U.S. DEPARTMENT OF ENERGY

Fiscal Year 2014 Methane Hydrate Program

Report to Congress
March 2016

United States Department of Energy
Washington, DC 20585

Message from the Secretary

The Department of Energy is required[1] 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 to Congress, *Fiscal Year 2014 Methane Hydrate Program*. The report was prepared by the Department of Energy's Office of Fossil Energy and summarizes the progress made in this area of research.

This report is being provided to the following Members of Congress:

- **The Honorable Joseph R. Biden, Jr.**
  President of the Senate
- **The Honorable Paul Ryan**
  Speaker of the House of Representatives
- **The Honorable Lisa Murkowski**
  Chairwoman, Senate Committee on Energy and Natural Resources
- **The Honorable Maria Cantwell**
  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 Frank Pallone, Jr.**
  Ranking Member, House Committee on Energy and Commerce
- **The Honorable Thad Cochran**
  Chairman, Senate Committee on Appropriations
- **The Honorable Barbara Mikulski**
  Ranking Member, Senate Committee on Appropriations
- **The Honorable Harold Rogers**
  Chairman, House Committee on Appropriations
- **The Honorable Nita M. Lowey**
  Ranking Member, House Committee on Appropriations

[1] Section 968 of the Energy Policy Act of 2005

- **The Honorable Lamar Alexander**
  Chairman, Subcommittee on Energy and Water Development
  Senate Committee on Appropriations
- **The Honorable Dianne Feinstein**
  Ranking Member, Subcommittee on Energy and Water Development
  Senate Committee on Appropriations
- **The Honorable Mike Simpson**
  Chairman, Subcommittee on Energy and Water Development
  House Committee on Appropriations
- **The Honorable Marcy Kaptur**
  Ranking Member, Subcommittee on Energy and Water Development
  House Committee on Appropriations

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

Sincerely,

Ernest J. Moniz

Executive Summary

This report describes actions taken in Fiscal Year (FY) 2014 to implement DOE's methane hydrate research and development program (the Program)[2]. This report outlines key accomplishments of the Program during FY 2014 and provides a bibliography of peer-reviewed papers, articles, and conference presentations that appeared during the year. The Energy Policy Act of 2005 stipulated that the Secretary of Energy provide this report to Congress annually.

The Program is managed within the Department of Energy (DOE) by the Office of Oil and Natural Gas and conducted through the National Energy Technology Laboratory (NETL). The fundamental goals and nature of the program remained as in prior years – conduct collaborative R&D to deliver science and technology to further understand the nature and regional context of gas hydrate deposits, the physical properties and characteristics of gas hydrate-bearing sediments and environmental implications of naturally-occurring methane hydrate.

In FY 2014, the Program received $8 million in direct appropriations for R&D related to methane hydrates. With this funding, the Program continued its cooperative efforts with industry, academia, national laboratories, and international partners to expand its research portfolio through one new financial assistance award in the area of U.S. deepwater gas hydrate resource characterization. This new contract was awarded to a research team led by the University of Texas-Austin to conduct further deepwater gas hydrate exploration and sampling at sites identified by prior DOE-funded expeditions. This project is fully integrated into the existing portfolio of 23 projects awarded through financial assistance opportunity announcements in prior years.

The Program also maintained active international collaborations throughout FY 2014 highlighted by the continuing collaboration with Japan on the development of viable project structures for potential methane hydrate recovery research in Alaska; as well as developing and testing of marine gas hydrate sampling and analysis devices.

[2] Authorized by the Methane Hydrate Research and Development Act of 2000 (30 U.S.C. 1902 et seq.; Public Law 106-193) as amended by the Energy Policy Act of 2005 (EPAct)

FISCAL YEAR 2014 METHANE HYDRATE PROGRAM

Table of Contents

I. Legislative Action

This report describes actions taken in Fiscal Year (FY) 2014 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 2014

In FY 2014, DOE continued field-based evaluations of gas hydrate phenomena. The year was marked by completion and close-out of long-standing cooperative agreements with Chevron and BP-Alaska. The Program also continued advancement of gas hydrate science and technology through various national laboratory projects, interagency agreements, and 24 cooperative agreements (primarily with universities). There were two key results from the FY 2014 Funding Opportunity Announcement (FOA): (1) selection and award of a new financial assistance agreement project with the University of Texas-Austin designed to gather *in situ* data from known and prospective gas hydrate deposits in the northern Gulf of Mexico; and (2) a lack of responsive applications to a call for collaborative research on gas hydrates on state lands in Alaska resulted in the further pursuit of direct collaboration among DOE, the USGS and Japan in this area.

Gas Hydrate Characterization Technologies

A key goal of the Program in FY 2014 was to work on determining the scale and nature of occurrence of gas hydrate on the U.S. Outer Continental Shelf. Since 2001, the flagship project in this effort has been the Gulf of Mexico Gas Hydrates Joint Industry Project (JIP), a cooperative research program between the DOE (in coordination with the USGS and BOEM) and an international consortium of industry partners under the leadership of Chevron. One of the specific objectives of the project was to assess the risks naturally-occurring gas hydrate poses to deepwater drilling; development of technologies to improve the detection, delineation, and characterization of marine gas hydrate; and creation of new tools for deepwater gas hydrate sample acquisition and analysis.

The JIP also provided the Program with the means to stage two major deepwater field expeditions guided by broad participation from numerous federal agencies, private companies, and academic institutions to test technologies and better describe the nature of gas hydrate resources: (1) a 2005 "Leg I" expedition and associated studies (scientific results published in FY 2009) that helped resolve the issue of drilling safely through the most typical gas-hydrate bearing sediments; and (2) a 2009 "Leg II" expedition (scientific results published in FY 2012) that discovered resource-grade gas hydrates and provided initial confirmation of the BOEM's 2008 gas hydrate resource assessment that attributed more than 6,000 trillion cubic feet of potentially recoverable gas hydrate in the Gulf of Mexico.

Since 2012, the JIP worked to further the development of deepwater pressure-coring tools and compatible pressure-core analysis devices. Field tests in FY 2013 of project-developed core analysis systems were conducted in Japan in collaboration with Japan, the USGS, and Georgia Tech. Construction of the Hybrid Pressure Coring System was completed in FY 2013 with land-based testing conducted in FY 2014. When testing, development, and prioritization of the remaining opportunities for tool improvement were completed, the project ended in FY 2014 and the tools were transferred to DOE.

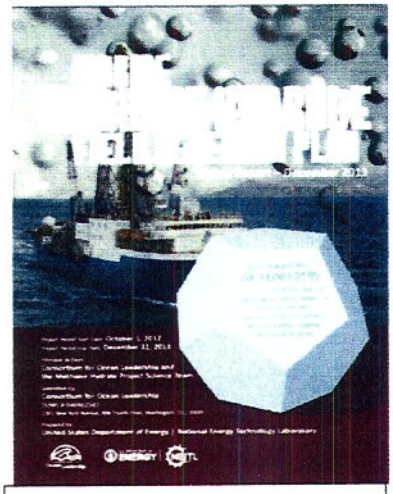


Figure 1: *A consensus view on the primary opportunities in domestic marine gas hydrate science (as reported by the Consortium for Ocean Leadership, Dec. 2013).*

The end of the JIP effort signaled the decreasing feasibility of collaboration with industry and utilization of industry drill ships for marine gas hydrate science. DOE worked with the Consortium for Ocean Leadership to develop science plans that would be consistent with use of established scientific drill ships such as those managed under the Integrated Ocean Drilling Program. This effort published the "Marine Methane Hydrate Field Research Plan" in the first quarter of FY 2014 (**Figure 1**). In the second quarter of FY 2014, DOE solicited new projects to pursue field evaluation of domestic marine gas hydrates, including the collection and analysis of samples for detailed evaluation of their potential response to both natural (climate-driven) and induced (resource extraction) environmental change. In late FY 2014, NETL awarded a new project to the University of Texas-Austin (see Appendix A for press release).

The program continued to support projects awarded in prior fiscal years that address the issue of gas hydrate characterization through seismic data interpretation. Two projects (with Oklahoma State University and Fugro GeoConsulting) utilized the log data acquired during the DOE-JIP 2009 expedition to further the calibration of gas hydrate saturation estimation from seismic data, as well as to improve the ability to delineate areas of potential free gas hazards (drilling hazards posed by the occurrence of free gas trapped at the base of the gas hydrate stability zone) that may be masked by association with overlying gas hydrates. In addition, an experimental effort with the Colorado School of Mines continued to develop experimental data to elucidate the controls of gas hydrate habit (i.e., the manner in which hydrate occurs) and saturation on acoustic wave velocities. A fourth project, with the Ohio State University, is enabling a comprehensive evaluation of potential gas hydrate occurrence in more than 1,700 industry well logs from the deepwater Gulf of Mexico (**Figure 2**). Each of these projects is scheduled for completion in FY 2015-16.

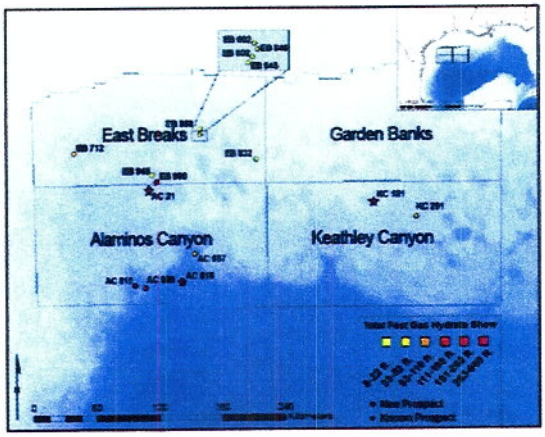


Figure 2: *Industry wells that contain previously reported (stars) and unreported (circles) gas hydrate in the northwestern Gulf of Mexico (as reported by Cook et al., 2014 DOE/NETL Fire in the Ice Newsletter).*

In FY 2013, DOE collaborated with BOEM and USGS to fund and plan a field program (conducted by the USGS) to gather high-resolution 2-D reflection seismic - as well as ocean-bottom seismic (OBS) - over the gas hydrate deposits that had been discovered during the 2009 DOE-Chevron JIP drilling. This program represented the first acquisition of high-resolution seismic data at the sites of known, high-concentration gas hydrates, and also the first to have available full, research-level well-log data to enable seismic data calibration. These data were initially reported in FY 2014 and are now publically available to guide any future gas hydrate pressure-coring research.

Other marine characterization projects added to the program portfolio late in FY 2013 were continued through FY 2014 and include an effort with Georgia Tech to develop new tools for the in situ measurement of the geomechanical properties of gas hydrate-bearing sediments. Such data cannot be gathered from standard cores or from well logging devices. A second project with UT-Austin, Ohio State, and Columbia University, utilized data obtained in the 2009 Gulf of Mexico drilling program to determine the nature of gas sourcing to resource-grade gas hydrates, including the potential for widespread contribution from deeper thermogenic gas sources. Current BOEM and other assessments generally rely solely on biogenic sources when estimating a region's gas hydrate potential.

