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Fieldwork

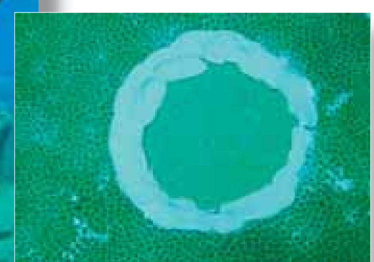
Coral Coring in Flower Garden Banks National Marine Sanctuary—a Collaborative Effort

By Chris Reich and Don Hickey

U.S. Geological Survey (USGS) scientists participated in a multiagency cruise during the week of May 23 to collect coral cores for paleoclimate studies in the Gulf of Mexico. The cruise was a milestone for managers at the National Oceanic and Atmospheric Administration (NOAA) Flower Garden Banks National Marine Sanctuary and researchers from Texas A&M University, who had postponed the cruise six times because of dive-boat engine failures or bad weather. This time it went off without a hitch—no mechanical glitches with the dive boat (merchant vessel *Fling*), the best weather the boat operators had seen in a long time, and a drilling team composed of some seasoned veterans from both NOAA and the USGS. In addition, **Emma Hickerson**, research coordinator for Flower Garden Banks National Marine Sanctuary, was able to gather a group of coral-disease researchers from Mote Marine Laboratory, George Mason University, and NOAA to look into a recent occurrence of white-plague disease in the sanctuary. The plague is the first-recorded coral disease for the area and has sanctuary management concerned about the future health of the pristine coral-reef system.

Flower Garden Banks National Marine Sanctuary is composed of three banks (East Flower Garden Bank, West Flower Garden Bank, and Stetson Bank) and encompasses an area of approximately 40 mi^2. The coral reefs cap the tops of salt domes that are believed to have formed approximately 10,000 years ago. East and West Flower Garden Banks are home to an almost-unheard-of 80-percent live-coral cover; Stetson Bank contains few corals as a result of its close proximity to the coast. For additional details on the Flower Garden Banks, visit URL **http://www.flowergarden.nos.noaa.gov/**.

◄ **Don Hickey** (right) cores one of the large Montastraea faveolata coral heads as **Chris Reich** (left) waits to help extract the core. Photograph by **Simone Francis** (Texas A&M University).



▲ After extracting a core, drillers inserted a cement plug with palygorskite clay around its edge into the hole. The coral will eventually overgrow the plug and fill the hole. Photograph by **Emma Hickerson**, Flower Garden Banks National Marine Sanctuary.

The primary focus of the cruise was to collect coral cores from two species: *Montastraea faveolata* and *Siderastrea radians*. Three cores of *M. faveolata* were recovered from East Flower Garden Bank, and two from West Flower Garden Bank; the longest core measured 2.1 m. The estimated growth rate of this species is approximately 10 mm/yr; thus, the long core will provide a record going back about 210 yr. At West Flower Garden Bank, two *S. radians* heads were cored, and a 2.2-m-long core was recovered. On the basis of *S. radians'* typical growth rate of about 4 to 6 mm/yr, that core will give researchers an unprecedented record back some 500 years for the Flower Garden Banks area. This cruise is the first on which such long coral cores have been collected within the marine sanctuary boundaries.

The cores will be analyzed for $\delta^{18}O$ value, which will be used as a proxy indicator of paleoclimate sea-surface salinity and temperature for the Flower Garden Banks area of the Gulf of Mexico. **Amy Bratcher** (Ph.D. candidate at Texas A&M University and one of the drillers during the cruise) will slab the cores, sample the core slices, and run the samples on an inductively

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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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Fieldwork, continued

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coupled plasma mass spectrometer (ICP/MS). In addition, **Chuck Holmes** (USGS, St. Petersburg, FL) will use laser-ablation ICP/MS techniques on the core slabs to observe variations in trace-metal contents. Variations in trace-metal contents within the coral skeletons may lead to a better understanding of Mississippi River discharge in the Gulf of Mexico, as well as fluctuations in the Gulf of Mexico Loop Current. These results, the first obtained for the Flower Garden Banks area, will provide new insights into coral growth and other physical-oceanographic processes.

None of this work would have been possible were it not for the well-rounded cast of drillers and support divers assembled by **Emma Hickerson**. The corals were drilled by three teams, each consisting of three divers. This arrangement worked well because diving in water depths of 65 to 80 ft required divers to spend 2.5 hours at the surface between dives to avoid physiological problems. Continually rotating the three teams allowed each team to conduct three to four dives each day. All participants brought a wealth of knowledge about the Flower Garden Banks and shared their previous experiences in coral coring.

Location of study sites within Flower Garden Banks National Marine Sanctuary. Both East and West Flower Garden Banks were visited for coring. (Modified from figure provided by Flower Garden Banks National Marine Sanctuary.)

