U.S. Department of Energy • Office of Fossil Energy • National Energy Technology Laboratory

Fire in the Ice

Vol. 5, Iss. 4 Methane Hydrate Newsletter

CONTENTS

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INTEGRATED OCEAN DRILLING PROGRAM EXPEDITION 311 – CASCADIA MARGIN GAS HYDRATES

by the IODP Expedition 311 Shipboard Scientific Party

The Integrated Ocean Drilling Program's (IODP) Expedition 311 was designed to further constrain models for the formation of marine gas hydrate in subduction zone accretionary prisms. The scientific objectives of this expedition included characterizing the deep origin of the methane, its upward transport, its incorporation in gas hydrate, and its subsequent loss to the seafloor.

From September 19, 2005 through October 28, 2005, IODP Expedition 311 drilled and cored a transect of four sites (U1325, U1326, U1327, U1329) across the Northern Cascadia Margin to study gas hydrate occurrences and formation models for accretionary complexes. In addition to the transect sites, a fifth site was visited (Site U1328, representing a cold vent with active fluid and gas flow). The four transect sites represent different stages in the evolution of gas hydrate across the margin, from the earliest occurrence on the westernmost first accreted ridge (Site U1326) to its final stage at the eastward limit of gas hydrate occurrence on the margin in shallower water (Site U1329).

Pressure Core Specialist manipulates a pressure core recovered during the IOPP Expedition 311.

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This newsletter is available online at www.netl.doe.gov/scngo/NaturalGas/hydrates/index.html

Interested in contributing an article to *Fire in the Ice*?

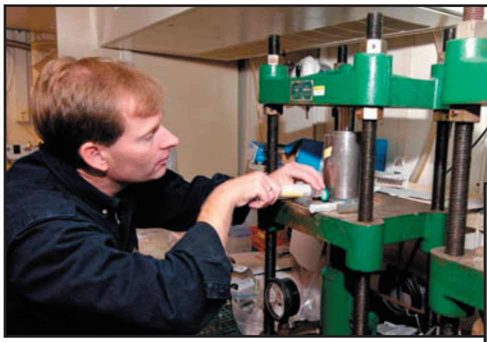
This newsletter now reaches nearly 500 scientists and other individuals interested in hydrates in sixteen countries. If you would like to submit an article about the progress of your methane hydrates research project, please contact Karl Lang at 703 891-4813 (klang@hartenergy.com)

Logging-while-drilling/measurement-while-drilling (LWD/MWD), carried out at the start of the expedition prior to coring, provided a set of measurements guiding subsequent coring and special tool deployments at all five sites. Additional wireline logging at each site and two vertical seismic profiles at Sites U1327 and U1328 were also completed. A total of 1217.76 meters (m) of sediment core was recovered using conventional wireline coring systems interspersed with 43 pressure core deployments.

Indirect evidence for the presence of gas hydrate was found in the downhole logging program's recording of increased electrical resistivities and P-wave velocities, and in the low salinity interstitial water anomalies, numerous infrared cold spots, decrease in void gas C1/C2 ratios, and gas hydrate-related sedimentological moussy/soupy textures observed in the recovered cores. Gas hydrate was also observed directly in the recovered cores and over 30 gas hydrate samples were preserved in liquid nitrogen for shore-based studies.

The combined observations show that gas hydrate occurs mainly within coarser grained turbidite sands and silts. The occurrence of gas hydrate appears to be controlled by three key factors and the concentration of gas hydrate changes significantly as those factors vary in the sediments across the margin. The key controlling factors are: (a) local methane solubility linked with pore water salinity, (b) fluid/gas advection rates, and (c) availability of suitable host material (coarse-grained sediments).

The Expedition 311 Preliminary Report will soon be available on the following IODP web site: http://iodp.tamu.edu/scienceops/expeditions/exp311.html. Other reports, including daily and site summaries, are already posted on the IODP web site, along with the Scientific Prospectus for the expedition.



Geochemist squeezes a core sample to extract the interstitial water for chemical analysis.

Hydrate samples fizzing and bubbling as they decompose at ambient conditions.

The JOIDES Resolution drillship

USING ACOUSTIC INVERSION TO IMAGE BURIED GAS HYDRATE DISTRIBUTION

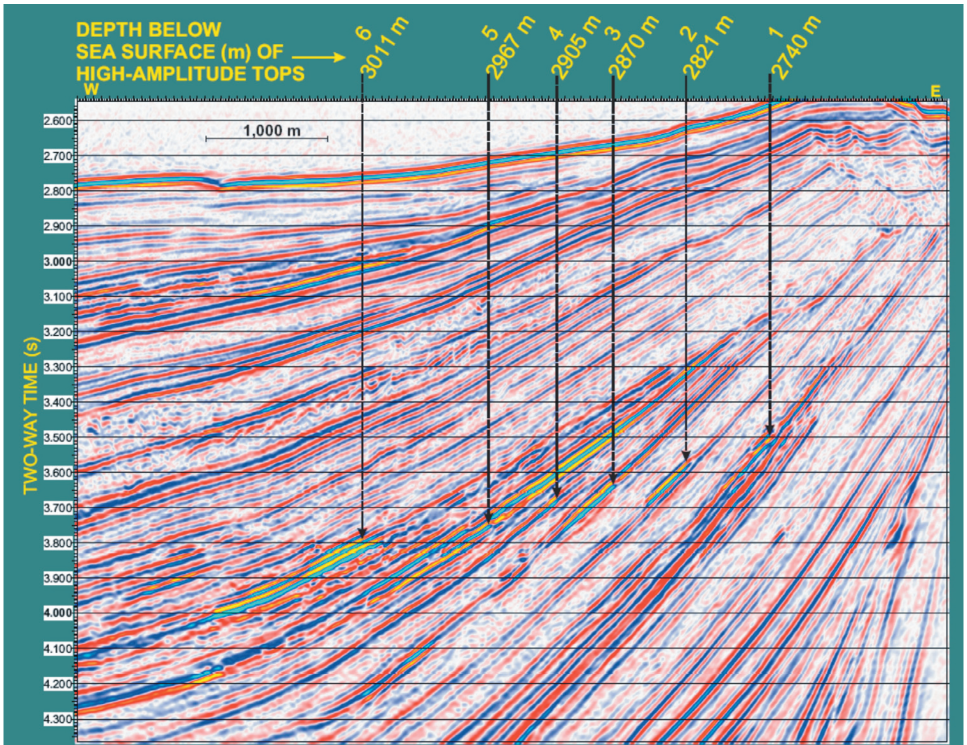
Dan McConnell and Zijian Zhang, AOA Geophysics, Houston, TX

Can acoustic inversion of 3-D seismic data help image gas hydrate deposits? Preliminary tests indicate that it may be a useful tool.

