USGS
Sound Waves Coastal Science and Research News from Across the USGS
http://soundwaves.usgs.gov/

Research

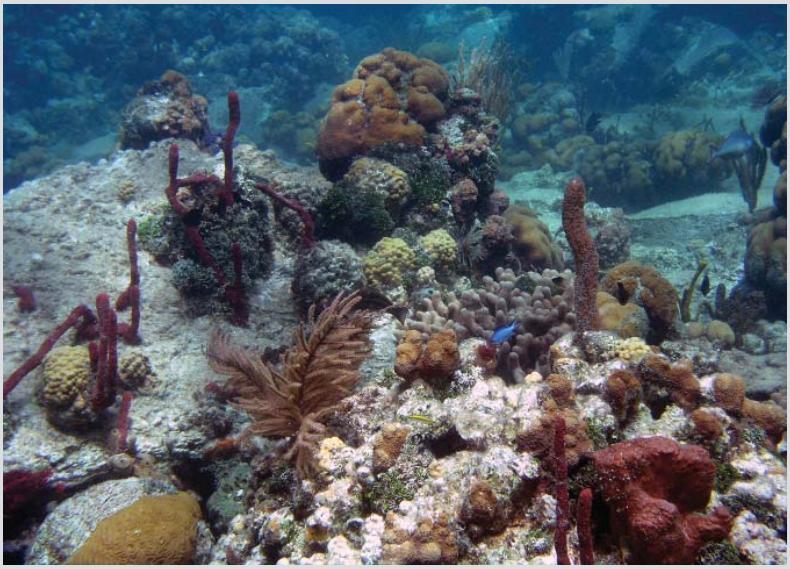
Discovering the Effects of CO_2 Levels on Marine Life and Global Climate

By Kate Bradshaw

The causes and effects of climate change have been widely discussed and debated for decades. Most scientists agree that increased carbon dioxide (CO_2) in the atmosphere resulting from the burning of fossil fuels is causing global warming, at least in part. However, global warming is not the only effect of CO_2 emissions.

In recent months, the media have begun to focus on another effect of rising atmospheric CO_2 concentrations: the effect of increasing CO_2 levels on marine life. The oceans absorb 22 million tons of carbon dioxide every day, writes **Richard Feely**, a scientist with the National Oceanic and Atmospheric Administration (NOAA) in a 2006 science brief, "Carbon Dioxide and Our Ocean Legacy" (**http://www.pmel.noaa.gov/pubs/PDF/feel2899/feel2899.pdf**). Although this absorption is said to significantly reduce atmospheric greenhouse-gas levels, some scientists have observed that such an excess of CO_2 may be altering the chemistry and biology of the world's oceans.

When the oceans absorb CO_2, the chemical reaction that takes place produces carbonic acid (H_2CO_3), which increases the acidity (lowers the pH) of seawater. Many scientists believe that decreasing pH in the oceans interferes with the ability of certain marine animals, such as corals and other calcifying marine organisms, to make their skeletons and shells from calcium carbonate minerals. Other marine species that may be affected include lobsters, snails, starfish, oysters, clams, and various species of phytoplankton, which are all species that occupy vital spots in the global-ocean food web. These environmental impacts would reverberate through economies everywhere; various industries, including tourism and fisheries, would likely suffer if the ecology of our oceans were to be altered.



*Typical coral-reef community observed in the U.S. Virgin Islands. Some species are labeled at left: Ma, boulder star coral (*Montastrea annularis*); Dc, knobby brain coral (*Diploria clivosa*); Pa, mustard hill coral (*Porites astreoides*); Pp, finger coral (*Porites porites*); D, dead coral (probably* Porites astreoides*); O, octocoral (soft coral); S, sponge. Photograph by* ***Nathan Smiley****, USGS.*

In the past year, numerous agencies and organizations have contributed time, money, research, and insight with the aim of better understanding the impact of carbon dioxide on life in our oceans. The U.S. Geological Survey (USGS) contributes substantially to this effort by conducting research and sharing knowledge with such partners as NOAA, the National Science Foundation (NSF), and the National Center for Atmospheric Research (NCAR).

In April 2005, the USGS, NOAA, and NSF cohosted a scientific workshop at the USGS Florida Integrated Science Center (FISC) office in St. Petersburg, Fla., which examined carbon dioxide's effects

(CO_2 and Marine Life continued on page 2)

Sound Waves

Editor
Helen Gibbons
Menlo Park, California
Telephone: (650) 329-5042
E-mail: hgibbons@usgs.gov
Fax: (650) 329-5190

Print Layout Editors
Susan Mayfield, Sara Boore
Menlo Park, California
Telephone: (650) 329-5066
E-mail: smayfiel@usgs.gov; sboore@yahoo.com
Fax: (650) 329-5051

Web Layout Editor
Jolene Shirley
St. Petersburg, Florida
Telephone: (727) 803-8747 Ext. 3038
E-mail: jshirley@usgs.gov
Fax: (727) 803-2032

SOUND WAVES (WITH ADDITIONAL LINKS) IS AVAILABLE ONLINE AT URL
http://soundwaves.usgs.gov/

Contents

Submission Guidelines

Deadline: The deadline for news items and publication lists for the March issue of *Sound Waves* is Thursday, January 11.
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).

Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

U.S. Geological Survey
Earth Science Information Sources:

Need to find natural-science data or information? Visit the USGS Frequently Asked Questions (FAQ's) at URL **http://www.usgs.gov/search/faq.html**

Can't find the answer to your question on the Web? Call 1-888-ASK-USGS

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

Research, continued

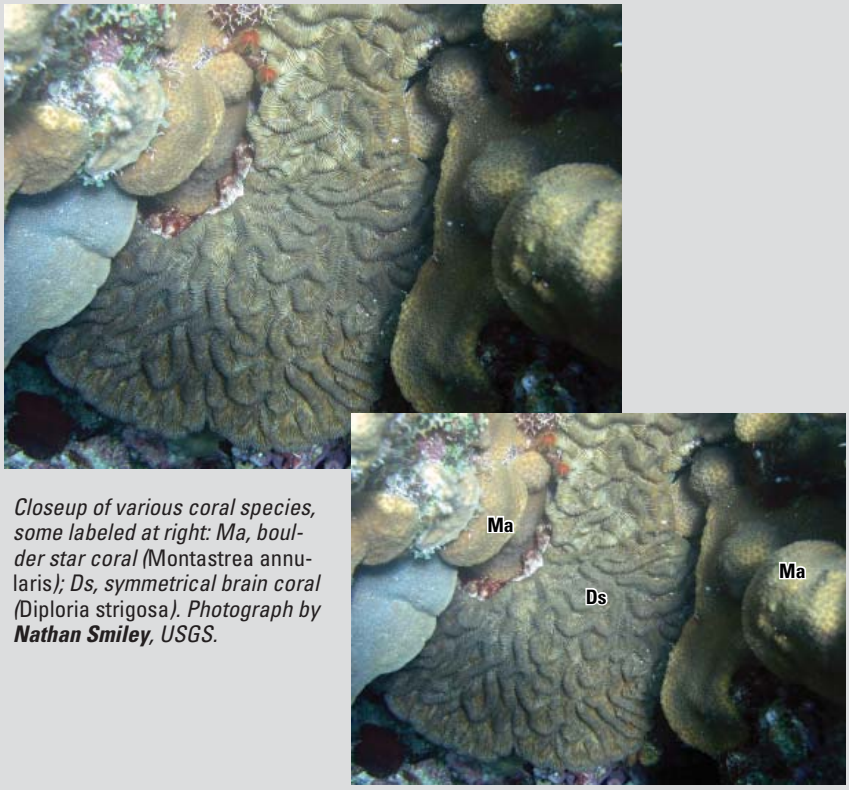
(CO_2 and Marine Life continued from page 1)

on marine life. "The workshop convened international experts to compare their research and propose courses of action to further investigate the impacts of rising levels of CO_2 on marine life," said USGS scientist **Lisa Robbins**, cohost and coorganizer of the workshop. Panelists for the workshop included scientists from government agencies and academic institutions. Topics addressed included the background and importance of the issue, major gaps in collective scientific knowledge, emerging technologies, responses of ecosystems and calcifying organisms, and the design of experimental and monitoring systems.

Working with the workshop organizers, **Joanie Kleypas** of NCAR compiled the findings and conclusions of the 2005 workshop in a report released in summer 2006, entitled "Impacts of Ocean Acidification on Coral Reefs and Other Marine Calcifiers: A Guide for Future Research" (URL **http://www.ucar.edu/news/releases/2006/report.shtml**). The report provides a collection of discoveries shared and facts established at the workshop, future predictions, and recommendations in regard to the fulfillment of pressing needs within the field and collaboration among scientists at the international level. The authors of the report are **Kleypas**, **Feely** (NOAA), **Victoria Fabry** (California State University, San Marcos), **Chris Langdon** (University of Miami), **Christopher Sabine** (NOAA), and **Robbins** (USGS).

In addition to hosting and participating in such collaborations, the USGS also is carrying out extensive research on carbon dioxide levels and their effect on rates of calcification by marine calcifiers. In the 1990s, **Lisa Robbins** and **Kim Yates**, both then at the University of South Florida, studied marine calcifying microbes and their role in sequestering atmospheric CO_2, with support from the U.S. Department of Energy and the Electric Power Research Institute. Now at the USGS, both have continued to contribute to our understanding of the effects of CO_2 on coral

(CO_2 and Marine Life continued on page 3)



*Closeup of various coral species, some labeled at right: Ma, boulder star coral (*Montastrea annularis*); Ds, symmetrical brain coral (*Diploria strigosa*). Photograph by* ***Nathan Smiley****, USGS.*

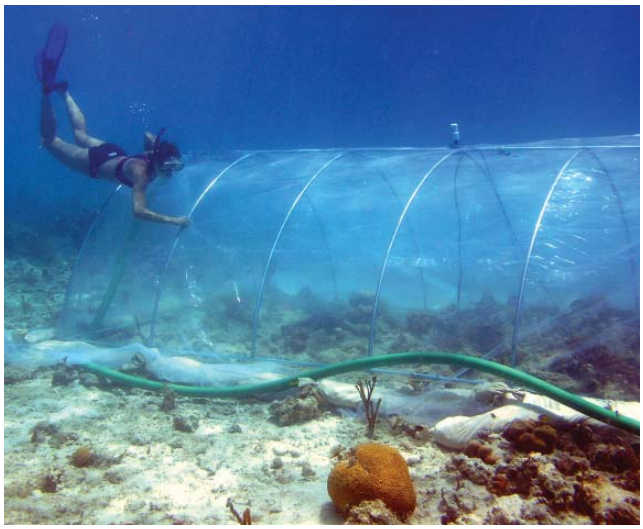
(CO_2 and Marine Life continued from page 2)

reefs, funded by the USGS Coastal and Marine Geology Program.

