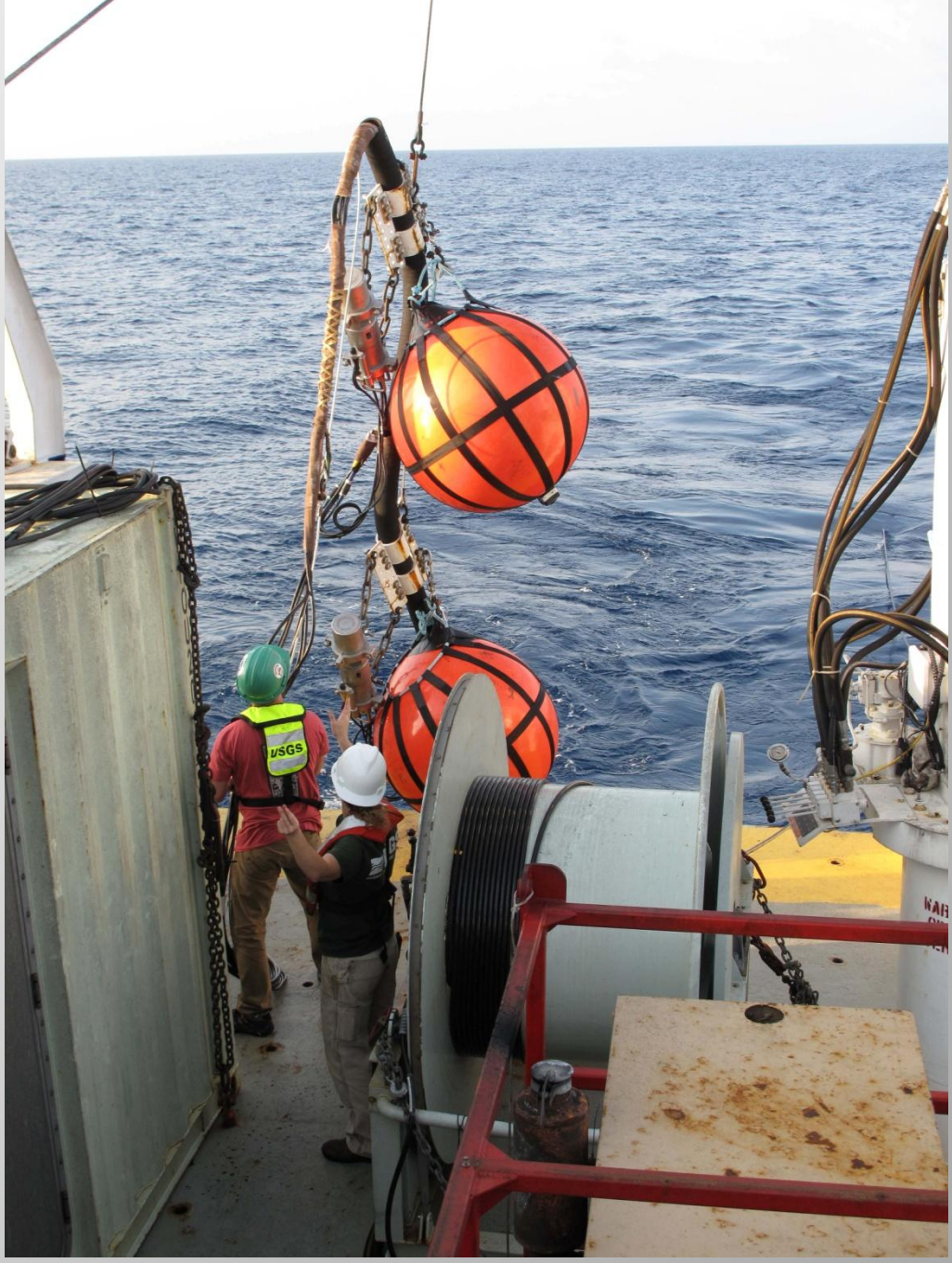
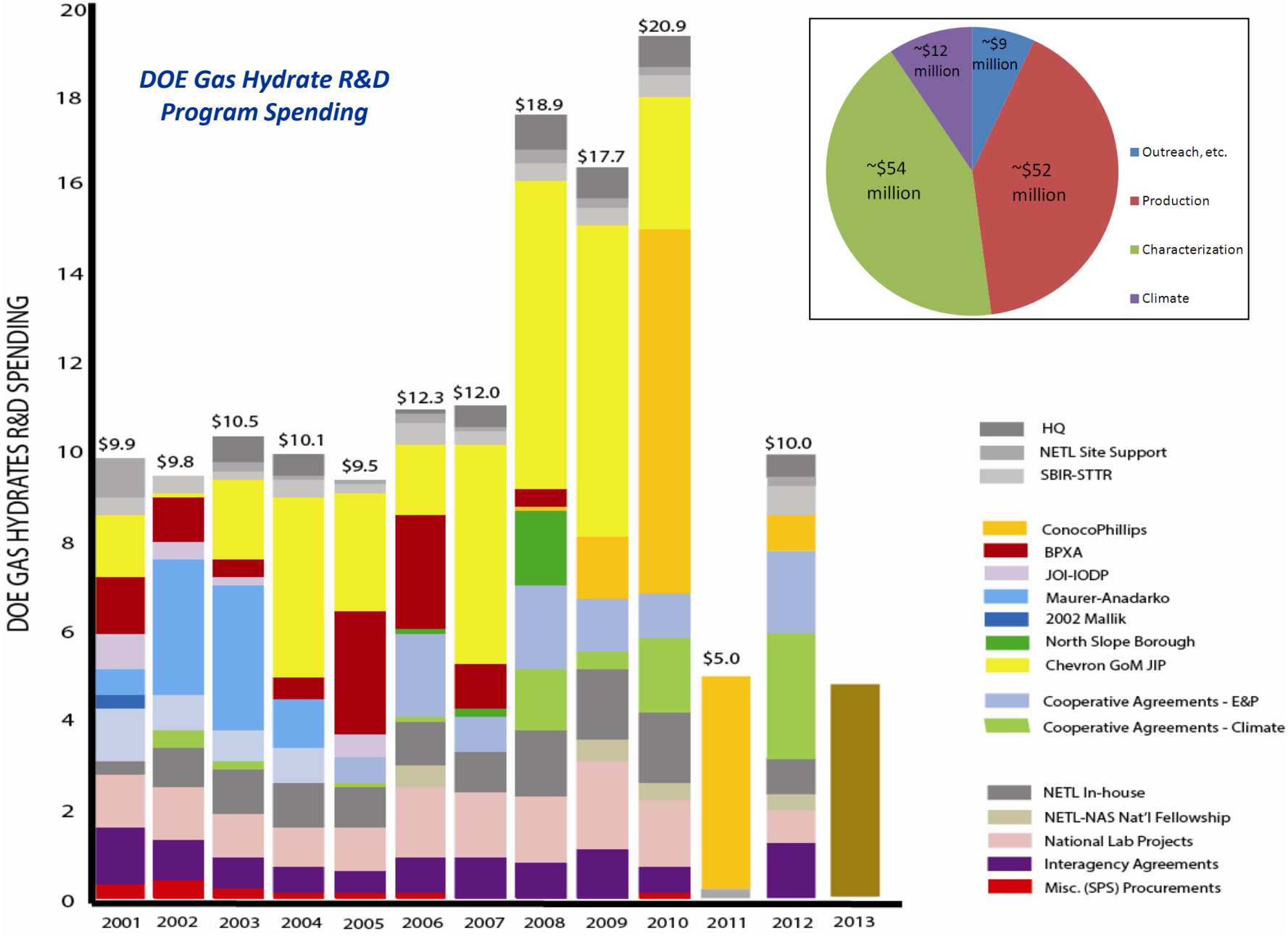
Gas Hydrate Program Activities in FY2013

Methane Hydrate Federal Advisory Committee

Ray Boswell, DOE/NETL

June 7, 2013




DOE Gas Hydrate R&D Program Spending
DOE GAS HYDRATES R&D SPENDING
0
2
4
6
8
10
12
14
16
18
20
$9.9
$9.8
$10.5
$10.1
$9.5
$12.3
$12.0
$18.9
$17.7
$20.9
$5.0
$10.0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
~$12 million
~$9 million
~$54 million
~$52 million
Outreach, etc.
Production
Characterization
Climate
HQ
NETL Site Support
SBIR-STTR
ConocoPhillips
BPXA
JOI-IODP
Maurer-Anadarko
2002 Mallik
North Slope Borough
Chevron GoM JIP
Cooperative Agreements - E&P
Cooperative Agreements - Climate
NETL In-house
NETL-NAS Nat'l Fellowship
National Lab Projects
Interagency Agreements
Misc. (SPS) Procurements

Historical Results (through 2010)

- Conducted three safe/successful Arctic/Deepwater field programs on time, on budget.
- Resolved GH-drilling hazards facing GoM operations.
- Identified the resource target (sands:10,000s Tcf); with international implications.
- 2007 test with BP key input to USGS confirmation of technically-recoverable resources in AK: test earned industry buy-in for subsequent scientific testing in PBU.
- 2009 GoM program proved GH exploration approach with field results, and further informed 2008 BOEM assessment.
- Enabled the first modeling of GH response to climate change. Supported post-Macondo science.
- Coordinated international modeling consortium; moved simulation to use of geologically-robust inputs
- Earned positive external engagement/review (NRC, FAC, Interagency, Industry, Conferences, Key Publications, etc.)

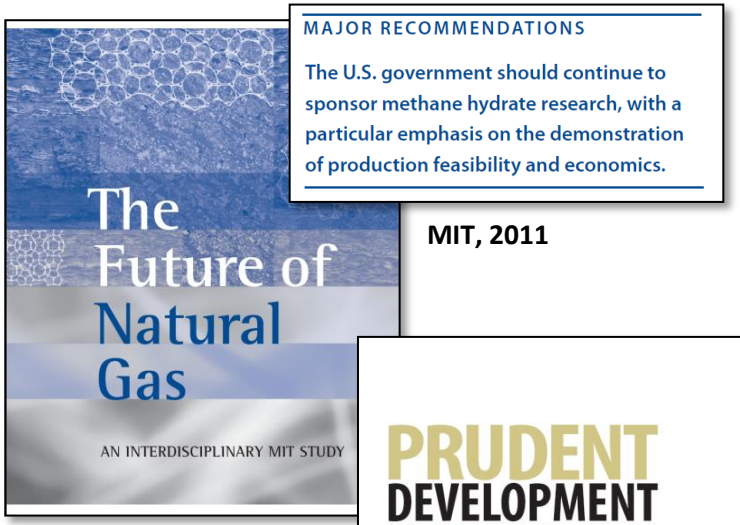

Ignik Sikumi Test Site, Alaska North Slope, March 2012

FY2011-12 Results

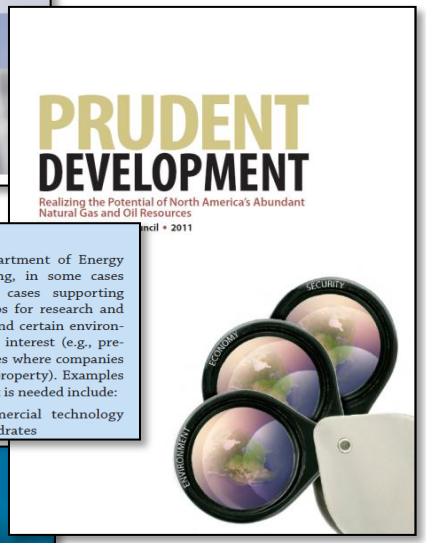
- Rebuilt program portfolio; developed new collaborative interagency projects;
- Pursuing new marine sci. options and new arctic testing options.
- Drilled, logged, instrumented *Iġnik Sikumi* well (‘11). Conducted field trial of exchange (’12).
- Successful engagement with DOE Office of Science and Japan enabled project continuation during year of $0 appropriation.
- *J Mar Pet Geol* (Jan. 2011): 23 papers: ’07 AK Mt Elbert
- *J Mar Pet Geol* (Sept 2012): 14 papers: ‘09 GoM JIP Leg II
- 2011 NPC Report and other publications

Gas Hydrates: Status

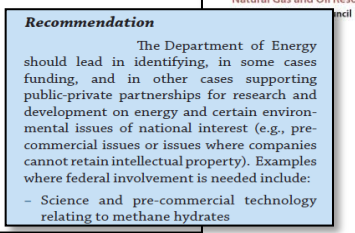
- **The federal role in gas hydrate science and technology development is widely accepted**
  - tangible, wide-ranging, public benefits.
  - consensus that DOE has managed the effort well in engaging industry, integrating NL and federal capabilities, and enabling int'l collaboration
- **The overarching goals and next steps are clear and the groundwork well laid**
  - monitored production tests as feasible to refine production potential – environmental impacts
  - resource confirmation throughout the US OCS
  - sampling/analysis of marine occurrences
  - refinement/field calibration of exploration technologies
  - integration of GH science into global carbon cycle models
- **Lab and modeling work as needed <u>but the answers will come from the field</u>**
  - the work to be done is <u>complex (technically/logistically) and costly</u>
  - Completion of the program's long-standing goals will require multiple field programs.
  - Industry perspectives change rapidly as does industry interest in enabling research.

