Methane Hydrate Workshop

as part of the

FY 2013 Methane Hydrate Field Program

Consortium for Ocean Leadership
June 4-6, 2013

Funded by DOE–NETL (DE-FE0010195)

DOE – NETL Funding Opportunity Objectives

This announcement is a critical component of advancing several of the specific mandates previously established for the Methane Hydrate Program under the Methane Hydrate Act of 2000 (as amended by Section 968 of the Energy Policy Act of 2005) including direction to: conduct basic and applied research to identify, explore, assess, and develop methane hydrate as a commercially viable source of energy; identify methane hydrate resources through remote sensing; assist in developing technologies required for efficient and environmentally sound development of methane hydrate resources; conduct basic and applied research to assess and mitigate the environmental impact of hydrate degassing (including both natural degassing and degassing associated with commercial development); and develop technologies to reduce the risks of drilling through methane hydrates. This "Methane Hydrates Funding Opportunity Announcement" supports these goals by developing new cooperative agreements between the federal government and industry, academia, and state agencies and institutions to investigate these issues.

In parallel with attempts to evaluate production potential of methane from hydrates, the DOE also wishes to advance the knowledge base associated with the nature and occurrence of hydrates, the geological and hydrological systems that produce hydrate deposits, and the role gas hydrates play in the global environment.

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Project intent, objective and goals

- The intent of the project is to create a better understanding of the impact of methane hydrates on safety and seafloor stability as well as to provide data that can be used by scientists in their study of climate change and assessment of the feasibility of marine methane hydrate as a potential future energy resource.

- The primary objective of the project is to enable scientific 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 U.S. with an emphasis on the Gulf of Mexico and the Atlantic margin.

- The goals that must be reached to obtain the objective are to assemble the methane hydrate project science team led by a community liaison. Engage the hydrate community through a community workshop with the goal of developing a methane hydrate "science plan" for a methane hydrate sampling program.

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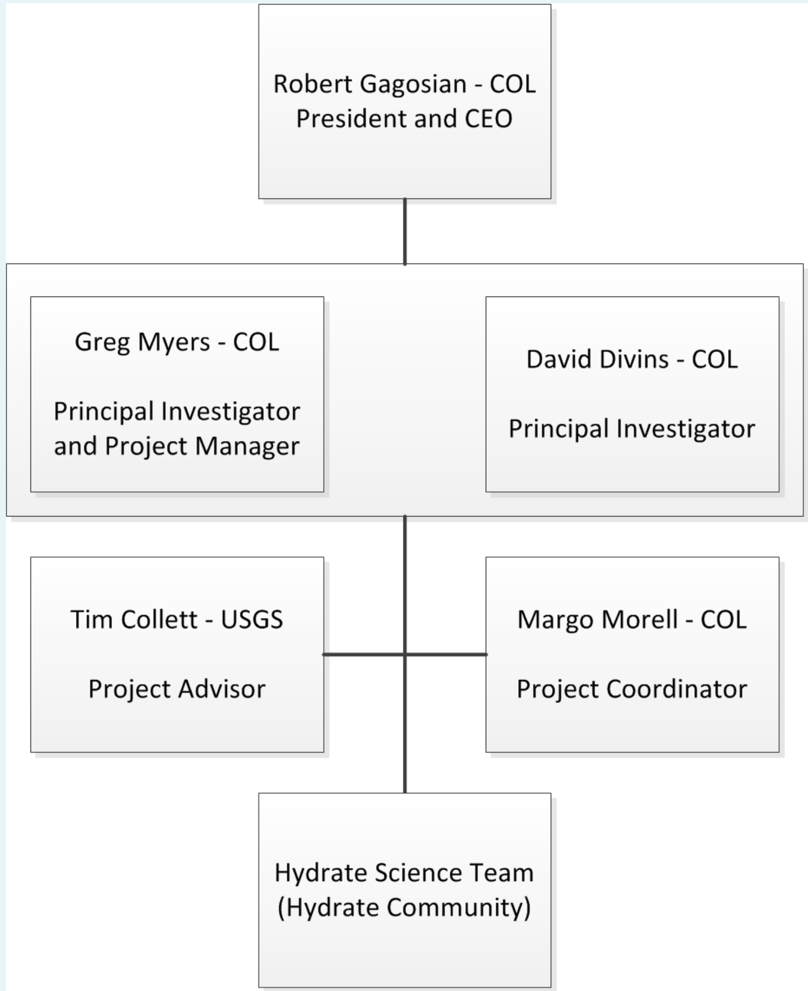
Organizational Structure



