

GH International



MHFAC Meeting, April 4, 2017



US - International Formal Agreements

GH R&D Collaboration



DOE – METI Statement of Intent

NETL – JOGMEC MoU

NETL – JOGMEC CRADA

USGS – AIST Letter of Intent



DOE – MoPNG MoU

USGS – DGH/MoPNG MoU



DOE – MKE Statement of Intent

USGS – KIGAM Letter of Agreement





Japan

Summary of R&D: Alaska and Nankai: 1995-2016

1998: First Mallik Well

1999: Nankai Discovery Well

2002: Mallik Thermal Production Test

2004: Nankai Exploration Program

2007: Mallik Depressurization Test #1

2008: Mallik Depressurization Test #2

2008: Nankai Trough Resource Assessment

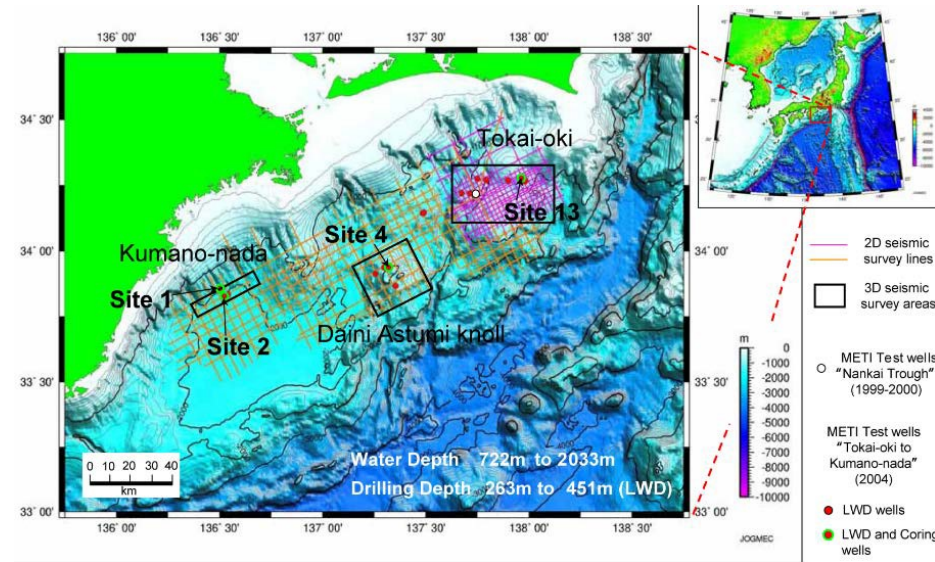
2008: Exploration Approach Published

