USGS

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Fieldwork

USGS Scientists Discover Gas Hydrate in Southern California During Cruise to Study Offshore Landslides, Earthquake Hazards, and Pollution

By Cathy Frazee, Homa Lee, Bill Normark, and Brian Edwards

A sediment-sampling cruise led by U.S. Geological Survey (USGS) scientists in late July 2003 discovered gas hydrate, an icelike crystalline solid containing trapped molecules of natural gas, in sediment off southern California. To our knowledge, this is the first discovery of gas hydrate in the area north of the Gulf of California and south of the Mendocino Triple Junction (in northern California).

The cruise was part of the USGS' CABRILLO (Southern CAlifornia Bight Regional Investigations Life, Land, and Ocean) project, which addresses issues that affect southern California coastal communities. The most heavily populated urban corridor along the U.S. West Coast, the southern California coastal region hosts millions of human inhabitants onshore and countless marine organisms, including marine mammals and commercially important fish, in diverse habitats offshore. Both the human and nonhuman inhabitants are at risk from pollution and toxic waste, degradation of freshwater supplies by saltwater intrusion, and the potential for earthquakes, underwater mass-wasting events (landslides and slumps), and tsunamis. USGS scientists, in conjunction with local agencies (such as the Water Replenishment District of Southern California, the Los Angeles County Department of Public Works, the Southern California Coastal Water Research Project, the city of Los Angeles, the Orange County Sanitation District, and the Southern California Earthquake Center), are studying these potential threats.

The recent cruise had multiple goals, primarily:

1. To better understand the mechanics and timing of submarine sediment failures on part of the mainland slope of the Santa Barbara Channel (studied by piston coring)
2. To better understand the neotectonics and timing of recent fault movement in the inner California Continental Borderland, from Anacapa Island to San Diego, CA (studied by piston coring and gravity coring)
3. To characterize the stratigraphy and sedimentology of offshore facies that constitute part of the onshore coastal aquifer systems contaminated by saltwater intrusion (studied by vibracoring)
4. To estimate the mass balance of contaminants (chlorinated hydrocarbons and trace metals) associated with sediment deposited on the Los Angeles margin (Point Dume to Huntington Beach, CA) (studied mainly by box coring)

To achieve these goals, the scientific staff sampled sediment by using the various coring devices, and they conducted

(Gas-Hydrate Discovery continued on page 2)

White chunks of gas-hydrate ice are visible at the bottom of this piston core, collected from a water depth of 813 m in Santa Monica Basin. To our knowledge, this is the first discovery of gas hydrate in the area north of the Gulf of Mexico and south of the Mendocino Triple Junction (in northern California). The gas hydrate was found at an unusually shallow depth in the sediment—only 2.1 m below the sea floor.

"What do you mean, it's a worm tube? Looks like a Tipparillo to me!" (Left to right: ***Eric Grossman*** *examines a worm tube as* ***Brian Edwards*** *and* ***Jon Warrick*** *look on.)*

Pete Dartnell *(left) and* ***Simon Barber*** *assist in the deployment of a box corer.*

Sound Waves

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Contents

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Publications: When new publications or products are released, please notify the editor with a full reference and a bulleted summary or description.
Images: Please submit all images at publication size (column, 2-column, or page width). Resolution of 200 to 300 dpi (dots per inch) is best. Adobe Illustrator© files or EPS files work well with vector files (such as graphs or diagrams). TIFF and JPEG files work well with raster files (photographs or rasterized vector files).

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Want to e-mail your question to the USGS? Send it to this address: **ask@usgs.gov**

Fieldwork, continued

(Gas-Hydrate Discovery continued from page 1)

CHIRP (compressed high-intensity radar pulse) high-resolution seismic-reflection profiling. Piston cores for the earthquake-hazard and tsunami studies were taken at sites identified on high-resolution stratigraphic records compiled from Huntec and Geopulse boomer data collected on previous cruises. To prepare for statistical analysis, more than half of the box cores were placed randomly, and the rest were placed by using information from a multibeam map. Vibracoring stations were chosen on the basis of CHIRP data collected on this cruise.

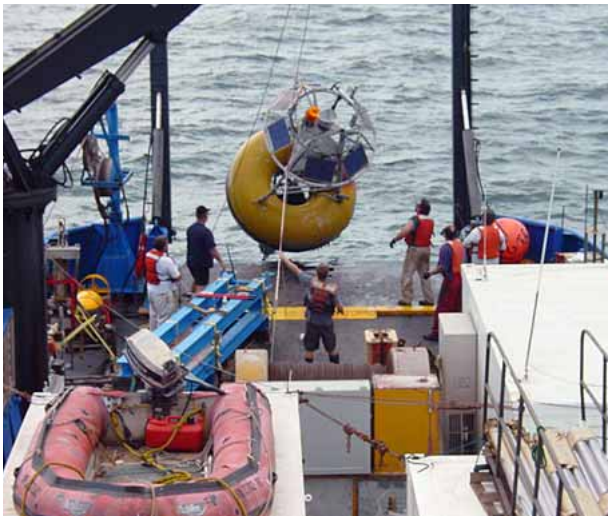
It was in connection with the fourth goal—study of contaminants—that the gas hydrate was discovered, at a site chosen for sampling of sea-floor discharges of methylmercury. The gas hydrate was discovered in a short piston core taken from a water depth of 813 m near the summit of a mud diapir in Santa Monica Basin. The discovery core was 2.1 m long and apparently stopped in the gas hydrate, as evidenced by chunks of gas-hydrate ice at the bottom of the core. Violent degassing of a section of the core resulted in spontaneous extrusion of the sample from the coreliner in the ship's laboratory. Fresh mussel shells recovered from the top of the core indicate the presence of a "cold seep" community supported by methane venting from the diapir.

The existence of gas hydrate at such a shallow depth in the sediment—only 2.1 m below the sea floor—was unexpected. The mud diapir on which the gas hydrate was sampled has extruded through well-bedded sediment on the lower slope of the basin; it is about 300 m in diameter at its base and less than 100 m across its gently sloping summit. Subsequent sampling in the area of the diapir, using piston, gravity, and box corers, failed to sample more gas hydrate but did recover additional cold-seep fauna.

In all, we collected 29 piston cores, 25 gravity cores, 43 box cores, and 19 vibracores, plus 3 hours of CHIRP high-resolution seismic-reflection data in support of the vibracoring operations. We successfully collected core samples from each planned site within the study area. More cores were collected per day on this cruise than on any of the preceding cruises supporting the CABRILLO project. Most piston cores and vibracores, as well as subsamples from box cores, were analyzed for physical properties by using the Geotek Multi-Sensor Core Logger (MSCL) at sea to avoid changes caused by porewater loss and sediment compaction during transport or storage. Planned onshore analyses of cores collected on the cruise include strat/sed (SS), radiocarbon dating, chlorinated hydrocarbon (CH), trace metals (TM), ^{210}Pb, texture, foraminifers, and grain size. Statistical analyses will evaluate the variation of contamination levels over the area of the Los Angeles margin.

