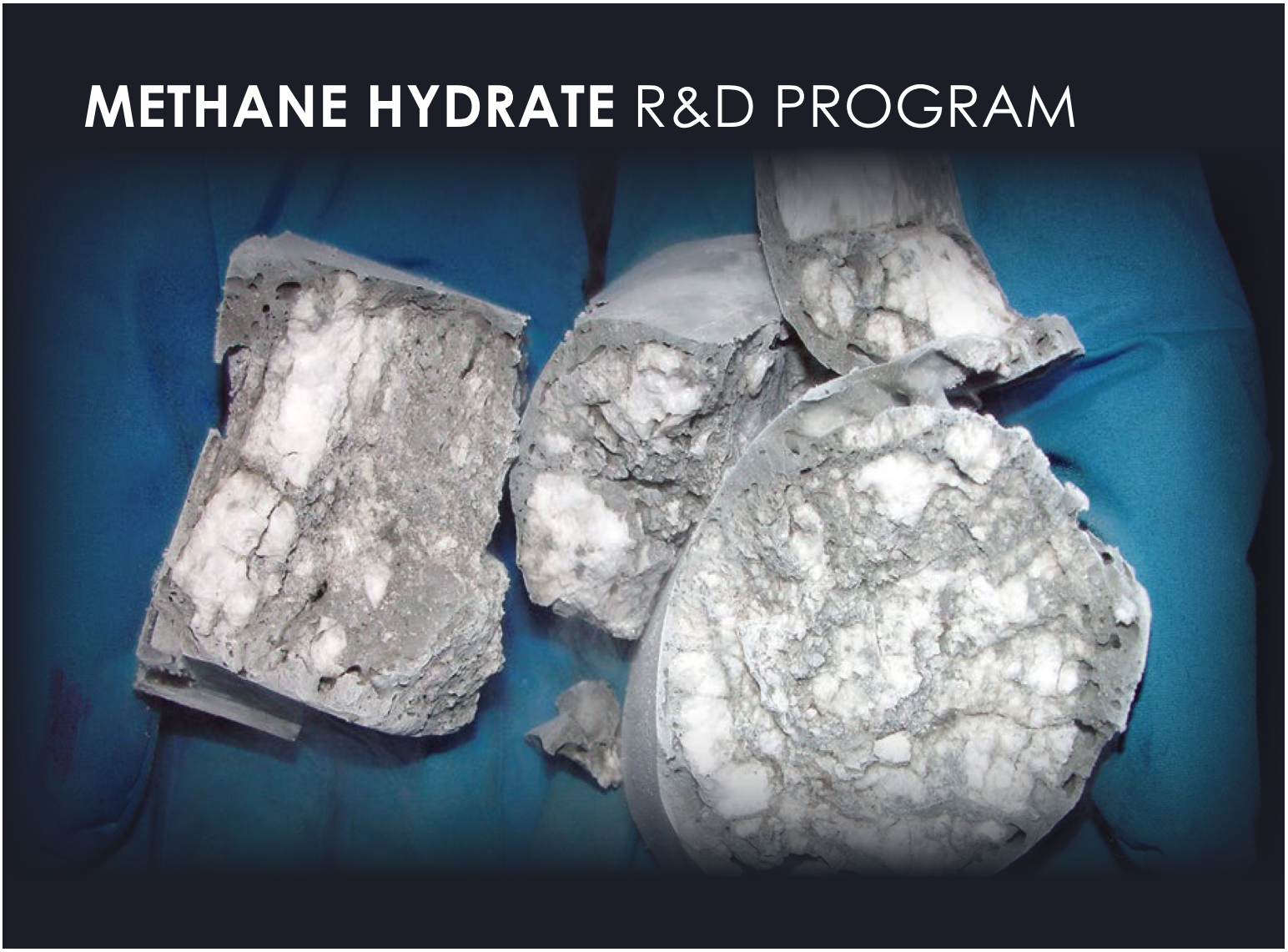
METHANE HYDRATE R&D PROGRAM



NETL

NATIONAL ENERGY TECHNOLOGY LABORATORY

OVERVIEW

Since 2000, NETL has been leading a coordinated Methane Hydrate R&D Program to advance scientific knowledge of gas hydrates as they occur in nature. Program efforts have been focused on three overarching goals: (1) to evaluate the nation's methane hydrate resource, (2) to build knowledge and understanding of the role of methane hydrates in the environment, and (3) to understand how production technologies would affect hydrate reservoir properties and behavior.

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U.S. DEPARTMENT OF ENERGY | NATIONAL ENERGY TECHNOLOGY LABORATORY

NETL implements this effort as part of DOE's Oil & Gas Program.

Program 099, August 2021

PARTNERSHIPS AND STRENGTHS

To achieve these goals and expand scientific knowledge of naturally occurring hydrate-bearing formations, NETL's Methane Hydrate Program directors created partnerships with top researchers across a broad spectrum of organizations, primarily: U.S. National Laboratories and government agencies including the U.S. Geological Survey; domestic and international research organizations; public and private universities; and industry entities.

