USGS

Sound Waves

Coastal Science and Research News from Across the USGS

http://soundwaves.usgs.gov/

Research

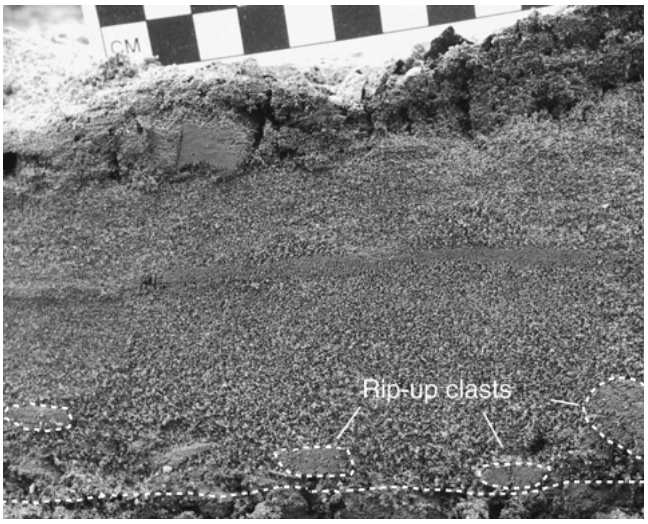
Distinguishing Tsunami from Storm Deposits in the Geologic Record

By Robert A. Morton, Guy Gelfenbaum, Bruce E. Jaffe, and Helen Gibbons

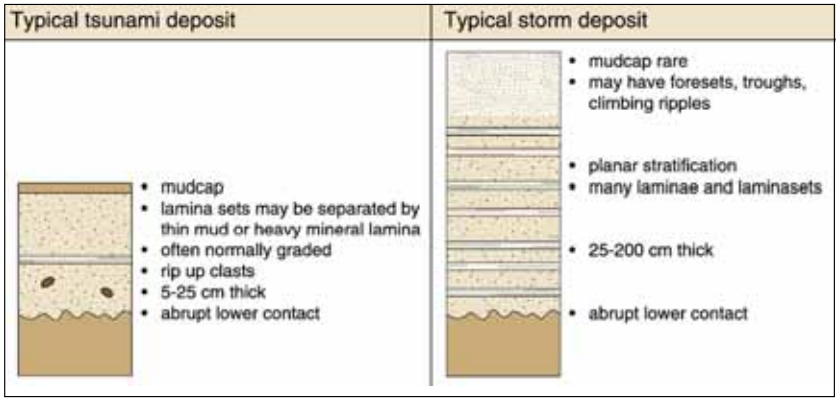
The destruction caused by the Indian Ocean tsunami in December 2004 and Hurricane Katrina in August 2005 stunned observers around the world. These extreme events served as reminders that tsunamis and coastal storms are two of the most dangerous hazards to coastal population centers and economic infrastructures. U.S. Geological Survey (USGS) scientists have been studying geologic impacts from extreme wave events and have recently published a paper that will help researchers distinguish ancient tsunami deposits from large-storm deposits in the geologic record—a capability that is vital for assessing the threat that an area faces from these two hazards.

Both tsunamis and large storms cause death and damage along low-lying coastal areas, and both occur with regularity, although tsunamis are much less frequent than coastal storms. Because of their infrequency, tsunamis are poorly documented in historical records for many of the areas where they pose a threat. In these areas, interpreting the geologic record may be the only way to discover the history of past tsunamis and the likely hazard from future tsunamis. Both tsunamis and large storms, particularly hurricanes, are capable of inundating coastal areas and depositing sandy sediment over broad areas landward of the beach. Correctly identifying a sandy bed

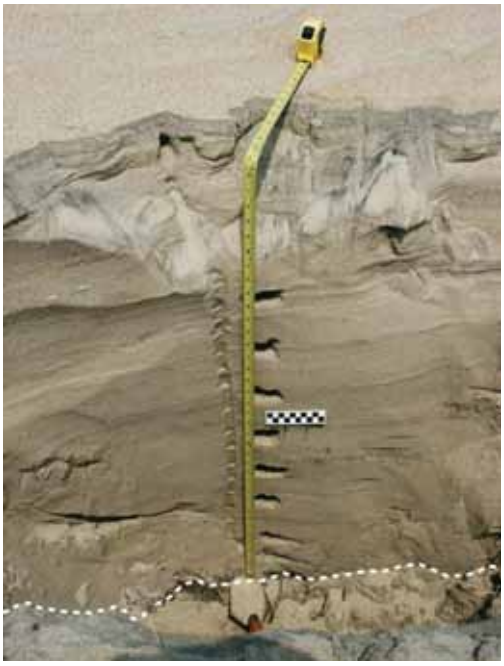
(Tsunami or Storm continued on page 2)



This approximately 10-cm-thick tsunami deposit in La Quinta, Perú, contains mud clasts near its base and a thin layer of mud separating lower and upper sandy layers. It was deposited in 2001. Each square in black-and-white ruler at top of photograph is 1 cm long.



Composite characteristics of typical sandy tsunami and storm deposits.



This approximately 1-m-thick deposit laid down by Hurricane Isabel at Hatteras, North Carolina, in 2003 contains multiple laminasets of sand. Each square in black-and-white ruler near center of photograph is 1 cm long.

