USGS

Sound Waves

Coastal Science and Research News from Across the USGS

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Research

USGS Sedimentologist David Rubin Serves as External Expert During NASA Announcement of Evidence for Flowing Water on Mars

By Helen Gibbons

U.S. Geological Survey (USGS) scientist **David Rubin** participated as an external expert in a National Aeronautics and Space Administration (NASA) press conference on March 23 in which the agency announced the first firm, direct evidence for flowing water on the surface of Mars.

That evidence consists of bedding structures—particularly, fine layers called trough cross-laminae—in the rock outcrop rimming Eagle Crater, where NASA's Mars exploration rover *Opportunity* landed at about 9 p.m. PST on January 24. The structures have been documented in images taken by *Opportunity* and studied by the rover science team over the past weeks.

John Grotzinger, rover science-team member from the Massachusetts Institute of Technology (MIT), presented the sedimentologic evidence in a series of images, starting with a time-lapse movie shot by **Dave Rubin** and **Jon Nelson** (USGS) of sand in a flume organizing itself into ripples with sinuous crests as water flows over it. The movie was followed by a video simulation, also produced by **Rubin**, of migrating, sinuous-crested ripples seen from overhead and in cutaway sections that show bedding patterns which match those in the Martian rocks. (The movie and simulation can be downloaded from URL **http://walrus.wr.usgs.gov/seds/Movie_list.html**.)

Next, **Grotzinger** showed images of the Martian rocks themselves, calling viewers' attention to the trough cross-laminae, which he described as "opening-upward smiles," that particularly moved the scientists to interpret the layers as having been deposited by flowing water. **Grotzinger**

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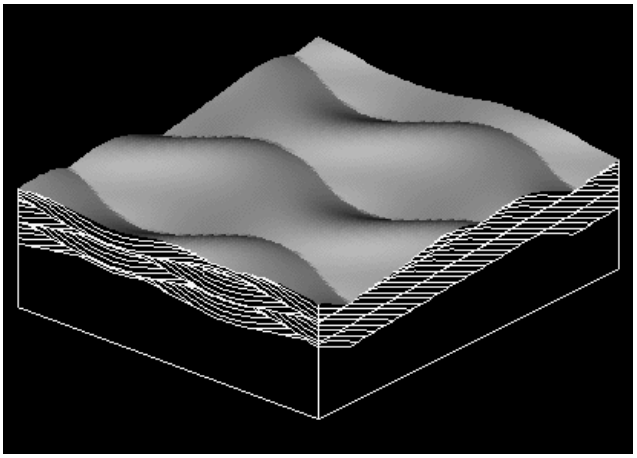
Panelists at NASA's March 23 press conference, at which the agency announced evidence for flowing water on the surface of Mars. (Left to right) ***Steve Squyres*** *(Cornell University, principal investigator for the science payload on Mars exploration rovers* Opportunity *and* Spirit*),* ***John Grotzinger*** *(rover science-team member from MIT's Department of Earth, Atmospheric and Planetary Sciences),* ***Ed Weiler*** *(NASA's associate administrator for the Office of Space Science),* ***Dave Rubin*** *(external expert from the USGS), and* ***James Garvin*** *(NASA's lead scientist for Mars and the Moon). Photo credit: NASA/Renee Bouchard.*



Block diagram of computer-simulated migrating ripples with sinuous crests. Trough cross-beds are visible in the lower left cross section, in which the ripples are migrating away from the viewer. Note similarities to bedding patterns in the closeup image of the Martian rock called Last Chance (page 3). (Diagram is figure 34a from Cross-Bedding, Bedforms, and Paleocurrents *by* ***David Rubin****, available online at URL* ***http://walrus.wr.usgs.gov/seds/table_of_contents.html****.)*

Sound Waves

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Images: Please submit all images at publication size (column, 2-column, or page width). Resolution of 200 to 300 dpi (dots per inch) is best. Adobe Illustrator© files or EPS files work well with vector files (such as graphs or diagrams). TIFF and JPEG files work well with raster files (photographs or rasterized vector files).

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Research, continued

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said, "We feel very confident that this adds up to a story about ripples moving in water rather than in wind." He said that the ripples had been formed in water at least 5 cm (2 in) deep, possibly much deeper, by currents flowing at speeds of 10 to 50 cm/s, or about 1 mph.

The sedimentologic findings build on chemical findings announced three weeks earlier, in a press conference on March 2, when NASA announced the presence in the outcrop of abundant sulfate salts and widely varying concentrations of bromine—characteristics of rocks on Earth that formed by the evaporation of seawater. The chemical evidence showed that liquid water once soaked the rocks, but the scientists could not say at that time whether it was surface water or ground water.

