MMS OCEAN SCIENCE

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MAY/JUNE 2005

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Then...

Now

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MMS OCEAN SCIENCE is published bi-monthly by the Minerals Management Service to communicate recent ocean science and technological information and issues of interest related to offshore mineral recovery, ocean stewardship, and mineral revenues.

Please address all questions, comments, suggestions, and changes of address to:

Mary Boatman
MMS OCEAN SCIENCE Editor
Minerals Management Service
1201 Elmwood Park Boulevard
New Orleans, LA 70123

mary.boatman@mms.gov

(504) 736-2781

ABOUT THE COVER

Top: Crewboat approaching oil drilling platform and tender (1948). Photo courtesy of Mr. Roy Smith.

Bottom: The Mobile Offshore Drilling Unit (MODU) *Ocean America,* built in 1988. Photo courtesy of Diamond Offshore.

All photos courtesy of Minerals Management Service unless otherwise noted.

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NEW & OLD

The *Deepwater Pathfinder*. Photo courtesy of Transocean.

The first platform installed out of sight of land in 1947 by Kerr-McGee. The platform operated for 37 years and produced 1.4 million barrels of oil and 307 million cubic feet of natural gas.

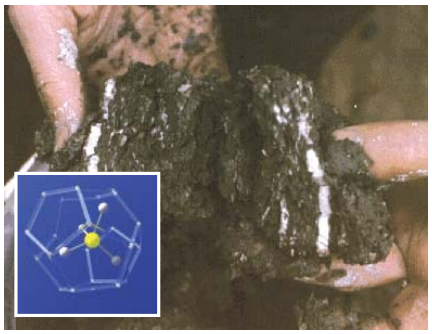
ENERGY FRONTIERS

What is now an industry that generated $8 billion in oil and gas royalties for the U.S. in 2004 alone had its beginnings in 1896 off a pier in California, when H.L. Williams built a wharf that extended about 300 feet into the ocean and erected a drilling rig. Offshore drilling began over 50 years later when Kerr-McGee completed the first offshore well from a fixed platform out of sight of land in the Gulf of Mexico (GOM). Then, in 1953, the framework of the modern offshore drilling industry was formed when the Outer Continental Shelf (OCS) Lands Act assigned leasing and regulation responsibility for offshore energy and mineral resources to the Department of the Interior and ultimately to the Minerals Management Service (MMS).

Although the first offshore discovery wells were erected in the GOM, fields in other offshore areas followed. The first Pacific offshore drilling and production platform was erected five years later, in 1958, followed by the first Alaskan Prudhoe Bay discovery in 1967.

As oil demand has increased, production and exploration on the OCS have gone higher and deeper. The record for production was set in 1998 in the Ursa field in the GOM, and in 2000 the world record for deepwater drilling from an anchored rig in the GOM was set at 7,790 feet. But, as with all records, these were meant to be broken. New records include a GOM gas flow record from Shell's Mensa well at 143 million cubic feet per day and a world water depth drilling record at 10,011 feet of water from the drillship *Discoverer Deep Seas*.

Today, there are more than 4,000 oil and gas production platforms in the GOM and off the coasts of Alaska and California providing 23% of the natural gas and 30% of oil produced domestically in the United States. The U.S. continues to import two-thirds of its energy needs. Research sponsored by MMS and its academic and industry partners is seeking to discover new and alternative energy resources, such as gas hydrates, to offset our Nation's reliance on foreign oil and gas supplies. As history proves, new resources, methods, and discoveries will be found and new records broken as we explore new and old frontiers.



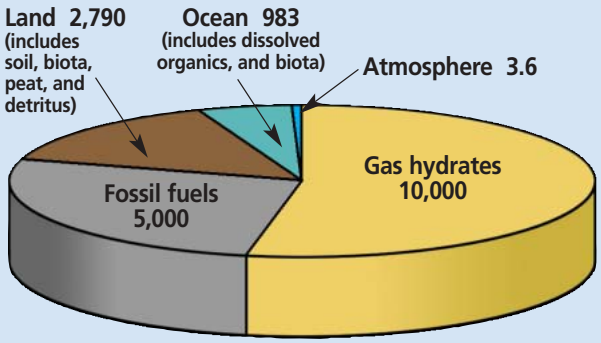
Above: White band of hydrate in the sediment. Inset: Model of methane molecule with a 'cage' of water molecules surrounding it. Photo and diagram courtesy of the U.S. Geological Survey.

Potential Energy Resource – Assessing Gas Hydrate Reserves

Gas hydrates represent a vast potential energy resource for the United States. In fact, it is estimated that the amount of gas hydrates available worldwide is more than the amount of conventional carbon resources known today. Because of the probability that large-scale production of gas hydrates will be developed within the next 10 to 20 years, the Minerals Management Service (MMS), in its role as manager of the Nation's offshore mineral resources, has undertaken an assessment of the extent of the gas hydrate resource available in the United States.

Gas hydrates look and act like ice, but they are crystalline solids that consist of gas molecules, usually methane, surrounded by water molecules. Because the molecules are so densely packed, they can store large quantities of methane. Much less is known about the birth of hydrates than is known about conventional gas origins, making any method of assessment a challenge.