Assessing the risk of gas hydrate to deepwater oil and gas developments is a challenge. As more deepwater developments are putting “steel in the ground,” industry geohazards interpreters and geotechnical engineers are assessing the risk to deepwater developments from gas hydrate dissociation.

In most cases, no gas hydrate hazards are interpreted for the typical deepwater exploration and production well. However, there are scenarios where buried gas hydrate deposits are interpreted to be present. In the deepwater Gulf of Mexico, we interpret gas hydrate deposits (hazards in our jargon) where high flux of fluids intersect (gas hydrate) reservoir sands at the base of gas hydrate stability.

Even where there is an obvious gas hydrate trap it is much easier to see the gas than the gas hydrate in seismic data. But we sometimes see anomalous reflectors that we interpret to be isolated gas hydrate deposits. As acoustic blanking in seismic data could, in some cases, be interpreted as disseminated gas hydrate, concentrated gas hydrate in a reservoir sand is likely to produce a good, although patchy, reflector. Gas hydrate deposits in excess of a certain concentration are probably imaged in seismic data.



Seismic section along principal seismic traverse (PST). 3-D seismic data show depth below sea surface of high amplitude dim-outs at the base of gas hydrate stability. Six reflectors along the PST that show amplitude dim-outs are labeled 1 through 6, with 1 being the oldest.

Figure 1

Acoustic inversion of seismic data, the process of estimating the wavelet that produced the seismic trace in order to create an earth model of acoustic impedance, may help image the distribution of gas hydrate deposits. In simple terms, inversion of seismic data transforms the data from a series of reflection interfaces to a series of layers. Ideally (for a deepwater clastic section) the (velocity x density) layers would correspond to sand layers and clay layers and be influenced by their pore filling (brine, gas, oil, gas hydrate).

In a seismic data example from the Gulf of Mexico, gas hydrate traps are evident, but the extent of the gas hydrate deposit forming each trap is not (Figure 1). A simple acoustic inversion of the seismic data can make the data easier to understand. The polarity reversal in the reflection interfaces in the seismic data is resolved into layer properties after the inversion (Figure 2). Gassy sediments fill the silt/sand layer below the base of gas hydrate stability, gas hydrate fills the pore space at the base of gas hydrate stability and the concentration tapers off with distance updip from the gas/gas hydrate interface.

Figures 3 through 7 show that significant gas hydrate accumulations can occur where gas hydrate reservoir sands intersect the base of gas hydrate stability in areas of high fluid flux and, that these deposits are easier to interpret in the acoustic impedance (inversion) sections.

Figure 3 shows an arbitrary slice though the amplitude data showing a meandering sand-prone channel. A prominent gas accumulation is associated with the updip sandy channel levee, but is trapped against the base of gas hydrate stability. Figure 4 depicts the corresponding slice through the acoustic impedance (inversion) data showing gas. Note that high impedance is interpreted to be gas hydrate deposits forming traps updip of gas.

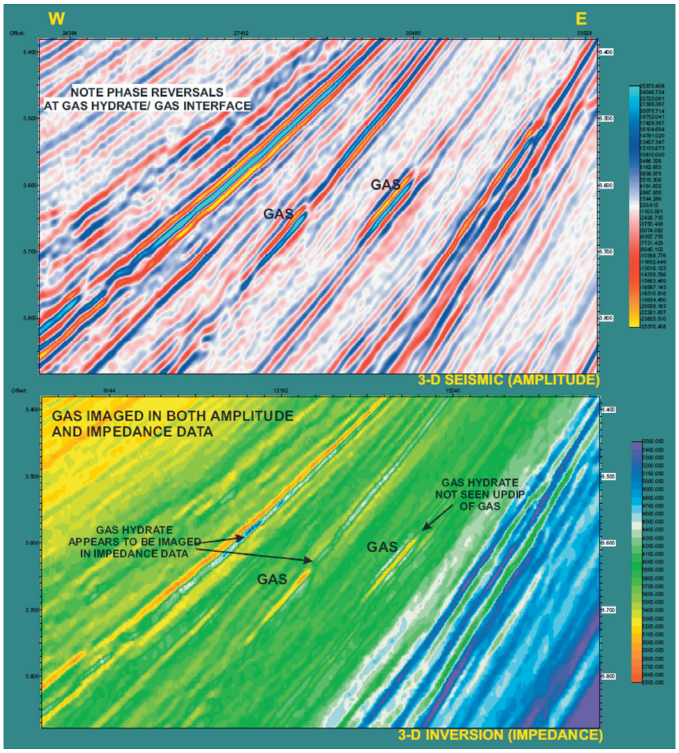


Figure 2

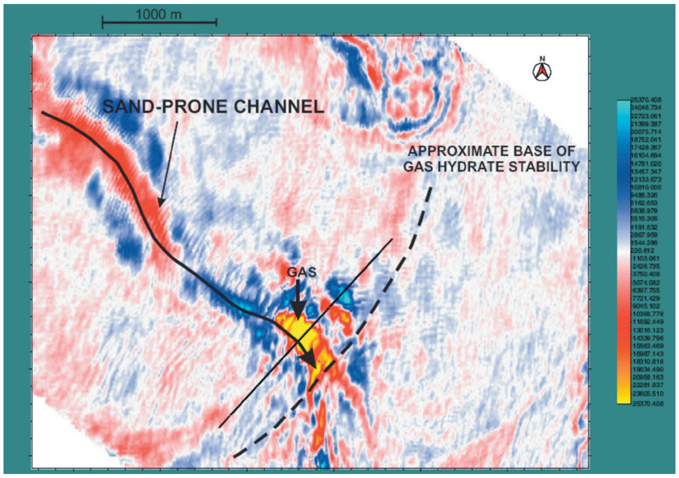


Figure 3

Most gas hydrate is shown to be concentrated in the upper part of the channel levee deposits directly above the gas (Figure 5).

Figure 6 shows an arbitrary line (shown on Figure 3) through the amplitude data showing a gas sand, while Figure 7 depicts the corresponding arbitrary line through the impedance data revealing gas hydrate above free gas in a gas hydrate reservoir at the base of gas hydrate stability.

A successful inversion usually requires high signal-to-noise data, a wide bandwidth, and sonic and density logs. Inversions of the shallow section are often not tried because sonic and density logs are rarely available. Log-to-log transforms are also difficult at shallow depths because of the wide hole conditions and erratic logs typical of the top hole section. Nevertheless, there are data substitutes that may be employed in the shallow section.

While the lack of good sonic and density log data is a recognized hurdle to inversion, mudline compaction models have been successfully employed as a substitute for density logs. Other workers that have used inversion methods in the shallow section have had similar constraints but have apparently yielded good results. Integration of geotechnical data from deepwater borings (direct lithology and density measurements) could also be used as an input to inversion. These data, combined with borehole wireline logging to provide the velocity data, may provide a robust input to the shallow-section inversion.