Sedimentologic evidence gathered shortly after the March 2 press conference caused the scientists to conclude that the outcrop had formed in surface water, an environment even more likely than ground water to have been capable of supporting life. NASA's associate administrator for the Office of Space Science **Ed Weiler** said, "We thought, since these conclusions were very profound, that we ought to go through a peer-review process" before announcing them.

NASA's lead scientist for Mars and the Moon, **Jim Garvin**, lined up six reviewers, including two from the University of Texas, Austin and Dallas, and one each from the Open University in London, Los Alamos National Laboratory, the Geological Survey of Canada, and the USGS. The USGS reviewer, **Dave Rubin**, is an expert on sedimentology and bedforms on the Western Coastal and Marine Geology Team at the USGS Pacific Science Center in Santa Cruz, CA.

Rubin expressed his support for the interpretations presented by **Grotzinger** at the press conference, saying: "When **John** and **Jim** first sent me [the images], I was astonished. There on Mars were sedimentary structures just like we see on Earth. You can go out to your nearest beach or creek and take a shovel and dig in and see some of these same kinds of structures." As an example, **Rubin** showed a photograph of trough cross-laminae in sand deposited by the Colorado River that look much like those seen in the images of Martian rocks.

Being a conscientious reviewer, **Rubin** also played devil's advocate, offering an alternative interpretation of the Martian rocks' trough cross-laminae: that they might have been deposited by wind. But the shape and scale of the Martian bedding structures—the sets of cross-laminae are trough shaped and only a few centimeters thick—led him to favor deposition by water. He said, "Probably the best [alternative explanation] I could come up with would involve very small windblown bedforms, and probably the best way to keep the windblown bedforms small would be to have water just beneath the surface. So, even in the best counterexample I could come up with, there probably would be water at the surface, if not above the surface." **Rubin** concluded that the rover science team's interpretation of the Martian rocks as water-laid deposits was the best explanation for the rocks' textures.

According to **Grotzinger**, the environment at the time the rocks were form-

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Cross-laminae deposited by ripples in the Colorado River in the Grand Canyon, AZ. These structures resemble those in the Last Chance microscopic-imager (MI) mosaic (page 3). Photograph by ***Dave Rubin****, USGS.*

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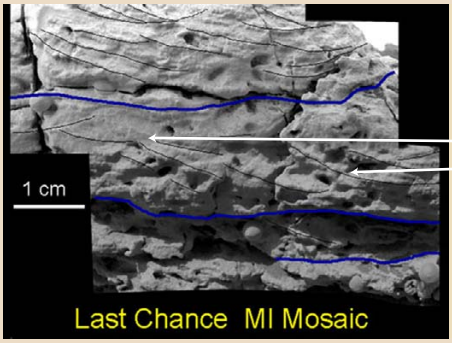
ing could have been a salt flat, or playa, sometimes covered by shallow water and sometimes dry. Such environments on Earth, either at the edge of oceans or in desert basins, can have currents of water that produce the type of ripples seen in the Martian rocks. The scientists cannot tell yet how deep the water was, when or how long it flowed, or what the climate was like at the time. Although running water might seem to imply a warm climate, **Steve Squyres** of Cornell University, principal investigator for the science payload on *Opportunity* and its twin Mars exploration rover, *Spirit*, pointed out that the water could have been flowing under a cover of ice. [See article entitled "Microbial Life in Perennially Ice Covered Lakes in the McMurdo Dry Valleys, Antarctica," this issue, for an example of an ice-covered life-supporting environment on Earth.]

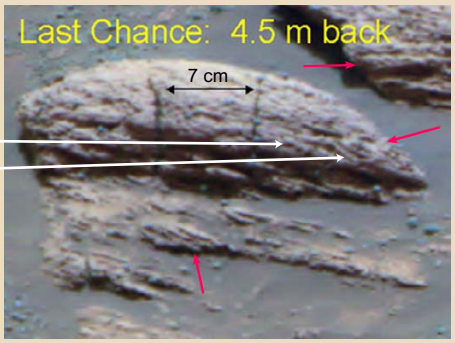
Squyres also noted that the environment in which the Eagle Crater rocks appear to have formed would be not only a habitable environment, one capable of supporting life, but also a good environment for preserving the evidence of past life. As salt crystals precipitated in the rocks, for example, they would trap chemicals from the seawater that might hold clues to the presence of life.

Addressing a question about the possible presence of fossils in the Martian rocks, **Rubin** said that, on Earth, there could be microscopic fossils, such as mats of algae, in rocks formed in similar environments. Then he got a twinkle in his eye and added, "Some of the rocks [formed on Earth in] these same kinds of environments also have dinosaur footprints." That drew a laugh from the other panelists, who were probably relieved when **Rubin** went on to say, "But there's no reason to think that there would be anything like that here."