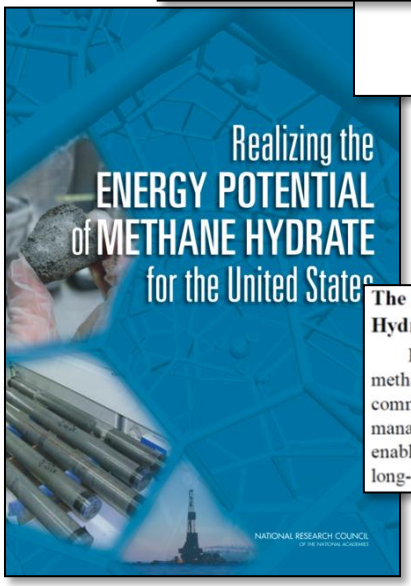


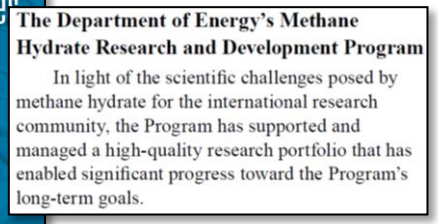
MIT, 2011



NPC, 2011







NRC, 2010

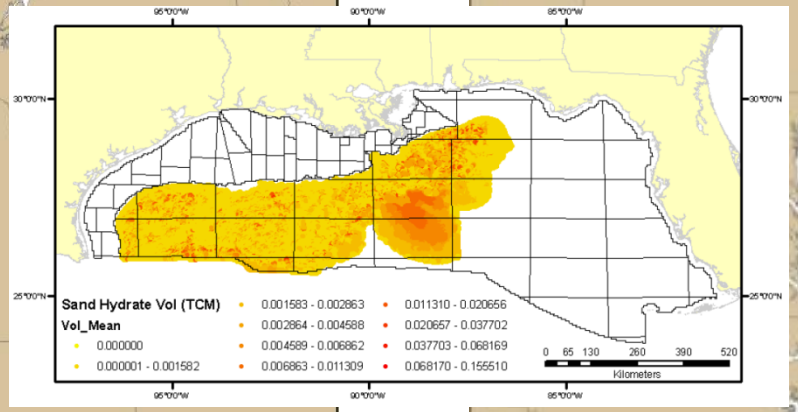
Plans for FY2013

1. Commence detailed analyses of FY2012 AK test results
2. Continue to work with external parties (non PBU partners) toward development of proposal for long-term test site at PBU with DOE engagement.
3. Work with the GoM JIP, Japan, USGS, others to finalize design, build, and test, pressure coring devices and assoc. equipment and develop feasible options to use it.
4. Guide initiation of 14 new FY12 projects,
5. Continue to rebuild program portfolio with targeted solicitation designed to
    1. Explore options for field studies for GH characterization
    2. Advance predictive capability re GH response to induced changes
    3. Advance understanding of potential GH response to environmental change
6. Continue to enable full interagency coordination
    1. Revise unpublished 2009 Long-range Roadmap
    2. Conduct 3-agency seismic data effort in the GoM
    3. Support USGS-BLM Alaska North Slope GH assessment
7. Continue to enable full international collaboration
    1. Support for NGHP-Exp-02 (India) planning
    2. Continue modeling collaborations with KIGAM (Korea) and similar future expedition planning support
    3. Collaborate with Japan on marine coring technology
    4. Collaborate with NRL, NZ, Germany on marine characterization
8. Complete UNEP effort, release materials to public.
9. Solicit/evaluate new Hydrate Fellowship candidates

BP-operated L-pad (background: site of planned long-term test program) and Ignik Sikumi well-site (foreground): Prudhoe Bay Unit, Alaska

US Marine Gas Hydrates

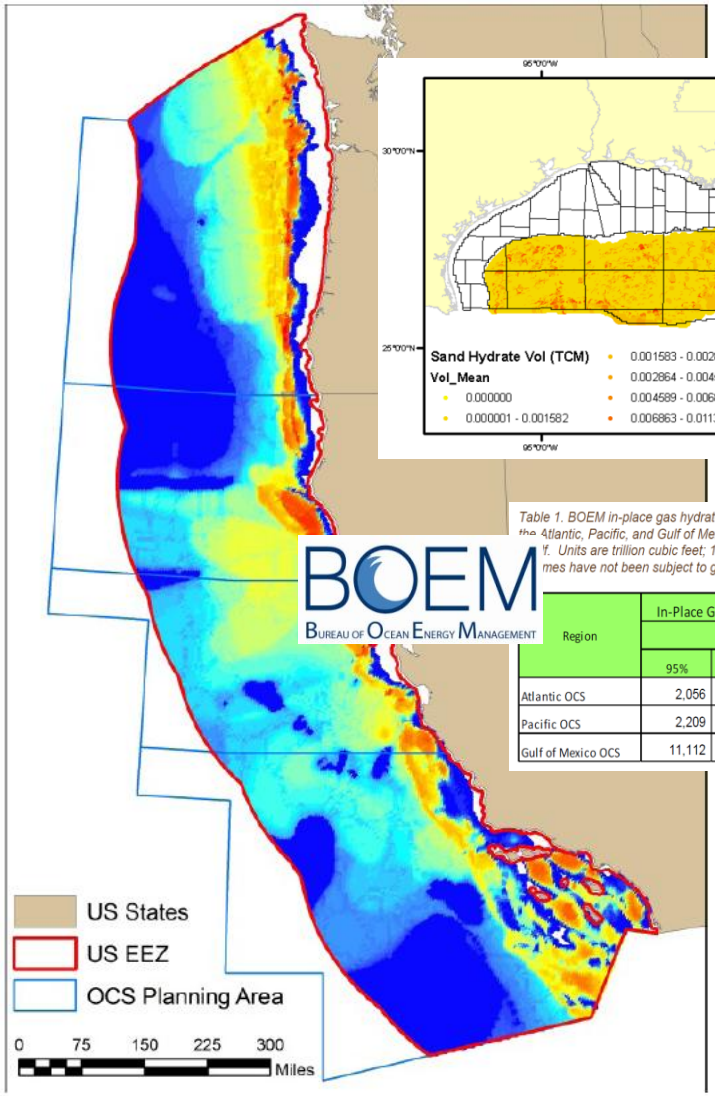
BOEM L-48 Assessment

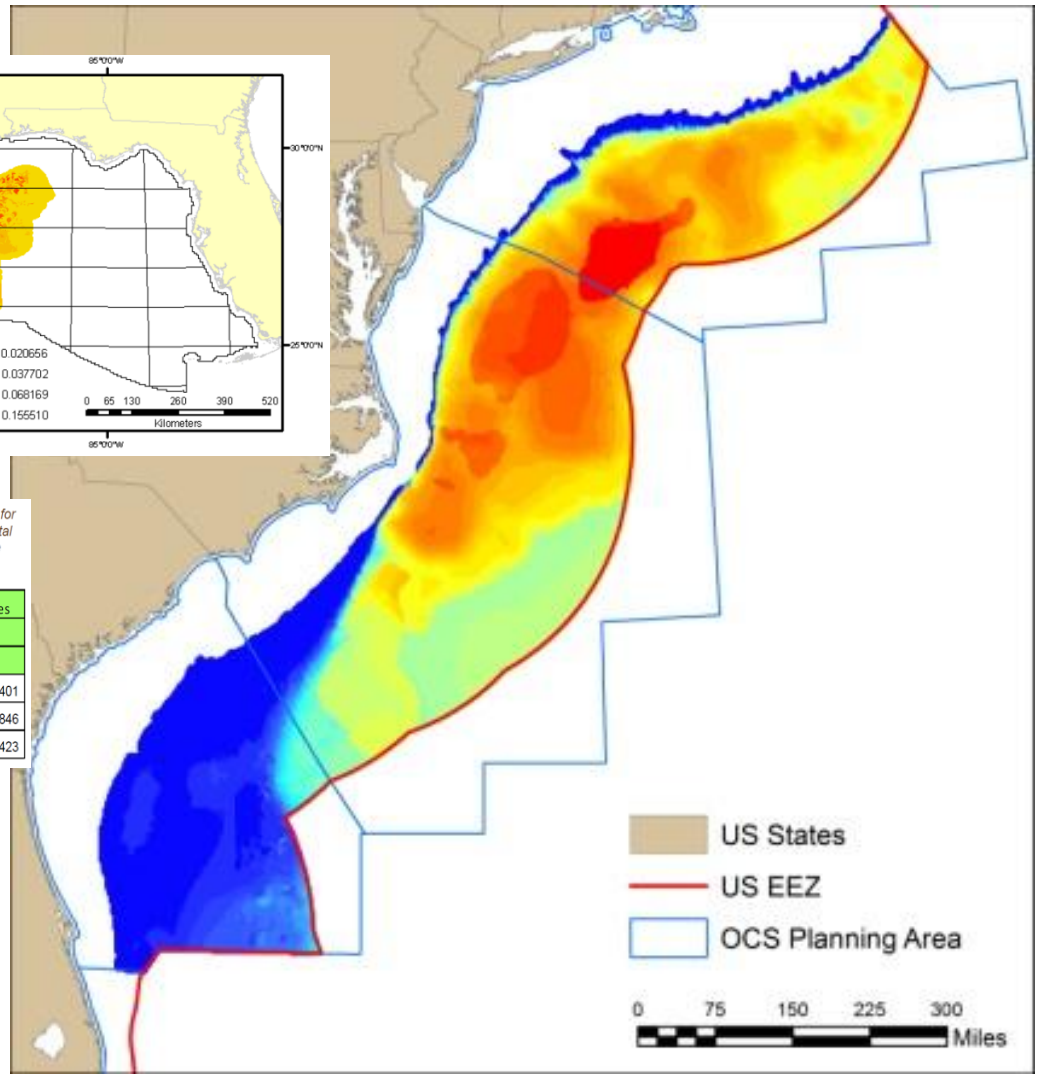


BOEM
Bureau of Ocean Energy Management

Table 1. BOEM in-place gas hydrate resource volumes for the Atlantic, Pacific, and Gulf of Mexico Outer Continental Shelf. Units are trillion cubic feet; 1 x 10^{12} ft^3. Resource estimates have not been subject to geologic risk.

Region	In-Place Gas Hydrate Resources Gas (Tcfg)		
	95%	Mean	5%
Atlantic OCS	2,056	21,702	52,401
Pacific OCS	2,209	8,192	16,846
Gulf of Mexico OCS	11,112	21,444	34,423





Chevron/DOE Gulf of Mexico Gas Hydrates Joint Industry Project

Chevron NETL USGS science for a changing world

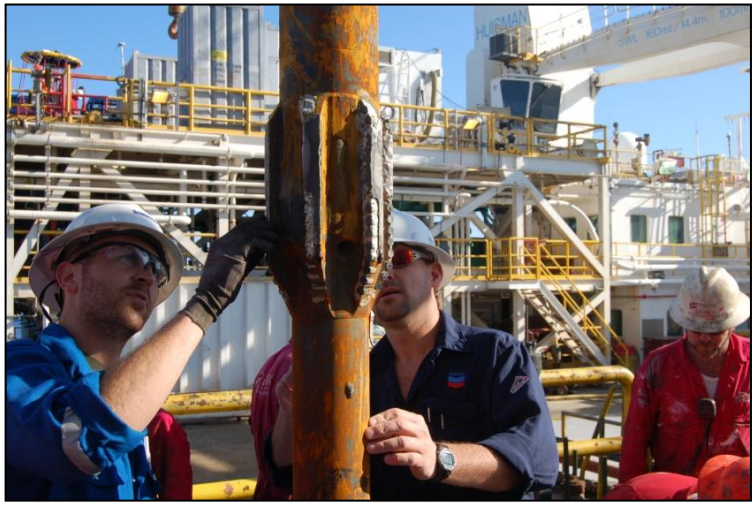
JIP Members

JOGMEC Statoil TOTAL ConocoPhillips KNOC Korea National Oil Corporation HALLIBURTON Schlumberger BOEM Bureau of Ocean Energy Management Reliance Industries Limited

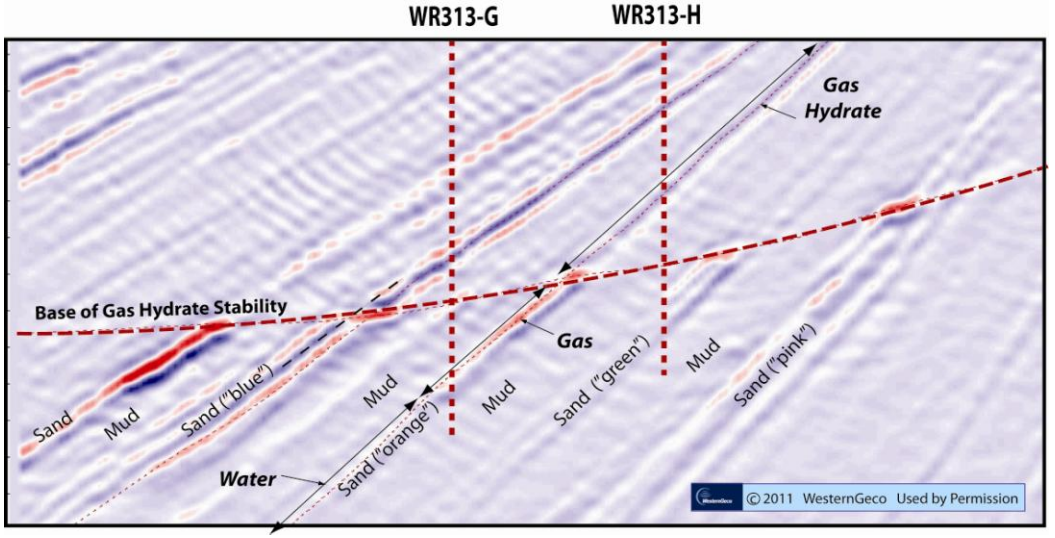
Participating Groups

Scripps Institution of Oceanography UCSD RICE Unconventional Wisdom Georgia Tech AOA Geophysics Inc. Aumann & Associates NRL WesternGeco GEO TEK