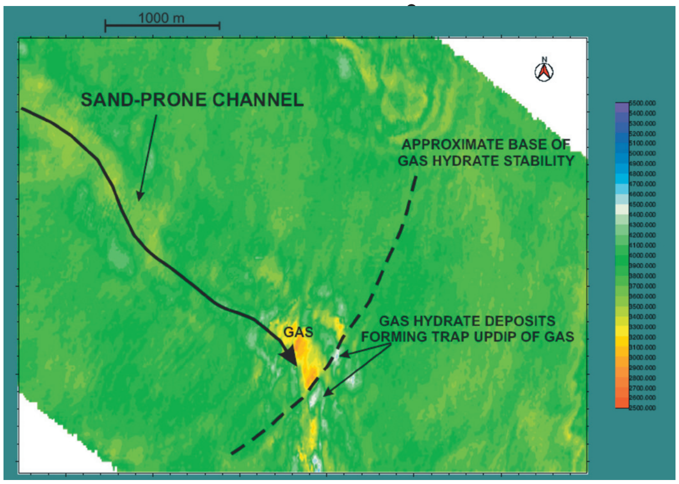


Figure 4

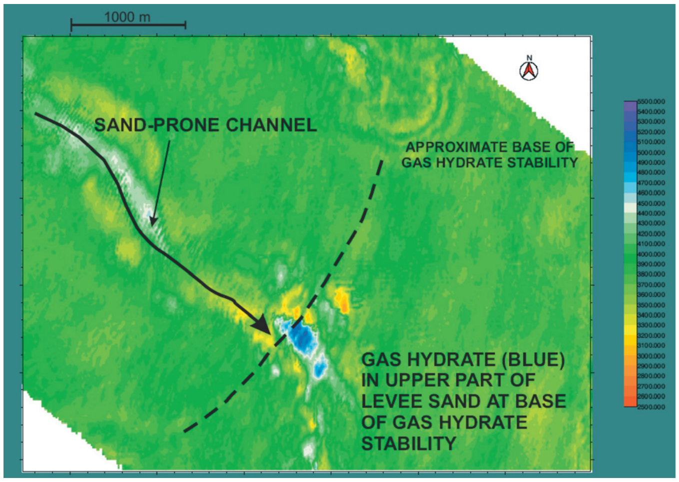


Figure 5

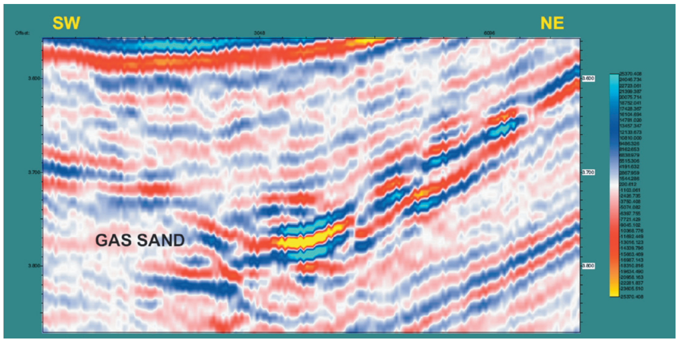


Figure 6

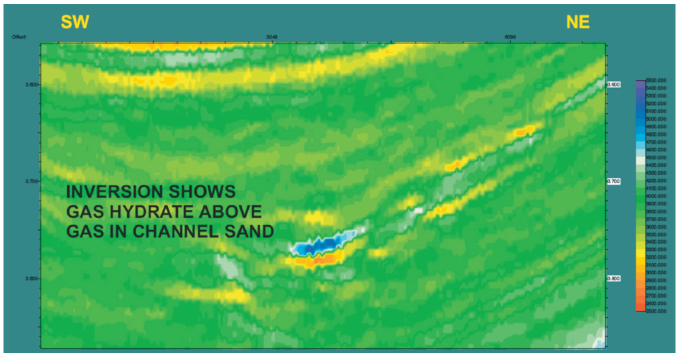
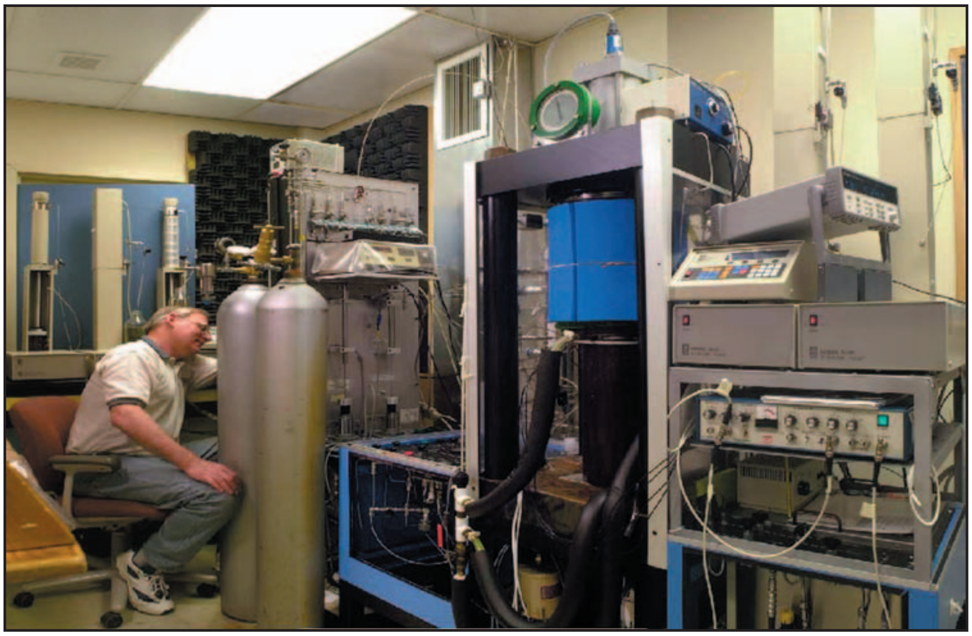


Figure 7

PHYSICAL PROPERTY STUDIES IN THE USGS GHASTLI LABORATORY

William J. Winters, William F. Waite, Deborah R. Hutchinson, and David H. Mason, USGS