Squyres agreed that if there are any fossils in the Martian rocks, they would probably be microscopic and too small for *Opportunity's* instruments to see. Finding signs of past or present life will likely require sending human geologists or, in the near term, a robot to bring back samples for study on Earth. ❁



Mosaic of some of the 152 microscopic-imager (MI) frames of the Martian rock called Last Chance that Opportunity *took on sols 39 and 40 (Mar. 3 and 4, 2004). This view shows cross-laminae that trend downward from left to right, traced with black lines in the interpretative overlay. These cross-laminae are consistent with dipping planes on the downcurrent side of migrating ripples. Thicker blue lines indicate boundaries between possible sets of cross-laminae. (Note: The designers of the microscopic imager never envisioned using it to make big image mosaics such as the one shown here; among the many people who achieved what* ***Steve Squyres*** *calls a "remarkable feat of robotic imaging" was* ***Ken Herkenhoff*** *of the USGS Astrogeology Team in Flagstaff, AZ.)*



Panoramic-camera image of the Martian rock called Last Chance at Eagle Crater, taken at a distance of 4.5 m (15 ft) during Opportunity's *17th sol (Feb. 10, 2004). The inferred sets of fine layers at angles to each other (cross-laminae) are as much as 2 to 3 cm (approx. 1 in.) thick. The features indicated by the middle red arrow suggest trough cross-lamination, likely produced when flowing water shaped sinuous ripples in underwater sediment and pushed the ripples to migrate in one direction. The direction of the ancient flow would have been from left to right, possibly with a component either toward or away from the viewer. The lower and upper red arrows point to cross-lamina sets that are consistent with underwater ripples in the sediment having moved in water flowing from left to right.*

Images courtesy of NASA, the Jet Propulsion Laboratory, Cornell University, and the USGS. These and additional images can be viewed at URL ***http://marsrovers.jpl.nasa.gov/gallery/press/opportunity/20040323a.html****.*

Fieldwork

Microbial Life in Perennially Ice Covered Lakes in the McMurdo Dry Valleys, Antarctica

By John Lisle

The climate of the South Pole is about as different from the warm, subtropical climate of St. Petersburg, FL, as a researcher can imagine. The South Pole, however, is where **John Lisle**, a microbial ecologist at the U.S. Geological Survey (USGS)'s Center for Coastal and Watershed Studies in St. Petersburg, worked for three Antarctic summers in a row, from 2000 to 2002. He was part of a team investigating how bacteria and their viruses, or bacteriophage, interact and how these interactions influence carbon and nutrient cycling in aquatic systems.

Before joining the USGS, **John** was part of a multidisciplinary-research group working in the National Science Foundation (NSF)'s Long Term Ecological Research (LTER) site in the McMurdo Dry Valleys, Antarctica (for more information about the site, visit URL **http://www.lternet.edu/sites/mcm/**). The Dry Valleys compose the coldest and driest desert on Earth, making this region one of the most extreme environments on the planet. Within the ice-free valleys are

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lakes that have been perennially covered with 3 to 6 m of ice for hundreds of years. The lakes were formed when glaciers receded. Owing to the absence of wind-driven mixing, all the lakes are highly stratified with regard to temperature, salinity, nutrients, and primary productivity, and all are extremely stable. An additional factor contributing to the extreme conditions is a 6-month period of darkness during which there is no sunlight to drive photosynthesis and primary productivity.

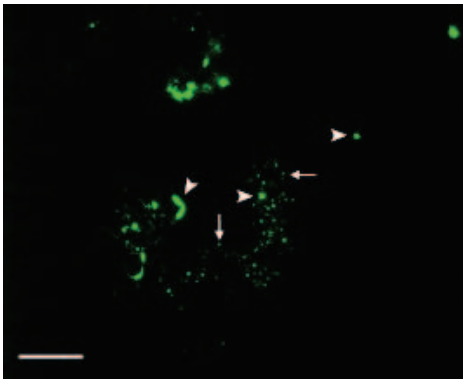
***John Lisle** doing fieldwork in the McMurdo Dry Valleys, Antarctica.*

The question **John** and his colleagues were addressing was "How are the microbial components of these lakes surviving during the cold, dark months of winter?" The first step in answering this question was to determine the abundances of bacteria and bacteriophage in each lake at different depths. The next step was to assess whether bacteria-bacteriophage interactions and cycles, which have been documented in more temperate climates, also occur in these extreme environments. Examples are lysis (the rupture of a bacterial cell by bacteriophage that have replicated within the cell, resulting in bacterial death and the release of thousands of new bacteriophage) and lysogeny (a state in which bacteriophage lie dormant within a bacterium, awaiting favorable conditions for replication).