LAMONT-DOHERTY EARTH OBSERVATORY THE EARTH INSTITUTE AT COLUMBIA UNIVERSITY BRG Borehole Research Group

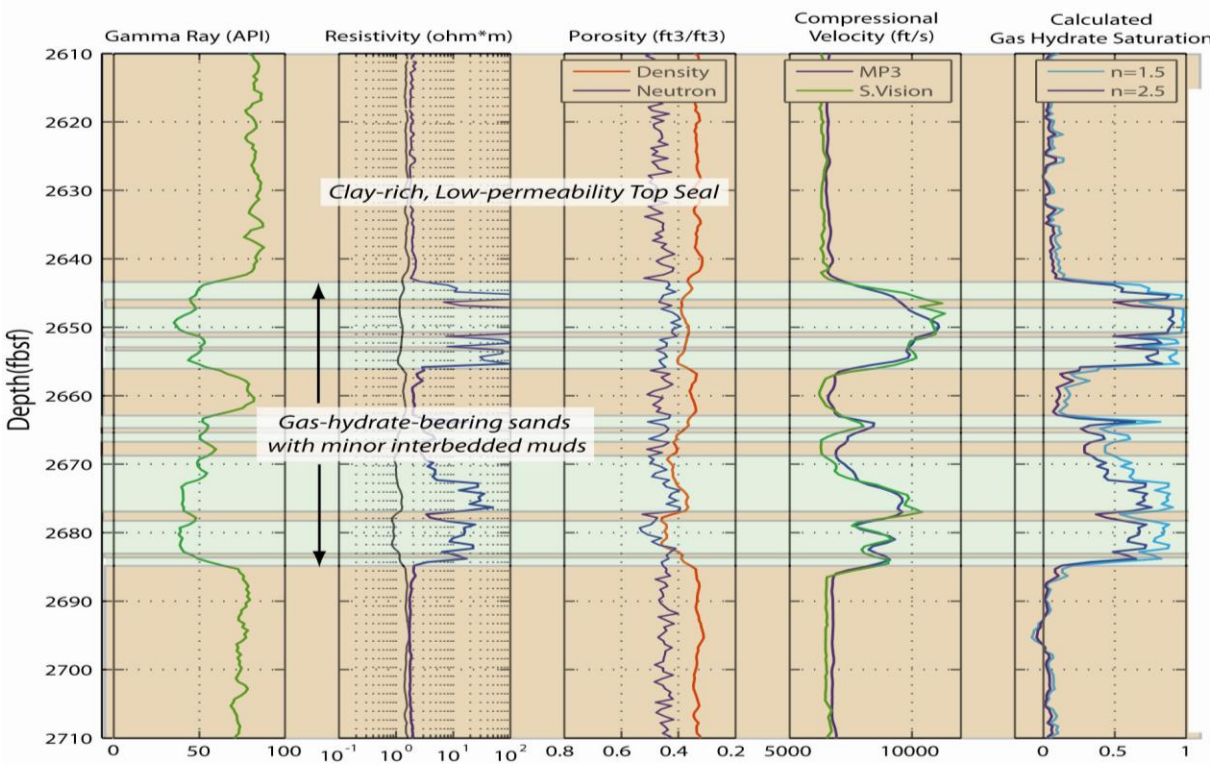


Safe Drilling



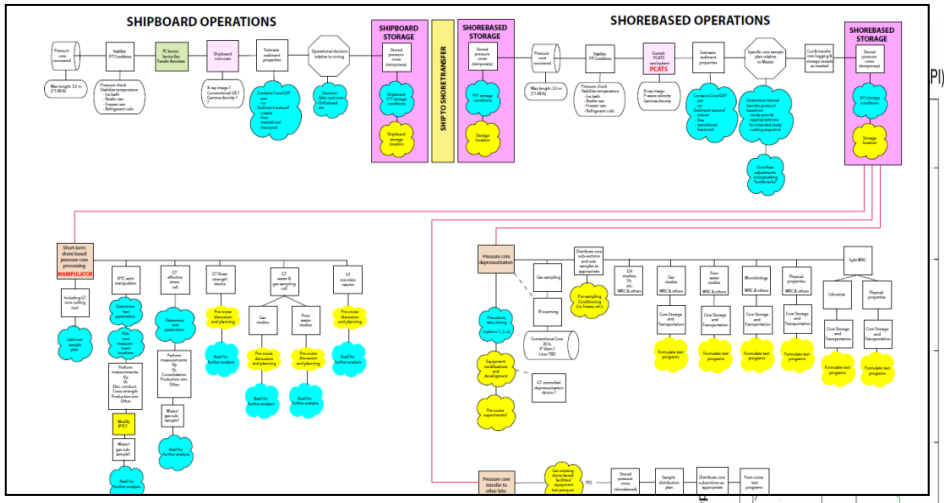
Exploration Technology

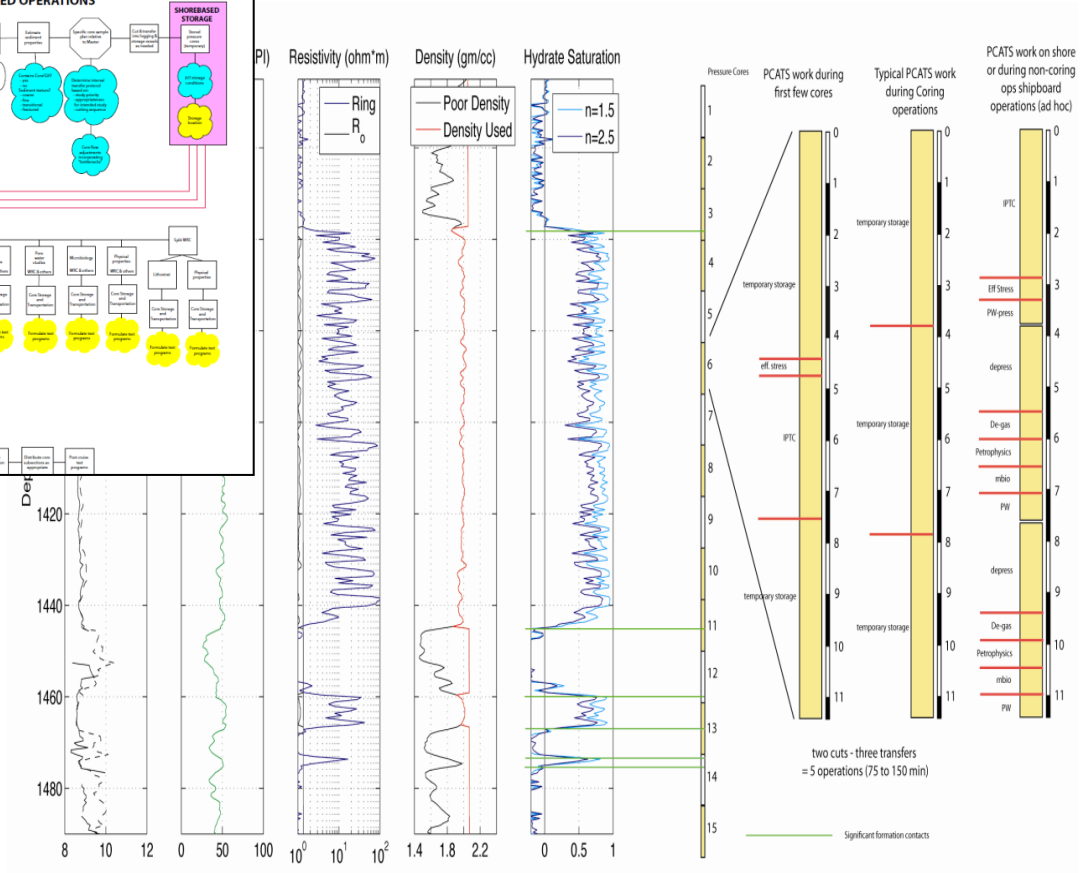
Resource Confirmation



US Marine Gas Hydrates

Coring Program Planning within the JIP

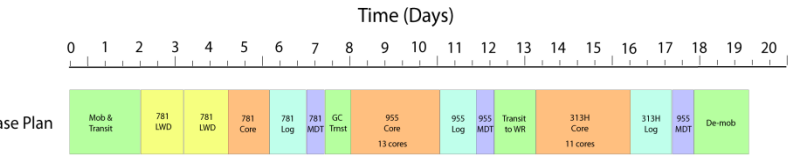




Update on the Gulf of Mexico Joint Industry Project

In 2001, the Gulf of Mexico Hydrate Joint Industry Project (JIP) partnered with the U.S. Department of Energy (DOE) to investigate the implications of gas hydrates in the deepwater Gulf of Mexico. The JIP includes Chevron, ConocoPhillips, Japan Oil Gas and Metals National Corporation, Statoil, Total, Schlumberger, Halliburton, Korea National Oil Company, Reliance Industries Limited, and the U.S. Bureau of Ocean Energy Management. Chevron manages the JIP and has a Cooperative Agreement with the DOE.

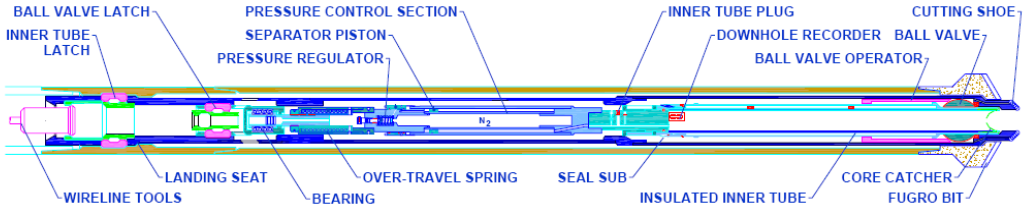
Highlights of this eleven year effort include two drilling programs (the 2005 "Leg I" program: see FITI, Volume 5, Issue 3 & Volume 8, Issue 1; and the 2009 "Leg II" program; see FITI, Volume 9, Issue 2 & Volume 9, Issue 3) that have greatly advanced fundamental gas hydrate science and played a pivotal role in advancing the understanding of gas hydrate drilling hazards and the petroleum systems approach to gas hydrate exploration. As the project moves toward its conclusion, the JIP and DOE have determined that they will focus full attention on the development and testing of an integrated suite of pressure coring and pressure core analysis devices with research and development experts in the U.S. Geological Survey, Georgia Institute of Technology, Aumann and Associates, Inc., Geotek and other academic institutions and contractors. No other drilling programs will be conducted.

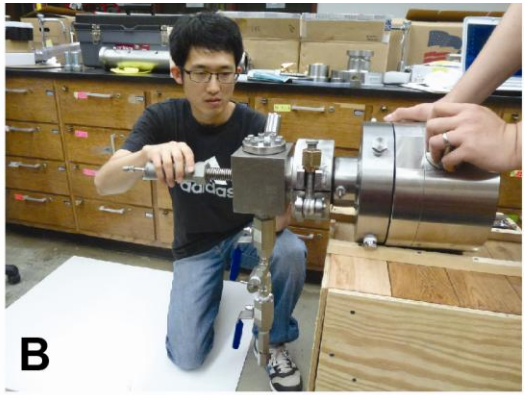


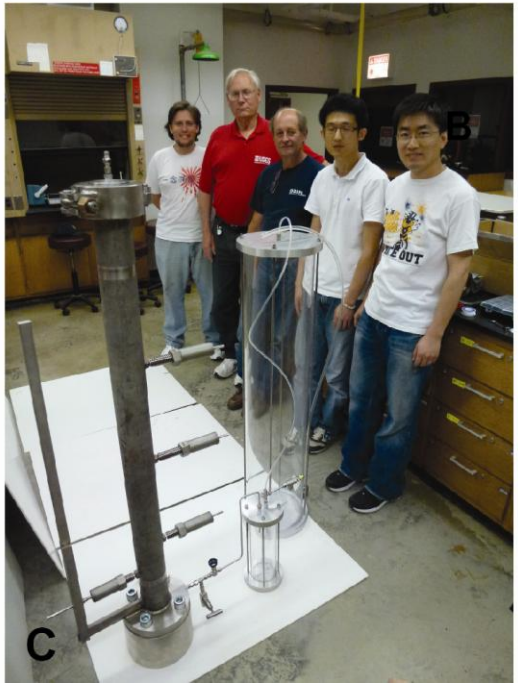
Gulf of Mexico JIP

Current Activities

- Synthesized Laboratory samples not sufficient to understand the nature of marine gas hydrate
- In situ data collection is limited
- Off-the-shelf coring equipment can not deliver analyzable samples to the surface
- JIP is working to develop coring and core analyses equipment to enable future field data collection
- Ongoing collaborations with Japan in design and field testing of components
- Field tests at Catoosa site slated for Q4, 2013.
- NETL developing final tool dispensation plan







New Projects

Planning for Marine Drilling Programs

- Full review of public domain GoM deepwater data (OSU)
- Two groups (COL, Fugro) with extensive gas hydrate field operations experience
- Only Planning Phases were proposed in sufficient detail for award
- JIP tool development targeting these ships
- Field Ops likely require new proposal to new solicitation