2012: Collaboration on Ignik Sikumi Program

2012: Preparatory drilling for Nankai Test

2013: First Nankai Production Test

2016: Preparatory drilling for 2nd Nankai Test





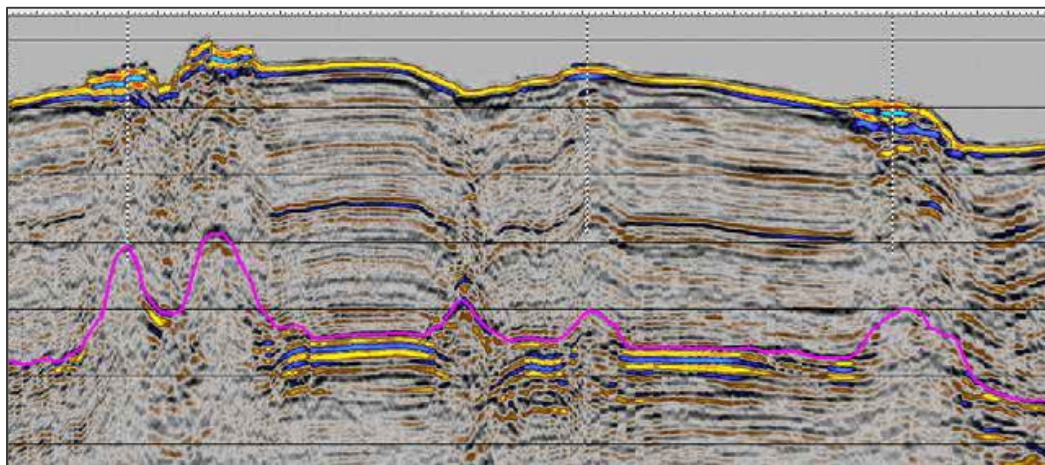
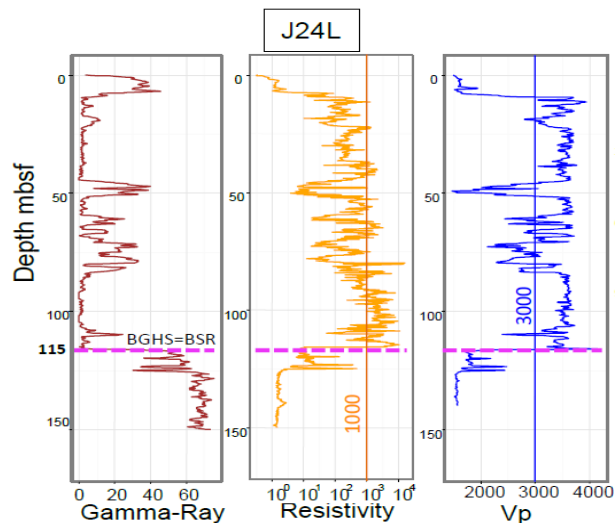
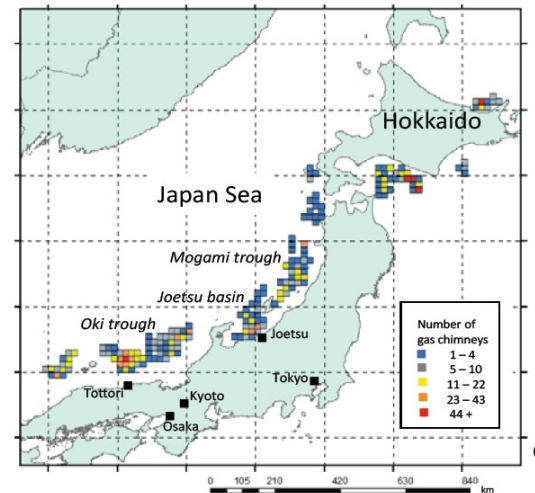
Japan

Japan Sea Project: METI – ARNE; AIST; Universities

LWD at 33 sites

- 1,742 mapped “chimneys”
- From 5 to 50 per 100 mi²
- 450 to 1500 m water depth
- .1 to 1 km in diameter:
- Up to 100 m thickness (to BGHSZ)
- Site J24: Cores are 80% bulk GH
- Gas is “mixed source”

Matsumoto et al., FITI, 2017





Japan

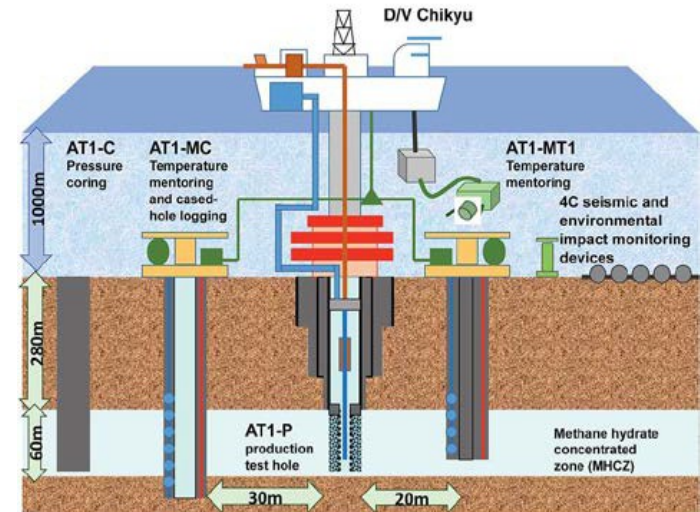
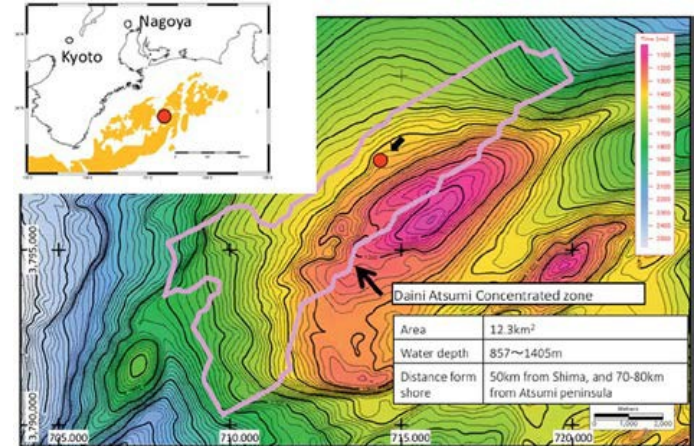
2013 and 2017 Production Tests in Nankai Trough