Bacterial abundances in the lakes were found to range from 3.04×10^4 to 3.48×10^7 per milliliter, and bacteriophage abundances from 1.66×10^5 to 4.64×10^7 per milliliter. Both abundances are similar to those found in temperate climates. When samples were treated with a lysogenic stimulant, as much as 62.5 percent of the bacterial population were found to be lysogenic (bacteria that are hosts to dormant bacteriophage until more favorable conditions for bacteriophage replication exist outside the cell). This percentage is relatively high compared with lysogeny rates in more temperate and productive waters, suggesting that lysogeny may be the preferred "lifestyle" for bacteriophage in extreme environments.

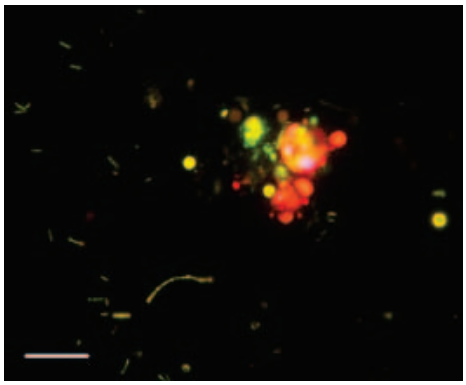
These observations are also significant with regard to a fundamental understanding of how dissolved and particulate organic carbon and nutrients contained with the bacterial biomass are cycled through the microbial loop and made available to the photosynthetic algae that are the sole source of primary production in these lakes. The importance of the microbial loop to cycling of carbon and other nutrients associated with the lysed bacterial biomass is heightened because there are no grazers in these ecosystems. Therefore, most of the dissolved organic carbon from the bacteriophage-lysed bacteria is recycled back through the bacterial populations.

An additional observation during these studies was the presence of lake aggregates at all depths in all the lakes. When stained with fluorescent labels, the aggregates were found to be composed of proteins and carbohydrates, with bacteria and bacteriophage embedded within the aggregates' matrix. We feel that these aggregates serve as nutritional "oases" within these extreme environments, in which the bacteria can survive during the dark months of winter by using extracellular enzymes to slowly digest the aggregate matrix. In addition to direct use of the aggregate for nutrients, the lysis of bacteria by bacteriophage within these aggregates also provides a source of carbon.



Bacteria (arrowheads) and bacteriophage (arrows) in lakewater samples. (Bar is 10 µm long.)

It may appear that the study of bacteria-bacteriophage interactions in the McMurdo Dry Valleys is not applicable to studies of temperate coastal water and sediment systems; however, this is not the case for the following reasons: (1) Transition zones, such as oxic-anoxic interfaces, are expanded to meter thicknesses in the Dry Valley lakes in comparison with the same types of zone in more temperate and mixed aquatic systems, where the zone may be only a few millimeters thick; and (2) the Dry Valley lakes are not mixed and do not support trophic levels above the phytoplankton. Together, these characteristics make the perennially frozen lakes of the McMurdo Dry Valleys excellent model systems for studying microbial interactions, because most of the confounding variables that exist in other aquatic systems are absent. The data from these studies will be published in the international journal *Microbial Ecology* in the coming months.❁



Stained lake aggregate, showing photosynthetic algae (red), bacteria (rod shaped), and other unclassified microorganisms. (Bar is 10 µm long.)

New Coral Reef Exhibit in the Florida Keys

By Gene Shinn

In 1999, the U.S. Geological Survey (USGS) donated the central exhibit for the dedication of Windley Key Fossil Reef Geological State Park and its Alison Fahrer Environmental Education Center (see article in *Sound Waves,* February 1999, URL **http://soundwaves.usgs.gov/1999/02/index.html**). Yet another exhibit was added early this year. The park and environmental-education center are located in an old quarry on Windley Key, FL, within the Key Largo Limestone, a fossil coral reef of Pleistocene age.

The new exhibit showcases a modern coral sample collected more than 25 years ago that has yielded copious information about historical climatic events.

Working out of the USGS Fisher Island Field Station in Miami Beach in 1975, **Harold Hudson** (now chief restoration officer with the National Oceanic and Atmospheric Administration [NOAA]'s Florida Keys National Marine Sanctuary, Key Largo) and **Bob Halley** (now a geologist at the USGS Center for Coastal and Watershed Studies [CCWS] in St. Petersburg, FL) cored one of the largest and oldest living head corals in the Florida Keys, recovering a core 4 inches in diameter and 10 feet long. The core was slabbed, and X-ray photographs were prepared. **Harold** measured and counted the annual growth bands in the X-radiographs and determined that the coral had begun growing on Pleistocene limestone the same year that the pilgrims landed at Plymouth Rock, and so we dubbed the core the "Bicentennial Core." The photographs and core data were used in several presentations, and the core and another taken from the same coral in 1978 became the basis of a Ph.D. dissertation by **Ellen Druffel**.