The cruise was conducted from the *Auriga*, a 176-ft-long crabbing boat out of Seattle, WA, which personnel from the USGS' Marine Facility in Redwood City, CA, transformed into an oceanographic research vessel by installing the Coastal and Marine Geology team's standard shipping-container vans, each outfitted for a specific scientific function. The ship departed from Redwood City on July 18, 2003, carrying 17 cruise participants (15 USGS Coastal and Marine Geology team members and

(Gas-Hydrate Discovery continued on page 3)



Recovery of UCLA/MBARI mooring by various crew members.

(Gas-Hydrate Discovery continued from page 2)

two Skidaway Institute of Oceanography employees) from San Francisco Bay to southern California. About a week into the cruise, a group from the Dana Point Ocean Institute (see URL **http://www.ocean-institute.org/index2.html)** arrived onboard with a new cruise member and were given a short tour of the ship.

At the end of the cruise, a representative from the University of California, Los Angeles (UCLA), joined the *Auriga* to lead the recovery of a mooring that had been deployed jointly by UCLA and the Monterey Bay Aquarium Research Institute (MBARI) about 2 years ago in about 500 m of water in the middle of Santa Monica Bay. The mooring, protected by a large surface buoy with numerous topside instruments, had been collecting data for a study of long-term oceanographic and atmospheric conditions at the site. (For further information concerning the data collected by the mooring instrumentation, see URL **http://www.ioe.ucla.edu/mucla/**.)

The success of this cruise was due to the excellent precruise planning conducted by the cruise chief scientists and to the enthusiastic support of the cruise participants. USGS employees (in alphabetical order) included **Simon Barber**, **Mike Boyle**, **Brad Carkin**, **Jamie Conrad**, **Pete Dartnell**, **Brian Edwards** (co-chief scientist), **Cathy Frazee**, **Eric Grossman**, **Lori Hibbeler**, **Homa Lee** (co-chief scientist), **Bill Normark**, **Walt Olson**, **Kevin O'Toole**, **Jon Warrick**, and **Hal Williams**. Skidaway Institute of Oceanography employees onboard were **Claudia Venherm** and **Alyson Cotton**. Representing UCLA's Institute of the Environment was **Levanto Schachter**. We owe special thanks to the USGS Marine Facility team for their timely and professional support, and to the *Auriga* crew for their excellent piloting of the ship and timely transits: owner/engineer, **Richard Kelly**; captain, **Ted Blinkers**; second mate, **Donna White**; third mate, **William White**; and crew mates, **Tom Lyon** and **John Kelly**. Last, but certainly not least, we appreciate the superior cooking of the *Auriga's* chef, **Modu Ndiaye**. (For additional information about cruise participants and logistics, see URL **http://walrus.wr.usgs.gov/infobank/a/a103sc/html/a-1-03-sc.meta.html**.)

Life in the Deep Gulf of Mexico—Exploring Deep-Water-Coral Habitats

By John Bratton

The National Oceanic and Atmospheric Administration (NOAA)'s Office of Exploration (OE) sponsored a recent cruise on the NOAA ship *Ronald H. Brown* to explore deep-water-coral habitats (at depths ranging from about 200 to 2,000 ft) along the shelf edge and in canyons of the northern Gulf of Mexico, including sites previously mapped by USGS emeritus scientist **Jim Gardner** and others (see URL **http://walrus.wr.usgs.gov/pacmaps/wg-index.html**).

Some topographic features in the Gulf of Mexico have been identified as crucial spawning sites for commercially important fishes and reef-building deep-water corals. Cruise participants sought to learn more about the deep-water-coral systems and their inhabitants, whose abundance, extent, and diversity in the gulf are poorly understood. A better understanding of these fragile and potentially valuable resources can assist management decisions in this region of extensive human activity. The USGS participated in this cruise as part of its ongoing commitment to provide geologic-science support to NOAA in its characterization and management of the resources of national marine sanctuaries and other important habitats.

The cruise departed from Panama City, FL, on September 21 and ended in Gulfport, MS, on October 2, successfully

(Deep Gulf continued on page 4)

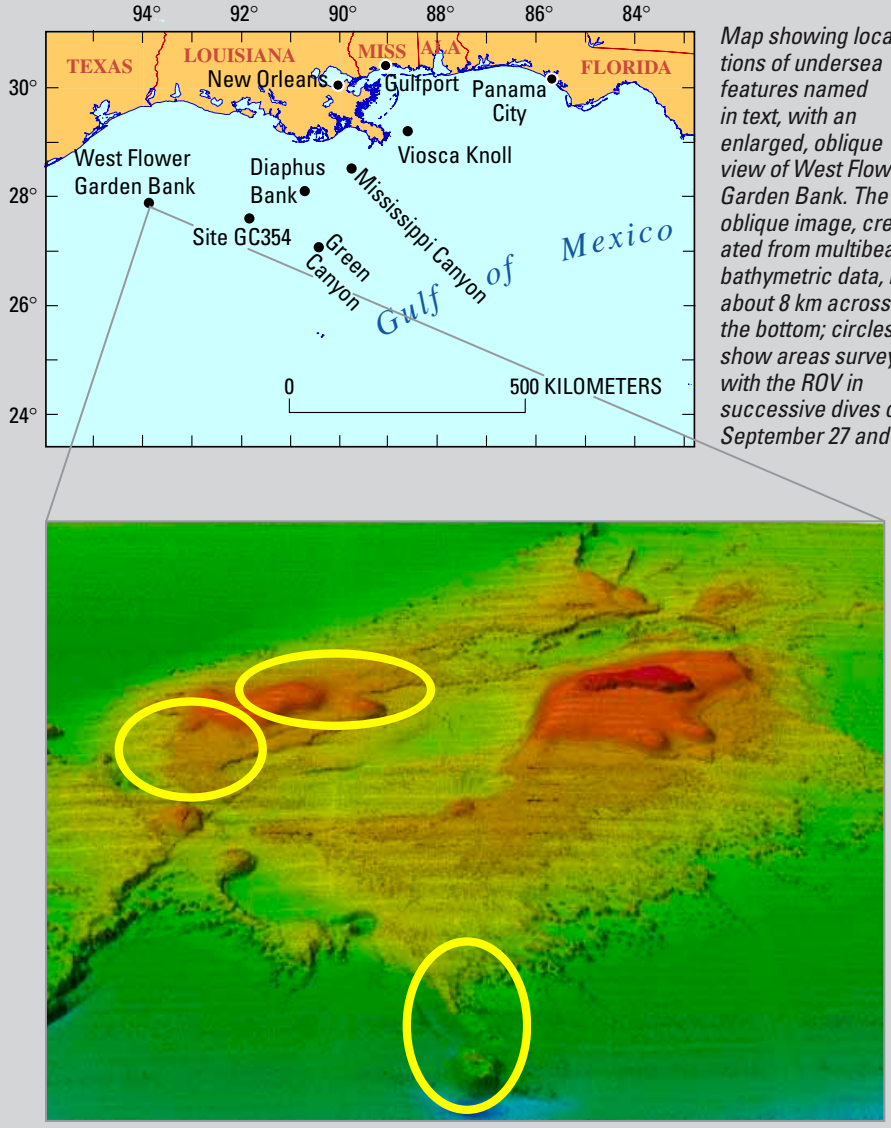
The NOAA ship Ronald H. Brown *just before leaving port in Panama City, FL.*

