the Interagency Technical Coordination Team.

Technology Transfer

DOE and its research partners continued to disseminate research results to the scientific community during FY 2012. Appendix A provides a list of 60 peer-reviewed publications, 49 grey literature and government publications, and 84 professional conference presentations that occurred during the fiscal year and that resulted, in whole or in part, from DOE support. The listing includes the hard-copy publication in June of 2012 of 14 peer-reviewed papers of scientific results from the 2009 Joint Industry Program drilling in the Gulf of Mexico as Volume 34 of Elsevier's *Journal of Marine and Petroleum Geology*. Many of these papers had appeared online in FY 2011.

In addition, the DOE/NETL Methane Hydrate Newsletter, *Fire in the Ice*, continued to report on global developments in gas hydrate R&D in FY 2012. This periodic publication is distributed to 1,500 subscribers in more than 40 countries. NETL also provided weekly, real-time updates to the public on the progression of its Ignik Sikumi gas hydrate field trial through the NETL website.

NETL is also supporting an ongoing global assessment of gas hydrate science and technology issues being conducted by the UNEP (see www.methanegashydrates.org). A two-volume hard-copy book and associated web-based products is scheduled to be released in the spring of 2013. The steering committee includes representatives from NETL and the USGS, as well as from Canada, Japan, Korea, India, Germany, and Norway.

III. Conclusion

This report describes the accomplishments of the DOE-led national Methane Hydrate R&D Program in FY 2012. DOE effectively managed ongoing work funded in prior years to further advance science and technology development activities designed to determine the resource potential and environmental implications of gas hydrate.

Work in 2012 was highlighted by the successful drilling, logging, and completion of a fully-instrumented scientific well-bore within the Prudhoe Bay infrastructure area of the Alaska North Slope. In addition, the Department's efforts to maintain and expand industry and international collaborations were successful and aided in assuring that the field testing portion of the program could be conducted in FY 2012. This will be a critical milestone in advancing the scientific understanding of gas hydrate reservoir response to alternative gas hydrate production strategies and will provide vital information to the future planning of extended-duration production tests.

In the Gulf of Mexico, evaluation of the data acquired in the Program's landmark 2009 exploration was completed and reported to the public, and expanding international collaboration continues to advance the preparations for further future marine resource sampling and characterization. The Program also continued its work with academia, DOE national laboratories, and other federal agencies to better understand the potential response of gas hydrate to ongoing climate change. Finally, the Program maintained active international R&D collaborations with Japan, India, and Korea throughout FY 2012.

Information on the Program, including detailed summaries of all active and completed projects and reports and publications resulting from DOE-funded investigations, are regularly updated and can be found at www.netl.doe.gov. Further information on the Program, including Program reports and activities of the Methane Hydrate Advisory Committee, is available at www.fe.doe.gov.

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Appendix A: FY 2012 Publications and Reports

Peer-Reviewed Publications

1. Archer, D., Buffett, B.A., and McGuire, P.C., 2012. A two-dimensional model of the passive coastal margin deep sedimentary carbon and methane cycles. *Biogeosciences*, v. 9, pp. 1-20.
2. Archer, D. and Buffett, B.A., 2012. A two-dimensional model of the methane cycle in a sedimentary accretionary wedge. *Biogeosciences*, v. 9, pp. 3323-3336.
3. Behseresht, J., and Bryant, S., 2012. Sedimentological control on saturation distribution in arctic gas-hydrate-bearing sands. *Earth and Planetary Science Letters*, Vol. 341–344, August, pp. 114–127.
4. Boswell, R., Collett, T., Frye, M., Shedd, W., McConnell, D., and Shelander, D., 2012. Subsurface gas hydrates in the northern Gulf of Mexico. *J. Marine Pet. Geol.*, v. 34, no.1, pp. 4-30, doi: 10.1016/j.marpetgeo.2011.10.003.
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Grey Literature