FUGRO

CONSORTIUM FOR Ocean Leadership

DISCOVERY • UNDERSTANDING • ACTION

Schlumberger

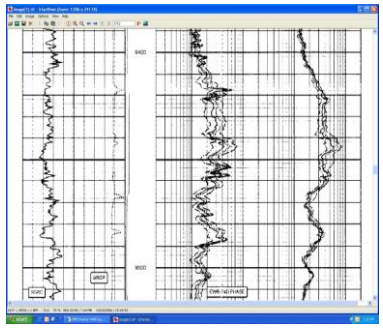
USGS science for a changing world

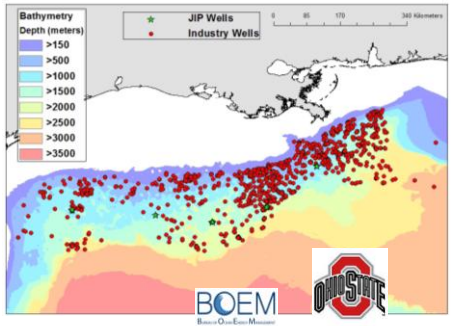
GEO TEK

Aumann & Associates

MIT

USGS science for a changing world

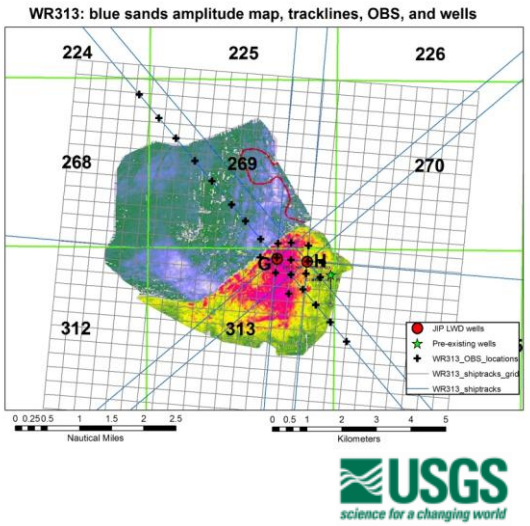


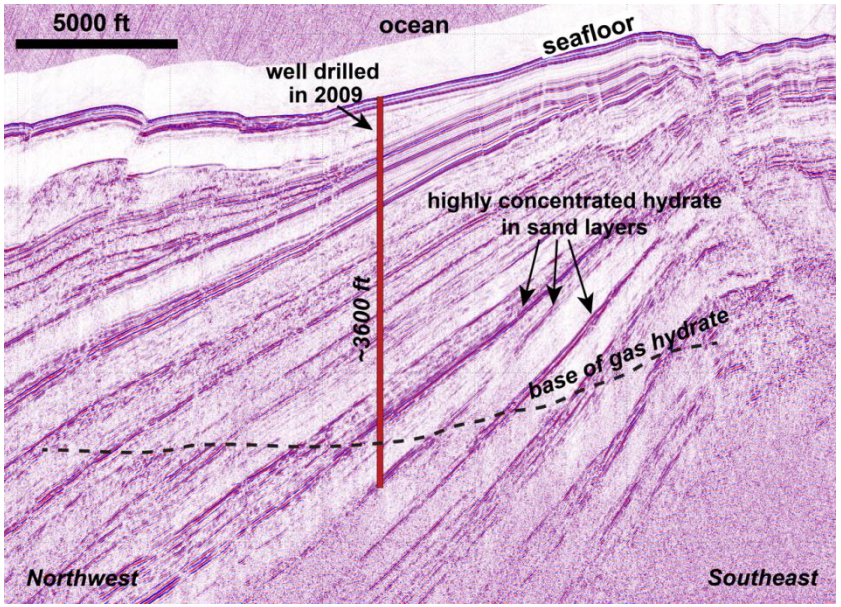


New Interagency Effort: GoM OBS

Conducted by USGS; Planned and co-funded by USGS, DOE, and BOEM

- Collect adv. seismic at JIP Leg II sites – not possible under CA due to new DOE NEPA guidance
- USGS has collected 2D (pseudo 3D) and OBS
- First OBS at sites with known concentrated hydrate and extensive log calibration data.
- Improved interpretation of detailed architecture at each site: guidance to future coring programs
- Insight into GH exploration using V_s in addition to traditional V_p data
- Completed Spring, 2013 from *RV Pelican*
- USGS ~$650k; DOE ~$650k; BOEM ~$175k





USGS science for a changing world

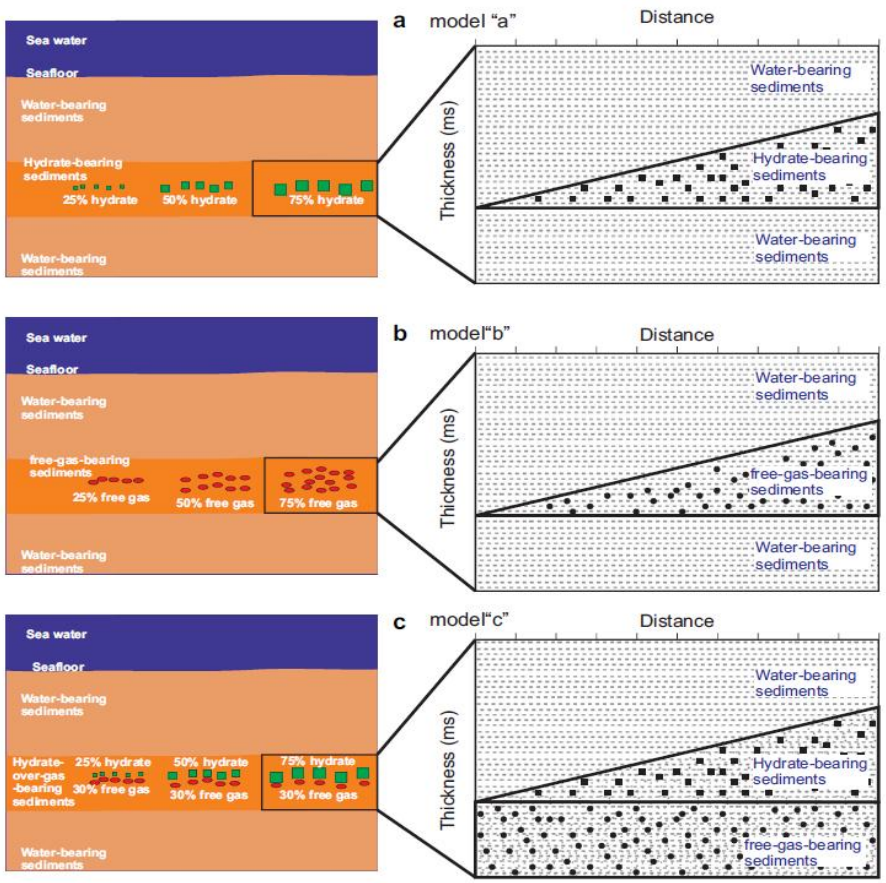
BOEM Bureau of Ocean Energy Management

NETL

New Projects

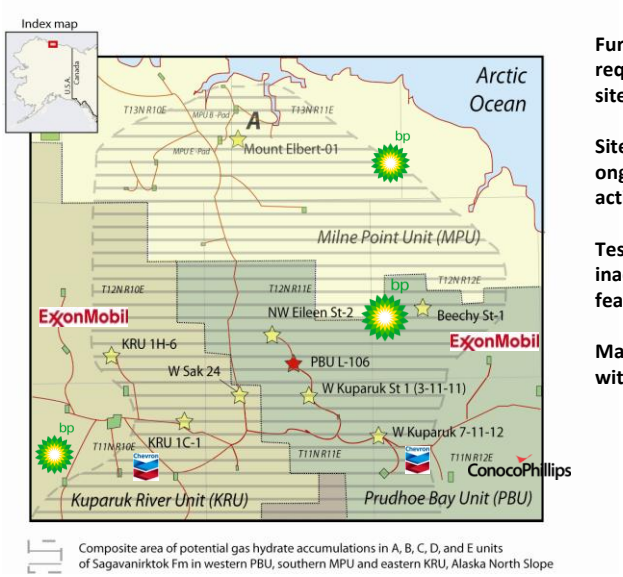
Seismic Characterization

- Confirmation of physics for Rock-Physics models
- Recalibration of GH-inversion using 2009 well results.
- Provide additional insight on hydrate and free gas occurrence and distribution in future potential coring sites
- Support evaluation of gas hydrate geohazards



Alaska Gas Hydrates

Pursuing Opportunities for further field testing programs



Further Field Testing requires access to a site.

Sites exist in areas of ongoing industry activity

Test plans that utilize inactive sites may be feasible.

Maintaining active CA with BPXA


PBU L-pad and melting Ignik Sikumi ice pad, June, 2012.


Abandoned PBU 3-11-11 pad

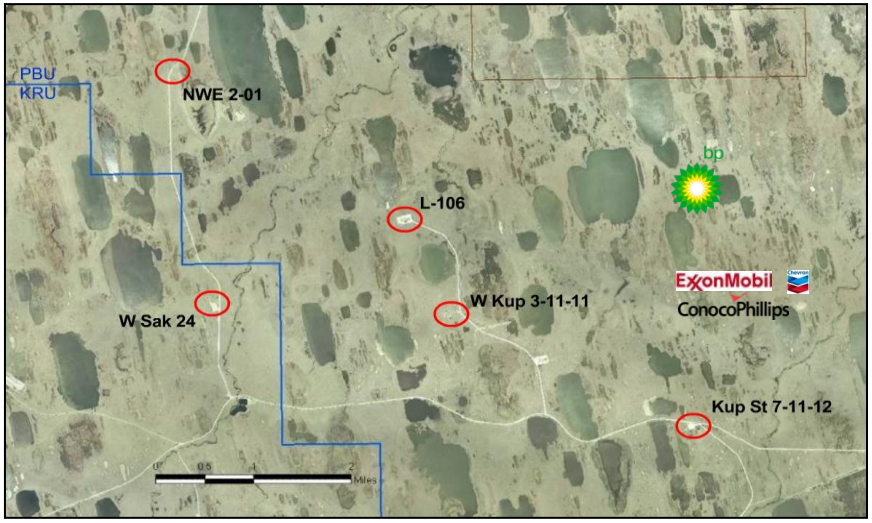

MPU K-pad

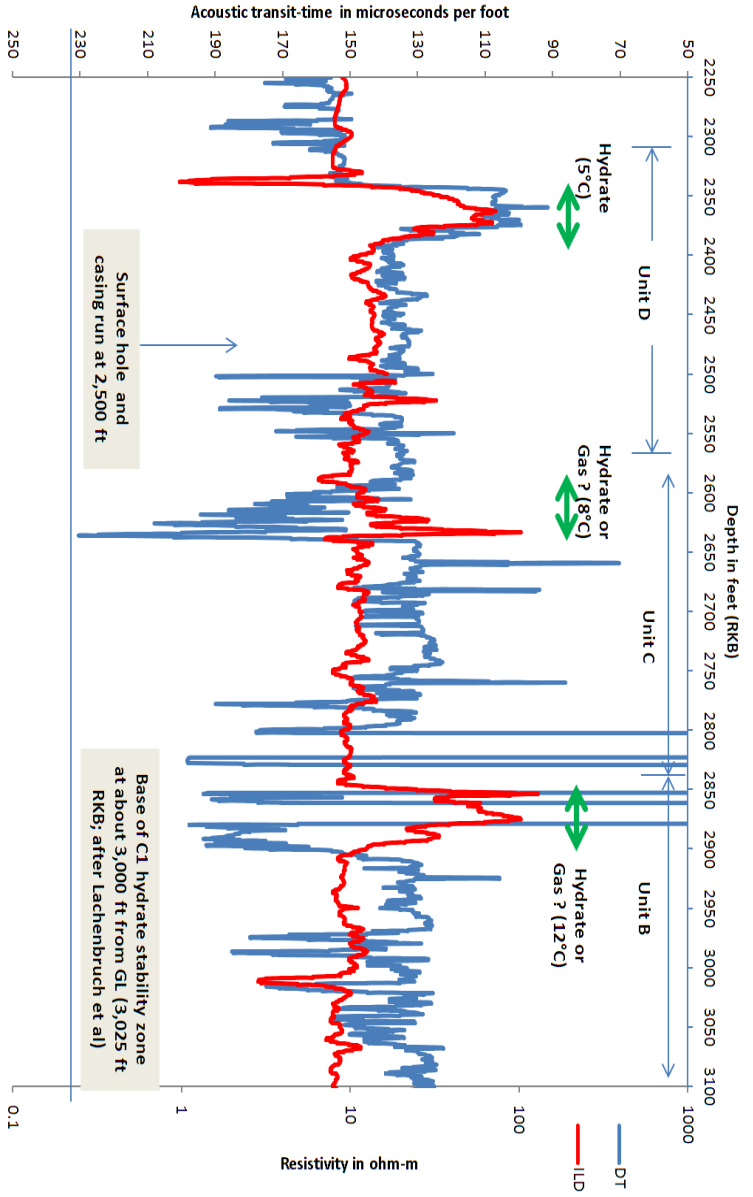
NETL

USGS science for a changing world

Alaska Gas Hydrates

Example: PBU Kup St. 7-11-12





TOTAL PROJECT : $28.9 M DOE : $15.6 M JOGMEC: $7.7M CONOCOPHILLIPS: $5.7 M

FY12: Release of 2011 log data

FY13: Release of 2012 production data:

FY13: Public Workshop hosted by ConocoPhillips in Houston

FY13: Initiation of modeling studies with NETL, PNNL; interest from Japan, Germany, Norway.