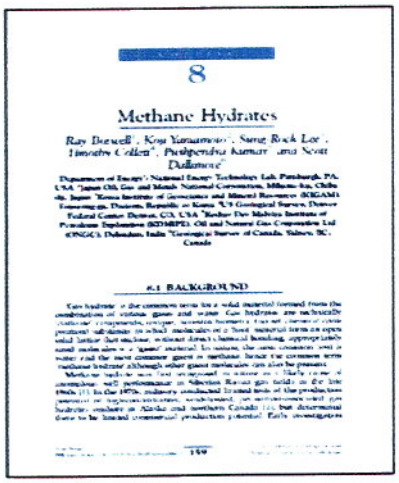
Gas Hydrate Recovery Technologies

From 2001 until 2014, DOE maintained a cooperative agreement with BP Exploration-Alaska (BPXA). The goal of the collaboration was to characterize the nature and commercial implications of gas hydrate resources on the Alaska North Slope (ANS) 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 full, peer-reviewed, scientific results volume published in FY 2011), remained active into FY 2014 as both parties continued to explore options for cooperative research. In the second quarter of FY 2014, a decision was made by BP not to continue the project due to various reasons, including the imminent sale by BP of its relevant Alaska acreage, which includes the Milne Point Unit (MPU) on the ANS.

The interagency methane hydrate effort to investigate recovery of onshore methane hydrate resources in Alaska continued however, and was primarily focused on unleased acreage just to the east of Milne Point that was set aside by the Alaska Department of Natural Resources (AK DNR) in August 2013 until the potential use of that acreage for possible DOE gas hydrate R&D could be determined. After a series of public meetings to gauge industry interest, DOE solicited proposals in March 2014 for gas hydrate studies on the set-aside lands; however, changes in the prioritization of gas hydrate R&D within the interested companies resulted in no acceptable proposals being submitted. DOE then continued to work with the state of Alaska and the Japan Oil Gas and Metals National Corporation (JOGMEC) to explore other viable project structures.

Collaborative work with the Japan Oil Gas and Metals National Corporation (JOGMEC) and USGS continued review of available data to assess the presence and nature of methane hydrates within the acreage, and late in FY 2014, the AK DNR extended the lease set-aside for another 12 month

period. To facilitate this collaboration, NETL and JOGMEC began an effort to develop a Memorandum of Understanding in FY 2014.



8

Methane Hydrates

6.1 BACKGROUND

Figure 3: *State of the art review of gas hydrate production technology based on cumulative learnings from International field experiments as reported by Boswell et al., 2014 in Elsevier's Future Energy, 2nd Edition.*

Analysis and reporting on prior year efforts also continued in FY 2014. An international consensus review of gas hydrate production technology was published as a Chapter in Elsevier's Future Energy (2nd Edition) (**Figure 3**).

Also notable is the initial report on the scientific findings of the FY 2012, ConocoPhillips-Alaska-DOE-JOGMEC field trial of gas hydrate response to injection of CO_2+N_2 mixed gas (**Figure 4**). That review included the following primary conclusions: 1) confirmation of the presence of free water within the gas hydrate reservoir, a finding with significant implications for recovery processes based on injection; 2) induced gas hydrate destabilization is strongly self-limiting, dispelling any notion of the potential for uncontrolled destabilization; 3) appropriate gas mixes can be successfully injected into hydrate-bearing reservoirs; 4) sand production can be managed through standard engineering controls; 5) reservoir heat exchange during depressurization was much more favorable than expected – largely mitigating concerns for near-well-bore freezing, and; 6) CO_2-CH_4 exchange can be accomplished in natural reservoirs, although the extent is unknown.

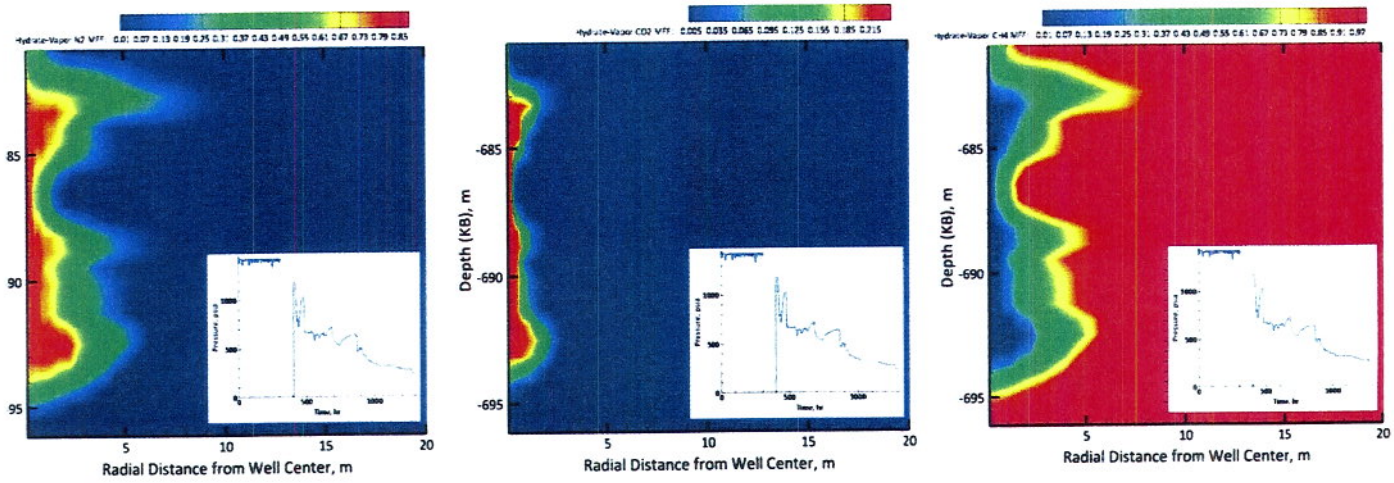


Figure 4: *Distribution of various chemical species (N_2 (left), CO_2, and CH_4(right)) within gas hydrate at the end of the Iġnik Sikumi injection phase (as reported in Anderson et al., 2014, International Conference on Gas Hydrates).* The color bar represents the proportion (%) of each gas species to the total gas phase.

Gas Hydrate Environmental and Global Climate Studies

In FY 2014 DOE continued to support a range of studies designed to determine the sources, sinks, and fluxes of methane in gas-hydrate-bearing environments. The goal was to understand what role gas hydrate plays in natural geohazards, in the global cycling of carbon over long time frames, and in the potential nearer-term feedbacks in response to warming climates. This effort reflects DOE's effort to be responsive to the intent of the original Methane Hydrate Research and Development Act, which directs 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.

The FY 2014 DOE portfolio in this area was focused on a mix of numerical modeling and field data collection efforts designed to inform predictive models with accurate characterizations of gas hydrate occurrence in climate sensitive settings; to record evidence of gas hydrate formation and dissociation, to evaluate potential links between those phenomena and ongoing environmental change; and to determine the flux and fate of methane between sediments, the oceans, and the atmosphere.

In the U.S. Arctic (Beaufort Shelf), Southern Methodist University and the University of California San Diego (UCSD) - Scripps Institute of Oceanography continued efforts to understand potential gas hydrate occurrence and dynamics. UCSD completed a shallow controlled-source electromagnetic (CSEM) survey designed to constrain the distribution of relict permafrost on the near-shore shallow shelf (**Figure 5**), while SMU studied the dynamics of deepwater gas hydrate stability via modeling of heat flow data in comparison to seismically-imaged distributions of gas hydrate stability.

A number projects selected in prior Fiscal Years continued to investigate potential deepwater gas hydrate-climate linkages in FY 2014. The University of Texas-Austin continued 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. The University of Oregon contributed fundamental studies of the linkages of gas hydrate occurrence on sediment strength and potential natural geohazards such as gas venting and seafloor instability. In the Gulf of Mexico, the University of Mississippi deployed and retrieved instruments designed to capture temporal changes in hydrate systems associated with sea-floor mounds using time-lapse electrical resistivity methods. The USGS (via funding support from a DOE-USGS Interagency Agreement) participated in FY 2014 field expeditions to the U.S. mid-Atlantic and Svalbard North Atlantic margins to measure rates of gas flux from recently-observed deepwater seeps. On the Pacific Margin, the University of Washington gathered time-series data on ocean temperatures and locations of methane releases (**Figure 5**).

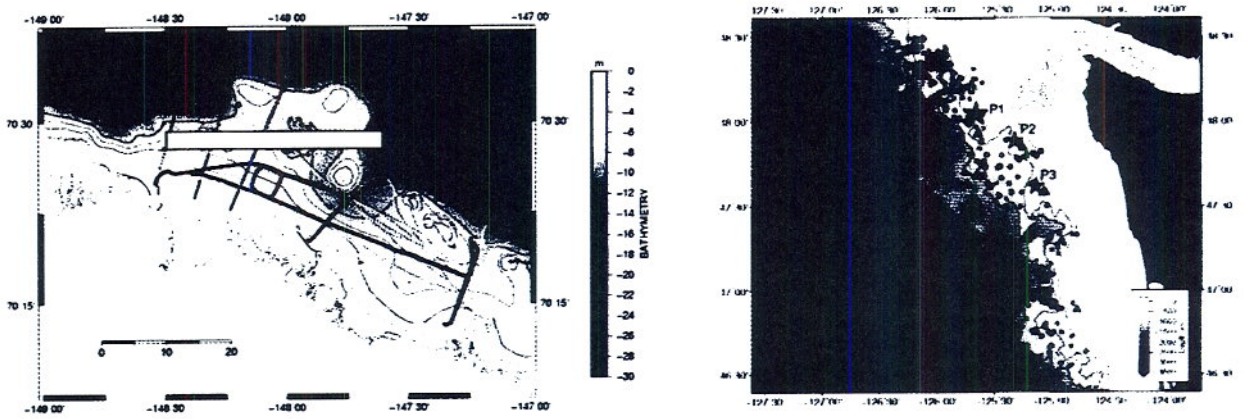


Figure 5: *Left: Tracklines of CSEM data collected by Scripps Institute of Oceanography in 2014. The data are designed to constrain the current extent of relict permafrost on the shallow US Arctic (Beaufort) shelf. Right: Ocean temperature data gathered by the U. Washington that supports modeling of the causes and rates of methane release along the U.S. Pacific Northwest continental margin.*

Fundamental Experimental and Modeling Studies

In FY 2014, the Program supported focused experimental and numerical modeling studies to provide foundational science regarding the nature of hydrate-bearing sediments and their potential response to changes in their environment, either natural or induced. Texas A&M and Georgia Tech focused on integrating hydraulic/petrophysical characteristics with geomechanical modeling to expand the ability of models to capture not only fluid movement but potential grain mobilization/reorganization as well. Studies at Wayne State University (now transferred to Arizona State University) provided improved parameterization of capillary pressure and relative permeability phenomena for use across the entire range of gas hydrate numerical simulation.