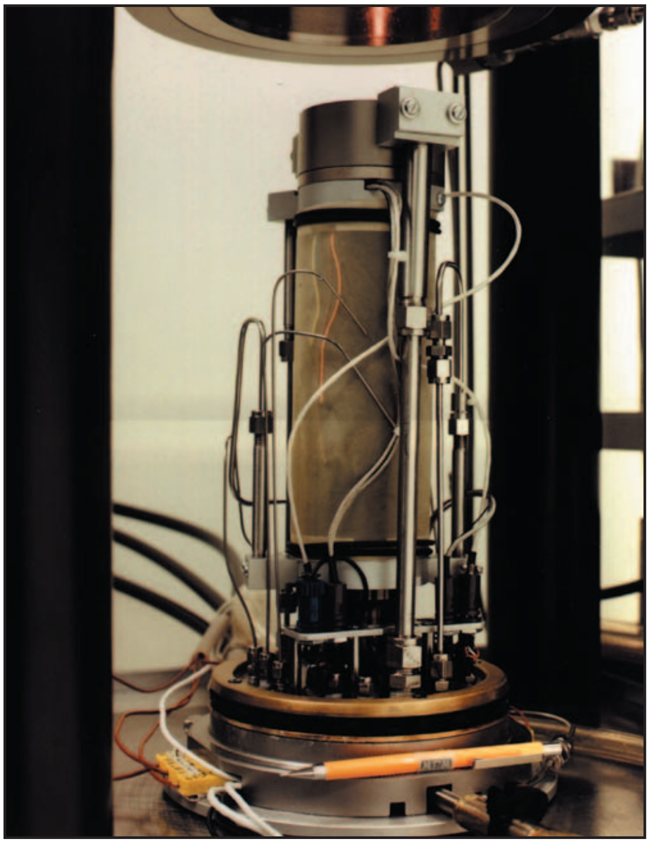
One of the many challenges in studying methane hydrate is that it is unstable at typical surface pressure and temperature conditions. To enable methane hydrates and hydrate-bearing sediments to be formed, analyzed, and experimented with, the National Energy Technology Laboratory (NETL), and the U.S. Geological Survey (USGS) in Woods Hole, MA collaborated in the development of the Gas Hydrate And Sediment Test Laboratory Instrument (GHASTLI). Over the past decade, the USGS has been operating GHASTLI and collaborating in the development of new sample handling tools and procedures, in an effort to improve our ability to analyze methane hydrate in the lab. These tools will enable hydrate researchers to more confidently link field studies (for example geophysics or drilling) with theoretical and predictive studies, leading to a better understanding of the geological conditions and processes that control the growth and concentration of natural gas hydrates, how hydrates affect the properties of the host sediments, and how the hydrate-sediment system changes when hydrate dissociates and releases the previously bound gas. To date, GHASTLI has been used to measure natural samples from ODP Leg 164 (Blake Ridge off the U.S. southeast Atlantic margin), Leg 204 (Hydrate Ridge off the Pacific Northwest margin) and the Mallik well (Mackenzie Delta in northwestern Canada). Additional samples in the queue for analysis are from the Chevron Joint Industry Project Experiment in the Gulf of Mexico and most recently, from IODP Leg 311 off Vancouver Island. Several foreign nations have asked whether GHASTLI will be available to analyze samples that might be recovered during national drilling programs. The ability to perform lab testing of hydrates within sediments is one of the unique capabilities of GHASTLI that separates it from other simulators at NETL and elsewhere.



Gas Hydrate And Sediment Test Laboratory Instrument (GHASTLI).

GHASTLI is unique in having six subsystems for controlling: (1) sample temperature, (2) axial load, (3) confining pressure, (4) back pressure, (5) flow rate of pore gas/water, and 6) pressure control for pore gas/water. Samples tested in GHASTLI consist of either laboratory-formed samples created from well-characterized sediments or natural samples obtained via coring or drilling. Hydrate has been formed within sediment samples by slowly pushing methane gas into the sediment and displacing the water in the pores, or by filling the pores with methane and then lowering the temperature of the sample until pressure-temperature conditions are within the gas-hydrate stability zone. GHASTLI can accommodate relatively large specimens (71-mm diameter by 140-mm height), which allows natural samples obtained from coring and drilling operations to be used. The most common properties measured and monitored during an experiment are acoustic velocity (p-wave), shear strength, electrical resistivity, and permeability. Experiments employing GHASTLI typically last between 2 weeks and 4 months.

One important application of the properties measured in GHASTLI is the determination of the strength of the sea-floor deposits. This information can help to quantify hazards that hydrates may pose to the stability of drilling platforms, wells, pipelines, and other rigid structures installed on the sea floor where hydrates are found. Observations in GHASTLI also help define conditions under which the disturbance of hydrate might lead to dissociation, information that is needed for ultimately developing this potentially vast energy resource, as well as for helping researchers understand how the global hydrate reservoir might release methane during global warming and trigger a positive feedback to climate change.



Close-up view of a test specimen about to be raised into the main pressure vessel (visible at the top of the photograph).

Improving the Ability to Study Natural Samples

Physical properties of sediment containing hydrates would ideally be measured in situ, either during drilling operations or sea-floor experiments. Well logs provide information on bulk physical properties of sediments and pore-filling fluids, but properties such as shear strength and permeability are not easily measured during drilling. Such measurements can be made in GHASTLI, although acquiring, transporting, and restabilizing a natural sample in GHASTLI disturbs the sample. As a result, physical property values measured in GHASTLI are not identical to values measured in situ.

Two approaches are being pursued to reduce this discrepancy: (1) limiting the disruption to natural samples and (2) quantifying the effects of disruption on physical properties. Typically, natural core material must be depressurized twice prior to commencing physical property measurements in GHASTLI: once in the field when the sample is transferred from the sampling device into a pressure vessel, and again when the sample is transferred into GHASTLI.

To eliminate the depressurization step in the field, a transport vessel was built (in collaboration with GeoTek Ltd.) to accept a sample directly from a pressurized coring system. This vessel was used during the 2005 Chevron/DOE Joint Industry Program's (JIP) hydrate drilling project in the Gulf of Mexico (see figure). In addition, the USGS is using GHASTLI to recreate, and study the effects of, the pressure and temperature changes experienced by a core sample during recovery, transport, and transfer into lab equipment. By striving to limit disturbance in natural hydrate samples and by quantifying the effects of sample disturbance, scientists can more appropriately relate laboratory measurements to in situ properties.

Pressure vessel containing a natural sediment sample recovered during the 2005 Gulf of Mexico Joint Industry Project (JIP) drilling cruise that has not been depressurized.

Sediment and Pore-Space Constituent Effects on Sediment Acoustic Properties

The USGS is also conducting experiments with GHASTLI on a range of sediments to help isolate the effects on sediment acoustic properties attributed to grain size from those related to hydrate occurrence. Whether hydrate floats in the pore spaces or cements the sediment grains together are end-member conditions that are being tested, as is the additional presence of gas, water, or ice in the pores along with the hydrate. These factors complicate how the measurements are interpreted, but this interpretation is essential for assessing the potential economic value or geologic extent of a hydrate reservoir.