2013 Field Experiment

- First demonstration of technical recoverability of gas from marine gas hydrate
- Depressurization reached 25 m in 6 days
- Stable production obtained

2017 Test

- Designed for longer duration
- Demonstration of sustained flow and well/equipment survivability.
- Evaluation of rates and sources of gas and water flow
- Two test wells with alternative completion systems



Fujii et al., 2015. Konno et al., 2017



India



DOE-MoPNG MoU: DOE-USGS-ONGC

India-US Collaboration

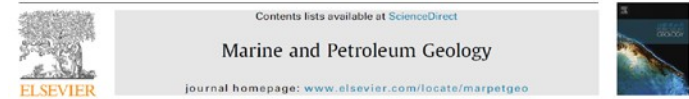
- Planning, Execution of NGHP-01 and NGHP-02
- Evaluation and publication of Scientific Results
- Evaluation of NGHP-02 pressure cores
- Site evaluation for NGHP-03
- Support for planning/execution of NGHP-03
- Scientist postings at LBNL, NETL being pursued

India R&D Status

- Planning NGHP-03, extended duration field experiment
- One or more sites: focus on depressurization

Numerical Simulation Studies

- USGS-AIST evaluation of NGHP-02 pressure cores
- NETL, LBNL, USGS integrated geomechanical production simulations for two sites



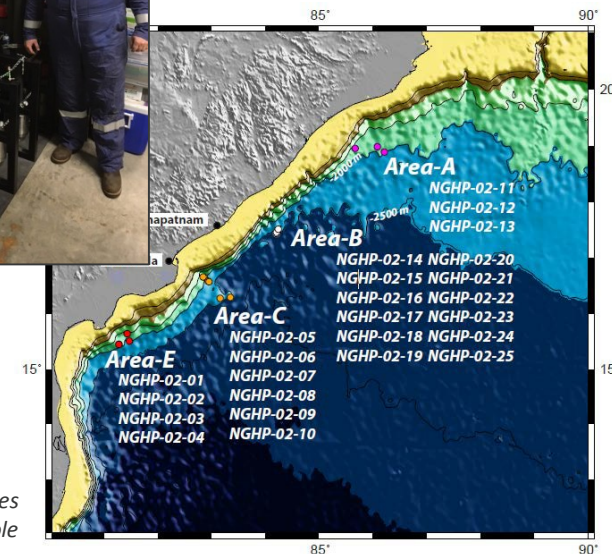
Research paper
Geologic implications of gas hydrates in the offshore of India: Results of the National Gas Hydrate Program Expedition 01

Timothy S. Collett ^{a,*}, Ray Boswell ^b, James R. Cochran ^c, Pushpendra Kumar ^d, Malcolm Lal ^e, Aninda Mazumdar ^f, Mangipudi Venkata Ramana ^g, Tammiseti Ramprasad ^h, Michael Riedel ^b, Kalachand Sain ⁱ, Arun Vasant Sathe ^j, Krishna Vishwanath ^k, NGHP Expedition 01 Scientific Party

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^b U.S. Department of Energy, National Energy Technology Laboratory, 626 Cochran's Mill Rd., Pittsburgh, PA 15236, USA
^c Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY 10964, USA
^d Oil and Natural Gas Corporation Ltd., Institute of Engineering and Ocean Technology, ONGC Complex, Phase II, Panvel 410221, Navi Mumbai, India
^e Directorate General of Hydrocarbons, Plot No 2, Sector 73, Noida, India