*Coral cores collected from coral heads at West Flower Garden Bank. Photograph by **Emma Hickerson**, Flower Garden Banks National Marine Sanctuary.*

Research

Brief Tsunami Warning Startles U.S. West Coast, Reveals Strengths and Weaknesses in Tsunami Preparedness

By Helen Gibbons

A magnitude 7.2 earthquake off the northern California coast on the evening of June 14 triggered a brief tsunami warning for the entire U.S. west coast, and a flurry of news-media inquiries to earthquake and tsunami experts in the U.S. Geological Survey (USGS) and the National Oceanic and Atmospheric Administration (NOAA). NOAA's National Weather Service issued the tsunami warning about 5 minutes after the earthquake struck and cancelled it

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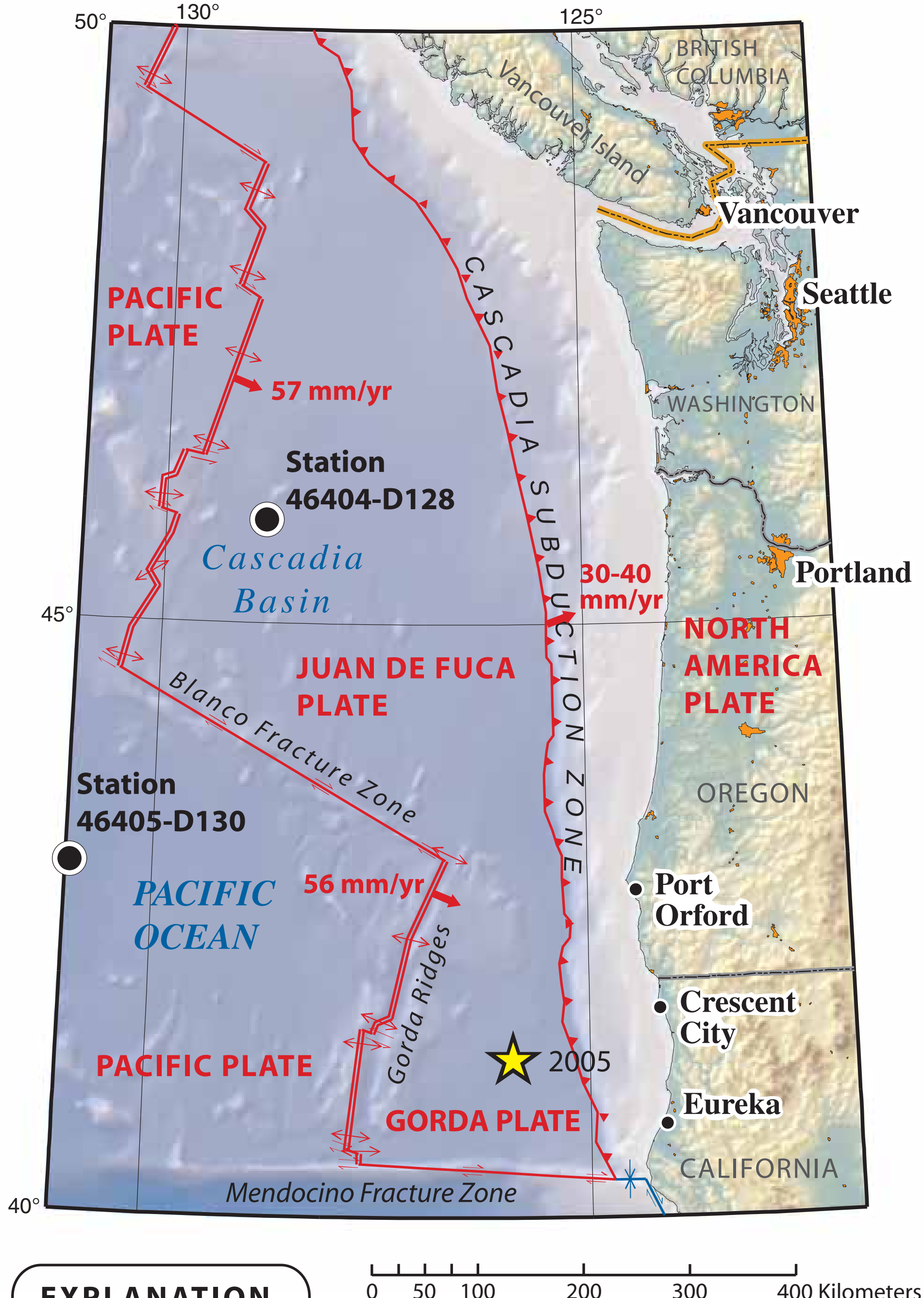
(Tsunami Warning continued from page 2)

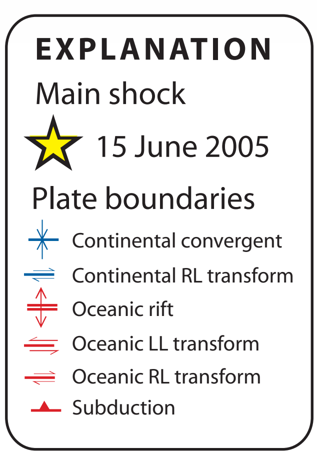
about 1 hour later, after data received from shoreline tide gauges and ocean-bottom sensors showed that the earthquake had generated only a small tsunami, about 1 cm high in the open ocean and not readily detectable at nearby tide gauges.