"The formation of gas hydrate accumulations," says Pulak K. Ray, Chief Geologist with MMS, "is geologically much different than that of conventional oil and gas deposits and perhaps more akin to the formation of sedimentary ore deposits or hydrothermal deposits."



Distribution of methane gas on the earth's surface. Numbers are in gigatons (1015 tons) of carbon.

Because of this difference, MMS has "adopted a methodology (currently being refined) that is a simplification of the size/number model at the core of the 'prospect-counting' play analysis approach, with a change in the emphasis on volumetrics," says Ray.

The identification of the amount of gas hydrate reserves in the Gulf of Mexico, as well as in Alaska, represents a step toward the large-scale development of this potentially important energy source. With more knowledge about the scope of those reserves, MMS will be better able to determine fair market value for the resources, ensuring that the development of our natural resources will be profitable for all.

NATIONAL SCIENCE TEACHERS ASSOCIATION
THE HEART OF SCIENCE

Each year, members of the National Science Teachers Association (NSTA) assemble to attend workshops, discuss current research data, and meet with colleagues to talk about classroom activities that motivate children to learn science. This year, the NSTA met in Dallas with the theme "Deep in the Heart of Science." Over 12,000 teachers from all 50 states and some 20 countries attended, making it the largest gathering of science educators in the world.

Minerals Management Service (MMS) representatives have been attending the annual conference for 10 years, telling the teachers about ocean science, distributing energy education material, and encouraging teachers and students to visit the Kids Page portion of mms.gov.

This year, MMS played on the NSTA theme at the MMS display booth by proclaiming to be "Deep in the Heart of Ocean Science" – and the teachers loved it.

Dr. Fred Pilz, MMS Pacific Regional Office, explains the MMS posters to teachers attending the Dallas conference.

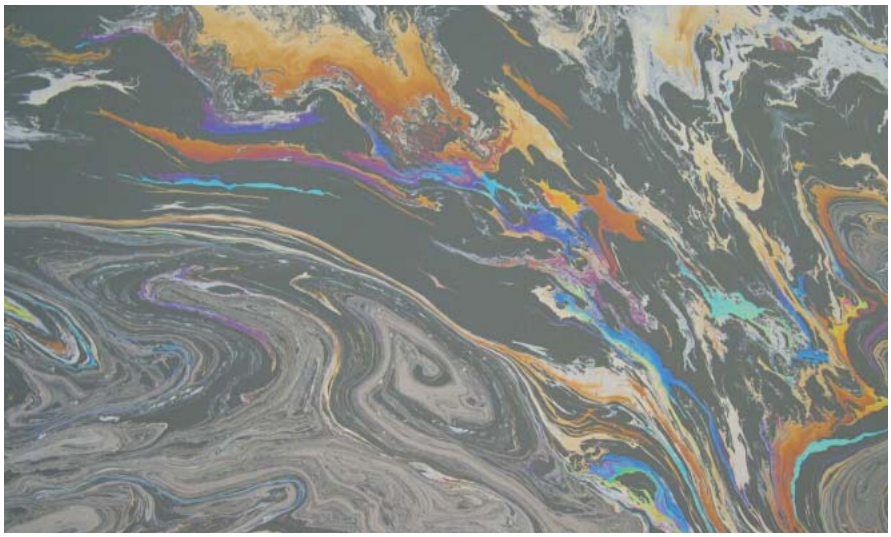
The NSTA conference has, and continues to be, an excellent venue for MMS to educate the American people about the MMS energy mission, our trust responsibilities, and monies we collect and distribute. The teachers were impressed when they learned that MMS oversees the safe and clean production of over one-third of the Nation's energy and has collected some $150 billion over the past 22 years.

At the Dallas convention, MMS released "The New DOI: Our Ocean Role" poster designed by the MMS Environmental Division. The poster was well received as teachers were eager to learn that MMS oversees some 300 million acres of onshore land, but were surprised to learn about the Federal lands located on the Outer Continental Shelf. The fact is that most folks think of parks and land management and not about 1.76 billion acres that are under water.

The Gulf of Mexico Regional Office's new "Shipwrecks of the Gulf of Mexico" poster was also a big hit, as were other MMS educational materials, such as "Tidepool Math," the Drilling for Oil game, "Ocean Energy," and a new 12-page catalog of all the MMS educational materials.

FINGERPRINTING SEEPS IN THE SANTA MARIA BASIN

NATURAL SEEPS SAMPLED



Left: Rainbow sheen evidence of natural seeps.
Below center: Tar sample recovered by ROV.

Geologists estimate that over a hundred barrels of oil seeps out of natural cracks in the seafloor every day offshore California as it has for thousands of years. These seeps are common along the coast of California, notably in the Santa Barbara Channel near Coal Oil Point. As part of the Minerals Management Service's (MMS) Environmental Studies Program, MMS has partnered with U.S. Geological Survey (USGS) and the County of Santa Barbara to locate and fingerprint seeps found in the western Santa Barbara Channel and southern Santa Maria Basin.

Active tar seeps have been located using "sniffer" surveys (surveys that detect the presence of oil or gas in the water column) so that scientists can collect samples of tar directly from seeps on the ocean floor. Tarballs are also being collected systematically on nearby beaches, and oil samples are being taken from offshore production platforms as a part of the study.