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

Research	**1**
Fieldwork	**3**
Outreach	**6**
Awards	**6**
Staff and Center News	**7**
Publications	**8**

Submission Guidelines

Deadline: The deadline for news items and publication lists for the January-February 2008 issue of *Sound Waves* is Friday, November 30.
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

(Tsunami or Storm continued from page 1)

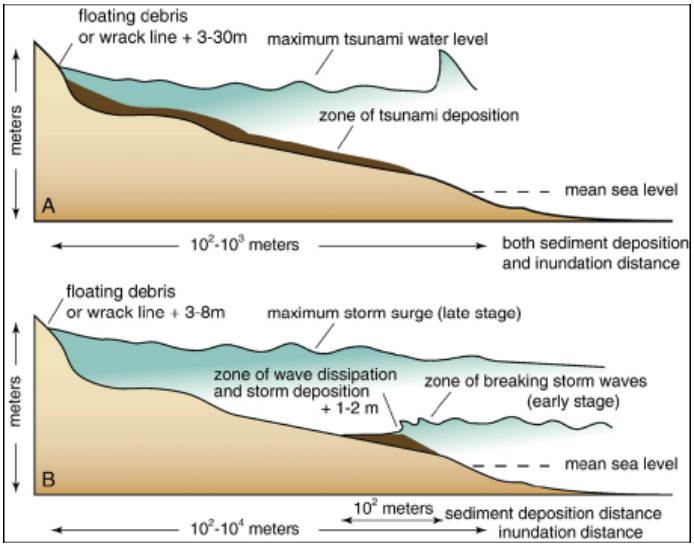
in the geologic record as either a tsunami or a storm deposit is critical for determining the frequency of each hazard.

The new paper, "Physical Criteria for Distinguishing Sandy Tsunami and Storm Deposits Using Modern Examples," was released August 2007 in a special issue of the journal *Sedimentary Geology* titled "Sedimentary Features of Tsunami Deposits—Their Origin, Recognition, and Discrimination" (v. 200, no. 3-4). The authors—geologist **Robert Morton** (St. Petersburg, Florida) and oceanographers **Guy Gelfenbaum** (Menlo Park, California) and **Bruce Jaffe** (Santa Cruz, California)—were motivated to conduct this study by comments from tsunami scientists who speculated that tsunami and storm deposits are too similar to be able to distinguish the origin of deposition. After discovering common research interests during a USGS Coastal and Marine Geology Program science-planning workshop in 2002 (see URL **http://soundwaves.usgs.gov/2002/02/meetings.html**), **Morton** and **Gelfenbaum** initiated discussions with coastal scientists **Jaffe** and **Bruce Richmond** (USGS) and **James Goff** (National Institute of Water and Atmosphere [NIWA] Science, New Zealand) that eventually led to this comparative analysis of modern events. (See related article in *Sound Waves*, October 2002, URL **http://soundwaves.usgs.gov/2002/10/**.)

Morton, **Gelfenbaum**, and **Jaffe** began their work by examining modern deposits whose origins—tsunami or large storm—are known. The new paper compares deposits from recent tsunamis in Papua New Guinea (1998) and Perú (2001) with deposits from Hurricane Carla in the Gulf of Mexico (1961) and Hurricane Isabel in the western Atlantic Ocean (2003). The authors conclude that certain physical characteristics may, indeed, be useful for distinguishing the two types of deposit. These characteristics include sediment composition, texture, and grading (how grain size changes from bottom to top); types and organization of sediment layers; deposit thickness and geometry; and whether the deposit drapes the preexisting landscape or levels it by filling in low places.

Tsunami deposits are generally less than 25 cm thick, extend hundreds of meters inland from the beach, and have an overall tendency to drape the preexisting landscape. They commonly consist of a single, homogeneous bed that grades from coarser grained at the bottom to finer grained at the top, or a bed with only a few thin layers. Mud clasts or thin layers of mud within the deposit are strong evidence of tsunami origin. Twig orientation or other indicators of return (seaward) flow during deposition of the sediment are also diagnostic of tsunami deposits. Tsunami deposits thicken and then thin landward, with a maximum deposit

(Tsunami or Storm continued on page 3)



Comparison of typical inundation distances, sediment-transport distances, and maximum water levels (indicated by height of wrack line) for deposition by tsunamis (A) and coastal storms (B).

(Tsunami or Storm continued from page 2)

thickness typically more than 50 m inland from the beach because a zone of erosion commonly is present near the beach.

Storm deposits, in contrast, generally are more than 30 cm thick and will not advance beyond the low places they are able to fill in the preexisting topography. They typically consist of multiple laminasets—sets of extremely thin (less than 1 cm thick) layers called laminae. Features that favor storm deposits are the types of stratification associated with the transport of sediment by rolling and bouncing along the bottom (foresets, climbing ripples, backsets), and numerous thin (millimeters to a few centimeters) laminasets of alternating coarse and fine grain size indicative of high-frequency waves. Abundant shell fragments organized in laminae also favor a storm origin. Storm deposits contain no internal mud layers and rarely contain pieces of mud. Maximum deposit thickness is near the shore, and landward thinning of the deposit is commonly abrupt. Storm deposits fill in topographic lows, and the upper surface is relatively uniform in elevation alongshore.