"This was a good test of the [tsunami-warning] system, and the system itself worked very well," said **Eric Geist**, a USGS geophysicist stationed in Menlo Park, CA. The National Weather Service issued the tsunami warning from its West Coast and Alaska Tsunami Warning Center (WC/ATWC) in Palmer, AK, at 7:56 p.m. PDT, about 5 minutes after the earthquake struck. The warning estimated that the initial wave would take just 38 minutes to travel from the earthquake epicenter to Crescent City, CA, which lies about 150 km (90 mi) northeast of the epicenter and has been hit by tsunamis in the past. One of the National Weather Service's TsunamiReady communities (see URL **http://www.stormready.noaa.gov/tsunamiready/**), Crescent City sounded its warning sirens shortly after 8:00 p.m., and thousands of residents and visitors were evacuated. In many other areas, communication problems prevented the tsunami warning from reaching the public until after the warning had been canceled. "Once an alert is issued by the National Weather Service, it gets relayed to two large groups: emergency managers and the public. Tuesday's warning was a good wakeup call," said **Geist**. "It revealed some gaps in communication and planning that local agencies and communities now have an opportunity to fix."

The tsunami warning was based on the earthquake's large magnitude—initially calculated at 7.4 by the WC/ATWC and later revised to 7.2 by the USGS National Earthquake Information Center (after information about all the long-period seismic waves had been received from stations around the world). Concern was increased by the epicenter's location near the Mendocino Triple Junction, an intersection of three faults that include the Cascadia subduction-zone thrust fault, which is capable of generating large tsunamis. These parameters—magnitude and location—can

(Tsunami Warning continued on page 4)





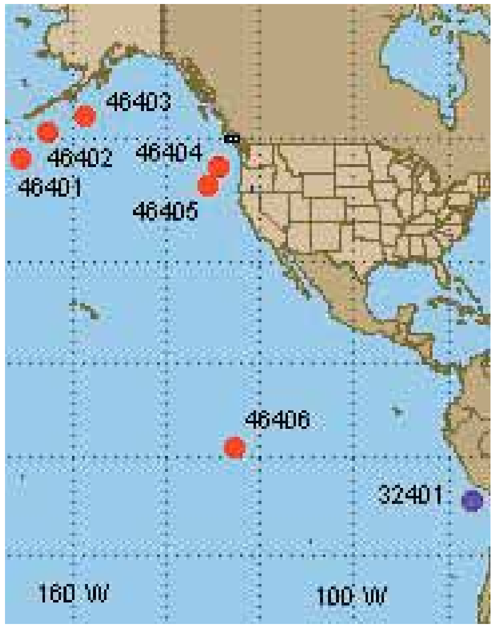
*Tectonic setting of the magnitude 7.2 earthquake that triggered a brief tsunami warning for the U.S. west coast. The earthquake occurred on June 15 UTC (Coordinated Universal Time), which was June 14 PDT. Star, earthquake epicenter; dots, approximate locations of NOAA ocean-bottom tsunami sensors. Thick red arrows show directions of plate motion. RL, right lateral; LL, left lateral. (Map modified from poster at URL **http://wwwneic.cr.usgs.gov/neis/poster/2005/20050615.html**.)*

(Tsunami Warning continued from page 3)

be calculated within minutes of the earthquake's occurrence, allowing a warning to be issued fast enough for evacuation of the closest coastal areas.

Information that takes longer to gather is used to determine whether a tsunami warning should be expanded, continued, or canceled. Most important is direct measurement of water levels by NOAA's ocean-bottom sensors and shoreline tide gauges—data relayed by satellite to the tsunami-warning centers. Well after the predicted arrival times, no tsunami had been clearly detected at the three tide gauges nearest the epicenter—in Humboldt Bay near Eureka, CA; at Crescent City, CA; and at Port Orford, OR. (Later analysis—after filtering out "noise" caused by wind waves and other factors—revealed that the tide-gauge data did record a tsunami; its height at Crescent City was estimated at 10 cm by the WC/ATWC.) An offshore bottom sensor farther from the epicenter recorded a miniscule tsunami—about 1 cm high—in the open ocean. After careful consideration of all available information, the National Weather Service canceled the tsunami warning at 9:09 p.m. PDT.

Analysis of earthquake data helped seismologists explain why only a tiny tsunami had been generated: the earthquake occurred on a strike-slip fault, now believed to be a left-lateral fault within the Gorda plate, a fault-ridden piece of oceanic crust being compressed and deformed by the northward-moving Pacific plate. Earthquakes on strike-slip faults produce much less vertical movement of the sea floor than do earthquakes on thrust faults—such as the thrust fault whose rupture triggered the devastating December 2004 Indian Ocean tsunami—and so strike-slip earthquakes are unlikely to generate damaging tsunamis. Such earthquakes can, however, trigger landslides capable of generating dangerous tsunamis, as noted by scientist **Bruce Turner** of the WC/ATWC, who emphasized the importance of using direct measurements of water level, rather than identification of the type of fault the earthquake ruptured, to determine when to call off a tsunami warning.



Locations of ocean-bottom tsunami sensors in the Pacific Ocean as of June 2005.

NOAA uses two types of water-level sensors to detect tsunamis: shoreline tide stations and offshore ocean-bottom sensors called DART (Deep-ocean Assessment and Reporting of Tsunamis) buoys. Currently, NOAA operates several dozen tide stations on Pacific coastlines and six DART buoys in the Pacific Ocean: two offshore the Cascadia subduction zone in northern California and the Pacific Northwest (one of these, station 46405-D130, recorded the 1-cm-high tsunami generated by the recent earthquake), three offshore the Aleutian Island subduction zone in Alaska, and one on the Equator about 5,000 km west of Peru. The Hydrographic and Oceanographic Service of the Chilean Navy (SHOA) operates a seventh sensor off the coast of Chile. (For more information, visit URL **http://www.ndbc.noaa.gov/dart.shtml**.)