In March 2006, **Yates** and USGS scientist **Bob Halley** published a paper titled "CO_3^{-2} Concentration and pCO_2 Thresholds for Calcification and Dissolution on the Molokai Reef Flat, Hawaii" in the journal *Biogeosciences* (URL **http://www.biogeosciences.net/3/357/2006/bg-3-357-2006.html**). **Yates** and **Halley** used the Submersible Habitat for Analyzing Reef Quality (SHARQ) to measure, in situ, CO_2's impact on rates of calcification and dissolution in Molokai coral-reef habitats. "We want to look at how increases in atmospheric CO_2 are affecting the ability of reefs to grow," said **Yates**. Increases in pCO_2 cause a decrease in CO_3^{-2} concentration, which in turn can decrease rates of skeletal production in corals and increase rates of carbonate sediment dissolution. "The question is whether or not reefs will be able to continue to grow enough to keep up with rising sea levels, or if they will begin to erode away or become dominated by more opportunistic non-calcifying species, such as algae and sponges," said **Yates**. **Yates** and **Halley** have used the SHARQ in similar research in Florida Bay, Biscayne National Park, the U.S. Virgin Islands, and the Bahamas (for example, see "USGS Collaborates with Biscayne National Park on Coral-Reef Research" in *Sound Waves*, August 2000, at URL **http://soundwaves.usgs.gov/2000/08/**).

"What we measure," continued **Yates**, "is the net result of the calcification of corals and other marine calcifiers and the dissolution of sediments at different levels of pCO_2. This lets us determine what we call CO_2 thresholds." These thresholds are the amount of CO_2 that needs to be present before the rates at which sediments are dissolving exceed the rates at which calcifying marine organisms produce the calcium carbonate needed to make shells or skeletons. At the Molokai reef site, **Yates** and **Halley** found that the average threshold value for carbon dioxide in seawater was 654 parts per million (ppm), while the present-day level of atmospheric CO_2 is 380 ppm. Some scientists predict that atmospheric CO_2 levels will reach 560 ppm by 2065 and 700 ppm by 2100; this increase may prove to be a major threat to marine habitats. **Yates** and **Halley** found that CO_2 in seawater on the Molokai reef flat is already exceeding the 654-ppm threshold approximately 18 percent of the time.

The results of **Yates** and **Halley's** study, in combination with the work of other scientists, can help resource managers predict future impacts on marine habitats. For example, **Yates** and **Halley** are working with USGS research oceanographers **John Brock** and **David Zawada** to combine their data on reef processes with benthic-habitat maps produced by **Brock** and **Zawada**. Combining the datasets will allow scientists to develop predictive capabilities for assessing the impact of environmental stress on coral reefs. According to **Zawada**, the georeferenced imagery that he and **Brock** gather using the USGS Along-Track Reef Imaging System (ATRIS) can be combined with **Yates** and **Halley's** data in a Geographic Information System (GIS) database for use by people ranging from scientists to politicians. (ATRIS produces video footage and photographs of the sea floor keyed to precise geographic locations and water depths; see URL **http://coastal.er.usgs.gov/remote-sensing/advancedmethods/atris.html**).



***Kim Yates** inspects the Submersible Habitat for Analyzing Reef Quality (SHARQ) in preparation for taking field measurements in Long Bay, U.S. Virgin Islands.*

***Lisa Robbins** looks over the report "Impacts of Ocean Acidification on Coral Reefs and Other Marine Calcifiers: A Guide for Future Research" (URL **http://www.ucar.edu/news/releases/2006/report.shtml**), which she and other scientists wrote as a result of a workshop hosted at the USGS office in St. Petersburg, Fla., in 2005.*

Also involved in studying ocean acidification is USGS scientist **Ilsa Kuffner**, currently nearing the conclusion of an experiment she is conducting with colleagues **Paul Jokiel** and **Ku'ulei Rodgers** at the Hawai'i Institute of Marine Biology and **Andreas Andersson** and **Fred Mackenzie** at the University of Hawai'i Department of Oceanography. This experiment, jointly funded by the USGS Geologic Discipline's Coastal and Marine Geology Program and the USGS Biological Resources Discipline's Terrestrial Freshwater and Marine Ecosystems Program, is an "open seawater experiment" in which seawater continually gets pumped from coral-reef flats into tanks. It is similar to **Yates** and **Halley's** work with the SHARQ in that some parameters are controlled while others are left to reflect natural cycles and processes.

The outdoor tanks, which are 1 m^2 in area by 0.5 m deep, are exposed to full sun so that they undergo realistic diurnal, or daily, fluctuations in calcification and dissolution. There are six tanks: three

(CO_2 and Marine Life continued on page 4)

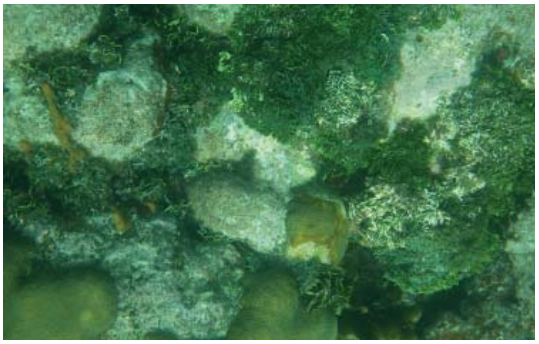
(CO_2 and Marine Life continued from page 3)

control tanks, and three "treatment tanks" with identical acid treatments. In addition to the coral colonies that the researchers added to the tanks, organisms that arrive as larvae in the circulating seawater "recruit," or settle, in the tanks over time, resulting in dynamic, naturally established biological communities. The chemistry is altered in the treatment tanks by slowly dripping dilute hydrochloric acid as the seawater passes through to simulate CO_2 levels predicted for the year 2100. Marine organisms established in the tanks include various types of algae, cyanobacteria, mollusks, and crustaceans.

Ilsa Kuffner's *experimental outdoor flowthrough tanks at the Hawai'i Institute of Marine Biology on Oahu.*

In agreement with other recent studies, **Kuffner's** group observed a 15- to 20-percent reduction in coral-calcification rates in the treatment tanks, and **Kuffner** said that she has seen some additional, surprising results, especially for the encrusting community. In the control tanks, the presence of crustose coralline algae was visually apparent, owing to its red hue. In the treatment tanks, however, this calcifying red alga, which is known to attract coral larvae for permanent settlement, was extremely sparse. "You can plainly see which tanks are treatments and which are controls," **Kuffner** said. "It's really striking."

According to **Kuffner**, this research suggests that ocean acidification "could affect the ecology of coral-recruitment processes," which means that young coral may have difficulty finding places to settle in the absence of such calcifiers. "It's been a very interesting experiment to watch," she added.



Star coral surrounded by macroalgae, imaged by the USGS Along-Track Reef Imaging System (ATRIS) in Dry Tortugas National Park off the southwest coast of Florida (URL ***http://coastal.er.usgs.gov/remote-sensing/advancedmethods/atris.html****).*

Understanding ocean acidification also may help scientists discover whether and how lower pH values interact with other environmental factors within an ecosystem, and the resulting effects on wildlife. For example, USGS coral-reef ecologist **Ginger Garrison** researches various aspects of African and Asian dust transported by global wind patterns. She is especially focused on potential impacts on human health and coral reefs due to the microorganisms and synthetic organic chemicals that may travel with the dust (for example, see "Researcher Follows Trail of Dust to Investigate Its Effects on Human and Coral Health" in *Sound Waves*, July 2006, at URL **http://soundwaves.usgs.gov/2006/07/research3.html**). **Garrison** hopes to examine whether or not a more acidic ocean will affect the availability of dust-derived nutrients to marine organisms and the solubility and bioavailability of toxins transported with African and Asian dust. "The question is, does it affect critters on the reef, and how?" **Garrison** said.

All of this information plays a vital role in the larger context of understanding and predicting the impacts of climate change. "The USGS is conducting a wide range of studies that assess the impacts of climate change on ecosystems," said **Virginia Burkett**, Global Change Science Coordinator for the USGS and one of the authors of "Climate Change 2001," the third assessment report by the United Nations Intergovernmental Panel on Climate Change (IPCC) (see URL **http://www.grida.no/climate/ipcc_tar/wg2/index.htm**). **Burkett** is also an author of the IPCC's fourth assessment report, to be released in 2007. "The IPCC is appointed to assess and synthesize the peer-reviewed literature about what the science is telling us about climate change and its impacts, and to develop a consensus on the rates and impact of increasing CO_2 and other greenhouse-gas emissions," **Burkett** said. Other data the panel uses include findings from USGS studies of the impacts of CO_2 on estuarine seagrass beds and coastal marshes. "This information is used to inform policy," **Burkett** added.

Tom Armstrong, Program Coordinator for the USGS Earth Surface Dynamics Program, uses the results of such research to inform policymakers about the effects of global climate change. He has briefed the White House science advisor and Congress on global warming. Recently, he addressed a U.S. Senate Subcommittee on the past and projected effects of climate change, using several striking results from scientific research conducted by the USGS and other agencies.

