

MIMS OCEAN SCIENCE

VOLUME 2 ISSUE 5
SEPTEMBER/OCTOBER 2005

THE SCIENCE & TECHNOLOGY JOURNAL OF THE MINERALS MANAGEMENT SERVICE

**Hidden
Treasures
of the Deep**

**Searching for
Cities of Cold**

**Mystery of
Deepwater
Coral
Communities**

**Skyscrapers in
the Deep**

**Have You
Heard?**

**Exploring
Mega-furrows**

**An Unlikely
Oasis – The
Boulder Patch**



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.



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ABOUT THE COVER

Top: This piece of *Madrepora oculata* was collected at the *Lophelia* coral banks. Very different from the surrounding pale white *Lophelia*, scientists have never seen this type of coral there before. Photo courtesy of the National Oceanic and Atmospheric Administration.

Bottom: Growth found in the Boulder Patch. Photo Courtesy Brenda Konar, University of Alaska Fairbanks.

All photos courtesy of Minerals Management Service unless otherwise noted.

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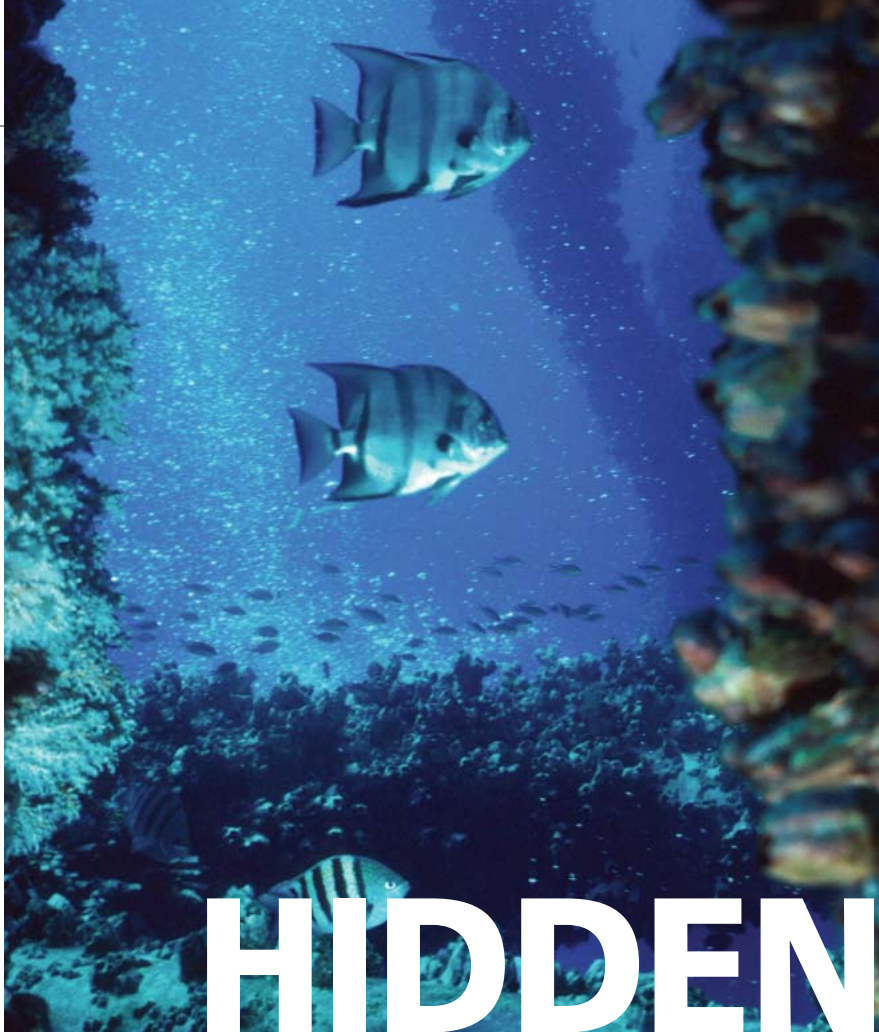
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Left: Spadefish under a platform in the Gulf of Mexico. Photo by Gregory S. Boland.

Top: Cardinal fish near corals in the Gulf of Mexico. Photo by Gregory S. Boland.