Prompted by the December 2004 Indian Ocean tsunami, the United States plans to greatly expand its network of DART buoys, not only in the Pacific Ocean but also in the Atlantic Ocean and the Caribbean Sea. NOAA and the USGS held a joint workshop in early July to discuss the selection of sites for the new buoys, with the USGS providing information about which areas are most likely to undergo tsunami-triggering earthquakes, landslides, and volcanic eruptions. ☸

Outreach

Standing-Room-Only Lecture on "Tsunamis—Lessons and Questions from the Indian Ocean Disaster"

By Helen Gibbons

Listeners flocked to a public lecture on tsunamis at the U.S. Geological Survey (USGS) center in Menlo Park, CA, on June 30, their interest sparked by a tsunami warning issued for the U.S. west coast just two weeks earlier (see "Brief Tsunami Warning Startles U.S. West Coast," this issue). Planned months ago as part of the center's monthly public-lecture series, the fortuitously timed event featured three USGS tsunami experts who offered their insights to an overflow crowd of more than 250 people. **Eric Geist**, **Bruce Jaffe**, and **Brian Atwater** described the severe impact of huge waves striking countries around the Indian Ocean during the tsunami of December 26, 2004, and discussed the potential for tsunami-triggering earthquakes on the Cascadia subduction zone off northern California, Oregon, and Washington.

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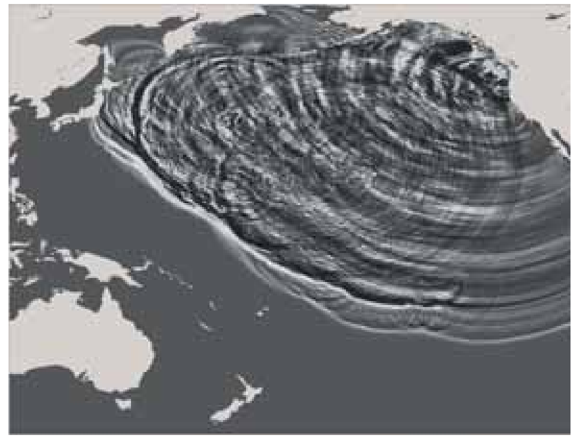
Geophysicist **Eric Geist** (Menlo Park, CA) led off the lecture with a brief introduction to tsunami basics, including an explanation of how earthquakes generate tsunamis, how tsunamis speed through the deep ocean at jet-airliner speeds (500-600 mph), and how they steepen and slow (to 20-30 mph) as they approach the shore. He used striking computer animations to illustrate important aspects of the December 2004 tsunami, including why it hit some areas harder than others and how it eventually reached coastlines all around the globe. With another computer animation, **Eric** showed what a tsunami generated by a large earthquake on the Cascadia subduction zone might look like. He sprinkled tsunami-safety tips through his talk and directed listeners to Web sites offering tsunami-inundation maps for the San Francisco Bay area (URL **http://www.abag.ca.gov/bayarea/eqmaps/tsunami/**) and information about the National Weather Service's program to promote tsunami-ready communities (URL **http://www.prh.noaa.gov/ptwc/tsunamiready/tsunamiready.htm**).

Oceanographer **Bruce Jaffe** (Santa Cruz, CA) showed dramatic photographs of coastal destruction by the December 2004 tsunami in regions visited by USGS scientists on international survey teams: Sri Lanka, the Republic of Maldives, and Indonesia's island of Sumatra. He explained how survey teams collect physical evidence that a tsunami leaves in its wake, to document its wave height and force. A specialist in the study of sediment deposited by tsunamis, **Bruce** explained how researchers attempt to use data from tsunami deposits to "back-calculate" the height and power of a tsunami. Such analysis could enable the use of ancient tsunami deposits to learn more about the size of the tsunamis that deposited them and about the likely risk of tsunamis in regions where written records of tsunamis are sparse (most everywhere but Japan). **Bruce** noted that the tsunami waves in Sumatra were higher than expected (up to 30 m high), a finding that may affect planning for tsunamis along U.S. coastlines.



Computer simulation of a tsunami generated by a large earthquake on the Cascadia subduction zone in 1700, created by ***Kenji Satake*** *of Japan's National Institute of Advanced Industrial Science and Technology. This view shows the tsunami 10 hours after the earthquake triggered it. From USGS Professional Paper 1707, "The Orphan Tsunami of 1700," to be published jointly with the University of Washington Press.*

Geologist **Brian Atwater** (Seattle, WA) focused on the U.S. Pacific Northwest, telling a "detective story" about the accumulation of evidence which finally convinced scientists that large, tsunami-generating earthquakes have occurred on the Cascadia subduction zone. The evidence includes "ghost forests" drowned by saltwater tides after earthquake-induced subsidence of coastal land, sheets of sand deposited by ancient tsunamis, and Japanese records of an "orphan tsunami"—a tsunami not associated with any local earthquake there—that struck Japan in early 1700. **Brian** explained some of the details which made the story so compelling that it transformed the scientific community's perception of earthquake hazards in the Pacific Northwest: scientists who believed in 1980 that the Cascadia subduction zone could not produce earthquakes large enough to generate tsunamis came to realize, by the mid-1990s, that it had produced many such earthquakes, the latest on the evening of January 26, 1700, as calculated from the Japanese tsunami records. (For his research on this topic, **Brian** was named one of the "Time 100," *Time* magazine's list of the world's 100 most influential people in 2005; see URL **http://www.time.com/time/2005/time100/**). **Brian** pointed out that this improved understanding of the Cascadia subduction zone's ability to produce large earthquakes and tsunamis had led to tsunami-evacuation maps for dozens of Pacific Northwest communities before the December 2004 Indian Ocean tsunami increased concern about Cascadia tsunamis.