1. Boswell, R., Collett, T., Dallimore, S., Frye, M., 2012. Geohazards associated with naturally-occuring gas hydrate. Fire in the Ice Newsletter, v. 12, no. 1, pp. 11-15.
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6. Everett, S.M., Rawn, C.J., Chakoumakos, B.C., Keffer, D.J., Huq, A., and Phelps, T.J., 2012. A Study of the solid solution of CH4 and CO2 in gas hydrates. Invited talk at the Chemical Biomedical Engineering Graduate Seminar, University of Tennessee, Sept., Knoxville, TN.
7. Farrel, H. and Hester, K., 2012. CO2/CH4 Hydrate Exchange Field Trial Technical Update, Methane Hydrate Advisory Committee Meeting, July 26, Houston, TX.
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14. Moridis, G.J., 2012. Investigating hydrate deposit behavior in oceanic systems and their consequences on marine hillslope erosion and stability. Invited speaker, August 12, University of Auckland, NZ.
15. Moridis, G.J., 2012. Status of gas production from geological hydrate deposits. Invited presentation, February 12, 2012, Stanford University, Stanford, CA.
16. Moridis, G.J., Collett, T.S., Boswell, R., Hancock, S., Rutqvist, J., Santamarina, C., Kneafsey, T., Reagan, M.T., Pooladi-Darvish, M., Kowalsky, M., Sloan, E.D., and Coh, C., 2012. Gas Hydrates as a Potential Energy Source: State of Knowledge and Challenges. In: Advanced Biofuels and Bioproducts, J.W. Lee (ed.), pp. 977-1035, Springer, New York, Heidelberg, Dordrecht, London, doi: 10.1007/978-1-4614-3348-4.
17. Pohlman, J., Ruppel, C., Maue, C., Brothers, L., Kessler, J., and Worley, C., 2012. Real-time mapping of seawater and atmospheric methane concentrations offshore of Alaska's North Slope. Sound Waves, USGS newsletter.
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19. Ruppel, C., 2011, Planned scientific drilling on the US Beaufort margin. IODP USSSP workshop on Catching Climate Change in Progress—Drilling on Circum-Arctic margins, San Francisco, December 10-11.
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Government Reports

1. Balczewski, J., 2012. Characterizing Natural Gas Hydrates in the Deep Water Gulf of Mexico: Applications for Safe Exploration and Production Activities, Semi-Annual Progress Report, October 2011 – March 2012. Chevron, DOE Award No.: DE- DE-FC26-01NT41330. March, 2012. (click here)
2. Balczewski, J., 2011. Characterizing Natural Gas Hydrates in the Deep Water Gulf of Mexico: Applications for Safe Exploration and Production Activities, Semi-Annual Progress Report, April 2011 – September, 2011. Chevron, DOE Award No.: DE- DE-FC26-01NT41330. October, 2011. (click here)
3. Beaudoin, Y., 2011. Global Assessment of Methane Gas Hydrates, Semi-Annual Progress Report, Stiftelsen GRID-Arendal, DOE Award No.: DE-FE0003060. October 2011. (click here)
4. Beaudoin, Y., 2012. Global Assessment of Methane Gas Hydrates, Semi-Annual Progress Report, Stiftelsen GRID-Arendal, DOE Award No.: DE-FE0003060. April 2012. (click here)
5. Constable, S., 2011. Gas Hydrate Characterization in the GoM using Marine EM Methods. Quarterly Progress Report, July 2011 – September 2011, Scripps Institution of Oceanography, University of California San Diego, DOE Award No.: DE-NT0005668. October 2011. (click here)
6. Constable, S., 2012. Gas Hydrate Characterization in the GoM using Marine EM Methods. Quarterly Progress Report, January 2012 – March 2012, Scripps Institution of Oceanography, University of California San Diego, DOE Award No.: DE-NT0005668. April 2012. (click here)
7. Dunbar, J., 2011. Electrical Resistivity Investigation of Gas Hydrate Distribution in Mississippi Canyon Block 118, Gulf of Mexico. Quarterly Progress Report, July – September 2011, Baylor University, DOE Award No.: DE-FC26-06NT42959. October 2011. (click here)
8. Dunbar, J., 2012. Electrical Resistivity Investigation of Gas Hydrate Distribution in Mississippi Canyon Block 118, Gulf of Mexico. Quarterly Progress Report, January 2012 – March 2012, Baylor University, DOE Award No.: DE-FC26-06NT42959. April 2012. (click here)
9. Juanes R. and Bryant, S. L., 2011. Mechanisms Leading to Co-Existence of Gas and Hydrate in Ocean Sediments, Quarterly Progress Report, July – September 2011, University of Texas, DOE Award No.: DE-FC26-06NT43067. October 2011. (click here)
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12. Kirchman, D., 2012. Characterization of Methane Degradation and Methane-Degrading Microbes in Alaska Coastal Water, Final Report. DOE Award No.: DE-NT0005666. March 2012. (click here)
13. Lewis, S., 2011. 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, Semi-Annual Progress Report, April 1 – September 30, 2011. BP Exploration (Alaska), DOE Award No.: DE- DE-FC26-01NT41332. October 31, 2011. (click here)
14. Lorenson, T.D., and Collett T.S., 2011. Gas hydrate prospecting using well cuttings and mud-gas geochemistry from 35 wells, North Slope, Alaska: U.S. Geological Survey Scientific Investigations Report 2011-5195, 27 p., CD ROM, click here)
15. Lutken, C., 2012. Hydrate Research Activities that both Support and Derive from the Monitoring Station/Seafloor Observatory, Mississippi Canyon 118, Northern Gulf of Mexico, Semiannual Progress Report, July –December 2011, University of Mississippi, DOE Award No.: DE-FC26-06NT42877. February 2012.
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17. Santamarina, J. C., 2011. Methane Recovery from Hydrate-bearing Sediments. Final Project Report, Georgia Institute of Technology, DOE Award No.: DE-FC26-06NT42963. November 2011. (click here)
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19. Schoderbek, D., 2012. ConocoPhillips Gas Hydrate Production Test. Semi-Annual Progress Report, First Half, 2012, ConocoPhillips Gas Hydrate Production Test. DOE Award No.: DE-NT0006553. July 31, 2012. (click here)
20. Tréhu, A., 2011. Heat Flow and Gas Hydrates on the Continental Margin of India, Final Scientific/Technical Report. Oregon State University, DOE Award No.: DE-NT0005669. November, 2011. (click here)
21. Valentine, D., 2011. Assessing the Efficacy of the Aerobic Methanotrophic Biofilter in Methane Hydrate Environments, Quarterly Progress Report, July 2011 – September 2011. University of California Santa Barbara, DOE Award No.: DE-NT0005667. October 2011. (click here)
22. Valentine, D., 2012. Assessing the Efficacy of the Aerobic Methanotrophic Biofilter in Methane Hydrate Environments, Quarterly Progress Report, October 2011 – December 2011. University of California Santa Barbara, DOE Award No.: DE-NT0005667. February 2012. (click here)
23. Wooller, M., 2011. Source Characterization and Temporal Variation of Methane Seepage from Thermokarst Lakes on the Alaska North Slope in Response to Arctic Climate Change, Quarterly Progress Report, July 2011 – September 2011. University of Alaska Fairbanks, DOE Award No.: DE-NT0005665. October 2011. (click here)
24. Wooller, M., 2012. Source Characterization and Temporal Variation of Methane Seepage from Thermokarst Lakes on the Alaska North Slope in Response to Arctic Climate Change, Quarterly Progress Report, October 2011 – December 2011. University of Alaska Fairbanks, DOE Award No.: DE-NT0005665. February 2012. (click here)