These samples are being fingerprinted using a new biomarker procedure developed by USGS. The procedure allows chemists to group oil samples and predict more accurately the origin of a sample of oil from this region. Previous chemical techniques could not adequately distinguish between the closely related Monterey Formation oils.

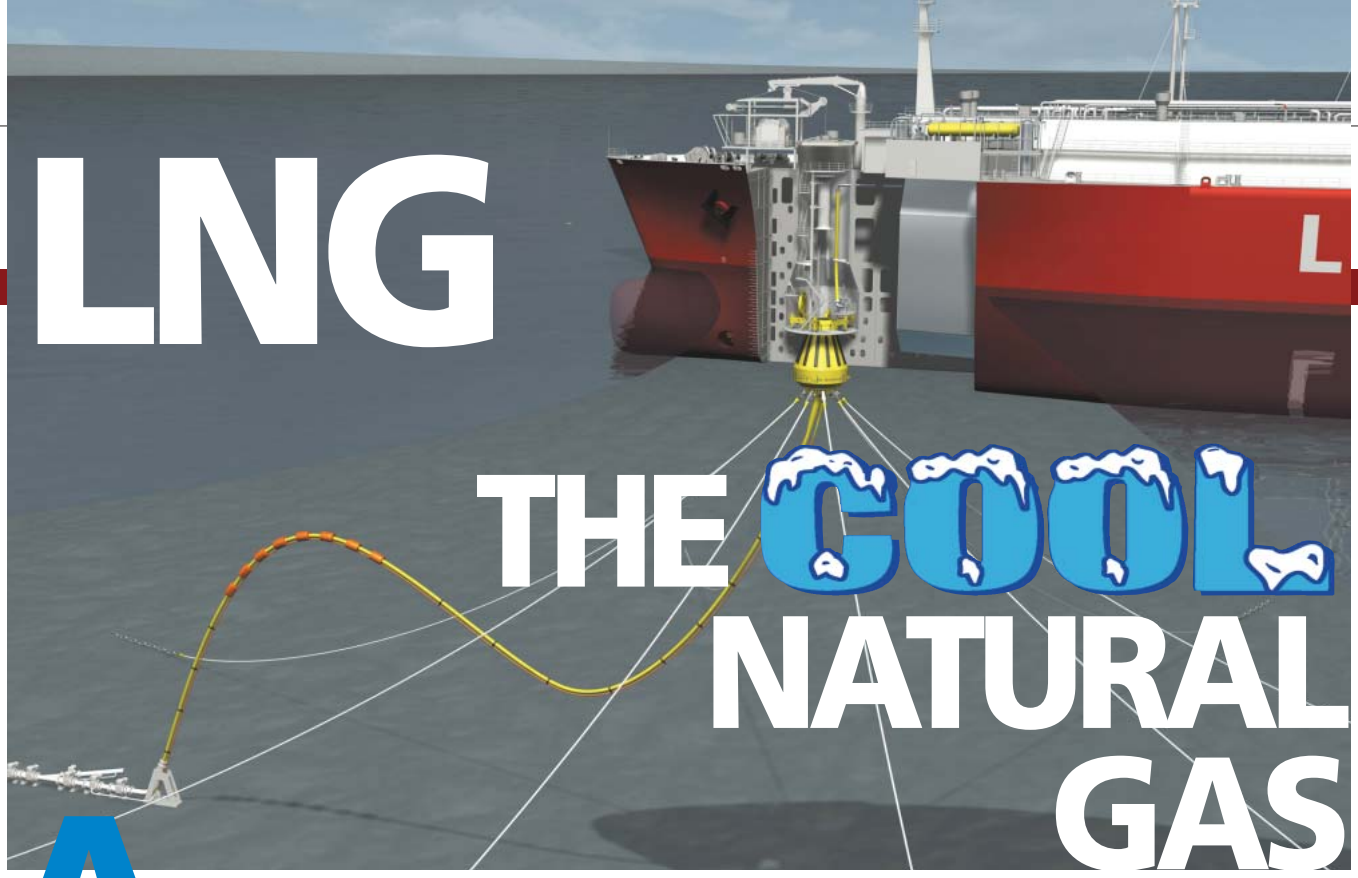
The Monterey Formation rock is known as a "glassy" chert, known for its tendency to shatter like glass. Geological processes cause it to shatter, forming cracks that may lead to the surface. Oil changes as it travels up these cracks from deep oil reservoirs to the surface; it is these changes that allow chemists to differentiate between naturally seeping oil and produced oil. One product of the study will be a joint fingerprinting library, which will be used by scientists to determine the origin of an oil spill, whether from a natural seep or a man-made source.

Hundreds of oil samples and tarballs are chemically analyzed and grouped on the basis of biomarker ratio similarities. Values of the ratios are represented by degree of color on a blue to red scale and statistically grouped into one of eight groups.