According to **Armstrong**, the Earth Surface Dynamics Program deals mainly with climate change and forecasting changes in CO_2 levels. This work often involves tracing patterns of atmospheric CO_2 concentrations over very long spans of geologic time, using such methods as ice-core and tree-ring studies. "What we work on is establishing the broader con-

(CO_2 and Marine Life continued on page 5)

(CO_2 and Marine Life continued from page 4)

text of climate change," **Armstrong** said. "[Scientists working within the Earth Surface Dynamics Program] collect data in the paleorecord and build those data into predictive models."

He believes that researching the effects of increasing CO_2 on marine ecosystems is important for understanding the environmental impacts of global warming. "As the atmosphere goes, so go the oceans," he said. The **Kleypas** workshop report (2006) supports this view, citing a 2004 paper by **Sabine** and others in the journal *Science*, titled "The Oceanic Sink for Atmospheric CO_2," (URL **http://www.sciencemag.org/cgi/content/abstract/305/5682/367**), which reports that about a third of the total amount of CO_2 released into the atmosphere by human activities has been taken up by the oceans. This figure is expected to climb to 90 percent over the long term.

While understanding the impacts of increasing atmospheric CO_2 concentrations is essential, also vital to our understanding of climate change is determining how much of the increase is anthropogenic (human caused) and not simply due to a natural, cyclical rise in CO_2 levels, according to **Armstrong**. Anthropogenic increases in atmospheric CO_2 concentrations can be somewhat mitigated, he says, but the effects of natural CO_2-level change can be compensated for only by adaptation. For example, in 2003, an estimated 53 percent of the U.S. population lived in coastal communities; many of these people would be forced to move inland in the face of unpreventable sea-level rise caused by a natural cycle of global warming.

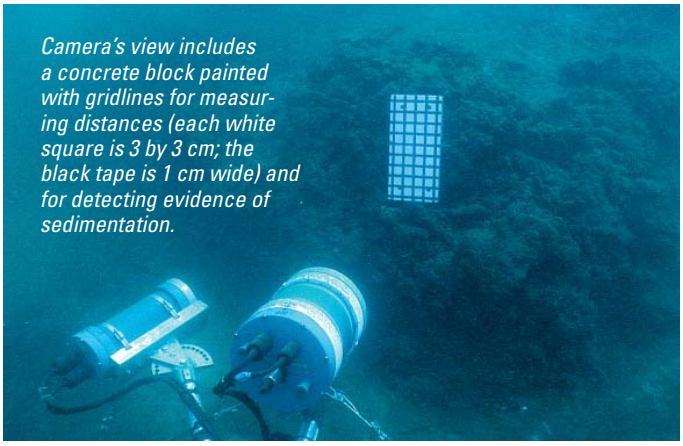
Whether increases in atmospheric CO_2 concentrations are anthropogenic or not, **Armstrong** says that with glacial melting factored in, sea levels are expected to rise by 2 to 9 m over the next century. "The best science today is telling us that we have got to start planning," **Armstrong** said. The more scientific research that the USGS, NOAA, and others conduct on the numerous impacts of rising CO_2 levels, **Armstrong** believes, the better scientists will be able to quantify the critical nature of the situation for policymakers.

"The more science we do, the more we find that [CO_2 level] changes were far greater than expected," **Armstrong** added. "[The research] means everything."

Portable Underwater Photographic Tripod for Coral-Reef Studies

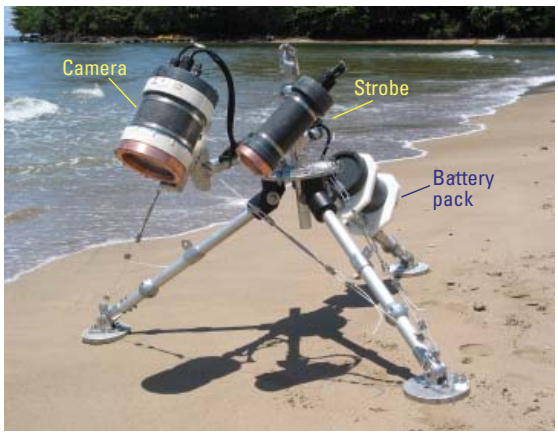
By Hank Chezar

A newly designed underwater tripod was developed to more easily photograph and study the movement of sediment in coral-reef habitats, regardless of sea-floor roughness or slope. The basic design parameters were portability, light weight, and easily adjustable arms and legs for onsite configuration. These qualities give coral-reef scientists freedom to move the tripod or adjust the housing components for optimum results over a wide variety of bottom morphologies. The tripod also had to be robust, so as to withstand long-term deployments during large storm events and precarious positioning on the seabed.



Camera's view includes a concrete block painted with gridlines for measuring distances (each white square is 3 by 3 cm; the black tape is 1 cm wide) and for detecting evidence of sedimentation.

The framework of the new tripod is composed predominantly of anodized aluminum plate and tubing to resist corrosion by seawater, off-the-shelf Speed-Rail fittings to enable a wide variety of configurations, and customized adjustable brackets. The Speed-Rail fittings and customized brackets allow the camera and strobe housings to be shifted up and down and side to side and rotated in vertical and horizontal planes to capture exactly the desired view. Pad eyes (metal pads with holes through which a shackle can be put) are welded at numerous spots on the frame so that it can be secured firmly to the seabed with sand anchors—large metal spirals that are screwed 3 to 4 ft down into the sea-floor sediment. Guy lines are connected to the electronic housings to minimize vibrations caused by underwater currents and wave surge.



Newly designed underwater tripod for studying sediment flux in coral-reef habitats.

The tripod was first deployed last summer for 3 months near the Hanalei River outlet on the Island of Kauai in Hawai'i. Divers positioned the tripod near a coral colony at a water depth of about 10 m. A concrete block painted with gridlines, used both for scale and for detecting evidence of sedimentation, was positioned almost

(Underwater Tripod continued on page 6)

(Underwater Tripod continued from page 5)

vertically within the camera's view. The system's electronics included a Canon 20D high-resolution digital still camera with intervalometer (for time-lapse photography), electronic strobe, and battery pack. The camera was set to take a photograph every 4 hours. The system operated successfully for the entire 3-month deployment, collecting more than 575 images. An image obtained early in the study shows the water as calm and clear, with no accumulated sediment on the block or turbidity in the water column. A second image taken 1 week later, however, shows turbid water and an accumulation of sediment on the block. A photograph taken by a diver just before recovery of the instrument shows biofouling by algae and other organisms that have accumulated on the system's components.

Photograph taken just before the instrument was picked up off the sea floor shows the system's components covered by algae and other organisms.

Image taken early in the study (top) shows no accumulated sediment on the block or turbidity in the water. Second image taken 1 week later (bottom) shows turbid water and an accumulation of sediment on the block.

USGS Helps Shape New "Disasterville" Exhibit at Museum in Florida

By Dennis Krohn

The Museum of Science and Industry (MOSI) in Tampa, Fla., held a grand opening of its Disasterville exhibit on August 4, 2006. Attending from U.S. Geological Survey (USGS) Florida Integrated Science Center offices in Tampa and nearby St. Petersburg were **Kim Haag**, **Dennis Krohn**, and former center director **Lisa Robbins**. Disasterville is an exhibit that explains the perils of eight major natural hazards: hurricane, hail, flood, wildfire, tornado, earthquake, volcano, and lightning. The USGS was involved in the exhibit's earliest stages and was instrumental in the decision to expand its focus away from the more local hazards of hurricanes, wildfires, and tornadoes to hazards that may affect the entire Nation. Personnel at USGS offices in both Tampa and St. Petersburg were a scientific resource for the museum.

The USGS was one of many major sponsors attending the opening ceremonies; others included the Institute for Business and Home Safety, the National Weather Service, the Southwest Florida Water Management District, and the Florida Department of Community Affairs. Tampa's Bay News 9 provided publicity for the opening, and the TV station's chief meteorologist, **Mike Clay**, was a keynote speaker. To make the evening more authentic, Lupton's Catering donated a delicious meal with the same food line they gave first responders after Hurricane Katrina.

USGS personnel worked closely with **Wit Ostrenko**, President of MOSI, early in the process to develop multiple natural-hazard scenarios. **Ostrenko** ran an early brainstorming session, called a "charette," at the USGS office in St. Petersburg. A key turning point in the project occurred in 2003 when the National Science Foundation (NSF) awarded a major grant to MOSI to design and proceed with the exhibit. USGS senior scientist **Lisa Robbins** had helped review the grant proposal and was later appointed to MOSI's Board of Directors, strengthening the ties between

(Disasterville continued on page 7)

(Disasterville continued from page 6)

MOSI and the USGS. After that, USGS hydrologist **Kim Haag** was asked to join the MOSI CIRQLE, a senior advisory group that organizes special events two or three times each year, featuring keynote speakers from around the world.

The Disasterville exhibit came into focus when a team from the Walt Disney Co. came to MOSI and held a 2-day workshop to create imaginative scenarios for the exhibit. **Dave Conley**, MOSI's Vice President of Exhibits, set up and organized the workshop. USGS geologist **Dennis Krohn** was able to provide technical expertise at the workshop, along with scientists from the National Weather Service and emergency-response officials from Hillsborough County. Many of the ideas developed at this workshop became part of the final exhibit. A unique aspect of working with the Disney team was that they provided real-time cartoon graphics to help illustrate ideas that the participants were trying to conceptualize.

***Kim Haag** is blown away inside a wind tunnel at the Hurricane area of the Disasterville exhibit. Notice the wind-speed reading at the top of the tube.*

Several of the display ideas for Disasterville came from exhibits that USGS centers had used for their open houses (for example, see URL **http://coastal.er.usgs.gov/exhibits.html**). A wave tank shown at the 2005 USGS open house in St. Petersburg became the major part of the MOSI exhibit's Tsunami area; the cutaway cross section of an erupting volcano used at numerous St. Petersburg outreach events became a model for the different layers of a volcano displayed at MOSI; geologists **Dina Venezky** and **Mike Clynne** of the USGS Volcano Hazards team in Menlo Park, Calif., provided rock samples for the MOSI Volcano exhibit; and MOSI's earthquake-shaking and seismic exhibit, complete with ancient seismometers, is similar to earthquake exhibits offered at the USGS 2006 Menlo Park open house (see URL **http://openhouse.wr.usgs.gov/exhibits.html**.)