Technical Presentations

1. Behseresht, J. and Bryant, S., 2011. Effect of relative permeability characteristics and gas/water flow on gas-hydrate saturation distribution. SPE Paper 147221 presented at SPE Annual Technical Conference and Exhibition, Oct. 30-Nov 2, Denver, CO.
2. Boswell, R., 2012, Gas hydrate E&P R&D at the US DOE. US-Norway MOU Workshop, September, 2012, Washington, DC.
3. Boswell, R., 2012. Gas hydrates: the next frontier energy resource and climate change wildcard? Invited presentation, AIChE, March 15, Pittsburgh, PA.
4. Boswell, R., 2012. A synoptic view of gas hydrates. Invited presentation, Gordon Research Conference, March 18, San Diego, CA.
5. Brothers, L.L., Hart, P.E., and Ruppel, C., 2011. Subsea permafrost mapped across the US Beaufort Sea using multichannel seismic data. Abstract GC511-06 presented at American Geophysical Union Fall Meeting, Dec. 5-9, San Francisco, CA.
6. Brothers, L.L., Van Dover, C.L., German, C.R., Kaiser, C.L., Yoerger, D.R., Ruppel, C.D., Lobecker, E., Skarke, A.D., 2012. Evidence of extensive gas venting at the Blake Ridge and Cape Fear diapirs. Presented at American Geophysical Union Fall Meeting, Dec. 5-9, San Francisco, CA.
7. Camilli, R., Farr, N., Pontbriand, C., Kapit, J., Ware, J., Pizarro, O., and Whelan, J., 2012. Long-term benthic boundary layer monitoring at the Mississippi Canyon Block 118 hydrates observatory. Presented at Ocean Sciences Annual Meeting, Feb. 19-24, Salt Lake City, UT.
8. Carrière, O. and Gerstoft, P., 2012. Cross-correlation processing for deepwater subseafloor imaging with an OBS array. Presented at Gordon Research Conference on Natural Gas Hydrate Systems, March 18-23, Ventura, CA.
9. Carrière, O. and Gerstoft, P., 2011. Monitoring gas hydrate with noise. Abstract OS12-06 presented at American Geophysical Union Fall Meeting, Dec. 5-9, San Francisco, CA.
10. Chatterjee, S., Dickens, G. R., Bhatnagar, G., Chapman, W. G., Dugan, B., Snyder, G.T., and Hirasaki, G.J., 2012. Modeling shallow pore water chemistry as a proxy for methane hydrate abundance in marine sediments. Presented at 1st International Conference on Upstream Engineering and Flow Assurance, American Institute of Chemical Engineers (AIChE), April 1-5, Houston, TX.
11. Chatterjee, S., 2012. Lithologic heterogeneities and focused fluid flow governing gas hydrate distribution in marine sediments. Presented at 1st International Conference on Upstream Engineering and Flow Assurance, American Institute of Chemical Engineers (AIChE), April 1-5, Houston, TX.
12. Chatterjee, S., 2012. Methane hydrate distribution in heterogeneous marine sediments. Presented at 5th Oil and Gas High Performance Computing Workshop, Rice University, March 1, Houston, TX.
13. Chatterjee, S., Dickens, G.R., Chapman, W.G., Dugan, B., Snyder, G.T., and Hirasaki, G.J., 2012. Modeling pore water profiles of marine gas hydrate systems: The extreme case of ODP Site 685/1230m Peru Margin. Presented at Gordon Research Conference on Natural Gas Hydrate Systems, March 18-23, Ventura, CA.
14. Collett, T.S., 2011. Gas hydrates energy resources - gas hydrate petroleum systems. Proceedings of the 7th International Conference on Asian Marine Geology, CSIR-National Institute of Oceanography, Oct. 11-14, 2011, Goa, India, 2 p.
15. Collett, T.S., 2011. The 2006 Indian National Gas Hydrate Program Expedition 01: operations and scientific results. Proceedings of the International Workshop on Scientific Drilling in the Indian Ocean, Oct. 17-18, 2011, Goa, India, 21 p.

