Methane Hydrate Field Program Workshop

Consortium for Ocean Leadership
1201 New York Ave, Fourth Floor
Washington DC

June 4-6, 2013

The United States Department of Energy's (DOE) National Energy Technology Laboratory in partnership with the Consortium for Ocean Leadership (COL) has initiated a new field-focused methane hydrate research project. This project was proposed as a planning effort that could inform, and potentially lead to future projects ultimately including offshore drilling field expeditions. The primary objective of this project is to conduct planning that will help define and enable future ocean drilling, coring, logging, testing, and analytical activities to assess the geologic occurrence, regional context, and characteristics of methane hydrate deposits along the continental margins of the United States. It is also envisioned that this effort will reach out to the international research community to develop a more global vision of methane hydrate research goals and needs. To this end, COL is leading an effort to identify the range of scientific questions and unknowns that need to be addressed within methane hydrate science by working inclusively within the greater methane hydrate research community to solicit input and develop a comprehensive "Marine Hydrate Research Expedition Science Plan" (Science Plan). COL has assembled a "Hydrate Project Science Team" consisting of representatives from academia, industry, and government who are to steering this effort from start to completion. The foundation for the Science Plan will be established by hosting the "Hydrate Community Workshop" in Washington, D.C. on June 4-6, 2013 with the purpose of obtaining input from a broad section of the scientific community. This workshop will also provide an excellent learning opportunity, as well as a venue for the exchange of ideas among a highly interdisciplinary group of scientists and engineers.

The workshop will focus on specific scientific challenges that must be dealt with to advance our understanding of methane hydrates and also how these challenges can be resolved with the support of scientific drilling. In preparation for this workshop, the COL-DOE "Hydrate Project Science Team" has worked with other members of the hydrate science community to develop an initial list of methane hydrate challenges around which the workshop will be organized. This list of challenges is not intended to represent the entire range of methane hydrate research interests and at the same time it not designed to limit the scope of the workshop. This initial list of challenges should be considered only a starting point to help organize the workshop. As described in the workshop agenda (included at the end of this workshop planning document), this three-day long workshop will feature a series of plenary presentations to introduce and explore some of the more important methane hydrate research challenges. Most of the workshop, however, will be built around topical breakout sessions developed along the initial list of methane hydrate research challenges. It is envisioned that the breakout sessions will strive to further refine our collective understanding of each of the challenges being considered and at the same time explore other challenges and opportunities. One of the proposed goals of the breakout sessions is the consideration and the potential proposal of specific scientific drilling expeditions that would address a particular methane hydrate science challenge or a range of challenges.

In the following section of this workshop planning document we introduce the initial list of challenges around which the workshop will be organized.

Methane Hydrate Science Challenges

(1) Methane Hydrate Resource Assessment

COL-DOE Science Team Champions: Tim Collett and Matt Frye

One of the primary goals of methane hydrate research and development is the identification and quantification of the amount of technically and economically recoverable natural gas that might be stored within methane hydrate occurrences. A number of new quantitative estimates of in-place methane hydrate volumes and for the first time technical recoverable assessments have been undertaken using petroleum systems concepts developed for conventional oil and natural gas exploration. Additional work is needed to understand and compare the underlying assumptions in the various existing methane hydrate assessment methodologies. Questions and concerns about the geologic data and concepts as applied within the various completed assessments also need rigorous review and further development. Assessment approaches need to evolve with and contribute to our growing understanding of methane hydrates. It is also recognized that specialized assessment methodologies will be required to address the wide ranging characteristics of methane hydrate systems in nature.