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Technical approach

- **Phase 1**– Assemble the gas hydrate project science team led by a community liaison. Engage the hydrate community through a community workshop with the goal of developing a methane hydrate "science plan" for a hydrate sampling program. Based on our experience leading scientific ocean drilling efforts, a science plan is a critical step needed to define the knowledge gaps, articulate hypotheses, determine regions for exploration, and develop measurement/ sampling requirements. This information, assembled in one document is a vital foundation needed for successful completion of subsequent phases.

- **Phase 2 (Not part of this project)**-With successful completion of Phase 1, create the detailed drilling/coring/logging project "operational plan" and prepare all documents such as the Deepwater Operations Plan (DWOP) and Hazard Identification (HAZID) assessment including drilling permits, hazard site reviews, and specialty engineering studies needed to execute the drilling plan. This phase will build upon the accomplishments of the Phase -1 science team which, under Phase 2 will be augmented by the inclusion of experienced operational engineers and technical staff as required.

- **Phase 3 (Not part of this project)** – Under Phase 3, execute the drilling/coring/logging/testing plan as developed in Phase 1 and 2 of this project.

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Deliverables

- Project Management Plan (PMP) — Available online
- Historical Methane Hydrate Project Review and Synthesis Report — Available online
- Scientific Community Workshop and Report
- Marine Hydrate Research Expedition Science Plan

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Project Website

oceanleadership.org/methane

Project Science Team
Marine Gas Hydrate Community Workshop
Program Planning and Review Documents

Methane Hydrate Field Program

In October 2012, the United States Department of Energy's National Energy Technology Laboratory (DOE-NETL) in partnership with the Consortium for Ocean Leadership (Ocean Leadership) initiated the Methane Hydrate Field Research Program. This research project is part of an expanding portfolio of DOE-NETL projects designed to increase the understanding of methane hydrates' potential as a future energy supply.

DEPARTMENT OF ENERGY · UNITED STATES OF AMERICA

NETL NATIONAL ENERGY TECHNOLOGY LABORATORY

Purpose

The primary objective is to conduct scientific planning that will help define and enable future scientific 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. This effort will also help reach out to the international research community to develop a more global vision of gas hydrate research goals and needs.

To accomplish these objectives, DOE-NETL and Ocean Leadership have assembled a gas hydrate project science team. Additionally, future community engaging activities are planned, starting with a research community workshop in June 2013 with the goal of developing a hydrate "science plan" for a gas hydrate sampling program.

Upcoming Events

Marine Gas Hydrate Community Workshop
4 -6 June 2013

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Upcoming Events

June 4, 2013:
Save The Date: Capitol Hill Ocean Week (all day)

June 24, 2013:
2013 AGU Science Policy Conference: Preparing for Our Future (all day)

September 23, 2013:
OCEANS 2013 MTS/IEEE San Diego (all day)

November 11, 2013:
WUWNet'13 (all day)

Popular This Month

ONW: Week of May 27, 2013 – Number 204: Ocean News Weekly provides you with the most useful and timely information regarding our efforts.

