

Fieldwork

Calibrating Proxies for the Study of Holocene Climate Change in the Northern Gulf of Mexico

By Kathy Tedesco

To better anticipate future changes in the Earth's climate, it is necessary to differentiate between natural and anthropogenic influences on the climate system. Paleoclimate reconstructions provide information regarding the timing and magnitude of natural climate variability. Researchers use proxy data from such natural sources as tree rings, corals, and marine sediment to extend the climate record beyond that of the approximately 100-yr-long instrumental record. The accuracy of reconstructions of past environmental conditions, including the temperature and productivity of the ocean, depends largely on the reliability of these proxy records. To make optimal use of the information derived from the sedimentologic record, sedimentary properties need to be calibrated to current oceanographic and biologic conditions by measuring modern mass fluxes (rates at which particles sink through the water column) of carbonate, biogenic opal, organic carbon, and terrigenous material and by analyzing microfossil assemblages and shell chemistry.

Researchers from the U.S. Geological Survey (USGS) office in St. Petersburg, Florida, and the University of South Carolina recently began a study to calibrate commonly used proxy records—such as oxygen-isotope and Mg/Ca ratios in planktonic foraminifera—from Gulf of Mexico sediment. They deployed a sediment-trap mooring in the northern Gulf of Mexico to measure the flux and chemistry of planktonic foraminiferal shells and organic material collected in the trap. Data will be compared with concurrent hydrographic and climatic observations. The results will provide better calibration



Don Hickey (USGS, left) and **Eric Tappa** (University of South Carolina) deploy a *McLane Mark 78* sediment trap from the R/V *Pelican* in the Gulf of Mexico. Photograph by **Wendy Kelly** (USGS).

of standard climate proxies, leading to improved interpretation and correlation between marine and continental paleoclimatic records.

In January 2008, **Kathy Tedesco**, **Don Hickey**, and **Wendy Kelly** (USGS) participated with **Eric Tappa** (University of South Carolina) in a cruise aboard the research vessel (R/V) *Pelican*, operated by the Louisiana Universities Marine Consortium (LUMCON). They deployed a mooring equipped with a *McLane Mark 78* sediment trap in the northern Gulf of Mexico near the Pigmy Basin in approximately 1,300 m of water. The trap is positioned at a depth of approximately 800 m on the mooring to guarantee collection of deeper-dwelling species of planktonic

foraminifera (for example, *Globorotalia* spp.). Samples will be analyzed for carbonate, biogenic silica, and organic carbon contents; foraminiferal assemblages; and stable-isotope and Mg/Ca ratios.

Seawater samples were collected with a *SeaBird Carousel* Water sampler equipped with twelve 5-liter Niskin bottles for chemical analyses, such as the oxygen-isotopic composition of seawater, plus a conductivity-temperature-depth (CTD) sensor and a dissolved-oxygen sensor to provide seasonal profiles of temperature, salinity, and dissolved oxygen. Two box cores were taken at the mooring site to help develop a climate record for the region during the Holocene.

(Climate Proxies continued on page 2)

Sound Waves

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Contents

Fieldwork	1
Outreach	5
Awards	7
Publications	7

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Deadline: The deadline for news items and publication lists for the July issue of *Sound Waves* is Friday, May 9.

Publications: When new publications or products are released, please notify the editor with a full reference and a bulleted summary or description.

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

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

Fieldwork, continued

(Climate Proxies continued from page 1)

The Gulf of Mexico is a semi-enclosed basin surrounded by the gulf coast of the United States, Mexico, and Cuba. The climatology of this region is driven by seasonal migration of the Intertropical Convergence Zone (ITCZ), an area of low pressure that forms where the northeast trade winds meet the southeast trade winds near the Earth's equator. Surface-ocean circulation is dominated by the Loop Current, which enters the gulf between Cuba and the Yucatán Peninsula, then loops east and south before exiting through the Straits of Florida. The position of the Loop Current is driven by seasonal fluctuations in the ITCZ and the prevailing wind direction, such that during Northern Hemisphere winter the current is farther south and during Northern Hemisphere summer the current penetrates deep into the gulf. The sensitivity of the region to the seasonal migration of the ITCZ makes it an ideal location for studying Holocene climate variability.