Bottom: Nudibranch on a platform leg. Photo courtesy of Milton Love.



HIDDEN

TREASURES OF THE DEEP

Our Nation is blessed with an abundance of both natural and man-made treasures – from the grandeur of the Rocky Mountains, to the red rock canyons of Arizona and Utah, the frozen expanses of Alaska, the rolling hills and historic villages of Virginia, and the wildlife communities of our national parks. But not all of our resources are as visually accessible as these. Beneath the waters of the Outer Continental Shelf (OCS) lie mountains, trenches, rolling hills, and vast plains as astonishing as on land.

Far beneath the ocean's surface at depths reaching down to 10,000 feet, previously unknown marine communities are thriving. Living on gases seeping from vents in the earth's crust, these animal communities present researchers with an exciting opportunity to study life forms which do not conform to previously held "rules" about what is needed to sustain life. They live in an inhospitable environment - under high pressure, in sometimes boiling hot

water with no visible light – yet they not only survive, but multiply.

Just as there are communities living in the hot water of magma vents, there are communities which thrive in the cold water. Coral reefs, which provide shelter and food sources for thousands of marine animals, have grown for hundreds of years in waters below 50 degrees Fahrenheit. The study of these living communities and how to protect them while recovering mineral resources from the OCS is an ongoing mission for Minerals Management Service (MMS), a Federal agency within the Department of the Interior.

The ocean can also be a place of deceptive calm. Underneath its glassy surface, storms can rage. Currents strong enough to carve deep furrows in the

ocean regularly rise and fall. These "storms of the deep" can potentially affect oil and gas development activity and are being closely studied to find ways to lessen their effect on equipment.

The more we explore the depths of the OCS, the more questions we find that need to be answered. It is a rich study area for the MMS and its academic partners. New technologies are being constantly developed based on the knowledge we gain in those studies. Mysterious animals, unusual communities, and ocean floor formations are being discovered regularly as exploration reaches greater depths. What new mystery will be uncovered next? Stay tuned as MMS continues to discover the hidden treasures of the deep.

SEARCHING FOR CITIES OF COLD



A new species of segmented worm (*Hesiocaeca methanicola*, the "iceworm"), was found sculpting exposed gas hydrates. Photo by Charles Fisher, Penn State University.

The cold ocean depths, where little or no sunlight is found, seem inhospitable for a thriving animal community. Yet there on the ocean floor, hundreds or even thousands of feet below the surface, are colonies of animals such as tubeworms, mussels, and clams. These communities form around hydrocarbon seeps or "leaks" in the earth's surface. Animal life at this depth relies not on photosynthesis, but on chemosynthesis, a remarkable foundation of life supporting large assemblages of animals discovered only 38 years ago. Chemosynthesis is independent of sunlight, the source of energy for every other form of life on earth. Chemosynthetic bacteria are plentiful around the seeps but also inhabit the insides of many types of larger animals, providing their food requirements through the use of

chemicals seeping from the sea floor. Life here requires little warmth to develop. Unlike the hot vents along tectonic plates in other parts of the world, the Gulf of Mexico (GOM) has "cold seeps."

The deepest chemosynthetic communities found in the northern GOM to date were recently discovered by Chevron at a water depth of over 9,000 feet in the Alaminos Canyon. Surprisingly, at first the communities at this great depth look similar in many ways to those at shallow depths, but these deep communities have been found to have many different species with very few similarities to their shallow water counterparts.

The Minerals Management Service (MMS), as part of its mission to protect offshore natural resources, is exploring ways to develop deepwater oil and gas resources without disturbing these

chemosynthetic communities that have taken years to develop. Studies to date have shown that these communities show no adverse effect from oil and gas exploration and development. Communities near current oil fields continue to flourish.

The MMS continues to require that oil and gas operators ensure the ongoing health of these deepwater colonies by requiring some activities, such as drilling, maintain a distance of at least 1,500 feet from the community. Other disturbances such as pipelines, anchors, ropes, or chains must maintain a distance of 250 feet. A new study funded by MMS and the National Oceanic and Atmospheric Administration's Office of Ocean Exploration will begin to look at the very deep communities of the GOM between 3,000 and 10,000 feet deep. The famous research submersible, *Alvin*, will be making dives to investigate these cold seep communities in the deepest parts of the Gulf to understand how they are different and if any new protective measures might be necessary to avoid harming them.