We have performed acoustic wave speed measurements in samples containing hydrate, gas and water to simulate marine-like conditions, or in frozen samples to simulate permafrost-like systems. During these tests, measured Vp values ranged from less than 1.0 km/s in gas-charged silt to 4.0 km/s and 4.33 km/s in hydrate-bearing and frozen sand, respectively. We also evaluated the effect of grain size on acoustic properties of sediment containing gas hydrate. Test results from reconstituted clayey silt indicate that p-wave velocity increased during initial hydrate formation and reached a maximum of 1.97 km/s. This velocity is much lower than Vp obtained from sieved Ottawa sand, where Vp is 3.08 km/s, even though the samples contained comparable amounts of gas hydrate. These results pose a challenge for interpreting field seismic data that lack sample-verified grain-size and hydrate-saturation information.

The Next Challenge: Mimicking the Range of Hydrate-Forming Environments

Laboratory-formed hydrates in GHASTLI are generally formed in the presence of free gas. Under these conditions, hydrate tends to form as cement, surrounding and binding sediment grains together to form a strong, acoustically fast material even with free gas persisting in the sample. Gas-rich environments can be found near active sea-floor seep sites, or at the base of the hydrate stability zone where hydrate overlies free gas (and forms a bottom simulating - BSR - reflection). These free-gas environments are the geological conditions that GHASTLI is most suitable for reproducing.

Another hydrate environment, perhaps the one where most of the known hydrate occurs, is the case of hydrates formed from gas dissolved in seawater. Hydrate growth in these environments may only fill the pores and not form cement between sediment grains. GHASTLI has not yet been able to simulate environments where dissolved methane forms hydrate, but this is a capability currently being explored. Utilizing GHASTLI’s flow-through fluid and gas-handling abilities, hydrate formation effects in different geological settings can be systematically investigated to examine relationships between remotely-sensed properties and pore-space hydrate content.

No one measurement, test condition or sample type will answer all our questions about naturally occurring hydrate. GHASTLI has therefore been designed to measure many different physical properties while maintaining the flexibility to simulate a variety of geologic environments. We continue to work on expanding the measurement capacity (for example, shear-wave speed and electrical resistivity tomography) to provide a more complete understanding of hydrate behavior.

MEASURING GAS HYDRATE DYNAMICS IN SEDIMENTS AT IN SITU CONDITIONS

Devinder Mahajan, Michael Eaton, Harsimran Kaur, Keith Jones, Huan Feng, and Roger Flood. Brookhaven National Laboratory and State University of New York at Stony Brook

Pristine samples recovered from hydrate sites confirm that sediments are an integral part of the subsurface environment in which natural hydrates occur and that the grain size and composition of the constituents of these sediments can vary, even within a specific hydrate site. It would be logical to assume that the "host" sediments and the associated hydrate (the "guest" in a macro sense) would have physical properties that are mutually affected during the hydrate formation process. Field sample analysis supports that assumption; the Mallik 2L-38 well (Mackenzie Delta, Canada) hydrates occur as coarse-grained units (pore-filling) whereas in the near-surface fine grained sediments such as are found in the Gulf of Mexico (GOM), hydrates may occur through cementation. Factors such as cementation phenomena, type of hydrate formation, and hydrate content, among others, will help to determine the ultimate selection of a suitable commercial methane recovery method, so gaining a better understanding of gas hydrate dynamics at in situ conditions is a worthwhile goal.

The focus of our effort is to establish the dynamics of hydrates within host sediments for which the data remain scarce. Below we describe our two-pronged approach: 1) characterization of depleted sediments from various hydrate sites using x-ray Computed Microtomography (CMT) and 2) utilization of the characterized sediments to study hydrate dynamics in a recently commissioned Flexible Integrated Study of Hydrates (FISH) unit.

Characterization of Depleted Sediments Using X-Ray Computed Microtomography (CMT)

Our goal is to establish 3-D morphology, pore-space pathways, porosity, and permeability for both depleted as well as pristine field sediment samples. The synchrotron computed microtomography (CMT) set-up at the X-27A tomography beam line (National Synchrotron Light Source (NSLS), Brookhaven National Laboratory) is being used as to study sediments from various hydrate sites. The high x-ray intensity of the synchrotron x-ray source makes it possible to work with small voxel sizes, 3 µm x 3 µm x 3 µm, to investigate the microstructure of sediments. In the set-up, radiation from a bending magnet at an energy of 14.89 Kev illuminates a sample area about 7 mm in width and about 2 mm high and is detected using a YAG scintillator 0.50 mm in thickness. A series of exposures are made at angles from 0° to 180° in steps of 0.18° with a charge-coupled device (CCD) camera (size: 1335 x 1017 pixels). The data are corrected for overexposed pixels and the images are used to construct a 2-dimensional (2-D) map of the attenuation coefficients for each pixel in a matrix that corresponds to the number of pixels in the horizontal size of the stored CCD pictures. A 3-D volume can then by assembled by stacking the 2-D sections into a 3-D matrix.

The visualization of the 3-D volume obtained from such a tomographic investigation of a depleted sediment sample, recovered from a depth of 667 meters at Blake Ridge, is shown in Figure 1. This is a partial volume cut from the full data set. The pixel size is 0.0067 mm so that the volume shown is 0.67 mm x 0.67 mm x 1.34 mm. We used the 3dma software developed by Lindquist et al. (http://www.ams.sunysb.edu/~lindquis/3dma/3dma_rock/3dma_rock.html) to segment the data into solid and pore space (Figure 2) and obtain sediment porosity and the 2-D correlation function. The 2-D correlation function in itself yields estimates of the porosity, specific surface area, mean particle size, and permeability as reported in literature. More complex 3dma analyses yield non-intersecting pathways through the volume (tortuosity) (Figure 3), pore volumes, permeability and throat sizes.

The measured value of sample micro-porosity using CMT is 55.8% versus the bulk-porosity value of 51.0% obtained from conventional gravimetric methods. The value of the tortuosity found for the sample using the 3dma program was 1.89. Further analysis is now underway to extract other parameters from the CMT data.

The FISH Unit for Hydrate Dynamics Study in Depleted Sediments

Four unique features define the construction of the FISH unit. These are:

- A conveniently exchangeable hydrate-forming pressure vessel for flexibility,
- The confinement of sediments within the hydrate forming vessel,
- A capability for direct observation of hydrate dynamics, and
- Precision data collection instrumentation for reproducibility.