On the October 2004 offshore field survey, seeps in three parts of the Channel were sampled and found to be surprisingly different. Numerous natural seeps were discovered on the ocean floor near Point Conception; these seeps are characterized by heavy tar and no gas. Tar seeps in this area form hardened "cones," which are colonized at the base by anemones and other invertebrates. These cones are often associated with long ribbons of "fresh" tar 10-15 feet long, which break off and float to the ocean surface.

chert (chûrt) n. *A very fine-grained rock formed in ancient ocean sediments. It often has a semi-glassy finish and is usually white, pinkish, brown, gray, or blue-gray in color.*

Tar "whip" discovered offshore Point Conception.



LNG THE COOL NATURAL GAS

Excelerate Energy's *Gulf Gateways* Energy Bridge buoy compartment. Photo courtesy of Excelerate Energy.

According to the U.S. Energy Information Administration (EIA), the U.S. could face a shortfall in supply of natural gas of about 5 trillion cubic feet (Tcf) by 2020. Gas supplies to meet that demand can be brought in from Canada, the Gulf of Mexico, and Alaska through existing pipelines, but how does one import natural gas from countries where there are no connecting pipelines? The answer may be liquefied natural gas (LNG). In fact, the National Petroleum Council estimates that, by the year 2025, as much as 25 percent of all U.S. natural gas supplies will come from LNG.

LNG has been produced and used by some countries for decades. Japan, currently the leading LNG importer with 48 percent of the world's annual usage, acquires LNG from the Kenai, Alaska, terminal, which was constructed in 1969. When the cost of processing LNG became too costly, some LNG receiving facilities in the U.S. fell into disuse in the 1970's. However, with the current rising demand and decreasing supply of natural gas in its original form, countries and energy companies are taking a second look at LNG.

Of the four LNG import terminals in the continental U.S., three were formerly closed because of lack of demand for LNG and the high costs associated with liquefying, transporting, and regasifying it. All four of those facilities are open again and the downturn suffered by LNG facilities in the 1970's and 1980's is over, as LNG imports to the U.S. from 1995 to 2001 increased by more than 13 times.

LNG is natural gas that has been cooled or "frozen" through a cryogenic process into a liquid. It can then be pumped into insulated tanks for transportation by railcars, trucks, or ships. When the LNG reaches its destination, it is stored in a cryogenic storage tank that has a stainless steel inner core and a steel or aluminum outer tank. The LNG can also be taken directly to a regasification unit. These units use seawater or air to reheat the LNG until it reverts to gaseous natural gas.

Currently, the most common use for LNG is "peak-shaving" for local power and gas companies. Peak-shaving occurs

Energy Bridge: World's First Deepwater Liquefied Natural Gas Port

Liquefied natural gas (LNG) is typically transported by a tanker built specifically for that use. Each new 3 billion cubic foot (Bcf) capacity tanker costs about $260 million. The LNG cargo is cooled by using a small part of the cargo, or boiloff (0.15 to 0.25 percent per day), and burning it as boiler fuel. Once the tanker arrives at its destination, the LNG is regasified on the ship and the gas is transferred to existing pipelines on the seafloor.

The first of these facilities has been developed by Excelerate Energy. Excelerate Energy's *Gulf Gateway* Energy Bridge is the world's first deepwater LNG port to commence operations. The terminal, which is located 116 miles off the coast of Louisiana in 298 feet of water, will deliver about 500 million cubic feet of natural gas per day of regasified LNG into the pipeline grid via the Sea Robin and Blue Water subsea systems.

The United States imported LNG from several countries in 2003: Trinidad and Tobago, 378.07 Bcf; Algeria, 53.42 Bcf; Nigeria, 50.07 Bcf; Qatar, 13.62 Bcf; and Oman, 8.63 Bcf.

when gas demand spikes (for instance, during the winter heating or summer air conditioning season) and cannot be met through the utility's typical pipeline source. Stored LNG can be converted from its liquefied state back to its gaseous state to supplement the utility's pipeline supplies.

LNG's use is not limited to cities that have access to offshore or coastal receiving terminals via pipeline. More remote areas of the U.S. without pipeline access can use LNG as back-up fuel for peak-use days by transporting it by truck and storing it for those occasions. While propane currently serves this purpose in many cities, LNG is safer and does not require blending with the pipeline stream like propane. Another possible niche use for LNG is a trailer-mounted regasification unit that can meet demand in emergencies or other special situations.

New technologies make locating new receiving terminals offshore an attractive option, since offshore terminals can avoid some higher costs associated with coastal terminals. One method for processing and delivering LNG from an offshore terminal is regasifying LNG onsite and distributing it through a major company's existing offshore and coastal pipelines. Another method is to receive the LNG at the offshore terminal, load it on a tanker with regasifying capabilities, and then discharge the now-regasified product to an undersea pipeline.

The Minerals Management Service (MMS) is partnering with the U.S. Coast Guard, the lead agency, in reviewing the impacts from placement of offshore LNG facilities. Pipelines used to transport the gas are permitted and inspected by MMS. Through oversight and partnership, MMS will continue to ensure that LNG is not just a "cool", but a safe energy source.