As research and development in deepwater GOM continues, MMS continues with its commitment to add to its informational databases and ensure its stakeholders have the knowledge necessary for responsible planning and development. The more we know about these "cities of cold," the better we can protect and preserve them for future generations.

UPCOMING CONFERENCE

Website: <http://www.mms.gov/SciConferences.htm>

The Third International Symposium on Deep-Sea Corals: Science and Management will be held November 28 – December 2, 2005, in Miami, FL.

FOR MORE INFORMATION:

Chemosynthetic Communities in the Gulf of Mexico

Website: www.gomr.mms.gov/homepg/regulate/enviro/chemo/chemo.html

THE MYSTERY OF DEEPWATER CORAL COMMUNITIES DEEPENS

COLD CORAL

When thinking of coral, one usually imagines brightly colored Caribbean reefs in warm, sun-drenched waters, teeming with colorful fish and vacationing scuba divers. But some of the oldest and largest coral structures on the planet are neither colorful nor warm. These coral communities inhabit deep ocean depths devoid of sunlight, but abounding with life.

Although scientists have known about deepwater coral communities for many years, studies of the organisms in the Gulf of Mexico (GOM) are just beginning to be completed as part of Minerals Management Service's (MMS) mission to document and protect offshore ecosystems. The depth of the communities in the GOM have made study difficult, but the use of manned and unmanned submersibles has made the exploration of these deepwater communities possible.

Deepwater coral, known as *Lophelia pertusa*, is white and slow-growing (less than one inch per year), and large communities of this coral may be as old as hundreds or thousands of years. *Lophelia* is found in almost every ocean in the world at depths of 650 feet to as much as 10,000 feet. A study currently being funded by MMS and conducted by the research firm Continental Shelf Associates and a variety of other groups including the University of Alabama, University of Oregon, Pennsylvania University, and in conjunction with the USGS is beginning to document the structure and distribution of the *Lophelia* communities in the GOM. This study will establish baseline knowledge of the species and its associated unique habitat which will be augmented by later, more detailed studies.

Another MMS-funded study, conducted with the University of North Carolina – Wilmington, Center for Marine Science, is focusing on the comparison of deepwater coral reefs in the Atlantic with those in the GOM. Similar *Lophelia* coral habitats are also



Lophelia coral from off the coast of North Carolina. Photo by Bruce Moravchik, National Oceanic and Atmospheric Administration.

found off the southeastern U.S. The study will analyze coral ecosystems across depth, latitude, and habitat zones to document the uniqueness of each coral community and compare the structure and animal composition to similar communities in the Gulf.

In shallower waters on the Gulf continental shelf other MMS coral studies, in collaboration with Louisiana State University, are gathering data on coral communities growing on offshore platforms. These studies will determine how deep the coral will develop, how far from shore they will develop, what the limits of the communities are (salinity, temperature, turbidity, etc.), and the degree of genetic similarity between the corals found on different platforms compared to a natural coral reef in the northern GOM, the Flower Garden Banks.

As oil and gas exploration and development activities move deeper into the GOM, new and unique marine

ecosystems continue to be discovered. It is vital to establish a basic biology database and understanding of these new communities. Only by knowing the current state of the ecosystem can decisionmakers at MMS determine how these communities might be impacted by oil and gas exploration and production, and how they, and the marine life which they support can be protected.

FOR MORE INFORMATION:

Ongoing Research at MMS:

Website: www.gomr.mms.gov/homepg/regulate/environ/ongoing_studies/gm/GM-03-x12.html

Website: www.gomr.mms.gov/homepg/regulate/environ/ongoing_studies/gm/GM-04-x12.html

Website: www.gomr.mms.gov/homepg/regulate/environ/ongoing_studies/gm/GM-03-02.html



Photo by Gregory S. Boland.

HOME TO NEW COMMUNITIES

Majestically rising from the Hadal depths, encased in a living armor, the enormous oil and gas platforms on the Outer Continental Shelf (OCS) seem like extraterrestrial monuments in the natural beauty of the ocean surrounding them. Yet to marine life living beneath them, these platforms are a first-class, high-rise hotel: a skyscraper for fish. In fact, each offshore platform can support communities of fish through the entire water column 20 to 50 times greater than similar areas of open water. Ten to twenty thousand fish and millions of barnacles, coral and other invertebrates form a community pulsating with life under each platform.