Congress Receives FY 2012 National Oceanographic Partnership Program Report to Congress: The NOPP is legislated to annually report to Congress on the activities of the Program related to identifying and carrying out partnerships among a

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Methane Hydrate Science Challenges

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

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(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. <u>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.</u> 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 reservoirs using existing technologies. 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 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 "operational" 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 "operational" 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 an hazard to shallow drilling and well completions. Despite the concerns associated methane hydrate related geohazards, 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.

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(6) Methane Hydrate Laboratory and Field Characterization

COL-DOE Science Team Champions: Dave Goldberg, Jang-Jun Bahk, 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. <u>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.</u> 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.

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

- **(5) MH Petroleum Systems**
- **(1) MH Resource Assessment**
- **(4) MH Role in the Global Carbon Cycle**
- **(6) MH Laboratory and Field Characterization**

Breakout 1.B. Methane hydrate production analysis

- **(2) MH Production Analysis**
- **(6) MH Laboratory and Field Characterization**

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

- **(3) MH Related Geohazards**
- **(6) MH Laboratory and Field Characterization**

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Breakout Session (1) - Framing Questions

(1) Existing methane hydrate science challenges – each breakout should review the challenges as described in the workshop planning document, consider required modifications, additions, and/or reconsiderations or possible new direction?

(2) What data needs to be collected to address the particular methane hydrate science challenges, both during drilling and the pre-post phases of a scientific drilling project?

(3) Are there specific locations and or research areas that could be drilled to advance our collective understanding of a particular methane hydrate research challenge?

(4) What laboratory (including analysis of natural and synthetic core materials) and/or modeling studies are needed to advance our collective understanding of each methane hydrate research challenge?

(5) What R&D requirements are needed to advance new field measurements and/or instrumentation to achieve the methane hydrate research challenges as described?

(6) What are the particular needs for the integration of data and models to further our understanding of the gas hydrate challenges as described in the workshop planning documents?

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Methane Hydrate Science

Challenges

(1) MH Resource Assessment and Global Carbon Cycle

(2) MH Production Analysis

(3) MH Related Geohazards

~~(4) MH Role in the Global Carbon Cycle~~

~~(5) MH Petroleum Systems~~

~~(6) MH Laboratory and Field Characterization~~

Crosscutting Issues

Methane Hydrate System

Methane Hydrate Laboratory and Field Characterization

Up-scaling: molecular-micro-mega-regional-global

Methane Hydrate Field Program Workshop

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 Discussions (2) - Proposed Scientific Drilling Expeditions

Focus on proposed scientific drilling expeditions (research site/location) as recommended out of the topical breakouts from Days One and Two

Plenary Review and Discussion

(1) Methane Hydrate Science Challenges

(2) Proposed Scientific Drilling Expeditions (research site/location)

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

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Site/Expedition: (1A-1)
Challenge or science issue to be addressed: Global Carbon Cycle and Temporal - Updip Limit
General geologic setting or model: Upper Slope
Specific Location: Beaufort Shelf; Cascadia Margin; Cape Fear; Hikurangi Margin; Northern Europe (Svalbard); Cape Hatteras
Location geologic conditions: Well defined upper limit of gas hydrate stability, evidence of venting, evidence of temperature changes in water column (present and paleo), evidence of altered stability field
Scientific objectives: Reconstruct paleo changes in thinning; understand response of system to change/forcing – present and past; consequences of change (gas flux rates, seafloor stability, geomechanics); interpret present thermodynamic state; ground truth existing acoustic data; rate of dissociation; response of microbes; shallow sediment carbon cycle
Drilling strategy: Transect, or multiple transects – including reference site
Required technology

- **-Downhole tools:** Formation temperature/pressure measurement and thermal conductivity
- **-Logging:** LWD
- **-Coring:** High res fluid chemistry, phys props, sedimentology (paleo proxy), biostrat, paleomag
- **-Pressure coring**
- **-Instrumentation:** Monitoring