This "ghost forest" near the mouth of the Copalis River, Washington, was killed by saltwater tides after an earthquake in 1700 caused the land to subside. Photograph taken during a very high tide in December 1997 by ***Brian Atwater****. From USGS Professional Paper 1707, "The Orphan Tsunami of 1700," to be published jointly with the University of Washington Press.*

Eric, **Bruce**, and **Brian** gave interviews to reporters before the lecture and fielded numerous questions from the audience afterward. To see an archived videotape of the lecture, including the question-and-answer session, visit URL **http://online.wr.usgs.gov/calendar/2005.html**. For more information about **Eric** and **Bruce's** tsunami research, visit URL **http://walrus.wr.usgs.gov/tsunami/**. For more information about **Brian's** "detective story," visit URL **http://www.washington.edu/burkemuseum/earthquakes/bigone/detective.html**. ❁

A Teacher, Technology, and Tadpoles—Summer Internship at USGS National Wetlands Research Center

By Susan Horton

Computer-science high-school teacher **Chasity Menard** didn't expect to be mucking around in Louisiana's Atchafalaya Swamp when she began a three-day summer internship at the U.S. Geological Survey (USGS) National Wetlands Research Center (NWRC) in Lafayette, LA. After all, she is a self-proclaimed "computer nerd," not a wetland scientist.

The internship, a "job shadow" program, is a partnership with the Iberia Parish School System and businesses in the area to offer educators an opportunity to gain firsthand knowledge of the skills, attitudes, and attributes necessary to be successful in today's workforce. **Menard** asked to be placed at NWRC because she had worked there as a student intern while majoring in computer science at the University of Louisiana, Lafayette, and she knew that the center has a cadre of technology professionals.

During the first two days of her internship, **Menard** met with USGS and IAP World Services, Inc. (contractor) staff as they worked on computer-program design, database construction, personal digital assistants (PDAs), and Help Desk calls. USGS electrical engineer **Kathy Ladner** had **Menard** review an electronic field guide to the mammals and birds of Louisiana that will be part of an educational CD-ROM on coastal-wetlands loss for students in grades K-4. **Menard** was briefed by USGS librarian **Linda Broussard** on the role of computers and the Internet in facilitating document delivery and Interlibrary Loan services, as well as how resource sharing increases scientists' access to information throughout the world. **Broussard** explained NWRC's contributions to a digital library called the National Biological Information Infrastructure (NBII), and **Menard** joined **Broussard** for a Webinar (Web training) on the use of a new version of the NBII Web Resource Input tool.

*USGS contractor **Jason Sullivan** (IAP World Services, Inc.; left) and **Chasity Menard** check a dip net for frog eggs in the Atchafalaya Swamp.*

*At the USGS National Wetlands Research Center, contractor **Susan Bergeron** (IAP World Services, Inc.; left) shows teacher **Chasity Menard** an animation for a new K-4 educational CD-ROM on Louisiana's wetlands.*

The third day of **Menard's** job shadowing held a few surprises, beginning with the warning, "We have some rubber boots and insect repellant for you; be sure to wear some long pants and a long-sleeve shirt tomorrow." **Menard**, along with a reporter and photographer from the Lafayette *Daily Advertiser*, accompanied USGS ecologist **Dana Drake** and contract biologist **Jason Sullivan** into the Atchafalaya Swamp to observe how these scientists use such technology as PDAs, remote data loggers, and the Global Positioning System to study amphibian populations in Louisiana's forested wetlands. The data logger (a.k.a. frog logger) allows the remote recording of frog calls as a way to help researchers determine what frog species are using specific habitats. The research team also looks for tadpoles and egg masses and screens frogs for possible health problems. For more information about USGS amphibian research, visit the Amphibian Research and Monitoring Initiative (ARMI) Web site at URL **http://armi.usgs.gov/**.

Menard's day with the field biologists was perhaps the most revealing about the center's use of computer technology, showing **Menard** how it extends far beyond the walls of the science center into wetland habitats. In those field settings, technology supports USGS scientists as they inventory, monitor, and analyze natural resources such as amphibians.

In the fall, **Menard** will be incorporating what she learned at NWRC into new lessons and special projects for her computer-science students at New Iberia Senior High School, challenging them to expand the ways they think about and use technology, and preparing them for a possible technology career in the real world.

*USGS contractor **Mayra Silva** (IAP World Services, Inc.; left) shows computer-science teacher **Chasity Menard** how PDAs are used by USGS researchers.*

2004 Indian Ocean Tsunami—New USGS Web Site About Initial Findings in Sumatra

A 10-day survey of the Indonesian island of Sumatra soon after it was struck by the December 2004 tsunami is the subject of a new USGS Web site at URL **http://walrus.wr.usgs.gov/tsunami/sumatra05/**. Entitled "The 26 December 2004 Indian Ocean Tsunami: Initial Findings from Sumatra," the Web site contains a wealth of information gathered during an international survey conducted from January 20 to 29, 2005. More than 500 photographs posted there illustrate the effects of the tsunami and provide glimpses into the day-to-day lives of the residents and the survey team.