The first tenants to move in when a platform is erected are the encrusting invertebrates such as barnacles, coral, sponges, and mussels. These small species find the stable and durable legs

BUILDING SKYSCRAPERS IN THE DEEP

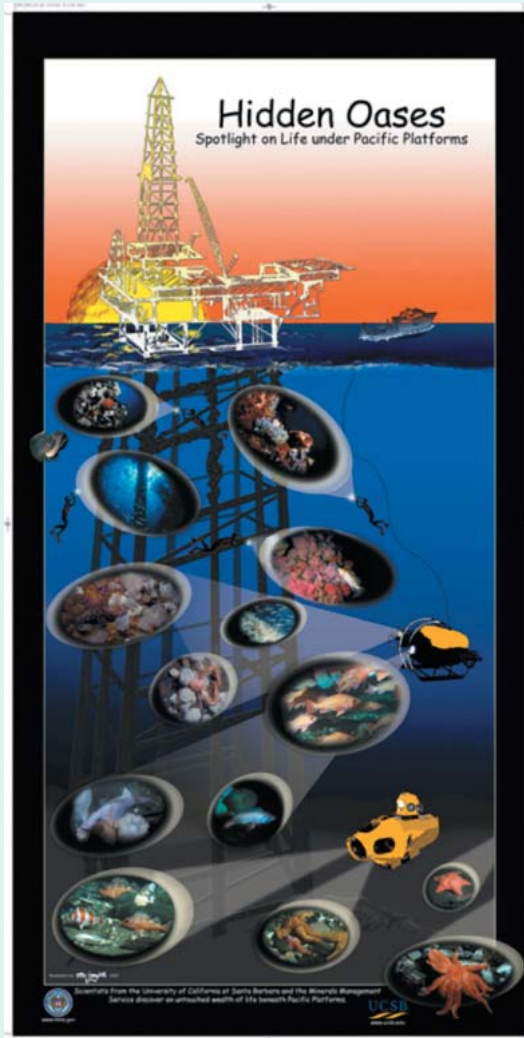
of the platform, which can be as wide as 6 feet in diameter, an ideal surface on which to attach. After the platform has become encrusted by invertebrate fauna, large species begin to arrive, attracted by the food supply.

In the shelter of the platform, fish larvae and juveniles find relative safety from predators. Juvenile fish can grow at shallower levels in the water column, away from the adults and the predators gathered at deeper depths. Coral communities attached to the platform also serve as a nursery for larvae and rich feeding grounds for young fish. The complex support system which stabilizes

the platform also serves as home for thousands of mature fish. Many predatory fish gather at the platform to feed during the daylight hours, before heading for the open ocean to feed at night. The ocean surrounding the platforms is so teeming with life that 70 percent of all saltwater fishing excursions in the Gulf of Mexico (GOM) off Louisiana are to oil and gas platforms.

As oil and gas platforms begin to deplete the fields beneath the ocean floor and are scheduled for decommissioning, Congress, MMS, and state agencies are examining the advisability of removing these rich and diverse ocean

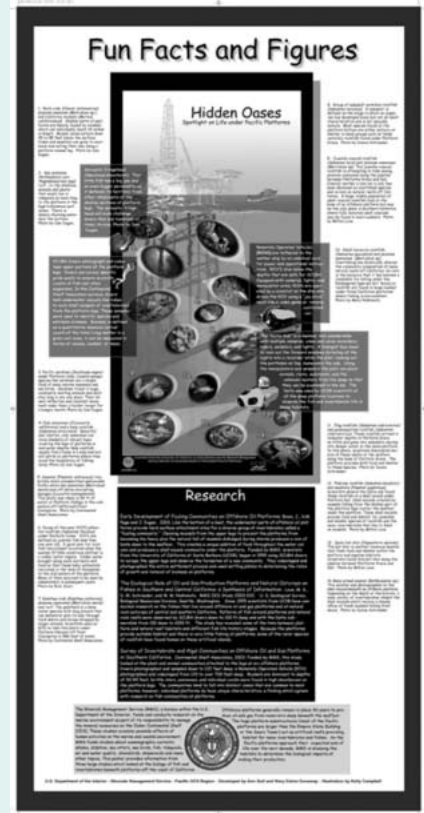
POSTER DETAILS DIVERSE COMMUNITIES UNDER PACIFIC PLATFORMS