Has the location been previously drilled, what did we learn? No

Site/Expedition: (1A-3)
Challenge or science issue to be addressed: High GH concentrations in sand reservoirs
General geologic setting or model: Deepwater fans; turbidites
Specific Location: GOM (WR313, GC 955); new jersey margin; Mackenzie Delta; SW Taiwan; Hikurangi Margin; Ulleong Basin
Location geologic conditions: Well defined upper limit of gas hydrate stability, evidence of venting, evidence of temperature changes in water column (present and paleo), evidence of altered stability field
Scientific objectives: GH saturation; understand mechanism of formation of high concentration GH in deep marine sand deposits; ground truth predictive models and assessments
Site Survey Requirements: Existing industry seismic; nearby well control is desirable
Drilling strategy: Twin existing wells if available; transect to test migration
Required technology

- **-Logging:** LWD and/or wireline
- **-Coring:** Standard
- **-Pressure coring:** Essential
- **-Instrumentation:** Standard

Has the location been previously drilled, what did we learn? Yes; depth, thickness, and likely areal extent of reservoir; acoustic properties; in other cases, NO
Pre and post laboratory and modeling requirements: Extensive pressure core analysis

Site/Expedition: (1A-4)
Challenge or science issue to be addressed: Global Carbon Cycle and Temporal
General geologic setting or model: High flux vent/chimney mechanism of formation and evolution
Specific Location: GOM, Cascadia, Alaska North Slope – Various tectonic settings
Location geologic conditions:
Scientific objectives: Understand mass flux, methane flux to water column, gas flux to HSZ, impact on microbiology, kinetics of rapid formation of hydrate and dissociation, spatial variation of shallow sediment carrying capacity (AOM)
Site Survey Requirements:
Drilling strategy:
Required technology
- **-Logging:**
- **-Coring:**
- **-Pressure coring:**
- **-Instrumentation:**

Has the location been previously drilled, what did we learn?
Pre and post laboratory and modeling requirements:

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Site/Expedition: (1A-5)
Challenge or science issue to be addressed: Global Carbon Cycle
General geologic setting or model: All margins
Specific Location: Global
Location geologic conditions:
Scientific objectives: Defining metrics that control GCC budget over time; establish thresholds, informing global/local assessment models
Site Survey Requirements: Piggyback
Drilling strategy: Wells (data) of opportunity, establish a consistent protocol, overseeing champion
Required technology

- **-Logging:**
- **-Coring:**
- **-Pressure coring:**
- **-Instrumentation:**

Has the location been previously drilled, what did we learn?
Pre and post laboratory and modeling requirements:

Site/Expedition: WR 313 (1B-1)
Challenge or science issue to be addressed: Methane hydrate production analysis
General geologic setting or model: Sand reservoirs
Specific Location:
Location geologic conditions:
Scientific objectives:
Drilling strategy:
Required technology

- **-Logging**
- **-Coring**
- **-Pressure coring**
- **-Instrumentation**

Has the location been previously drilled, what did we learn?

Site/Expedition: GC781 Mad Dog (1B-2)
Challenge or science issue to be addressed: Methane hydrate production analysis
General geologic setting or model: Sand reservoirs
Specific Location:
Location geologic conditions:
Scientific objectives:
Drilling strategy:
Required technology

- **-Logging**
- **-Coring**
- **-Pressure coring**
- **-Instrumentation**

Has the location been previously drilled, what did we learn?

Site/Expedition: (1C-1)

Challenge or science issue to be addressed: Preconditioning of areas for slope failure with high gas hydrate saturations

General geologic setting or model: Toe of the slope, looking for downdip edge of future retrogressive failure

Specific Location: North wall of Storegga slope, northwest Svalbard, Cape Fear slide

Location geologic conditions: 1-3^{o} slope, high gas hydrate saturation in a stable environment; hydrates with free gas

Scientific objectives: Understanding of strength at toe of slope and potentially how/what causes retrogressive failure; impacts of dissolution and dissociation

Drilling strategy: Shallow, riserless drilling transects

Required technology

- **-Logging**
- **-Coring**
- **-Pressure coring**
- **-Instrumentation**

Has the location been previously drilled, what did we learn?