The ROV Innovator 12 *being lowered into the water to begin a dive. The cylinder on the top of the ROV is a detachable winch and housing that reels the ROV's control tether in and out; it is known as the tether-management system, or TMS.*

(Deep Gulf continued from page 3)

navigating the difficult End-of-Fiscal-Year Passage. [Note to non-USGS readers: it is logistically complex to conduct field operations across the start of the Federal Government's new fiscal year, which begins on Oct. 1.] The primary device used for data collection was Sonsub's remotely operated vehicle (ROV) *Innovator 12*, a working-class ROV used primarily on offshore oil rigs and pipelines. Cruise personnel conducted 11 ROV dives at deep sites near Mississippi Canyon, Green Canyon, and Viosca Knoll and at shallower sites at Diaphus Bank and West Flower Garden Bank, as well as some multibeam bathymetric mapping. Samples of fish, deep-sea corals, echinoderms, crustaceans, algae, mollusks, sponges, rocks, tube worms, water, and sediment were collected by using the ROV. The dives were documented by about 50 hours of video footage and several hundred still photographs and samples. The science plan was designed by personnel from the Flower Garden Banks National Marine Sanctuary (FGBNMS) and the University of Alabama, Dauphin Island (DI).

Chief scientists were **G.P. Schmahl** (FGBNMS) and **Will Schroeder** (DI, not on board); **John McDonough** (OE) served as cruise coordinator. **John Bratton** (USGS, Woods Hole, MA) provided input on geologic framework of habitats, hard-substrate lithology, sedimentology, and influence of sea-level change on the systems. Thirteen other scientists and science-support personnel participated, including **Emma Hickerson** (FGBNMS), **Doug Weaver** (FGBNMS), **Mary Wicksten** (Texas A&M University), **Peter Etnoyer** (Marine Conservation Biology Institute), **Susanne Fredericq** (University of Louisiana, Lafayette), **Ron Hill** (National Marine Fisheries Service, Galveston, TX), **Julie Olson** (University of Alabama), **Sandra Brooke** (Oregon Institute of Marine Biology), and **Brett Phaneuf** (Texas A&M University). Staff from C&C Technologies, Inc., were responsible for underwater navigation. To view images, daily logs, and short topical articles prepared by cruise scientists for the Northern Gulf of Mexico Deep Sea Habitats cruise, visit URL **http://oceanexplorer.noaa.gov/explorations/03mex/welcome.html**.



Map showing locations of undersea features named in text, with an enlarged, oblique view of West Flower Garden Bank. The oblique image, created from multibeam bathymetric data, is about 8 km across the bottom; circles show areas surveyed with the ROV in successive dives on September 27 and 28.

This video still image shows authigenic carbonate on the sea floor derived from cold seeps, and associated live tube worms. It was shot at a depth of about 1,800 ft at site GC354. The inset photograph shows a pair of chemosynthetic tube worms collected at the site. Tape measure is about 50 cm long.

Before and After Surveys Document the Impacts of Hurricane Isabel

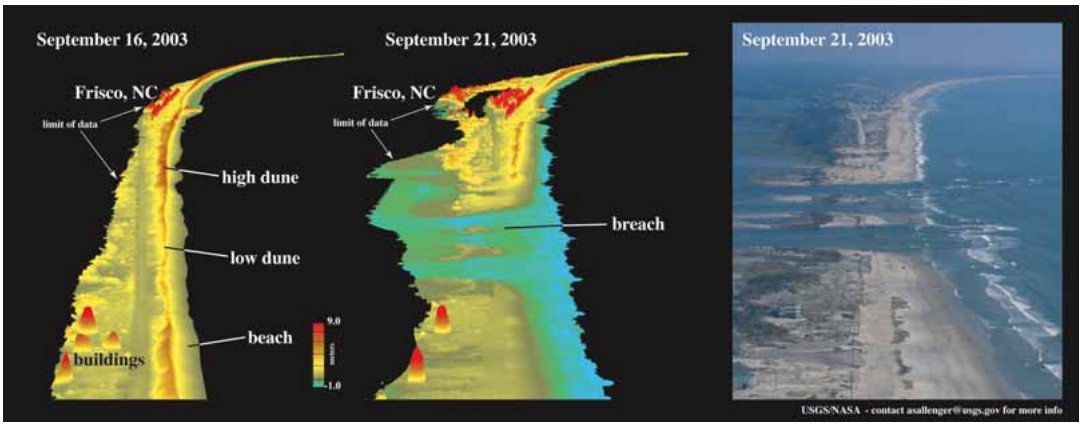
By Abby Sallenger

On September 18, 2003, Hurricane Isabel pounded the northern Outer Banks of North Carolina. At the U.S. Army Corps of Engineers (USACE)'s Field Research Facility in Duck, 125 km north of where the eye wall cut across Hatteras Island, the category 2 storm generated record conditions for 27 years of monitoring: an 8.1-m wave height measured at a wave-rider buoy in 20 m of water, and a 1.5-m storm surge.