(2) Methane Hydrate Production Analysis

COL-DOE Science Team Champions: Jarle Husebø and Tim Collett

A primary goal of the U.S. national methane hydrate research program has been the determination of the viability of gas production from methane hydrate reservoirs. Today, a wealth of data gathered in the lab, during field tests, and in numerical simulation studies indicates that gas is technically recoverable from methane hydrates hosted in porous and permeable (sand or sandstone) reservoirs using existing technologies. However, what is not well understood is how long it might take to recover those volumes, from how many wells, with what water production, and what wellbore completion technologies will be required. A program of extended term field tests is needed to address these issues and move toward a better understanding of the economics of natural gas production from methane hydrates reservoirs. To be most effective, this program should feature a series of tests, utilizing different approaches, and applied over a range of geologic settings. To prepare for future field production test it is envisioned that more information is needed on: (1) the geology of the hydrate-bearing formations, on a large scale - the distribution of hydrates both throughout the world and on small scale – their occurrence and distribution in various host sediments; (2) the reservoir properties/characteristics of methane hydrate reservoirs; (3) the production response of various methane hydrate accumulations at both the lab scale and through production modeling; (4) the environmental and economic issues controlling the ultimate resource potential of methane hydrates; and (5) the development of numerical models that represent observed phenomena in field and laboratory experiments.

(3) Methane Hydrate Related Geohazards

COL-DOE Science Team Champions: Craig Shipp and Jarle Husebø

Relative to the presence of methane hydrate in nature, the term “geohazard” generally encompasses two areas of concern: “naturally-occurring” geohazards that emerge wholly from geologic processes and “industrial” geohazards that represent latent natural hazards that may be triggered by human activities. It is generally believed that the presence of

methane hydrate increases the mechanical strength of the sediment within which it resides. However, the dissociation of that methane hydrate releases free gas and excess pore water, which may substantially reduce the geomechanical stability of the affected sediments. The potential linkage between large-scale mass wasting events and the dissociation of methane hydrates has been a topic of interest over the past decade, but there is little agreement on the role methane hydrate plays in slope stability processes. In comparison to most conventional hydrocarbon accumulations, methane hydrates occur at relatively shallow depths and therefore as a potential "industrial" geohazard could contribute to seafloor displacements over the long-term development of a methane hydrate accumulation. Methane hydrates in some cases are also considered to represent a hazard to shallow drilling and well completions. Addressing these issues with confident scientific and technical approaches remains a challenge because little data or research exist to support or refute existing theories for understanding the role of methane hydrates as a geohazard.

(4) Methane Hydrate Role in the Global Carbon Cycle

COL-DOE Science Team Champions: Mitch Malone and Marta Torres

It has been shown that methane is an important component of the Earth's carbon cycle on geologic timescales. Whether methane once stored as methane hydrate has contributed to past climate change or will play a role in the future global climate remains unclear. A given volume of methane causes 15 to 20 times more greenhouse gas warming than carbon dioxide, so the release of large quantities of methane to the atmosphere could exacerbate atmospheric warming and cause more methane hydrates to destabilize. Some research suggests that this has happened in the past. Extreme warming during the Paleocene-Eocene Thermal Maximum about 55 million years ago may have been related to a large-scale release of global methane hydrates. Some scientists have also advanced the Clathrate Gun Hypothesis to explain observations that may be consistent with repeated, catastrophic dissociation of methane hydrates and triggering of submarine landslides during the Late Quaternary (400,000 to 10,000 years ago). Considerable interest exists to understand the geologic processes associated with methane hydrate formation and decomposition, as well as the possible role of methane hydrate in global climate change.

(5) Methane Hydrate Petroleum Systems

COL-DOE Science Team Champions: Matt Frye, Jang-Jun Bahk, and Marta Torres

In recent years significant progress has been made in addressing key issues on the formation, occurrence, and stability of methane hydrate in nature. The concept of a methane hydrate petroleum system, similar to the concept that guides conventional oil and gas exploration, has been developed to systematically assess the geologic controls on the occurrence of methane hydrate in nature. The methane hydrate petroleum system concept has been used to guide the site selection process for numerous recent methane hydrate scientific drilling programs. At the same time the petroleum system concept has been used to assess the impact of geologic variables, such as "reservoir conditions" or the "source" of the gas with the hydrates on the occurrence and physical nature of methane hydrate at various scales. Although there have been significant advancements in our understanding the geologic controls on the occurrence of methane hydrate our understanding how the various components of a methane hydrate system interact to form the immense range of observed hydrate types and morphologies is incomplete. It is also acknowledged that much of the methane hydrate research efforts continue to focus on describing hydrates as static deposits rather than understanding them as part of a dynamic system. There is an obvious growing need for the development of integrated time dependent models to understand the

geologic controls on the formation, occurrence, and stability of methane hydrates in nature.