Through these partnerships, NETL's Methane Hydrate R&D Program has succeeded in supporting a range of investigations including geophysical data analysis for mapping subsurface hydrate, field sampling of hydrate-bearing formations for onsite and laboratory analysis, development of specialized pressure core sampling and handling tools, establishing world-class laboratory facilities for physical property analysis of hydrate specimens under controlled pressure and temperature conditions, and expansion and optimization of numerical models that predict hydrate reservoir behavior. In addition, NETL has established itself as a supporter of emerging hydrate scientists and a communication hub for hydrate researchers and stakeholders worldwide.

PAST PROGRAM ACCOMPLISHMENTS

In its 21 years of collaborative efforts with committed partners, the program has made significant strides in the following R&D areas:

- Evaluating and characterizing the gas hydrate resource in the Gulf of Mexico and Alaska North Slope
- Designing and testing hydrate sampling and analysis technologies in onshore and offshore environments
- Knowledge sharing and data exchange with international partners on hydrate field projects around the world
- Collaborative development and testing of reservoir modeling codes that incorporate hydrate behavior
- Building data and knowledge on the role of hydrate deposits in the global carbon cycle and global climate change
- Leading outreach and communication efforts through the Methane Hydrate Fellowship Program and the "Fire in the Ice" Newsletter

NEW AND ONGOING RESEARCH THRUSTS

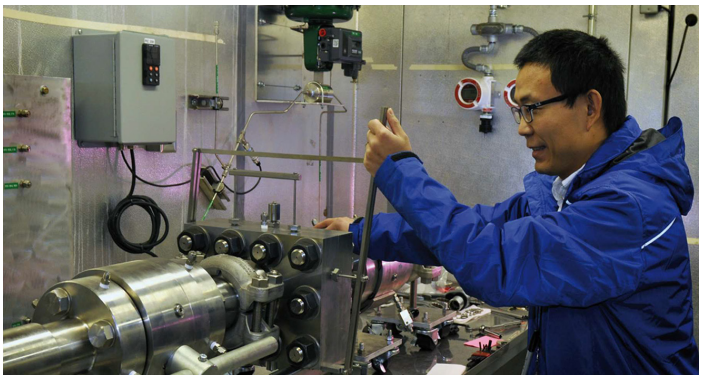
HYDRATE-CLIMATE INTERACTIONS

Several research efforts aimed at addressing hydrate-climate interactions are being spearheaded by the National Labs. One project is aimed at determining the effect of climate change on hydrate stability in continental margin settings, and another is investigating the influence of possible future production on the earth's atmospheric carbon budget.

NETL's Research and Innovation Center is collaborating with WVU to conduct an environmental life cycle analysis of gas hydrate systems to understand potential climate impacts of possible future production of gas from hydrates. USGS researchers will provide geological expertise and production engineering data in support of this project.

Lawrence Berkeley National Laboratory will launch a new investigation of subsea permafrost and sub-permafrost hydrate systems in continental shelf settings using their Tough+hydrate family of modeling tools. The objective is to evaluate the impacts of methane release into the water column in response to ocean warming, with a careful look at potential release of CO_2 to the atmosphere after oxidation of the methane. This project also relies on data and expertise provided by the USGS.

Pacific Northwest National Lab (PNNL) is beginning to test realistic strategies for creating stable CO_2 gas hydrate in subsurface geologic reservoirs to examine the viability of pursuing this approach on a commercial scale. The study will rely on the PNNL's STOMP-HYDT-KE family of simulators.



METHANE HYDRATES

ESTABLISHING A LONG-TERM TEST SITE

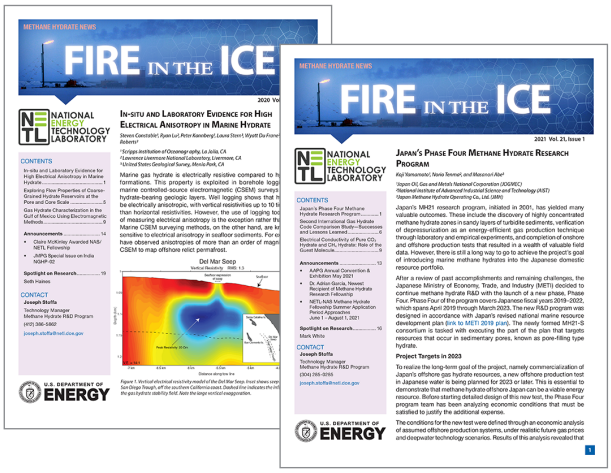
An ongoing and successful effort has been to establish a site for long-term testing of methane hydrate reservoirs on the North Slope of Alaska. The plan for this project was developed through collaboration between NETL and Japan Oil, Gas, and Metals National Corporation, with technical and scientific expertise provided by the USGS. This project earned recognition as an NETL Science and Technology Accomplishment during 2020.