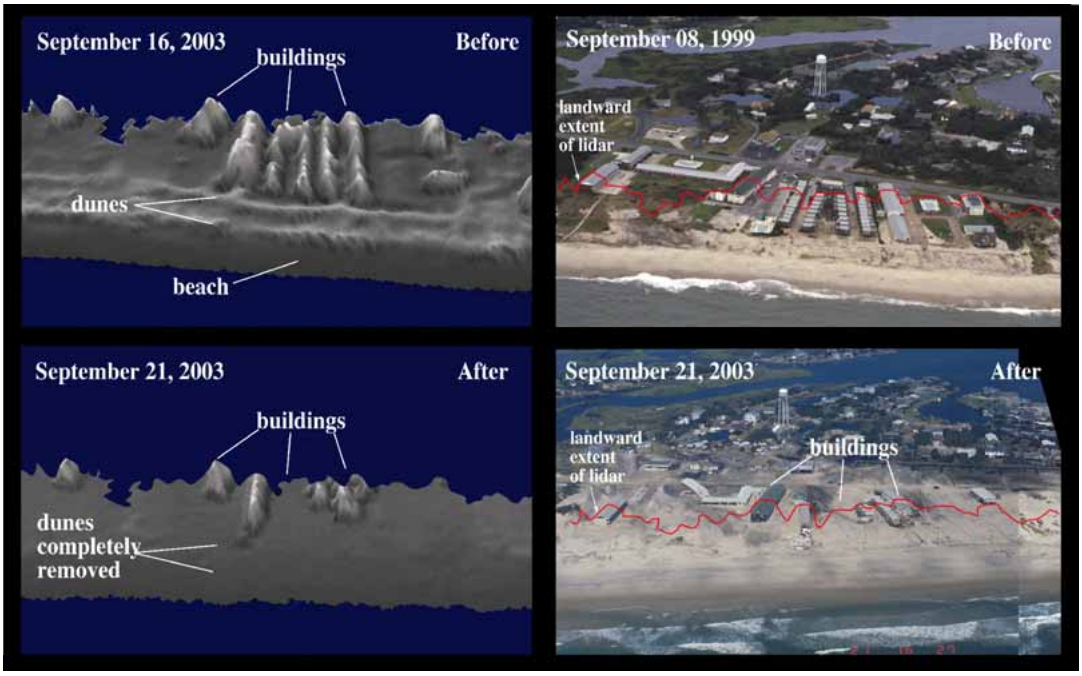
In a cooperative program between the U.S. Geological Survey (USGS) and the National Aeronautics and Space Administration (NASA), airborne lidar (NASA's EAARL [Experimental Advanced Airborne Research Lidar]) was used to survey the beaches and dunes along a 350-km-long reach from Cape Henry at the mouth of Chesapeake Bay to Cape Lookout, NC. With the accurate long-range forecast by the National Oceanic and Atmospheric Administration (NOAA)'s National Hurricane Center, we were able to acquire a prestorm survey only 2 days before Isabel's landfall. A poststorm survey flown 3 days after impact allows detection of coastal change.

In addition to lidar surveys, USGS personnel from St. Petersburg, FL, and Woods Hole, MA, made other assessments. **Dennis Krohn**, **Karen Morgan**, and **Russ Peterson** photographed and videotaped the impact zone from a twin-engine plane operating out of St. Petersburg's Albert Whitted Field (see oblique aerial photographs). A ground team consisting of USGS personnel **Jeff List**, **Hilary Stockdon**, **Meg Palmsten**, and **Abby Sallenger**, plus University of South Florida (USF) graduate student **Laura Fauver**, drove in a four-wheel-drive vehicle from Virginia Beach, VA, to a new breach through Hatteras Island, southwest of Cape Hatteras, traveling on the beach where possible. **Billy Reynolds** negotiated numerous roadblocks and set up his global-positioning-system

(Hurricane Isabel continued on page 6)



(Left to right) The first two images show high-resolution topography of a part of Hatteras Island, measured with NASA's EAARL, before and after Hurricane Isabel. Different colors indicate different elevations; in general, the hotter the color, the higher the elevation. The third image is an oblique aerial photograph taken after the storm.



Hatteras Village, about 5 km southwest of the breach through Hatteras Island. On the left are grayscale images of elevations, measured with NASA's EAARL, before (above) and after (below) Hurricane Isabel; the lighter the shade, the higher the elevation. The laser reflects from buildings as well as from the ground; thus, elevations include those of the tops of manmade structures. Note in the grayscale elevation surfaces that the dunes were completely destroyed during the storm, exposing the motels to attack by Isabel's waves.

(Hurricane Isabel continued from page 5)

(GPS) base station (in support of EAARL) where the eye wall cut across Hatteras Island. **Amar Nayegandhi** processed part of the EAARL data within a week of landfall, using ALPS, the Airborne Lidar Processing System developed by **John Brock** and his group; and **Kristy Guy** created the grayscale lidar images that accompany this article.

Preliminary analyses of the EAARL data from Hatteras Island show extensive beach changes and dune erosion, as well as destruction of infrastructure and buildings, particularly in Hatteras Village. The most extensive beach changes were associated with the opening of a breach (approximately 500 m wide and divided into three separate channels) that completely severed the island. The main breach (see top photograph on previous page), and a smaller one several kilometers to the south (not shown), occurred at minimums in both island elevation and island width. (Note that the EAARL data shown here did not extend across the entire island width, which was determined from other sources.) Storm-surge estimates are being generated by NOAA, using the standard SLOSH (Sea, Lake, and Overland Surges from Hurricanes) model, and will provide sea-level approximations on either side of the island; gradients in sea level may have generated currents that could have carved the breach. Calculated sea-level gradients will be coupled with EAARL topography and topographic change to determine vulnerability criteria for breach openings on barrier islands.

The USACE is tasked with closing the breach so that NC Highway 12 can be rebuilt to provide access to Hatteras Village. The plan is to pump sand through pipes from a flood-tidal delta approximately 6 km away and choke off the tidal currents that now scour the breach floor and keep it open. Within 10 days of landfall, we were able to provide the USACE with high-resolution topographic data to assist in their efforts.

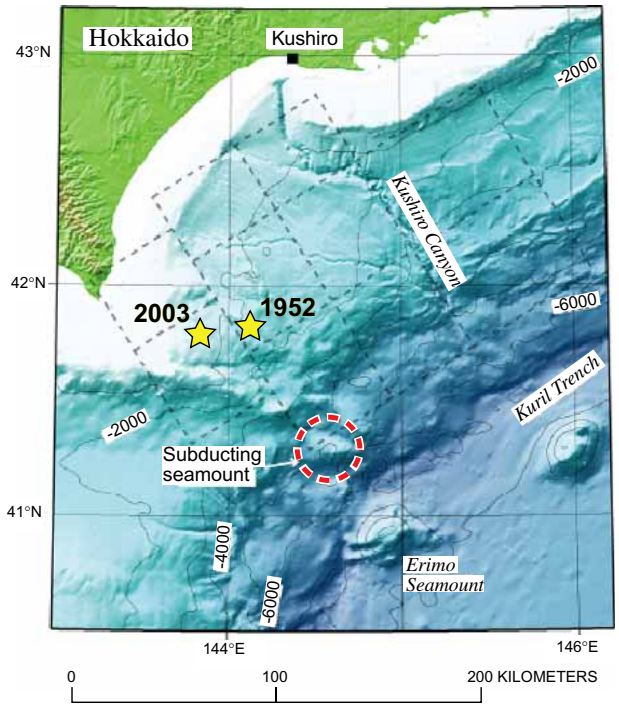
In addition, the USACE conducted bathymetric surveys of the breach and acoustic profiling of its poststorm tidal currents. Collectively among the USGS, NASA, USACE, and NOAA, the Hurricane Isabel breach is likely the most extensively ever monitored and offers the opportunity to develop and thoroughly test models of breach development.

