THE UNIVERSITY OF TEXAS AT AUSTIN • JACKSON SCHOOL OF GEOSCIENCES • 2012 NEWSLETER

2012 Newsletter

THE UNIVERSITY OF TEXAS AT AUSTIN

JACKSON SCHOOL OF GEOSCIENCES

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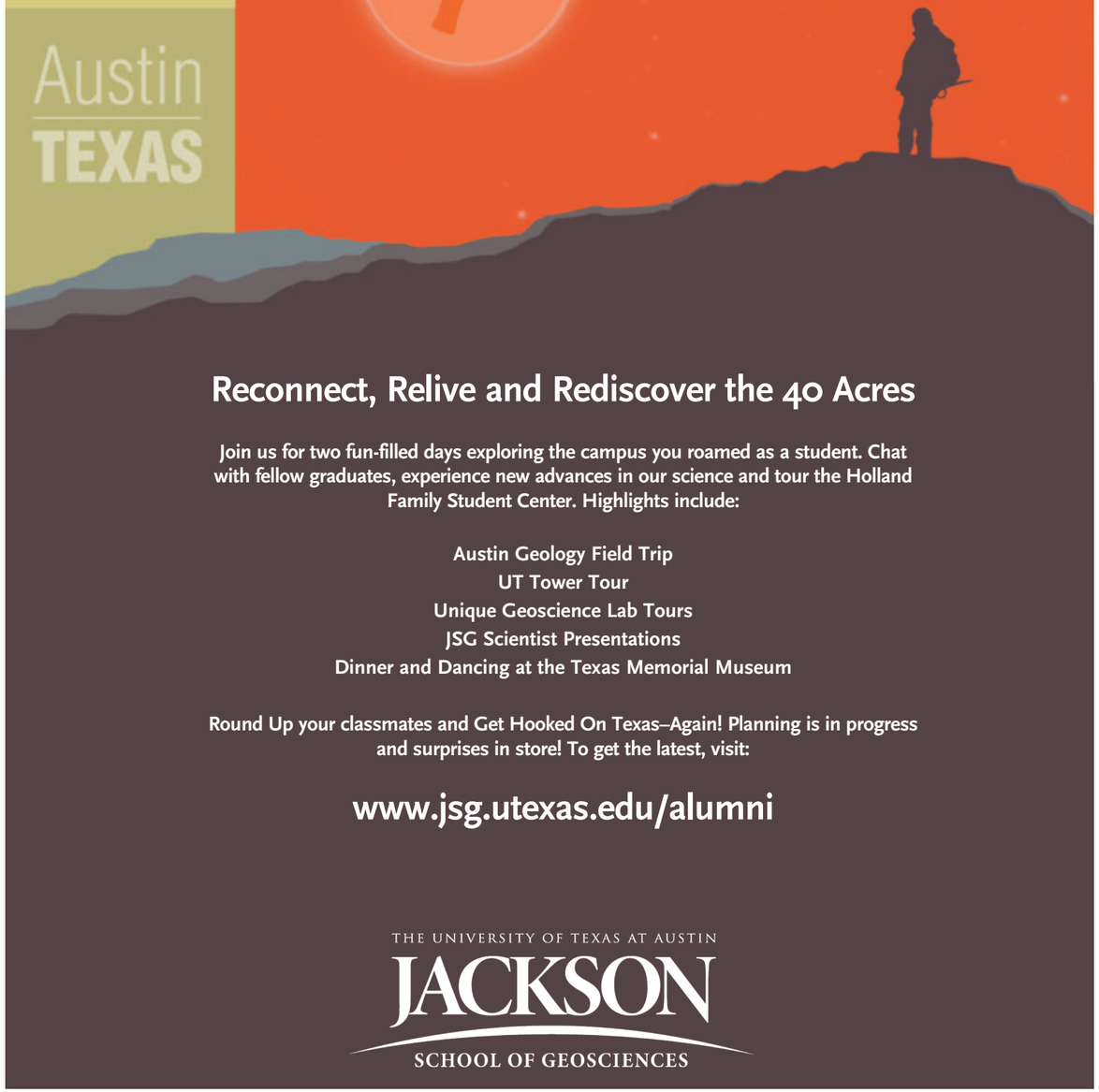

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The *Newsletter*, a tradition since 1950, is published annually for friends and alumni of the Jackson School of Geosciences at The University of Texas at Austin.

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On the cover: Satellite image showing Wax Lake Delta, one of the few places where Louisiana's coastline is actually expanding into the Gulf in a process described and researched by Jackson School scientists David Mohrig and Wonsuck Kim. See related story on page 44.

WELCOME

The front reception desk at the entrance of the new Holland Family Student Center.

Dear Alumni and Friends,

As always, this issue of our *Newsletter* reports on a number of great things that happened at the school over the past year. I'd like to call your attention to one in particular because it touches on many of the transformational changes taking place at the school.

Over the past several years, David Mohrig, Wonsuck Kim, and colleagues have dramatically advanced our understanding of land-building processes in the Mississippi Delta (page 44). Their multidisciplinary research addresses fundamental scientific problems, and it's also big-time public science that could positively impact millions of people in low-lying coastal regions. This is exactly the kind of work we set out to do when the Jackson School was created.

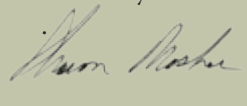
While New Orleans worries about too much water, Texas worries about not getting enough. To that end our scientists have been collaborating with UT Austin engineers and government agencies to help prepare the state more effectively for drought. You can see some of their lessons learned from the recent drought on page 52.

Our national postdoc fellows program has taken off in the past two years, as shown by the work of two postdocs featured in this issue—Jakob Vinther in paleontology (pages 5 and 20), and Britney Schmidt in planetary geosciences (page 56), who along with Don Blankenship garnered worldwide attention for evidence of liquid water on Jupiter's moon, Europa.

Among our many world-class activities in energy geosciences, you can read about two public-oriented efforts—Scott Tinker's thought-provoking and highly praised documentary *Switch* (page 48) and our most recent Latin American Forum on energy and the environment (page 64). Our fundamental research on nanotechnology for energy is also well represented (page 66).

On a more wistful note, two of our veteran, star performers retired this year, Director of Outreach Doug Ratcliff and Professor Leon Long. I know many of your lives were touched by one or both of these people, and you will enjoy our profiles of them on pages 18 (Ratcliff) and 37 (Long).

Finally, the school's most visible accomplishment on campus this year was the unveiling of our new Holland Family Student Center (page 40). Thanks to phenomenal support from alumni and friends, we were able to complete the center ahead of schedule and on budget, completely from private funds. The center is paying dividends already, creating a wonderful new communal space occupied constantly by our students, faculty, research scientists, and outside visitors, including recruiters. More than 350 alumni contributed to this major project. Your support means the world to us. Thank you.

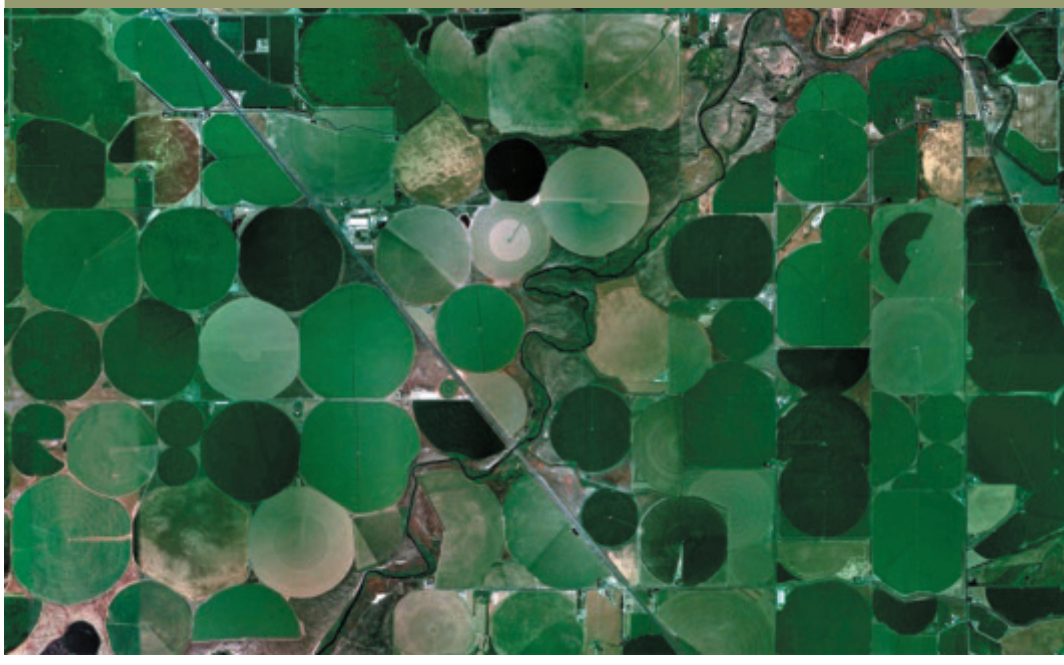


Sharon Mosher

RESEARCH HIGHLIGHTS

See this edition's feature articles for additional coverage of research highlights.

Farming the Cadillac Desert



The nation's food supply may be vulnerable to rapid groundwater depletion from irrigated agriculture, according to a new study by researchers at The University of Texas at Austin and elsewhere.

The study, which appears in the journal *Proceedings of the National Academy of Sciences*, paints the highest resolution picture yet of how groundwater depletion varies across space and time in California's Central Valley and the High Plains of the central U.S. Researchers hope this information will enable more sustainable use of water in these areas, although they think irrigated agriculture may be unsustainable in some parts.