One of the methods employed by the Minerals Management Service (MMS) in its ongoing mission to manage and protect America's coastal and ocean resources includes educational outreach. The MMS has produced a fact-filled educational poster summarizing three ongoing research projects that explore habitats found at various water depths beneath California offshore platforms. The "Hidden Oases" poster highlights and describes various seafloor habitats that exist in the Gulf and the geology that drives them, as well as the abundant marine animals associated with these extraordinary ecosystems.

This poster can be obtained at no charge from the Minerals Management Service, Pacific OCS Region, Attn: Public Information Office, MS 7000, 770 Paseo Camarillo, Camarillo, CA 93010. Telephone orders are accepted at 1-800-6-PAC-OCS, or fax orders to 805-389-7689.

Front and reverse of "Hidden Oases" poster. Available at no charge. Details above.



ecosystems. The Rigs to Reefs (RTR) program, which converts old platforms to artificial reefs, have been successful in Louisiana, Texas, and Mississippi. The MMS supports the rigs-to-reefs initiatives when and where the local or State governments have adopted a legal framework to enable reefing of decommissioned OCS oil and gas platforms. The ecological and economic benefits of allowing old platforms to remain in place allows the life under these "skyscrapers of the deep" to continue to flourish.

Starfish, anemones, and other organisms found on or near platforms along the California coast.
Photo by Donna Schroeder.





Two sperm whales "fluke-up" near the Texas A&M Research Vessel Gyre. Photo by Jonathan Gordon.

HAVE YOU HEARD?

Are you comfortable driving in the fog? Can you communicate effectively when all you hear is static? While it is possible to overcome each of these problems, the situations can produce tension, stress and discomfort. The question is, are cetaceans (whales and dolphins) in the Gulf of Mexico (GOM) experiencing the same tension, stress, and discomfort from the "fog" and static of man-made noise? In an effort to measure and mitigate any effects of air gun pulses to these endangered whales, the Minerals

TRACKING SPERM WHALES IN THE GULF OF MEXICO

Management Service (MMS) has partnered with the Office of Naval Research, National Science Foundation, industry, and the Department of

Commerce to measure air gun sound and its effects on the sperm whale – the largest cetacean in the GOM.

Cetaceans navigate by means of sound in the dim, dark world they inhabit. In the past, little has been known about the effects of noise generated by seismic surveys associated with oil and gas exploration. There was speculation, however, that man-made noise was negatively affecting cetaceans living near exploration activities. The potential for negative effects is especially apparent in the sperm whale (the species of whale written about in *Moby Dick*)

Texas A&M Research Foundation management team leading the sperm whale study, Dr. Doug Biggs, Dr. Matt Howard, and Dr. Ann Jochens, with cruise plan chart for the June, 2002 "S-tag" cruise. Photo by Bill Lang.



If a whale is sighted within 1,500 feet of a seismic vessel, operations are required to cease until the whale leaves the area.



Far left: The Relentless II (R2) follows a tagged whale within sight of the deep water production platform URSA. The R2 is a 21-foot research boat designed and built for whale research. Launched from the Gunter, the MMS boat is used for close approaches to whales for tag attachment, biopsy samples and ID photographs.

Left top: An ONR acoustic tag attached to a sperm whale from a 30-foot long carbon fiber pole on the R2. The tag has three suction cups and will remain attached for up to four hours. The released tag is located by radio signals and recovered - sound recordings and movement data are analyzed by a WHOI research team lead by Dr. Peter Tyack.

Left bottom: WHOI scientist, Mark Johnson, tags one in a group of four sperm whales.

which inhabits areas of the GOM where exploration activities are ongoing.

A pilot study in 2000-2001 enlisted the help of the former anti-submarine ship, now NOAA Research Vessel, the *Gordon Gunter*, which was built by the Navy for "silent running." The *Gunter* was refitted to listen for whales rather than submarines and, with the 27-foot research boat R2 on board, set out to take ID photos, obtain biopsy samples of the whales they encountered, and test new equipment - in particular, two types of whale tags.