These distinguishing characteristics are relatively easy to spot in recent deposits exposed over large areas but are trickier to identify in limited exposures of ancient, buried deposits. Tsunami and large-storm deposits have many similarities, and it is unlikely that unequivocal diagnostic attributes will be preserved at any single observation site—for example, in a trench dug to reveal buried layers. Multiple sample sites and a quasi-three-dimensional reconstruction of the sedimentary deposit in question would likely be required to adequately evaluate the origin of an ancient deposit. At many locations, the most reliable means of differentiating tsunami and storm deposits may be the context in which the deposit occurs. A sandy deposit associated, for example, with features produced by a large earthquake—including liquefaction structures and evidence of subsidence, such as buried soils and drowned forests—would likely have a tsunami origin.

The recent paper emphasizes the use of physical attributes to differentiate between tsunami- and storm-emplaced sand deposits. Other studies have examined the use of microfossil assemblages, pollen, and geochemical signatures as evidence for marine inundation and onshore sediment transport caused by tsunamis and storms. The authors note, "Perhaps combining complementary physical, paleontological, and chemical data will someday allow unequivocal differentiation of tsunami and storm deposits."

The full citation for the new paper is: Morton, R.A., Gelfenbaum, Guy, and Jaffe, B.E., 2007, Physical criteria for distinguishing sandy tsunami and storm deposits using modern examples, *in* Tappin, D.R., ed., Sedimentary features of tsunami deposits—their origin, recognition, and discrimination: Sedimentary Geology, v. 200, no. 3-4 (special issue), p. 184-207 [URL **http://www.sciencedirect.com/science/journal/00370738**].

Sea-Floor Mapping in the Gulf of Mexico Aboard the Research Vessel *Bellows*

By Whitney Neugebauer and Ellen Raabe

On August 27, 2007, scientists from the U.S. Geological Survey (USGS) and the University of South Florida (USF), with students from Eckerd College and USF, boarded the research vessel *Bellows* for a 4-day research cruise in the Gulf of Mexico. The ship left USF's College of Marine Science docks in St. Petersburg, Florida, with 13 persons on board. Leading the cruise were scientists **Al Hine** and **Stan Locker** of USF and **Ellen Raabe** of the USGS. The objectives were to investigate benthic habitat and associated shallow geologic framework on the West Florida inner continental shelf in support of the USGS Florida Shelf Habitat Mapping (FLaSH) project headed by **Lisa Robbins** (URL **http://coastal.er.usgs.gov/flash/**). The team surveyed new areas of the sea floor across the inner shelf to 60-m water depth, filling data gaps between previously mapped nearshore areas.

The technical crew included **Bekka Larson**, **Whitney Neugebauer**, **Graham Johnston**, and **Courtney Kniss** from Eckerd College; USF Marine Science graduate students **Kevin Bradley** and **Shane Dunn**; and Center for Ocean Technology/USF liaison **Mike Hall**. Researchers and technicians worked in 4-hour shifts around the clock to monitor equipment and perform computer processing. Weather during the cruise was generally uneventful, with only brief late-night swells.

***Whitney Neugebauer** (USGS/Eckerd College, left) and **Al Hine** (USF) examine material in grab sample obtained from a seagrass bed 20 nautical miles offshore Sarasota, Florida.*

The *Bellows* ran a 40-nautical-mile-long reconnaissance line, field-testing a Teledyne Benthos C3D sonar imaging system. A map covering an 800- to 900-m-wide swath of sea floor was produced in real time, from three transects extending seaward of Sarasota, Florida. Investigators were looking for confirmation of sinkhole depressions,

(Florida Mapping continued on page 4)

(Florida Mapping continued from page 3)

rock outcrops, and coarse-sediment patterns indicated by usSEABED—a database of sea-floor data of various types compiled from a wide range of sources (see URL **http://walrus.wr.usgs.gov/usseabed/**). A boomer seismic-profiling system and single-beam Quester Tangent Corp. acoustic bottom-classification system were also deployed. The new imaging system proved to be a powerful and useful instrument on this first deployment, although some refinement is already underway.

Initial evaluation of the swath map indicates a seaward transition to a relict shelf with high diversity of sea-floor zones, such as coarse sediment, sand ridge, rock ledge, and seagrass beds. Detailed sonar-image mosaics were collected over two sites with an EdgeTech Dual-Frequency 272-TD operating at 100 kHz. Sediment was collected with a Shipek sediment grab sampler for ground-truthing the imagery and for sediment analysis.

Collaboration between the USGS and USF will continue as data are processed and released. **Graham Johnston** (Eckerd College) will conduct grain-size analysis of the sediment samples, and **Whitney Neugebauer** (USGS/Eckerd College) will assist **Lisa Robbins** (USGS) in analysis of sediment texture and composition. **Neugebauer**, a student at Eckerd College pursuing degrees in anthropology and geology, has been working as an intern at the USGS with **Lisa Robbins** and **Ellen Raabe** since May 2007. Her work has included developing teaching modules for the FLaSH project and compiling digital archives of underwater video from pipeline surveys. She enjoyed her summer internship and is looking forward to continuing it in the academic year.❁

(Left to right) ***Stan Locker***, ***Shane Dunn***, ***Kevin Bradley***, *and* ***Al Hine*** *of USF prepare to deploy C3D sonar imaging system on the research vessel* Bellows *off Sarasota, Florida, August 27, 2007.*

Kevin Bradley *(left) and* ***Shane Dunn*** *of USF lower Shipek sediment sampler from the research vessel* Bellows.