16. Collett, T.S., and Dallimore, S., 2011. State-of-the-art scientific drilling operations and technology. Proceedings of the International Workshop on Catching Climate Change in Progress: Drilling on Circum-Arctic Shelves and Upper Continental Slopes, Dec. 10-11, 2011, San Francisco, CA, 1 p.
17. D'Emidio, M., Ingrassia, M., Lutken, C.B., Macelloni, L., Simonetti, A., Pizzi, M., Lapham, L.L., Wilson, R., Hsing, P., and Fisher, C., 2012. Biogeophysical classification of seafloor seeps at a carbonate-hydrate mound, Northern Gulf of Mexico. Poster presented at the Gordon Research Conference on Natural Gas Hydrate Systems, March 18-23, Ventura, CA.
18. D'Emidio, M., Ingrassia, M., Lutken, C.B., Macelloni, L., Simonetti, A., Pizzi, M., Lapham, L.L., Wilson, R., Hsing, P., and Fisher, C., 2012. Biogeophysical classification of seafloor seeps at a carbonate-hydrate mound, Northern Gulf of Mexico. Presented at Ocean Sciences Annual Meeting, February 19-24, Salt Lake City, UT.
19. Disenhof, C., Wooller, M., Pohlman, J.W., and Rose, K., 2011. Lithology of Alaskan thermokarst lake facilitates methane flux. Abstract GC41B-0806 presented at American Geophysical Union Fall Meeting, Dec. 5-9, San Francisco, CA.
20. Du Frane, W.L., Stern, L.A., Constable, S., Weitemeyer, K.A., and Roberts, J.J., 2011. Electrical properties of methane hydrate + sediment mixtures. Abstract OS12A-03 presented at American Geophysical Union Fall Meeting, Dec. 5-9, San Francisco, CA.
21. Dugan, B., Daigle, H., Chatterjee, S., Bhatnagar, G., Gu, G., Dickens, G.R., Hirasaki, G.J., and Chapman, W.G., 2011. Effects of flow focusing and geologic structures on gas hydrate saturation and distribution. Presented at Geological Society of America Annual Meeting, October 11, Minneapolis, MN.
22. Dunbar, J. A., 2012. Extrusion model for the distribution of hydrate at Woolsey Mound, Mississippi Canyon, Block 118, Gulf of Mexico. Presented at 2012 Ocean Sciences Annual Meeting, February 19-24, Salt Lake City, UT.
23. Easson, G., Lutken, C., Sleeper, K., Macelloni, L., and D'Emidio, M., 2012. Gas Hydrates Observatory at Mississippi Canyon 118. Presented at Ocean Sciences Annual Meeting, February 19-24, Salt Lake City, UT.
24. Edwards, B.D., Saint-Ange, F., Pohlman, J., Higgins, J., Mosher, D.C., Lorenson, T.D., and Hart, P.E., 2011. Sedimentology of cores recovered from the Canada Basin of the Arctic Ocean. Abstract PP33A-1915 presented at American Geophysical Union Fall Meeting, Dec. 5-9, San Francisco, CA.
25. Elliott, K., Van Dover, C.L., German, C.R., Kaiser, C.L., Brothers, L., Yoerger, D.R., Kinsey, J.C., Coleman, D.F., Martinez, C., Pinner, W., and Kennedy, B.R., 2012. Integrating telepresence technologies with AUV operations for exploration of cold seep communities in the vicinity of Blake Ridge and Cape Fear Diapirs in the Western Atlantic. Abstract OS51D-1914 presented at American Geophysical Union Fall Meeting, Dec. 5-9, San Francisco, CA.
26. Everett, S.M., Rawn, C.J., Chakoumakos, B.C., Keffer, D.J., Huq, A., and Phelps, T.J., 2012. Neutron Diffraction Studies of Mixed CO2 – CH4 Gas Hydrates. Poster presentation at the Gordon Research Conference for Natural Gas Hydrate Systems, March, Ventura, CA.
27. Everett, S.M., Rawn, C.J., Chakoumakos, B.C., Keffer, D.J., Huq, A., and Phelps, T.J., 2012. Molecular visualization of CH4 and CO2 in mixed gas hydrates by high resolution neutron diffraction. Presentation at the STAIR annual meeting, May, Elizabethton, TN.
28. Everett, S.M., Rawn, C.J., Chakoumakos, B.C., Keffer, D.J., Huq, A., and Phelps, T.J., 2012. Molecular visualization of CH4 and CO2 in mixed gas hydrates by high resolution neutron diffraction. Presented at the American Crystallographic Association meeting, July, Boston, MA.
29. Farr, N., Sleeper, K., Camilli, R., Pontbriand, C., and Ware, J., 2011. New developments in optic modems and chemical sensors in deep marine environments. Abstract OS13D-1558 presented at American Geophysical Union Fall Meeting, Dec 5-9, San Francisco, CA.