The 2003 Hokkaido Earthquake and Tsunami—Collaborative Research

By Eric Geist, Kenji Hirata, and Rob Kayen

On September 25, 2003, a magnitude (*M*) 8.3 offshore earthquake struck Hokkaido, Japan. The earthquake and ensuing tsunami injured 589 people and resulted in significant damage to port and coastal communities. In 1952, a similar earthquake in terms of epicentral location and magnitude (*M* 8.1) occurred along this part of the Kuril subduction zone. These two earthquakes are referred to as the 1952 and 2003 Tokachi-Oki earthquakes. Their similarity allows scientists to determine (1) how the rupture mechanics of an earthquake affects a subsequent earthquake in the same location, (2) how details of nearly identical earthquakes affect tsunami runup and inundation, and (3) how quantitative assessments of ground failure perform during a major earthquake.

During 2001 and 2002, the U.S. Geological Survey (USGS)'s Coastal and Marine Geology (CMG) team in Menlo Park, CA, hosted visiting scientist **Kenji Hirata** from the Japan Marine Science and Technology Center (JAMSTEC; see URL **http://www.jamstec.go.jp**). During his time at the USGS, **Kenji** worked with scientists from both the CMG team and the Earthquake Hazards team to examine the rupture mechanics of the 1952 Tokachi-Oki earthquake, as determined from tide-gauge records of the tsunami. Results of this study were published earlier this year in the April issue of the *Journal of Geophysical Research* and presented at the 2003 Annual Meeting of the Seismological Society of America in San Juan, Puerto Rico.



Bathymetry and sea-floor features near the source region of the 1952 and 2003 Tokachi-Oki earthquakes, whose epicenters are indicated by stars. Thin dashed lines are the surface projections of hypothetical subfaults used in the tsunami model.

The scientists determined the slip distribution of this event (typically, sections of a fault slip different amounts during an earthquake), as well as what factors might

(Hokkaido Earthquake continued on page 7)

(Hokkaido Earthquake continued from page 6)

control rupture along a subduction-zone fault. Preliminary results indicate that the 2003 Tokachi-Oki earthquake occurred primarily in a region that had high slip in 1952 and ruptured in an *M* 7.0 earthquake in 1962. This anomalous part of the fault may represent a "sticking point" or asperity. A seamount chain on the Pacific plate is being subducted in this region; however, the spatial relationship between subducted seamounts and the asperity is unclear. Future research will better define the relationship between high-slip regions from the past earthquakes (defined primarily by analysis of tsunami records) and the rupture pattern of the 2003 Tokachi-Oki earthquake.

Kenji also worked with CMG scientists during his time at the USGS to analyze micro-tsunamis recorded by one of JAMSTEC's real-time, cabled, deep-sea observatories. These observatories include two ocean-bottom seismometers (OBSes) and tsunami sensors deployed at various water depths, as well as an "Advanced Technology Observation Station" that includes a current meter, heat-flow meter, hydrophone, conductivity-temperature-depth (CTD) sensor, video camera, and acoustic Doppler current profiler. (See URL **http://www.jamstec.go.jp/jamstec-e/shinkai/KANSOKU/index.html** for a description of one of these observatories.) The use of micro-tsunamis to determine the source parameters of moderate offshore earthquakes was published this year in *Earth and Planetary Science Letters* (v. 208). The Hokkaido deep-sea observatory recorded the 2003 Tokachi-Oki earthquake and tsunami. These data, in addition to data from a rapid-response OBS deployment, should provide important information with which to increase our understanding of tsunami generation and the physics of subduction-zone earthquakes.

Even though the 1952 and 2003 Tokachi-Oki earthquakes were very similar in terms of their locations and magnitudes, the tsunami damage patterns were very different. This result is consistent with the results of modeling by CMG scientist **Eric Geist**, who showed that local tsunami-runup patterns depend on the details of complex earthquake rupture: namely, the slip-distribution pattern. Part of the increased runup during the 1952 tsunami may also have to do with the unique hydrodynamics of runup on snow- and ice-covered land. More than 4 m of runup was observed along a stretch of coastline between Kushiro and Monshizu (in northeastern Hokkaido). The 1952 Tokachi-Oki earthquake and tsunami resulted in 28 people dead and 287 injured—the tsunami alone swept away 91 houses. In contrast, the tsunami following the 2003 Tokachi-Oki earthquake did much less damage, mainly beaching fishing vessels and sweeping away parked cars. Initial results indicate that most of the slip for the 2003 event occurred at deeper focal depths than that for the 1952 event. In addition, the tsunami that was generated by the 2003 earthquake mostly affected the rugged, sparsely inhabited coastlines of southern Hokkaido.

Large ice blocks entrained during runup of the 1952 Tokachi-Oki tsunami. Photograph courtesy of the Kushiro Branch of the Japan Meteorological Agency.

Fieldwork is currently being conducted to determine the level of ground failure associated with the 2003 Tokachi-Oki earthquake and to test recently developed ground-failure-assessment techniques. CMG scientist **Robert Kayen** was invited to participate in an Earthquake Engineering Research Institute (EERI)-sponsored reconnaissance of the 2003 Tokachi-Oki earthquake in Hokkaido to report on the locations and severity of landslides and other damage caused by ground failure. Extensive ground-failure damage was reported at port facilities, river embankments, and river deposits in southeastern Hokkaido, especially in the Tokachi and Kushiro areas. In 2001, **Rob** (then a visiting professor at Kobe University) conducted numerous spectral-analysis-of-surface-wave (SASW) tests at Kushiro and other locations of previous ground failure in Hokkaido and is familiar with the region. The SASW test, which is a non-invasive way to produce a shear-wave-velocity profile of the ground, is used to quantitatively assess the liquefaction potential of soil. One purpose of the reconnaissance is to evaluate the ground performance at the 2001 SASW test sites during the 2003 Tokachi-Oki earthquake. **Rob** will be joined by **Yasuo Tanaka** (Kobe University), **Takahiro Sugano** (Japan Port and Harbor Research Institute), **Scott Ashford** (University of California, San Diego), and **David Keefer** (USGS, Earthquake Hazards team).