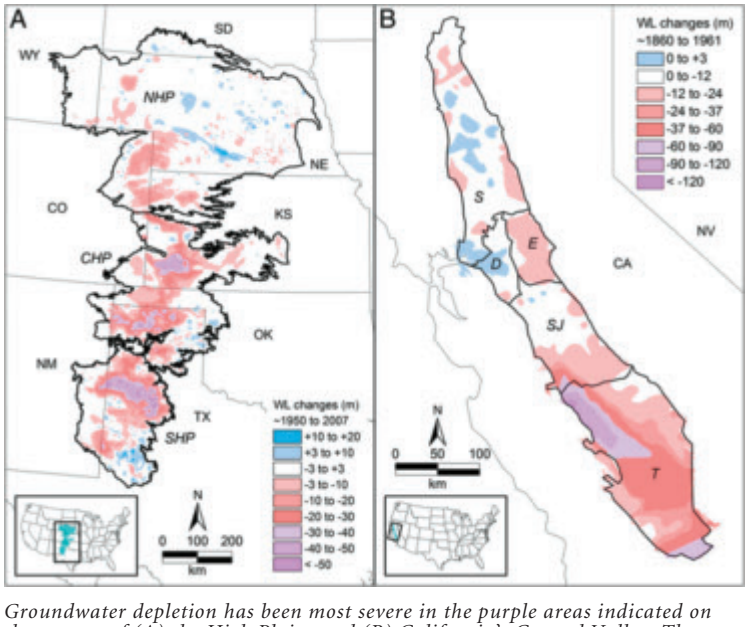
"We're already seeing changes in both areas," said Bridget Scanlon, senior research scientist at the Bureau of Economic Geology and lead author of the study. "We're seeing decreases in rural populations in the High Plains. Increasing urbanization is replacing farms in the Central Valley. And during droughts some farmers are forced to fallow their land. These trends will only accelerate as water scarcity issues become more severe."

Three results of the new study are particularly striking: First, during the most recent drought in California's Central Valley, from 2006 to 2009, farmers in the south depleted enough groundwater to fill the nation's largest man-made reservoir, Lake Mead near Las Vegas—a level of groundwater depletion that is unsustainable at current recharge rates. Second, a third of the groundwater depletion in the High Plains occurs in just 4 percent of the land area. And third, the researchers project that if current trends continue some parts of the southern High Plains that currently support irrigated agriculture, mostly in the Texas Panhandle and western Kansas, will be unable to do so within a few decades.

California's Central Valley is sometimes called the nation's "fruit and vegetable basket." The High Plains, which run from northwest Texas to southern Wyoming and South Dakota, are sometimes called the country's "grain basket." Combined, these two regions produced agricultural products worth $56 billion in 2007, accounting for much of the nation's food production. They also account for half of all groundwater depletion in the U.S., mainly as a result of irrigating crops.

Scanlon and her colleagues at the U.S. Geological Survey and the Université de Rennes in France used water level records from thousands of wells, data from NASA's GRACE satellites, and computer models to study groundwater depletion in the two regions. Byron Tapley, director of the university's Center for Space Research, led the development of the GRACE satellites, which recently celebrated their 10th anniversary.

Scanlon and her colleagues suggested several ways to make irrigated agriculture in the Central Valley more sustainable, such as replacing flood irrigation systems (used on about half of crops) with more efficient sprinkle and drip systems, and expanding the



Groundwater depletion has been most severe in the purple areas indicated on these maps of (A) the High Plains and (B) California's Central Valley. These heavily affected areas are concentrated in parts of the Texas Panhandle, western Kansas, and the Tulare Basin in California's Central Valley.

Main Crater Lake, Taal Volcano, Philippines.

practice of groundwater banking—storing excess surface water in times of plenty in the same natural aquifers that supply groundwater for irrigation.

But Scanlon and other experts don't think that long-term, these or other engineering approaches will solve the problem in the High Plains.

"Basically irrigated agriculture in much of the southern High Plains is unsustainable," said Scanlon.

Black Smokers

Scientists have discovered a new type of hot spring along the banks of a volcanic lake in the Philippines. These "terrestrial smokers" are cousins to submarine black smokers, hydrothermal vents on the seafloor that spew plumes of hot, nutrient-rich water and often support rich communities of life.

Terrestrial smokers might represent a missing piece of the heat budgets for many active volcanoes around the world. Getting those budgets right might help scientists better forecast the size and timing of future eruptions at volcanoes with crater lakes—although one expert cautioned it might take many years of observations at multiple sites to make meaningful improvements in forecasts.

Perhaps of more immediate interest, because of their unique chemical properties, the newly discovered hot springs might harbor life forms new to science.

The team, led by Bayani Cardenas, associate professor in the Jackson School, discovered the springs along the banks of a crater lake inside the still active Taal Volcano, about 31 miles from Manila. Cardenas speculates that terrestrial smokers may exist in many other parts of the world where bodies of cool surface water sit atop geothermal sources, for example in rivers at Yellowstone National Park and the Newberry caldera in Oregon.

Based on their observations and computer simulations, the researchers conclude that cool lake water seeps into the lake bed near the shore, mixes with hot, shallow groundwater and then rises back to the surface in a loop or convection cell. The water coming out of the spring flows underground at a rate of hundreds of meters per day, as compared to about a third of a meter per day for water in the High Plains of the central U.S. So much lake water is cycled through these convective cells that the entire contents of the lake are recycled in a matter of days.

"I was astounded when I calculated the flow rates," said Cardenas. "I was running around wondering if I should hand back my Ph.D. But we rechecked everything and consulted other colleagues and now we're confident in our results."

The report was published Jan. 21 in the journal *Geophysical Research Letters*.

Scientists have theorized the existence of such convective cells, but this is the first direct evidence of their existence. The spring water emerges at up to 60 degrees Celsius (140 degrees Fahrenheit). The springs are invisible to the unaided eye, but in infrared video, chaotic plumes of red and yellow swirl and push out into a field of blue.

The lake water is fairly acidic (with a pH of about 2 or 3) and the groundwater is only slightly acidic (pH of about 5). The two mix over a very short distance to form spring water.

"And when you have large pH contrasts like that, and metals and nutrients dissolved in the water, there are often lots of interesting things happening with bacteria there," said Cardenas. "We just uncovered the hydraulics, the mechanics behind it, but now that we know there are these waters that are mixing there quite vigorously, there's much more work that can be done."

Feathery Attractions

A team of American and Chinese researchers has revealed the detailed feather pattern and color of *Microraptor*, a pigeon-sized, four-winged dinosaur that lived about 120

Bayani Cardenas (left) captures infrared video of a newly discovered terrestrial smoker in Taal Volcano, Philippines

million years ago. A new specimen shows the dinosaur had a glossy iridescent sheen and that its tail was narrow and adorned with a pair of streamer feathers, suggesting the importance of display in the early evolution of feathers, as presented in the March 9 edition of the journal *Science*.

The research was conducted by scientists at the Beijing Museum of Natural History, Peking University, The University of Texas at Austin, the University of Akron, and the American Museum of Natural History.

By comparing the patterns of pigment-containing organelles from a *Microraptor* fossil with those in modern birds, the scientists determined the dinosaur's plumage was iridescent with a glossy sheen like the feathers of a crow. The new fossil is the earliest record of iridescent color in feathers.

A new reconstruction of the dinosaur will help scientists approach the controversy of how dinosaurs began the transition to flight.

Since it was discovered as the first four-winged dinosaur in 2003, *Microraptor* has been at the center of questions about the evolution of feathers and flight. A number of scientists have proposed aerodynamic functions for various feathery features such as its tail, forewing shape and hind limbs, going so far as to place *Microraptor* models in wind tunnels and launch them from catapults. Once thought to be a broad, teardrop-shaped surface or with a shape more like that of a paper airplane meant to help generate lift, *Microraptor*'s tail fan is actually much narrower with two elongate feathers off of its tip. The researchers believe the tail feathering may have been ornamental and probably evolved for courtship and other social interactions and not as an adaptation for flight.

"Most aspects of early dinosaur feathering continue to be interpreted as fundamentally aerodynamic, optimized for some aspect of aerial locomotion," said Julia Clarke, one of the paper's co-authors and an associate professor of paleontology at the Jackson School. "Some of these structures were clearly ancestral characteristics that arose for other functions and stuck around, while others may be linked to display behaviors or signaling of mate quality. Feather features were surely shaped by early locomotor styles. But, as any birder will tell you, feather colors and shapes may also be tied with complex behavioral repertoires and, if anything, may be costly in terms of aerodynamics."

Above: Reconstruction of Microraptor *from new specimen and digital overlays of previous specimens. Credit: Mick Ellison/ AMNH. Below: Microraptor fossil.*

Information on feather color of a variety of dinosaurs has recently come to light, since the first color map of an extinct dinosaur showed black and white spangles, red coloration, and gray body color in a species called *Anchiornis* in 2010. Based on the new data from *Microraptor* and these other finds, a complex color repertoire that includes iridescence is probably ancestral to a group of dinosaurs called Paraves that originated at least 140 million years ago and includes dinosaurs such as *Velociraptor* as well as *Archaeopteryx*, *Anchiornis* and living birds.

The researchers studied feathering, melanosome shape and density from a *Microraptor* fossil working closely with collaborators at the Beijing Museum of Natural History. The samples and preservation of melanosomes were assessed by Jakob Vinther, a Jackson School postdoctoral fellow for 2011-13, whose breakthrough research in 2009 spurred analysis of the shape of melanosomes in well-preserved fossilized feather imprints.

The research was funded by the National Science Foundation, the Air Force Office of Scientific Research, the Natural Science Foundation of China, the Beijing Municipal Bureau of Human Resources, and the Beijing Academy of Science and Technology.