30. Gaddipati, M. and Anderson, B.J., 2012. 3D Reservoir modeling of depressurization-induced gas production from gas hydrate reservoirs at the Walker Ridge site, Northern Gulf of Mexico. Paper OTC 23582 presented at Offshore Technology Conference, Apr. 30-May 3, Houston, TX.
31. Garapati, N. and Anderson, B.J., 2012. Implementation of cell potential code into HydrateResSim simulator. CO2 Capture, Sequestration, Conversion and Utilization, FUEL: Division of Fuel Chemistry, 243rd ACS National Meeting, San Diego, CA.
32. Garapati, N. and Anderson, B.J., 2012. Injection of Carbon Dioxide and Nitrogen in to Methane Hydrate Reservoirs: Binary HydrateResSim Simulations. AICHE Annual meeting, Pittsburgh, PA.
33. Garapati, N., Velaga, S., and Anderson, B.J., 2012. Gas Hydrates Modeling: Spanning Multiple Scales. AICHE Annual meeting, Pittsburgh, PA, USA, 2012.
34. Hart, P. and Ruppel, C., 2012. Gas hydrates on the Beaufort outer continental slope, IODP workshop on Beaufort Sea drilling, February 12-15, Kananaskis, Alberta.
35. He, R., Wooller, M.J., Pohlman, J.W., Quensen, J., Tiedje, J.M., and Leigh, M.B., 2011. Diversity of aerobic methanotrophs and their response to temperature changes in arctic lake sediments. Presented at American Geophysical Union Fall Meeting, Dec. 5-9, San Francisco, CA.
36. He., R., Leigh, M.B., Pohlman J.W., and Wooller M.J., 2011. Active methanotrophs and their response to temperature changes in arctic lake sediments. Abstract B13F-0641 presented at American Geophysical Union Fall Meeting, Dec 5-9, San Francisco, CA.
37. Hester, K.C., 2011. Energy production from natural gas hydrate deposits through CO_2exchange: Concept, advantages, and challenges. Symposium on Natural Gas Hydrates at Institute of Advanced Sustainability Studies (IASS), November, Potsdam, Germany.
38. Hunt, A., Pohlman, J., Stern, L., Ruppel, C., Moscati, R., Landis, G., and Pinkston, J., 2011. Observations of mass fractionation of noble gases in synthetic methane hydrate. International Conference on Gas Geochemistry 2011, December, La Jolla, CA.
39. Joseph, C., Torres, M., Martin, R., Rose, K., Pohlman J.W., and Riedel, M., 2011. Methane sources, fluid flow, and diagenesis along the northern Cascadia Margin: Using the carbonate record to link modern fluid flow to the past. Presented at American Geophysical Union Fall Meeting, Dec. 5-9, San Francisco, CA.
40. Kannberg, P.K., Constable, S., Weitemeyer, K.A., and Trehu, A.M., 2011. Resistivity structure at the summit of South Hydrate Ridge, Abstract OS13C-1547 presented at American Geophysical Union Fall Meeting, Dec. 5-9, San Francisco, CA.
41. Kapit, J., Camilli, R., Farr, N., Ware, J., Pontbriand, C., Hammer, B., and Backus, S., 2012. Improving the sustainability of long-term uncabled hydrate observatories: Technologies for efficient data retrieval and renewable power. Ocean Sciences Annual Meeting, February 19-24, Salt Lake City, UT.
42. Kelley, J.T. and Brothers, L.L., 2012. Northeast pockmark fields: Shallow marine liquefaction landforms resulting from seismic events? Presented at the Northeastern Section GSA Meeting, GSA Abstracts with Programs, Vol. 41, No. 3
43. Kim, J. and Moridis, G.J., 2012. Modeling and Numerical Simulation for Coupled Flow and Geomechanics in Composite Gas Hydrate Deposits. Presented at the 46th U.S. Rock Mechanics/Geomechanics Symposium, June 24-27, Chicago, IL.
44. Kim, J., Moridis, G.J., Yang, D., and Rutqvist, J., 2012. Numerical studies on two-way coupled fluid flow and geomechanics in hydrate deposits. SPE Conference Paper 141304, 17 p.
45. Klein, D., Schoderbek, D., and Howard, J., 2012. Comparative Formation Evaluation Methodologies for Gas Hydrate Evaluation in Iġnik Sikumi #1, Alaska North Slope, AAPG 2012 Annual Convention and Exhibition, April 22-25, Long Beach, CA.