Site/Expedition: (1C-2)
Challenge or science issue to be addressed: Production related geohazards with a deepwater, deep sand
General geologic setting or model: Deepwater, deep sand reservoir as selected by the production group
Specific Location: Determined by the production group
Location geologic conditions:
Scientific objectives: Understand how strength and stress state around the producing interval (reservoir and seal) change with production of gas hydrate; subsidence issues, brittle or plastic deformation, fluid flow changes in reservoir and seal; associated benthic and seafloor geomorphology changes
Drilling strategy: Controlled production test; geohazard evaluation and monitoring wells; cabled observatories
Required technology

- **-Logging**
- **-Coring**
- **-Pressure coring**
- **-Instrumentation**

Has the location been previously drilled, what did we learn?

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Site/Expedition: (1C-3)
Challenge or science issue to be addressed: Production related geohazards with a shallow reservoir; how is it different from a deeper reservoir
General geologic setting or model: Shallow reservoir with controlled perturbation
Specific Location: Southern Hydrate Ridge
Location geologic conditions:
Scientific objectives: Understand how strength and stress state around the producing interval (reservoir and seal) change with production of gas hydrate; subsidence issues, brittle or plastic; deformation, fluid flow changes in reservoir and seal; associated benthic and seafloor geomorphology changes; comparison of difference between perturbation of shallow and deep hydrate systems; fate of gas formed during shallow dissociation
Drilling strategy: Production test either by thermal stimulation or pressure depletion; geohazard evaluation and monitoring wells; cabled observatories
Required technology

- **-Logging**
- **-Coring**
- **-Pressure coring**
- **-Instrumentation**

Has the location been previously drilled, what did we learn? Yes

Site/Expedition: (1C-4)

Challenge or science issue to be addressed: What is fate of water and gas produced from hydrate permafrost

General geologic setting or model: Arctic permafrost site

Specific Location:

Location geologic conditions: Where top of GHSZ is within the permafrost zone

Scientific objectives: See how freezing of water produced impacts seal capacity, how pressure below may increase below seal

Drilling strategy: Transect across the permafrost-hydrate boundary

Required technology

- **-Logging**
- **-Coring**
- **-Pressure coring**
- **-Instrumentation:** Pressure, temperature more important than usual

Has the location been previously drilled, what did we learn?

Site/Expedition: (1C-5)
Challenge or science issue to be addressed: Hydrate response to earthquakes to assess natural perturbation
General geologic setting or model: Rapid response after a large earthquake in a hydrate-bearing region
Specific Location: Chile, Japan, Cascadia
Location geologic conditions:
Drilling strategy:
Required technology

- **-Logging**
- **-Coring**
- **-Pressure coring**
- **-Instrumentation:**

Has the location been previously drilled, what did we learn?

Site/Expedition: (1C-6)

Challenge or science issue to be addressed: Understanding relation of BSR to free gas beneath; relation to saturations (FG, GH) and geology/lithology

General geologic setting or model:

Specific Location: Wells of opportunity with some very selected geophysical measurements (e.g., VSP) to get at GH and FG saturations at BSR

Location geologic conditions:

Scientific objectives:

Drilling strategy:

Required technology

- **-Logging**
- **-Coring**
- **-Pressure coring**
- **-Instrumentation:**

Has the location been previously drilled, what did we learn?