Mapping the Sea Floor Southwest of Santa Rosa Island, California

By Guy Cochrane

U.S. Geological Survey (USGS) staff used sonar to map approximately 50 km^2 of the continental shelf southwest of Santa Rosa Island in the northern Channel Islands off California last August. The sonar survey is a continuation of a cooperative mapping project with Channel Islands National Marine Sanctuary (URL **http://channelislands.noaa.gov/**), designed to map geology and benthic habitat primarily in the sanctuary's jurisdiction, although other areas of mutual interest have also been mapped, including California State Marine Protected Areas.

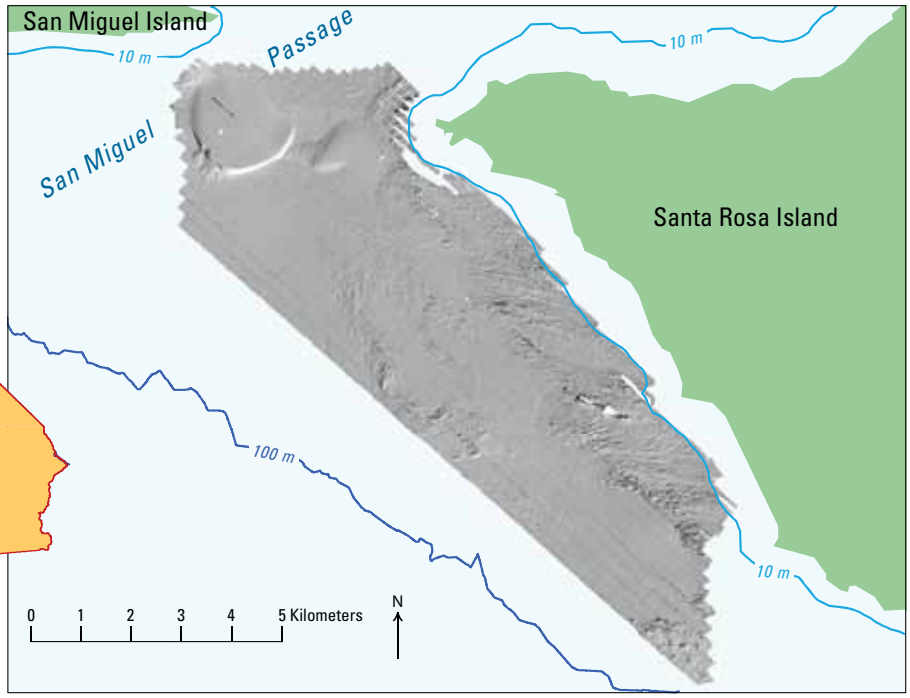
David Finlayson and **Gerry Hatcher** participated in the 2-week cruise, from August 6 through 18, 2007, along with project chief **Guy Cochrane**. **Mike Boyle** helped install USGS instruments on the Channel Islands National Marine Sanctu-

(Santa Rosa Mapping continued on page 5)

Gerry Hatcher *(left) and* ***David Finlayson*** *monitor and process sonar data on the research vessel* Shearwater.

(Santa Rosa Mapping continued from page 4)

California, showing islands mentioned in text and area of Channel Islands National Marine Sanctuary (darker shading).



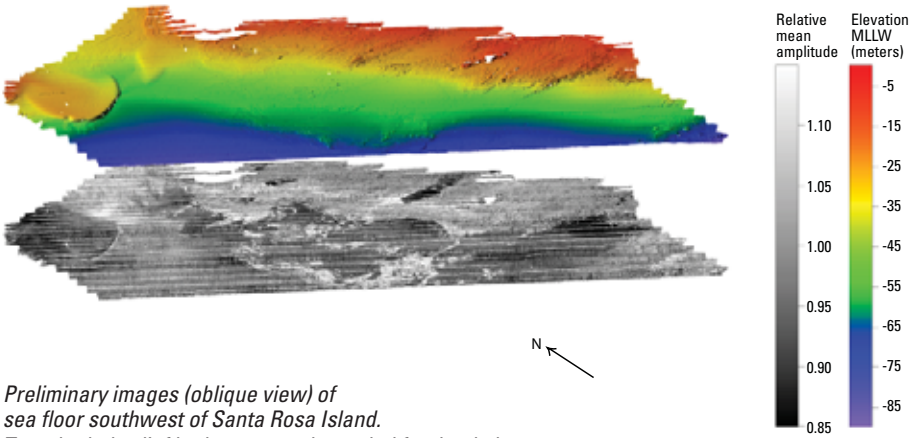
Shaded-relief bathymetry (gray tones) of area southwest of Santa Rosa Island mapped with sonar in 2007.

ary's research vessel *Shearwater*, used for the survey. The scientists lost 2 days of the cruise to repairs after part of the vessel's port rudder linkage sheared through, but nevertheless accomplished much of the planned mapping.