Sample of conceptual artwork provided by a Disney team during the design phase of the Disasterville exhibit.

The main thoroughfare of MOSI's exhibit, Disaster Street, has several immersive exhibits that surround the visitor with the sensations of disasters. A partly overturned house in the Tornado area has large plasma-TV screens to represent its windows and a realistic sound track to simulate an approaching tornado. A wind-tunnel tube in the Hurricane area lets a visitor feel the effects of being totally surrounded by winds of a (minimal) hurricane. A lightning exhibit at the Wildfire area lets the visitor feel an electric spark through a wire-mesh glove to experience lightning firsthand. The introductory focal point of the exhibit is a digital globe that shows geologic, water, and atmospheric features from a planetary perspective.

A far-sighted and innovative part of Disasterville is the Weather Quest exhibit sponsored by Tampa's Bay News 9. Here,

(Disasterville continued on page 8)

***Dennis Krohn** and daughter **Hannah** at the Disasterville Volcano exhibit, where a docent is explaining the properties of different types of lava.*

(Disasterville continued from page 7)

four different groups of visitor volunteers respond to separate disasters and are required to prepare a response plan and present it to the public. Each disaster group has a dedicated set of computer terminals so that they get to experience firsthand the different roles that scientists, emergency-response officials, and the media play in a disaster. Text modified from the MOSI Web site describes this exhibit as:

"…a *heart-pounding*, "MINDS-ON," team-oriented, 'news' assignment interactive exhibit… As a news reporter you must MONITOR a series of weather and geological forecasting information. A deadly disaster is imminent, and you must GATHER and utilize scientific DATA to predict the development of potential chaos. You must work closely with your news team to IDENTIFY and SOLVE hazardous situations. Finally, in a mock TV News studio you will PREPARE and present your report forewarning the public of a natural disaster!"

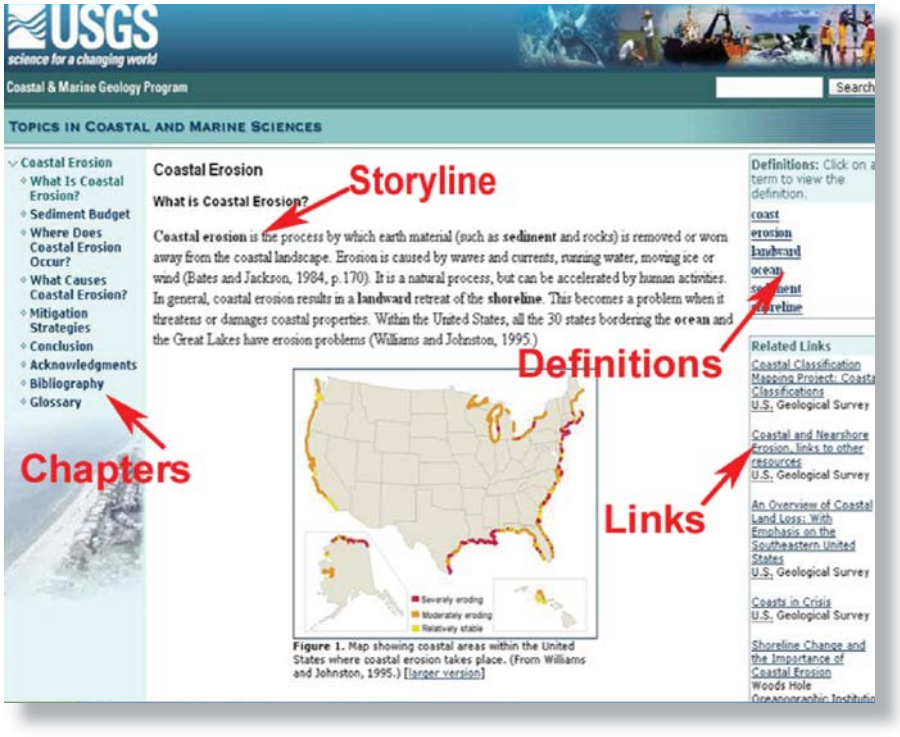
For more information about MOSI and the Disasterville exhibit, visit URL **http://www.mosi.org/disasterville.html**.

Debut of Web Site *Topics in Coastal and Marine Sciences*

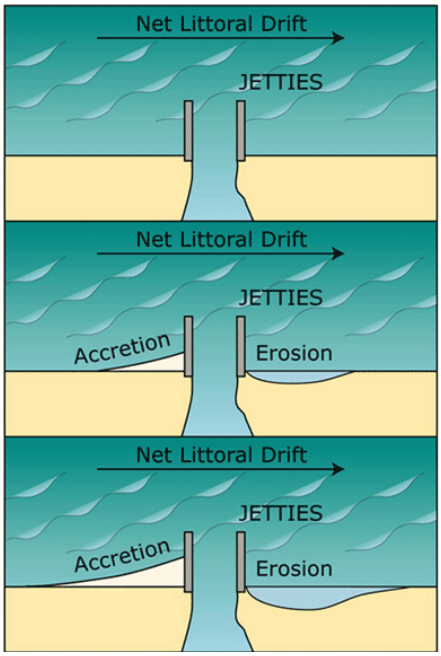
By Frances Lightsom

The U.S. Geological Survey (USGS) Coastal and Marine Geology Program has released the first segment of its Web-site series *Topics in Coastal and Marine Sciences,* part of the Coastal and Marine Knowledge Bank. This series is designed to provide background information to assist teachers and students in using our USGS scientific products and is told in the form of a storyline with chapters. The new Web site covers coastal erosion, as part of the Coastal Change Hazards node of the Knowledge Bank. Short descriptions and illustrations describe sediment budgets, causes of coastal erosion, and mitigation strategies, with links to related USGS Web pages. A popup glossary includes references to sources of the definitions, and a bibliography highlights USGS research achievements. *Topics* was written by **Mital Shah** (now at the University of Florida), with assistance from **Dennis Krohn**, **Betsy Boynton**, **Jolene Shirley**, **Theresa Burress**, **Bob Morton**, **Monty Hampton**, and **Fran Lightsom**. It was originally derived from USGS Open-File Report 03-337, entitled "An Overview of Coastal Land Loss: With Emphasis on the Southeastern United States" (URL **http://pubs.usgs.gov/of/2003/of03-337/**), by **Robert A. Morton**.

Topics in Coastal and Marine Sciences is online at URL **http://marine.usgs.gov/kb/topics/cch/**.



*Screen snapshot of opening page (URL **http://marine.usgs.gov/kb/topics/cch/**) of the Coastal Erosion segment of the Coastal and Marine Knowledge Bank, illustrating organization of the topics section as a storyline divided into chapters, definitions, and additional links.*



*Sample diagram showing a series of images that depict erosion and accretion along a jetty. (Modified by **Betsy Boynton**, USGS, from figure by Washington State Department of Ecology, URL **http://www.ecy.wa.gov/programs/sea/coast/erosion/jetty.html**.)*

Exploring the Deep Biosphere

By Lisa Robbins

Beautiful Vancouver, British Columbia, was the venue for the "Exploring Subseafloor Life" workshop.

The exploration of microorganisms living deep in the ocean crust (the deep biosphere) was the topic of a lively meeting in fall 2006. More than 80 scientists from 11 countries met in Vancouver, British Columbia, Canada, on October 3-5, 2006, to participate in a workshop entitled "Exploring Subseafloor Life with the Integrated Ocean Drilling Program" (URL **http://www.iodp.org/subseafloor-life/**). This workshop, sponsored by Integrated Ocean Drilling Program-Management International (IODP-MI) and Joint Oceanographic Institutions (JOI), was limited to invited participants. Representing the U.S. Geological Survey (USGS) was **Lisa Robbins**, senior scientist and biogeochemist from the USGS Florida Integrated Science Center office in St. Petersburg, Fla., whose interest lies in microbial-rock and microbial-sediment interactions. Other participants representing diverse scientific fields came from academia, government, and industry. The Steering Committee, cochaired by **Steven D'Hondt** (University of Rhode Island) and **Fumio Inagaki** (Japan Agency for Marine-Earth Science and Technology [JAMSTEC]), was composed of scientists from the United States, Japan, and Germany. Discussions at the workshop suggested that microbes and microbial communities within the deep biosphere can influence a wide range of phenomena, including gas hydrates, sediment and rock diagenesis, evolution, and even ocean-atmosphere chemistry and climate change!

The workshop was initiated by **Holly Given**, Director of Science Development and Coordination at JOI, with the support of JOI's U.S. Science Advisory Committee for Scientific Ocean Drilling (USAC), of which **Robbins** is a member. According to **Given**, the workshop was developed with three objectives in mind:

- creating a white paper in which the scientific community outlines major themes and scientific targets for future drilling,
- enhancing collegial relationships within the scientific microbial community, and
- presenting information about IODP opportunities to members of the microbiology and biogeochemistry community who have not typically participated in the program's seagoing research expeditions.

The workshop provided overviews by JOI President **Steve Bohlen** and IODP-MI President and Chief Executive Officer (CEO) **Manik Talwani**, as well as plenary talks by scientists, on opportunities in deep-biosphere studies, highlighting how little is really known about this potentially extensive and diverse habitat and the microbes that live in it. Breakout groups discussed specific topics to be highlighted in the white paper, due to be released in 2007. **Given** said: "We are thrilled with the outcomes of the workshop. We've captured the interest of new scientists and have sound advice from science-community experts on how to incorporate microbiological research into the drilling program that will undoubtedly lead to exciting new discoveries about life in deep-ocean sediments and the crust below."

Workshop participants were placed into four subgroups. The subgroup shown here discussed overarching issues of microbial habitability of the deep biosphere.