The Colorado School of Mines continued its experimental effort to validate current models for the interpretation of gas hydrate saturation from seismic data. FY 2014 research conducted at NETL was highlighted by new information on the geomechanical and acoustic properties of laboratory-synthesized, non-cementing hydrate-bearing sediments. Improvement of simulation capabilities for evaluation of the response of gas hydrate deposits using depressurization continued throughout FY 2014 at Lawrence Berkeley National Laboratory (LBNL), Pacific Northwest National Laboratory (PNNL) and NETL with a focus on the geomechanical implications of production. LBNL, along with PNNL, also continued international collaborative research activities with the Korea Institutes of Geosciences and Mineral Resources (KIGAM) to assess gas hydrate reservoir data acquired during 2010 drilling in Korea.

International Collaboration

DOE maintained active engagement and discussion with the world's leading international gas hydrate R&D programs in FY 2014. Formal departmental-level agreements continued with the governments of Japan (Ministry of Economy, Trade, and Industry), and Korea (Ministry of Knowledge Economy). Extensive coordination of research objectives continued with the Japanese program, including the further refinement of marine pressure coring and core analysis

devices. DOE (with USGS and BOEM) also actively collaborated with India (Directorate General of Hydrocarbons).

DOE-NETL maintains active collaborations and communications with gas hydrate efforts in New Zealand, China, Canada, and Taiwan. DOE-NETL also presented on gas hydrate exploration fundamentals in Brazil at the request of Petrobras.

Fellowship Program

NETL, in cooperation with the National Academies, first awarded National Gas Hydrate R&D Program Fellowships in 2007. Active fellows in FY 2014 included Dr. Jennifer Fredericks (Desert Research Institute and U. California-Berkeley) and Dr. Jeffrey Marlow (California Institute of Technology). No new research fellows were selected in FY 2014.

Program Management and Oversight

Throughout FY 2014, DOE/NETL continued to manage a broad portfolio of R&D projects. The program executed a solicitation for new research projects in two major technical topic areas. Topic Area #1 was Extended Duration Testing of Arctic Gas Hydrate and Topic Area #2 was Field Programs for Marine Hydrate Characterization. Seven resultant applications were received (two in Topic Area #1 – one of which was evaluated; and five in Topic Area #2 – all were evaluated). No project was selected in Topic Area #1. In Topic Area #2, one new cooperative agreement was selected and negotiated (see Appendix A for NETL's October 22, 2014, press release related to this new project). This FY 2014 award was announced shortly after FY 2014 ended. Also in FY 2014, the program continued to manage a range of ongoing projects, field work proposals, and interagency agreements. Program oversight activities in FY 2014 included two meetings of the program's Federal Advisory Committee (March 28, 2014 in Galveston, TX; and May 15, 2014 via teleconference) and continued engagement via the Interagency Technical Coordination Team (January 22, 2014).

Technology Transfer

DOE and its research partners continued to disseminate research results to the scientific community during FY 2014. Appendix B provides FY 2014 public press release related to an award presented to a gas hydrate researcher. Appendix C lists 48 peer-reviewed publications, 90 grey literature and government publications, and 55 professional conference presentations that occurred during the fiscal year and that resulted, in whole or in part, from DOE support. NETL/DOE also provided keynote presentations during general sessions at the Gordon Research Conference (GRC) on gas hydrate, convened supplementary meetings at the GRC for young researchers, and presented the latest concepts for marine gas hydrate exploration at the Society of Petroleum Engineer's annual Offshore Technology Conference. In addition, the DOE/NETL Gas Hydrate Newsletter, *Fire in the Ice*, continued to report on global developments in gas hydrate R&D in FY 2014. This periodic publication is distributed to approximately 1,500 subscribers in more than 35 countries.

NETL also supported an ongoing global assessment of gas hydrate science and technology issues being conducted by the United Nations Environmental Program. NETL provided extensive input to the drafting of this global gas hydrate assessment throughout FY 2014. A two-volume hard-copy book "Frozen Heat" and associated web-based products was completed in early FY 2015 and released in the second quarter of FY 2015. The steering committee included 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's Methane Hydrate R&D Program in FY 2014. DOE effectively managed ongoing work funded in prior years and awarded a new project with FY 2014 appropriations to further advance science and technology development activities designed to determine the resource potential and environmental implications of gas hydrate.

The Program continued its cooperative efforts with industry, academia, national laboratories, and international partners to expand its research portfolio through the award of a new financial assistance award in the area of U.S. deepwater gas hydrate resource characterization. DOE awarded a new contract to a research team led by the University of Texas-Austin to conduct further deepwater gas hydrate exploration and sampling at sites identified by prior DOE-funded expeditions.

The Program maintained active international R&D collaborations with Japan, India, and Korea throughout FY 2014 highlighted by the continuing collaboration with Japan on the development of viable project structures for methane hydrate recovery research in Alaska. Collaborative work with JOGMEC and USGS included review of available data to assess the presence and nature of methane hydrates within the withdrawn state acreage on the ANS. In late-FY 2014 the AK DNR extended the lease set-aside for another 12-month period to allow for further evaluation of that acreage for possible DOE gas hydrate R&D.

Finally, DOE and its research partners continued to disseminate research results to the scientific community during FY 2014 through an extensive technology transfer program. Nearly 200 peer-reviewed publications, grey literature and government publications, and professional conference presentations that occurred during FY 2014 were a result, in whole or in part, from DOE support.

Information on the DOE Methane Hydrate 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 http://www.netl.doe.gov/research/oil-and-gas/methane-hydrates. Further information on the Methane Hydrate Program, including program reports and activities of the Methane Hydrate Advisory Committee, including a May 2014 letter to the Secretary of Energy, are available at http://energy.gov/fe/science-innovation/oil-gas-research/methane-hydrate.

DOE-HQ Program Contact
Guido DeHoratiis
Office of Fossil Energy FE-30
U.S. Department of Energy
Washington, DC 20585
(202) 586-5600

NETL Program Contact
Dr. Ray Boswell
National Energy Technology Laboratory
U.S. Department of Energy
Pittsburgh, PA 15236
(412) 386-7614

Appendix A: Press Release (Oct. 22, 2014) Regarding FY 2014 New Project Selection

NEW PROJECT TO IMPROVE CHARACTERIZATION OF U.S. GAS HYDRATE RESOURCES

WASHINGTON, D.C. —The U.S. Department of Energy (DOE) today announced the selection of a multi-year, field-based research project designed to gain further insight into the nature, formation, occurrence and physical properties of methane hydrate-bearing sediments for the purpose of methane hydrate resource appraisal.

Since the passage of the Methane Hydrate Research and Development Act of 2000, the DOE has led a coordinated national methane hydrate research and development (R&D) program in collaboration with six other federal agencies, universities, industry, and international R&D programs. The DOE program mission is to advance the scientific understanding of naturally occurring methane hydrate so that its resource potential and environmental implications can be fully understood.

Methane hydrate — natural gas trapped in an ice-like cage of water molecules — occurs in both terrestrial and marine environments. Terrestrial deposits have been found in sediments within and beneath permafrost in Arctic regions, such as on the North Slope in Alaska. Prior programs in Alaska have explored gas hydrate reservoir potential and alternative production strategies, and additional testing programs are in development. While not part of this announcement, DOE intends to further evaluate production methods on terrestrial methane hydrate deposits in Alaska.

Marine gas hydrates occur in shallow sediments in deepwater settings along the continental margins. Prior marine investigations, primarily through the DOE-supported Gulf of Mexico Joint Industry Partnership's (JIP), confirmed methods for safe drilling in hydrate-bearing sediments (Leg I expedition in 2005) and documented the occurrence of high-quality gas hydrate reservoirs in areas of the Gulf of Mexico such as Green Canyon and Walker Ridge (Leg II expedition in 2009). However, significant research remains to better define resource volumes and accurately assess the production potential of methane hydrates in deepwater settings.

The objectives of the marine gas hydrate program are to: (1) collect a full suite of in situ measurements and core samples to characterize the physical properties of marine methane hydrates; (2) assess their potential response to possible production activities; and (3) further delineate the occurrence and nature of gas hydrates in the U.S. outer continental shelf. This new project, managed by the Office of Fossil Energy's National Energy Technology Laboratory, has been selected to achieve these objectives and is the next logical step in assessing marine hydrate sediments:

The University of Texas at Austin (Austin, Texas) — The University of Texas at Austin, along with The Ohio State University, Columbia University-Lamont Doherty Earth Observatory, the Consortium for Ocean Leadership, and the U.S. Geological Survey, will characterize and prioritize known and prospective drilling locations with a high probability of encountering concentrated methane hydrates in sand-rich reservoirs. A focused drilling program will acquire conventional cores, pressure cores, and downhole logs; will measure in situ properties; and will measure reservoir response to short-duration pressure perturbations. The field campaign will offer an ideal opportunity to deploy and test several coring and hydrate characterization tools developed through previous DOE-supported research efforts.

Post-cruise analyses will determine the in situ concentrations, the physical properties, the lithology, and the thermodynamic state of methane hydrate bearing sand reservoirs. The field data collected and analyzed will strengthen our ability to estimate the occurrence and distribution of marine hydrates and lay the groundwork needed to simulate production behavior from sand-rich reservoirs. (DOE Funding: $41,270,609; Cost Share: $17,030,884; Duration: 48 months)

Appendix B: Press Release (Apr. 14, 2014) Regarding Prestigious Award to NETL Gas Hydrate Researcher

NETL-REGIONAL UNIVERSITY ALLIANCE RESEARCHER TO RECEIVE NATION'S HIGHEST AWARD FOR YOUNG SCIENTISTS

MORGANTOWN, WV - Dr. Brian Anderson, a research fellow of the NETL-Regional University Alliance and associate professor of chemical engineering at West Virginia University, was recognized during a special event at U.S. Department of Energy Headquarters April 14 for receiving the highest honor the U.S. government can bestow on an outstanding scientist in the early stages of his research career.

Dr. Anderson, a versatile researcher, author, teacher, and student mentor was named as a recipient of the Presidential Early Career Award for Scientists and Engineers, or PECASE, in recognition for his innovative work in natural gas hydrates and geothermal energy systems. PECASE awards recognize recipients' exceptional potential for leadership at the frontiers of scientific knowledge and their commitment to community service as demonstrated through professional leadership, education, and community outreach. The awards are conferred annually by the President of the United States and are based on recommendations from participating government agencies. Dr. Anderson's innovative science combined with his commitment to excellence as an educator has placed him among the top energy professionals in the country. His energy research specialties "run hot and cold" because his work demonstrating the potential of engineered geothermal systems — heat from beneath the earth's surface — contrasts with his other specialty, the promise of methane hydrate — a form of energy encased in ice just below the earth's permafrost.

At NETL, Dr. Anderson coordinates the Laboratory's International Methane Hydrate Simulator Code Comparison project, an international effort aiding the development of multimillion-dollar demonstration-scale hydrate production tests. His work on the development of a full 3-D model of the hydrate deposits in the Gulf of Mexico was the first of its kind in the world and is now assisting the simulation of hydrate deposits off the coast of Japan. He also co-authored the seminal Massachusetts Institute of Technology report, "Future of Geothermal Energy," which is guiding the research and advancements required to make geothermal energy resources a part of the U.S. energy portfolio. Dr. Anderson is recognized at NETL, and in the greater research community, as an up-and-coming leader in energy research. In 2011, he was a part of a team of scientists that earned a Secretary's Achievement Award from the Department of Energy, its highest level of internal, non-monetary recognition.