FY13: ConocoPhillips final report and test summary published in Proceedings of the Arctic Technology Conference.

FY13: JPT review article Published.

JOGMEC

ConocoPhillips

NETL

Iġnik Sikumi Test Analyses

Learnings to Date

Field Scientific Experiment – Not a technology demonstration

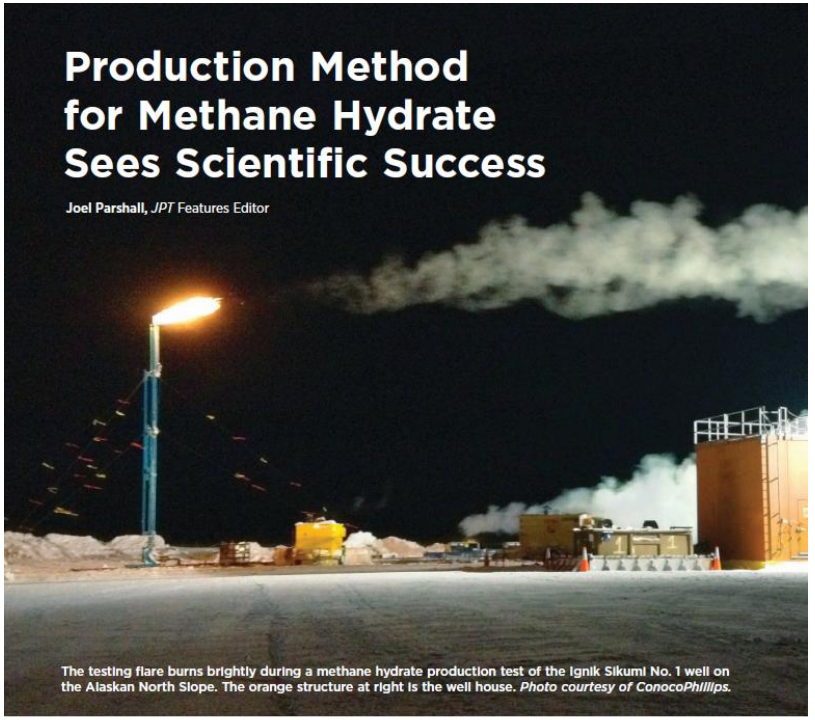
Further lab data deemed inefficient

Ultimate field technology (as standalone) would include injectors and producers and complex well geometries

Can Exchange enable improved performance of GH wells in specific settings (carbon balance; mech. stability)?

Test provides datasets to assess

- **Geologic condition of ANS hydrates**
- **Well design and control issues**
- **Ability to inject gases**
- **Ability to obtain exchange**
- **Reservoir Temperature response**
- **Reservoir Geomechanical response**
- **Reservoir Pressure response**
- **Unable at present to constrain the contribution of various downhole processes**
  - Dissolution of CO_2 in formation water (likely minor)
  - Dissolution of CH_4-MH in gas injectant
  - Exchange (nature and rate)
  - Nature of various mixed hydrates formed



Production Method for Methane Hydrate Sees Scientific Success

Joel Parshall, *JPT* Features Editor

The testing flare burns brightly during a methane hydrate production test of the Ignik Sikumi No. 1 well on the Alaskan North Slope. The orange structure at right is the well house. *Photo courtesy of ConocoPhillips.*

A production method that could unlock large reserves of methane hydrate in sand-dominated reservoirs was tested successfully from a scientific and operational standpoint in a recent research experiment on the Alaskan North Slope (ANS). The experiment was conducted by the National Energy Technology Laboratory (NETL) of the United States Department of Energy (DOE) in partnership with ConocoPhillips and Japan Oil, Gas, and Metals National Corporation.

A proof-of-concept test was conducted between 15 February and 10 April at the Ignik Sikumi No. 1 well in the Prudhoe Bay field operated by ConocoPhillips. The production technique featured the injection of carbon dioxide (CO_2) to exchange and release methane (CH_4) from the hydrate, a method developed through laboratory collaboration between the University of Bergen in Norway and ConocoPhillips. The released gas was then produced by means of reservoir depressurization.

"The test objective was to perform injection and flowback from a single well to validate that the CO_2/CH_4 exchange mechanism demonstrated in laboratory tests will occur in a reservoir of natural methane hydrates," said Ray Boswell, technology manager for gas hydrates at the NETL. It was the first field-level trial of a production method involving the exchange of CO_2 with the methane molecules contained in a methane hydrate structure. "The focus of the test, including the design of the well, was on the technical feasibility of this new technology, rather than an attempt to produce gas at commercial rates," Boswell said.

CO_2 Mixture Injected in Reservoir

The Ignik Sikumi well test was equipped with downhole fiber-optic distributed temperature and acoustic sensing, three downhole pressure gauges, and full surface instrumentation,

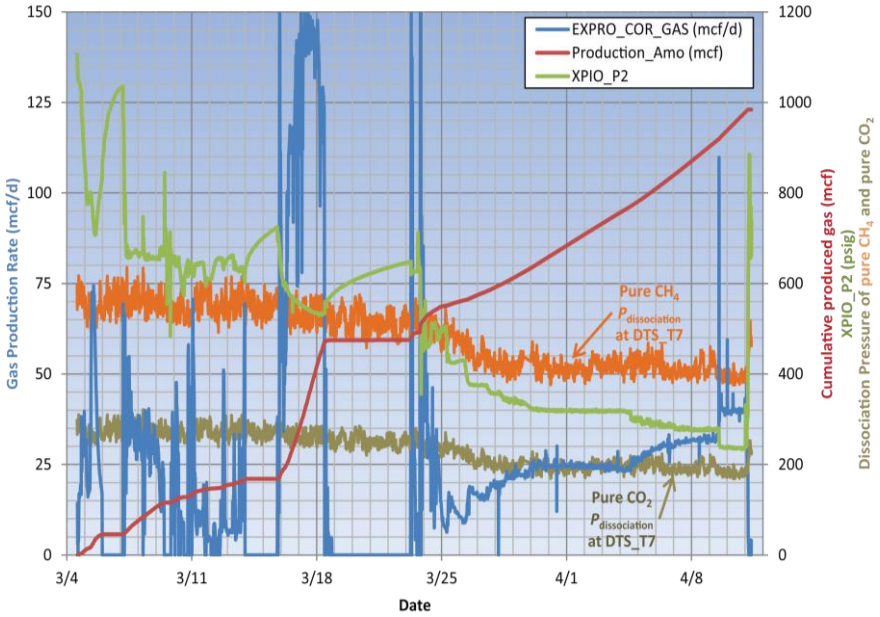
Journal Petroleum Technology, August 2012

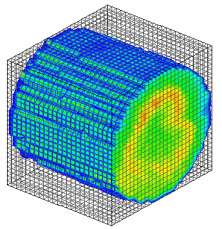
ConocoPhillips JOGMEC NETL USGS science for a changing world

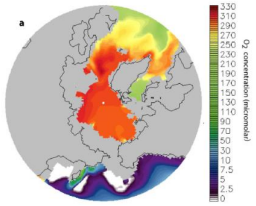
Continuing NL Projects

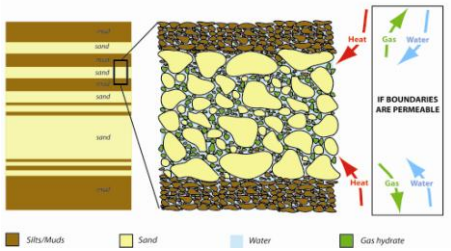
GH Production Simulation and Experimentation

- **Experimental**
  - Tightly focused on specific issues; mixed gas formation kinetics
- **Numerical Simulation**
  - Depressurization
  - CO_2-CH_4 Exchange
  - Geomechanics/Subsidence
  - Environmental Response (LBNL-LANL)
  - Coordinated with Experimental Efforts in each Lab





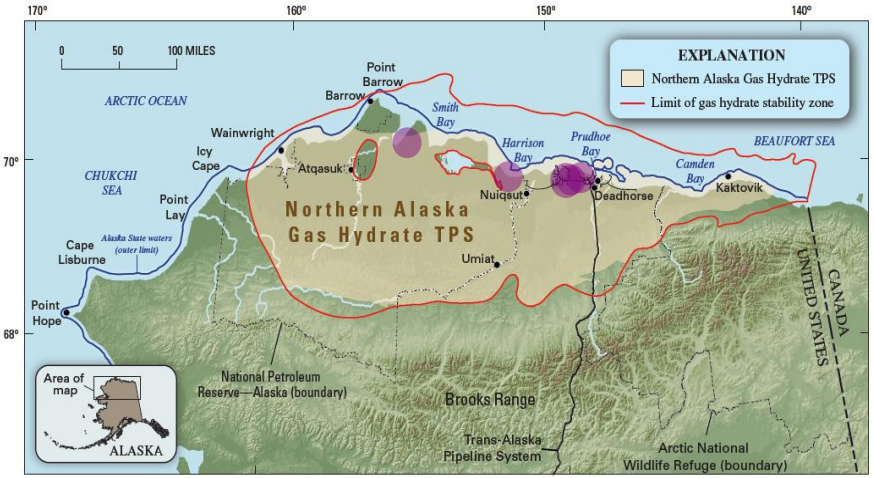


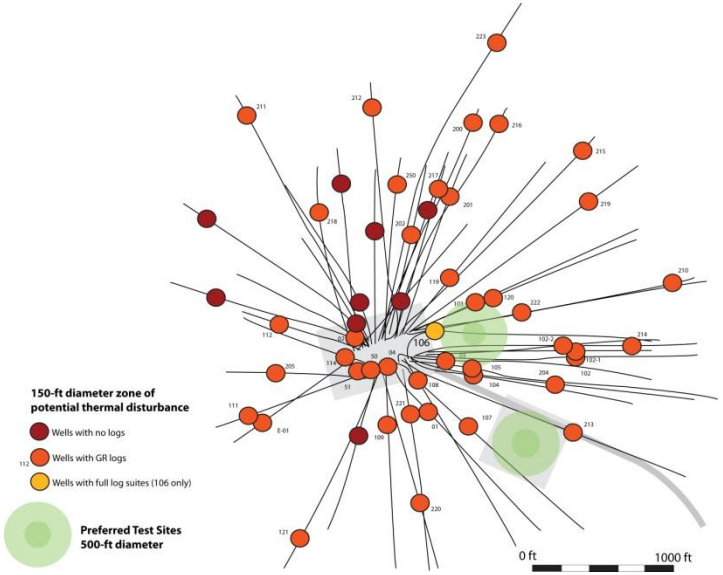


New Interagency Effort: ANS Life-cycle Assessment

USGS-BLM Funding to NETL (WVU)

- **Part of larger USGS study funded by BLM**
- **Task 1: Develop production models**
  - Mt. Elbert
  - PBU L-pad
  - PBU alt (down-dip)
  - NPRA (Moose's Tooth)
  - NPRA (Barrow)
- **Task 2: Full-field Life-Cycle Simulations**
  - Production
  - Subsidence/other env costs
  - Costs/Economics