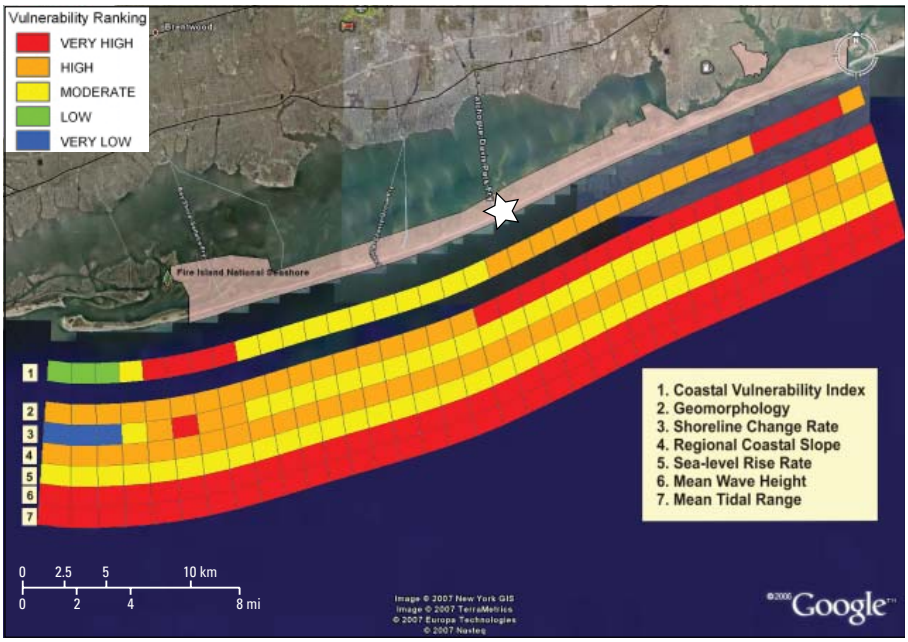
Workshop on New Directions in Geographic Visualization of Scientific Data

By Frances Lightsom

On November 8 and 9, 2006, the U.S. Geological Survey (USGS)'s Woods Hole Science Center in Woods Hole, Mass., cosponsored a workshop for the Woods Hole scientific community called "New Directions in Geographic Visualization of Scientific Data." The workshop attracted scientists and information technologists from five Woods Hole scientific institutions, who discovered common interests and resolved to continue to sponsor joint seminars and workshops on visualization techniques. The workshop was organized by **Chris Polloni** and **Fran Lightsom** of the USGS' Woods Hole Science Center and **Roger Goldsmith** and **Art Gaylord** of the Woods Hole Oceanographic Institution (WHOI).

The workshop's keynote speech was presented by **Brian Davis** of the USGS Center for Earth Resources Observation and Science (EROS) in Sioux Falls, S.D. In presenting the development of the GeoWall 3D visualization system (see URL **http://geowall.geo.lsa.umich.edu/home.html**), **Davis** emphasized features that make a visualization technology widely useful in scientific research.

Although the workshop was organized as an overview of the geographic visualization techniques that are currently in use within the Woods Hole scientific community, the most exciting presentations were of scientific use of the visualization techniques: **Elizabeth Pendleton** (USGS) showed how she uses Google Earth to provide coastal-vulnerability information; **Maurice Tivey** (WHOI) showed how he used Fledermaus visualizations to explore a submarine ridge; **Andy Maffei** (WHOI) showed how he created customized real-time displays for coordinating the work of multiple oceanographic ships in a cooperative oceanographic experiment. Other speakers brought in the perspectives of educators and scientific illustrators.



Relative coastal vulnerability to sea-level rise at Fire Island National Seashore, displayed in Google Earth (modified for publication at reduced size). Innermost color bar is relative coastal-vulnerability index (CVI); other color bars are geologic variables (2-4) and physical-process variables (5-7). Large-scale (10-15 km) coastal vulnerability is controlled by differences in geologic framework east and west of Watch Hill (star). Smaller-scale (2-5 km) variations in vulnerability reflect rates of historical shoreline change. For more information about CVI assessment for Fire Island National Seashore, see USGS Open-File Report 03-439 at URL ***http://pubs.usgs.gov/of/2003/of03-439/****.*

Corporate sponsors ESRI (Environmental Systems Research Institute) and IVS 3D (Interactive Visualization Systems) sent representatives to present new features and learn more about how scientists use their products. The sponsors provided refreshments for workshop breaks and for an evening reception with exhibits and demonstrations.

For more information, visit URL **http://woodshole.er.usgs.gov/~gv/bin/view/**.

Western Region Biologists Receive 2006 Department of the Interior Honor Awards

Several biologists conducting research in coastal areas were among the recipients of U.S. Department of the Interior (DOI) Honor Awards celebrated at the U.S. Geological Survey (USGS) Western Region Awards Ceremony held October 12, 2006, at the USGS center in Menlo Park, Calif.

USGS research microbiologist **James R. Winton** received a Distinguished Service Award, the highest departmental honor award that can be granted to a career employee. **Winton's** award was presented to him at a DOI ceremony in Washington, D.C., on May 4, 2006, but it was celebrated again at the Western Region ceremony, where USGS Western Regional Deputy Director **Brian Cole** read the award citation, noting that **Winton** was being honored "in recognition of his outstanding contributions to the U.S. Geological Survey on the diseases of Pacific and Atlantic salmon. **Dr. Winton**

(DOI Honor Awards continued on page 11)

(DOI Honor Awards continued from page 10)

has been instrumental in saving salmon listed as threatened or endangered. He developed an application of a new molecular approach for rapid and precise detection and control of several major viral and bacterial pathogens of salmon and trout, and applied the approach to develop new vaccines to control diseases. His work has been critical to salmon recovery and to protecting important stocks through improved hatchery practices. Many of the technologies pioneered by his research have been transferred to Federal, State, tribal, and private-sector laboratories to help solve problems in fishery biology. **Dr. Winton's** research has formed the basis for improved methods currently used by resource managers to operate State and Federal fish hatcheries, as well as the worldwide aquaculture industry. Because of his specialized knowledge, **Dr. Winton** became one of the principal designers of a state-of-the-art USGS Fisheries Laboratory in Seattle. The facility is the most advanced center for fish-health research in the Nation and is frequented by international visitors seeking information for their own research facilities. For his outstanding contributions to the USGS, **Dr. James R. Winton** is granted the highest honor of the Department of the Interior, the Distinguished Service Award."

USGS research zoologist **R. Mike Anthony** received the Meritorious Service Award, the second-highest departmental honor award that can be granted to a career employee. **Anthony** was unable to attend the ceremony in Menlo Park but received his award the next day in a ceremony at the USGS Alaska Science Center in Anchorage. As noted in his award citation, **Anthony** was honored "in recognition of his outstanding contributions to the U.S. Geological Survey in the field of waterfowl management. He is internationally recognized for his research on the management of major waterfowl species in significant population decline, particularly Pacific black brant and dusky Canada geese of the Arctic. In seeking ways to reverse these declines, **Richard Anthony** developed methods to identify important predators of each species, leading to techniques and procedures that have been adopted by researchers and managers in North America and Europe. He developed aerial-videography and digital-imagery techniques to improve monitoring of Pacific black brant colonies and to reduce the impact of their primary predator, the arctic fox. He has also developed methods leading to significant discoveries about bald eagles being an important nest predator of dusky Canada geese. His internationally published research has been instrumental in bringing sound science to the complex issues of managing declining migratory-waterfowl species. For his outstanding contributions to the USGS, **Richard M. Anthony** is granted the Meritorious Service Award of the Department of the Interior."

*Research microbiologist **James Winton**, recipient of a DOI Distinguished Service Award. Learn more about **Winton** and his work at URL **http://wfrc.usgs.gov/about/profiles/Prof_Winton.htm**.*

For their research on the effects of mercury on bird reproduction in the San Francisco Bay and Delta, USGS scientist **Josh T. Ackerman** and U.S. Fish and Wildlife Service scientist **Collin Eagles-Smith** each received a Superior Service Award, which is granted by DOI for significant acts, services, or achievements that materially aid the successful accomplishment of the DOI mission. **Eagles-Smith** was honored as "the lead U.S. Fish and Wildlife Service (USFWS) scientist on a joint USGS/USFWS study to investigate the effects of mercury on bird reproduction in the San Francisco Bay and Delta for the past several years. This CALFED-funded project has far-reaching implications for evaluating the impact of mercury on birds in both field and laboratory settings, establishing new standards

*USGS supervisory wildlife biologist **Dirk Derksen** (left) presents a DOI Meritorious Service Award to USGS research zoologist **R. Mike Anthony** in a ceremony at the USGS Alaska Science Center in Anchorage on October 13, 2006. Learn more about **Anthony** and his work at URL **http://alaska.usgs.gov/staff/staffbio.php?employeeid=115**.*

for avian health criteria that will provide a foundation of toxicological understanding that will last for many years to come. Results from these studies will also aid in establishing appropriate protections for avian wildlife affected by mercury contamination." Addressing **Eagles-Smith** as he received his award, **Brian Cole** said: "You have spent the past two years tirelessly dedicating yourself to the largest joint project that the USGS Western Ecological Research Center has engaged in. Your efforts have made this joint project extremely successful and resulted in high praise. In addition, you have been the primary lead on compiling the required Quarterly Reports and have taken on the responsibility of communication liaison. You have set high standards for excellence in all aspects of your work on this project and have gained the respect of managers from both agencies. A great deal of the credit for this project's success goes to you."