(6) Methane Hydrate Laboratory and Field Characterization

COL-DOE Science Team Champions: Dave Goldberg, Jang-Jun Bahk, and Carolyn Koh

The development of geophysical, well log, and core analysis diagnostic instrumentation and analytical methods contribute directly to the explorationist's ability to locate and define hydrate-bearing reservoirs. The analysis of geophysical, well log and sediment core data have yielded critical information on the location, extent, sedimentary relationships, and the physical characteristics of methane hydrate deposits and their energy resource potential. The development of methane hydrate exploration methods and refined resource estimates is a growing focus of integrated laboratory and field geophysical, logging, and coring studies in both onshore and offshore environments. Integrated methane hydrate laboratory, field and modeling studies are needed to further characterize the geologic controls on the occurrence of methane hydrate in nature and to measure their effects on the physical, mechanical, and reservoir properties of methane-hydrate-bearing sediments. These studies require improved understanding of the physical properties of naturally occurring hydrate-bearing sediments (HBS) versus laboratory synthesized HBS, and the effect of different hydrate formation mechanism(s) on the HBS physical properties. As we look to the future, methane hydrate energy assessments will require a more detailed understanding of the natural methane hydrate reservoir and its relationship to the surrounding geologic formations. This work will also provide information on hydrate production technology, sea floor stability, and other environmental issues.

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Agenda

Day One - Tuesday June 4, 2013 (09:00-17:00 hr)

9:00-9:30 Workshop Check-In and Breakfast

9:30-10:30 Opening Session

-Introductions
-Project Overview and Meeting Goals (G. Myers)
-DOE Program Perspective (R. Boswell)
-Project Science Team Contributions (T. Collett) – *Historical Review and Science Planning*

10:30-12:30 Invited Plenary Presentations

(1) Methane Hydrate Resource Assessment
(2) Methane Hydrate Production Analysis
(3) Methane Hydrate Related Geohazards
(4) Methane Hydrate Role in the Global Carbon Cycle
(5) Methane Hydrate Petroleum Systems
(6) Methane Hydrate Laboratory and Field Characterization

12:30-13:30 Lunch (at Ocean Leadership)

13:30-17:00 Breakout Session (1)

-Development and Tasking Breakout Groups for Breakout Session (1)

-Breakout Discussions (1) - *Methane Hydrate Science Challenges*

Breakout 1.A. Methane hydrate petroleum systems with considerations of methane hydrate resource assessment and global carbon cycle analysis

Breakout 1.B. Methane hydrate production analysis

Breakout 1.C. Methane hydrate related geohazard characterization and assessment

-Breakout Reporting (1) - *Methane Hydrate Science Challenges*

Day Two - Wednesday June 5, 2013 (09:00-17:00 hr)

9:00-9:30 Breakfast

9:30-12:30 Breakout Session (1) - Continued

-Breakout Discussions (1) - *Methane Hydrate Science Challenges*

Breakout 1.A. Methane hydrate petroleum systems with considerations of methane hydrate resource assessment and global carbon cycle analysis

Breakout 1.B. Methane hydrate production analysis

Breakout 1.C. Methane hydrate related geohazard characterization and assessment

-Breakout Reporting (1) - *Methane Hydrate Science Challenges*

12:30-13:30 Lunch (at Ocean Leadership)

13:30-17:00 Breakout Session (2)

-Development and Tasking Breakout Groups for Session (2)

-Breakout Discussions (2) - *Proposed Scientific Drilling Expeditions*
New Breakouts Groups: Focus on proposed scientific drilling expeditions as recommended out of the topical breakouts from Days one and two.

-Breakout Reporting (2) – *Proposed Scientific Drilling Expeditions*

Day Three - Thursday June 6, 2013 (09:00-13:00 hr)

9:00-9:30 Breakfast

9:30-13:00 Plenary Review and Discussion

(1) Methane Hydrate Science Challenges

(2) Proposed Scientific Drilling Expeditions

(3) Methane Hydrate Laboratory and Field Characterization Research and Development

-Science Plan Development and Path Forward