46. Kullerud, L. and Beaudoin, Y., 2012. Frozen Heat: UNEP Global Outlook on Methane Gas Hydrates, Arctic Frontiers 2012, January 25-27, Tromso, Norway.
47. Lapham, L.L., Wilson, R.M., Riedel, M., and Chanton, J., 2012. Measuring in-situ methane concentrations over time near Bullseye vent, Vancouver Island. Presented at the Gordon Research Conference on Natural Gas Hydrate Systems, March 18-23, Ventura, CA.
48. Leifer, I., Rehder, G.J., Solomon, E.A., Kastner, M., Asper, V.L., Joye, S.B., 2011. Methane rising from the deep: Hydrates, bubbles, oil spills, and global warming. Presented at American Geophysical Union Fall Meeting, Dec. 5-9, San Francisco, CA.
49. Lorenson, T.D., Hart, P.E, Pohlman, J., and Edwards, B.D, 2011. Sources and implications of hydrocarbon gases from the deep Beaufort Sea, Alaska. Abstract PP33A-1918 presented at American Geophysical Union Fall Meeting, Dec. 5-9, San Francisco, CA.
50. Lorenson, T.D., Collett, T.S., and Schoderbek, D.A., 2012. Geochemical evidence for gas hydrate occurrences in ConocoPhillips gas hydrate production test well, North Slope, Alaska, AAPG 2012 Annual Convention and Exhibition, April 22-25, Long Beach, CA.
51. Lorenson, T.D., Collett, T.S., and the Ignik Sikumi Scientific Party, 2012. Geochemical monitoring of gas hydrate production by CO2/CH4 exchange in the Ignik Sikumi gas hydrate production test well, Alaska North Slope, Abstract OS33E-04 presented at the American Geophysical Union Fall Meeting, Dec. 3-7, San Francisco, CA.
52. Lutken, C., Simonetti, A., Ingrassia, M., Macelloni, L., Knapp, J., Fisher, C., Caruso, S., and D'Emidio, M., 2011. Biogeophysical classification of seafloor seeps at a carbonate-hydrate mound, northern Gulf of Mexico. Presented at AAPG International Conference and Exhibition, October 23-27, Milan, Italy.
53. Lutken, C., Sleeper, K., Easson, G., Macelloni, L., and Smith, G., 2012. The GOM Gas Hydrates Seafloor Observatory: Producing Science for National and Global Management Decisions, AGU Science Policy Conference 2012, April 29-May 2, Washington, DC.
54. Martens, C., Mendlovitz, H., White, B., Hoer, D., Sleeper, K., Chanton, J., Wilson, R., and Lapham, L., 2011. Continuous In Situ Measurements of Near Bottom Chemistry and Sediment-Water Fluxes with the Chimney Sampler Array, Abstract OS31B-08 presented at the American Geophysical Union Fall Meeting, Dec. 5-9, San Francisco, CA.
55. Maue, C., Yvon-Lewis, S.A., Kessler, J.D., Pohlman, J.W., Bergeron, E., Worley, C., Ruppel, C.D., and Sparrow, K., 2012. Monitoring methane fluxes with an integrated seawater equilibrator and cavity ring-down spectrometer (CRDS): System validation and application. Ocean Sciences Meeting, Feb 20-24, Salt Lake City, UT.
56. Moridis, G.J., 2012. Recent modeling studies of gas production from hydrate deposits and of the corresponding geomechanical system response. Keynote Speaker, 34th International Geological Congress, August 5-10, Brisbane, Australia.
57. Moridis, G.J., 2012. Evaluation of CO2 substitution for CH4 in hydrate-bearing media. Invited speaker, Gordon Research Conference on Natural Gas Hydrate Systems, March 18-23, Ventura, CA.
58. Pack, M.A., Pohlman, J.W., Ruppel, C., and Xu., X., 2012. Low-level 14C methane oxidation rate measurements modified for remote field settings. Abstract OS43B-1823 presented at the American Geophysical Union Fall Meeting, Dec. 3-7, San Francisco, CA.
59. Pizzi, M., Macelloni, L., Lutken, C., and D'Emidio, M., 2012. Temporal evolution of MC118 Woolsey Mound seep activity: constraints from analysis of small-scale salt-induced sediment deformation, The Gordon Research Conference on Natural Gas Hydrate Systems, March 18-23, Ventura, CA.
60. Pohlman, J.W., Kessler, J.K., Maue, C., Yvon-Lewis, S.A., Ruppel, C.D., Brothers, L., Sparrow, K., Bergeron, E., and Worley, C., 2012. Methane fluxes to the atmosphere from thawing submarine permafrost in the shallow Beaufort Sea, Alaska. Ocean Sciences Meeting, Feb 20-24, Salt Lake City, UT.