Ackerman was the lead USGS scientist for this high-visibility research program. Addressing **Ackerman** at the ceremony, **Brian Cole** said: "Your exceptional performance, especially in coordinating USGS research efforts with other researchers, has exceeded normal expectations, while your outstanding mentoring skills have guided

(DOI Honor Awards continued on page 12)

(DOI Honor Awards continued from page 11)

other field and laboratory technicians toward meeting your high standards of excellence. You have accepted a high level of responsibility to make sure the project succeeds through coordinating sample collection and preparation, data analysis, interpretation, and report writing. In addition, you have developed and given comprehensive, professional presentations to the research team and managers from multiple agencies. The joint research team has received high praise from CALFED, as well as from the State of California, other State and Federal agencies, and Congressional Representatives. It is largely because of you that this project has been successful for the USGS, and it is a pleasure to present to you the Superior Service Award of the Department of the Interior and the U.S. Geological Survey for your outstanding contributions."❁

*U.S. Fish and Wildlife Service fish and wildlife biologist **Collin Eagles-Smith** (left photograph) and USGS wildlife biologist **Josh Ackerman** (right photograph) accept DOI Superior Service Awards from USGS Acting Western Regional Director **Anne Kinsinger** for their research on the effects of mercury on bird reproduction in the San Francisco Bay and Delta.*

USGS Ridge-to-Reef Team Honored for Work in Hawaiian Islands

The U.S. Geological Survey (USGS) 2006 Western Region Innovation in Integrated Science Award was presented to the USGS Ridge-to-Reef team for their multidisciplinary work in the Hawaiian Islands (see URL **http://biology.usgs.gov/pierc/Pollution_and_Ecological_Restoration.html**). The recipients, who were honored at the USGS Western Region Awards Ceremony on October 11, 2006, in Menlo Park, Calif., are: remote-sensing expert **Pat Chavez** (Flagstaff, Ariz.), marine geologist **Michael Field** (Santa Cruz, Calif.), biologist **David Helweg** (Hawaii National Park, Hawaii), botanist **Jim Jacobi** (Hawaii National Park, Hawaii), geomorphologist **Jonathan Stock** (Menlo Park, Calif.), and hydrologist **Gordon Tribble** (Honolulu, Hawaii).

*Members of the USGS Ridge-to-Reef team **Mike Field** (left photograph) and **Jon Stock** (right photograph) accept plaques commemorating the team's 2006 Western Region Innovation in Integrated Science Award, presented by USGS Acting Western Regional Director **Anne Kinsinger**.*

Mike Field and **Jon Stock** represented the team at the ceremony, accepting the award from USGS Acting Western Regional Director **Anne Kinsinger**. As noted at the ceremony: "This multidisciplinary group has been working together on the islands of Molokai, Kauai, and Maui to explain how changing tropical watersheds are affecting coral ecosystems and coastal habitats. This work is a direct response to the Hawaiian Land-Based Sources of Pollution Local Action Strategy and is being implemented under the U.S. Coral Reef Task Force. The team works closely with local watershed partnerships, Federal and State agencies, and universities, providing new scientific understanding and products that are useful to, and used by, resource managers. [The work honored by] this award is a modern-day example of the basic science that drove the U.S. Geological Survey in its early days. The Ridge-to-Reef team is looking at landscape-level problems, putting aside the interests and limitations of each scientific discipline, and is doing great research which is having practical results."❁

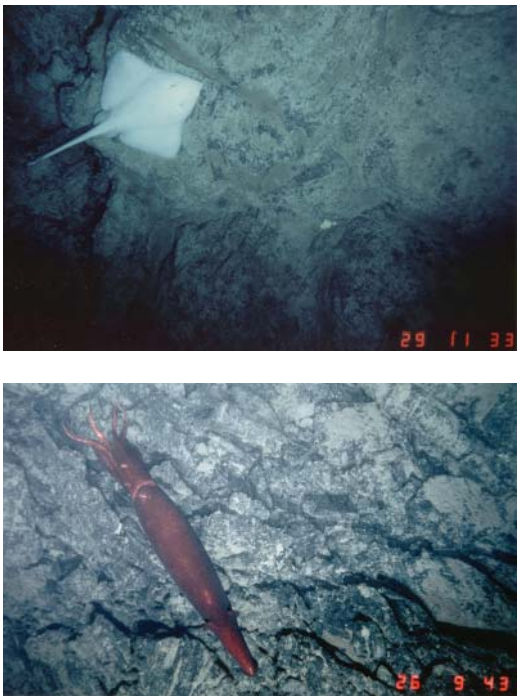
Video Footage of Pacific Ocean Bottom Transferred to DVD

Video footage of the sea floor collected during U.S. Geological Survey (USGS) research cruises in the Pacific Ocean is now available in DVD-Video format in a set of 328 USGS Open-File Reports. The cruises took place from 1983 to 2000, many of them in response to **President Reagan's** Exclusive Economic Zone Proclamation of 1983. Collected off the United States' west coast, around the Hawaiian Islands, and in the central Pacific Ocean, the sea-floor footage was recorded on various media, including Beta III and VHS videotapes. Much of this media is now deteriorating, prompting the transfer of the video footage onto DVD-Video discs. These discs offer several advantages over videotapes: they require less storage space, are easier to transport, can be distributed more widely, and will not be degraded by viewing.

The 328 Open-File Reports—each one on a DVD-Video disc that can be viewed on a computer monitor or television screen—were produced over several years by authors **Henry Chezar** and **Ivy Newman** with help from media specialist **Mike Diggles** and volunteer **Sarah Chezar**. There are now five copies of these 328 discs in existence: at the USGS libraries in Menlo Park, Calif., Denver, Colo., and Reston, Va.; in **Chezar's** USGS Western Coastal and Marine Geology Team archives; and at the USGS Publications Warehouse, from which they can be purchased (see URL **http://infotrek.er.usgs.gov/pubs/**).

The 328 Open-File Reports/DVD-Video discs are listed and described in an online catalog:

Chezar, Henry, and Newman, Ivy, 2006, Overview, DVD-video disc set of seafloor transects during USGS research cruises in the Pacific Ocean: U.S. Geological Survey Open-File Report 2004-1101 [URL **http://pubs.usgs.gov/of/2004/1101/**].



A skate (top) and squid (bottom) captured in video footage of the sea floor at Juan de Fuca Ridge, about 500 km off the coast of Oregon, in September 1984 during USGS cruise A-2-84-WF (USGS Open-File Reports 2004-1108-A through 2004-1108-E).

Recently Published Articles

Atwater, B.F., Cisternas V., Marco, Bourgeois, Joanne, Dudley, W.C., Hendley, J.W., II, and Stauffer, P.H., compilers, 1999, Revisado y reimpreso; 2006, Sobreviviendo a un tsunami: lecciones de Chile, Hawai y Japon: U.S. Geological Survey Circular 1218 [URL **http://pubs.usgs.gov/circ/c1218/**].

Barnhardt, W.A., and Sherrod, B.L., 2006, Evolution of a Holocene delta driven by episodic sediment delivery and coseismic deformation, Puget Sound, Washington, USA: Sedimentology, v. 53, no. 6, p. 1211-1228 [URL **http://www.blackwell-synergy.com/doi/abs/10.1111/j.1365-3091.2006.00809.x**].

Barras, J.A., 2006, Land area change in coastal Louisiana after the 2005 hurricanes—a series of three maps: U.S. Geological Survey Open-File Report 2006-1274 [URL **http://pubs.usgs.gov/of/2006/1274**].

Barth, G.A., Scholl, D.W., and Childs, J.R., 2006, Possible deep-water gas hydrate accumulations in the Bering Sea: Fire in the Ice, fall issue, p. 10-11 [URL **http://www.netl.doe.gov/technologies/oil-gas/FutureSupply/MethaneHydrates/newsletter/newsletter.htm**].

Bruns, T.R., Alpers, C.N., and Carlson, Paul, 2006, Distribution, thickness, and volume of fine-grained sediment from precipitation of metals from acid-mine waters in Keswick Reservoir, Shasta County, California: U.S. Geological Survey Open-File Report 2006-1377 [URL **http://pubs.usgs.gov/of/2006/1377/**].

Chezar, Henry, and Newman, Ivy, 2006, [Various titles; DVD-Video disc set of seafloor transects during USGS research cruises in the Pacific Ocean]: U.S. Geological Survey Open-File Report 2004-1102 through 2004-1188 [described in overview listed below].

Chezar, Henry, and Newman, Ivy, 2006, Overview, DVD-Video disc set of seafloor transects during USGS research cruises in the Pacific Ocean: U.S. Geological Survey Open-File Report 2004-1101 [URL **http://pubs.usgs.gov/of/2004/1101/**].

Childs, J.R., and Stevenson, A.J., 2006, Swath bathymetric survey of Englebright Lake, Yuba-Nevada Counties, California: U.S. Geological Survey Open-File Report 2006-1346 [URL **http://pubs.usgs.gov/of/2006/1346/**].

Collins, B.D., and Kayen, Robert, 2006, Land-based lidar mapping; a new surveying technique to shed light on rapid topographic change: U.S. Geological Survey Fact Sheet 2006-3111 [URL **http://pubs.usgs.gov/fs/2006/3111/**].

Grossman, E.E., Barnhardt, W.A., Hart, P., Richmond, B.M., and Field, M.E., 2006, Shelf stratigraphy and the influence of

(Recently Published continued on page 14)

(Recently Published continued from page 13)

antecedent substrate on Holocene reef development, south Oahu, Hawaii: Marine Geology, v. 226, no. 1-2, p. 97-114.

Hapke, C.J., and Green, K.R., 2006, Coastal landslide material loss rates associated with severe climatic events: Geology, v. 34, no. 12, p. 1077-1080 [URL **http://www.gsajournals.org/perlserv/?request=get-abstract&doi=10.1130%2FG22900A.1**].

Hutchinson, D.R., Collett, T.S., Ruppel, C., and Roberts, H.H., 2006, Heterogeneity and dynamics in gas hydrate occurrence; lessons learned from the Gulf of Mexico [abs.]: Science and Technology Issues in Methane Hydrate R&D, Engineering Conferences International, Kauai, Hawaii, March 5-9, 2006, Abstracts Volume, unpaginated.

Hutchinson, D.R., Ruppel, C., Collett, T.S., Pohlman, J., Hart, P.E., and Snyder, F., 2006, Minibasins and subsurface gas hydrate in the Gulf of Mexico [abs.]: International Sedimentological Congress, 17th, Fukuoka, Japan, August 27-September 1, 2006, abstracts, v. B, p. 6.