Formerly with the Woods Hole Oceanographic Institution, **Ellen**, who is now a professor at the University of California, Irvine, performed year-by-year ^{14}C analyses on the core to look for variations related to climate change and seawater circulation over the past 200 years. Among her observations, later published in *Science,* were that the ^{14}C data clearly reflected the period of atmospheric nuclear testing, and she could see lowered water temperature associated with the later part of the Little Ice Age. Various stress bands are visible in the X-radiograph, including one that correlates with an 1895 cold front that killed orange groves in central Florida. Another stress band was formed during an unusually cold front in the winter of 1969-70; that cold spell killed numerous 100-plus-year-old nearshore corals. The Bicentennial Core also contains a wide stress band that formed in many corals between 1941 and 1942. We assumed for many years that this band was yet another sign of a cold winter because of its similarity to the one that formed in 1969-70. Recent studies since the late 1980s, however, have shown that water temperatures high enough to cause bleaching in corals (expulsion of symbiotic algae) can also produce stress bands. With this new information, one wonders whether bleaching due to high temperatures could have caused the 1941-42 stress band.

The "Bicentennial Core" on display at the Alison Fahrer Environmental Education Center in Windley Key Fossil Reef Geological State Park, FL.

Harold and the curators of Windley Key Fossil Reef State Park's environmental-education center recently prepared two displays of the Bicentennial Core. The actual core with notations and associated photographs rests alongside the coral reef geologic exhibit prepared 5 years ago by the CCWS. The other display is the X-radiograph of the core mounted vertically, with notations of historical events that occurred during the coral's lifetime. The new exhibit credits the USGS and is seen by approximately 14,000 people each year.

In addition to Florida Keys tourists, college geology and biology students and numerous high-school groups visit the quarry and environmental-education center several times each week. College geology departments across the United States send groups on field trips to the Keys to study modern carbonate processes. The National Film Board of Canada is planning a series on the geology of barrier islands that will include the USGS exhibits as a way to show the geologic development of the Florida Keys.

USGS Assists in Latest JASON Expedition—Louisiana's Disappearing Coastal Wetlands

By Jeff Williams

Educating teachers and middle-school students across the Nation and worldwide about how Earth systems operate, and stressing the importance of science in understanding these complex systems, has been the central mission of the JASON Foundation for Education. One way the foundation accomplishes its mission is by administering the JASON Project, which offers students real and virtual field expeditions to various geologic features: ocean regions, polar areas, active volcanoes, and tropical rainforests (for more information, visit URL **http://www.jason.org/**). The latest expedition planned by the JASON Project will take students on a journey to the Louisiana Delta plain and wetlands to help them learn about the region's geologic history, structure, and processes and the reasons for the rapid changes taking place.

JASON called on U.S. Geological Survey (USGS) scientist **S. Jeffress Williams**, of the USGS Woods Hole Science Center, to assist in planning and designing the Louisiana expedition. A coastal-marine geologist with more than 15 years of coastal-research experience in Louisiana, **Jeff** will serve as the science-context expert for the team of writers for the JASON Expedition "Disappearing Wetlands." The planning process started with a workshop and planning meeting on March 13-15, 2004, where **Jeff** presented a talk entitled "Overview of Life, Earth, and Physical Science of the Louisiana Wetlands." The talk was based on research by **Jeff** and others, much of which is reported in the new USGS publication "Coastal Erosion and Wetland Change in Louisiana: Selected USGS Products" (USGS Digital Data Series-79, URL **http://pubs.usgs.gov/dds/dds79/HTMLDOCS/intro.htm**).

Look for this latest expedition offering to schools in the near future.

USGS Scientist Inspires Students at a High-School Career Day in California

By Carol Reiss

U.S. Geological Survey (USGS) scientist **Carol Reiss** participated in Prospect High School's career day in Saratoga, CA, on February 26. Instead of the usual presentations in front of an assembled audience, this career day was run more like a career fair, where participants set up displays on tables and students visited the displays. This arrangement allowed students to interact with the people whose displays particularly interested them. Teachers had to sign up in advance, and four classes per hour were allowed to circulate through the exhibits, which were open to all students during break and lunch. Many visitors were attracted to **Carol's** display of a computerized seismic program created by **Alan Jones** (Binghamton Univ.), which shows historical earthquakes and volcanic eruptions around the margins of the Pacific Plate (the Ring of Fire) set to music. (To download this free software program, visit URL **http://www.geol.binghamton.edu/faculty/jones/** and click on "Seismic-Eruptions.") One teacher overheard students talking about **Carol's** exhibit and reported their comment: "When she talked about science, it didn't seem boring at all!" After the session, the exhibitors were treated to a catered lunch.