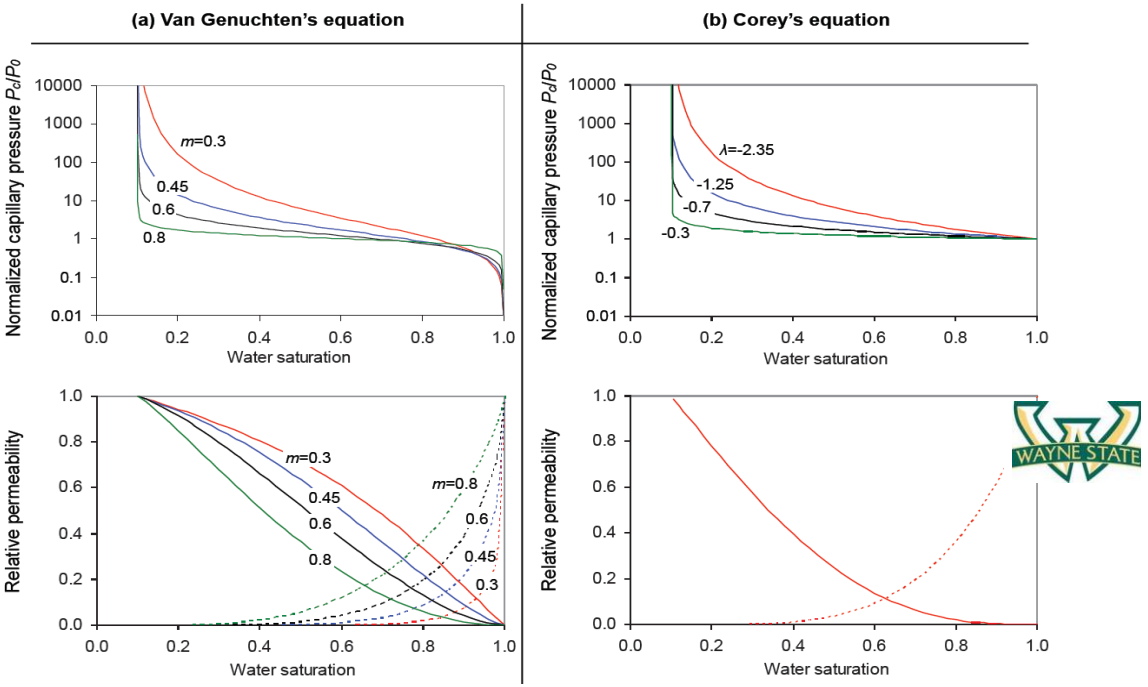




New Projects

Gas Hydrate Petrophysics

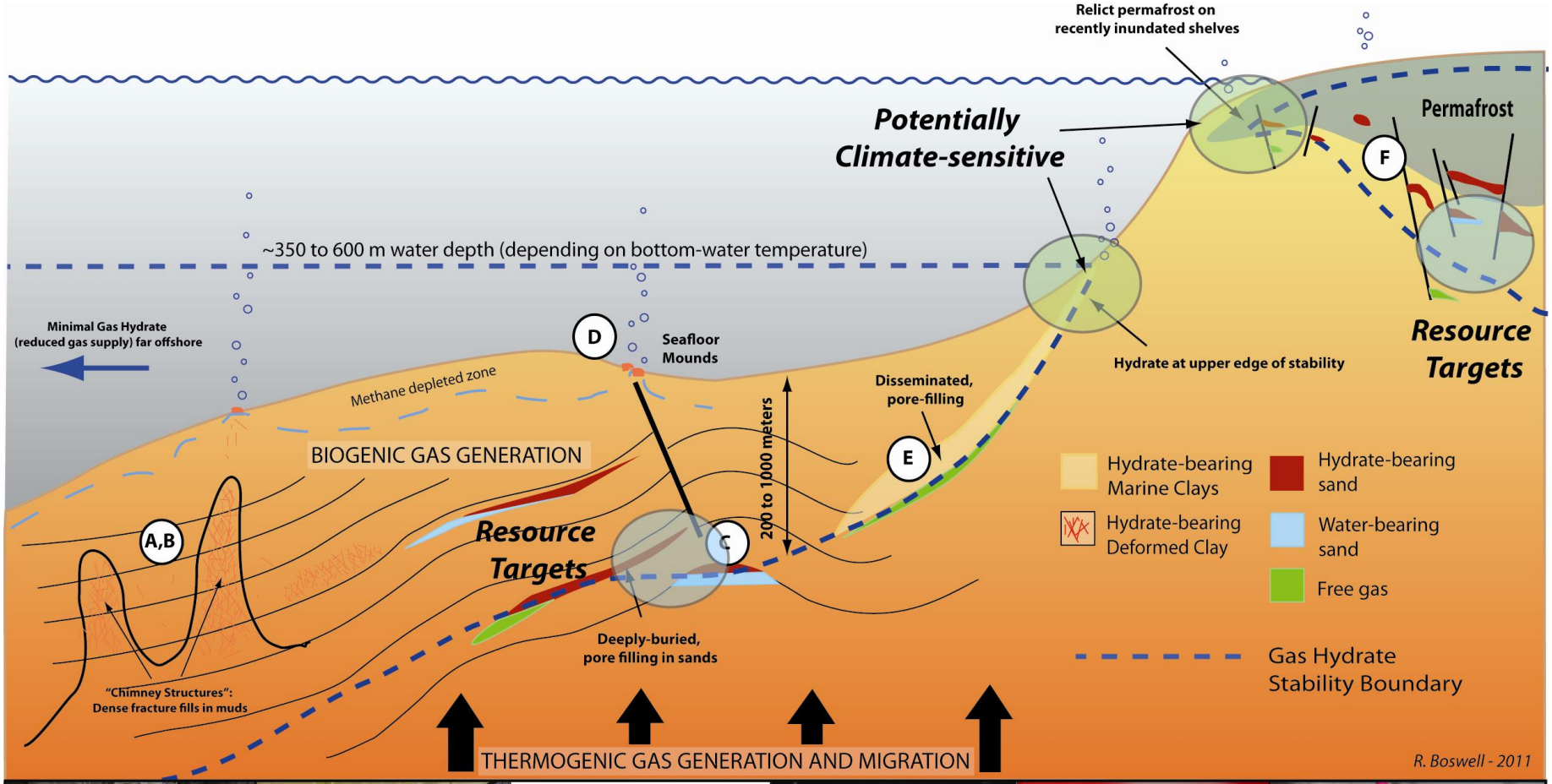
- New Formulations for Capillary Pressure and Relative Permeability
- Potential for permeability development due to volume change in fine-grained systems



WAYNE STATE

Georgia Tech

Gas Hydrate in the Global Environment

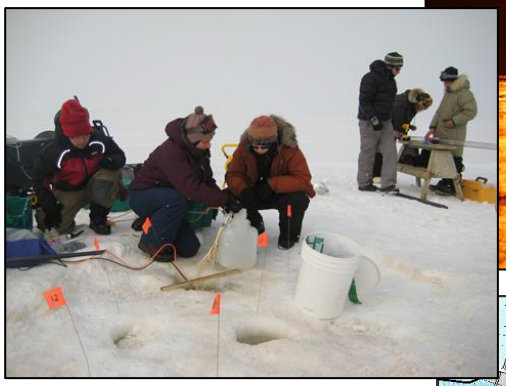


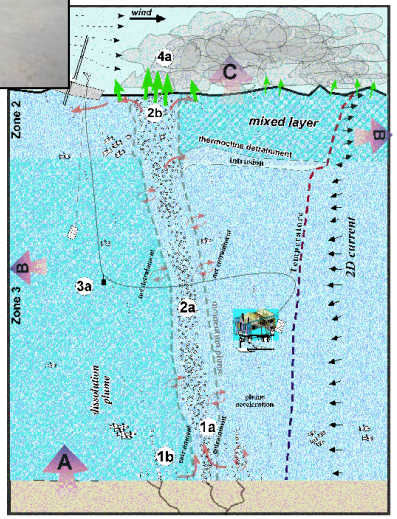
A B C D E F

Gas Hydrate Climate Interactions

- **Drivers**
  - Included in original authorizing legislation (2000 and 2005 EPACT)
  - Unaddressed in collaborating agency portfolios
  - Key public concern that could complicate resource development initiatives
  - Need to display an integrated scientific review of issues prior to development

- **Accomplishments**
  - TAMU-CC/FSU/Scripps - HYFLUX Project
  - NRL/NETL/U Delaware – MITAS Expedition
  - U. Chicago/UCB- Basin-scale models
  - UCSB: Assessing oceanic biofilter; post-Macondo
  - UAF/USGS - Alaska thermokarst studies
  - USGS: Mapping relict permafrost offshore Alaska
  - LBNL/LANL: COSIM (IPCC model) w/ GH models
  - *Roughly 5% of annual budget*



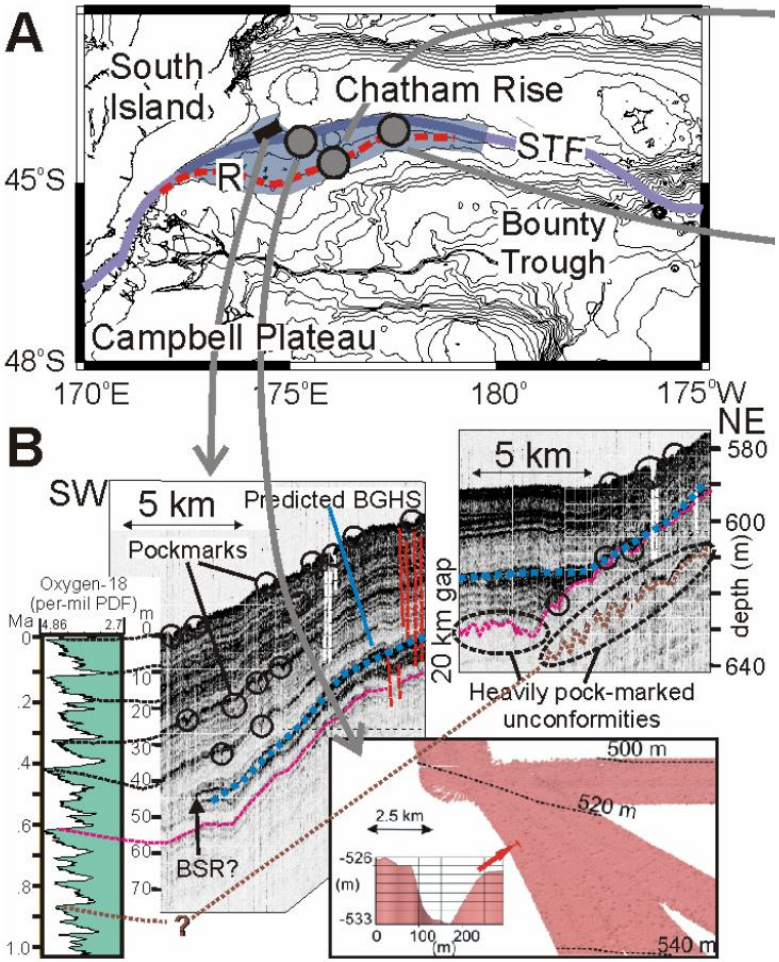


- **FY2012 Projects**
  - Assessing current state of the Beaufort Shelf (SMU, OSU, USGS)
  - New CSEM tools for delineating extent of relic permafrost (Scripps Inst.)
  - Constraining past methane flux from core data (OSU, UNH)
  - Deepwater Gas Hydrate response to environmental change (UT, U. Miss.)

New Interagency Effort: CH_4 dynamics off NZ

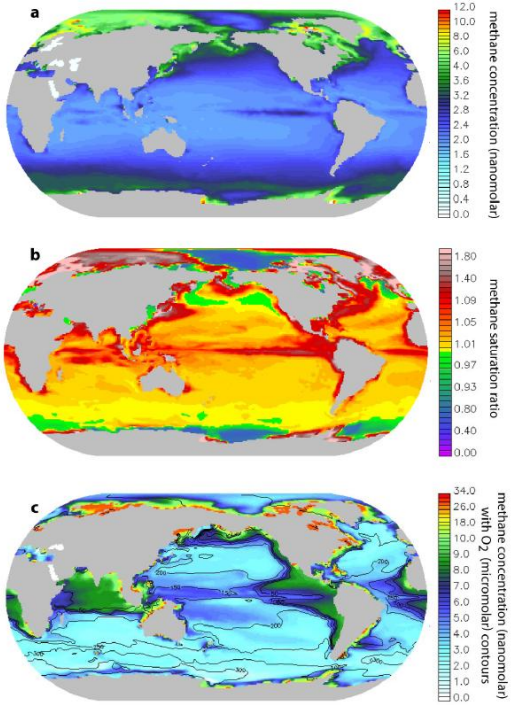
Co-funded by NRL, NZ, Germany

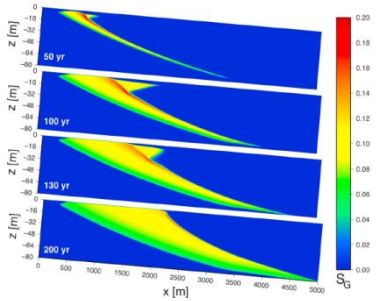
- **Gas Hydrate Dynamics off Chatham Rise, NZ**
  - Area of extensive sea-floor depressions
- **Geophysics, Coring, Geochemistry, Modeling**
- **Funding**
  - NZ Gov: $950k to GNS Science,U. Otago, & U. Aukland, LBNL
  - Germany: IFM-Geomar
  - DOE to NRL: $**225**k (2 yrs)
  - NRL Direct: $581k

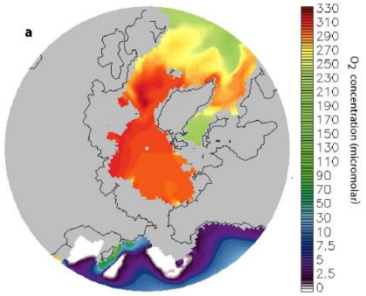


Continuing NL Project: GH-GCC modeling

- **Analytical treatment of GH potential response/feedback to warming climates**
- Combine GH modeling (Tough) with Ocean Circulation models (COSIM-POP) and Ocean geochemistry/ecology models
- Predict deepwater gas hydrate response to GCC scenarios and implications for oceans/atmosphere
- Recent warming consistent with observed plumes
- Geochemical (oxygen depletion/acidification) implications greatest in arctic







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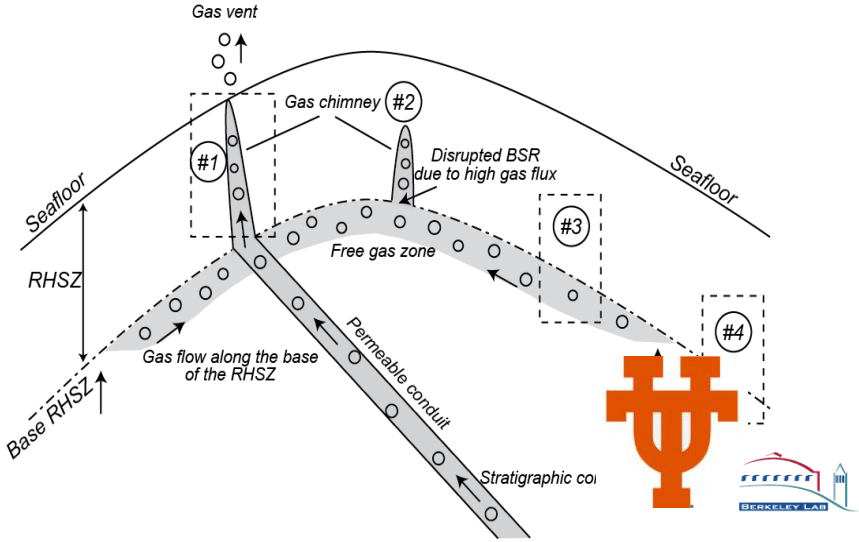
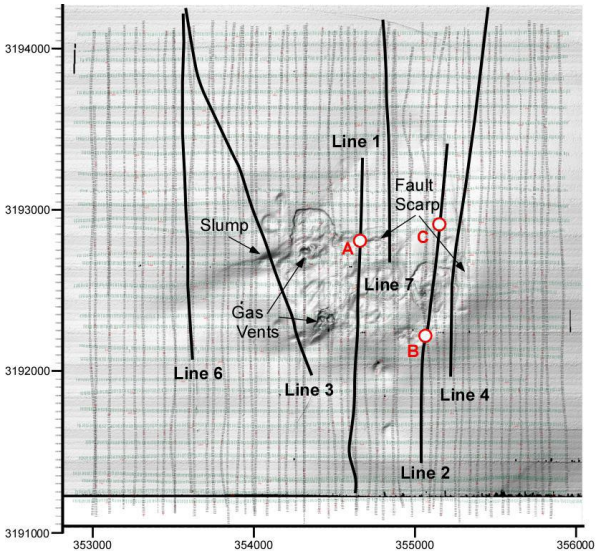
BERKELEY LAB

New Projects

Shallow gas and gas hydrate dynamics in the Gulf of Mexico

- Predicting/observing the response of GH-systems under changing environmental conditions
- 3D modeling and experimentation re gas invasion and migration incorporating salinity, heat, and geomechanical affects
  - Marine settings: Can gas migrate through overlying GHSZ?
  - Arctic settings: Free gas conversion to GH?