For more information:

MMS Map and Information on Proposed Offshore Receiving Terminals in GOM

Website: www.gomr.mms.gov/homepg/offshore/LNG/lng_index.html

Energy Information Administration (EIA) Analysis of LNG

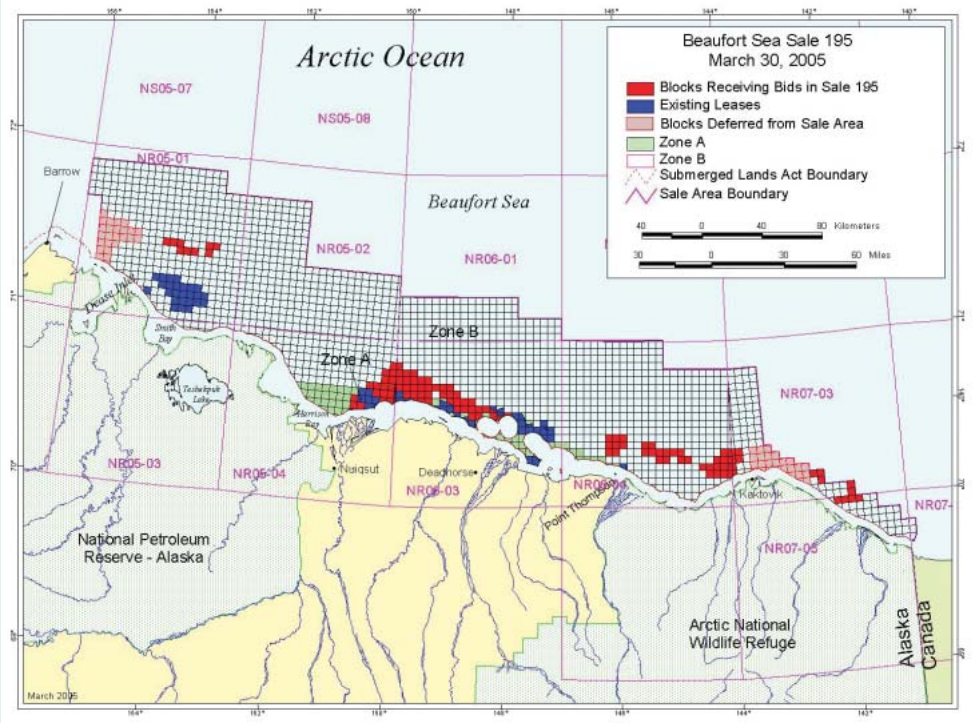
Website: www.eia.doe.gov/oiaf/servicerpt/natgas/chapter3.html

An Examination of the Development of Liquefied Natural Gas Facilities on the Gulf of Mexico

Website: www.gomr.mms.gov/homepg/regulate/environ/ongoing_studies/gm/GM-92-42-112.html

Beaufort Sea Lease Sale Brings Unexpected Success

The Minerals Management Service (MMS) Beaufort Sea Sale 195 was highly successful. On March 30, MMS's Alaska office received $46,735,081 in high bids on 121 blocks, covering about 619,000 acres. This was the largest number of bids and money exposed at any Alaska Outer Continental Shelf (OCS) sale since 1988. The big surprise of the sale was that Shell Offshore returned to Alaska in a big way, with 86 bids for over $44 million. Armstrong Alaska picked up 21 blocks, ConocoPhillips 12, and North American Civil Recoveries Arbitrage (NACRA) 2. The sale high bid, by Shell, was $12,220,173 on a Hammerhead Prospect block. Companies were reminded of the requirement of coordinating all activity with the subsistence whaling communities, if activities might affect the annual bowhead whale hunt. The sale area was contiguous to that offered by the State of Alaska in its recent Beaufort Sea sale. All high bids are now under fair market value review to decide bid acceptance.



NORTH TO ALASKA

THE ICY ROAD TO EXPLORATION

Satellite photo of Alaska and adjacent seas.

An arctic, ice-dominated environment, like that in the Beaufort Sea on the northern coast of Alaska, imposes very different technological challenges from those faced in other Outer Continental Shelf (OCS) regions. The arctic presents formidable challenges, such as remote locations, fragile landscapes and wildlife, and extreme temperatures (sometimes 60˚F below zero) that affect both human and machine. Innovative solutions to these problems include using what the arctic has plenty of – ice!

The solid ice season usually occurs from November through April. Ice roads are generally used for access during this period. Since the early 1970's, oil companies have been using ice roads to support exploratory drilling in Alaska. Construction of ice roads, ice islands, and ice airstrips is standard practice for modern Alaskan arctic oil exploration projects. Typically, construction begins during December, the well is drilled during February and March, and the rig is demobilized during April. The ice melts during breakup, leaving virtually no trace of the exploration project.

Tanker spraying water to build up ice surface.

Ice roads are constructed by harvesting available ice and snow from lakes to form a road base, and then using tankers to spray water to build up ice surfaces. Ice islands are often used to support drilling and/or production facilities. Ice islands are created by pumping seawater onto the frozen sea ice sheet. The water freezes in layers until the ice is grounded onto the seafloor or is thick enough to accommodate the weight of a drilling rig and equipment. About 1-1.5 million gallons of water are required to build a mile of road 6 inches thick and 40 feet wide, while an ice island will need 2-3.5 million gallons.

Mars Spray Ice Island. Offshore Alaska.