Previous studies in the Caribbean Sea and Gulf of Mexico show evidence of linkages between the position of the ITCZ and changes in planktonic foraminiferal flux, shell chemistry, and sediment geochemistry during the Holocene. The main objective of this project, to calibrate sediment proxy records, will lead to a better understanding of past changes in the position of the Intertropical Convergence Zone and its relation to global climate fluctuations during the Holocene.

Future cruises to the mooring site are currently scheduled aboard the R/V *Pelican* for April, August, and October 2008 and January 2009, at which times the trap will be recovered, samples retrieved, and the trap redeployed. A USGS Mendenhall Postdoctoral Research Fellowship awarded to **Kathy Tedesco** supports this research.

To learn more about paleoclimatology, visit the National Oceanic and Atmospheric Administration's Web site at URL <http://www.ncdc.noaa.gov/paleo/paleo.html>. To learn more about proxies, read Wefer, G., Berger, W.H., Bijma, J., and Fischer, G., 1999, Clues to ocean history; a brief overview of proxies, in Fischer, G., and Wefer, G., eds., Use of proxies

(Climate Proxies continued on page 3)



Deployment of SeaBird Carousel Water sampler equipped with twelve 5-liter Niskin bottles and a conductivity-temperature-depth (CTD) sensor. Photograph by Wendy Kelly (USGS).



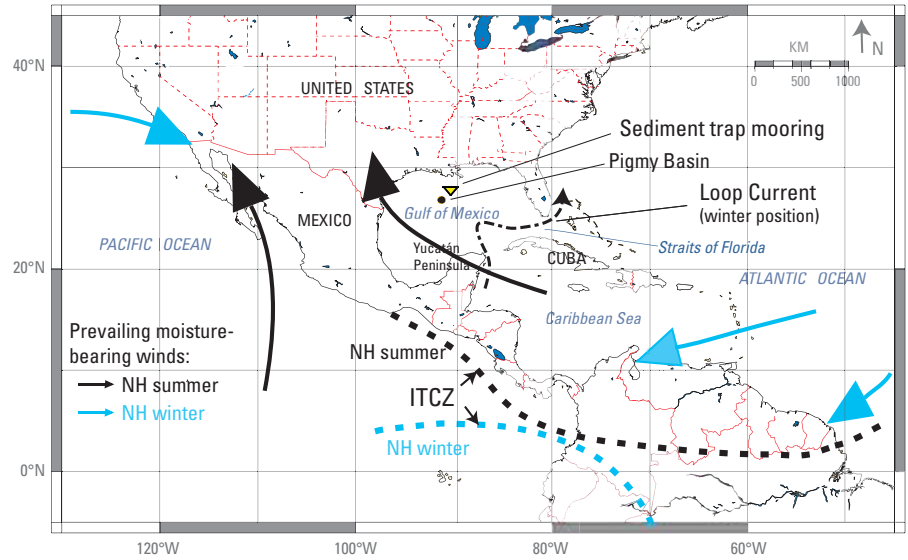
Recovery of box cores. Photograph by Wendy Kelly (USGS).

Fieldwork, continued

(Climate Proxies continued from page 2)

in paleoceanography; examples from the South Atlantic: Springer-Verlag, Berlin, p. 1-68 (can be previewed at URL <http://books.google.com/books?id=e8IIokyIG7gC&printsec=frontcover#PPA1,M1>). For information about additional USGS climate-change studies, visit "Climate Change Science" at URL <http://geochange.er.usgs.gov/>.

Gulf of Mexico, showing location of sediment-trap mooring (yellow triangle), generalized paths of prevailing moisture-bearing winds (bold arrows), and position of the Intertropical Convergence Zone (ITCZ; dashed lines) for Northern Hemisphere winter (blue) and summer (black).