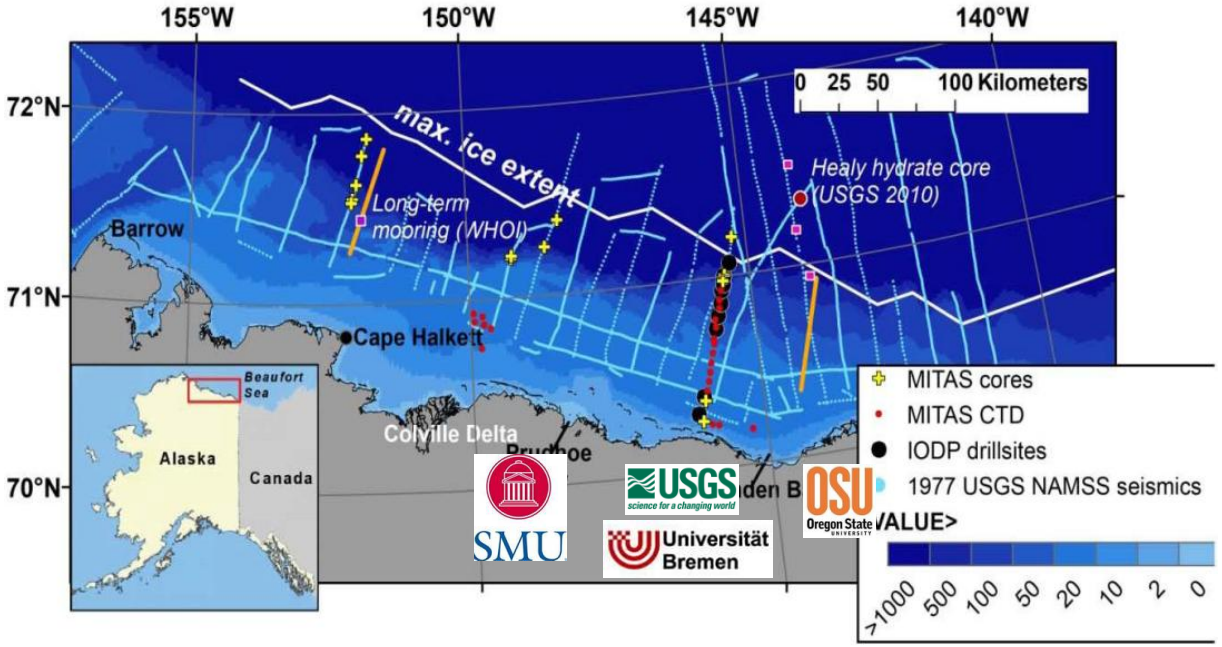


- Movable ocean-floor observatory with time-series DNR surveys (MC118 site).
- Associated with prior (2006+) Congressionally-directed projects

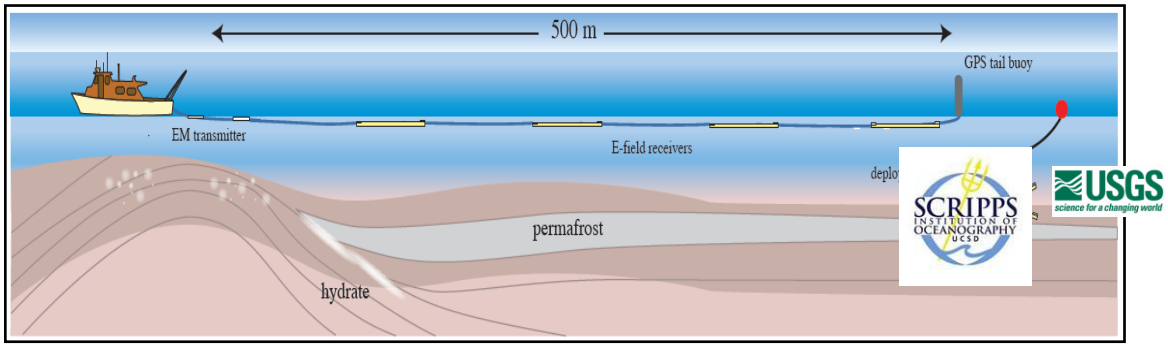
New Projects

Gas Hydrate dynamics on the Beaufort Continental Shelf and Slope

- Understand how US Arctic Slope is responding (and will respond) to ongoing environmental change.



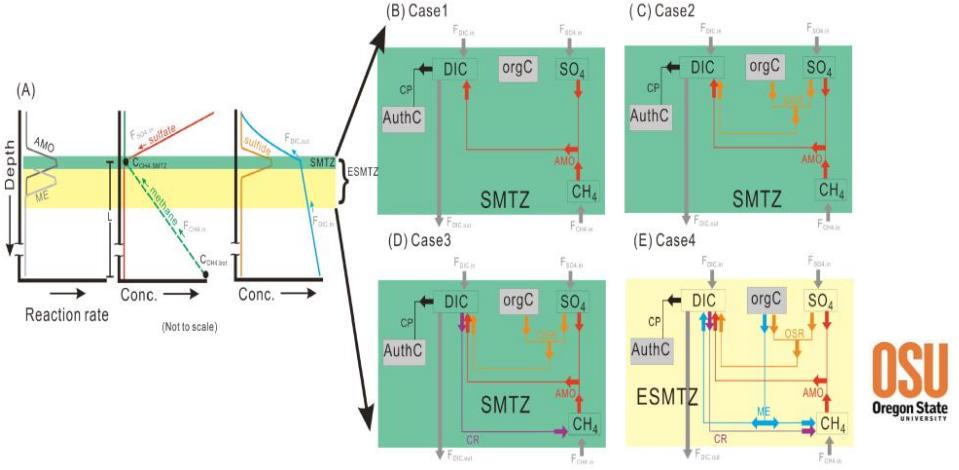
- Develop new tools for assessing relict permafrost extent

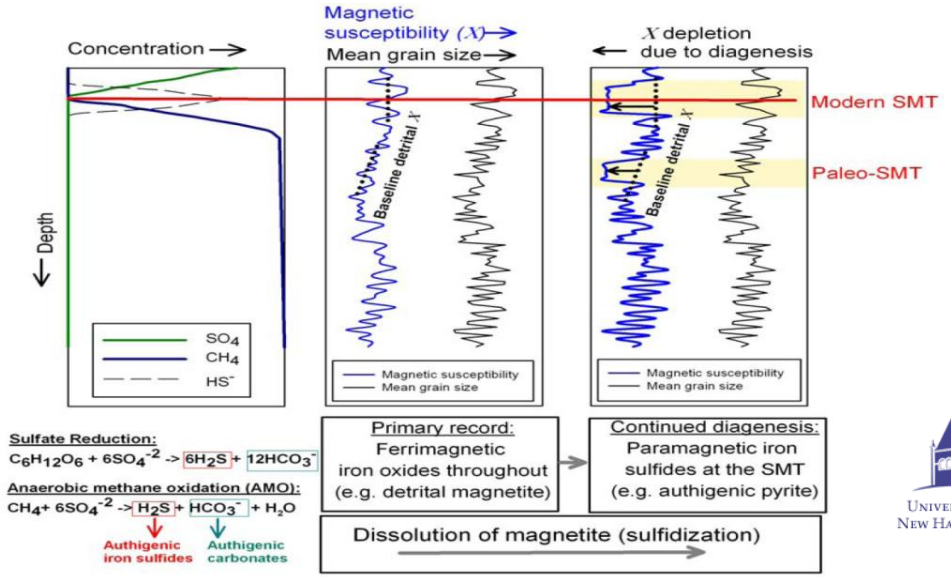


New Projects

Constraining Methane Flux from geochemical and lithostratigraphic data

- Ease the correlation of past changes in CH_4 flux to environmental events
- Application of Crunch-Flow routines to constrain present carbon fluxes at gas-hydrate bearing sites by modeling SMT geochemistry
- Reconstructing Paleo-SMT Positions on the Cascadia Margin using Magnetic Susceptibility





Methane Hydrate Fellowship

8 selected since 2007

Jeffrey Marlow (Cal Tech)
Active NETL-NAS Fellow

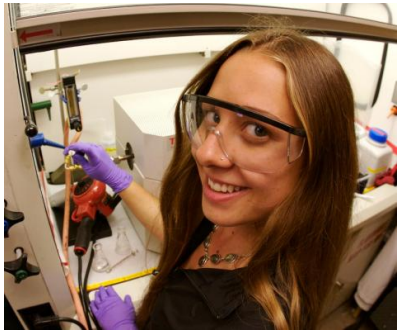
Ann Cook (Columbia)
Now at Ohio St.

Evan Solomon (Scripps)
Now at U. Washington

Laura Lapham (FSU)
Now at U. Maryland

Rachel Wilson (FSU)
Active NETL-NAS Fellow

Laura Brothers (USGS)
Now at USGS



Monica Heinz (UCSB)
Now with ARCADIS

Hugh Daigle (Rice)
Now with UT-Austin

A Global Gas Hydrate Assessment

UN Environmental Programme

- **Illustrated, comprehensive review of gas hydrate science**
  - hard copy and web product
  - designed for national resource policy decision-makers, media, public
  - coordination by UNEP-Grid
  - steering committee from participating groups
  - www.methanegashydrates.org
- **Two Books - Seven Chapters**
  - GH science
  - GH in global carbon cycle
  - GH and climate change
  - GH in global energy systems
  - GH resources/exploration
  - GH production technologies
  - GH societal implications

World Wildlife Fund
http://www.worldwildlife.org

KIGAM
http://www.kigam.re.kr/

GEOMAR

NETL
http://www.netl.doe.gov/

Statoil
http://www.statoil.com/

USGS
http://energy.usgs.gov/other/gashydrates/

Gas Hydrates on the Norway-Barents Sea-Svalbard margin
http://folk.uib.no/nglbh/GANS/index.html

Schlumberger
http://www.slb.com/

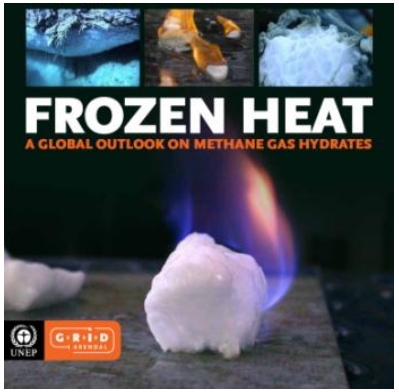
Canadian Polar Commission
http://www.polarcom.gc.ca/

Geological Survey of Canada
http://gsc.nrcan.gc.ca/
The Geological Survey of Canada, a part of the

JOGMEC
http://www.jogmec.go.jp/english/index.html

GFZ German Research Centre for Geosciences
http://www.gfz-potsdam.de/

Directorate General of Hydrocarbons, India
http://www.dghindia.org/



FUNDING OPPORTUNITY ANNOUNCEMENT

U. S. Department of Energy

National Energy Technology Laboratory

FY 2013 Methane Hydrates

Funding Opportunity Number: DE-FOA-0000891

Announcement Type: Initial

CFDA Number: 81.089 Fossil Energy Research and Development

Issue Date:	05/06/2013
Letter of Intent Due Date:	Not Applicable
Pre-Application Due Date:	Not Applicable
Application Due Dates:	TOPIC AREAS 2 AND 3 07/10/2013 at 11:59:59 PM Eastern Time TOPIC AREA 1 07/26/2013 at 11:59:59 PM Eastern Time

FY13 Solicitation

The objective of this FOA is to develop, modify, and evaluate tools, technologies, and approaches to advance hydrate science, contribute to ongoing programmatic efforts to better characterize naturally-occurring gas hydrate deposits, as well as further our understanding of their role in the natural environment.