The initial study was remarkably successful with over 60 hours of data retrieved from tags on three female sperm whales. Based on this study and the best available information

worldwide, MMS has concluded that noise, specifically from seismic activity, does not seriously affect cetaceans in the GOM. According to MMS, "geological and geophysical activities are not expected to result in significant adverse impacts to any of the potentially affected resources."

Nonetheless, MMS regulations to reduce the amount of noise to which

whales are exposed will remain in place. If a whale is sighted within 1,500 feet of a seismic vessel, operations are required to cease until the whale leaves the area. A gradual ramp up of the signal volume is required after the whale leaves. Ramp ups must be done during daylight hours for better visual confirmation that the whale is no longer in the area.

As more knowledge is gained about the sperm whale and other species in the GOM, Pacific, and Alaska regions, MMS will continue to review and revise regulations concerning their protection. The goal of MMS research and regulations is to protect the Nation's energy, marine, and human resources while still encouraging responsible oil and gas exploration.

FOR MORE INFORMATION:

Gulf of Mexico Sperm Whale Research

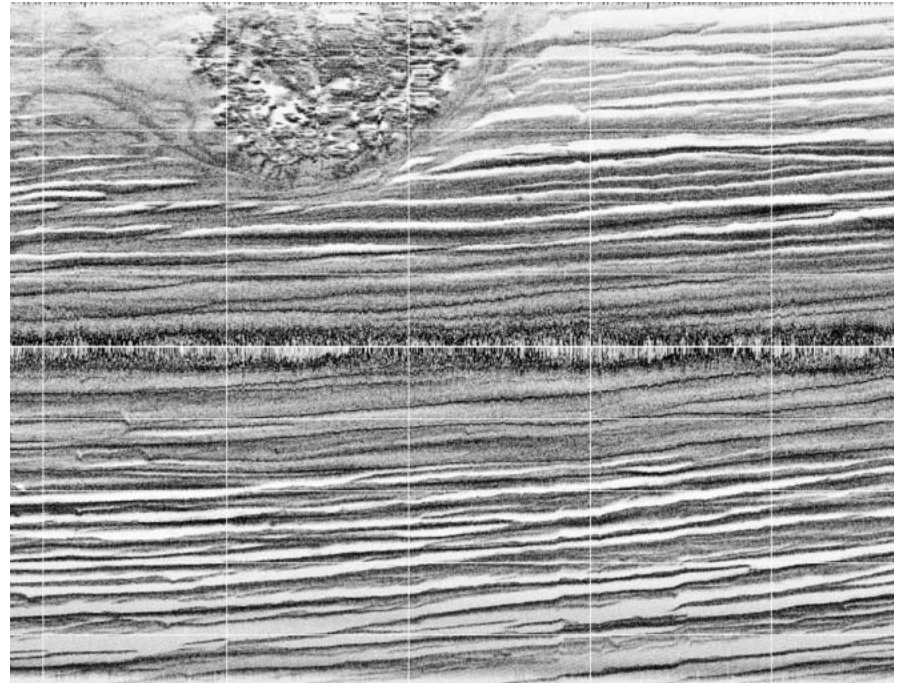
Website: www.gomr.mms.gov/homepg/regulate/environ/marmam/sperm_research.html

EXPLORING MEGA-FURROWS

The image of the ocean appearing calm and tranquil after a hurricane is reassuring, but it can be deceptive. Beneath that calm, at 10,000 feet, another storm may be brewing. This storm could be devastating, too, and can leave deep furrows in the ocean bed as it passes. Scientists are just beginning to study “mega-furrows” that have recently been discovered on the ocean floor at the base of the Sigsbee Escarpment in the northwestern Gulf of Mexico (GOM). The furrows are believed to be formed by sudden rising currents with enormous power and force.

Scientists were just beginning to recognize that there were strong currents in the deep GOM, but during an exploratory dive on the manned submersible craft, *Alvin*, scientists from Texas A&M and the National Science Foundation found themselves literally in the “eye of the storm.” The massive wall of water they encountered was estimated to be 2,000 feet thick and moved at 1-1.5 knots (or 1.2 to 1.8 miles per hour), far above the normal speed of 1/10 knot. Scientists have now recorded currents that are well over 2 miles per hour. The current is suspected to be strong enough to erode miles of deep furrows up to 100 feet wide and 30 feet deep in the ocean floor.