Tar Balls from Southern California Seeps Appear on Central California Beaches

By Helen Gibbons, Bob Rosenbauer, Tom Lorenson, and Randy Imai (CDFG Office of Spill Prevention and Response)

When tar balls appeared on California beaches south of San Francisco in late January 2008, beachgoers wondered whether the sticky black globs were residues of oil spilled nearly 3 months earlier by the container ship *Cosco Busan* in San Francisco Bay. On November 7, 2007, the *Cosco Busan* struck the San Francisco-Oakland Bay Bridge in heavy fog, tearing a 100-ft-long gash in the port side of the ship that punctured one ballast tank and two fuel tanks. Within 10 to 15 seconds, an estimated 58,000 gallons of oil (about the volume of two backyard swimming pools) spilled into the bay. In response to that spill, a Unified Command composed of the U.S. Coast Guard, the California Department of Fish and Game (CDFG), and a contractor hired to represent the ship's owner was established to coordinate and manage clean-up operations. Upon the appearance of tar balls on Pacific coast beaches on January 28, 2008, the Unified Command responded quickly, mobilizing more than 75 personnel to clean the affected shoreline over a 3-day period. At the same time, the Coast Guard collected samples of the tar balls for chemical analysis by the CDFG's Office of Spill Prevention and Response (OSPR).

The chemical analysis by OSPR showed that the tar balls were not residues of the



Natural tar seep offshore Gaviota in approximately 60-m water depth. Photograph by Donna Schroeder, MMS.

Cosco Busan spill but had a natural origin in the Miocene Monterey Formation, an oil-bearing rock that is the source of many natural oil and tar seeps along the California coast, as well as much of the oil produced by California's onshore and offshore oil wells. This result was confirmed by geochemists from the U.S. Geological Survey (USGS), who have been "fingerprinting" tars and oils from natural seeps, offshore oil and gas platforms, and California shorelines for more than 10 years. Their

(Tar Balls continued on page 4)



Fieldwork, continued

(*Tar Balls continued from page 3*)

studies—conducted in cooperation with the Minerals Management Service (MMS)—have shown that virtually all the tar balls that wash up on the California coast come from natural seeps of oil and tar derived from the Monterey Formation. Natural seeps occur both onshore (the La Brea Tar Pits are a famous example) and offshore. Most of the known sea-floor seeps are in the Santa Barbara Channel in southern California, where tar balls (to the surprise of unsuspecting tourists) are common year-round on beaches nearest the seeps.

Tar balls that appear on central California shores during the winter months mostly originate in southern California seeps, as evidenced by their chemical fingerprints. These tar balls are believed to be carried northward by the Davidson Current, which periodically flows northward along the California coast, often aided by winter storms that bring southwesterly winds to the region. Unusually large numbers of tar balls sometimes appear on central California beaches after a series of storms, as occurred in January 2008 and a year earlier, in February 2007 (see “Tar Balls Washed onto Central California Beaches by Storms” in *Sound Waves*, May 2007, URL <http://soundwaves.usgs.gov/2007/05/research2.html>).

Although natural seeps have long been a part of the California landscape, the appearance of tar on beaches where it is not commonly seen arouses much curiosity. USGS research geologist **Tom Lorenson**, who leads a cooperative USGS-MMS effort to chemically fingerprint tar and oil seeps along the southern California coast, fielded several inquiries about the likely origin of the tar balls that appeared in late January. He was interviewed by newspaper reporters from the *San Francisco Examiner* and the *TriValley Herald*, as well as a television reporter from the San Francisco NBC affiliate (NBC 11).

On January 31 and February 1, **Jackson Currie** of the USGS Pacific Science Center in Santa Cruz, California, and **Leticia Diaz**, a work-study student from nearby Cabrillo College, collected tar-ball samples from affected beaches for analysis in the USGS organic geochemistry laboratory in Menlo Park, California; resulting



Tar “whip” found floating in the ocean offshore Point Conception in August 2005.



*USGS scientists **Keith Kvenvolden** (left, initiator of USGS studies of California coastal oil residues) and **Fran Hostettler** pick up a tar “whip” on Jalama Beach in 2003.*

data will become part of the natural-oil-seep fingerprint library being compiled in cooperation with MMS.

Having determined that the tar balls were a natural phenomenon and that they were weathered and posed no significant threat to the environment, the Unified Command suspended cleanup operations

and sent a fact sheet to agencies in the affected region, offering the following tips:

- While tar balls may seem firm on the outside, if broken open they will reveal a sticky interior that can quickly soil your hands and clothing; if found, simply leave them alone.