Knowledge about earthquakes and their effects learned in one of the most seismically active regions in the world will be applied to study and help mitigate damage from earthquakes and tsunamis along U.S. coastlines.❁

***Kenji Hirata** works in his office during his time as a visiting scientist at the USGS in Menlo Park, CA.*

USGS Participates in Marion County Springs Festival in Florida

By Lisa Smith

On September 27, the U.S. Geological Survey (USGS) hosted a booth at the second annual Marion County Springs Festival, held from 10 a.m. to 4 p.m. at Rainbow Springs State Park near Dunnellon, FL. Rainbow Springs is a magnitude-one spring that produces approximately 500 million gallons of clear water each day (see note at end of article for an explanation of spring magnitudes).

A mix of public and private organizations sponsored the festival, including Progress Energy, the Dunnellon Chamber of Commerce, Rainbow Springs State Park, the Marion County Clean Water Program, the Southwest Florida Water Management District, the St. Johns River Water Management District, Mister Landscaper, the U.S. Forest Service, Silver Springs Attractions, the Ocala/Marion County Chamber of Commerce, and others. About 30 groups hosted booths at the event, which was coordinated by **Larry Chalfant** of the Marion County Clean Water Program.

The purpose of the festival is to educate the public on Florida springs, their value, and how everyone can make a difference in their preservation for the betterment of the community. This year's festival drew approximately 1,000 visitors. Educational seminars were held throughout the day. Booths set up around the park had displays and literature available for the public. Speakers included State Senator **Nancy Argenziano** (keynote speaker), Marion County Commissioners **Jim Payton** and **Parnell Townley**, and other public officials. **Trudy Phelps**, a hydrologist at the USGS office in Altamonte Springs, gave a seminar entitled "Quality of Groundwater in the Silver Springs Area." Jon Semmes and the Florida Friends, a local band, provided live country music. Families enjoyed swimming in the sparkling turquoise water and picnicking at the park facilities.

Leel Knowles, a hydrologist at the USGS office in Altamonte Springs, was one of the volunteers staffing the USGS booth. **Leel's** studies include measuring surface waters in the Indian River Lagoon to determine the quantity of runoff entering the estuarine environment, and developing a water budget for Rainbow Springs and Silver Springs. Evapotranspiration is the largest component of the water budget besides rainfall. **Leel** is currently studying how wetlands are recharged, by investigating wetlands' response to evapotranspiration, soil moisture, and rainfall. These data are placed in a State-wide network and used in numerical models to predict what will happen in various scenarios. Of particular concern is how much water can safely be withdrawn without causing undesirable effects on the surface. If the models indicate that water levels will fall below an acceptable threshold, actions can be taken to reduce the amount withdrawn from wetlands.

*Public affairs specialist **Hannah Hamilton** (left) from the USGS office in Gainesville, and **Diane Easton** of Project Wild, an educational outreach program.*

Harley Means, a geologist with the Florida Geological Survey (FGS) in Tallahassee, staffed a booth for the FGS, a division of the Florida Department of Environmental Protection (DEP). His presentation, "Where Does Our Springs Water

(Springs Festival continued on page 9)

(Springs Festival continued from page 8)

Come From?," gave an overview of the geology of the springs that flow into the Rainbow Springs basin. He also spoke on the Florida Springs Initiative, a DEP program to investigate springs-related issues.

Wayne Knudson, a charter member of the Marion County Aquaholics Paddlers Group, a canoeing and kayaking club with 175 members, staffed a booth for the organization, which is dedicated to the conservation and preservation of springs. **Wayne** conducted the opening ceremony, "Sacred Water Dedication," in full Native American garb. In 1997, the Aquaholics Paddlers officially adopted the Oklawaha River from the Greenway Trails System. Three or four times a year, they do a river cleanup and had their most recent collection of garbage on display. The Aquaholics' Web site is at URL **http://www.geocities.com/mcaquaholics/**.

People of all ages and backgrounds attended the event. Organizers hope that the festival will stimulate year-round activity in the community. Planning is already underway for the third annual Marion County Springs Festival, which will be held in September 2004 at the following springs: Silver Glen Springs on September 24, Silver Springs Attraction on September 25, and Juniper Springs on September 26, 2004. For more information, please contact the Marion County Clean Water Program at (352) 671-8364, or the Marion County Chamber of Commerce at (352) 629-8051.

Note: *The USGS Fact Sheet "Springs of Florida" (FS 151-95, available online at URL* ***http://fl.water.usgs.gov/Abstracts/fs151_95_spechler.html****) notes that springs can be classified on the basis of several characteristics, including discharge rate, aquifer source, or water temperature. The most common classification of Florida's springs is by discharge rate.* **O.E. Meinzer**, *a USGS pioneer groundwater scientist, devised a classification system in 1927 based on discharge rate; for example, a magnitude-one spring discharges at 65 Mgal/day or more. The classification system ranges from magnitude one through magnitude eight, with magnitude-eight springs discharging less than 0.65 Mgal/day.*

Coastal and Marine Geology Team Helps Guide More Than 1,000 Students Through USGS Earth Science Week Exhibits

By Helen Gibbons

On October 14, U.S. Geological Survey (USGS) personnel in Menlo Park, CA, hosted more than 1,000 students, mainly 4th- through 7th-graders, as the kids and their teachers visited nearly 30 exhibits set up around campus for Earth Science Day, a 1-day celebration of this year's Earth Science Week (Oct. 12-18).

Members of the Coastal and Marine Geology (CMG) team were important contributors to this event, in which school groups arrived at one end of campus and followed a prescribed route to presentations in several buildings. The first stop was "The Microscopic World of One-Celled and Multi-Celled Organisms," presented by CMG scientist **Mary McGann** in a conference room in Building 1.

First impressions are important, and **Mary** gave a fine first impression of the USGS as she interacted with the students and offered vivid analogies to help them understand why planktonic foraminifers (or forams) have the shapes they have, how abundant benthic forams are in sea-floor mud, and just how tiny most forams are. She told of a Japanese foram (*Trochammina hadai*) that has recently invaded San Francisco Bay, demonstrated how foram-rich mud samples are collected and processed, and, of course, invited the students to look through numerous microscopes set up around the room. The energetic **Mary** worked without a break during the student tours, from about 8:30 a.m. until 2:30 p.m.,

When the fast-arriving students began to overflow the hallways of Building 1, ***Bruce Rogers*** *(in back) got creative and held groups outside, pointing out crystals in a granite slab that faces the walkway and using them to explain how granite crystallizes, how the Sierra Nevada mountains were formed, and why the granitic rocks of the Sierra attract so many rock climbers.*

Mary McGann *asks students what shape they think would best help planktonic forams float (she's holding a clue in her hand).*

(Earth Science Week continued on page 10)

(Earth Science Week continued from page 9)

and she must have made it look easy—one of the parents accompanying a school group asked, "Do you offer this every day?"