Unraveling Ice Sheets

A new study examining nearly 40 years of satellite imagery has revealed that the floating ice shelves of a critical portion of West Antarctica are steadily losing their grip on adjacent bay walls, potentially amplifying an already accelerating loss of ice to the sea.

The most extensive record yet of the evolution of the floating ice shelves in the eastern Amundsen Sea Embayment in West Antarctica shows that their margins, where they grip onto rocky bay walls or slower ice masses, are fracturing and retreating inland. As that grip continues to loosen, these already-thinning


Joseph Macgregor

ice shelves will be even less able to hold back grounded ice upstream, according to glaciologists at The University of Texas at Austin's Institute for Geophysics (UTIG).

Reporting in the *Journal of Glaciology*, the UTIG team found that the extent of ice shelves in the Amundsen Sea Embayment changed substantially between the beginning of the Landsat satellite record in 1972 and late 2011. These changes were especially rapid during the past decade. The affected ice shelves include the floating extensions of the rapidly thinning Thwaites and Pine Island Glaciers.

"Typically, the leading edge of an ice shelf moves forward steadily over time, retreating episodically when an iceberg calves off, but that is not what happened along the shear margins," says Joseph MacGregor, research scientist associate and lead author of the study. An iceberg is said to calve when it breaks off and floats out to sea.

"Anyone can examine this region in Google Earth and see a snapshot of the same satellite data we used, but only through examination of the whole satellite record is it possible to distinguish long-term change from cyclical calving," says MacGregor.

The shear margins that bound these ice shelves laterally are now heavily rifted, resembling a cracked mirror in satellite imagery until the detached icebergs finally drift out to the open sea. The calving front then retreats along these disintegrating margins. The pattern of marginal rifting and retreat is hypothesized to be a symptom, rather than a trigger, of the recent glacier acceleration in this region, but this pattern could generate additional acceleration.

"As a glacier goes afloat, becoming an ice shelf, its flow is resisted partly by the margins, which are the bay walls or the seams where two glaciers merge," explains Ginny Catania, assistant professor at UTIG and co-author of the study. "An accelerating glacier can tear away from its margins, creating rifts that negate the margins' resistance to ice flow and causing additional acceleration."

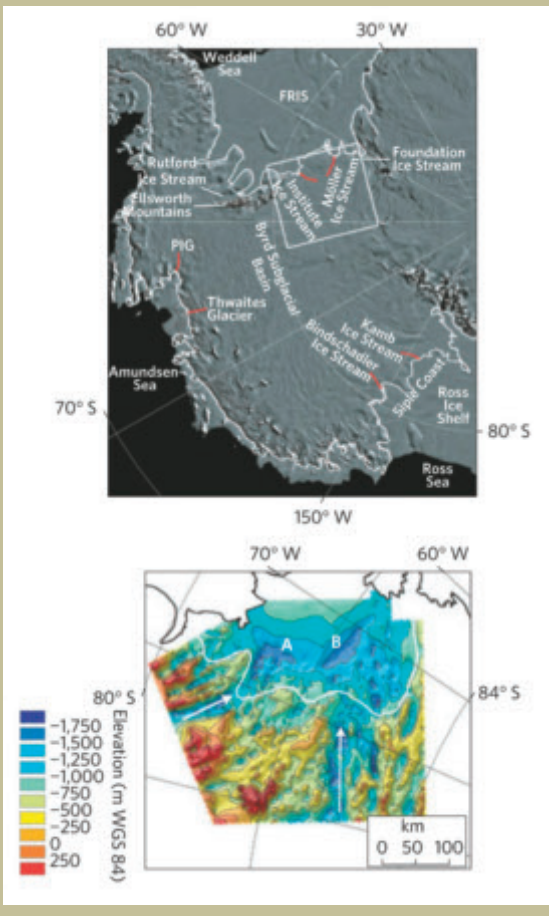
The UTIG team found that the largest relative glacier accelerations occurred within and upstream of the increasingly rifted margins.

The observed style of slow-but-steady disintegration along ice-shelf margins has been neglected in most computer models of this critical region of West Antarctica, partly because it involves fracture, but also because no comprehensive record of this pattern existed. The authors conclude that several rifts present in the ice shelves suggest that they are poised to shrink further.

This research is sponsored in part by the National Science Foundation.

Vulnerable Basin

Using ice-penetrating radar instruments flown on aircraft, a team of scientists from the U.S. and U.K. have uncovered a previously unknown sub-glacial basin nearly the size of New Jersey beneath the West Antarctic Ice Sheet (WAIS) near the Weddell Sea. The location, shape, and texture of the mile-deep basin suggest that this region of the ice sheet is at a greater risk of collapse than previously thought.



Bottom Image: This radar image of bedrock elevation reveals the new sub-glacial basin (purple and blue regions). The basin is divided into two components (A and B) and lies just inland of the West Antarctic Ice Sheet's grounding line (black line), where streams of ice flowing toward the Weddell Sea begin to float. Top Image: White box indicates location of bottom image. Pine Island Glacier (PIG) and Thwaites Glacier—two parts of the West Antarctic Ice Sheet previously studied by the U.S. and U.K. researchers—drain into the Amundsen Sea.

Team members at the University of Texas Institute for Geophysics (UTIG) compared data about the newly discovered basin to data they previously collected from other parts of the WAIS that also appear highly vulnerable, including Pine Island Glacier and Thwaites Glacier. Although the amount of ice stored in the new basin is less than the ice stored in previously studied areas, it might be closer to a tipping point.

"If we were to invent a set of conditions conducive to retreat of the West Antarctic Ice Sheet, this would be it," said Don Blankenship, senior research scientist at UTIG and co-author on the new paper. "With its smooth bed that slopes steeply toward the


Rifts along the northern shear margin of Pine Island Glacier (upper right of image). Photo by Michael Studinger, NASA's Operation IceBridge.

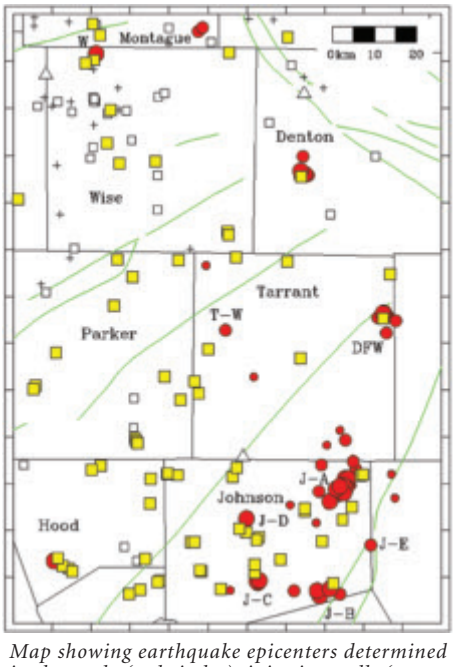
interior, we could find no other region in West Antarctica more poised for change than this newly discovered basin at the head of the Filchner-Ronne Ice Shelf. The only saving grace is that losing the ice over this new basin would only raise sea level by a small percentage of the several meters that would result if the entire West Antarctic Ice Sheet destabilized."

The study's co-authors also included Duncan Young, research scientist associate at UTIG. The study, published this week in the journal *Nature Geoscience*, was carried out in a collaboration led by the University of Edinburgh with the British Antarctic Survey and the Universities of Aberdeen, Exeter, and York, as well as The University of Texas at Austin.

The seaward edge of the newly discovered basin lies just inland of the ice sheet's grounding line, where streams of ice flowing toward the sea begin to float.

Two features of the basin, which is entirely below sea level, are particularly worrisome to scientists: First, like a cereal bowl, its edges slope down steeply. If the grounding line begins to retreat upstream, seawater will replace it and more ice will begin to float. The study's authors predict that this positive feedback mechanism would sustain retreat of the ice sheet until eventually all of the ice filling the basin goes afloat. Second, the bed of the basin on which the ice rests is smooth. There are few big bumps, or "pinning points," to hold back sliding ice.

The newly discovered basin covers 20,000 square kilometers (7,700 square miles), nearly the size of New Jersey, and is well below sea level, nearly 2 kilometers (about 1.2 miles) deep in places.



Map showing earthquake epicenters determined in the study (red circles), injection wells (squares and + symbols) in use since October 2006, seismograph stations (white triangles), and mapped faults (green lines). Visit JSG website for larger version with more detail. Credit: Cliff Frohlich.

Small Quakes

Most earthquakes in the Barnett Shale region of North Texas occur within a few miles of one or more injection wells used to dispose of wastes associated with petroleum production such as hydraulic fracturing fluids, according to new research from The University of Texas at Austin. None of the quakes identified in the two-year study were strong enough to pose a danger to the public.

The study by Cliff Frohlich, senior research scientist at the Institute for Geophysics (UTIG), appeared in the journal *Proceedings of the National Academy of Sciences.*

"You can't prove that any one earthquake was caused by an injection well," says Frohlich. "But it's obvious that wells are enhancing the probability that earthquakes will occur."

Frohlich analyzed seismic data collected between November 2009 and September 2011 by the EarthScope USArray Program, a National Science Foundation-funded network of broadband seismometers from the Canadian border to the Gulf of Mexico. Because of the high density of instruments (25 in or near the Barnett Shale), Frohlich was able to detect earthquakes down to magnitude 1.5, far too weak for people to feel at the surface.

He found that the most reliably located earthquakes — those that are accurate to within about 0.9 miles (1.5 kilometers) — occurred in eight groups, all within 2 miles (3.2 kilometers) of one or more injection wells. Before this study, the National Earthquake Information Center had only identified two earthquake groups in the area strongly associated with specific injection wells. This suggests injection-triggered earthquakes are far more common than is generally recognized.

Most earthquakes identified in the study ranged in magnitude from 1.5 to 2.5, meaning they posed no danger to the public.