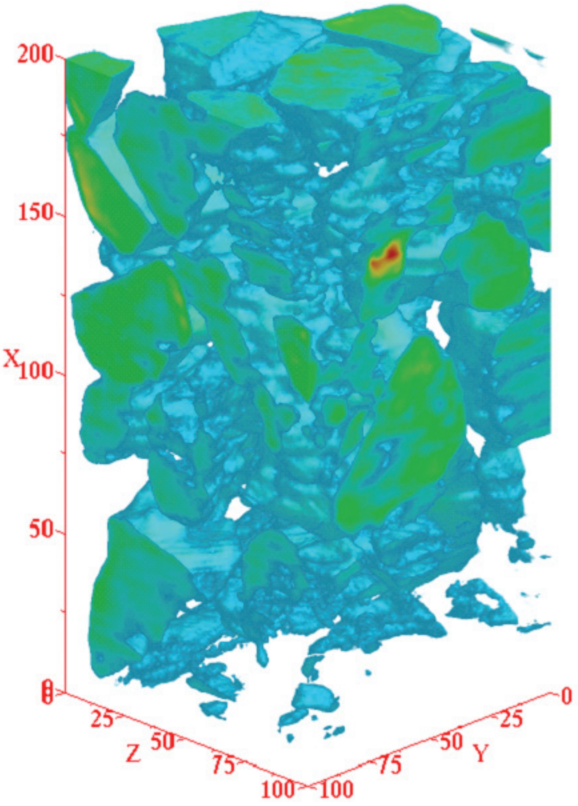


Figure 1. Partial view of the tomographic volume measured for a Blake Ridge sediment. Shown here is the morphology of the sediment on a micrometer scale (pixel size = 0.0067 mm).

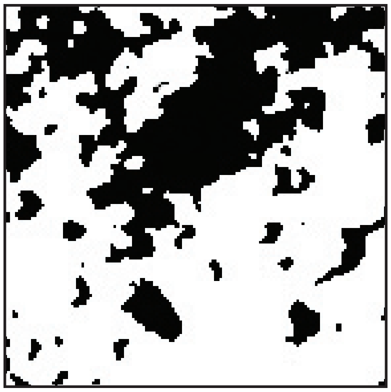


Figure 2. Binary image of a linear slice through a sediment sample (dimensions: 200 x 200 pixels) from Blake Ridge showing solid (black) and pore (white) spaces.

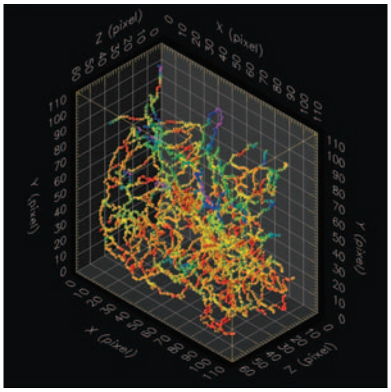


Figure 3. Fluid flow pathways reconstructed from the data in Figures 1 and 2. Colors show width (small: red and large: blue) differences within the pathways.

The main component of the bench-top FISH unit is a 200 mL high-pressure vessel that can be conveniently exchanged with vessels of varying volume and is rated for -20°C to +40°C and 0 to 12 MPa (Figure 4). The vessel has rectangular viewing windows (12"long x 1"wide). Experimental gas and water are brought into contact in the reactor in a countercurrent fashion to help agitate the liquid and clay sediments and achieve a uniform system. Before coming into contact with the sediment and water, the gas passes through a customized sparger of glass wool sandwiched between two 50 m stainless-steel sieves. The sparger's "sandwiched" configuration serves two purposes. First, it reduces or eliminates channeling in the sediment by creating tiny bubbles that travel upwards and continuously mix sediment, gas and water. In this manner, the bubble size is controlled by the gas flow rate, which in turn can be precisely controlled by a needle valve. Second, the sparger that confines sediments within the pressure vessel also acts as a one-way valve to water, eliminating back flow of the water and sediment into the gas lines, averting any potential for plugging. The calibrated needle valve is used to attain lower flow rates (<70ml/min). Trace gases may be injected to determine sediment stability during the cycle of hydrate formation and decomposition if so desired. A built-in sample port allows collection and analysis via gas chromatography of the gases surrounding the hydrate, while the compartmentalized design and other safety features allow for safe operation at higher pressures. Lab View software allows around-the clock collection and analysis of hydrate data.

In nature, gas formation by microbes and subsequent gas percolation through the seafloor occur slowly. This achieves almost 100% conversion of the water/gas to hydrates, but does so over a period of thousands of years. Due to the time scale of laboratory experiments, a compromise between accurate reproduction of in situ conditions and hydrate production data is necessary.

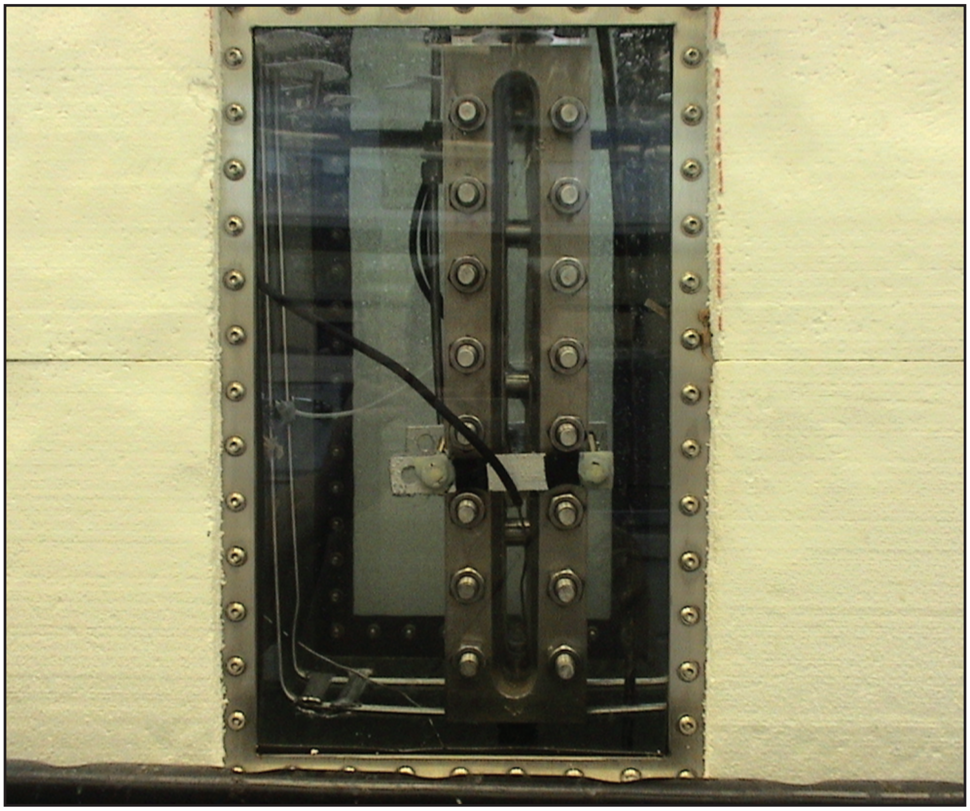


Figure 4. View of the FISH pressure vessel with 12-inch long windows through which formation or decomposition of hydrates is observed.