In addition to ice roads and islands, other innovative steps are being explored to decrease the impact of drilling and exploration activities on the landscape and animal population. In especially sensitive areas, directional drilling is being explored. The drilling site can be located in a less sensitive site and drilling angled to explore under the sensitive site with no adverse effect. The same techniques can be used to drill many wells from a single site, thus reducing the potential disturbance of the landscape. New technologies are also being used to monitor wellheads remotely and muffle equipment to reduce the contact between human and animal for the protection of each.

One of the most important challenges in the arctic is the restoration and remediation of the landscape of the drilling site after the well is abandoned. Ice pads and roads reduce the need for restoration by reducing the amount of damage to the tundra. Steps are taken to ensure the site is returned as closely as possible to its condition before drilling. If needed, the site is recontoured and revegetated to meet State and Federal requirements, so that all evidence of human presence is removed.

As we move farther into the arctic wilderness and deeper into the ocean, the Minerals Management Service and industry are working hard to find new and innovative ways to protect those environments while developing the natural resources that lie beneath them. This is one instance where icy roads aren't considered dangerous, but welcome.

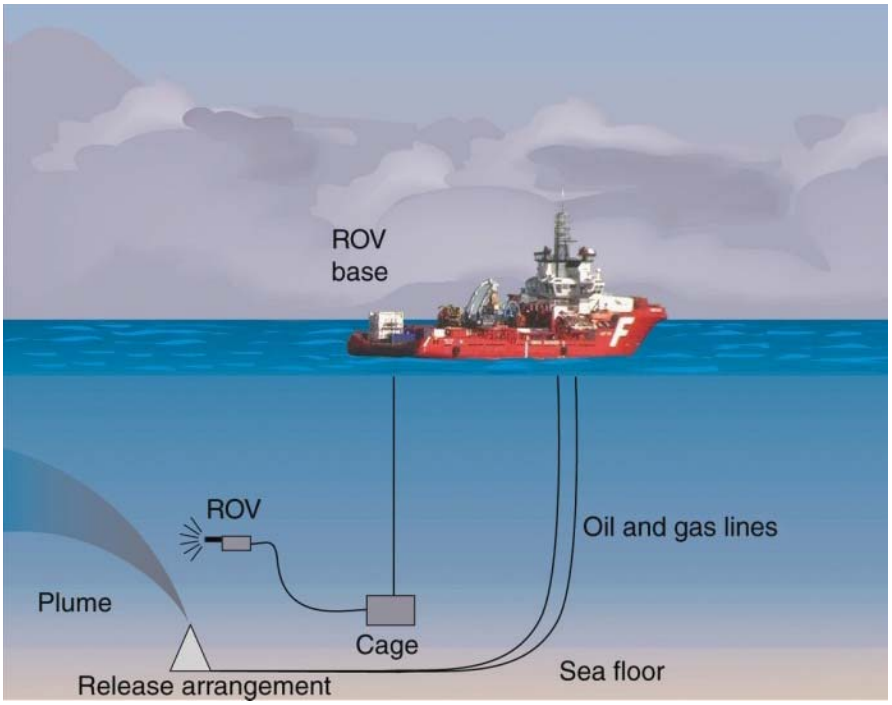
PROMOTING RAPID RESPONSE

In June 2000, the Minerals Management Service (MMS), 23 oil companies with holdings in deepwater, and the Norwegian government worked together to conduct a Joint Industry Project known as Deep Spill. Deep Spill is a model of cooperation between Government and industry in conducting needed research to address operational issues in deepwater. This project increased our understanding of how potential oil spills from deepwater wells and pipelines may behave in the ocean environment.

Collecting data from under the sea and above the release site by using various vessels, aircraft and airborne imaging technology, scientists carefully studied controlled releases of oil and gas into the sea. There were four controlled releases of oil and gas over a three-day period off the coast of Norway from a depth of 844 meters. This experiment helped establish the most effective response plan in the event of an oil or gas blowout in deepwater.

Past experiments have shown that oil and gas behave differently under the high pressures and low temperatures found in deepwater when compared with those of shallower depths. These experiments provided baseline data to validate and improve existing oil-spill models that will be used to guide cleanup efforts in the event of an accidental release during actual drilling and production operations. These models are part of the oil-spill contingency plans submitted by industry to MMS for approval prior to the commencement of drilling.

Dr. Mary Boatman of the U.S. Minerals Management Service and Dr. Cortis Cooper of Chevron stand in the foreground, observing the Project Deep Spill oil release through the use of an echo sounder onboard one of the research vessels off Norway.



Layout of the ROV arrangement operating on the seafloor. The oil and gas were pumped through different lines, made of coiled steel tubing, from *Far Grip* and down to the release arrangement on the seafloor.

"The experiments all went successfully and according to our careful planning, in spite of losing a day or so to bad weather," said Chevron's Senior Staff Scientist Cortis Cooper, leader of the Joint Industry Project.

In a final report, E. Eric Adams, Senior Research Editor, Department of Civil and Environmental Engineering, MIT, noted that "Deep Spill experiments show that some of the oil surfaces more rapidly than expected based on the individual rise velocity of the fastest rising (largest) oil droplets, suggesting some group or secondary plume effects. The greater than expected rise velocity means that the oil will surface closer to the release point, making calculations based on the rise velocity conservative."