Coastal and Marine Geology Program Scientists Attend USGS GIS Workshop

by Florence Wong, VeeAnn Cross, and Kristy Guy

A U.S. Geological Survey (USGS) Geographic Information Systems (GIS) Workshop held March 1-5, 2004, in Denver, CO, featured new and developing spatial-data and analysis technologies. GIS scientists from the three Coastal and Marine Geology Program (CMGP) centers contributed posters on current work and were able to take advantage of the workshops led by vendor specialists and by USGS Geographic Information Office (GIO) staff.

Abby Sallenger's group (represented by **Kristy Guy** from the Center for Coastal and Watershed Studies in St. Petersburg, FL) presented a striking poster on the breaching of Hatteras Island, NC, during Hurricane Isabel in 2003, based on timely lidar (light detection and ranging) surveys before and after the storm's landfall. (See related story in *Sound Waves,* November 2003, at URL **http://soundwaves.usgs.gov/2003/11/fieldwork2.html**).

Florence Wong and **Lori Hibbeler**, from the Western Coastal and Marine Geology Team in Menlo Park, CA, showcased sedimentologic, geochemical, hydrologic, structural, and hazard studies in their coastal and marine GIS for the southern California margin.

CMGP scientists from the USGS' Woods Hole Science Center won the "You Make Us Proud To Be Geeks" poster prize for a group of posters targeting several recent projects. **Ed Sweeney** completed processing on the AMS120 sidescan-sonar data set collected by **Herman Karl** and others in the Gulf of the Farallones in 1989 (for information about this cruise, visit URL **http://walrus.wr.usgs.gov/infobank/f/f989nc/html/f-9-89-nc.meta.html**), and featured the sidescan-sonar mosaic in a "where's the shipwreck?" puzzle. **Sarah Fuller**

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and **Lian Scully** presented two posters on Stellwagen Bank National Marine Sanctuary. One poster showed boulder ridges and bedrock outcrops mapped from sun-illuminated bathymetry, backscatter images, and, where available, videographic and/or photographic images; the other poster used a modified Terrain Ruggedness Index model to indicate abrupt changes in elevation within the same area. **Dave Stolper** presented his estuarine-sedimentation model in a poster and also demonstrated the ArcGIS extension running on his laptop; his model predicts the response of estuarine habitats to sea-level rise, sedimentation, and management interventions. **VeeAnn Cross** presented recent work with **Dave Twichell**, comparing Lake Mead and the John Day Reservoir in her poster titled "Are All Reservoirs Created Equal?"

At daily plenary sessions, representatives of the USGS, other Federal agencies, academia, and private organizations were invited to provide overviews of mapping research, scientific visualization, data acquisition, and software trends. Keynote speaker **Michael Goodchild** (University of California, Santa Barbara) emphasized the importance of the science of geography beyond storing and mapping data. **Mark DeMulder** (USGS) reported on the growth of *The National Map* (at URL **http://nationalmap.usgs.gov/index.html**), which provides a seamless elevation-data set and will be expanded to include higher-resolution digital raster graphics (scanned USGS topographic sheets). **Karen Sideris**, USGS Geographic Information Officer,

"GIS Alien" statuette, awarded to scientists from the USGS Woods Hole Science Center who won the "You Make Us Proud To Be Geeks" poster prize at the recent USGS GIS Workshop.

noted that the workshop was a rare opportunity for her to focus on the "G" part of her title, in contrast to dealing with the security measures and other administrative issues that have filled her to-do list. **Ann Miglarese** of the National Oceanic and Atmospheric Administration (NOAA)'s Coastal Services Center (visit URL **http://csc.noaa.gov/**) reported on several initiatives in which NOAA and USGS interests overlap: coastal change and analysis, coral and coastal-watershed mapping based on satellite data, and high-resolution elevation data (for example, lidar and IFSAR [Interferometric Synthetic Aperture Radar]). **Geoff Dorn**, of the University of Colorado's BP Center for Visualization (visit URL **http://www.bpvizcenter.com/**), demonstrated a three-dimensional mapping environment that a user can stroll through. **Nick Van Driel** (USGS, Sioux Falls, SD) reminded us about the growing wealth of remotely sensed image data available from the USGS' EROS Data Center in South Dakota (visit URL **http://edc.usgs.gov/**). Many others shared their insights about the pervasiveness of GIS in science, governance, and policy-making.

Attendees were offered hands-on workshops in which they could learn or refresh their skills in such areas as raster data processing and analysis, database management, mapmaking, and metadata. Reflecting the USGS' interest in human health (visit URL **http://health.usgs.gov/**), a special-paper session focused on applications of GIS to health issues.

The USGS' GIS users community has representatives from across the Nation and from all disciplines. One of the greatest benefits of this workshop was the opportunity to discuss, in person, common research and technical problems in the new, USGS-wide consolidation of GIS oversight under the USGS Geographic Information Office.