61. Pohlman, J.W., Lorenson, T.D., Hart, P.E, Ruppel, C.D., Joseph, C., Torres, M.E., and Edwards, B.D., 2011. Evidence for Freshwater Discharge at a Gas Hydrate-Bearing Seafloor Mound on the Beaufort Sea Continental Slope. Abstract GC41B-0813 presented at American Geophysical Union Fall Meeting, Dec. 5-9, San Francisco, CA.
62. Powell, C.L., Valentich-Scott, P., Lorenson, T.D., and Edwards, B.D., 2011. Megafauna recovered from a cold hydrocarbon seep in the deep Alaskan Beaufort Sea, including a new species of Axinus (Thracidae: Bivalvia: Mollusca). Abstract PP33A-1917 presented at American Geophysical Union Fall Meeting, Dec. 5-9, San Francisco, CA.
63. Reagan, M.T., 2012. Consequences of hydrate dissociation in response to climate change. Poster presented at the 2nd Gordon Research Conference on Natural Gas Hydrates, March 18-23, Ventura, CA.
64. Reagan, M.T., 2012. Massively parallel simulation of field-scale oceanic gas hydrate deposits. AIChE Spring Meeting, April 1-5, Houston, TX.
65. Reagan, M.T., Moridis, G.J., Boyle, K.L., Freeman, C.M., Pan, L., Keen, N., and Husebo, J.A., 2012. Massively parallel simulation of field-scale oceanic gas hydrate deposits. Proceedings of the 2012 TOUGH Symposium, September 17-19, Berkeley, CA.
66. Rees E.V., Nakagawa, S., and Kneafsey, T.J., 2011. Seismic property changes in methane gas hydrate bearing sediments during geomechanical testing. Abstract GC41B-0804 presented at American Geophysical Union Fall Meeting, Dec. 5-9, San Francisco, CA.
67. Rosenbaum, E. and Seol, Y., 2012. Pore scale characterization of hydrate bearing sediments: Utilizing micro x-ray CT scanner. Presented at the Gordon Research Conference on Natural Gas Hydrates, March 18, Ventura, CA.
68. Ruppel, C., Brothers, L.L., Hart, P.E., and Worley, C., 2011. The distribution of subsea permafrost and shallow methane on the central U.S. Beaufort Inner Shelf from newly acquired geophysical data, AGU Fall Meeting, Abstract GC52A-04.
69. Ruppel, C., 2012. Summary of IODP USSSP workshop on scientific drilling in the Circum-Arctic, at: IODP workshop on Beaufort Sea drilling, Kananaskis, Canada, 12-15 February.
70. Ruppel, C., 2012. Scientific drilling of a shelf-upper continental slope transect on the US Beaufort Sea passive margin, IODP workshop on Beaufort Sea drilling, Kananaskis, Canada, 12-15 February, 2012.
71. Scandella, B., Hemond, H., Ruppel, C.D., and Juanes, R., 2011. Escape paths for biogenic methane gas in lake sediments: morphology and dynamics. Abstract H21B-1089 presented at American Geophysical Union Fall Meeting, Dec. 5-9, San Francisco, CA.
72. Schoderbek, D., 2012. ConocoPhillips north slope hydrate exchange field trial: Overview and update. Society of Petroleum Engineers, Alaska Section, February 16, 2012.
73. Seol, Y., Choi, J., Boswell, R., Rosenbaum, E., and Juanes, R., 2011. X-ray computed-tomography imaging of preferential mode of gas migration through water-saturated sediments. Presented at American Geophysical Union Fall Meeting, December 5-9, San Francisco, CA.
74. Seol, Y. and Boswell, R., 2012. Progress in gas hydrate research and development in the United States. Fiery Ice, the 8th International Workshop for Methane Hydrate Research and Development, Sapporo, Japan, May 28 – June 1, 2012.
75. Seol, Y., Rosenbaum, E., and Boswell, R., 2012. Methane hydrate accumulation habits in porous media: X-ray CT scans and core scale modeling. Fiery Ice, the 8th International Workshop for Methane Hydrate Research and Development, Sapporo, Japan, May 28 – June 1, 2012.
76. Simonetti, A., Knapp, J., Knapp, C., and Lutken, C., 2012. 4d seismic imaging of a thermogenic gas hydrate system in the northern Gulf of Mexico (Woolsey Mound, MC118). Presented at The Gordon Research Conference on Natural Gas Hydrate Systems, March 18-22, Ventura, CA.