The WVU College of Engineering and Mineral Resources also named him "Teacher of the Year" and "Outstanding Teacher" in 2010. These awards recognized his work in the classroom and as faculty advisor to the WVU Energy Club, which has designed a biodiesel reactor to convert waste grease into fuel for campus buses. Dr. Anderson is the second NETL-RUA researcher to win a PECASE award since the alliance was formed in 2010. Dr. John Kitchin of Carnegie Mellon University was recognized in 2011.

Appendix C: FY 2014 Publications and Reports

Peer-Reviewed Publications

1. Bahk, J.-J., Kim, G.Y., Chun, J.-H., Kim, J.-H., Lee, J.Y., Ryu, B.-J., Lee, J.H., Son, B.K., and Collett, T.S., 2013. Characterization of gas hydrate reservoirs by integration of core and log data in the Ulleung Basin, East Sea. *Journal of Marine and Petroleum Geology*, v. 47, pp. 30-42.

2. Boswell, R., Yamamoto, K., Lee, S-R., Collett, T., Kumar, P., and Dallimore, S., 2014. Methane Hydrates. *In* Letcher, T., ed., *Future Energy*, 2nd Edition, Elsevier. Ch. 8, pp. 159-178.

3. Brewer, P.G., Peltzer, E.T., Walz, P.M., Coward, E.K., Laura A. Stern, L.A., Kirby, S.H., Pinkston, J., 2014. Deep sea field test of the CH_4 hydrate to CO_2 hydrate spontaneous conversion hypothesis. *Energy & Fuels*, doi: 10.1021/ef501430h.

4. Brothers, D.S., Ruppel, C., Kluesner, J.W., ten Brink, U.S., Chaytor, J.D., Hill, J.C., Andrews, B.D., and Flores, C., 2014. Seabed fluid expulsion along upper slope and outer shelf of the U.S. Atlantic continental margin. *Geophys. Res. Lett.*, doi: 10.1002/2013GL058048.

5. Brothers, L.L., Van Dover, C.L., German, C.R., Kaiser, C.L., Yoerger, D.R., Ruppel, C.D., Lobecker, E., Skarke, A.R., and Wagner, K.S., 2014. Evidence for extensive methane venting on the southeastern U.S. Atlantic margin. *Geology*, doi:10.1130/G34217.1

6. Carrière, O. and Gerstoft, P., 2013. Deepwater subseafloor imaging using active OBS interferometry. *Geophysics*, v. 78, pp. Q15-Q24.

7. Cha, J. and Seol, Y., 2013. Increasing gas hydrate formation temperature for desalination of high salinity produced water with secondary guests. *ACS Sustainable Chemistry and Engineering*, v. 1 no. 10, pp 1218–1224, doi: 10.1021/sc400160u.

8. Choi, J.-H., Dai, S., Cha, J.-H., and Seol, Y., 2014. Laboratory formation of non-cementing hydrates in sandy sediments. *Geochemistry, Geophysics, Geosystems*, v. 15, no. 4, pp. 1648-1656.

9. Coffin, R.B., Smith, J.P., Plummer, R.E., Yoza, B., Larsen, R.K., Millholland, L.C., and Montgomery, M.T., 2013. Spatial variation in shallow sediment methane source and cycling along the Alaskan Beaufort Sea. *Marine Petroleum and Geology*, v. 45, pp. 186-197.

10. Collett, T., Boswell, R., Cochran, J., Kumar, P., Lall, M., Mazumdar, A., Ramana, M., Ramprasad, T., Riedel, M., Sain, K., Sathe, A., and Vishwanath, K., 2014. Geologic implications of gas hydrates in the offshore of India: results of the National Gas Hydrate Program Expedition 01. *J. Mar. Pet. Geol.,* v. 58, pp. 1-28.

11. Cook, A.E. and Malinverno, A., 2013. Short migration of methane into a gas hydrate-bearing sand layer at Walker Ridge, Gulf of Mexico. *Geochemistry, Geophysics, Geosystems,* v.14, no. 2, pp. 283-291, doi: 10.1002/ggge.20040.

12. Cook, A.E., Goldberg, D., and Malinverno, A., 2014. Natural gas hydrates occupying fractures: A focus on non-vent sites on the Indian continental margin and the northern Gulf of Mexico. *Marine and Petroleum Geology, v.* 58, pp. 278-291, doi: 10.1016/j.marpetgeo.2014.04.013.

13. Cueto-Felgueroso, L. and Juanes, R., 2014. A phase-field model of two-phase Hele-Shaw flow. *Journal of Fluid Mechanics*, v. 758, pp. 522-552.

14. Dai, S., Wuttke, F., and Santamarina, J.C., 2013. Coda wave analysis to monitor processes in soils. *ASCE Journal of Geotechnical and Geoenvironmental Engineering*, v. 139, no. 9, pp. 1504-1511.

15. Dai, S. and Seol, Y., 2014. Water permeability in hydrate-bearing sediments: A pore-scale study. *Geophysical Research Letters*, v. *41*, no. 12, pp. 4176-4184.

16. Frederick, J.M., and Buffett, B.A., 2014. Taliks in relict submarine permafrost and gas hydrate deposits: Pathways for methane escape under present and future conditions. *Journal of Geophysical Research Earth Surface*, v. 119, doi:10.1002/2013JF002987.

17. Gaglioti, B.V., Mann, D.H., Jones, B.M., Pohlman, J.W., Kunz, M.L., and Wooller, M.J., 2014. Radiocarbon age-offsets in an arctic lake reveal the long-term response of permafrost carbon to climate change, *J. Geophys. Res. Biogeosci.*, v. 119, pp. 1630–1651, doi:10.1002/2014JG002688.

18. Hong, W.-L., Torres, M.E., Kim, J.-H., Choi, J., and Bahk, J.-J., 2013. Carbon cycling within the sulfate-methane-transition-zone in marine sediments from the Ulleung Basin. *Biogeochemistry*, pp. 1-20.

19. Hong, W.L., Torres, M.E., Kim, J.-H., Choi, J., and Bahk, J.-J., 2014. Towards quantifying the reaction network around sulfate-methane-1 transition-zone in the Ulleung Basin, East Sea, with a kinetic modeling approach. *Geochimica Cosmochimica Acta*, v. 140, pp. 127-141.

20. Hunt, A.G., Stern, L.A., Pohlman, J.W., Ruppel, C., Moscati, R., and Landis, G., 2013. Mass fractionation of noble gases in synthetic methane hydrate: Implications for the detection of naturally occurring methane hydrate dissociation. *Chemical Geology*, v. 339, pp. 242-250, doi: 10.1016/j.chemgeo.2012.09.033.

21. Jang, J. and Santamarina, J.C., 2014. Evolution of saturation and relative permeability during gas production from hydrate bearing sediments: Gas invasion vs. gas nucleation. *Journal of Geophysical Research*, v. 119, no. 1, pp. 116-126.

22. Joseph, C., Campbell, K.A., Torres, M.E., Martin, R.A., Pohlman, J.W., Riedel, M., and Rose, K., 2013. Methane-derived authigenic carbonates from modern and paleoseeps on the Cascadia margin: Mechanisms of formation and diagenetic signals. *Palaeogeography, Palaeoclimatology, Palaeoecology*, v. 390, pp. 52-67.

23. Kumar, P., Collett, T., Yadav, U., Boswell, R., Cochran, J., Lall, M., Mazumdar, A., Ramana, M., Ramprasad, T., Riedel, M., Sain, K., Sathe, A., and Vishwanath, K., 2014. Geologic implications of gas hydrates in the offshore of India: Krishna-Godovari Basin, Mahanadi Basin, Andaman Sea, and Kerala-Konkan Basin. *J. Mar. Pet. Geol.* V. 58, pp. 29-98.

24. Lapham, L.L., Wilson, R.M., Riedel, M., Paull, C.K., and Holmes, M.E., 2013. Temporal variability of *in situ* methane concentrations in gas hydrate-bearing sediments near Bullseye Vent, Northern Cascadia margin. *Geochemistry, Geophysics, Geosystems,* v. 14, pp. 2445-2459, doi: 10.1002/ggge.20167.

25. Lapham, L.L., Wilson, R.M., MacDonald, I.R., and Chanton, J.P., 2014. Gas hydrate dissolution rates quantified with laboratory and seafloor experiments. *Geochimica et Cosmochimica Acta*, v. 125, pp. 492-503, doi: 10.1016/j.gca.2013.10.030.

26. Lu, W.J., Guo, H.R., Chou, I.M., Burruss, R.C., and Li, L.L., 2013. Determination of diffusion coefficient of carbon dioxide in water between 268 and 473 K in a high-pressure capillary optical cell with *in-situ* Raman spectroscopic measurements. *Geochimica et Cosmochimica Acta*, v. 115, pp. 183-204.

27. Macelloni, L., Brunner, C., Caruso, S., Lutken, C., D'Emidio, M., and Lapham, L., 2013. Spatial distribution of seafloor biogeological and geochemical processes as proxies of fluid flux regime and evolution of a carbonate/hydrates mound, northern Gulf of Mexico. *Deep Sea Research, Part 1*, Manuscript Number: DSR1-D-12-00118R1.

28. Magen, C., Lapham, L., Pohlman, J.W., Marshall, K., Bosman, S., Casso., M., and Chanton., J., 2014. A simple headspace equilibration method for measuring dissolved methane. *Limnology and Oceanography: Methods*, v. 12, pp. 637-650, doi: 10.4319/lom.2014.12.637.

29. Mahabadi, N. and Jang, J., 2014. Relative water and gas permeability for gas production from hydrate-bearing sediments. *Geochemistry Geophysics Geosystems*, v. 15, pp. 2346-2353.

30. Marlow, J., Steele, J., Thurber, A., Ziebis, W., Levin, L., and Orphan, V., 2014. Carbonate hosted methanotrophy: An unrecognized methane sink in the deep sea. *Nature Communications,* v. 5, doi:10.1038/ncomms6094.

31. Marlow, J., Steele, J., Case, D., Levin, L., and Orphan, V., 2014. Microbial abundance and diversity patterns associated with sediments and carbonates from the methane seep environments of Hydrate Ridge, OR. *Frontiers in Marine Science,* v. 1, no. 44, doi: 10.3389/fmars.2014.00044.

32. Marlow, J., LaRowe, D., Ehlmann, B., Amend, J., and Orphan, V., 2014. The potential for biologically catalyzed anaerobic methane oxidation on Ancient Mars. *Astrobiology,* v. 14, no. 4, pp. 292-307, doi: 10.1089/ast.2013.1078.

33. Moridis, G.J., Kim, J., Reagan, M.T., and Kim, S.-J., 2013. Feasibility of gas production from a gas hydrate accumulation at the UBGH2-6 site of the Ulleung basin in the Korean East Sea. *Journal of Petroleum Science and Engineering*, v. 108, pp. 180-210, doi: 10.1016/j.cageo.2013.04.001.

34. Phrampus, B., Hornbach, M., Ruppel, C., and Hart, P., 2014. Widespread gas hydrate instability on the upper U.S. Beaufort margin. *J. Geophys. Res.*, v. 119, doi:10.1002/2014JB011290.