ASLO/TOS Ocean Research Conference

By Christina Kellogg

Though typically partnered with the American Geophysical Union (AGU), the American Society of Limnology and Oceanography (ASLO) chose this year to cosponsor their ocean-sciences meeting with The Oceanography Society (TOS). Held February 15-20 in Honolulu, HI, the conference provided a forum for researchers to highlight recent advances, with an emphasis on the integration of aquatic sciences, as well as on the breadth of ocean research, including engineering, industrial, public-policy, and marine research. Fifty-three sessions were organized under nine main subthemes:

- Midlatitude and high-latitude oceanography
- Coupled physical-biological processes
- Coral reefs
- Molecular ecology
- Biogeochemical cycles
- Observing systems
- Ocean color observations
- Pacific fisheries/Census of Marine Life
- Urban ocean—coastal ocean near centers of urban populations

Thematically organized poster sessions were held on three of the five evenings during the meeting, with concurrent cocktail receptions to draw attendees. More

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than 400 posters were on display during these sessions.

The U.S. Geological Survey (USGS)'s Coastal and Marine Geology Program was well represented at the conference. **Dale Griffin** (St. Petersburg, FL) spoke about atmospheric desert dust and its impact on ocean and human health. His talk generated so much interest that two journal editors in the audience have asked him to submit review articles on the topic to their respective publications.

Christina Kellogg (St. Petersburg) presented a poster describing her preliminary work on the microbial ecology of deep-water corals. Both shallow- and deep-water-coral scientists were interested in the work, and several new collaborations were discussed. **Christina** is already scheduled to participate in two deep-water-coral research cruises in summer 2004.

Several scientists from the USGS Western Coastal and Marine Geology Team in Menlo Park and Santa Cruz, CA, also attended the meeting and gave various presentations on microbial water quality, runoff, and the effects of contaminated sediment in California coastal waters.

***Christina Kellogg** has a bird's-eye view of the Hawai'i Convention Center, which housed this year's ASLO/TOS Ocean Research Conference.*

Louisiana Wildlife Federation Names Bob Stewart Professional Conservationist of the Year

By Gaye Farris

Robert E. Stewart, Jr., director of the U.S. Geological Survey (USGS)'s National Wetlands Research Center in Lafayette, LA, was named Professional Conservationist of the Year by the Louisiana Wildlife Federation at its achievement banquet in New Iberia, LA, on February 28. In response to this award, he has also received Congressional recognition from U.S. Senator **Mary Landrieu** and Representative **Chris John**.

According to the federation's executive director **Randy Lanctot**, the award was "for developing and guiding the Nation's premier wetlands-research facility and lending its expertise to better understand and preserve wetland resources."

The federation cited **Bob** for his involvement in inventorying wetlands throughout the United States and documenting their extent, values, and rates of loss. They noted his use of computer technology, remote sensing, and geographic information systems to guide that work. The federation recognized that the center's dramatic map images and wetlands-loss statistics have caught the public's attention. They added that through "his vision and persistence, the National Wetlands Research Center at the University of Louisiana at Lafayette was authorized in 1989 and was dedicated in 1992. Under **Stewart's** direction, the NWRC has become a world leader in wetlands science and a vital asset in Louisiana's coastal restoration effort."

***Bob Stewart** (right), director of the USGS National Wetlands Research Center, receives an award as Professional Conservationist of the Year from **Joe Herring**, outgoing president of the Louisiana Wildlife Federation.*

The federation identified **Stewart's** demeanor as positive, enthusiastic, and "key to his success in creating the collaborations that are a hallmark of the NWRC work, and in getting the support necessary to build its capacity." They added that in 2003, **Stewart** brought high-level Federal officials to Louisiana and engaged them in understanding coastal-wetlands loss and restoration needs.

Finally, the federation stated that under **Stewart's** direction, the National Wetlands Research Center in 2003 has:

- provided technical support for the Louisiana Coastal Area Ecosystem Restoration Study and Coastal Wetlands Planning Protection and Restoration Act projects;
- continued research and related publication of findings on the "brown marsh" salt-marsh dieback;
- enhanced collaboration on the concept of carbon sequestration as an incentive for the restoration of forested wetlands;
- studied the impact of invasive species on native habitats;
- provided technical support for conservation efforts in the Lower Mississippi Valley; and
- partnered with the Caddo Lake and Red River Watershed Management Institutes to provide science support, technical training, and education assistance.

The Louisiana Wildlife Federation is a nonprofit conservation, education, and advocacy organization with 13,000 members in the State. It is affiliated with the National Wildlife Federation.

USGS Paper Chosen as AGU Journal Highlight by the Editors of *Geophysical Research Letters*

The editors of the American Geophysical Union (AGU) journal *Geophysical Research Letters* have selected a paper by U.S. Geological Survey (USGS) scientist **Jon Warrick** and his colleague at Stanford University, **Derek Fong**, as an AGU Journal Highlight.