Data from the interferometric sidescan sonar were processed daily, producing a view of the sea floor surveyed that day. The mapping revealed rocky sea floor off Santa Rosa Island out to depths of 70 m; on the mainland coast, rocky sea floor is largely buried by sediment, and outcrops are limited to shallower water closer to shore. Rock outcrops on the sea floor are of particular interest because they support diverse communities of marine organisms, including rockfish, an important resource for commercial and recreational fisheries.

An unusual circular feature in the northwest section of the survey area is likely a deposit of sand. The scientists hypothesize that sand eroding from sandstone on the southeast side of San Miguel Island is being blown into the ocean and deposited in this area as a result of eddying and attenuation of currents from the northwest. Slumping is visible on the south edge of the sand deposit, where it abruptly rises more than 10 m above the surrounding shelf.

Recently, a larger cooperative project has been established to map all of the sea floor under the jurisdiction of the State of California, which extends from the shore out 3 mi. In this effort, the USGS is collaborating with California State University, Monterey Bay's Seafloor Mapping Lab; Moss Landing Marine Laboratories' Center for Habitat Studies; Fugro Pelagos, Inc.; and the California Coastal Conservancy. Future cooperative work with Channel Islands National Marine Sanctuary will likely focus on video ground-truthing in State waters, and sonar and video mapping in waters beyond State jurisdiction. ❁



Preliminary images (oblique view) of sea floor southwest of Santa Rosa Island. Top, shaded-relief bathymetry, color coded for depth; bottom, backscatter amplitude (amplitude of sound waves bounced from sea floor back to sonar receiver), with lighter gray tones for higher amplitudes (indicating harder or rougher bottom). Note circular feature at left (northwest), hypothesized to be sand blown off San Miguel Island and deposited by eddying and attenuation of currents from northwest.

Outreach

MicroBLOGology, or Microbial Week on the Deep-Sea News Blog

U.S. Geological Survey (USGS) environmental microbiologist **Christina Kellogg** was a co-organizer and guest blogger for Microbial Week on the Deep-Sea News blog (URL **http://scienceblogs.com/deepseanews/**). This event, which was held September 9-15, 2007, showcased the many amazing roles that microbes play in the deep ocean. Topics included bioprospecting, symbiosis, photosynthesis in the dark, microbial fuel cells, extremophiles, pathogens, and biogeochemical cycling. The posts can still be read by accessing the blog's archives at URL **http://scienceblogs.com/deepseanews/archives.php**, finding the "Search this blog" window on the left, and entering the keyword "microbes." Enjoy!

Banner displayed on Deep-Sea News Web site during Microbial Week (September 9-15, 2007).

***Christina Kellogg** streaked a bacterium,* Vibrio coralliilyticus, *onto TCBS (thiosulfate citrate bile salts sucrose) agar to advertise Microbial Week on the Deep-Sea News blog. This bacterium is the pathogen that causes bacterial bleaching in the coral* Pocillopora damicornis. *As the bacteria grow to form the letters, they metabolize sucrose in the agar, forming acid compounds; pH indicators in the agar turn yellow in response to the acid.*

Awards

USGS Employees in Florida Recognized for Contributions over Many Years of Service

Jess Weaver, the U.S. Geological Survey (USGS)'s Southeastern Regional Executive, presented milestone service awards to **Carolyn Price**, Supervisory Hydrologic Technician (40-Year Service Award), and **William Loftus**, Research Ecologist (30-Year Service Award), during an awards ceremony on September 5, 2007, at the USGS Florida Integrated Science Center (FISC) office in Fort Lauderdale, Florida. The award citations highlight the achievements of the honored employees:

***Carolyn Price** (left) receives a 40-Year Service Award from USGS Eastern Regional Executive **Jess Weaver**.*

Carolyn Price is recognized for her commitment to scientific excellence and is considered by many as the backbone of the Data Section. As the principal Supervisory Hydrologic Technician, **Carolyn** leads with a strong work ethic and an indepth institutional understanding of our data programs and products. **Carolyn** is an important reason why the data program in South Florida is a consistent and reliable scientific component of the USGS Florida Integrated Science Center's Fort Lauderdale office. **Carolyn** is a quiet but competent caretaker of a data program that is the envy of local agencies. She plays a significant role in this office with respect to computation and review of surface-water flows and annual-velocity indices that are especially difficult to perform in a low-flow hydrologic environment. Methods used to compute these low flows in South Florida have changed considerably during her career, from the use of deflection vanes to electromagnetic to hydroacoustic methods. **Carolyn** continues directing the publication of the annual databook for this office and served as the administrator of the Automated Data Processing System (ADAPS). During this past year, her colleagues have unquestionably recognized **Carolyn** as Fort Lauderdale's *de facto* Data Chief. Without her comprehensive understanding of USGS hydrologic databases and her technical, computational, editorial guidance, patient mentoring, and evenhanded supervision, this office could not have sustained its reputation for data excellence.