35. Pohlman, J.W., Riedel, M., Bauer, J.E., Canuel, E.A., Paull, C.K., Lapham, L., Grabowski, K., Coffin, R.B., and Spence, G.D., 2013. Increased efficiency of anaerobic methane oxidation in low-organic content methane seep sediments. *Geochimica et Cosmochimica Acta*, v. 108, pp. 184-201, doi: 10.1016/j.gca.2013.01.022.

36. Riedel, M., Collett, T.S., Kim, H.S., Kim, J.-H., Ryu, B.-J., Kim, G.Y., 2013. Large-scale depositional characteristics of the Ulleung Basin and its impact on electrical resistivity and Archie-parameters for gas hydrate saturation estimates. *Journal of Marine and Petroleum Geology*, v. 47, pp. 222-235.

37. Ryu, B.-J., Collett, T.S., Riedel, M., Kim, G.-Y., Chun, J.-H., Bahk, J.-J., Lee, J.-Y., Kim, J.-H., and Yoo, D.-G., 2013. Scientific results of the Second Gas Hydrate Drilling Expedition in the Ulleung Basin (UBGH2). *Journal of Marine and Petroleum Geology*, v. 47, pp. 1-20.

38. Seol, Y., Choi, J.-H., and Dai, S., 2014. Multi-property characterization chamber for geophysical-hydrological investigations of hydrate bearing sediments. *Review of Scientific Instruments*, v.85 (84501): pp. 1-8.

39. Simonetti, A., Knapp, J.H., Sleeper, K., Lutken, C.B., Macelloni, L, and Knapp, C.C., 2013. Spatial distribution of gas hydrates from high-resolution seismic and core data, Woolsey Mound, northern Gulf of Mexico. *Marine and Petroleum Geology*, v. 44, pp. 21-33.

40. Sivan, O., Antler, G., Turchyn, A., Marlow, J., and Orphan, V., 2014. Iron oxides stimulate sulfate driven anaerobic methane oxidation in seeps. *Proceedings of the National Academy of Sciences*, v. 111, no. 40, pp. E4139–E4147, doi: 10.1073/pnas.1412269111.

41. Skarke, A., Ruppel, C., Kodis, M., Brothers, D., and Lobecker, E., 2014. Widespread methane leakage from the seafloor on the northern US Atlantic margin, *Nature Geoscience*, v. 7, pp. 657-661, doi:10.1038/ngeo2232.

42. Stern, L.A. and Lorenson, T.D., 2014. Grain-scale imaging and compositional characterization of select India NGHP Expedition-01 gas-hydrate-bearing cores, and comparison to other natural gas hydrates. *Journal of Marine and Petroleum Geology*, v. 58, part A, pp. 206-222.

43. Wagner, K.S., McEntee, M.H., Brothers, L.L., German, C.R., Kaiser, C.L., Yoerger, D.R., and Van Dover, C.L., 2013. Cold-seep habitat mapping; High-resolution spatial characterization of the Blake Ridge Diapir seep field. *Deep Sea Research II: Topical Studies in Oceanography*, v. 92, pp. 183-188.

44. Waite, W.F. and Spangenberg, E., 2013. Gas hydrate formation rates from dissolved-phase methane in porous laboratory specimens. *Geophysical Research Letters*, v. 40, 6 pp., doi:10.1002/grl.50809.

45. Weitemeyer, K. and Constable, S., 2014. Navigating marine electromagnetic transmitters using dipole field geometery. *Geophysical Prospecting*, v. 62, pp. 573-593.

46. Wilson, R.M., Macelloni, L., Simonetti, A., Lapham, L., Lutken, C., Sleeper, K., D'Emidio, M., Pizzi, M., Knapp, J., and Chanton, J., 2014. Subsurface methane sources and migration pathways within a gas hydrate mound system, Gulf of Mexico. *Geochemistry, Geophysics, Geosystems*, v. 15, pp. 89-107.

47. Winters, W.J., Wilcox-Cline, R.W., Long, P., Dewri, S.K., Kumar, P., Stern, L., and Kerr, L., 2014. Comparison of physical and geotechnical properties of sediment from offshore India and other hydrate reservoirs. *Journal of Marine and Petroleum Geology*, v. 58, part A, pp. 139-167.

48. Yoshinaga, M.Y., Holler, T., Goldhammer, T., Wegener, G., Pohlman, J.W., Brunner, B., Kuypers, M.M., Hinrichs, K.-U., and Elvert, M., 2014. Carbon isotope equilibration during sulphate-limited anaerobic oxidation of methane. *Nature Geoscience*, doi: 10.1038/NGEO2069.

Grey Literature

1. Anderson, B., Boswell, R., Collett, T., Farrell, H., Ohtsuki, S., White, M., and Zyrianova, M., 2014. Review of the findings of the Ignik Sikumi CO_2-CH_4 gas hydrate exchange field trial. Proceedings of the 8th International Conference on Gas Hydrates (ICGH8-2014), July 28- August 1, 2014, Beijing, China, 17 p.

2. Boswell, R., Saeki, T., Shipp, C., Frye, M., Shedd, W., Collett, T., Shelander, D., and McConnell, D., 2014. Prospecting for gas hydrates resources. *Fire in the Ice* Newsletter, v. 14, no. 2, pp. 9-13.

3. Boswell, R., 2014. Developments in marine gas hydrate exploration. Paper OTC-25192 presented at Offshore Technology Conference, 7 pp.

4. Chaytor, J., Demopoulos, A., and Ruppel, C., 2013. Exploring undersea terrain off the northern US Atlantic coast via telepresence-enabled research cruise. Sound Waves, USGS newsletter, Nov/Dec 2013.

5. Haines, S., Hart, P., and Ruppel, C., 2013. New seismic data acquired over known gas hydrate occurrences in the deepwater Gulf of Mexico. Fire in the Ice Newsletter, v. 13, no. 2, pp. 3-6.

6. Handwerger, A.L. and Rempel, A.W., 2014. Environmental change, hydrate dissociation, and submarine slope failure along continental margins: The role of saturation anomalies in landslide triggering. Proceedings of the 8th International Conference on Gas Hydrates (ICGH8-2014), July 28-August 1, 2014, Beijing, China.

7. Hunt, A.G., Ruppel, C., Stern, L., and Pohlman, J., 2013. Using noble gas signatures to fingerprint gas streams derived from dissociating methane hydrate. Fire in the Ice Newsletter, v. 13, no. 2, pp. 23-26.

8. Irizarry, J.T. and Rempel, A.W., 2014. How methane solubility changes with hydrate saturation, pore size, and salt content in polydispersed media. Proceedings of the 8th International Conference on Gas Hydrates (ICGH8-2014), July 28-August 1, 2014, Beijing, China.

9. Lutken, C.B., D'Emidio, M., Macelloni, L., Ingrassia, M., Pierdomenico, M., Asper, V., Diercks, A., Woolsey, M.U., and Jarnagin, R., 2013. Challenges in imaging the deep seabed: Examples from Gulf of Mexico cold seeps. GCAGS Transactions, 2013 New Orleans, LA.

10. Majumdar, U., Cook, A., Ismail, S., Frye, M., and Shedd, W., 2014. Gas hydrate assessment in the northern Gulf of Mexico: Preliminary results reveal new prospects. Fire in the Ice Newsletter, v. 14, no. 2.

11. Majumdar, U., Cook, A., Ismail, S., Frye, M., and Shedd, W., 2014. A new approach to determining the occurrence of natural gas hydrate in the northern Gulf of Mexico using petroleum industry well logs. Proceedings of the 8th International Conference on Gas Hydrates, July 28-Aug 1, 2014, Beijing, China.

12. Ruppel, C. and Collett, T., 2013. Geological studies of methane hydrates reveal reserves with potential. Energy Focus, Fall edition, pp. 202-204.

13. Sapporo Scientific Team, 2013. Pressure core analysis tools used to characterize hydrate-bearing sediments from the Nankai Trough. Fire in the Ice Newsletter, v. 13, no. 2, pp. 19-22.

14. Schindler, M. and Batzle, M., 2014. Pore-scale investigation of hydrate-bearing sediments. In Pore Scale Science & Technology: Frontiers of Mesoscale Science, Poate, J., Kazemi, H.K., eds., World Scientific Council.

15. White M.D. and Lee, W.S., 2014. Guest molecule exchange kinetics for the 2012 Ignik Sikumi Gas Hydrate Field Trial. In Proceedings of 2014 Offshore Technology Conference, May 5-8, Houston, TX.

16. Weitemeyer, K., Constable, S., and Key, K., 2014. Mapping gas hydrate systems in the Gulf of Mexico using marine CSEM. In Proceedings of 2014 Offshore Technology Conference, May 5-8, Houston, TX.

Government Reports

1. Batzle, M., 2014. Measurement and Interpretation of Seismic Velocities and Attenuations in Hydrate-Bearing Sediments, DOE Award No.: DE-FE0009963, Quarterly Research Performance Progress Report (Period ending 9/30/2013). July 2014.

2. Batzle, M., 2014. Measurement and Interpretation of Seismic Velocities and Attenuations in Hydrate-Bearing Sediments, DOE Award No.: DE-FE0009963, Quarterly Research Performance Progress Report (Period ending 12/31/2013). July 2014.

3. Batzle, M., 2014. Measurement and Interpretation of Seismic Velocities and Attenuations in Hydrate-Bearing Sediments, DOE Award No.: DE-FE0009963, Quarterly Research Performance Progress Report (Period ending 3/31/2014). July 2014.

4. Batzle, M., 2014. Measurement and Interpretation of Seismic Velocities and Attenuations in Hydrate-Bearing Sediments, DOE Award No.: DE-FE0009963, Quarterly Research Performance Progress Report (Period ending 6/30/2014). August 2014.

5. Batzle, M., 2014. Measurement and Interpretation of Seismic Velocities and Attenuations in Hydrate-Bearing Sediments, DOE Award No.: DE-FE0009963, Quarterly Research Performance Progress Report (Period ending 9/30/2014). August 2014.

6. Beaudoin, Y.C., 2013. UNEP Global Outlook on Methane Gas Hydrates, DOE Award No.: DE-FE0003060, Semiannual Progress Report (April 2013 - September 2013). October 2013.

7. Beaudoin, Y.C., 2014. UNEP Global Outlook on Methane Gas Hydrates, DOE Award No.: DE-FE0003060, Semiannual Progress Report (October 2013 - March 2014). April 2014.

8. Bent, J.V., 2014. Characterizing Natural Gas Hydrates in the Deep Water Gulf of Mexico: Applications for Safe Exploration and Production Activities, Semi-Annual Progress Report, October 2013 – March 2014. Chevron, DOE Award No.: DE-FC26-01NT41330. March, 2014.

9. Bent, J.V., 2014. Characterizing Natural Gas Hydrates in the Deep Water Gulf of Mexico: Applications for Safe Exploration and Production Activities, Final Integrated Project Report #41330R28. Chevron, DOE Award No.: DE-FC26-01NT41330. June, 2014.