Proposed Scientific Drilling Expeditions

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

1A-1. Global Carbon Cycle; Upper Slope Limit; Beaufort Shelf; Cascadia Margin; Cape Fear; Hikurangi Margin; Northern Europe (Svalbard); Cape Hatteras

1A-3. Assessment, Deepwater fans/turbidites; GOM (WR313, GC 955); new jersey margin; Mackenzie Delta; SW Taiwan; Hikurangi Margin; Ulleong Basin

1A-4. Global Carbon Cycle; High flux vent/chimney; GOM, Cascadia, Alaska North Slope – Various tectonic settings

1A-5. Global Carbon Cycle and Assessment; Wells (data) of opportunity; Global

Breakout 1.B. Methane hydrate production analysis

1B-1. Walker Ridge 313 (JIP Leg II)

1B-2. GC781 Mad Dog (1B-2)

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

1C-1. Preconditioning of areas for slope failure with high gas hydrate saturations; Storegga slope, northwest Svalbard, Cape Fear slide

1C-2. Production related geohazards with a deepwater, deep sand; WR and GC

1C-3. Production related geohazards with a shallow reservoir; Hydrate Ridge

1C-4. What is fate of water and gas produced from hydrate permafrost, Arctic

1C-5. Hydrate response to earthquakes to assess natural perturbation, Rapid response