NGHP-02 p-cores arrive at USGS labs in Woods Hole



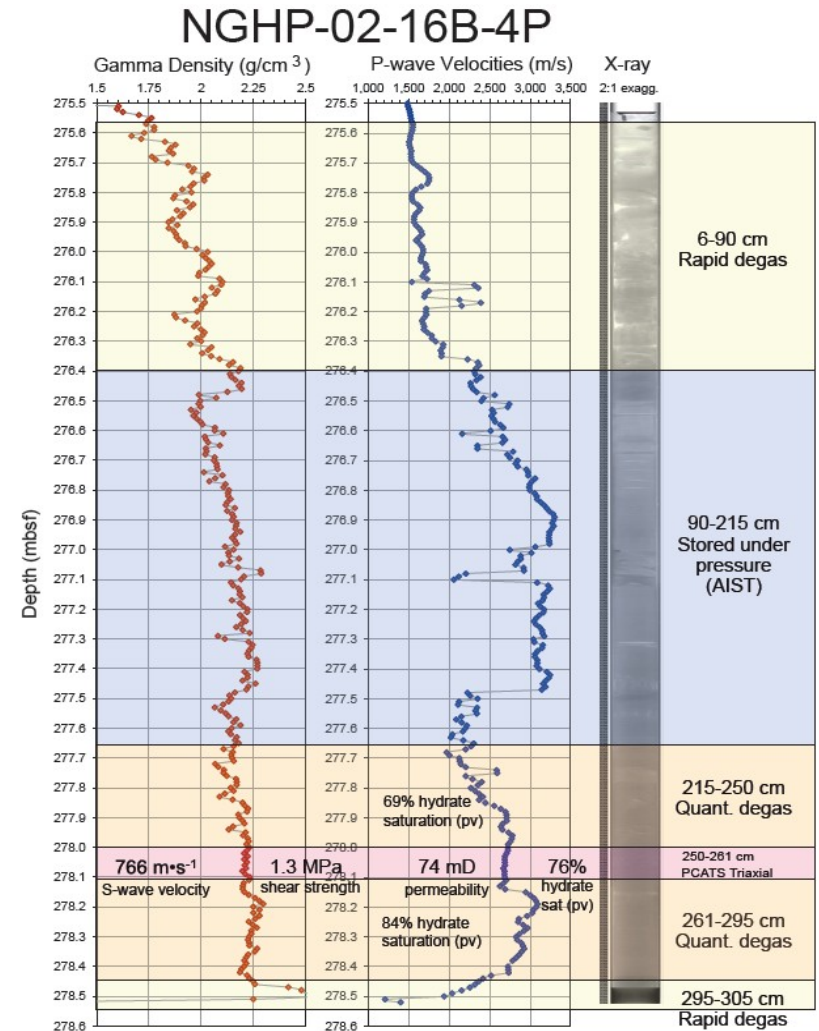
NGHP-02 sites drilled in p-cores arrive at USGS labs in Woods Hole



India

NGHP-02 Findings

- 80 Sites reviewed/ 25 drilled/ 16 cored: 42 holes in 147 days
- PCTB and PCATS with Triaxial
- Gas charge limitation in Mahanadi: Large GH-charged systems in KG basin.
- Well constrained accumulation in “Area B”
- New insights into reservoir petrophysics – further data from post-cruise studies conducted through collaborations with AIST (Japan) and USGS.