10. Coffin, R.B., Boyd, T.J., Rose, P.S., Yosa, B., Millholland, L.C. Downer R., and Woods, S., 2013. Geochemical Cruise Report SO226/2 RV Sonne Chatham Rise Expedition, US Naval Research Laboratory Technical Memorandum, NRL/MR/6110-13-9472.

11. Consortium for Ocean Leadership and the Methane Hydrate Project Science Team, 2013. Marine Methane Hydrate Field Research Plan, Topical Report, DOE Award No.: DE-FE0010195. December, 2013.

12. Constable, S., 2013. Mapping Permafrost and Gas Hydrate using Marine CSEM Methods, DOE Award No.: DE-FE0010144, Quarterly Research Performance Progress Report (Period ending 9/30/2013). November, 2013.

13. Constable, S., 2014. Mapping Permafrost and Gas Hydrate using Marine CSEM Methods, DOE Award No.: DE-FE0010144, Quarterly Research Performance Progress Report (Period ending 12/31/2013). January, 2014.

14. Constable, S., 2014. Mapping Permafrost and Gas Hydrate using Marine CSEM Methods, DOE Award No.: DE-FE0010144, Quarterly Research Performance Progress Report (Period ending 3/30/2014). April, 2014.

15. Constable, S., 2014. Mapping Permafrost and Gas Hydrate using Marine CSEM Methods, DOE Award No.: DE-FE0010144, Quarterly Research Performance Progress Report (Period ending 6/30/2014). July, 2014.

16. Cook, A., 2013. A New Approach to Understanding the Occurrence and Volume of Natural Gas Hydrate in the Northern Gulf of Mexico Using Petroleum Industry Well Logs, Quarterly Research Performance Progress Report– Period Ending September 30, 2013. DOE Award No.: DE-FE0009949. October, 2013.

17. Cook, A., 2014. A New Approach to Understanding the Occurrence and Volume of Natural Gas Hydrate in the Northern Gulf of Mexico Using Petroleum Industry Well Logs, Quarterly Research Performance Progress Report– Period Ending December 31, 2013. DOE Award No.: DE-FE0009949. January, 2014.

18. Cook, A., 2014. A New Approach to Understanding the Occurrence and Volume of Natural Gas Hydrate in the Northern Gulf of Mexico Using Petroleum Industry Well Logs, Quarterly Research Performance Progress Report– Period Ending March 31, 2014. DOE Award No.: DE-FE0009949. April, 2014.

19. Cook, A., 2014. A New Approach to Understanding the Occurrence and Volume of Natural Gas Hydrate in the Northern Gulf of Mexico Using Petroleum Industry Well Logs, Quarterly Research Performance Progress Report—Period Ending June 30, 2014. DOE Award No.: DE-FE0009949. July, 2014.

20. Daigle, H., 2014. Mechanisms for Methane Transport and Hydrate Accumulation in Coarse-Grained Reservoirs, DOE Award No.: DE-FE0013919, Quarterly Research Performance Progress Report (Period ending 01/31/2013). February, 2014.

21. Daigle, H., 2014. Mechanisms for Methane Transport and Hydrate Accumulation in Coarse-Grained Reservoirs, DOE Award No.: DE-FE0013919, Quarterly Research Performance Progress Report (Period ending 03/31/2014). April, 2014.

22. Daigle, H., 2014. Mechanisms for Methane Transport and Hydrate Accumulation in Coarse-Grained Reservoirs, DOE Award No.: DE-FE0013919, Quarterly Research Performance Progress Report (Period ending 06/30/2014). July, 2014.

23. Flemings, P.B., 2013. Deepwater Methane Hydrate Characterization and Scientific Assessment, Quarterly Research Performance Progress Report (Period Ending 9/30/2013), DOE Award No.: DE-FE0023919. October, 2013.

24. Flemings, P.B., 2014. Deepwater Methane Hydrate Characterization and Scientific Assessment, Quarterly Research Performance Progress Report (Period Ending 12/31/2013), DOE Award No.: DE-FE0023919. January, 2014.

25. Flemings, P.B., 2014. Deepwater Methane Hydrate Characterization and Scientific Assessment, Quarterly Research Performance Progress Report (Period Ending 3/31/2014), DOE Award No.: DE-FE0023919. May, 2014.

26. Flemings, P.B., 2014. Deepwater Methane Hydrate Characterization and Scientific Assessment, Quarterly Research Performance Progress Report (Period Ending 6/30/2014), DOE Award No.: DE-FE0023919. August, 2014.

27. Haines, S.S., Hart, P.E., Ruppel, C.D., O'Brien, T., Baldwin, W., White, J., Moore, E., Dal Ferro, P., and Lemmond, P., 2014. Cruise report for P1–13–LA, U.S. Geological Survey Gas Hydrates Research Cruise, R/V Pelican April 18 to May 3, 2013, Deepwater Gulf of Mexico. *U.S. Geological Survey Open-File Report 2014–1080*, 33 p.

28. Hornbach, M.J., 2013. Gas Hydrate Dynamics on the Alaskan Beaufort Continental Slope: Modeling and Field Characterization, Quarterly Progress Report, July-September, 2013. Southern Methodist University, DOE Award No.: DE-FE0010180. November, 2013.

29. Humphrey, G., 2014. Planning of a Marine Methane Hydrate Pressure Coring Program for the Walker Ridge and Green Canyon Areas of the Gulf of Mexico, DOE Award No.: DE-FE0010175, Quarterly Research Performance Progress Report (Period ending 09/30/2013). February, 2014.

30. Humphrey, G., 2014. Planning of a Marine Methane Hydrate Pressure Coring Program for the Walker Ridge and Green Canyon Areas of the Gulf of Mexico, DOE Award No.: DE-FE0010175, Quarterly Research Performance Progress Report (Period ending 12/31/2013). March, 2014.

31. Humphrey, G., 2014. Planning of a Marine Methane Hydrate Pressure Coring Program for the Walker Ridge and Green Canyon Areas of the Gulf of Mexico, DOE Award No.: DE-FE0010175, Quarterly Research Performance Progress Report (Period ending 03/31/2014). April, 2014.

32. Hunter, R. and Digert, S., 2013. 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, 43rd and 44th Quarterly Reports, 3Q2013 – 4Q2013 Semi-Annual Progress Report. BP Exploration (Alaska), DOE Award No.: DE-FC26-01NT41332. October 31, 2013.

33. Jang, J., 2013. Verification of capillary pressure functions and relative permeability equations for gas production, Quarterly Research Performance Progress Report (July – September 2013), Wayne State University, DOE Award No.: DE-FE-0009927.

34. Jang, J., 2013. Verification of capillary pressure functions and relative permeability equations for gas production, Quarterly Research Performance Progress Report (October – December 2013), Wayne State University, DOE Award No.: DE-FE-0009927.

35. Jang, J., 2014. Verification of capillary pressure functions and relative permeability equations for gas production, Quarterly Research Performance Progress Report (January – March 2014), Wayne State University, DOE Award No.: DE-FE-0009927.

36. Jang, J., 2014. Verification of capillary pressure functions and relative permeability equations for gas production, Quarterly Research Performance Progress Report (April – June 2014), Wayne State University, DOE Award No.: DE-FE-0009927.

37. Juanes, R., 2014. Fate of Methane Emitted From Dissociating Marine Hydrates: Modeling, Laboratory, and Field Constraints, Quarterly Research Performance Progress Report (Period Ending 12/31/2013). DOE Award No.: DE-FE0013999. January, 2014.

38. Juanes, R., 2014. Fate of Methane Emitted From Dissociating Marine Hydrates: Modeling, Laboratory, and Field Constraints, Quarterly Research Performance Progress Report (Period Ending 3/30/2014). DOE Award No.: DE-FE0013999. May, 2014.

39. Juanes, R., 2014. Fate of Methane Emitted From Dissociating Marine Hydrates: Modeling, Laboratory, and Field Constraints, Quarterly Research Performance Progress Report (Period Ending 6/30/2014). DOE Award No.: DE-FE0013999. August, 2014.

40. Kneafsey, T.J., 2013. Properties of Hydrate-Bearing Sediments Subjected to Changing Gas Compositions, Quarterly Report for work performed under ESD12-011, for period covering July 1-September 30, 2013.

41. Kneafsey, T.J., 2014. Properties of Hydrate-Bearing Sediments Subjected to Changing Gas Compositions, Progress Report for work performed under ESD12-011, for period covering July 1, 2013-April 30, 2014.

42. Lee, M.W., 2013. Comparison of methods for predicting shear wave velocities of unconsolidated shallow sediments in the Gulf of Mexico, U.S. Geological Survey Scientific Investigations Report 2013–5141, 11 p.

43. Lewis, K.A., and Collett, T.S., 2013. Brookian sequence well log correlation sections and occurrence of gas hydrates, north-central North Slope, Alaska: U.S. Geological Survey Scientific Investigations Report 2013–5050, 23 p.

44. Lutken, C.B., 2013. Temporal Characterization of Hydrates System Dynamics beneath Seafloor Mounds: Integrating Time-Lapse Electrical Resistivity Methods and in situ Observations of Multiple Oceanographic Parameters, Quarterly Progress Report covering the period July – September, 2013. DOE Award No.: DE-FE0010141. Submitted by The Center for Marine Resources and Environmental Technology, University of Mississippi. November, 2013.

45. Lutken, C.B., 2013. Hydrate Research Activities that both Support and Derive from the Monitoring Station/Seafloor Observatory, Mississippi Canyon 118, Northern Gulf of Mexico, Final Technical Report covering the period July 1, 2006 – July 31, 2013, DOE Award No.: DE-FC26-06NT42877. Submitted for The

Gulf of Mexico Hydrates Research Consortium by The Center for Marine Resources and Environmental Technology, University of Mississippi. December, 2013.

46. Lutken, C.B., 2014. Temporal Characterization of Hydrates System Dynamics beneath Seafloor Mounds: Integrating Time-Lapse Electrical Resistivity Methods and in situ Observations of Multiple Oceanographic Parameters, Quarterly Progress Report covering the period October – December, 2013. DOE Award No.: DE-FE0010141. Submitted by The Center for Marine Resources and Environmental Technology, University of Mississippi. February, 2014.

47. Lutken, C.B., 2014. Gas Hydrate Monitoring Station Project: A Remote Station to Monitor the Gas Hydrate Stability Zone in the Northern Gulf of Mexico, Final Technical Report for Cooperative Agreement M08AC12912 between the Minerals Management Services, Department of the Interior, and the Center for Marine Resources and Environmental Technology, University of Mississippi, covering the period January 1, 2008 – December 31, 2010. Submitted for The Gulf of Mexico Hydrates Research Consortium by The Center for Marine Resources and Environmental Technology, University of Mississippi. March, 2014.

48. Lutken, C.B., 2014. Temporal Characterization of Hydrates System Dynamics beneath Seafloor Mounds: Integrating Time-Lapse Electrical Resistivity Methods and in situ Observations of Multiple Oceanographic Parameters, Quarterly Progress Report covering the period January – March, 2014. DOE Award No.: DE-FE0010141. Submitted by The Center for Marine Resources and Environmental Technology, University of Mississippi. April, 2014.