1C-6. Understanding BSR free-gas relationship; Wells of opportunity

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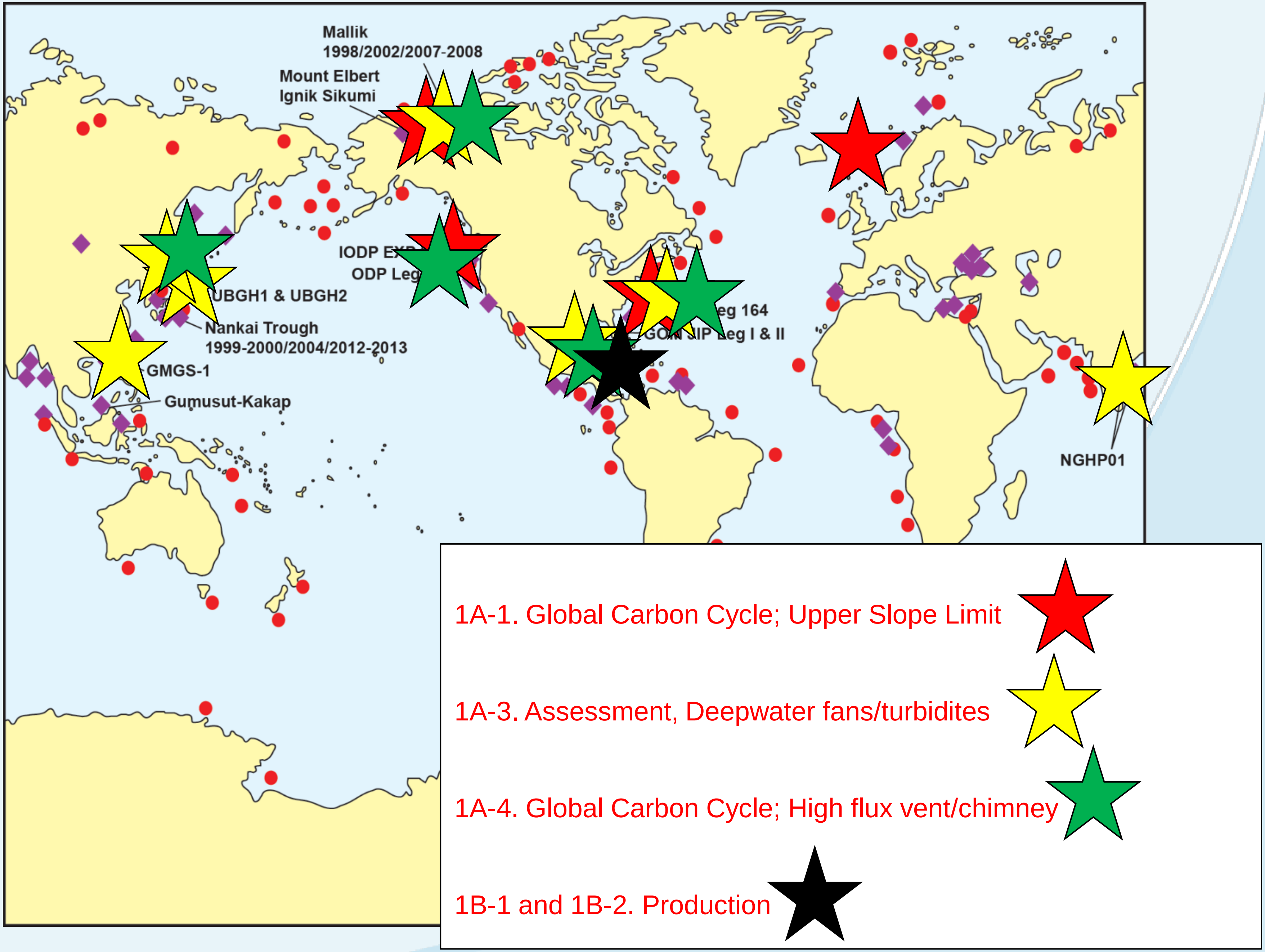
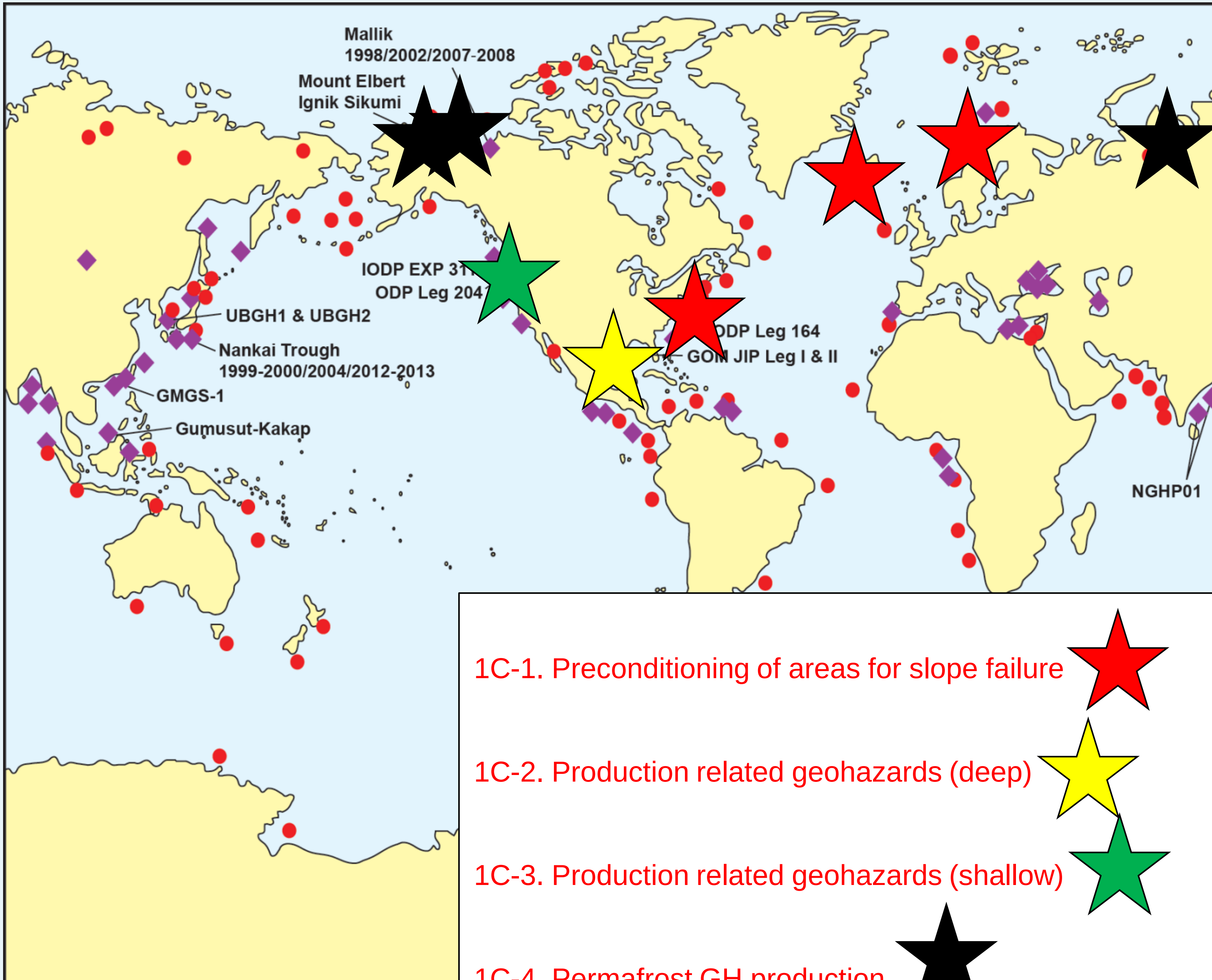