"I didn't find any higher risks from disposal of hydraulic fracturing fluids than was thought before," says Frohlich. "My study found more small quakes, nearly all less than magnitude 3.0, but just more of the smaller ones than were previously known. The risk is all from big quakes, which don't seem to occur here."

All the wells nearest to the eight earthquake groups reported high injection rates (maximum monthly injection rates exceeding 150,000 barrels of water). Yet in many other areas where wells had similarly high injection rates, there were no earthquakes. Frohlich tried to address those differences.

"It might be that an injection can only trigger an earthquake if injected fluids reach and relieve friction on a nearby fault that is already ready to slip," says Frohlich. "That just isn't the situation in many places."

Frohlich is careful to point out that he did not evaluate the possible correlation of earthquakes with the actual hydraulic fracturing process, but rather the effects of disposing of fracturing fluids and other wastes in these injection wells.

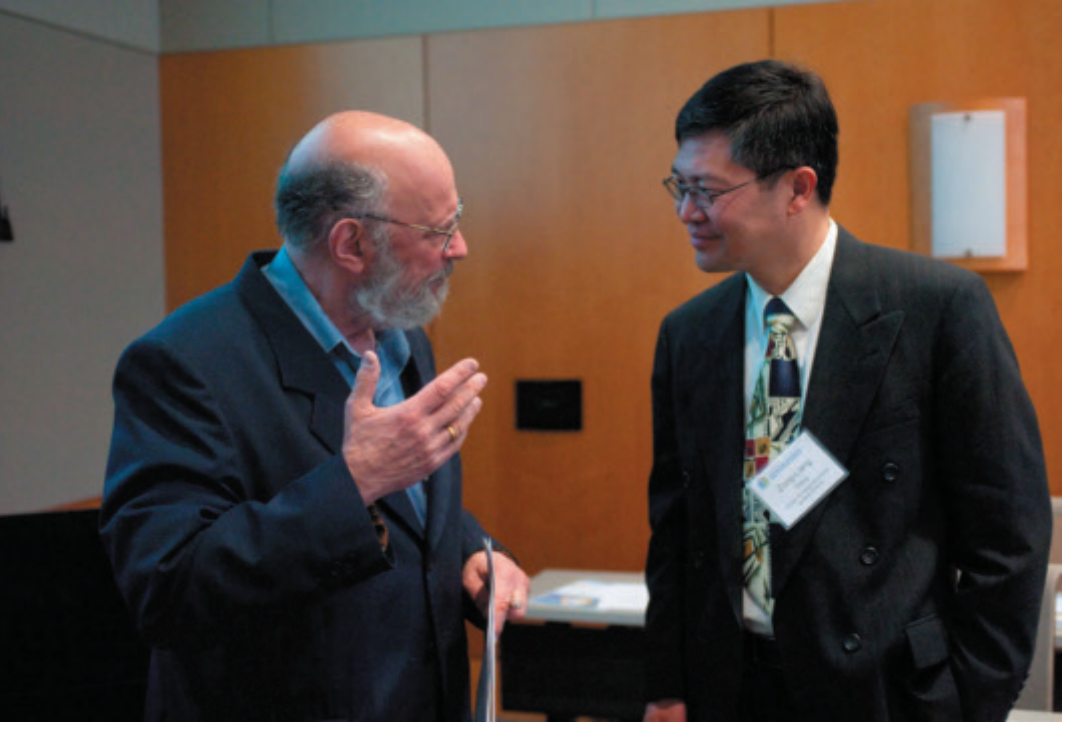
Support for this study came from the U.S. Geological Survey and the Jackson School of Geosciences.

Water Forum

In February, Liang Yang and David Maidment, co-directors of the university's Center for Integrated Earth System Science, hosted a day-long Water Forum, featuring presentations by researchers from UT Austin and Texas A&M University, local water authorities such as the Lower Colorado River Authority, and scientists and policy makers from an alphabet soup of state agencies including the Texas Water Development Board (TWDB), Texas Commission on Environmental Quality (TCEQ), and Texas Parks and Wildlife Department (TPWD).

"Often academic research is happening in isolation from what people need on the ground," said Jay Banner, professor in the Jackson School and director of the university's Environmental Science Institute. "There's great potential for bringing those people together and having greater dialogue, so water resource managers can explain what their needs are and researchers can gear their research towards greater application."

In the morning, a series of resource man-



Liang Yang (right) at the 2012 Water Forum.

agers described specific research projects and information that university partners could provide to help the state deal with the ongoing drought. In the afternoon, UT researchers outlined their current and future drought-related research that could help.

Rong Fu, professor in the Jackson School, described a previously overlooked factor that can make droughts more intense. That factor is an unusually warm, dry wind blowing into Texas from the west during the spring. Indeed, this factor seems to have played a critical role in making the 2011 drought the worst single-year drought in Texas history. This new understanding could help climate modelers improve their drought forecasts.

Cedric David, a postdoctoral researcher, unveiled RAPID, a computer model that forecasts water levels in rivers and lakes. By providing information on how much water will actually be available a few months in advance at the local level, this tool would be extremely useful for resource managers and large-scale water users such as power plant operators.

"Often academic research is happneing in isolation ... there's great potential for bringing people together."

—Jay Banner

The forum also featured presentations by the Jackson School's Bridget Scanlon on using groundwater to buffer drought, Liang Yang on the potential for a seasonal water availability forecast, Jay Banner on reconstructing past climate in Texas, and Bayani Cardenas on how dam releases affect surface water-groundwater interactions. A second water forum is planned for October 2012.

Center for Earth System Science

In summer 2011, Liang Yang, professor in the Jackson School of Geosciences and David Maidment, professor in the Cockrell School of Engineering, established the Center for Integrated Earth System Science (CIESS) to foster collaborative study of Earth as a coupled system with focus on atmosphere, land, water, environment, and society. The center is designed to provide a platform for scientists in the Jackson School, Cockrell School, and other colleges, schools and units at the university to work across traditional boundaries that divide disciplines.

The goal of CIESS is to answer a wide variety of earth science questions that dovetail with the overall Jackson School strategic plan. Such questions include:

How do Earth's atmosphere, ocean, biosphere, cryosphere, and lithosphere interact on all time and space scales?

How can we use in situ measurements, global satellite observations, proxy data, and computational analysis to describe and understand Earth's dynamic system?

What has been the impact of human activity on Earth?

What is the future of our environment under climate change, land use change, and water use change?

How accurate are climate system models in providing seamless predictions at daily, seasonal, decadal or centennial timescales? Can we improve these predictions?

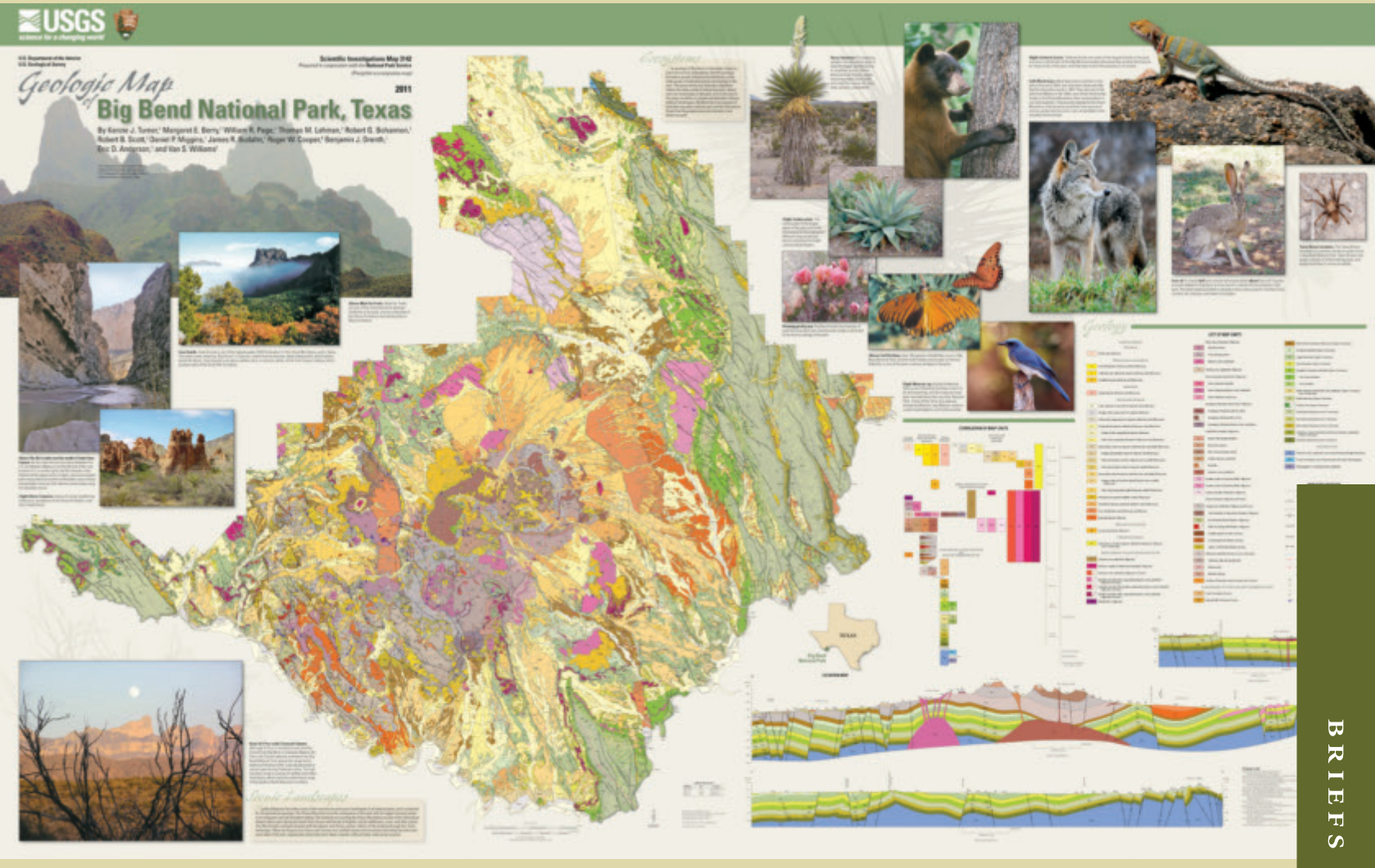
How can we reduce modeling uncertainties and make reliable predictions of extreme events at regional scales? How can we make rational decisions under uncertainties in order to mitigate, prevent, plan for, or adapt to the negative potential impacts of global change?