Why did this sudden “storm” occur? Investigators suspect the influence of Rossby waves, which are a result of the earth’s rotation. Ocean topography and inter-ocean connections are also suspected to influence the strong flow.



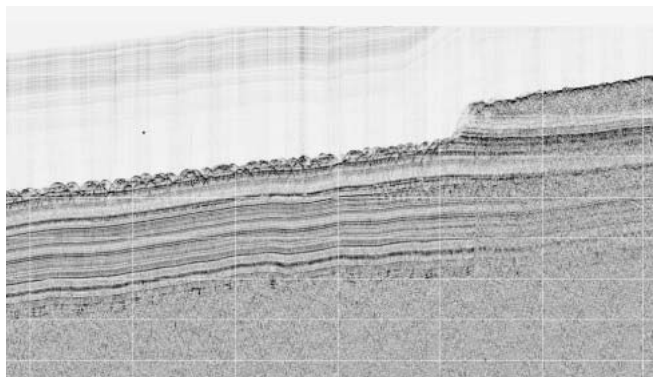
Post processed side scan data provide an example of mega-furrows and a seafloor slump deposit at the base of the Sigsbee Escarpment. The mega-furrows are 5 to 50 meters in width and 1 to 3 meters in depth. These erosional features extend for kilometers and are the result of bottom currents. The slump deposits are more resistant to the erosional process. Courtesy of C & C Technologies.

Study into the origin of the flows is on-going.

The study of mega-furrows has become important because oil and gas exploration has begun in the areas they are found. The implications of extremely strong currents and their ability to erode and undercut ocean floors where pipelines and other sea floor installations might be located are apparent. Engineers must find ways to reduce the wear and tear on equipment

by strong currents, stabilize pipelines, and prevent the mass dispersion of exploration drilling muds in the strong currents before exploration in the area continues.

The Minerals Management Service (MMS) continues to collect data about the currents and the furrows they leave behind. Knowing the processes which cause these phenomena will enable both MMS and oil and gas operators in the area to develop safe and environmentally responsible exploration and production.



The subbottom profiler data shown are processed and saved in SEG Y and XTF. A subbottom profile, running from north to south across the slump deposits shows furrowed seafloor in the form of hyperbolic echoes. Courtesy of C & C Technologies.

FOR MORE INFORMATION:

Ongoing research at MMS:

Website: www.mms.gov/tarprojects/479.htm

Website: www.gomr.mms.gov/homepg/regulate/environ/ongoing_studies/gm/GM-03-x11.html

AN UNLIKELY OASIS

THE BOULDER PATCH



Chances are, the last place you would think of as an oasis for scuba diving is Alaska's Arctic Ocean coast. This isn't surprising since much of the state's northern coast consists of mud, and on a warm day the ocean might be a teeth-chattering 30 degrees Fahrenheit. But, it may be worth another look.

Twenty-five years ago, geologists looking for oil in Stefansson Sound came across a jumble of rocks, boulders, and cobbles. Ken Dunton, a marine scientist at the University of Texas at Austin, was among the first to lay eyes on what is now called the Boulder Patch. According to Dunton, "The boulder patch I think is most appreciated if you've spent day after day diving, like we did in 1978, on mud, being promised that there was a big area of cobbles and boulders covered with luxuriant sea life." On the eleventh dive Dunton and his team came upon the hidden treasure of

rocks and cobbles with a rich community of organisms.

"This oasis is as rare as it is beautiful. The rocks themselves are unlike anything north of the Brooks Range," says Dunton.

Today, these boulders lie in about 20 feet of water and are covered by sea ice during nine months of the year. And yet, life thrives here. Plants and animals have evolved unique ways of surviving the dark, frigid water.

The Boulder Patch may be a place of hearty corals, kelp, and sea anemones, but it isn't invulnerable. Surrounding it are America's largest oil and gas deposits. Nearby Endicott Island, a man-made gravel pad, pumps thousands of barrels of oil each day from beneath the patch.