Notification of Activities that May Require an Environmental Assessment:
This funding opportunity announcement permits the use of DOE program funds and/or cost share project funds for research activities that include acquisition of active source seismic or large-scale vibra-coring, etc., as part of the application. Applications that include these activities, or others that do not qualify for a categorical exclusion under the National Environmental Policy Act (NEPA), could require the completion of an environmental assessment (EA) prior to the undertaking of project activities. The time required for the performance of that type of environmental review/analysis (typically 6-12 months for an EA) will likely preclude award of these projects prior to the end of the current fiscal year (September 30, 2013) or cause a delay in the initiation of field work.

E. ANTICIPATED AWARD SIZE

DOE anticipates making multiple awards. Individual award size could range from $300,000 to $1,500,000 (including cost share contribution) depending on type and extent of research proposed; award size for field-based research projects could be up to $25,000,000 for total project value (including cost share).

FY13 Solicitation

Topic Area 1 –Characterization of Gas Hydrate Deposits

Applications are sought that will utilize existing field data, and/or collect field data (including log, core, and remote sensing data) to evaluate the occurrence, nature, and behavior of gas hydrate geologic systems. Applications that evaluate gas hydrate occurrences on the Alaska North Slope, including those areas beyond the existing Prudhoe Bay infrastructure area, as well as within the highest hydrate-potential areas within the U.S. lower-48 outer continental shelf as identified in the Bureau of Ocean Energy Management's (BOEM) recently released assessment (BOEM Assessment), will be considered highly responsive.

Topic Area 2 – Response of Gas Hydrate Reservoirs to Induced Change

Applications are sought that utilize data from past scientific field experiments (for example, the Mt. Elbert and Iġnik Sikumi tests in Alaska; Mallik tests in Canada) to (1) provide insight into the design of future field production experiments and (2) elucidate the nature of gas-hydrate-bearing sediments and their response to induced changes in physical and/or chemical environmental conditions.

Topic Area 3 – Response of Methane Hydrate Systems to Environmental Change

Applications are sought for research to clarify gas hydrate's role in the global natural environment, with specific emphasis on research that synthesizes existing insights and information to clarify the potential for significant feedbacks to warming climates (and attendant implications for ocean and atmospheric chemistry and geohazards) from climate-driven gas hydrate dissociation.

Take Away Messages

State of the Gas Hydrate R&D Program at mid FY2013

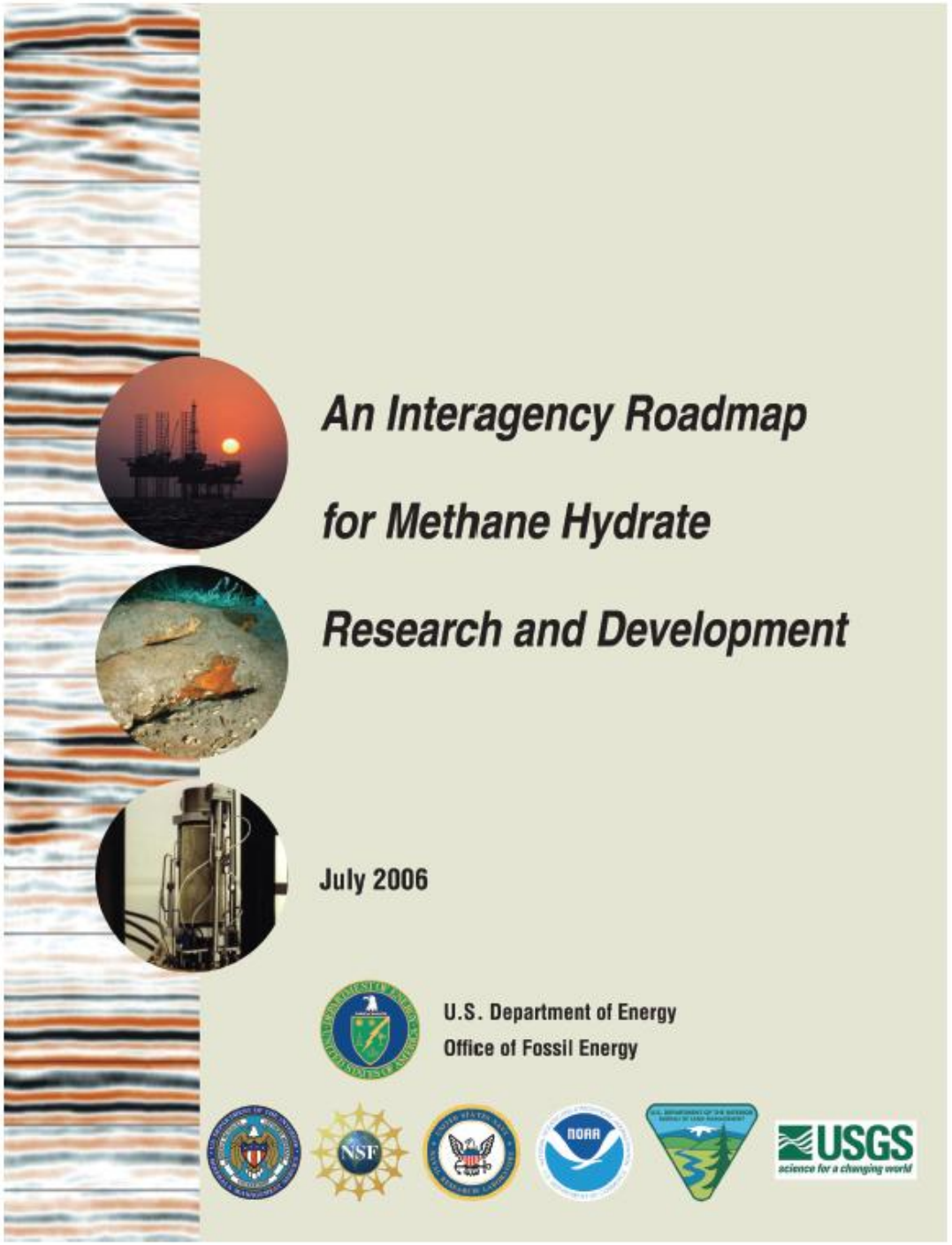
- **US Marine gas hydrate exploration**
  - Engage academic and service co. research groups to advance marine field programs
  - JIP Sites provide unprecedented opportunities for further scientific evaluation
  - BOEM L-48 offshore assessment released, with major interpreted resources off both the Pacific and the Atlantic coasts
  - Challenge to scale projects within likely budgets
- **US Arctic testing programs**
  - Gas Prices/Oil Prices/Reorganizations/Company debarments
  - Opportunity to working with external groups with common desires re field programs (potentially privately funded, but with US gov involvement).
  - New DOE-AK DNR MoU.
- **ConocoPhillips/JOGMEC test data evaluation underway**
  - Will be a government effort; ConocoPhillips has reassigned personnel
  - Exchange technology as a possible component of future production systems
  - Modeling consortia with US and International participation
  - Foundation of future tests remains depressurization.
- **Interagency/International**
  - Japan's successful test and announcement of future plans.
  - US-Japan collaboration on core analysis
  - Korea and India with major investments planned and desire for US collaboration.
- **GH-GCC linkages**
  - Key locations known; scale of impacted resources less so
  - Prime focus of roughly half of newly-awarded projects.

Gas Hydrate Program
FY14 and Beyond

Methane Hydrate Federal Advisory Committee

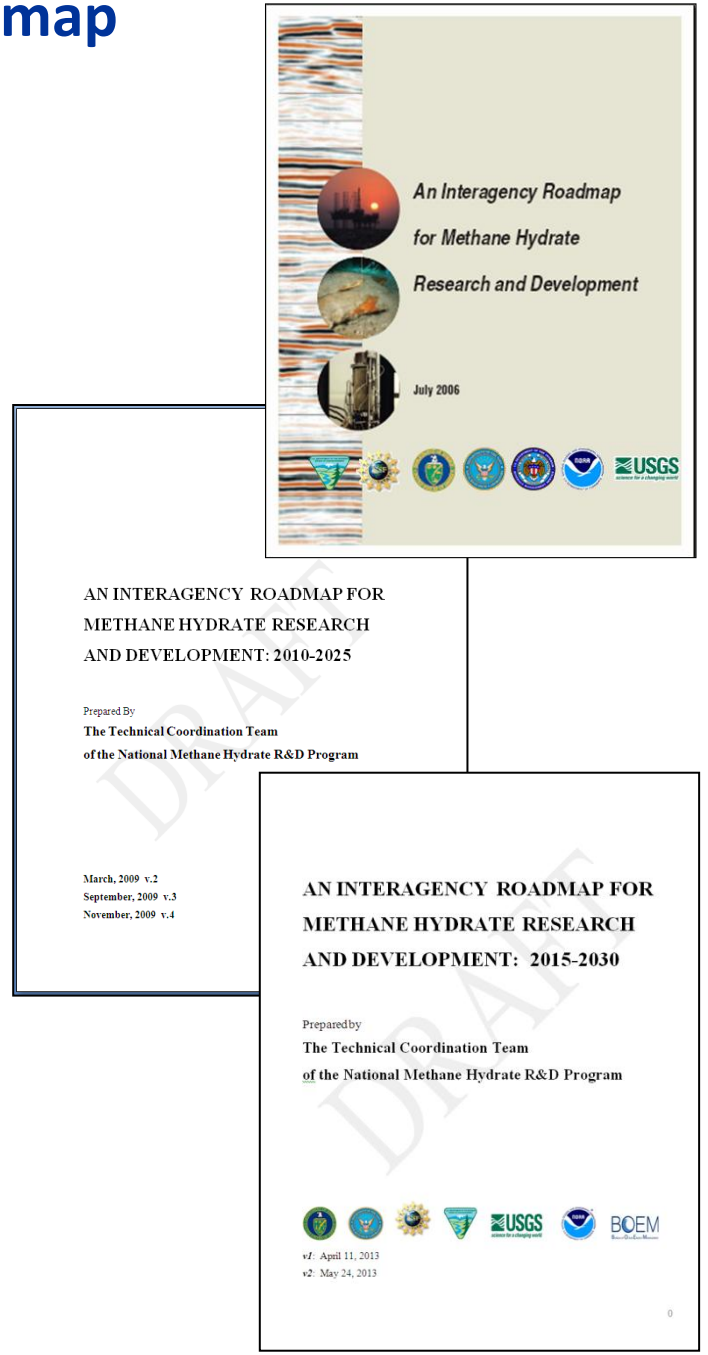
Ray Boswell, DOE-NETL
Washington D.C.
June 7, 2013

U.S. DEPARTMENT OF ENERGY | National Energy Technology Laboratory



Interagency R&D Roadmap

- **First Published in 2006**
  - Spurred by EPACT Sec 968 re-authorization
  - Activities scaled to EPAct levels, extended out to 2025.
  - Corresponding 5-year plan released in 2007
- **Unpublished Revision in 2009/2010**
  - FAC comments re relevance to likely budgets
  - FY11
- **Draft revision: 2013**
  - Early FY13 Wash DC meeting hosted by NOAA
  - Initial draft submitted to FAC late May.
  - Calibrates goals to specific “planning budgets” of $10 million/year.



Current Roadmap Draft

1. **Executive Summary**
2. **Background**
   - Recent advances; state-of-the-art
3. **US National Program**
   - Structure and priorities
4. **Roadmaps**
   - Planning assumptions
   - Goals at $10 Million
   - Priority research areas
   - Discussion on implications for a $25 million program
5. **Summary**

- **Note**
  - Modest budget increase primarily enables work to happen sooner and more comprehensively.
- **Critical Questions**
  - Are the goals appropriate?
  - Are the plans appropriate for addressing the goals?
  - Are the described budget levels appropriate?

Proposed Program Goals ($10 million)

10-year Program Goals at planned budget levels: 2015-2025

Ongoing: Monitor opportunities to contribute to the planning and implementation of extended-duration production tests in collaboration with the State of Alaska, ANS industry, and other interested parties

By 2015: through analyses of existing data, determine the optimal production methodologies for potential testing and application on the Alaska North Slope.

By 2017: provide an initial estimate of the role of gas hydrate in the flux of methane from sediments to the ocean/atmosphere in key settings across a range of temporal and spatial scales;

By 2022: document the potential for ongoing climate change to affect the stability of coastal gas hydrates, and to evaluate the impact of gas hydrate degassing on atmospheric greenhouse gas concentrations.

By 2025: provide via targeted drilling and/or remote sensing programs, refined models for gas hydrate occurrence within resource-relevant, environmentally sensitive, and/or geohazard prone, accumulations within the U.S. OCS.

Proposed Program Goals ($25 million)

Program Goals at alternative budget levels: 2015-2025

Ongoing: Monitor opportunities to contribute to the planning and implementation of extended-duration production testing in collaboration with the State of Alaska, Alaska North Slope industry, and other interested parties

By 2015: through analyses of existing data, determine the optimal production methodologies for potential testing and application on the Alaska North Slope.

By 2015: provide an initial estimate of the role of gas hydrate in the flux of methane from sediments to the ocean/atmosphere in key settings across a range of temporal and spatial scales;

By 2020: document the potential for ongoing climate change to affect the stability of the gas hydrates, and to evaluate the impact of gas hydrate degassing on atmospheric greenhouse gas concentrations.

By 2022: provide via targeted drilling and/or remote sensing programs, refined models for gas hydrate occurrences within resource-relevant, environmentally sensitive, and/or geohazard prone, accumulations within the US OCS.

THANK YOU