Statoil Funds New Fellowships

International energy company Statoil awarded fellowships to eight graduate students from UT Austin, funding research in geology, geophysics, and petroleum engineering. Fellowships will last two to three years, depending on the length of the student's degree program. Statoil will contribute a total of $5 million to the work of fellows over the coming five years. The research partnership is Statoil's largest agreement with a university outside Norway and its first in the United States.

"We aim for a significant growth in our activities in North America," said Karl Johnny Hersvik, senior vice president for research & development at Statoil, "and want to attract top students and talents from top universities."

"Through this partnership, Statoil will work with the students and share important data," said Jackson School Professor Peter Flemings. "It could be a really successful model that gives the students exposure to exciting problems and data sets and deeper experience."



Bureau of Economic Geology Publishes New Map of Big Bend

In October 2011 at the GSA meeting in Minneapolis, the Bureau of Economic Geology unveiled a new geologic map of Big Bend National Park. The map culminated more than seven years of work in a project sponsored jointly by the USGS and National Park Service (NPS). Numerous agencies, including BEG, were involved in the effort that NPS lead geologist Bruce Heise described as "the single largest undertaking ever supported by the GRI," the Geologic Resource Inventory. Eddie Collins, Pat Dickerson, and the late Bill Muehlberger were key in providing support from the Jackson School.

"The geology was complex and the terrain rugged," said Heise. "It is an outstanding new geologic product and the GRI team is very excited to have been involved with it. There are many, many people involved with the production of both the map and the NPS GIS. The BEG effort was spearheaded by Eddie Collins who should receive tremendous credit for his involvement in his agency's efforts."

Recent bureau publications, including the *Geologic Map of the Glenn Spring Quadrangle, Big Bend National Park, Texas* (MM0046), *Geologic Map of Mariscal Mountain, Big Bend National Park, Texas* (MM0048) and *Geologic Maps of the Upper Cretaceous and Tertiary Strata, Big Bend National Park, Texas* (MM0050) include information used in the project. To learn more, access the map project at the USGS and NPS sites.

Eddie Collins

The competitive program was based on proposals submitted by students and their faculty/researcher advisers and evaluated by a small team of leaders from UT Austin and Statoil. "I was very impressed by the breadth and quality of the proposals," said Scott Tinker, acting associate dean of research in the Jackson School, who helped design the program with Statoil. "We anticipate the program will continue to strengthen in the coming years."

Carbon Storage Leadership

The Bureau of Economic Geology's Gulf Coast Carbon Center (GCCC) continues to lead the way as the country's largest academic research group working in geologic storage of carbon dioxide. This past year, GCCC scientists published several important research findings. Here are a few highlights.

Katherine Romanak, Changbing Yang, and Brad Wolaver led an international team of scientists that investigated allegations of leaking CO_2 at a farm in Saskatchewan. They found no evidence that carbon dioxide was leaking from geologic reservoirs. "The CO_2 injected by Cenovus Energy as part of its enhanced oil recovery project is not the source of CO_2 found on the Kerr farm," said Carmen Dybwad, chief executive officer of IPAC-CO_2, the organization that instigated the project. "The levels of natural CO_2 we found were normal."

In a study published in the journal *Chemical Geology*, Jiemin Lu, Susan Hovorka, and others showed that injecting large amounts of CO_2 in a brine reservoir in Cranfield, Mississippi over a long period of time (more than 1 million tons in the first year alone) caused only minor chemical reactions with minerals in the reservoir. "Brine chemistry remained largely unchanged, which contrasts with significant changes observed in other field tests," write the authors. At the Cranfield site, they note, reservoir geochemistry is not useful in predicting the fate of injected CO_2.

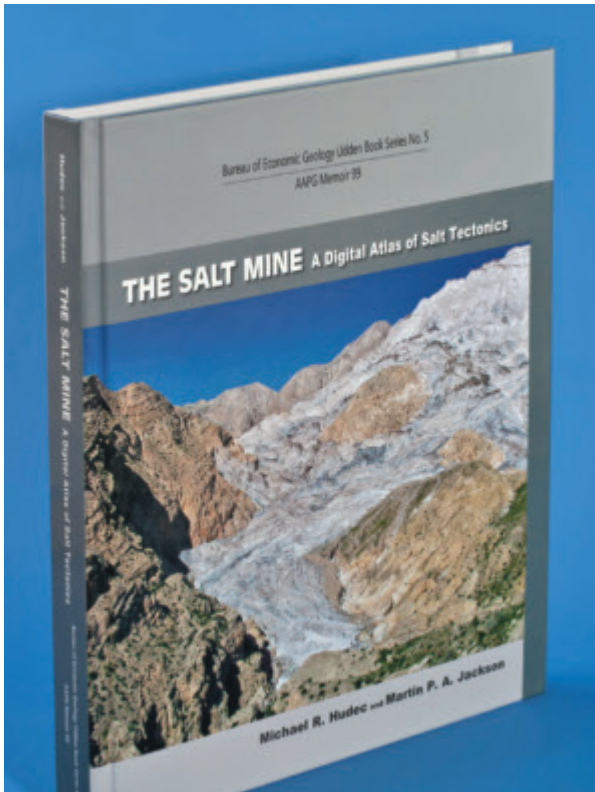
A team of GCCC scientists studied a West Texas oil field that has been the site of CO_2 enhanced oil recovery for more than 35 years. Their goal is to develop methods for monitoring CO_2 injections and to ensure it does not leak and contaminate drinking water. They found a natural geochemical process called dedolomitization at the SACROC site might be misinterpreted as resulting from a human-caused CO_2 leak. In the *International Journal of Greenhouse Gas Control*, they report that dissolved inorganic carbon (DIC) would provide a more reliable indicator of a hypothetical CO_2 leak.

Seyyed Hosseini and J.P. Nicot used a computer model to find out if removing brine from a CO_2 injection interval and re-injecting it into overlying shallow aquifers would increase the CO_2 storage capacity or reduce risks of leaks. Reporting in the journal *Greenhouse Gases Science and Technology*, they find that depending on the circumstances, brine re-injection can increase storage capacity by 30 percent or more and reduce potential CO_2 leakage risks.

Influencing the global agenda: *During the United Nations Climate Change Conference from Nov. 27-Dec. 5, 2011 in Durban, South Africa, Katherine Romanak (left) was invited to present a talk on geologic carbon storage at an official side event aimed at informing negotiators and other delegates about various aspects of carbon capture and storage (CCS) and its potential inclusion in the U.N.'s Clean Development Mechanism.*

The Salt Mine

More than 10 years in the making, *The Salt Mine, a Digital Atlas of Salt Tectonics*, by Michael R. Hudec and Martin P. A. Jackson, is now available through the Bureau of Economic Geology's publication sales website. A collaborative effort by the Applied Geodynamics Laboratory and the Bureau's team of graphics, GIS, editing, photography, and digital media staff, this hard-bound, four-color volume and accompanying interactive DVD has been published as the BEG's Udden Book Series No. 5 and AAPG Memoir 99. *The Salt Mine* provides a guided tour of some of the finest examples of salt tectonics in both classic and little-known salt basins, including outcrop views, geologic maps, aerial photographs, satellite images, seismic sections, geologic cross sections, conceptual sketches, and animations. The DVD contains more than 1,350 color images and 50 animations and is fully searchable. The book showcases 400 of the most interesting and visually appealing of the full-color images in the digital atlas. To learn more, or to purchase *The Salt Mine*, visit the publications page on the Bureau's website.



El Tatio: Science for Society

Last year, Suzanne Pierce was selected as one of the first 20 Fulbright Nexus Scholars, a group of early to mid-career experts working to bridge the gap between science research and the needs of society. The program is the newest initiative of the U.S. Department of State. Pierce's project focused on helping indigenous communities in the Atacama Desert of Chile develop strategies for sustainable use and conservation of natural resources in order to foster socioeconomic development.

When a well that was being tested by a geothermal exploration company accidentally blew out in Chile's El Tatio Geothermal Field (ETGF), indigenous people living nearby launched a massive protest. They were concerned that the accident, which created a 60 meter tall artificial geyser and took a month to control, had permanently damaged a natural geyser field that they considered sacred and which attracts tourists from around the world. In response, the Chilean government implemented a moratorium on geothermal projects in the country. But was the decision based on science or perception?

Working with students from UT Austin's Energy and Earth Resources graduate program and collaborators from two Chilean Universities—the Universidad de Chile and Catolica del Norte—Pierce, research assistant professor in the Jackson School, demonstrated that there was no long term damage to ETGF.

"When it comes to conflict over energy and earth resources a lot of the discussion is driven by emotion and misperception, rather than conversations, where people are fighting about it publically instead of sitting down and saying realistically what's going on and what do we do together to make it better?" she said.

For her Fulbright Nexus project, Pierce visited with 19 indigenous community members to host a dialogue about water resource and energy issues, using techniques designed by the Department of State for conflict resolution. The indigenous stakeholders outlined goals to generate electric power and sell it to copper mine operators, start their own geothermal and groundwater monitoring network, and develop a science-based tourism industry.