(Milestone Awards continued on page 7)

(Milestone Awards continued from page 6)

Dr. William Loftus is recognized for 30 years of service with the Department of the Interior, spanning several bureaus within DOI, including the National Park Service, the National Biological Survey, and the U.S. Geological Survey (USGS). Most of **Dr. Loftus**' scientific career has centered on research into the ecology of freshwater communities in the Florida Everglades. His scientific contributions and accomplishments are extensive and include the development of a long-term program for Everglades fishes and invertebrates, experimental investigations using mesocosms [large tanks that allow researchers to control variables] to resolve predator/prey and native/nonnative fish interactions, development of methods for field studies, and assessment of the use of subterranean aquatic habitats as dry-season wetland refuges. **Bill** has served as the program manager for Everglades freshwater ecology studies and has worked tirelessly to improve understanding of the aquatic-community dynamics caused by hydrologic variations, landscape changes, and natural and anthropogenic disturbances. **Bill's** important contributions to ecologic understanding of the Everglades include research into the invasive Asian swamp eel and other nonnative fishes, as well as examination of potential mitigation methods. Additionally, he has performed mercury and food-web research to investigate mercury bioaccumulation in freshwater animals. **Dr. Loftus** has served as a mentor and advisor to university graduate students and continues to train future ecologists.

***William Loftus** (left) receives a 30-Year Service Award from USGS Eastern Regional Executive **Jess Weaver**.*

Coring Demonstration Aboard the Research Vessel *G.K. Gilbert*

By McCarron Best

On a sunny day in St. Petersburg, Florida, an unusual crew boarded the U.S. Geological (USGS) research vessel *G.K. Gilbert*. **Felton Jones**, Chief of Acquisitions and Grants, in town for a meeting at the USGS Florida Integrated Science Center's office in St. Petersburg, took part in a vibracore demonstration aboard the ship. Also present were Associate Center Director **Jack Kindinger** and Marine Operations Manager **Terry Kelley**.

Rich Young captained the *Gilbert*, and geologists **Julie Bernier** and **Nancy DeWitt** led the demonstration, with help from research associate **Kyle Kelso**. The group took a brief turn around Tampa Bay and anchored a few miles from shore for a display of the vessel's impressive marine-science capabilities. As the geologists took a core sample, **Jack Kindinger** explained the procedure to everyone else.

(Gilbert Vibracore continued on page 8)

*(Left to right) **Terry Kelley**, **Felton Jones**, **Rich Young**, and **Jack Kindinger** enjoy the interior of the research vessel* G.K. Gilbert *before leaving shore.*

(Gilbert Vibracore continued from page 7)

Because the core will not be used for any current scientific investigations, it will be saved and put on display in the upcoming USGS Florida Integrated Science Center open house in St. Petersburg in November.

The demonstration, which took place on August 28, 2007, served as a fascinating way to glimpse the work done day in and day out on one of our greatest maritime assets, the *G.K. Gilbert.*

(Left to right) ***Kyle Kelso***, ***Julie Bernier***, *and* ***Nancy DeWitt*** *cut the core pipe after collection of a vibra-core sample.*

Recently Published Articles

Barnard, P.L., Eshleman, Jodi, Erikson, Li, and Hanes, D.M., 2007, Coastal processes study at Ocean Beach, San Francisco, CA; summary of data collection 2004-2006: U.S. Geological Survey Open-File Report 2007-1217, 165 p. [URL **http://pubs.usgs.gov/of/2007/1217/**].

Brien, D.L., and Reid, M.E., 2007, Modeling 3-D slope stability of coastal bluffs using 3-D ground-water flow, southwestern Seattle, Washington: U.S. Geological Survey Scientific Investigations Report 2007-5092, 54 p. [URL **http://pubs.usgs.gov/sir/2007/5092/**].

Butman, B., Dalyander, P.S., Bothner, M.H., and Lange, W.H., 2007, Time-series photographs of the sea floor in western Massachusetts Bay, version 1, 1989-1993: U.S. Geological Survey Data Series 265, DVD-ROM [URL **http://pubs.usgs.gov/ds/265/**].

Covault, J.A., Normark, W.R., Romans, B.W., and Graham, S.A., 2007, Highstand fans in the California borderland; the overlooked deep-water depositional systems: Geology, v. 35, no. 9, p. 783-786, doi: 10.1130/G23800A.1 [URL **http://www.gsajournals.org/perlserv/?request=get-abstract&doi=10.1130%2FG23800A.1**]

Draut, A.E., Bothner, M.H., Reynolds, R.L., Buchan, O.C., Cochran, S.A., Casso, M.A., Baldwin, S.M., Goldstein, Harland, Xiao, Jiang, Field, M.E., and Logan, J.B., 2007, Sedimentary properties of shallow marine cores collected in June and September 2006, Hanalei Bay, Kaua'i, Hawai'i: U.S. Geological Survey Data Series 289 [URL **http://pubs.usgs.gov/ds/289/**].

Field, M.E., Berg, C.J., and Cochran, S.A., 2007, Science and management in the Hanalei watershed; a trans-disciplinary approach: U.S. Geological Survey Open File Report 2007-1219 [URL **http://pubs.usgs.gov/of/2007/1219/**].

Foxgrover, A.C., Dartnell, Peter, Jaffe, B.E., Takekawa, J.Y., and Athearn, N.D., 2007, High-resolution bathymetry and topography of south San Francisco Bay, California: U.S. Geological Survey Scientific Investigations Map 2987 [URL **http://pubs.usgs.gov/sim/2007/2987/**].