Mallik
1998/2002/2007-2008
Mount Elbert
Ignik Sikumi
UBGH1 & UBGH2
Nankai Trough
1999-2000/2004/2012-2013
GMGS-1
Gumusut-Kakap
NGHP01
1A-1. Global Carbon Cycle; Upper Slope Limit
1A-3. Assessment, Deepwater fans/turbidites
1A-4. Global Carbon Cycle; High flux vent/chimney
1B-1 and 1B-2. Production



1C-1. Preconditioning of areas for slope failure

1C-2. Production related geohazards (deep)

1C-3. Production related geohazards (shallow)

1C-4. Permafrost GH production

Two Deliverables from this Workshop

Workshop report

The Workshop Report will include a complete synthesis of the results of the Hydrate Community Workshop, which will be incorporated into the final version of this historical review.

Methane hydrate project science plan

- Is the primary deliverable of this effort and is the Final Report for Phase 1 of this project
- Is intended to set the goals for the hydrate drilling expedition and sampling program
- Will include specific recommendations of drilling leg(s) and drill sites specifically selected to address the methane hydrate research goals identified in this study

Various technical concerns will also be addressed, including:

- recommendations regarding the type and amount of conventional and pressure cores should be acquired, what type of core analysis should be performed, wireline and/or logging-while-drilling log data, and what allocations should be made for formation testing.

The Methane Hydrate Science Plan may be used in a possible Phase 2 to develop the operational plan for a future field program

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Primary Input to Science Plan

- Most import – your input from this workshop is the primary source of data for the science plan. Thank you for your hard work and solid contributions over the last 2.5 days with us!

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Science Plan Development Approach

- **Now -** Collect all materials from this workshop and begin synthesizing
- **Early July** – Complete workshop report and circulate
- **Late July** – Convene meeting with science team to write a formal version of the science plan
- **End of September** – Submit science plan to DOE-NETL

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Proposed Outline of the Science Plan

I. Marine Methane Hydrate Science Plan
   A. Executive Summary
   B. Approach
   C. Goals

II. Challenges
   A. MH Resource Assessment and Global Carbon Cycle
      1. Description and discussion
      2. Drilling program requirements
         a) Site Identification
         b) Site Characterization and systems analysis
         c) Drilling and sampling program
         d) Tools and equipment
   B. MH Production Analysis
      1. Description and discussion
      2. Drilling program requirements
         a) Site Identification
         b) Site Characterization and systems analysis
         c) Drilling and sampling program
         d) Tools and equipment
   C. MH Related Geohazards

III. Cross cutting relationships between challenges
   A. MH Systems
   B. MH Laboratory and Field Characterization
   C. Upscaling

IV. Recommendations

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