Perhaps the most important outcome of discussions is that indigenous groups see the process of scientific dialogue as an opportunity to look toward a new future, one where they build capacity and knowledge about their resources. Additionally, participants are willing to learn more about geothermal energy and they are considering opening conversations with the mining and energy industries.

As part of the project, Pierce also created ENCOMPASS, a cyber platform for scientists to share information with each other and the public. She is now developing a system for linking the data, videos and computer simulations housed on the ENCOMPASS platform with a portable, multi-touch computer table. She envisions a day when several stakeholders could stand around the table, play out various scenarios, and see the outcomes, essentially role playing different visions for the future.

El Tatio Geyser, Chile.

Jay Famiglietti

SPEAKERS & LECTURERS

The Case for GRACE

Over the last decade, satellite observations of Earth's water cycle from NASA's GRACE (Gravity Recovery and Climate Experiment) mission have provided an unprecedented view of global hydrological change and freshwater availability. Administered by the Center for Space Research at UT Austin, where the Jackson School's Clark Wilson has an appointment as a research professor, GRACE has helped to confirm that precipitation, evaporation, and continental discharge rates are increasing, that the mid-latitudes are drying while the high and low latitudes are moistening, and that the hydrologic extremes of flooding and drought are becoming even more extreme.

Jay Famiglietti, director of the Center for Hydrologic Modeling at the University of California, Irvine, is a firm believer that GRACE is transforming climate science. Famiglietti shared his thoughts during the 2012 Birdsall-Dreiss lecture tour, which brought him to the Jackson School in March.

"The GRACE data has really revolutionized our understanding of how water is stored across the continents. It's given us a global picture of what I call real water use, as opposed to something that's based on statistics," Famiglietti said.

The GRACE mission draws its data from twin satellites that make detailed measurements of Earth's gravity field. Flying an orbit that covers most of the Earth's surface every 30 days, the satellites are adept at measuring the substance most likely to cause gravitational changes that quickly:

water. Floods, droughts, or other changes that rapidly affect ice and water levels all show up prominently in GRACE's data.

Famiglietti and his colleagues have made especially good use of GRACE to examine groundwater depletion. In a 2011 paper in *Geophysical Research Letters*, they reported that between October 2003 and March 2010 California's Central Valley lost an estimated 20.3 cubic kilometers of water – about two-thirds the volume of Lake Mead – with the aquifer dropping at a rate of about 1.2 inches a year.

"The groundwater that's being depleted will not be replaced, because it's not raining as much," said Famiglietti.

While explaining the value of GRACE's data, Famiglietti made the case for extended, long-term funding of the mission.

"Groundwater depletion is a global phenomenon," he said. "People have been saying it for a long time, but without the picture provided by GRACE, it's hard to get them to listen."

Dune filtration in action.

Viral Flows

How many live viruses can your cup of water have in it before you decide not to drink it? In the Netherlands, municipal drinking water must have no more than one virus per 5,000 cubic meters of water, or about two Olympic-size swimming pools.

A third of drinking water in the Netherlands comes from surface water, which can easily be contaminated with pathogenic microorganisms and viruses from wastewater discharges or manure runoff.

Majid Hassanizadeh, professor at Utrecht University in the Netherlands, visited Austin in March to deliver his Darcy Lecture as part of a world tour sponsored by the National Groundwater Association. He described how sand dunes are used to provide the last of several purification steps. Pre-treated surface water flows along in canals next to naturally occurring sand dunes. Pure drinking water is extracted from wells about 60 meters from the canals. As the water filters through the sand, viruses stick to sand grains, where most are chomped up by bacteria and protozoans. By the time the water reaches the wells, the viral concentrations are well below the allowable limit.

Hassanizadeh uses physical field models, computer simulations and lab experiments to study the factors that control how far viruses move through sand. He's discovered that changes in calcium concentrations or in the saturation of sand can cause viruses that were once trapped to become remobilized.

Hassanizadeh's research could help water suppliers know when to stop extracting drinking water from a system, for example during heavy rainfall. There are other motivations for the work—for example, determining how far apart groundwater wells and sewage lines could safely be to prevent viral contamination.

Making the Most of Models

Models are an omnipresent tool for public science, particularly when societies try to grapple with resource issues such as energy, water, and land use. But how can we make sure models work as well as possible to help us make the best long-term decisions?

Tony Jakeman of the Fenner School of Environment and Society at the Australian National University took up this question with a focus on sustainable groundwater in his October 2011 Fred L. and Frances J. Oliver Distinguished Lectureship in Texas Hydrology and Water Resources.

"When integrated modelling works," said Jakeman, "the results can be transformational, but the core elements for generating that success are not always clear. There is an elusive element to finding the best mix of methods, models and approaches for any given problem."

One problem, noted Jakeman, is that many environmental issues are often "wicked or messy problems," with lots of ambiguity, no single right or wrong solution, and many conflicting pressures. Solving such problems involves making compromises while "working with limited knowledge to hit a moving target."

Taking groundwater as an example, he noted some of its "messy" characteristics: it's often linked to surface water; because it's not highly visible, its misuse arouses less concern; it has long turnover times and uncertain storage; and present monitoring techniques are not adequate for understanding the resource.

Despite these obstacles, Jakeman believes integrated models can help us move toward the tough decisions needed for groundwater management. In the end, said Jakeman, while "wicked" and messy problems like groundwater management may not have right or wrong answers, they do have better or worse solutions, which our decision support systems need to pursue.

Tony Jakeman, Suzanne Pierce, Dean Sharon Mosher.

Students Organize First JSG Research Symposium

In February, the Graduate Student Executive Committee and ConocoPhillips put on the first Annual Jackson School Research Symposium. Conceived of and organized by students, the goal was to stage an AGU-style poster competition with students presenting their research. Faculty and research scientists served as judges. The event was a major success and will hopefully become a new tradition at the school.

Best Posters for 2012

Undergraduate: 1st Place: Quinn Wenning, 'Characterizing Reactive Flow Paths in Fractured Cement.' 2nd Place: Robert Zinke, 'Pre-eruptive storage conditions and the eruption of Douglas Knob obsidian lava dome, Yellowstone Caldera.'

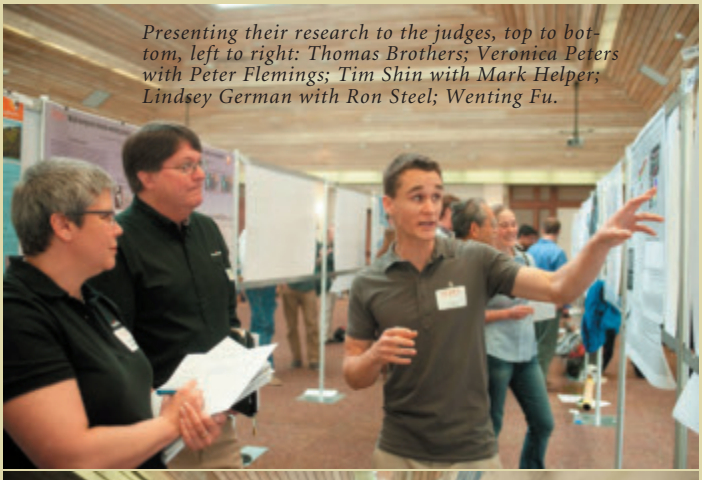
Early-Career Graduate: 1st Place: Qinjian Jin, 'The Change in Wind and Dust Storm in the Middle East in multi-decadal scale and Their Correlations.' 2nd Place: Maureen LeVoir, 'Preliminary analysis of the Baranof Fan system, Gulf of Alaska, based on 2D seismic reflection and multibeam bathymetry data.'

Late-Career M.S.: 1st Place: Bryant Kopriva, 'Stratigraphic Response of Variable Mini-Basin Subsidence Patterns Due to Autogenic Effects.' 2nd Place: Justin Fitch, 'Retroarc foreland basin evolution during Paleogene shortening, northern Altiplano plateau, southern Peru.'

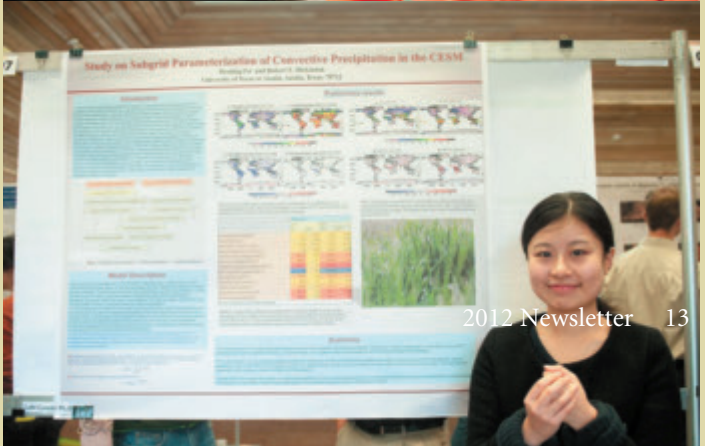
Late-Career Ph.D. : 1st Place: Charles Brothers, 'New constraints on the formation of Abalos Mensa, Planum Boreum Mars from radar stratigraphy and high-resolution imagery.' 2nd Place: Ethan Lake, 'Geometric controls on large volume mid-crustal magma chambers and magma evolution zones: A 3-D modeling approach.'

Best Represented Group

1st Place: Danny Stockli. 2nd Place: Tim Shanahan. ✷



Presenting their research to the judges, top to bottom, left to right: Thomas Brothers; Veronica Peters with Peter Flemings; Tim Shin with Mark Helper; Lindsey German with Ron Steel; Wenting Fu.