The full reference for the paper is Warrick, J.A., and Fong, D.A., 2004, Dispersal scaling from the world's rivers: Geophysical Research Letters, v. 31, no. 4, L04301, doi: 10.1029/2003GL019114, 2004.

The summary printed below (in shaded box) was published in *Geophysical Research Letters* and distributed to interested news media in advance of the paper's publication on March 10, 2004. (The summary is available online at URL **http://www.agu.org/sci_soc/prrl/jh031004.html**.)

*River plumes along the Santa Ynez Mountains of southern California after rainfall from a 1998 El Niño storm. Conspicuous plume at lower right is flowing from Gaviota Creek. In their recent paper, **Warrick** and **Fong** show that many such small river plumes are important pathways of continental material entering the ocean, and their cumulative effect on coastal areas likely exceeds that of the largest river systems. View westward toward Point Conception. Photograph by **Mark Defeo**.*

Small rivers' impact on coastal ocean biogeochemistry

A new investigation that evaluates the biogeochemical impact from the flow of small rivers into the coastal ocean shows that the cumulative effect of many river plumes likely exceeds that of the largest river systems. **Warrick** and **Fong** show that flooding rates among smaller rivers, particularly tributaries from mountainous regions, cumulatively provide greater amounts of mass and momentum into the ocean than huge, well-studied rivers like the Mississippi and Amazon. The authors also provide information that can be used to mathematically model the impact from such small rivers and estimate their contribution into the world's oceans. They note, however, that sediment and biological material ejected from rivers varies widely, which can affect the coastal geochemical properties like nutrient dispersion and resulting algal blooms. The researchers suggest that the study can be used to track particulate materials from the hydrologic processes into the oceans.

Title: Dispersal scaling from the world's rivers

Authors:

Jonathan A. Warrick, Coastal and Marine Geology, U.S. Geological Survey, Menlo Park, CA; **Derek A. Fong**, Environmental Fluid Mechanics Laboratory, Stanford University, Stanford, CA.

Source: *Geophysical Research Letters* (GRL) paper: 10.1029/2003GL019114, 2004❁

USGS Papers Highlight Major Events in the Florida Keys During the Past 325,000 Years

In two papers by U.S. Geological Survey (USGS) authors, the *Geological Society of America Bulletin* is publishing a comprehensive, regional-scale analysis of the shallow geologic framework of coral reefs in the Florida Keys National Marine Sanctuary. The analysis is a compilation and assimilation of new and existing data sets, acquired by USGS scientists and other workers since the 1960s, that allow fresh interpretations of geomorphic development on a windward, tectonically stable platform margin over the past 325 ka.

The first paper, published in July 2003, showcases updated, detailed color contour maps of the Pleistocene bedrock surface and the thickness of overlying Holocene accretions. The maps are the most extensive produced to date, encompassing approximately 2,130 km^2, or 25 percent, of the sanctuary. The map of the Pleistocene bedrock surface reveals the influence of an uneven, west-sloping topography on Holocene flooding history and coral-reef evolution. The map of Holocene accretions indicates that sediment is being transported off the lower-elevation area of the shelf.

The second paper, which will appear in the summer 2004 issue, provides a new, geomorphogenic approach to developing shelf-edge models by using seismic, core, aerial-photomosaic, and high-precision radiometric-age data correlated with eustatic sea-level maximums.

Together, the two papers provide a cohesive scientific database and overall perspective not previously available for the well-studied Florida Keys. Beyond their local relevance, the papers also represent a distinctive contribution to coral-reef-complex characterization in general, both at modern and ancient platform margins.

(Florida Keys continued on page 10)

(Florida Keys continued from page 9)

Key results with potential application to other reef-rimmed platform margins include:

- influence of paleogeography, paleotopography, and physical environment;
- replication of localized stratigraphic and shelf-edge symmetry and asymmetry perpetuated by repetitive transgressive processes;
- development of upward, landward, and seaward reef-complex buildups;
- manifestation of laterally alternating areas of shelf-margin progradation (during Holocene time in Florida, not previously formally documented) by infilling of discontinuous backreef troughs (of Pleistocene age in Florida); and
- validation that not all windward margins fit the classic steeply inclined model.

The papers will be of interest to archeologists, climatologists, oceanographers, coral-reef scientists, carbonate geologists, geomorphologists, sedimentologists, stratigraphers, the hydrocarbon industry, government agencies, and academia. Beyond its scientific value, the information in these papers will be useful in local policy decisions, ranging from placing mooring buoys and offshore fixed navigation markers to implementing resource management and ecosystem restoration.

Full references for the two papers:

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