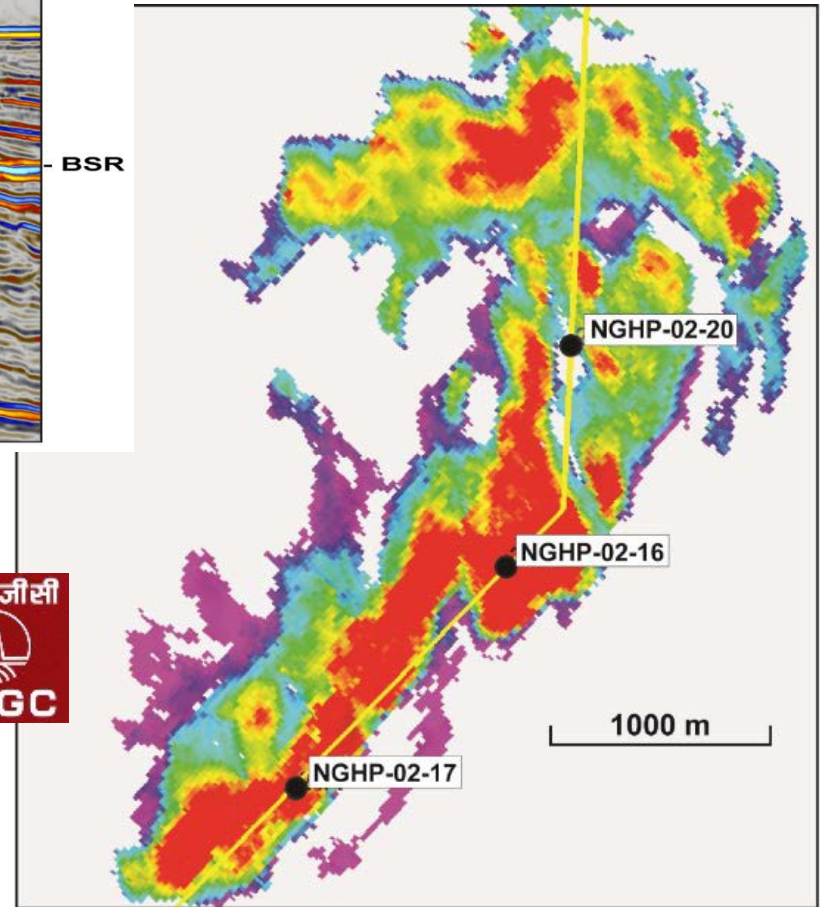
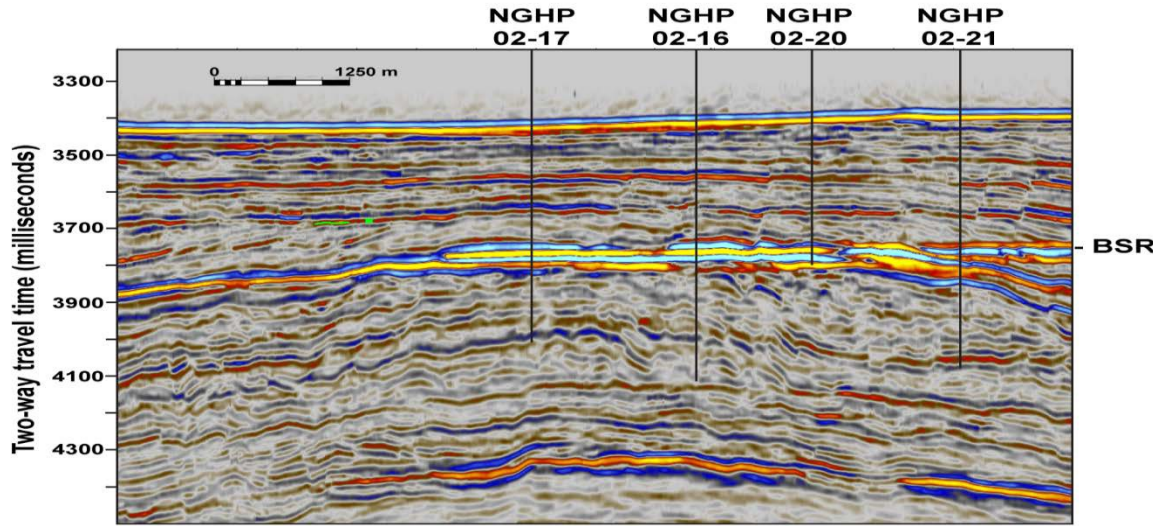


Kumar et al., FITI, 2016



India

Area B



Kumar et al., FITI, 2016



S. Korea

DOE-MKE MoU: NETL-TAMU-KIGAM CA: NETL-GHDO joint funding for NL FWPs

UBGH-01 (2007) and UBGH-02 (2010)

- Substantial USGS support
- DOE support for US scientist participation
- Special Volume publication in 2014

NETL, USGS, LBNL support for UBGH-03 planning

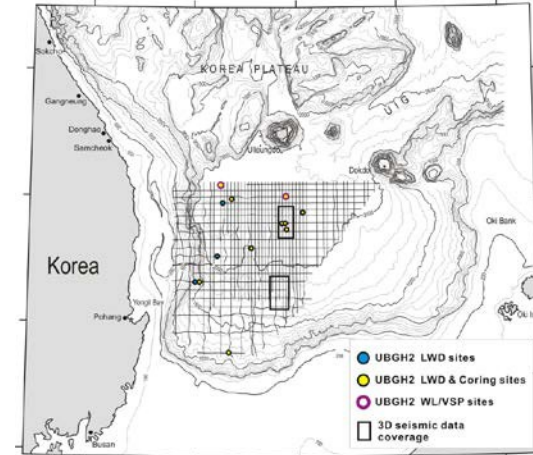
- Site selection
- Numerical prediction of reservoir response