BRIEFS

Jamie Austin (orange) on the Nautilus Live.

OUTREACH

Live from the Deep

Jamie Austin, senior scientist at the Institute for Geophysics, has been sharing the wonders of ocean exploration with people all over the world through two innovative and linked outreach programs—one organized by Robert Ballard, famed discoverer of the *Titanic*, and the other by the National Oceanic and Atmospheric Administration (NOAA). Like conventional research expeditions, teams of scientists head out for weeks or months at a time on large ships packed with sonar mapping equipment, remotely operated vehicles (ROVs), underwater video cameras, and other high tech equipment.

But there's a twist: using a high bandwidth satellite connection, the video feed from the ROVs on the seafloor and round-the-clock commentary from the scientists are streamed live on the Internet. Ballard calls this system "telepresence." Online viewers experience the live video feeds while biologists, geologists and explorers talk about what they're seeing in real time. When a previously undescribed sea creature darts in front of the camera, or the first human eyes fall on an ancient shipwreck or geologic formation, the scientists are sharing in the moment of discovery with viewers thousands of miles away in classrooms, living rooms and offices.

Nautilus Live, led by Ballard, is a series of ongoing expeditions aboard Ocean Exploration Trust's research vessel *E/V Nautilus* combining telepresence with biological, geological, and archaeological exploration. Austin was co-chief scientist for part of the 2010 and 2011 expeditions. In the Western Mediterranean, the team sampled volcanic rocks and searched for mud volcanoes, hydrothermal vents, and gas seeps near the boundary between the African and Eurasian plates. Near the coast of Israel, they explored sink hole-like features on the seafloor, a deep-sea coral reef, and cold natural gas seeps supporting large colonies of clams and tubeworms. Off the coast of Spain, the team also explored the remains

Nautilus Live ROV view.

of an ancient Roman shipwreck site dotted with rows of partially buried clay jars, called amphorae, used by the Romans to transport olive oil, wine, and grains. To see a highlights video of the 2011 expedition, go to http://bit.ly/Te7LSu

Austin also served as science lead for NOAA's eight week Gulf of Mexico expedition aboard their ship *Okeanos Explorer* in April 2012. One of the major focuses of the expedition was trying to quantify how much natural gas bubbles up from seeps on the floor of the gulf to distinguish natural effects from human-caused impacts resulting from past and (perhaps) future oil spills. The crew tested techniques for measuring the natural gas flux from individual seeps, documented unique deep-water coral communities, and explored two shipwrecks. Experts suspect one of the ships—a well-preserved copper-sheathed wooden ship filled with artifacts including bottles, plates, anchors, cannon, and stacked muskets—was an early 19th century privateer.

In 2013, scientists aboard both ships expect to be conducting exploration expeditions around the Caribbean. Stay tuned!

Geophysics Alumni Shake the Earth

The UT team for Bowie High School Science Day used a vibroseis truck to run demonstrations on earthquakes, waves, and engineering to survive earthquakes. Left to right: Roberto Gutierrez (B.S. Geophysics '84, Ph.D. Geophysics '90), four Bowie students, Farn-Yuh Menq and Robert Kent from UT Civil Engineering's NEES – National Earthquake Engineering Simulation facility, and Clark Wilson, JSG professor and NEES co-director. The organizer (not pictured) is Jill Harding (B.S. Geology '84), the head of the Science Department at Bowie.

Getting the Word Out on Carbon Sequestration

This past year, scientists from across the Jackson School have stepped up their efforts to inform and inspire students, teachers, policy makers, and future workers about the growing field of carbon sequestration—the underground storage of carbon dioxide from burning fossil fuels.

The Bureau of Economic Geology's Gulf Coast Carbon Center (GCCC) has been especially active on the international stage.

In fall 2011, Katherine Romanak spoke at events in Durban, South Africa and Abu Dhabi, UAE aimed at informing negotiators and other delegates involved in international climate negotiations about various aspects of carbon capture and storage (CCS) technology and its potential inclusion among techniques that developing countries can use to earn and sell emission reduction credits under the Kyoto Protocol.

In August, Susan Hovorka, principal investigator of the GCCC, gave the keynote talk at the 34th International Geological Conference in Brisbane, Australia, focusing on the Cranfield project.

Several outreach efforts strengthened ties with Chinese scientists and policy makers. Hovorka presented an overview of CCS technologies at the China-Australia Geologic Storage Technical Symposium in Beijing in April. In May, the GCCC hosted the DOE-sponsored Carbon Capture, Utilization, and Storage & CO_2-EOR Technology Exchange at the Houston Research Center, which featured speakers from China and the U.S. Changbing Yang was invited to speak on monitoring the large-volume CO_2 injection at Cranfield at the International Workshop on Geological CO_2 Sequestration in Changchun in July. Romanak was a speaker and student mentor at the International Energy Agency Greenhouse Gas R&D Program's International Summer School hosted by Tsinghua University in Beijing in August.

Scientists from the GCCC, the Institute for Geophysics, and the Department of Petroleum and Geosystems Engineering also conducted outreach through STORE, a DOE-funded project to help create a skilled workforce for the CCS industry and foster public understanding of climate change mitigation technology. Last fall, Jon Olson was the opening speaker for a conference of over 500 Texas science teachers from across the Rio Grande Valley. Other STORE researchers led workshops. Also last fall, Romanak, Kathy Ellins, Hilary Olson and Jon Olson gave keynote talks and workshop presentations to over 8,000 attendees at the Florida Association of Science Teachers Annual Conference. In January, STORE members put on an educational workshop sponsored by Chevron for 50 visiting students from the University of Stavanger in Norway who spent a week in Houston, Texas learning more about U.S. oil and gas operations. The workshop included a field trip to the Hastings Field, south of Houston.

Horns & Aggies Team Up for Science Teachers

Texas A&M University's College of Geosciences has teamed up with the Jackson School in a project to improve geoscience education for Texas high school students.

The project, funded by the National Science Foundation, is known as "Diversity and Innovation for Geosciences in Texas" (DIG Texas). Led by the university's two geosciences deans, Kate Miller at Texas A&M and Sharon Mosher at the Jackson School, the group has worked together to establish a community of geoscientists and educators across Texas.

"The collaboration is designed to improve opportunities at the graduate and undergraduate level by joining geosciences departments across Texas into a coherent network, and also to work toward improved geosciences literacy among Texas high school science teachers," says Eric Riggs, assistant dean of Texas A&M's College of Geosciences.

Texas public high schools have the option of offering an Earth and Space Science capstone course to fulfill the fourth year of science required for graduation under the state's graduation plan, explains Kathy Ellins, a geoscience education researcher at the Jackson School's Institute for Geophysics.

"DIG Texas aims to boost the capacity of Texas schools to offer Earth and space science through effective teacher development programs that provide highly qualified Earth science teachers," she adds.

The two universities also will jointly host educators from across the state as part of long-established student recruitment programs. Organizers say this collaboration gives the two universities that have the flagship geosciences programs the opportunity to showcase their collective programs and present a unified vision of the geosciences in Texas.

DIG student examines a fish during an outreach field trip. Photo: Texas A&M.

Both institutions have long histories of initiatives to enhance diversity in geosciences, officials note, and DIG Texas representatives say they expect to lead to a network of professionals excited about working for a more diverse and better prepared population of students entering geosciences.

Scenes from GeoFORCE 2012

Left to right, top to bottom: Denise Butler, Shell geologist and Geology Foundation Advisory Council member, with GeoFORCE Alaska; U.S. Assistant Secretary for Water and Science Anne Castle with GeoFORCE Texas 12th Grade Academy; 12th Grade Young Geoscientists at El Capitan with the Bureau of Economic Geology's Xavier Janson.

GeoFORCE Expands Model Program Into Alaska

The country's biggest geosciences pipeline program just got bigger. This past summer, 16 incoming high school freshmen from native villages on the North Slope of Alaska joined the inaugural class of GeoFORCE Alaska. Students set out on a week-long field trip through some of Alaska's geological hotspots, including Denali National Park, Earthquake Park in Anchorage, Healy coal deposits, the Fox permafrost tunnel, and several glaciers.

"I've never really had an interest in Geoscience, but now I can't wait to learn more," said one of the inaugural students.

GeoFORCE Alaska is an offshoot of the extremely successful GeoFORCE Texas program developed by the Jackson School. The overarching goal of GeoFORCE is to increase the number and diversity of students studying geosciences and engineering in college and entering the high-tech workforce. Each year, about 600 students from predominantly underserved schools in southwest Texas and the Houston area participate in GeoFORCE Texas.

The model is designed to be scalable and available for replication by other universities. The University of Alaska Fairbanks (UAF) is the first university to replicate the program. It is an ideal location because it has the most important traits for a successful program: a strong geology department with ties to a high need school district and local industry engaged in outreach.

"The North Slope is where you find a high proportion of Native Americans in small rural villages," said Eleanour Snow, interim director of outreach programs at the Jackson School. "Rural communities have a really difficult time delivering good science to the students and so in a way, the North Slope echoes our rural border towns in Texas."

Ed Duncan (BS '79, MA '87), CEO and president of Great Bear Petroleum, was already involved with GeoFORCE Texas when he suggested expanding the program to include students from Alaska. Duncan and Denise Butler, geoscience discipline lead for upstream Americas at Shell, lined up first-year funding from their companies, as well as other partners such as the Arctic Slope Regional Corporation. Duncan and Butler joined the students on last summer's field trip as sponsor representatives.

"It's (about) reaching out and hoping to find kids that have the aptitude to excel," Duncan told a reporter with the *Arctic Sounder* newspaper. "Find them early enough in their academic careers that we can get them interested in doing something really extraordinary, and then following through."