Gibbons, Helen, Dartnell, Peter, Foxgrover, A.C., Jaffe, B.E., Takekawa, J.Y, and Athearn, N.D., 2007, South San Francisco Bay, California: U.S. Geological Survey General Information Product 57, postcard [URL **http://pubs.usgs.gov/gip/2007/57/**].

Grossman, Eric, Stevens, Andrew, Curran, Chris, Smith, Collin, and Schwartz, Andrew, 2007, Bathymetry, substrate and circulation in Westcott Bay, San Juan Islands, Washington: U.S. Geological Survey Open-File Report 2007-1305, 42 p. [URL **http://pubs.usgs.gov/of/2007/1305/**].

Hart, K.M., 2007, Population biology of diamondback terrapins; lessons learned from a dissertation [abs.]: Symposium on the Ecology, Status, and Conservation of the Diamondback Terrapin, 4th, Millersville, Md., August 10-12, 2007, Program, p. 10.

Jaffe, B.E., and Gelfenbaum, Guy, 2007, A simple model for calculating tsunami flow speed from tsunami deposits: Sedimentary Geology, v. 200, no. 3-4, p. 347-361, doi:10.1016/j.sedgeo.2007.01.013 [URL **http://www.sciencedirect.com/science/journal/00370738**].

Kayen, R.E., and Barnhardt, W.A., 2007, Seismic stability of the Duwamish River delta, Seattle, Washington: U.S. Geological Survey Professional Paper 1661-E [URL **http://pubs.usgs.gov/pp/pp1661e/**].

Kellogg, C.A., 2007, Phage therapy for Florida corals?: U.S. Geological Survey Fact Sheet 2007-3065, 2 p. [URL **http://pubs.usgs.gov/fs/2007/3065/**].

Lester, L.A., Hart, K.M., Burke, R., King, T.L., and Crowder, L.B., 2007, Tracking terrapins through genetic analysis; multilocus assignment tests shed light on origin of turtles sold in markets [abs.]: Symposium on the Ecology, Status,

(Recently Published continued on page 9)

(Recently Published continued from page 8)

and Conservation of the Diamondback Terrapin, 4th, Millersville, Md., August 10-12, 2007, Program, p. 11.

McMullen, K.Y., Poppe, L.J., Twomey, E.R., Danforth, W.W., Haupt, T.A., and Crocker, J.M., 2007, Sidescan sonar imagery, multibeam bathymetry, and surficial geologic interpretations of the sea floor in Rhode Island Sound, off Sakonnet Point, Rhode Island: U.S. Geological Survey Open-File Report 2007-1150, DVD-ROM [URL **http://pubs.usgs.gov/of/2007/1150/**].

Poppe, L.J., Ackerman, S.D., Foster, D.S., Blackwood, D.S., Williams, S.J., Moser, M.S., Stewart, H.F., and Glomb, K.A., Sea-floor character and surface processes of Great Round Shoal Channel, offshore Massachusetts: U.S. Geological Survey Open-File Report 2007-1138, DVD-ROM [URL **http://pubs.usgs.gov/of/2007/1138/**].

Poppe, L.J., Denny, J.F., Williams, S.J., Moser, M.S., Forfinski, N.A., Stewart, H.F., and Doran, E.F., The geology of Six Mile Reef, eastern Long Island Sound: U.S. Geological Survey Open-File Report 2007-1191, DVD-ROM [URL **http://pubs.usgs.gov/of/2007/1191/**].

Rice, K.G., Waddle, J.H., Crockett, M.E., Bugbee, C.D., Jeffery, B.M., and Percival, H.F., 2007, Herpetofaunal inventories of the national parks of south Florida and the Caribbean; volume IV, Biscayne National Park: U.S. Geological Survey Open-File Report 2007-1057, 65 p. [URL **http://pubs.usgs.gov/of/2007/1057/**].

Smith, K.E.L., Barras, J.A., Penland, S., and Brock, J.C., 2007, Examining the landscape-level impacts of hurricanes on coastal wetlands; a focus on Louisiana [abs.]: Wetlands 2007, Watershed-Wide Strategies to Maximize Wetland Ecological and Social Services, Williamsburg, Va., August 28-30, 2007 [URL **http://www.aswm.org/calendar/wetlands2007/abstracts_3.htm#smith**].

Publications Submitted for Director's Approval

Barth, G.A., Scholl, D.W., and Childs, J.R., Focused accumulations of methane hydrate above deeply-buried basement highs in the deep-water Bering Sea basins [abs.]: American Association of Petroleum Geologists Annual Convention, San Antonio, Tex., April 20-23, 2008.

Cochran, S.A., Chavez, P.S., Isbrecht, JoAnn, and Bogle, R.C., Mapping suspended sediment concentration on a fringing coral reef using airborne multispectral remote sensing and in situ sampling; Moloka'i, Hawai'i [abs.]: American Geophysical Union Ocean Sciences Meeting, Orlando, Fla., March 2-7, 2008.

Collins, B.D., and Sitar, Nicholas, New approaches to stability analysis of steep coastal bluffs: American Society of Civil Engineers (ASCE) GeoCongress, New Orleans, La., March 9-12, 2008, Proceedings.

Field, M.E., Ogston, A.S., Storlazzi, C.D., Presto, M.K., and Cochran, S.A., Chronic turbidity on the Molokai fringing coral reef; goats, sugar, and watershed change [abs.]: American Geophysical Union Ocean Sciences Meeting, Orlando, Fla., March 2-7, 2008.