49. Lutken, C.B., 2014. Gas Hydrate Monitoring Station Project: A Remote Station to Monitor the Gas Hydrate Stability Zone in the Northern Gulf of Mexico, Final Technical Report for Cooperative Agreement M08AC12912 between the Minerals Management Services, Department of the Interior and the Center for Marine Resources and Environmental Technology, University of Mississippi, covering the period January 1, 2011 – December 31, 2013. Submitted for The Gulf of Mexico Hydrates Research Consortium by The Center for Marine Resources and Environmental Technology, University of Mississippi. July, 2014.

50. Lutken, C.B., 2014. Temporal Characterization of Hydrates System Dynamics beneath Seafloor Mounds: Integrating Time-Lapse Electrical Resistivity Methods and in situ Observations of Multiple Oceanographic Parameters, Quarterly Progress Report covering the period April – June, 2014. DOE Award No.: DE-FE0010141. Submitted by The Center for Marine Resources and Environmental Technology, University of Mississippi. August, 2014.

51. McConnell, D., 2014. Advanced Hydrate Reservoir Modeling Using Rock Physics Techniques, DOE Award No.: DE-FE0010160, Quarterly Research Performance Progress Report (Period ending 12/31/2013). January, 2014.

52. McConnell, D., 2014. Advanced Hydrate Reservoir Modeling Using Rock Physics Techniques, DOE Award No.: DE-FE0010160, Quarterly Research Performance Progress Report (Period ending 03/31/2014). April, 2014.

53. McConnell, D., 2014. Advanced Hydrate Reservoir Modeling Using Rock Physics Techniques, DOE Award No.: DE-FE0010160, Quarterly Research Performance Progress Report (Period ending 06/30/2014). July, 2014.

54. Myers, G., 2013. Methane Hydrate Field Program, Quarterly Research Performance Progress– Period Ending September 30, 2013, DOE Award No.: DE-FE0010195. October, 2013.

55. Myers, G., 2014. Methane Hydrate Field Program, Quarterly Research Performance Progress– Period Ending December 31, 2013, DOE Award No.: DE-FE0010195. January, 2014.

56. Rose, P.S., Millholland, L.C., Plummer, R.E., Reed, A., Montgomery, M.T., Boyd, T.J., and Coffin, R.B., 2013. Natural gas at seep site on the UK continental shelf, North Sea. US Naval Research Laboratory Technical Memorandum, NRL/MR/6110-13-9452.

57. Sanchez, M. and Santamarina, J.C., 2014. THCM Coupled Model for Hydrate-Bearing Sediments: Data Analysis and Design of New Field Experiments (Marine and Permafrost Settings), Quarterly Research Performance Progress Report (Period Ending 12/31/2013), DOE Award No.: DE-FE0013889. January, 2014.

58. Sanchez, M. and Santamarina, J.C., 2014. THCM Coupled Model for Hydrate-Bearing Sediments: Data Analysis and Design of New Field Experiments (Marine and Permafrost Settings), Quarterly Research Performance Progress Report (Period Ending 3/31/2014), DOE Award No.: DE-FE0013889. April, 2014.

59. Sanchez, M. and Santamarina, J.C., 2014. THCM Coupled Model for Hydrate-Bearing Sediments: Data Analysis and Design of New Field Experiments (Marine and Permafrost Settings), Quarterly Research Performance Progress Report (Period Ending 6/30/2014), DOE Award No.: DE-FE0013889. August, 2014.

60. Santamarina, J. C., 2013. Hydrate-Bearing Clayey Sediments: Morphology, Physical Properties, Production and Engineering/Geological Implications, Quarterly Research Performance Progress Report, Period Ending September 30, 2013, Georgia Institute of Technology, DOE Award No.: DE-FE0009897. October, 2013.

61. Santamarina, J.C., 2014. Hydrate-Bearing Clayey Sediments: Morphology, Physical Properties, Production and Engineering/Geological Implications, Quarterly Research Performance Progress Report, Period Ending December 31, 2013, Georgia Institute of Technology, DOE Award No.: DE-FE0009897. January, 2014.

62. Santamarina, J.C., 2014. Hydrate-Bearing Clayey Sediments: Morphology, Physical Properties, Production and Engineering/Geological Implications, Quarterly Research Performance Progress Report, Period Ending March 31, 2014, Georgia Institute of Technology, DOE Award No.: DE-FE0009897. April, 2014.

63. Santamarina, J.C., 2014. Hydrate-Bearing Clayey Sediments: Morphology, Physical Properties, Production and Engineering/Geological Implications, Quarterly Research Performance Progress Report, Period Ending June 30, 2014, Georgia Institute of Technology, DOE Award No.: DE-FE0009897. July, 2014.

64. Seol, Y., 2014. Natural Gas Hydrate Research, Award Number 2013.07.02, Fiscal Year 2014 Quarterly Progress Report (Jan—Mar, 2014). May, 2014.

65. Seol, Y., 2014. Natural Gas Hydrate Research, Award Number 2013.07.02, Fiscal Year 2014 Quarterly Progress Report (Apr—June, 2014). August, 2014.

66. Solomon, E., 2014. Characterizing the Response of the Cascadia Margin Gas Hydrate Reservoir to Bottom Water Warming Along the Upper Continental Slope, Quarterly Research Performance Progress Report (Period Ending 12/31/2013), DOE Award No.: DE-FE0013998. January, 2014.

67. Solomon, E., 2014. Characterizing the Response of the Cascadia Margin Gas Hydrate Reservoir to Bottom Water Warming Along the Upper Continental Slope, Quarterly Research Performance Progress Report (Period Ending 03/31/2014), DOE Award No.: DE-FE0013998. April, 2014.

68. Solomon, E., 2014. Characterizing the Response of the Cascadia Margin Gas Hydrate Reservoir to Bottom Water Warming Along the Upper Continental Slope, Quarterly Research Performance Progress Report (Period Ending 06/30/2014), DOE Award No.: DE-FE0013998. July, 2014.

69. Torres, M., 2013. Application of Crunch-Flow Routines to Constrain Present and Past Carbon Fluxes at Gas-Hydrate Bearing Sites, DOE Award No.: DE-FE0010496, Quarterly Progress Report (July-September, 2013). October, 2013.

70. U.S. Geological Survey Alaska Gas Hydrate Assessment Team, 2013. National Assessment of Oil and Gas Project—Geologic assessment of undiscovered gas hydrate resources on the North Slope, Alaska: U.S. Geological Survey Digital Data Series 69–CC, 100 p.

71. Vu, C., 2013. Characterizing Natural Gas Hydrates in the Deep Water Gulf of Mexico: Applications for Safe Exploration and Production Activities, Semi-Annual Progress Report, April 2013 – September 2013, DOE Award No.: DE-DE-FC26-01NT41330. October, 2013.

72. White, M.D., 2013. Kinetic Parameters for the Exchange of Hydrate Formers, Quarterly Report for work performed under Project 65213, for period covering October 1-December 31, 2013.

73. White, M.D., 2014. Kinetic Parameters for the Exchange of Hydrate Formers, Quarterly Report for work performed under Project 65213, for period covering January 1-March 31, 2014.

74. White, M.D., 2014. Kinetic Parameters for the Exchange of Hydrate Formers, Quarterly Report for work performed under Project 65213, for period covering August 1-September 30, 2014.

Technical Presentations

1. Akasaka, C., 2013. CO_2-CH_4 gas exchange field trial in Alaska field operation. Presented at JOGMEC TRC Week, State-of-the-Art Technology Development of Resources of Japan, Technology Research Center, November 2013, Makuhari, Japan.
2. Borglin, E., Kneafsey, T.J., and Nakagawa, S., 2013. Methane hydrate behavior when exposed to a 23% carbon dioxide 77% nitrogen gas under conditions similar to the ConocoPhillips 2012 Ignik Sikumi Gas Hydrate Field Trial. Presented at American Geophysical Union Fall Meeting, Dec. 9-13, San Francisco, CA.
3. Boswell, R., 2014. Status of gas hydrate resource evaluation. Presented at Gordon Research Seminar and Conference on Natural Gas Hydrate Systems, March 22-28, Galveston, TX (invited).
4. Boswell, R., 2014. Status of R&D relating to gas hydrate as a resource. Presented at Frontier Energy Series, Center for Strategic and International Studies, Sept. 18, Washington, D.C. (invited).
5. Brothers, D.S., Ruppel, C.D., Kluesner, J.W., Chaytor, J.D., ten Brink, U.S., and Hill, J.C., 2013. Pervasive evidence for seabed fluid expulsion on the U.S. Atlantic continental margin. Presented at American Geophysical Union Fall Meeting, Dec. 9-13, San Francisco, CA.
6. Darnell, K. and Flemings, P.B., 2013. Methane hydrate destabilization sensitivity to physical complexity and initial conditions in a numerical model. Presented at American Geophysical Union Fall Meeting, Dec. 9-13, San Francisco, CA.
7. Delwiche, K., Scandella, B., Juanes, R., Ruppel, C.D., and Hemond, H., 2013. Deploying methane bubble traps at varying lake depths to validate bubble dissolution models. Presented at American Geophysical Union Fall Meeting, Dec. 9-13, San Francisco, CA.
8. Durant, A.J., Lund-Myhre, C., Mienert, J., Myhre, G., Stohl, A., Isaksen, I., Pisso, I., Greinert, J., Nibet, E., Paris, J., Pyle, J.A., Belan, B.D., Ruppel, C.D., Schlager, H., and Spahni, R., 2013. Methane emissions from the Arctic OCean to the Atmosphere: Present and future climate effects (MOCA). Presented at American Geophysical Union Fall Meeting, Dec. 9-13, San Francisco, CA.
9. Farrell, H., 2013. Methane hydrates field trial overview. Presented at JOGMEC TRC Week, State-of-the-Art Technology Development of Resources of Japan, Technology Research Center, November 2013, Makuhari, Japan.
10. Frederick, J. M. and Buffett, B.A., 2014. Effect of submarine groundwater discharge on subsea permafrost and Arctic gas hydrate deposits. Presented at Gordon Research Seminar and Conference on Natural Gas Hydrate Systems, March 22-28, Galveston, TX.
11. Frederick, J. M. and Buffett, B.A., 2014. Effect of submarine groundwater discharge on the present-day extent of relict submarine permafrost on the circum-Arctic shelf. Presented at 4th European Conference on Permafrost, June 18-21, Evora, Portugal.
12. Haines, S., Hart, P., Shedd, W., Frye, M., Agena, W., Miller, J., and Ruppel, C., 2013. Seismic investigation of gas hydrates in the Gulf of Mexico: Results from 2013 high-resolution 2D and multicomponent seismic surveys. Presented at American Geophysical Union Fall Meeting, Dec. 9-13, San Francisco, CA.
13. Handwerger, A. L. and Rempel, A.W., 2014. Submarine landslides induced by environmental changes and hydrate dissociation along the continental shelf. Poster presented at Gordon Research Seminar and Conference on Natural Gas Hydrate Systems, March 22-28, Galveston TX.
14. Hester, K.C., 2013. CO_2/CH_4 hydrate exchange field trial, results and interpretation. Presented at JOGMEC TRC Week, State-of-the-Art Technology Development of Resources of Japan, Technology Research Center, November 2013, Makuhari, Japan.