77. Simonetti, A., Knapp, J., Riedel, M., and Knapp, C., 2012. Short and long-term dynamics of a thermogenic gas hydrate system in a cold seep area in the Gulf of Mexico deep waters (Woolsey Mound, MC118). Presented at 15th Annual AAPG-SEG Student Expo, September 17-18, Houston, TX.

78. Sleeper, K., Wilson, R., Chanton, J., Lapham, L., Farr, N., Camilli, R., Martens, C., and Pontbriand, C., 2011. Geochemical Arrays at Woolsey Mound Seafloor Observatory. Abstract OS13C-1545 presented at the American Geophysical Union Fall Meeting, Dec. 12-16, San Francisco, CA.

79. Stein, R., Coakley, B., Mikkelsen, N., O'Regan, M., and Ruppel, C., 2012. Future scientific drilling in the Arctic Ocean: Key objectives, areas, and strategies, EGU General Assembly, Abstract 1824.

80. Terry, D., Knapp, C., and Knapp, J., 2011. Effective-medium modules for marine gas hydrates, Mallik revisited. Abstract OS13C-1540 presented at the American Geophysical Union Fall Meeting, Dec. 5-9, San Francisco, CA.

81. Treude, T., Krause, S., Hamdan, L., Schweers, J., and Coffin, R., 2012. Decoupled anaerobic oxidation of methane and sulfate reduction within the methanogenic zone of Arctic sediments (Beaufort Sea, Alaska). European Geological Union, EGU2012-10644.

82. Velaga, S. and Anderson, B. J., 2012. Development and Testing of CO2-H2O Potentials for Gas Hydrate and Liquid Phases. CO2 Capture, Sequestration, Conversion and Utilization, FUEL: Division of Fuel Chemistry, 243rd ACS National Meeting, March, 2012, San Diego, CA.

83. Velaga, S. and Anderson, B. J., 2012. Understanding the Stability of Mixed Hydrates Containing Propane, Ethane and Methane under Deep Water Conditions. AICHE Annual meeting, Pittsburgh, PA.

84. Wilson, R.M., Lapham, L.L., Anderson, B., Garapati, N., and Chanton, J., 2012. Laboratory experiments probe hydrate dissolution rates. Poster presented at the Gordon Research Conference on Natural Gas Hydrate Systems, March 18-23, Ventura, CA.

85. Wilson, R.M., Lapham, L.L., Martens, C.S., Chanton, J.P., Mendlovitz, H., Sleeper, K., and Riedel, M., 2012. Time-series methane monitoring in gassy sediments and the benthic boundary layer. Ocean Sciences Annual Meeting, February 20-24, Salt Lake City, UT.