(*Tar Balls continued on page 5*)

Fieldwork, continued

(*Tar Balls continued from page 4*)

- Avoid direct skin contact with the oil.
 - If you get oil or tar on your skin, wash it off with soap and water.
 - Take precautions, such as washing your hands before eating, so you don't accidentally swallow the oil.
 - If you get oil on clothing, wash it in the usual way.
- There is no need to use harsh detergents, solvents, or other chemicals to wash oil from skin or clothing, and the use of such materials is discouraged.
 - Don't burn trash or driftwood contaminated with oil.
- For additional information, visit these USGS Web sites: "Offshore Hydrocarbon

Seeps in Southern California: A U.S. Geological Survey—Minerals Management Service Cooperative Project," at URL <http://walrus.wr.usgs.gov/research/projects/oilandgasseep.html>, and "Natural Oil and Gas Seeps in California," URL <http://geomaps.wr.usgs.gov/seeps/>.



Tar balls collected by **Jackson Currie** and **Leticia Diaz** at Moss Beach (left), San Gregorio Beach (center), and Scott Creek Beach (right) on January 31 and February 1, 2008.

Outreach

Dutch Consul Meets with USGS Scientists in Florida

By **Ann B. Tihansky** and **Gordon Anderson**

Arend C. Gouw, Dutch Consul and Deputy Head of Mission for the Netherlands Consulate General in Miami, Florida, and his assistant **Eva Roepers** met with scientists **Gordon Anderson** and **Karen Balentine** from the U.S. Geological Survey (USGS) on February 6, 2008. **Mr. Pex Langenberg**, a senior Dutch representative from the Netherlands Ministry of Transport, Public Works and Water Management based at the Royal Netherlands Embassy in Washington, D.C., was interested in visiting the Everglades to view and discuss Everglades science before a March 4, 2008, technical session to which the USGS had been invited. At the February 6 meeting, it was arranged that **Anderson**, **Balentine**, and

(*Dutch Consul continued on page 6*)



USGS scientists and Dutch students meet with **Arend Gouw** at the Netherlands Consulate General in Miami, Florida. From left to right, **Eva Roeper** (staff, Miami Dutch Consulate), **Karen Balentine** (Jacobs Technology employee contracted to the USGS and Everglades National Park), **Gordon Anderson** (USGS employee at Everglades National Park), **Arend Gouw** (Dutch Consul, Miami Dutch Consulate), and **Bram Zonder** and **Rene de Groot** (Dutch student interns with USGS at Everglades National Park).

Outreach, continued

(Dutch Consul continued from page 5)

Dutch interns **Bram Zonder** and **Rene de Groot** would assist with a field tour in Everglades National Park on February 29.

The mission of the Dutch Consulate in Miami is to assist Dutch companies in working with the U.S. Army Corps of Engineers and the South Florida Water Management District; however, the Dutch government is also interested in academic exchange with scientific programs both governmental and educational (for example, ongoing collaborations between Delft Hydraulics and Delft University of Technology personnel and USGS scientists). **Mr. Gouw** has requested further contact with the USGS, especially in Everglades National Park, where **Gordon Anderson** has been running a highly



During a February 29 visit to Everglades National Park, **Pex Langenberg** (right)—representative of the Netherlands Ministry of Transport, Public Works and Water Management—receives an overview of Everglades restoration and science from park superintendent **Dan Kimball**. Photograph by **Gordon Anderson**.

successful internship program for international students—many of them from the Netherlands—for several years. (For example, see “Students from the Neth-

erlands Assist USGS Staff in Florida,” *Sound Waves*, November 2004, URL <http://soundwaves.usgs.gov/2004/11/staff2.html>.)

USGS Participates in Judging Falmouth Academy Science Fair Projects

By **Jeff Williams**

Middle- and high-school science fairs are important events each year that spark students’ interest in science and motivate them to pursue scientific study in high school and college and, eventually, go into scientific careers. Fairs also serve to increase public understanding and appreciation of a wide range of scientific issues, including the need to use science to protect the environment and the Earth’s natural resources and to aid humankind.