Our baseline run was designed to investigate the effect of inlet gas flow rate on hydrate formation with a mixture of 20 ml water and 60g sediment that were cooled to 4°C in the hydrate-forming vessel. This formation method contrasts with previously reported laboratory experiments in which hydrates were formed from finely powdered ice, and the temperature was increased to stimulate formation. Because the previous methods do not accurately reflect oceanic conditions, we have chosen to use water rather than ice as the aqueous phase that interacts with methane in the FISH unit.

In our effort to achieve maximum hydrate production with maximum inlet gas flow rate, we observed that at high inlet flow rates (>1000 ml/min), the asymptotic decay suggests very little, if any, hydrate formation due to minimum gas-sediment-water interaction (Figure 5). But the occurrence of another apparent asymptote at low flow rates (< 150 ml/min) represents a physical limit to the amount of hydrate that can form based on the total available volume of water in the system. The latter result suggests that it may be possible to replicate the conditions and hydrate saturation level found in nature, in a laboratory setting, in a much shorter period of time. We are continuing to investigate this phenomenon as well as hydrate dynamics under both gas-rich and gas-lean conditions. Cage occupancy and lattice size analysis are being performed to correlate with hydrate forming method, sediment porosity, and other sediment properties.

The versatility of the FISH unit is allowing us to establish reproducible procedures for studying hydrate dynamics in a natural-mimic setting. Our study now extends to sediment samples that were recently recovered during the DOE-JIP GOM cruise. A correlation of hydrate content at varying depths and hydrate mounds in the vicinity of a specific hydrate site will yield data that will test the limits of laboratory studies and yield correlations that may lead to develop an environmentally-benign commercial method of methane recovery from hydrates.

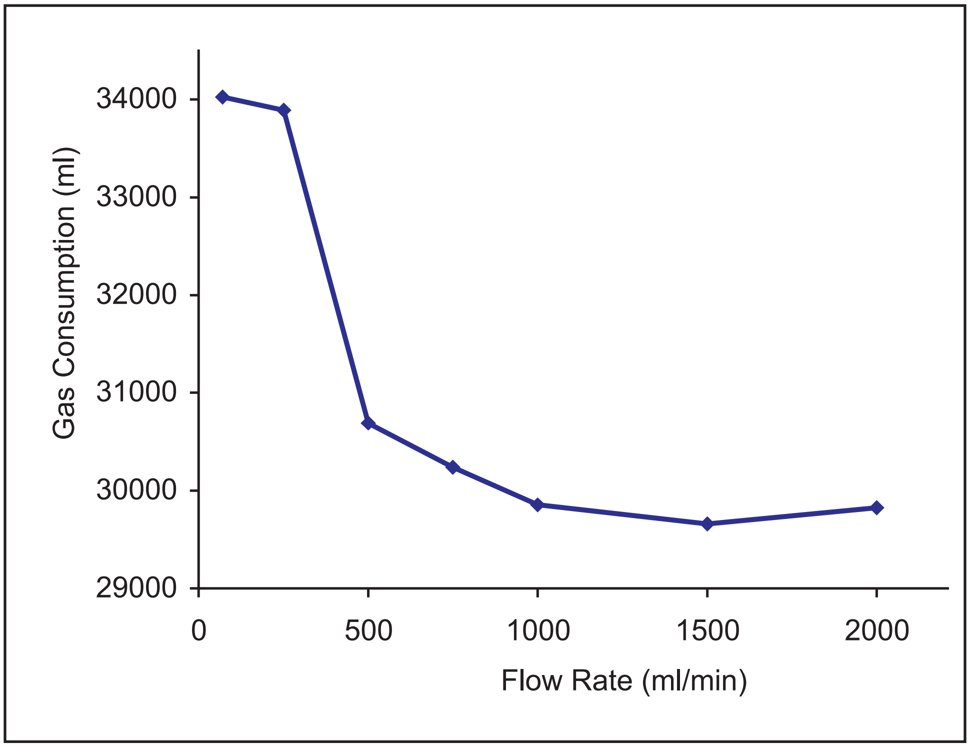


Figure 5. Hydrate gas consumption versus inlet gas flow rate in a depleted sediment (from Blake Ridge)/methane /water system.

ICC Members Named

The Methane Hydrates Research and Development Act of 2000 (as re-authorized in 2005) specifies that representatives of seven federal agencies working in methane hydrates meet twice a year to ensure full coordination of their activities. The membership of the Interagency Coordination Committee (ICC) will be as follows:

James Slutz: Department of Energy-Office of Fossil Energy
Brenda Pierce: U.S. Geological Survey
Robert LaBelle: Minerals Management Service
Bhakta Rath: Naval Research Lab
Richard Spinrad: National Oceanic and Atmospheric Administration
Nick Douglas (Washington DC) and Robert Fisk (Alaska): Bureau of Land Management
Bilal Haq: National Science Foundation

To enable full coordination of technical activities, the ICC will continue to rely upon consultations within a subsidiary Technical Coordination Team, consisting of:

Ray Boswell: Department of Energy - National Energy Technology Lab
Deborah Hutchinson and Tim Collett: U.S. Geological Survey
George Dellagiarino, Roger Amato, Jess Hunt, and Pulak Ray: Minerals Management Service
Joe Gettrust and Rick Coffin: Naval Research Lab
Kimberly Puglise: National Oceanic and Atmospheric Administration
Robert Fisk: Bureau of Land Management
Bilal Haq: National Science Foundation

Deployment Plans Adjusted for Katrina

The Gulf of Mexico Gas Hydrates Research Consortium met in Oxford, Mississippi, November 15-16, with the goal of reestablishing a program of deployments for components of their sea-floor observatory (SFO). The SFO is designed to perform continuous monitoring of gas hydrates on the sea floor and in the shallow sub-bottom. The first components of the sea-floor station, two 10m probes that collect pore fluids and temperature data, were deployed in Mississippi Canyon 118 in May, 2005. Retrieval of the data from these probes and deployment of additional novel technologies had been scheduled for October. However, the infrastructure upon which the deployment vessel and its two manned submersibles depended fell victim to Hurricane Katrina.

As it is presently envisioned, the completed SFO will include systems and sensors that will collect geophysical, geochemical, and microbial data from the sea floor, the sub-sea floor, and the lower water column. Eventually, these data will be communicated, via fiber-optic link, to land where they will be deposited in a databank that will be accessible to interested users.