The Web site was created by USGS oceanographer **Guy Gelfenbaum**, a member of the International Tsunami Survey Team, and **Laura Zink Torresan**, webmistress for the Western Coastal and Marine Geology team. (See related article, "Astonishing Wave Heights Among the Findings of an International Tsunami Survey Team on Sumatra," in *Sound Waves*, March 2005, at URL **http://soundwaves.usgs.gov/2005/03/**.) ❁

▲ *Residents and survey-team members disembark from a makeshift ferry used in place of a bridge washed out by the tsunami. (Photograph taken on January 24, 2005)*

▲ *Earthquake damage in Banda Aceh, such as this cracked wall, was much less severe than tsunami damage. (January 21, 2005)*

Guy Gelfenbaum *(left) says good-bye to some new friends on the survey team's last day in Banda Aceh. (January 29, 2005)*

Science on the Hot Seat in Public Forum About Coral Degradation

By John Kucek

Florida's coastal reefs are sites of invaluable biodiversity, as well as stunning beauty, for scientists and tourists alike. The threat of waters without the lush habitats could prove to be a nightmarish reality. On May 13, scientists, students, professors, and members of the general public met at the U.S. Geological Survey (USGS) Center for Coastal and Watershed Studies in St. Petersburg, FL, to discuss the state of coral reefs and a plan of action for preserving them. The discussion was the first of a seminar series called "Community, Science, and Environmental Policy Brown Bag Discussion," a lunch meeting held at noon. A crowd of more than 40 people met to discuss two differing viewpoints on how to remedy the degradation of U.S. coral reefs.

The meeting asked the question, "Are U.S. Coral Reefs on the Slippery Slope to Slime?", which is also the title of one of the reports presented for discussion. The article by University of Queensland, Australia, scientist **J.M. Pandolfi** and others (*Science*, v. 307, no. 5716, March 18, 2005) examines the impacts of pollution and other stresses on coral reefs, as well as what actions have proved successful in reversing reef degradation. Guest speakers addressing this controversial subject were put on the "hot seat"—literally. The seating arrangement centered on a speaker's stool in the middle of the room decorated with paper flames. As discussions started, it was clear that the exchange of ideas would be as heated as the seat appeared.

The "hot seat" provided for guest speakers at a public forum about how to deal with widespread coral degradation.

The study by **Pandolfi** and others notes that not only are the reef ecosystem's "goods and services worth more than $375 billion to the global economy each year," but the reefs also provide a habitat for a breadth of species that have little chance of flourishing anywhere else in the world. **John Ogden**, director of the Florida Institute of Oceanography in St. Petersburg and one **Pandolfi's** coauthors, was on hand to present his group's views. **Ogden** stressed that U.S. reef degradation

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(Hot Seat continued from page 7)

has definite causes, which he called the "Big Four": overfishing, pollution, global climate change, and coastal development. These economically induced factors place great stress on the reef, but, states **Ogden**, "a reduction of stress will allow the reefs to cope."

The reef's salvation may lie in strict reef zoning. "Slippery Slope..." notes actions that Australia has taken by regulating its reefs, often prohibiting visitors and marking certain areas as "no-take" zones. Similar actions, in combination with endangered-species-breeding programs and stricter pollution and development laws, could be a big step in reversing the current direction of U.S. reefs.

The counterpoint article was **Eugene Shinn's** "Mixed Value of Environmental Regulations: Do Acroporid Corals Deserve Endangered Species Status?" (*Marine Pollution Bulletin*, v. 49, no. 7-8, October 2004). Branching corals of the genus *Acropora*—major reef builders in the Caribbean—drastically declined throughout the region in the late 1970s and early 1980s, leading to calls for their legal protection. But **Shinn**, a USGS geologist, believes that scientists should be wary of diving headfirst into regulation. Before supporting an endangered species listing for acroporid corals, for example, scientists must ask some questions, such as "What will endangered-species status accomplish?" and "What precedents are there for demonstrating that endangered-species listing has favorable effects on endangered species of coral?"

Shinn voiced ideas at the meeting that countered those of **Ogden**, proclaiming, "We don't know what's killing these corals." He pointed out that listing them as endangered species might restrict scientists' ability to study the corals and determine what caused their decline. He added that fellow scientists might lose credibility by taking sudden actions and not having the science to support them. Like **Ogden**, **Shinn** believes society can no longer afford to put these issues off, but **Shinn** pointed out that controlling our own population growth may be more vital to reef replenishment than going after the "Big Four" causes of reef degradation targeted by **Ogden's** group.

The meeting was an opportunity for dialogue among scientists with different backgrounds and opinions. It was quite well received, and participants suggested numerous other heated topics for future discussions.

Hurricane Discussion Analyzes the Past, Provides Forum for Concerns About the Future

By Vanessa Espinar

Florida faced a harsh hurricane season in 2004. In anticipation of what may come this year, a group of scientists, researchers, and the public gathered June 3 at the U.S. Geological Survey (USGS) Center for Coastal and Watershed Studies in St. Petersburg, FL, to discuss "Hurricanes: Predicting Their Path of Destruction."