INTERNATIONAL COLLABORATION

NETL continues to collaborate with methane hydrate scientists and engineers around the world, in an environment of cooperation and knowledge sharing, to achieve a more complete understanding of hydrate deposits as they occur in a wide variety of geologic settings.

OUTREACH

NETL continues to publish "Fire in the Ice," the methane hydrate newsletter that serves the international hydrate R&D community. In addition, NETL and the National Academies of Science, Engineering, and Medicine continue their Methane Hydrate Fellowship program to support promising new researchers in methane hydrate science.

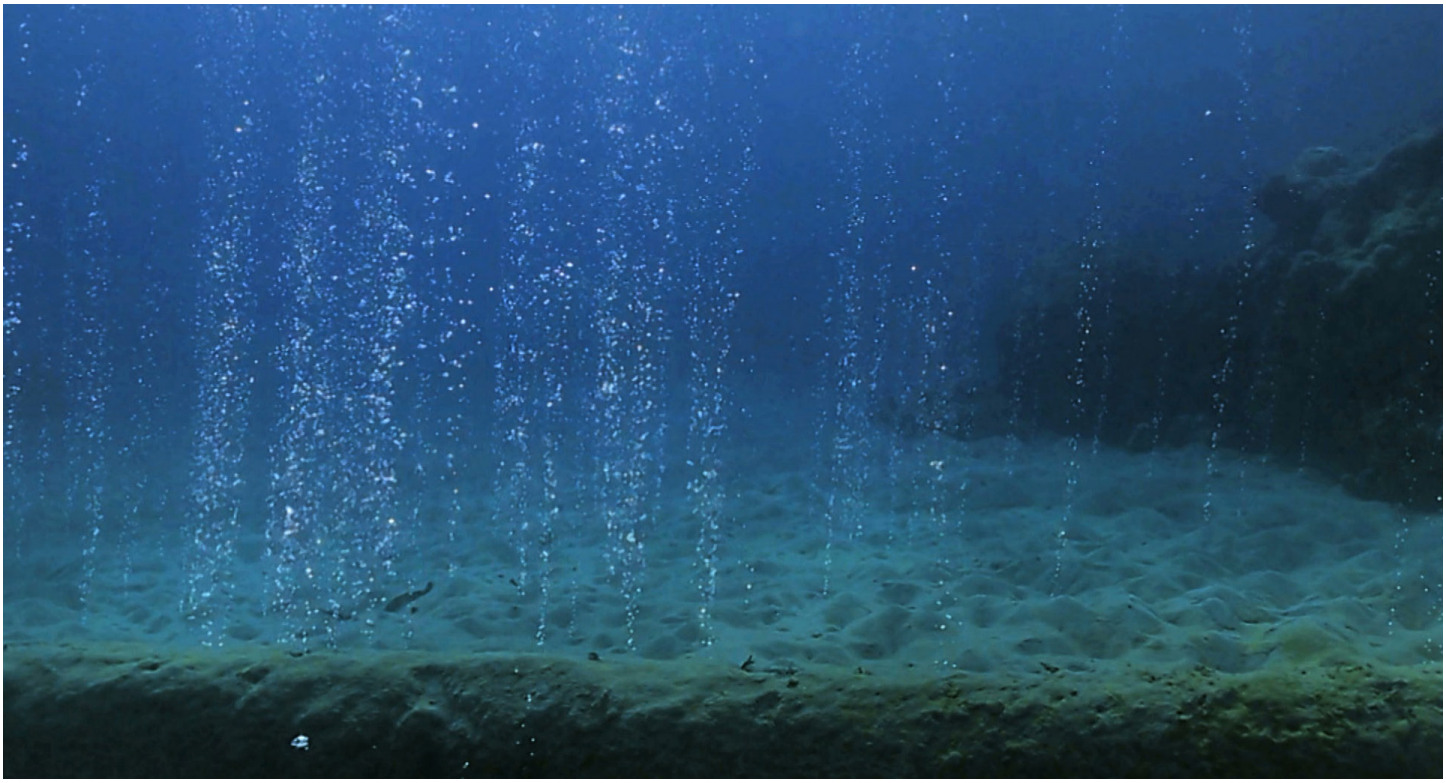


RELEVENT LINKS

NETL Methane Hydrate R&D Program Web Site: https://netl.doe.gov/oil-gas/gas-hydrates

NETL's Fire in the Ice Methane Hydrate Newsletter: https://www.netl.doe.gov/advsearch?tid=113

U.S. DOE Office of Fossil Energy Methane Hydrate Web Page: https://www.energy.gov/fe/science-innovation/oil-gas-research/methane-hydrate



Contacts

Joseph Stoffa
Technology Manager
NETL
Joseph.Stoffa@netl.doe.gov

Gabby Intihar
Program Manager
DOE Headquarters
Gabby.Intihar@hq.doe.gov