Adams also concluded that operating machinery directly above a spill may indeed be safe. "Echo sounders [prove] efficient at tracking oil and gas releases in the field and showed that the gas was completely dissolved before it could surface."

This project allows for a better understanding of potential spill behavior from deepwater oil and gas operations and will ensure that these spills are handled efficiently and rapidly.

FOR MORE INFORMATION:

Project "Deep Spill"

Website: www.mms.gov/tarprojects/377.htm

Experimental and Analytical Study of Multi-phase Plumes in a Stratified Ocean with Application to Deep Ocean Spills

Website: www.mms.gov/tarprojects/324.htm

DEEP GAS COULD EASE NATURAL GAS PRICE SPIKES

OUR NATION'S ENERGY FUTURE

Gas prices have sharply increased in the past two winters because of an increased demand and a diminishing supply. Those feeling the pinch of high gas bills can appreciate Minerals Management Service's (MMS) idea of providing an incentive for energy companies to increase the supply of natural gas in the near future. Approximately 56 million U.S. homes are heated with natural gas, and the vast majority of new power plants built in the next decade will use natural gas. Deep gas from an old frontier, existing shallow-water leases in the Gulf of Mexico (GOM), can help meet the energy needs of the Nation.

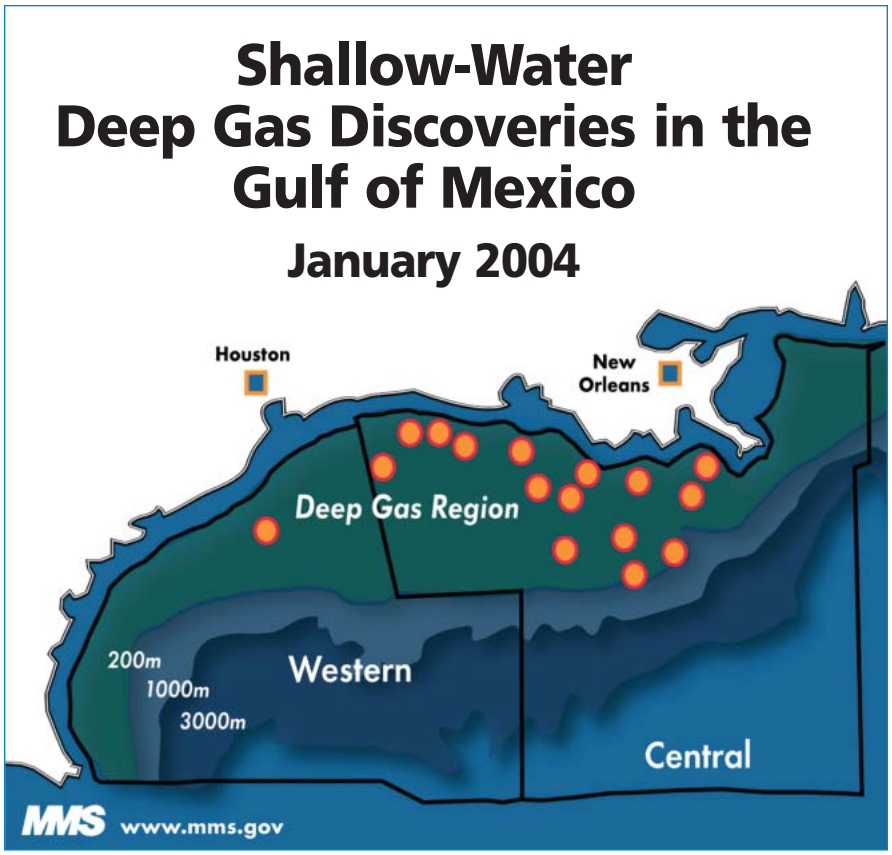
The MMS defines deep gas wells as those drilled to at least 15,000 feet true vertical depth below mean sea level in shallow water (less than 600 feet water depth) on the Outer Continental Shelf (OCS). For years, shallow water has been the "workhorse" of the Gulf, accounting for the bulk of oil and gas production. But production has declined every year since 1996. Relatively few wells, however, have explored depths below 15,000 feet. According to MMS research, up to 55 trillion cubic feet (Tcf) of undiscovered gas resources may underlie the untapped deep reaches of the shallow waters of the GOM. In fact, 10 Tcf of gas has already been discovered in exploration deeper than 15,000 feet.

The high cost of drilling deep gas (up to $50 million for a 20,000-foot well) and the risk associated with its exploration (one in four chance of success) has discouraged interest from energy companies. Finding the gas at such depths with extremely high temperature and pressure transitions is also an issue that has hindered exploration.

To provide an incentive to promote the exploration of shallow water despite the risks, MMS instituted its Deep Gas Initiative in January 2004 to provide substantial royalty relief for companies who gamble by exploring and developing deep gas wells in areas they currently lease. Regarding recent high natural gas prices, Interior Secretary Gale Norton stated, "We need to respond by encouraging production of deep gas resources that otherwise are financially risky for companies to explore and develop."

Not only will drilling deep gas in shallow water add to the Nation's gas resources, but MMS estimates that the drilling and production upgrades necessary for deep gas exploration could add 20,000 new jobs to the economy for the next six years.