A tentative series of cruises has been laid out for 2006, beginning in February. Deployments that rely upon the submersibles or remotely operated vehicles will be made as soon as these support vehicles can be scheduled. In the meantime, successfully tested geophysical arrays and sea-floor support systems - including those that will accomplish data collecting and retrieval/transmission - will be deployed. Additional components will be linked to the data-collecting network as soon as they are proven at the 900m water depth of the station site. In addition, the Center for Marine Resources and Environmental Technology, administrators of the Consortium, will conduct a very high resolution 2-D seismic survey in MC118. Completion of the station is planned for 2007.

Workshop on Gas Hydrates in Fine-Grained Sediments

Mature polygonal fault systems are familiar to the hydrocarbon industry because they provide the fracture porosity which hosts accumulations of oil and gas in shale sequences. These systems are named for the polygonal patterns the fault traces describe on horizontal slices of 3-D seismic data volumes. It is the multiplicity of trace intersections that allows fluids to migrate through formations that otherwise would be impermeable. Immature polygonal faulting is initiated near the sea floor in fine-grained sediments prior to consolidation. Features observed on very-high-resolution 2-D seismic profiles suggest that immature polygonal systems might be present on portions of the continental slope in the northern Gulf of Mexico. Since conditions there are favorable to the formation of hydrates, and since natural gas commonly occurs there, it is possible that natural gas hydrates can form within such immature systems.

A workshop to consider this possibility was organized in July, 2005, by the Center of Marine Resources and Environmental Technology of the University of Mississippi. It was funded by the Minerals Management Service of the U.S. Department of the Interior and was held near Victoria, British Columbia, at Dunsmuir Lodge, a conference venue operated by the University of Victoria. An international group of about 30 researchers participated. The disciplines represented included bioengineering, microbiology, geochemistry, geology and geophysics. Workshop topics focused on how marine gels in the water column become fine-grained deposits on the sea floor, how immature polygonal fault systems develop in those deposits and how gas hydrates form in faults. Most presentations and discussions were recorded on video tape. Presentation figures and graphics are being combined with the recordings to document the proceedings.

NETL Searching to Fill Geological and Environmental Sciences Research Position

NETL is currently recruiting for a scientist or engineer with an international reputation for scientific excellence and leadership. This senior-level position within OSER will lead the Focus Area for Geological and Environmental Sciences (GES). The incumbent will lead scientific and applied research in geological, chemical, microbiological, and engineering processes important to the extraction, production, and utilization of fossil energy resources. R&D performed by the GES Focus Area includes work on the improved exploration and production (E&P) of natural gas and oil from unconventional domestic resources including, for example, natural gas from tight gas and methane hydrate formations, oil shale and oil/tar sands, and geological sequestration of carbon dioxide and other greenhouse gases.

The salary range for this position is $107,550 to $140,300, with excellent benefits and flexible work schedules. Pay will be set within this range based on experience, and the position may be located in either Morgantown, WV or Pittsburgh, PA. For information about qualification requirements and procedures for applying, contact Scott Sigley at (304) 285-4470, or visit the career opportunities page on the NETL website at www.netl.doe.gov. U.S. citizenship is required for all Federal positions.

GAS HYDRATES KEEPS THIS ENGINEER FIRED UP

SHIRISH L. PATIL

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An active member of the local chapter of the Society of Petroleum Engineers, Shirish enjoys giving lectures to high school students and members of the community about conventional and unconventional fossil fuel resource potential in Alaska.

Outside of research, Shirish also enjoys serving his academic community and is President-Elect of the UAF Faculty Senate and a member of the University of Alaska Statewide Faculty Alliance.

As a petroleum engineer, Shirish Patil's interest in hydrocarbons is generally focused on figuring out ways to get them out of the ground so they can be put to practical use. His current research efforts related to gas hydrates follow that same path: reservoir modeling studies and economic assessments focused on the practicality of producing gas hydrates in Alaska. While Alaska's opportunities in conventional oil and gas production helped lure Shirish from his hometown of Pune, India to Fairbanks, it is his enthusiasm for advancing gas hydrate production technology from the laboratory to the field that helps to keep him there. And this is no mean feat … the average December temperature in Pune, in west-central India, is a balmy 70 °F compared to –7 °F for Fairbanks!

While studying Mechanical Engineering at the University of Pittsburgh, one summer Shirish had an opportunity to work for Dr. Gerald Holder, a leading authority on gas hydrates, who first tweaked his interest in fossil fuels. Later, at the University of Alaska Fairbanks (UAF) pursuing his graduate degree in Petroleum Engineering, Shirish met several other individuals who were conducting research in gas hydrates whose enthusiasm encouraged him to work in the same area. "After arriving in Fairbanks, I learned the resource potential for gas hydrates in Alaska. The shear size of this resource and the challenges surrounding its potential as a source of energy got me excited about research," says Patil. In 1987, he joined UAF's Petroleum Development Laboratory to set up an oil and gas research program. Early in his career, Patil credits Dr. Timothy Collett and Dr. V. Kamath with inspiring him to become a successful researcher, while in the last 5 years, it has been Robert Hunter, Tim Collett, Scott Digert, and Scott Wilson, who have helped him the most.

At UAF, Shirish has conducted a variety of gas hydrate studies, on topics ranging from thermodynamic behavior to production techniques (experimental and modeling) to drilling hazard prevention. He considers his most significant contributions to be those related to the ongoing BP Alaska Gas Hydrate Project, which include reservoir modeling studies, relative permeability experimental studies, formation damage assessment, and economic analyses. "This applied engineering research has allowed me to interact with E&P industry professionals as we look at the real life challenges in moving technology from the laboratory to the field," says Shirish. "Several challenges remain to be answered, however I am convinced that this research will lead us to advance gas hydrates production technology in Alaska and elsewhere."

Working with graduate students and playing a role in preparing the technologists who will advance hydrate technology to the next level is also satisfying to Shirish. In addition, he sees methane hydrate research as making a significant contribution towards one of the University of Alaska's primary missions: workforce and economic development. "I believe the Malik Consortium has demonstrated that production of natural gas from gas hydrates is technically feasible. Alaska's North Slope has a massive infrastructure in place and significant portions of the onshore gas hydrate resource, as much as 100 tcf, are underneath or near this infrastructure. I firmly believe the first commercial production of gas from gas hydrates will occur in Alaska and that while it is likely to be more of a synergistic type of production, potentially adding value to oil production, it will help support resource development and eventually lead to stand-alone gas hydrate development."

Shirish believes that moving hydrate production technology to the next level will require field data acquisition from a dedicated Alaska North Slope stratigraphic test followed by the demonstration of successful, long-term production testing of various potential technologies. "Data acquisition and production testing would not only answer many questions but would provide access to valuable subsurface data to help validate reservoir modeling and laboratory experiments," he adds.