On Friday, February 15, 2008, the U.S. Geological Survey (USGS) Woods Hole Science Center contributed 10 scientific staff to serve as judges for the Falmouth Academy Science Fair competition. The Academy is a private school in Falmouth, Massachusetts, that has been in operation for 30 years (URL <http://www.falmouthacademy.org>); the 2008 event was its 20th Science Fair. Nearly 200 students exhibited projects covering a range of topics, from “The Effect of Sleep Deprivation and Circadian Rhythm on Cockroach Olfactory Memory” to “How Do Currents and Water Heights Change During a Tidal Cycle?” to “Factors Affecting the Size of Sugar Crystals in Fudge.” The USGS Woods Hole Science Center scientists who served as judges were **Elizabeth Bailey**,



John Bratton, Brian Buczkowski, Deborah Hutchinson, John Pohlman, Andrew Schroth, Rich Signell, Dave Twichell, Bill Waite, and Jeff Williams. In addition, as part of an award ceremony toward the end of the fair, **Jeff Williams** presented a special award, the Estuarine

Water Quality Issues Award, sponsored by the Falmouth Associations Concerned with Estuaries and Saltponds, to junior **Annie Stimson** for her outstanding project, “Does Housing Density Around Ponds Affect Pond Nitrate Levels?” (The answer is “Yes!”)

Christine Fadeley Receives Superior Service Award

By Jeffrey A. Keay

U.S. Geological Survey (USGS) program analyst **Christine Fadeley** of the Florida Integrated Science Center office in Gainesville, Florida, has been awarded a Department of the Interior (DOI) Superior Service Award for her “exceptional service in support of biological science.” Superior Service Awards are granted for significant acts, services, or achievements that materially aid the successful accomplishment of DOI and USGS missions. **Christine**, who received the award in a ceremony held February 6, 2008, in Gainesville, has dedicated her career to supporting scientists in accomplishing their important research mission. She maintains an unwavering professionalism and is respected and appreciated for her thoroughness, attention to detail, and sincerity.

Here is an excerpt from the award letter written to **Christine** by USGS Director **Mark Myers**:

“You have maintained the highest standards of professionalism and integrity throughout your career, which you began as a Clerk Typist at the Leetown Science

Center in 1980. Through perseverance and dedication, you advanced your career to become a Budget Analyst, often serving as Acting Administrative Officer for the Leetown Science Center. In 1995, you assumed the role of Procurement Specialist for the Florida Integrated Science Center in Gainesville, Florida. In that role, you continued to demonstrate your attention to detail and commitment to accuracy, resulting in more than \$20,000 of savings to the Center. In March 2006, you accepted the role of Program Analyst coordinating biology science information and processes. You quickly and efficiently organized the new Fundamental Science Practices and Publication Service Center policies into readily accessible and easy-to-understand tables to help scientists and managers determine workflows for information-product review and approval processes. Your commitment to helping the science staff effectively and efficiently accomplish the mission of the Bureau has been repeatedly recognized by your supervisors and reaffirmed through awards given



*Superior Service Award recipient
Christine Fadeley.*

to you by the scientists themselves. It is my pleasure to recognize you for your outstanding role and dedicated career in helping the U.S. Geological Survey move forward in accomplishing its science mission.”

Congratulations to **Christine** on this recognition of her devoted career in public service! ❁

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- Ackerman, J.T., Eagles-Smith, C.A., Takekawa, J.Y., Bluso, J.D., and Adelsbach, T.L., 2008, Mercury concentrations in blood and feathers of pre-breeding Forster's terns in relation to space use of San Francisco Bay habitats: *Environmental Toxicology and Chemistry*, v. 27, p. 897-908 [URL <http://www.setacjournals.org/perlserv/?request=get-abstract&doi=10.1897%2F07-230.1>].
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(Recently Published continued on page 8)

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(Recently Published continued from page 7)

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Publications Submitted for Director's Approval

Bernier, J.C., Morton, R.A., and Barras, J.A., Constraining the timing, magnitude, and likely causes of historic

subsidence and wetland loss, Mississippi River delta plain, south-central Louisiana [abs.]: *International Delta*

Roundtable, Lafayette, La., November 28-30, 2008.

(Publications Submitted continued on page 9)

Publications, continued

(Publications Submitted continued from page 8)

- Butman, B., Dalyander, P.S., Bothner, M.H., and Lange, W.H., Time-series photographs of the sea floor in western Massachusetts Bay, version 2, 1989-1996: U.S. Geological Survey Data Series 265, version 2.0, DVD-ROM.
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