When buses began arriving one right after another, the student groups had to be held back and entertained while they waited their turn to enter the room housing **Mary's** exhibit. Luckily, many CMG team members had volunteered to monitor Building 1 hallways and help the students view the numerous posters and displays on the hallway walls. The creativity and positive energy of these volunteers were critical to the day's success. They were (in alphabetical order) **Carolyn Degnan**, **Venilda Dominguez**, **Greg Gabel**, **Helen Gibbons**, **Melissa Ingraça**, **Dan Mosier**, **Carol Reiss**, **Kevin Orzech**, **Bruce Rogers**, **Laura Torresan**, and **Florence Wong**.

Although the student groups were a bit more spread out by the time they reached the Coastal and Marine Geology team's second exhibit across campus in Building 3, the scene was still what CMG scientist **Susie Cochran-Marquez** described as "controlled chaos." She helped bring order to that chaos by ushering students in and out of the area where presenters **Tom Reiss** and **Gerry Hatcher** showed how

***Gerry Hatcher** (left) and **Tom Reiss** showed students how the USGS has used current drifters (instrumented orange saucers hanging at each end of frame) to track coral larvae in Hawaiian waters.*

the USGS has been "Using Current Drifters to Track Coral Larvae in Hawaii" (see related article in September 2003 *Sound Waves*). For this exhibit, **Tom Reiss** built an easy-to-assemble, lightweight frame that supported a video player and monitor on a central shelf and two large current drifters, one suspended on each side of the frame. **Gerry** and **Tom** took turns talking the students through a short video that showed the underwater spawning of corals off West Maui, the deployment of current drifters above the spawning corals, and the recorded tracks of the drifters as they floated along with the coral larvae (to view an animation of the drifter tracks, visit URL **http://walrus.wr.usgs.gov/infobank/a/a403hw/html/drifter.mpg**). After the video, **Gerry** and **Tom** fielded questions and gave the students a chance to pick up handouts and view the video components—drifter shells, global-positioning-system (GPS) unit, radio for transmitting position data to shore, strobe light to warn boaters of the drifter's presence, and so on—up close.

It was about 3:30 p.m. when the last students finally left the conference room where the drifters were on display. It had been a long day, but the unflagging good cheer and creativity of USGS volunteers all over campus had helped make the event exhilarating for everyone. To learn more about Earth Science Day at the USGS in Menlo Park, please visit URL **http://wrgis.wr.usgs.gov/wgmt/education/**.

USGS Helps Celebrate the Monterey Bay National Marine Sanctuary's 11th Anniversary

By Helen Gibbons

The U.S. Geological Survey (USGS)'s Coastal and Marine Geology (CMG) team helped celebrate the 11th anniversary of the establishment of the Monterey Bay National Marine Sanctuary by hosting a booth at the annual Shark Festival and Sanctuary Celebration, held September 27 in Santa Cruz, CA. Fine weather, live music, and inviting displays drew hundreds of visitors to the festival, where many of them stopped by the USGS booth to pick up handouts and check out the exhibits.

This year, **Gerry Hatcher**, **Tom Reiss**, and **Susie Cochran-Marquez** put together a display of current drifters used to track coral larvae off West Maui, Hawaii (see article in September 2003 *Sound Waves*). **Mary McGann** prepared displays of single-celled and multicelled microscopic

Visitors crowd the USGS booth (center) at the Shark Festival and Sanctuary Celebration on the Santa Cruz Wharf.

marine organisms for visitors to view through microscopes.

A steady stream of people were attracted to the booth by the microscopes and the bright-orange drifter shells. The visitors were educated and entertained by a large crew of CMG personnel, who took turns staffing the booth throughout the day (in alphabetical order): **Bill** and **Maria Adams**, **Carolyn Degnan**, volunteer **Nick Degnan**, **Amy Draut**, **Amy Foxgrover**, **Helen Gibbons**, **Ann Gibbs**, **Gerry Hatcher**, **Elaine Lakin-Wells**, **Mary**

(Sanctuary Anniversary continued on page 11)

(Sanctuary Anniversary continued from page 10)

McGann, **Greg Piniak**, **Curt Storlazzi**, and **Dana Wingfield**. Special thanks go to **Jane Reid**, who transported handouts and display materials from team offices in Menlo Park, Redwood City, and Santa Cruz to the festival site on the Santa Cruz Wharf. The contributions of all involved made it a highly successful and enjoyable day!

Mary McGann *(second from right) helps a young visitor view microscopic marine organisms, while* ***Amy Draut*** *(left rear) stands by to stamp cards for kids participating in the festival's treasure hunt.*

Curt Storlazzi *tells a visitor how the team used current drifters to track coral larvae off West Maui, Hawaii, in an effort to better understand controls on coral-reef health.*

USGS Hosts a Booth at the Sally Ride Science Festival at Stanford University

By Carol Reiss

The U.S. Geological Survey (USGS)'s Coastal and Marine Geology (CMG) team staffed a booth at the Sally Ride Science Festival held at Stanford University on October 4, 2003. **Sally Ride**, America's first woman in space, created this national program with the mission of supporting elementary- and middle-school girls in their exploration of the worlds of science, mathematics, and technology.

USGS scientists **Carol Reiss** and **Stephanie Ross** displayed spreading-ridge rocks, minerals, and fauna alongside a video of black smokers (hot-water vents at spreading ridges, where mineral-rich water spews from the vents, mixes with cold ocean water, and precipitates tiny particles that make the vent water look black). Available to view through microscopes were artfully displayed microorganisms sampled off Cordell Bank, north of the Farallon Islands, and provided by **Mary McGann**. A rack full of USGS brochures was nearly emptied by enthusiastic youth and parents!

The Sally Ride Science Club, which sponsored the festival, was created to increase the number of girls who are technically literate and who have the foundation they need to go on in science, math, or engineering. According to the Sally Ride Science Club, as many elementary-school girls as boys are interested in math and science, but by eighth grade, girls' interest and confidence in their abilities have eroded, even though they perform as well as boys. The Sally Ride Science Festivals are open to all ages but are especially targeted at sustaining the natural interest of girls in the critical upper-elementary and middle-school ages. This event, which drew about 750 girls and their parents, was an awesome venue in which to share our enthusiasm for the scientific research we conduct here at the USGS.

Stephanie Ross *(far right in large photo) and* ***Carol Reiss*** *(on left in small photo) took turns staffing the USGS booth, and each had an opportunity to meet astronaut* ***Sally Ride*** *(red shirt) when she stopped by the booth.*

A Report on the 25th Annual Blacks in Government National Training Conference

By Glynn Williams

The U.S. Geological Survey (USGS)'s Coastal and Marine Geology Program, Woods Hole Field Center, and the Special Emphasis Program Advisory Committee sponsored **Glynn Williams'** trip to the Blacks in Government (BIG) National Training Conference held in Denver, CO, August 25-29, 2003. The 25th annual BIG conference was exciting and informative, packed with employee-development, technical, and financial work-

(BIG Training continued on page 12)

(BIG Training continued from page 11)

shops, covering such topics as information technology (IT) and investment planning. There were insightful and revealing discussions of diversity issues, job enhancement, retirement preparation, and government-spending concerns. Some of the distinguished panelists included BIG **President Greg Reeves**, other executive BIG members, and local government officials, including Colorado **Governor Bill Owens** and newly elected Denver **Mayor John W. Hickenlooper**. **Greg Reeve's** first-year opening conference speech as BIG president was impressive and demonstrated his preparedness for the challenges ahead.