This was the second meeting in the Community, Science, and Environmental Policy Brown Bag Discussion series, a lunchtime forum for focusing on topics of interest to scientists, policymakers, and the general public. "One of the goals of the series is to present the scientists' perspectives on issues that are in the media and are of public interest," said **Ann Tihansky**, a USGS hydrologist who has been working in science communication and is one of the series organizers. "So many times, you hear about an issue in the news, and it's only part of the story. A lot of the science gets glossed over."

Organizations represented at the discussion included the USGS, the University of South Florida (USF)'s College of Marine Science, the Florida Wildlife Research Institute (FWRI), the National Marine Fisheries Service (NMFS), the Florida Institute of Oceanography (FIO), and the National Oceanic and Atmospheric Administration (NOAA). "Some folks from the public will be there to see and hear scientists and policymakers interact," said **Chris D'Elia**, Associate Vice Chancellor for Research and Graduate Studies at USF and another of the lunch-series organizers. "This will help the public appreciate some of the constraints. The discussion will also help scientists, especially, to learn how to communicate better with the public and to listen to their concerns."

***Dick Fletcher**, chief meteorologist at WTSP Channel 10, speaks with **Vanessa Espinar**, USF journalism intern at the USGS, about the importance of informing the public about hurricane hazards.*

To kick off the discussion, three Tampa Bay-area scientists with hurricane expertise gave presentations about hurricanes. **Abby Sallenger**, USGS oceanographer and project leader of the USGS National Assessment of Coastal Change Hazards, discussed the use of technology to forecast erosion before hurricane landfall. **Sallenger** showed slides of the collapse of five-story buildings and the disappearance of houses in Orange Beach, AL, during Hurricane Ivan and said that coastal Florida might face such destruction in the future. He related historical information on hurricane activity, pointing out that from 1965 to 1990, only two hurricanes affected

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(Hurricane Discussion continued from page 8)

Florida, whereas from 1940 to 1965, 17 hurricanes made landfall in Florida. "We're now back into an active hurricane period, and over the next few years we'll see more," he said. "Most of our heavy building in coastal areas occurred during the period of low hurricane activity. Perhaps our luck has run out." Looking at the damage caused last year by Hurricane Ivan in Alabama and comparing it with the damage caused by several hurricanes in Florida provided an important opportunity to "learn from the 2004 hurricane season," said **Sallenger**.

Bob Weisberg, a professor in the USF College of Marine Science, discussed his research on modeling how different factors affect the impact of storm surge. He pointed out four factors that help determine storm-surge impact in the Tampa Bay area: storm intensity, landfall location, speed of approach, and direction of approach. "If a hurricane lands north of Tampa Bay, we get a large surge, whereas if it lands south of Tampa Bay, we get a lesser surge," he said. Direction of approach is also a factor because storms approaching from the south have less of a surge than those approaching from the north. Speed plays a role because the faster the storm moves, the less time there is for water to be moved from one place to another; hence, the smaller the surge. "Slow-moving storms make larger surges," **Weisberg** said. Hurricane Charley's rapid speed and approach from the south help explain why a high-impact storm surge did not materialize.

Dick Fletcher, chief meteorologist at Tampa Bay's Channel 10, brought a news producer along to record the event and talked about the importance of getting vital information out to the public. "No matter how many words I say or what I say, I'm not done until [the public] understands what I mean," **Fletcher** said. In addition to getting the information out to the public, he has to find a way to convince people to take action. **Fletcher** added that the media should encourage the audience to pass the message along to others. "We grew up thinking it was normal not to have a lot of storms," he said. "We had a false sense of reality." **Weisberg** agreed, "We need to educate the public more so that they will take things more seriously."

The Center for Ocean Science Education Excellence (COSEE) provided the technology for a Webcast that allowed virtual guests to join in the discussions. After the scientists presented their various perspectives, the group discussion covered topics ranging from privatizing weather information to figuring out how to condense scientific information into simple words, a task that is more challenging than it first appears.

Meetings

USGS Hosts Scientific Workshop on the Impact of Carbon Dioxide on Marine Life

By Ann B. Tihansky

The U.S. Geological Survey (USGS), in cooperation with the National Oceanic and Atmospheric Administration (NOAA) and the National Center for Atmospheric Research (NCAR), hosted a 3-day workshop, from April 18 to 20, for more than 40 scientists at the USGS Center for Coastal and Watershed Studies in St. Petersburg, FL. The workshop on "Impacts of Increasing Atmospheric CO_2 on Coral Reefs and Other Marine Calcifiers" brought together international experts to compare their research and propose courses of action to deal with the impacts of rising levels of CO_2. The scientists examined the technology needed to monitor the CO_2 system in seawater and explored the best methods for sharing their knowledge and research findings. They also evaluated ways to identify future research needs that will address the observations of increased CO_2 levels in the world's oceans.

The world's oceans have absorbed about 30 percent of the CO_2 released by human activity in the past several decades, thus slowing global warming. This removal of CO_2 from the atmosphere has come at a cost, however, to coral reefs and other marine life, according to **Richard Feely**, an oceanographer at NOAA's Pacific Marine Environmental Laboratory. "Rising concentrations of CO_2 will significantly impact our oceans by drastically altering their pH balance," explained **Feely**, coauthor of a study on CO_2 and the oceans published last year in the journal *Science* (v. 305, no. 5628, July 16, 2004).