The Boulder Patch is an oasis of living sea life off Alaska's Arctic coast. Photo Courtesy Brenda Konar, University of Alaska Fairbanks.

In a study funded by British Petroleum and Minerals Management Service (MMS), Brenda Konar, an assistant research professor at the University of Alaska at Fairbanks, and a team of research scuba divers began research to further understand the effects of these man-made structures on the Boulder Patch.

Konar and her team collected some 70 rocks, each roughly the size of a football. They took them to a warehouse on Endicott Island and began the painstaking task of scraping, chipping and pounding off the corals and other sea life. When the rocks are put back into the patch, Konar will be able to monitor nature's progress as life returns to the bare rocks.

The data collected in this study, along with historical information, will provide a valuable database that can be used to assess the effects of oil and gas exploration in this region and will help further the mission of MMS in its role as a steward of the ocean environment.

The Boulder Patch sits in about 20 feet of water in Alaska's Prudhoe Bay. Courtesy Ken Dunton, University of Texas at Austin.

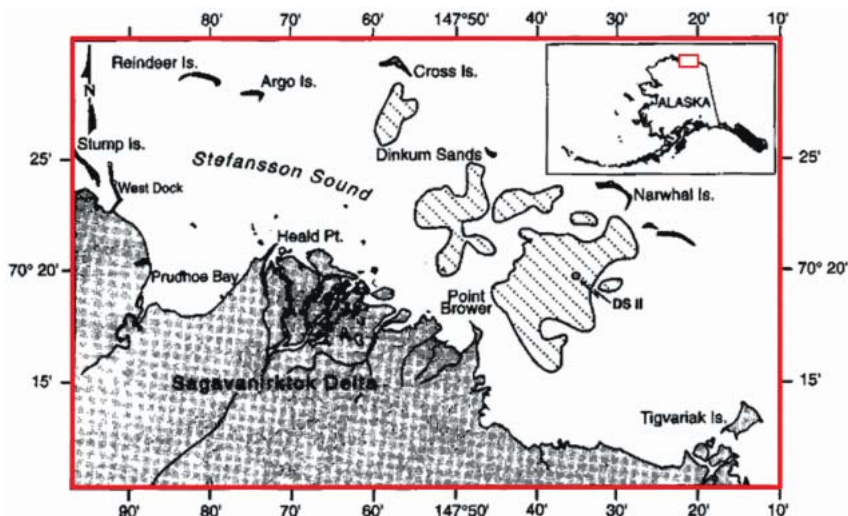
FOR MORE INFO:

Arctic Scenic Journeys

Website: http://www.uaf.edu/seagrant/NewsMedia/02ASJ/10.04.02boulder_patch.html

Boulder Patch Study MMS Report 2005-011

Website: <http://www.mms.gov/alaska/ref/AKPUBS.HTM>



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NEW WAVES Late-breaking News & Information

2005 Energy Policy Act Promotes Energy Production

On August 8, President Bush signed the 2005 Energy Policy Act, which encourages increased domestic production of oil and natural gas. This Act grants the Minerals Management Service (MMS) with new authority for federal offshore alternative energy uses and requires a comprehensive inventory of oil and gas resources on the Outer Continental Shelf (OCS).

Provisions in the legislation will increase incentives for domestic energy production, including royalty relief on existing non-producing OCS leases offshore Alaska, and additional royalty relief for deep water and ultra deep gas production in the Gulf of Mexico.

New coastal impact assistance provides \$250 million from OCS revenues to be shared annually among the eligible states from 2007 through 2010. Alaska, Alabama,

California, Louisiana, Mississippi and Texas are eligible for this program. The annual allocation for each state will be based on the ratio of OCS revenues generated off the state's coastline to total OCS revenues from leases lying beyond the three miles past State waters (the 8(g) zone) and within a distance of 200 nautical miles off that state.

The legislation also grants MMS new authority to regulate alternative energy uses of the OCS, including wind, wave, and solar energy. The States will share in 27 percent of the revenues generated from alternative energy activities within the 8(g) zone.

In addition, this legislation requires changes to the valuation and fee structure for geothermal energy, whether used directly as in a greenhouse heating system or to produce electricity. The provisions provide for a streamlined process and a fair return on the use of our national resource.

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