Geist, E.L., and Parsons, Tom, Distribution of tsunami inter-event times: Geophysical Research Letters.

George, D.A., and Warrick, J.A., Elwha River delta; geomorphology of a mixed-sediment beach [abs.]: American Geophysical Union Ocean Sciences Meeting, Orlando, Fla., March 2-7, 2008.

Hall, D.K., Williams, R.S., Jr., and DiGirolamo, N.E., Greenland ice sheet surface-temperature and melt variability, 2000-2006: Journal of Glaciology.

Hansen, J.E., Barnard, P.L., Erikson, L.H., and Eshleman, J.L., Wave forced sub-aerial beach variability, Ocean Beach, San Francisco, CA [abs.]: American Geophysical Union Ocean Sciences Meeting, Orlando, Fla., March 2-7, 2008.

Hein, J.R., Caroline Islands, *in* Gillespie, R., and Clague, D.A., eds., Encyclopedia of islands: Berkeley, University of California Press.

Hutchinson, D.R., and Collett, T.S., USGS gas hydrate studies [abs.]: International Conference on Gas Hydrates—Energy, Climate, and Environment, Taipei, Taiwan, October 4-5, 2007.

Jaffe, B.E., and Gelfenbaum, Guy, Inverse sediment transport modeling to learn hydrodynamic information contained in tsunami deposits [abs.]: American Geophysical Union Ocean Sciences Meeting, Orlando, Fla., March 2-7, 2008.

Kellogg, C.A., Aeromicrobiology; viruses, *in* section on aeromicrobiology/air quality, Encyclopedia of Microbiology: Amsterdam, Elsevier.

Lacy, J.R., and Wyllie-Echeverria, Sandy, Field measurements of current attenuation and vertical mixing in eelgrass meadows [abs.]: American Geophysical Union Ocean Sciences Meeting, Orlando, Fla., March 2-7, 2008.

Maier, K.L., Fildani, Andrea, Normark, W.R., McHargue, Tim, Paull, C.K., Graham, S.A., Clarke, Julian, McGann, Mary, and Caress, D.W., High-resolution imaging of reservoir architectures in weakly-confined deep-water channel systems [abs.]: American Association of Petroleum Geologists Annual Convention, San Antonio, Tex., April 20-23, 2008.

Osterman, L.E., Poore, R.Z., and Swarzenski, P.W., 1000 years of recurring natural and anthropogenic low-oxygen water on the Louisiana shelf, Gulf of Mexico [abs.]: American Geophysical Union Ocean Sciences Meeting, Orlando, Fla., March 2-7, 2008.

Piper, D.J., and Normark, W.R., Tubidite deposition; the role of initiating process and slope morphology on mid-latitude continental margins [abs.]: American Association of Petroleum Geologists Annual Convention, San Antonio, Tex., April 20-23, 2008.

Poore, R.Z., and Richey, J.N., Northern Gulf of Mexico climate variability [abs.]: American Geophysical Union Ocean Sciences Meeting, Orlando, Fla., March 2-7, 2008.

(Publications Submitted continued on page 10)

(Publications Submitted continued from page 9)

Presto, M.K., Storlazzi, C.D., Logan, J.B., and Grossman, E.E., Hydrodynamics and the dispersal of submarine groundwater discharge in Kaloko-Honokohau National Historical Park, Hawaii [abs.]: American Geophysical Union Ocean Sciences Meeting, Orlando, Fla., March 2-7, 2008.

Presto, M.K., Storlazzi, C.D., Logan, J.B., and Grossman, E.E., Submarine ground water discharge and fate along the coast of Kaloko-Honokohau National Historical Park, Hawaii: U.S. Geological Survey Open-File Report.

Richey, J.N., Poore, R.Z., and Flower, B.P., Mg/Ca in different size classes of planktonic foraminifers [abs.]: American Geophysical Union Ocean Sciences Meeting, Orlando, Fla., March 2-7, 2008.

Sigurðsson, O., and Williams, R.S., Jr., Geographic names of Iceland's glaciers; historical and modern: U.S. Geological Survey Professional Paper, 300 p.

Takesue, R.K., Bothner, M.H., and Field, M.E., Trace element compositions of upland soil and summer (2006) flood sediment in sediment traps, Hanalei Bay, Kauai [abs.]: American Geophysical Union Ocean Sciences Meeting, Orlando, Fla., March 2-7, 2008.

Tihansky, A.B., 2007, Topobathymetric map of Tampa Bay: U.S. Geological Survey General Information Product 56, postcard.

Waite, W.F., Kneafsey, T.J., Winters, W.J., and Mason, D.H., Physical property changes in hydrate-bearing sediment due to depressurization and subsequent repressurization: Journal of Geophysical Research.

Xu, J.P., Paull, C.K., Normark, W.R., Ussler, William, III, Caress, D.W., Keaten, Rendy, Barry, James, Covault, J.A., and Maier, K.L., Origins of large wave-shaped bedforms on the floor of Monterey Submarine Canyon [abs.]: American Geophysical Union Ocean Sciences Meeting, Orlando, Fla., March 2-7, 2008.