Jenkins, J.A., and LaPeyre, J.F., 2006, Cell proliferation detected with flow cytometric cell cycle analysis and immunohistochemical detection of proliferating cell nuclear antigen (PCNA) from somatic tissues of eastern oysters, *Crassostrea virginica*: Environmental Bioindicators, v. 1, no. 3, p. 177-190.

Kellogg, C.A., 2006, Characterization of microbial communities associated with African desert dust and their implications for human and ecosystem health: Chinese Journal of Geochemistry, v. 25 (Suppl.), p. 218-219.

Kellogg, C.A., and Griffin, D.W., 2006, Aerobiology and the global transport of desert dust: Trends in Ecology and Evolution, v. 21, no. 11, p. 638-644.

Kuffner, I.B., Walters, L.J., Becerro, M.A., Paul, V.J., Ritson-Williams, R., and Beach, K.S., 2006, Inhibition of coral recruitment by macroalgae and cyanobacteria: Marine Ecology Progress Series, v. 323, p. 107-117 [URL **http://www.int-res.com/abstracts/meps/v323/p107-117/**].

Lichtenberg, J.S., King, S.L., Grace, J.B., and Walls, S.C., 2006, Habitat associations of chorusing anurans in the lower Mississippi River alluvial valley: Wetlands, v. 26, no. 3, p. 736-744.

Martini, M., Butman, B., Ware, J., and Frye, D., 2006, Field tests of acoustic telemetry for a portable coastal observatory [abs.]: Oceans 2006, Boston, Mass., September 18-22, 2006.

Middleton, B.A., 2006, Baldcypress swamp management and climate change: U.S. Geological Survey Open-File Report 2006-1269, 3 p. [URL **http://pubs.usgs.gov/of/2006/1269/**].

Middleton, B.A., 2006, Fire management in fens and wet grasslands grazed by cattle: U.S. Geological Survey Open-File Report 2006-1268, 2 p. [URL **http://pubs.usgs.gov/of/2006/1268/**].

Middleton, B.A., 2006, Impoundment and baldcypress swamp management: U.S. Geological Survey Open-File Report 2006-1270, 4 p. [URL **http://pubs.usgs.gov/of/2006/1270/**].

Morton, R.A., Bernier, J.C., and Barras, J.A., 2006, Evidence of regional subsidence and associated interior wetland loss induced by hydrocarbon productions, Gulf Coast region, USA: Environmental Geology, v. 50, no. 2, p. 261-274.

Onuf, C.P., 2006, Biofouling and the continuous monitoring of underwater light from a seagrass perspective: Estuaries and Coasts, v. 29, no. 3, p. 511-518.

Paniagua-Chávez, C.G., Jenkins, J.A., Segovia, M., and Tiersch, T.R., 2006, Assessment of gamete quality for the eastern oyster (*Crassostrea virginica*) by use of fluorescent dyes: Cryobiology, v. 53, no. 1, p. 128-138.

Pendleton, E.A., Thieler, E.R., and Williams, S.J., 2006, Coastal vulnerability assessment of Kaloko-Honokohau National Historical Park to sea-level rise: U.S. Geological Survey Open-File Report 2005-1248 [URL **http://pubs.usgs.gov/of/2005/1248/**].

Pendleton, E.A., Thieler, E.R., and Williams, S.J., 2006, Relative coastal change-potential assessment of Glacier Bay National Park and Preserve: U.S. Geological Survey Open-File Report 2005-1247 [URL **http://pubs.usgs.gov/of/2005/1247/**].

Pendleton, E.A., Thieler, E.R., and Williams, S J., 2006, Relative coastal change-potential assessment of Kenai Fjords National Park: U.S. Geological Survey Open-File Report 2004-1373 [URL **http://pubs.usgs.gov/of/2004/1373/**].

Poppe, L.J., Williams, S.J., Doran, E.F., Moser, M.S., Forfinski, N.A., and Stewart, H.F., 2006, Sand wave morphology and sedimentary processes in the vicinity of Six Mile Reef, eastern Long Island Sound [abs.]: Geological Society of America Abstracts with Programs, v. 38, no. 7, p. 227 [URL **http://gsa.confex.com/gsa/2006AM/finalprogram/abstract_107897.htm**].

Raabe, E.A., Gulf of Mexico and southeast tidal wetlands satellite imagery; Big Bend wetlands Landsat MSS 1973-1987: U.S. Geological Survey Data Series 201-A, DVD [first disc in a series of satellite imagery].

Ramsey, E.W., III, 2006, Satellite monitoring of inland and coastal water quality; retrospection, introspection, future directions [book review]: Photogrammetric Engineering and Remote Sensing, v. 72, no. 11, p. 1211-1213.

Ramsey, E.W., III, Lu, Zhong, Rangoonwala, Amina, and Rykhus, Russell, 2006, Multiple baseline radar interferometry applied to coastal land cover classification and change analyses: GIScience and Remote Sensing, v. 43, no. 4, p. 283-309.

Rubin, D.M., Chezar, Henry, Harney, J.N., Topping, D.J., Melis, T.S., and Sherwood, C.R., 2006, Underwater microscope for measuring spatial and temporal changes in bed-sediment grain size: U.S. Geological Survey Open-File Report 2006-1360 [URL **http://pubs.usgs.gov/of/2006/1360/**].

Ryan, H.F., and Noble, M.A., 2006, Alongshore wind forcing of coastal sea level as a function of frequency: Journal of Physical Oceanography, v. 36, no. 11, p. 2173–2184 [URL **http://ams.allenpress.com/perlserv/?request=get-abstract&doi=10.1175%2FJPO2972.1**].

Scotti, A., Beardsley, R.C., and Butman, B., 2006, On the interpretation of energy and energy fluxes of nonlinear internal waves; an example from Massachusetts Bay: Journal of Fluid Mechanics, v. 561, p. 103-112, doi:10.1017/S0022112006000991.

(Recently Published continued on page 15)

(Recently Published continued from page 14)

Sullivan, C.M., Warner, J.C., Martini, M.A., Voulgaris, G., Work, P.A., Haas, K.A., and Hanes, D.M., 2006, South Carolina coastal erosion study data report for observations October 2003-April 2004: U.S. Geological Survey Open-File Report 2005-1429, 2 DVD-ROMs [URL **http://pubs.usgs.gov/of/2005/1429/**].

ten Brink, U.S., Geist, E.L., Lynett, P., and Andrews, B.D., 2006, Submarine slides north of Puerto Rico, and their tsunami potential, *in* Mercado-Irizarry, A., and Liu, P., eds., Caribbean Tsunami Hazard—Proceedings of the NSF Caribbean Tsunami Workshop: Singapore, World Scientific, p. 67-90.

Waite, W.F., Gilbert, L.Y., Winters, W.J., and Mason, D.H., 2005, Thermal property measurements in Tetrahydrofuran (THF) hydrate and hydrate-bearing sediment between -25 and +4° C. and their application to methane hydrate: International Conference on Gas Hydrates, 5th, Trondheim, Norway, June 13-16, 2005, Proceedings, v. 5, p. 1724-1733.

Warner, J.C., Sherwood, C.R., and Geyer, W.R., 2007, Sensitivity of estuarine turbidity maximum to settling velocity, tidal mixing, and sediment supply, *in* Maa, J.P.-Y., Sanford, L.P., and Schoellhamer, D.H., eds., Estuarine and coastal fine sediment dynamics: Amsterdam, Elsevier, p. 355-376.

Williams, S.J., Poppe, L.J., Arsenault, M.A., and Buczkowski, B.J., 2006, Applications of the USGS usSEABED database for regional-scale understanding of the geologic character and aggregate resources of the Atlantic inner continental shelf, Maine to North Carolina [abs.]: Geographic Information Systems and Ocean Mapping in Support of Fisheries Research and Management Conference, Cambridge, Mass., April 11, 2006, 4 p.

Winters, W.J., Waite, W.F., Mason, D.H., and Gilbert, L.Y., 2006, Physical properties of pressurized sediment from hydrate ridge, *in* Trehu, A.M., Bohrmann, Gerhard, Torres, M.E., and Colwell, F.S., eds., Drilling gas hydrates on Hydrate Ridge, Cascadia continental margin: Ocean Drilling Program Proceedings, Scientific Results, v. 204 [URL **http://www-odp.tamu.edu/publications/204_SR/204sr.htm**].

Wong, F.L., Venturato, A.J., and Geist, E.L., 2006, Seaside, Oregon, Tsunami Pilot Study—modernization of FEMA flood hazard maps; GIS data: U.S. Geological Survey Data Series 236 [URL **http://pubs.usgs.gov/ds/2006/236/**].

Publications Submitted for Director's Approval

Ackerman, S.D., Andrews, B.A., Barnhardt, W.A., and Butman, B., Summary of the coastal Massachusetts Sea-Floor Mapping Project; acquisition to distribution [abs.]: Coastal GeoTools '07, Myrtle Beach, S.C., March 5-8, 2007.

Barnard, P.L., Hanes, D.M., Liscinski, Jamie, and Elias, Edwin, Monitoring and modeling nearshore dredge disposal for indirect beach nourishment, Ocean Beach, San Francisco: International Conference on Coastal Engineering, 30th, San Diego, Calif., September 3-8, 2006, Proceedings.

Bruns, T.R., Characteristics of the Point Reyes Fault [structure 61], *in* Quaternary fault and fold database of the United States: URL **http://earthquakes.usgs.gov/regional/qfaults/**.

Cochrane, G.R., and Greene, H.G., Estimating rocky seafloor on the southern California continental shelf, *in* Lee, H.J., and Normark, W.R., eds., Earth science in the urban ocean; the southern California Continental Borderland: Geological Society of America Special Paper.

Collins, B.D., Kayen, Robert, Sitar, N., Patrick, P., and Puzio, A.M., Process-based empirical predictions of coastal cliff landslides in Quaternary marine terrace deposits, San Francisco, California, USA: International Conference on Landslides and Climate Change, Ventnor, Isle of Wight, U.K., May 21-24, 2007, Proceedings.