15. Kannberg, P., Constable, S., and Key, K., 2013. Hydrates in the California borderlands: 2D inversion results from CSEM towed and seafloor arrays. Presented at American Geophysical Union Fall Meeting, Dec. 9-13, San Francisco, CA.

16. Kannberg, P., Constable, S., and Key, K., 2014. Hydrates in the California borderlands: Results from controlled-source electromagnetic surveys. Presented at Gordon Research Seminar and Conference on Natural Gas Hydrate Systems, March 22-28, Galveston TX.

17. Kneafsey, T.J., Flemings, P.B., Bryant, S.L., You, K., and Polito, P.J., 2013. Preliminary experimental examination of controls on methane expulsion during melting of natural gas hydrate systems. Presented at American Geophysical Union Fall Meeting, Dec. 9-13, San Francisco, CA.

18. Kodis, M., Skarke, A., Ruppel, C., Weber, T., Lobecker, E., and Malik, M., 2013. U.S. Atlantic margin methane plumes identified from water column backscatter data acquired by NOAA ship Okeanos Explorer. Presented at American Geophysical Union Fall Meeting, Dec. 9-13, San Francisco, CA.

19. Lutken, C.B., D'Emidio, M., Macelloni, L., Ingrassia, M., Pierdomenico, M., Asper, V., Diercks, A., Woolsey, M.U., and Jarnagin, R., 2013. Challenges in imaging the deep seabed: Examples from Gulf of Mexico cold seeps. Presented at Gulf Coast Association of Geological Societies Annual Meeting, October 2013, New Orleans.

20. Mahabadi, N. and Jang, J., 2013. Verification of relative permeability equations for gas production from hydrate-bearing sediments. Presented at American Geophysical Union Fall Meeting, Dec. 9-13, San Francisco, CA.

21. Malinverno, A., Goldberg, D., 2014. Testing short-path migration as a methane hydrate formation mechanism in the Anadaman Sea and Kumano Basin. Poster presented at Gordon Research Seminar and Conference on Natural Gas Hydrate Systems, March 23-28, Galveston, TX.

22. Marlow, J., Steele, J., Ziebis, W., Thurber, A., Levin, L., and Orphan, V., 2014. The limits of methanotrophic metabolism. Presented at Southern California Geobiology Symposium, April 2014, Los Angeles, CA.

23. Marlow, J., Steele, J., Ziebis, W., Thurber, A., Levin, L., and Orphan, V., 2014. Carbonate hosted methanotrophy: An unrecognized methane sink in the deep sea. Presented at American Society for Microbiology, May 2014, Boston, MA.

24. Marlow, J., Steele, J., Skennerton, C., Pan, C., Chourney, K., Li, Z., Hettich, R., and Orphan, V., 2014. Environmental proteomics of methane seeps: An activity-based examination of metabolism and functional diversity. Presented at International Society of Microbial Ecology, August 2014, Seoul, South Korea.

25. Meyer, D. and Flemings, P.B., 2013. Thermodynamic state of hydrate-bearing sediments on continental margins around the world. Presented at American Geophysical Union Fall Meeting, Dec. 9-13, San Francisco, CA.

26. Meyer, D.W. and Flemings, P.B., 2014. Thermodynamic stability of gas hydrate systems on continental margins and in permafrost regions inferred from well log analysis. Presented at Gordon Research Seminar and Conference on Natural Gas Hydrate Systems, March 23-28, Galveston, TX.

27. Meyer, D. and Flemings, P.B., 2014. Thermodynamic state of gas hydrate in the Krishna-Godavari Basin inferred from well log analysis. Presented at 2014 Offshore Technology Conference, May 5-8, Houston, TX.

28. Nole, M. and Daigle, H., 2014. Determining methane hydrate equilibrium conditions in sediments from the Nankai Trough. Poster presented at Gordon Research Seminar and Conference on Natural Gas Hydrate Systems, March 23-28, Galveston, TX.

29. Ohtsuki, S., 2013. The first field trial of gas production, using CO_2-CH_4 exchange in Alaska. Poster presented at JOGMEC TRC Week, State-of-the-Art Technology Development of Resources of Japan, Technology Research Center, November 2013, Makuhari, Japan.

30. Pierdomenico, M., Guida, V., Macelloni, L., Gong, D., Scranton, M., Dierks, A., and Rona, P., 2014. Understanding the Hudson Submarine Canyon fishing "hotspot": The contribution of seafloor morphology, water mass dynamic, and methane emission on marine biodiversity. Presented at INCISE, 2nd International Symposium on Submarine Canyons, Sept. 29- Oct. 1, Edinburgh, Scotland.

31. Phillips, S.C., Johnson, J.E., Clyde, W., Setera, J., Hong, W.-L., and Torres, M., 2014. Unraveling depositional and diagenetic signals in magnetic susceptibility in gas-hydrate-bearing sediments along the Cascadia Margin. Poster presented at Gordon Research Seminar and Conference on Natural Gas Hydrate Systems, March 23-28, Galveston, TX.

32. Phrampus, B., Hornbach, M., Ruppel, C., and Hart, P., 2013. Alaskan Beaufort Sea heat flow and ocean temperature analysis: Implications for stability of climate-sensitive continental slope gas hydrates. Presented at American Geophysical Union Fall Meeting, Dec. 9-13, San Francisco, CA.

33. Pohl, M., 2014. Investigating the influence of clay content on ultrasonic velocities of THF hydrate-bearing sediment. Poster presented at the Gordon Research Seminar and Conference on Natural Gas Hydrate Systems, March 23-28, Galveston, TX.

34. Pohlman, J.W. and others, 2013. Methane emissions from a shallow gas seep in the Dutch North Sea: An analog for bubbling Arctic methane systems? Presented at final meeting of PERGAMON, November 2013, Kiel, Germany.

35. Pohlman, J.W. and others, 2014. Methane distribution and flux in the western Arctic Ocean. Poster presented at the Gordon Research Seminar and Conference on Natural Gas Hydrate Systems, March 23-28, Galveston, TX.

36. Raterman, K., 2013. CO_2/CH_4 hydrate exchange field trial, Basis for exchange and field test design. Presented at JOGMEC TRC Week, State-of-the-Art Technology Development of Resources of Japan, Technology Research Center, November 2013, Makuhari, Japan.

37. Rempel, A.W., 2014. Hydrate anomalies in heterogeneous sediments. Poster presented at Gordon Research Seminar and Conference on Natural Gas Hydrate Systems, March 23-28, Galveston, TX.

38. Ruppel, C.D., 2013. Gas Hydrates, climate change, and ocean-atmospheric methane fluxes in the Western Arctic Ocean. Presented at MIT Earth, Atmospheric and Planetary Sciences Distinguished Lecture Series, November 2013, Cambridge, MA.

39. Ruppel, C.D. and others, 2013. Methane in the western Arctic Ocean, Final meeting of PERGAMON, November 2013, Kiel, Germany.

40. Ruppel, C.D. and others, 2013. Methane hydrate dissociation and gas seepage on global upper continental slopes driven by intermediate ocean warming. Presented at American Geophysical Union Fall Meeting, Dec. 9-13, San Francisco, CA.

41. Ruppel, C.D., 2014. Climate-hydrate interactions in the Arctic and global system, Presented at Gordon Research Seminar and Conference on Natural Gas Hydrate Systems, March 23-28, Galveston, TX (invited).

42. Ruppel, C.D., 2014. Methane gas hydrates: energy resource and climate implications. Presented at Goldschmidt Conference, June 2014, Sacramento, CA (invited).

43. Ruppel, C.D., Brothers, L., Hart, P., and Herman, 2014. Subsea permafrost on the U.S. Beaufort margin. Presented at International Permafrost Association meeting, June 2014, Portugal.

44. Ruppel, C.D., 2014. Exploration in the Atlantic Canyons, NOAA OER Conference and Review, September 2014, Baltimore, MD (invited).

45. Sanchez, M., Shastri, A., and Santamarina, J.C., 2013. Modeling gas hydrate bearing sediments using a coupled approach. Proceedings of the Pan-American Conference on Unsaturated Soils, Cartagena, Colombia, eds. B. Caicedo, et al., pp. 545-550.

46. Sanchez, M., Santamarina, J.C., Shastri, A., and Xuerui, G., 2014. Coupled modeling of gas hydrate-bearing sediments. Presented at the 14th International Conference of the International Association for Computer Methods and Advances in Geomechanics, September 22-25, Kyoto, Japan.

47. Scandella, B., Urban, P., Delwiche, K., Greinert, J., Hemond, H., Ruppel, C.D., and Juanes, R., 2013. Quantifying methane flux from lake sediments using multibeam sonar. Presented at American Geophysical Union Fall Meeting, Dec. 9-13, San Francisco, CA.

48. Schindler, M. and Batzle, M., 2013. Rock physics characterization of hydrate-bearing porous media using micro x-ray computed tomography and ultrasonic velocity measurements. Presented at American Geophysical Union Fall Meeting, Dec. 9-13, San Francisco, CA.

49. Schindler, M. and Batzle, M., 2014. Pore-scale imaging and ultrasonic velocity measurements of THF-hydrate bearing sediments. Presented at the 8th International Conference on Gas Hydrates (ICGH8-2014), July 28-August 1, Beijing, China.

50. Skarke, A., Ruppel, C., Kodis, M., Lobecker, E., and Malik, M., 2013. Geologic significance of newly discovered methane seeps on the Northern US Atlantic margin. Presented at American Geophysical Union Fall Meeting, Dec. 9-13, San Francisco, CA.

51. Suzuki, K., Nakatsuka, Y., Fujii, T., Santamarina, J.C., Waite, W.F., Winters, W.J., Ito, K., Konno, Y., Yoneda, J., Kida, M., Jin, Y., Egawa, K., and Nagao, J., 2013. P-wave velocity features of methane hydrate-bearing turbidity sediments sampled by a pressure core tool, from the first offshore production test site in the eastern Nankai Trough, Japan. Presented at American Geophysical Union Fall Meeting, Dec. 9-13, San Francisco, CA.

52. Woolsey, M., Lowe, P.M., Tidwell, S., Jarnagin, R., Lutken, C.B., and D'Emidio, M., 2014. Undersea vehicles: Vital component of undersea ecosystems monitoring. Presented at Gulf of Mexico Oil Spill and Ecosystem Science Conference, Jan. 26-29, Mobile, AL.

53. Woolsey, M. and Woolsey, A., 2014. Improvements to a geographical technique for seafloor image mosaicking. Presented at Oceans 2014 MTS/IEE, September 14-19, St. John's, Newfoundland.

54. You, K. and Flemings, P.B., 2013. One dimensional advancing solidification front in the hydrate system. Presented at American Geophysical Union Fall Meeting, Dec. 9-13, San Francisco, CA.

55. You, K., Flemings, P.B., Bryant, S., Kneafsey, T., and Polito, P., 2014. Methane hydrate formation and dissociation at three-phase equilibrium at constant pressure. Presented at Gordon Research Seminar and Conference on Natural Gas Hydrate Systems, March 23-28, Galveston, TX.