By encouraging drilling of deep gas wells in already leased areas, MMS is ensuring that the natural resources in their care are used for maximum benefit and that our public lands (and waters) can provide energy sources for generations to come.



FOR MORE INFORMATION:

Deep Gas

Website: www.gomr.mms.gov/homepg/offshore/deepgas.html

Royalty Relief

Website: www.gomr.mms.gov/homepg/offshore/royrelef.html

Information for Consumers

Website: www.eia.doe.gov/oil_gas/natural_gas/analysis_publications/natbro/gasprices.htm

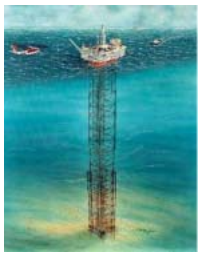
PETRONIUS WEATHERS THE STORM

MMS CHECKS IT OUT

A compliant tower platform, much like a fixed platform, is bottom founded, but allows for greater flexibility than a conventional fixed platform. This flexibility allows the compliant platform to flex when a force, such as a wave, current, or wind, is applied, which reduces the forces acting on the platform and foundation. Chevron's *Petronius* compliant tower platform is located in roughly 1,754 feet of water in the Central Gulf of Mexico, approximately 150 miles from downtown New Orleans.

On September 15, 2004, Hurricane Ivan passed about 25 miles to the west of *Petronius,* introducing the platform to enormous environmental loadings. The wave height was in excess of 90 feet for that location. Ivan delivered a wave into *Petronius*' deck 60 feet above sea level, causing significant damage to several of the platform's 4-foot-deep plate girders and below-deck piping and electrical systems. The wave force exerted extreme pressure on the side of the girders, resulting in permanent deflection of these beams.

The Office of Structural and Technical Support (OSTS) of the Minerals Management Service (MMS) has responsibility of ensuring that the platforms operating on the Outer Continental Shelf are designed, fabricated, installed, and maintained in accordance with regulations. It is the operator's responsibility to report all major damage and receive approval for subsequent repairs. After the storm had passed, Chevron informed MMS of the damage and began developing and implementing a repair plan. In the final stages of the repair, the Chief of OSTS, Tommy Laurendine, sent Fung Chan and Sean Verret, both structural engineers with OSTS, to *Petronius* to evaluate the repairs for final approval before production could be resumed, nearly six months later.



Above: The deck quarters of *Petronius* being transported offshore. Left: *Petronius* structure. Photos courtesy of Chevron.

The repairs Chevron implemented were documented by photographs and followed up by a final repair permit, including all pertinent design criteria and analysis results. The Chevron repairs included leaving the girders in their damaged state and adding additional beams. In the end, OSTS approved the repair and gave the green light for Chevron to begin producing 40,000 barrels per day again.

– by Sean Verret

Left: Picture of *Petronius* repair before painting was completed. Below: A view of *Petronius*' damaged deck plate girders. Photos courtesy of Chevron.

MMS – A Leader in Securing the Nation's Domestic Energy Supply

LNG ship close-up of mooring
Photo courtesy of Excelerate Energy.

NEW WAVES
Late-breaking News & Information

MMS Studies Ivan's Impact

Offshore oil and gas structures in the Gulf of Mexico stood up generally well against Hurricane Ivan last September, but experts want to know why they did and if they can be improved.

The Minerals Management Service (MMS) has awarded six contracts totaling more than $600,000 for studies to analyze and assess the damage and recommend any necessary changes in design or technology.

Ivan, which made landfall in Alabama on September 16, 2004, may have been the most damaging storm to hit the oil and gas industry in the Gulf, partly because there is more exploration and production underway there today.

"We are pleased that, in spite of the 140-mph winds of Hurricane Ivan, there was no loss of life and no significant pollution," said Johnnie Burton, MMS director. "We attribute this to the well-built facilities and the noble efforts to maintain and operate them. However, there is still room to improve."

Ivan also showed the Nation last September that hurricanes cannot only can cause death and destruction, but they can also raise oil prices when they tear through the Gulf. The price of oil jumped to $55 a barrel after Ivan made landfall and later fell when industry and regulators responded.

About 10 percent of the Gulf's production was interrupted for at least four months as companies repaired damage to platforms and the network of pipelines. The Gulf produces 30 percent of the Nation's oil and 23 percent of its natural gas.

The entire oil and gas infrastructure is online now, although some operations may not be producing at the same level they were before Ivan, MMS said.

Thirty-one platforms were seriously damaged and seven were destroyed. Five mobile drilling rigs were set adrift by the storm and later rounded up by U.S. Coast Guard and industry boats. One drifted 70 miles before it was caught.

Burton said the studies will ensure the safe, clean operation of the offshore oil and gas industry even when storms like Ivan tear through the Gulf.

"These studies will address short- and long-term adjustments in MMS's technical, engineering, and geologic standards and regulations to ensure that offshore oil and gas production remains safe, environmentally friendly, and less susceptible to interruption," she said.

MMS OCEAN SCIENCE
Minerals Management Service
Mail Stop 5431
1201 Elmwood Park Boulevard
New Orleans, LA 70123