Dadisman, S.V., Flocks, J., Williams, S.J., Reid, J., Calderon, K., and Paskevich, V., LASED and usSEABED data management and analysis tools to assist mapping coastal change of the Gulf coast [abs.]: Coastal GeoTools '07, Myrtle Beach, S.C., March 5-8, 2007.

Dartnell, Peter, Driscoll, Neal, Kvitek, Rikk, Normark, W.R., Iampietro, Pat, and Gardner, J.V., Multibeam bathymetry and selected perspective views offshore San Diego, CA: U.S. Geological Survey Scientific Investigations Map.

Dartnell, Peter, and Gardner, J.V., Seafloor terrain analysis and geomorphology of the greater Los Angeles margin and San Pedro Basin, southern California, *in* Lee, H.J., and Normark, W.R., eds., Earth science in the urban ocean; the southern California Continental Borderland: Geological Society of America Special Paper.

Draut, A.E., and Rubin, D.M., The role of aeolian sediment in the preservation of archaeological sites in the Colorado River corridor, Grand Canyon, Arizona; final report on research activities, 2003-2006: U.S. Geological Survey Open-File Report.

Edwards, B.D., Ehman, K.D., Ponti, D.J., and Reichard, E.G., Stratigraphic controls on salt water intrusion in the Dominguez Gap area of coastal Los Angeles, chap. 6.4 *of* Lee, H.J., and Normark, W.R., eds., Earth science in the urban ocean; the southern California Continental Borderland: Geological Society of America Special Paper.

Edwards, B.D., Hanson, R.T., Reichard, E.G., and Johnson, T.A., Characteristics of southern California coastal aquifer systems, chap. 6.1 *of* Lee, H.J., and Normark, W.R., eds., Earth science in the urban ocean; the southern California Continental Borderland: Geological Society of America Special Paper.

Erikson, L.H., Hanes, D.M., Barnard, P.M., and Gibbs, A.E., Swash zone characteristics at Ocean Beach, San Francisco, CA: International Conference on Coastal Engineering, 30th, San Diego, Calif., September 3-8, 2006, Proceedings.

Fisher, M.A., Ruppert, N.A., White, R.A., Sliter, R.W., and Wong, F.L., Augustine Volcano, Alaska; regional seismicity

(Publications Submitted continued on page 16)

(Publications Submitted continued from page 15)

and tectonics associated with its latest (2006) explosive-eruption phase [abs.]: Seismological Society of America Annual Meeting, Kona, Hawaii, April 11-13, 2007.

Gutmacher, C.E., Ross, S.L., Triezenberg, Peter, Sliter, R.W., Normark, W.R., and Edwards, B.D., High-resolution boomer seismic-reflection profiles of the shelf off southern California; Santa Monica Bay to San Diego: U.S. Geological Survey Open-File Report.

Hall, D.K., Williams, R.S., Jr., and DiGirolamo, N.E., MODIS derived surface temperatures of the Greenland ice sheet 2000-2006 [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 11-15, 2006.

Hanes, D.M., and Barnard, P.L., Morphological evolution in the San Francisco Bight: Journal of Coastal Research [special issue of papers from International Coastal Symposium, Gold Coast, Queensland, Australia, April 16-20, 2007].

Hanes, D.M., Elias, Edwin, and Barnard, Patrick, The morphology and dynamics of giant marine sand waves near San Francisco and their relationship to tidal forcing [abs.]: River, Coastal, and Estuarine Morphodynamics Symposium, 5th, Enschede, The Netherlands, September 17-21, 2007.

Hanes, D.M., Wright, S.A., and Topping, D.J., Acoustic measurements of the concentration of suspended sediment size classes, with application to the Colorado River, USA [abs.]: Underwater Acoustic Measurements Conference, 2nd, Heraklion, Crete, June 25-29, 2007.

Lemke, K.H., Rosenbauer, R.J., and Bird, D.K., Synthesis and stability of peptides in hydrothermal fluids: Nature.

Lemke, K.H., Rosenbauer, R.J., Bischoff, J.L., and Bird, D.K., A hydrothermal experimental study of the cobalt-cobalt oxide redox buffer: American Mineralogist.

Moore, L.J., List, J.H., Williams, S.J., and Stolper, D., Modeled barrier island response to sea-level rise scenarios: Science.

Normark, W.R., McGann, Mary, and Sliter, R.W., Radiocarbon dating of piston cores from the inner basins of the California Continental Borderland; evaluation of strain rates, landslide emplacement, and sedimentation rates, *in* Lee, H.J., and Normark, W.R., eds., Earth science in the urban ocean; the southern California Continental Borderland: Geological Society of America Special Paper.

Normark, W.R., Piper, D.J.W., Romans, B.W., Covault, J.A., Dartnell, Peter, and Sliter, R.W., Submarine canyon and fan systems of the California Continental Borderland, *in* Lee, H.J., and Normark, W.R., eds., Earth science in the urban ocean; the southern California Continental Borderland: Geological Society of America Special Paper.

Phillips, Eleyne, Storlazzi, Curt, Dartnell, Peter, and Edwards, Brian, Exploring rippled scour depressions offshore Huntington Beach, CA: Coastal Sediments Conference, New Orleans, La., May 13-17, 2007, Proceedings.

Rosenbauer, R.J., Grossman, Eric, and Takesue, Renee, A multi-index approach to understanding the paleo-occurrence of eelgrass (*Zostera marina*) in the nearshore of Puget Sound, WA [abs.]: Georgia Basin Puget Sound Research Conference, Vancouver, British Columbia, Canada, March 26-29, 2007.

Rosenbauer, R.J., and Koksalan, Tamer, Experimental determination of the solubility of CO_2 in electrolytes; application to CO_2 sequestration in deep-saline aquifers: Geochimica et Cosmochimica Acta.

Rosenbauer, R.J., Orem, W.H., Swarzenski, P.W., Kendall, Carol, and Hostettler, F.D., Carbon, nitrogen, and sulfur isotopes and elemental composition of sediment cores from the Mississippi River delta as indicators of hypoxia and sources of organic matter in the Gulf of Mexico: Marine Chemistry.

Rosenberger, K.J., Xu, Jingping, Stein, Eric, and Noble, M.N., Circulation and physical processes within the San Gabriel River estuary during summer 2005: U.S. Geological Survey Open-File Report.

Ruggiero, Peter, List, Jeff, Hanes, D.M., and Eshleman, Jodi, Probabilistic shoreline change modeling: International Conference on Coastal Engineering, 30th, San Diego, Calif., September 3-8, 2006, Proceedings.

Scholl, D.W., Barth, G.A., and Childs, J.R., Evidence that acoustic VAMP structures in the deep water Bering Sea basin represent large accumulations of methane hydrate with matching resource implications [abs.]: Geophysical Society of Alaska meeting, Anchorage, January 11, 2007.

Schroeder, D.M., and Cochrane, G.R., Application of benthic habitat maps in marine management; a pilot study in the Channel Islands National Marine Sanctuary: GeoHAB—Marine Geological and Biological Habitat Mapping meeting, Galway, Ireland, May 5-7, 2004, Proceedings.

Stockdon, H.F., Lillycrop, W.J., Howd, P.A., and Wozencraft, J.M., Need for sustained and integrated high resolution coastal mapping: Marine Technology Society Journal.

Swarzenski, P.W., Baskaran, M., Greening, H., Eckenrod, R., and Henderson, C., Tampa Bay as a model estuary for examining the impact of human activities on biogeochemical processes; an introduction: Marine Chemistry.

Swarzenski, P.W., Kruse, S., Greenwood, J., and Reich, R., Multi-channel resistivity investigations of the fresh water/salt water interface; a new tool to study an old problem [abs.]: International Union of Geodesy and Geophysics (IUGG) General Assembly, 24th, Perugia, Italy, July 2-13, 2007.

Thompson, D., Stockdon, H., Investigation of the relationship between hurricane waves and extreme runup [abs.]: American Geophysical Union Fall Meeting, San Francisco, Calif., December 11-15, 2006.

Thurston, K.J., Sherwood, C.R., and Butman, B., Sediment-transport dynamics in the Hudson Shelf Valley [abs.]: American Society of Limnology and Oceanography (ASLO) Aquatic Sciences Meeting, Sante Fe, N.Mex., February 4-9, 2007.

Twichell, D.C., Andrews, B., Bergeron, E., Danforth, W.W., Denny, J.F., Edmiston,

(Publications Submitted continued on page 17)

(Publications Submitted continued from page 16)

L., Irwin, B.J., O'Brien, T.F., Stevenson, W., and Worley, C.R., Benthic mapping in Apalachicola Bay, Florida; summary of acoustic mapping techniques and findings [abs.]: Coastal GeoTools '07, Myrtle Beach, S.C., March 5-8, 2007.

Twichell, D.C., Nelson, C.H., Kenyon, N.H., and Schwab, W.C., The influence of external processes on the latest Pleistocene and Holocene, *in* External controls on deep water depositional systems: Society for Sedimentary Geology (SEPM) Special Publication.

van der Meer, Fenneke, Hulscher, Suzanne, Hanes, Dan, and Elias, Edwin, San Francisco Bay sand waves; modelling and reality [abs.]: River, Coastal, and Estuarine Morphodynamics Symposium, 5th, Enschede, The Netherlands, September 17-21, 2007.

Warner, J.C., Butman, B., and Alexander, P.S., Storm-driven sediment transport in Massachusetts Bay: Continental Shelf Research.

Williams, S.J., Kulp, M., Penland, P.S., Kindinger, J.L., and Flocks, J.G., Mississippi River Delta Plain, Louisiana coast and inner shelf; Holocene geologic framework and processes, *in* Holmes, C.W., and Buster, N.A., eds., Geology, v. 1 *of* The Gulf of Mexico—origins, waters, and biota: College Station, Texas A&M University Press.