Researchers say the lower pH of ocean water means that

*Panelists at the CO_2 workshop press conference included scientists from governmental agencies and academic institutions (left to right): **Peter Betzer** (University of South Florida), **Joanie Kleypas** (NCAR), **Chris Langdon** (University of Miami), **Vicky Fabry** (California State University), **Richard Feely** (NOAA), **Lisa Robbins** (USGS), and **Chris Sabine** (NOAA).*

(CO_2 Workshop continued on page 10)

(CO_2 Workshop continued from page 9)

organisms that secrete calcium carbonate skeletons, such as corals and many microscopic plankton in the open ocean, will secrete calcium carbonate at much slower rates. "Increasing atmospheric CO_2 is damaging to coral reefs in two ways," says NCAR scientist **Joanie Kleypas**. "Coral bleaching is a visible consequence of warmer waters. While the effects of lower-pH ocean water on coral growth are not as visible [as bleaching], they are probably just as important to the coral-reef ecosystem." Photographs of malformed coccolithophorids taken by **Ulf Riebesell** of the Alfred Wegener Institute, Germany, illustrated how skeletal structures can be affected by changes in pH. Detrimental effects on the health of primary and secondary producers, a critical food source in the open ocean, can have broad implications for the health of ocean food webs.

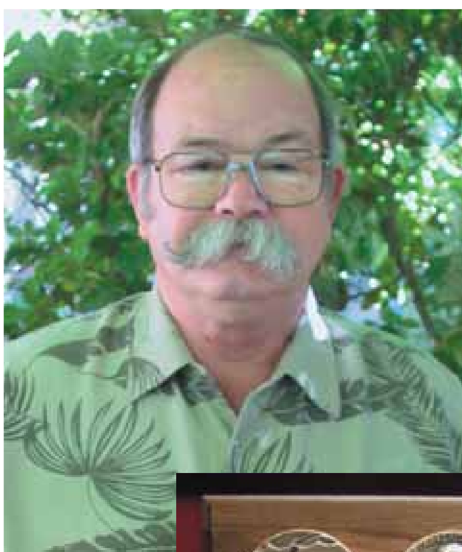
The workshop was followed by a press conference on April 20, with a panel of participating scientists led by **Richard Feely** sharing the findings and results of the workshop. A summary of the findings will be released by NCAR in the fall.

Awards

Bill Normark Receives a Medal Named for His Early Mentor, Francis P. Shepard

U.S. Geological Survey (USGS) geologist **William R. Normark** has been awarded the Francis P. Shepard Medal for Sustained Excellence in Marine Geology by the Society for Sedimentary Geology (SEPM). **Bill** received the medal on June 21, 2005, in Calgary, Alberta, Canada, at the SEPM annual meeting, held in conjunction with the annual conference of the American Association of Petroleum Geologists. A senior scientist with the USGS Western Coastal and Marine Geology Team in Menlo Park, CA, **Bill** has received numerous honors, but this medal has particular significance for him because he knew and admired **Fran Shepard**, the pioneering marine geologist for whom the medal is named.

Below are the biography and citation that were printed in the awards-ceremony program; they will also appear, along with a written response from **Bill**, in the November 2005 issue of the *Journal of Sedimentary Research*.



***Bill Normark** was awarded the Francis P. Shepard Medal for Sustained Excellence in Marine Geology.*

Bill Normark is as well known as it is possible to be in the marine geosciences. Although born in Seattle, his geologist father hauled him away from the sea to grow up in Wyoming and Utah.

Bill, for a reason forgotten, applied to Stanford (1961) to become a geo-mathematician. **Bill's** required introductory course in geology was providentially taught by **Bill Dickinson**. The geo-hook was set, and in his third year, **Bill** traded his math tables for a Brunton. The hook was fastened deeper by **Ben Page's** lecture based on **Bob Dietz's** essay "Commotions in the Oceans." **Bill's** career path was now clear, and he followed it to Scripps (1965), where they had ships he could use to see both the world and the sea floor.

Karma followed **Bill** because he was promptly invited by **Fran Shepard** to join a cruise to Monterey Canyon to have a look around at fan deposits and channel meanders. To get up close and familiar with deep-sea fans, young **Bill** was allowed to use **Fred Spiess'** newly created Deep Tow instrument, a tool perfectly matched to **Bill's** proclivity to extract the bigger picture recorded in the finer details of depositional and sedimentological patterns. His 1970 paper on fan growth defined the science of fan turbidite systems.

An opportunity in 1974 to return to sea and continue his studies of turbidite systems lured **Bill** from a faculty position at the University of Minnesota to join the USGS and help create its new marine program. A 30-year journey of intense scientific productivity (more than 200 titles) and managerial leadership earned him all the accolades and awards the USGS offers.

It is both splendid and befitting that the youth **Fran** took to sea in 1965 is SEPM's recipient of the medal bearing the name and image of **Bill's** mentor.

Biographer: **Dave Scholl**

Citation: In recognition of his pioneering research on the creation, sediment carrying, and sedimentological ways of turbidity currents, the deposition and shaping of the turbidite sequences of deep-sea fans and abyssal plains, the catastrophic emplacement of massive undersea slide bodies, and the accumulation of mineral masses at spreading centers.

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