A Webcast of the opening session is available at URL **http://www.bignet.org/webcast/august2003.htm**.

Mario Jones *(left, USGS Human Resources Specialist, Denver, CO) and* ***Glynn Williams*** *(Coastal and Marine Geology Program, Woods Hole, MA).*

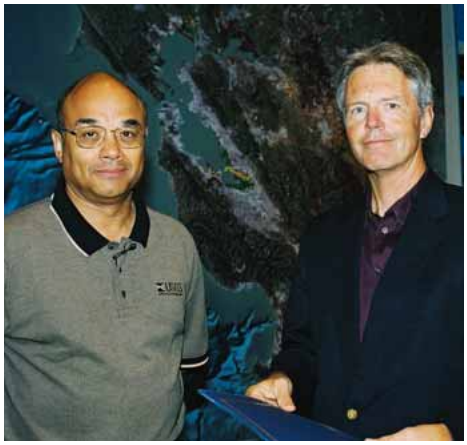
Some USGS personnel at the 25th annual BIG conference (left to right): ***Glynn Williams*** *(Coastal and Marine Geology Program, Woods Hole, MA),* ***Pat Schassburger*** *(Regional Outreach Coordinator, Denver, CO), and* ***Stephen Vandas*** *(Regional Outreach Coordinator, Denver, CO).*

The audience at the opening plenary session was spellbound by ***Tara Hooper's*** *rendition of our national anthem.*

Denver's ***Mayor Hickenlooper*** *at the podium.*

Research Ecologist Jim Estes Receives a Meritorious Service Award from the Department of the Interior

Jim Estes, a U.S. Geological Survey (USGS) research ecologist and adjunct professor at the University of California, Santa Cruz, received a Meritorious Service Award at the USGS Western Region Awards Ceremony held October 15, 2003, in Menlo Park, CA. The Meritorious Service Award was established by the Department of the Interior in 1948 and is the second-highest departmental honor award that can be granted to a career employee (the highest is the Distinguished Service Award).



Western Regional Geologist ***Wes Ward*** *(left) had the pleasure of presenting USGS research ecologist* ***Jim Estes*** *with a Department of the Interior Meritorious Service Award.*

Western Regional Director **Doug Buffington** read the following summary of **Jim's** citation at the ceremony:

> **Jim Estes** is awarded this citation in recognition of his exceptional research on the role of predators in coastal marine ecosystems. **Jim** discovered the keystone role of the sea otter in kelp forests, uncovering the dramatic effects that disturbing one element in this ecosystem had on its other elements. **Jim** has documented the collapse of the sea-otter/kelp-forest ecosystem in western Alaska and the role of killer-whale predation in the collapse [see article in October 2003 *Sound Waves*]. His outstanding and innovative research has taken the knowledge of worldwide marine ecosystems to new levels of understanding and appreciation, revealing the clear role of overfishing and consequent changes in ecological communities. **Jim's** work has already influenced global decision makers to set new policy goals for restoration and management of coastal ecosystems.

Gloria Maender Receives Communicator of the Year Award

Gloria Maender, outreach coordinator for the U.S. Geological Survey (USGS)'s Western Ecological Research Center and contributing editor of *Sound Waves*, received the Western Region Office of Communications' Communicator of the Year Award at the USGS Western Region Awards Ceremony held October 15, 2003, in Menlo Park, CA. The Communicator of the Year Award is given to an individual or group that has significantly contributed to raising the visibility and value of USGS science to external or internal audiences.

*Western Regional Geologist **Wes Ward** congratulates **Gloria Maender** upon her receipt of the Western Region Office of Communications' Communicator of the Year Award.*

Western Regional Director **Doug Buffington** read this summary of **Gloria's** citation at the ceremony:

> The award this year is presented to **Gloria Maender**, with the Western Ecological Research Center. **Gloria** is the gold standard for communications and outreach work in the USGS. Not only is she a very positive and energetic force in her center, but also in the entire Western Region and at Headquarters. Those who have worked with **Gloria** through the years are always impressed by her high standards, intelligence, sensibility, and good humor, as well as her unflagging ability to "know" and "sell" a good story. Just as importantly, she recognizes sensitive issues and handles them with expertise. She is genuinely passionate and dedicated to the USGS' mission and helping the public understand what we do by turning complex research results into meaningful, understandable, and exciting information. **Gloria** has made it her business to know each research scientist at her center and the work he or she does, so that she can promptly seize outreach opportunities whenever they arise. **Gloria** exemplifies how the regions and science centers can work together in ways that enhance the USGS mission.❁

Farewell to Fausto—Marine Realms Information Bank Leader Leaves USGS for Academia

By Debbie Hutchinson, Tom Aldrich, and Fran Lightsom

After working for more than 5 years on information and knowledge-bank research at the U.S. Geological Survey (USGS)'s Woods Hole Field Center, **Fausto Marincioni** left the USGS in September to take a faculty position in the Department of Earth and Environmental Sciences at Long Island University in New York. During his time in Woods Hole, **Fausto** completed his dissertation for the University of Massachusetts, Amherst, in information management during natural disasters. The legacy he leaves for the USGS is the unique software package that is an implementation of the concept of a distributed geolibrary, called the MRIB (Marine Realms Information Bank; see URL **http://mrib.usgs.gov/**). This system catalogs World Wide Web pages with unique metadata that allow users to search for information from any of many perspectives, enabling geographically based information registered in MRIB to be retrieved quickly and accurately. Beyond this notable achievement, **Fausto's** unusual wit, remarkable tennis ability, enthusiastic softball spirit, disarming Italian charm, and dedication to the USGS will be missed. We look forward to working with the students he promises to send our way for collaborative projects. In the final words of the farewell song (sung to the tune of "The Jolly Miller," an old English folk song) recorded for posterity at **Fausto's** going-away party:

***Fausto Marincioni**, with his unforgettable smile and charm.*

> We don't know how we'll get along
> Without his goodly cheer,
> As his spirit of life,
> Which charms away strife,
> Will no longer fall on our ear.
>
> *Refrain*:
> But this we know for certain,
> Forever we shall sing:
> If you've got a page,
> It's all the rage
> To be in M Rye B.❁

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