Joint Funding for Numerical Simulation Studies

- Denver Meeting in 2014 → projects with LBNL and PNL

New Cooperative Agreement with Texas A&M

- Ex KIGAM/LBNL modeler JiHoon Kim now at TAMU
- Project leverages data KIGAMs unique large-scale reactors



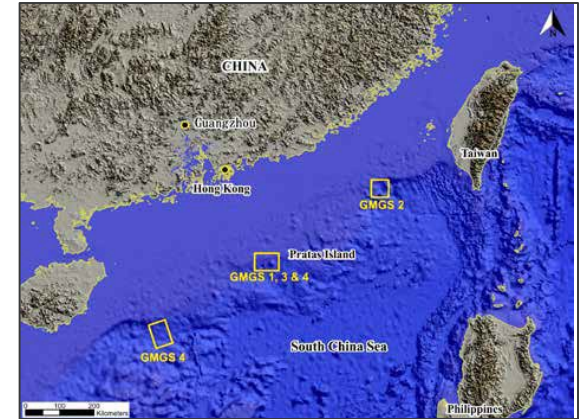


China

Very Active Program

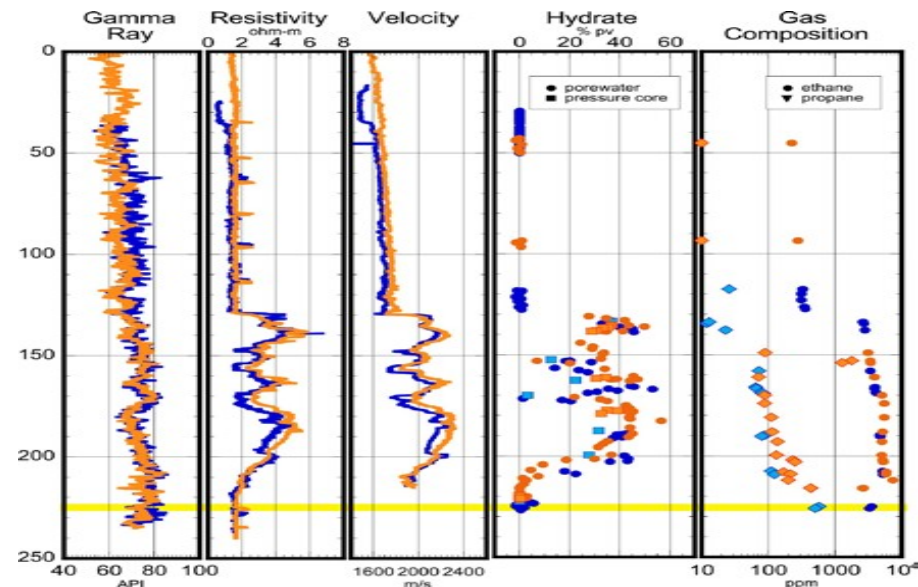
GMGS-2 (2013), GMGS-3 (2015) and GMGS-4 (2016)

- NETL publishes first public reports in FITI newsletter
- Primary focus is Pearl River mouth basin (Shenhu area)
- GMGS-4 added new area to the south (Xisha area); 58 days/ 21 sites
- Reservoirs appear to be clay-rich silt with S_{gh} up to 40% (anomalous)
- Lateral heterogeneity over short distances.
- 20 -90 m thick at BGHS: Some Structure II GH?
- **GMGS-05** planning ongoing.



Onshore Testing Underway

- Permafrost-associated: Thermogenic; Fractured-rock reservoirs
- Tibetan Plateau (Qilian) and Manchuria (Mohe)



Other International

Informal Collaborations

New Zealand

- IODP Exp.-372 (Nov '17 to Jan '18). “Creeping Deformation”
- NETL serves on advisory committee for GNS-lead program
- NETL supported recent NRL/GNS studies
- NETL supports Stanford U. in NZ PetroMod studies

Europe

- MIGRATE: Resource evaluation
- CAGE & MARUM (U. Bremen) expeditions to Svalbard
- CAGE at U. Tromso: “Sugar” Project at GEOMAR.

Other

- Recent visits to SENER, IMP (Mexico) in 2015 and 2016.
- DOE/USGS/JOGMEC Symposium to Petrobras in 2014.
- Ireland, Uruguay, Colombia, S. Africa, Turkey, Vietnam, Taiwan...