The GeoFORCE Alaska organizers hope to reach full capacity in 2015 with 160 students: 40 students per grade for ninth through twelfth grades. Each summer for four years, the program will take students on spectacular geologic field trips throughout the U.S. Thanks to generous support from industry and other sponsors, the trips are free to students.

"It would be a wonderful thing if there was a GeoFORCE in every state," said Snow. "I think the more kids we can reach the more benefit we can have around the country."

Below: Students and instructors from the GeoFORCE Alaska 9th grade academy with Alaska's Lieutenant Governor Mead Treadwell (center, middle row).

GeoFORCE Director Ratcliff Retires, Leaving Legacy of Highly Distinguished Service and Celebrated Programs

On August 31, Director of Outreach and International Programs Doug Ratcliff retired from the school—and sadly this time, it appears to be for real. Ratcliff retired from the university once before (2006). Within months, Dean Eric Barron lured him back by asking him to take over outreach and international programs, which allowed Ratcliff to oversee the Latin American Forum and GeoFORCE Texas.

Under Ratcliff's leadership, the forum renewed ties to Latin American leaders from government and industry. GeoFORCE, meanwhile, grew from a pilot program of 80 students in 2005 to a national model for K-12 science academies in 2012. This year, GeoFORCE's summer programs educated 620 students and launched the satellite expansion, GeoFORCE Alaska (see previous page). About 25 GeoFORCE students from the inaugural 2005 class will graduate from college this spring, 13 from UT Austin and four from the Jackson School.

Mike Loudin of ExxonMobil got to know Ratcliff in the early days of GeoFORCE. "What struck me immediately was his sense of mission," said Loudin, who praised Ratcliff's "top-shelf leadership qualities" of tenacity, vision, and enthusiastic engagement with stakeholders. "No matter what bumps in the road were encountered, Doug never lost sight of that mission and always exuded a sense of the inevitability of GeoFORCE's success."

"Doug has been the heart and soul of GeoFORCE since the program began," said Denise Butler of Shell. "He built the program from the ground up and today GeoFORCE is recognized as one of the most successful STEM programs in the country."

Ideas similar to GeoFORCE had been tried before without much success or endurance, notes Ratcliff's longtime boss and the inaugural dean of the Jackson School, Bill Fisher. GeoFORCE succeeded, says Fisher, because of Ratcliff: "In true fact, without Doug Ratcliff there would be no GeoFORCE."

"His commitment for doing the right thing and dedication to helping kids is an example for us all," said Ed Duncan, president and COO of Great Bear Petroleum. Duncan met Ratcliff as a student in Sharon Mosher's first structural geology class and they became lifelong friends, a relationship that contributed to the Alaska expansion.

After almost 40 years of professional service to the geosciences at UT Austin, Ratcliff leaves behind a major legacy. Starting as a clerk at the Bureau of Economic Geology, he became associate director of the Bureau and later the Jackson School, contributing immensely to the success of both organizations. A Renaissance man, Ratcliff practiced geology and and flew a plane for the Bureau, while later putting a 1978 MBA to great use managing finances for the Geology Foundation during the meteoric rise of its endowment.

"He was core in expanding the Bureau," says Fisher, and "a fundamental part of establishing the Jackson School and building it from scratch as an administratively efficient and effective organization."

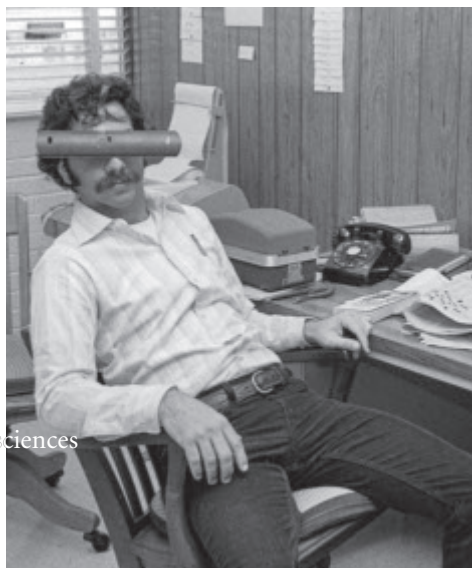
Recipient of the Bureau of Economic Geology Distinguished Alumnus Award (2004), the Jackson School's Walter Excellence Award (2010), and distinguished service awards from the Gulf Coast Association of Geological Societies (2002) and American Association of Petroleum Geologists (2008), Ratcliff has been known for years for his ethics, vision, and follow-through.

Especially the follow-through. Former colleagues at the Bureau and Jackson School—especially those whom Ratcliff supervised—will always remember the steady round of 5:30 a.m. e-mails that characterized any active professional engagement with Ratcliff. His hard work yielded dozens of success stories for the university. Some of the success stories are well known—like GeoFORCE and the expansion of core facilities at the Bureau—but just as many are known to only a few close colleagues. While accomplishing much for his employers, Ratcliff almost always sought to avoid the spotlight, preferring to speak through his actions.

His actions spoke volumes. And while Ratcliff likes to avoid the spotlight, this is, in Loudin's words, "maybe the one time when we get the last word, and so: Thank You for what you've done for so many deserving students, and for enriching so many colleagues' lives. You're special."

We couldn't have said it better.

Photos of Doug Ratcliff, counter-clockwise from top left: with wife Gail Gebink at the 2008 Latin American Forum; in the 1970s; hiding his identity at the Bureau; with GeoFORCE kids.



Alumni Video & Outreach Attracts Students to the Geosciences

Find the video at BeAGeo.com.

As geoscientists, we know the geosciences are an exciting, high-tech career choice with plenty of job opportunities. But students are rarely exposed to the geosciences as a career option. Help us change that.

The Jackson School is on a mission to show students that the geosciences integrate chemistry, physics, biology, computational sciences and math to solve real world, societally relevant problems. With a career in the geosciences they can make an impact on some of the most important social questions of our time. The Jackson School FANs (Friends and Alumni Network) launched the Earth is Calling outreach program last fall with a new website (www.BeAGeo.com), professional video, traveling booth, and brochures. Since then, volunteers have conducted classroom presentations in San Antonio and the Dallas area.

John Long (M.A. '78) almost didn't become a geologist. He went to college to be a writer, but when he took a geology class, something clicked. He switched majors and eventually went to work as a petroleum geologist. Now, he is taking an active role to ensure others learn earlier about the inspiring world of geosciences.

As co-director of the San Antonio chapter of the Jackson School FANs, he is leading the San Antonio effort to make sure students are exposed to geology early enough to make an informed choice. Long has assembled a team of 7 alumni volunteers and targeted 14 local schools for visits. His employer, Osborn Heirs Company, has been extremely supportive of his efforts.

"I found geology almost by accident," says Long. "The potential to get a kid involved in geology who might otherwise miss the opportunity, the way I almost did, is very exciting."

Last April, Long and other alumni made presentations about geoscience careers to over 100 students at Reagan High School. The Earth is Calling video was presented, along with personal stories of what life is like as a geologist. The science teacher who hosted the visit, Matt Montamat, says the program fills a void.

"Kids are concerned about the jobs they're going to have when they get out of college," says Montamat. "Not a lot of them thought of geology as a career option."

Long and other alumni also met with students at a career fair at Holmes High School. Long plans to ramp up efforts this fall and send volunteers to the 12 remaining schools in San Antonio.

In the April edition of *AAPG Explorer*, Sharon Mosher, dean of the Jackson School of Geosciences, expressed the concern of many experts in the geosciences.

"The pipeline is not prepared to meet the predicted future demand for a robust geoscience work force, so a multi-dimensional, sustained effort to increase the number of students embarking on a geoscience career is critical," Mosher emphasized.

Excitement about the Earth is Calling outreach program has spread beyond Texas. Rick Kolb (MA '81), senior geologist at an environmental consulting firm in Cary, North Carolina, regularly visits high schools and colleges to talk about geoscience careers. Last spring he began using the Earth is Calling materials in his classroom visits and has shared the materials with colleagues in the Association of Environmental and Engineering Geologists who do the same. This fall, a FANs board member will make a presentation about the program at the Geological Society of America annual meeting in Charlotte, North Carolina.

"We're non-denominational," says Long. "We don't push UT, we push geology, because it can be such a rewarding career for kids who want to do science."

BRIEFS

Opportunities for Alumni

We're asking alumni to serve as role models and ambassadors in their local high schools and inspire the next generation. With our toolkit—a tabletop display, short, high energy video, Q&A ice breakers and brochures—it's easy. Get your free kit at

» www.BeAGeo.com

—or contact Ann Flemings at aflemings@austin.utexas.edu.

IN THE NEWS 2011-12

Links to complete articles, streaming audio and video files, and current In the News items can be found on the news section of the JSG Web site.

Ancient Mollusk Reconstructed

***National Geographic*, Sept. 18, 2012**

A spiky, well-armored mollusk that lived in the ocean 390 million years ago has been brought back to life with the help of 3-D printers. To reassemble the specimen, a team led by Jakob Vinther, a postdoctoral fellow at the Jackson School, made a three-dimensional model of the fossil using a technology similar to medical CT scanning. National Geographic hosted a short video showing the reconstruction process.

Reconstruction of a multiplacophoran.

Study Sees Gas Price Rises

***Natural Gas Week*, Aug. 13, 2012**

U.S. natural gas prices are about to embark on a path to recovery in which prices will soar on a volatile route from today's upper $2/MMBtu range to $6 in 2015 and $7 in 2018, then ratchet up and down from $7 to $5 for the next 15 years, predicts the Bureau for Economic Geology's Center for Energy Economics. Natural gas prices will not follow the smooth path to the future predicted by the U.S. Energy Information Agency, according to the center's director, Michelle Foss. Reasons to expect a rise, says Foss, include growing demand, mild economic recovery, rising exports to Mexico, and flattening U.S. production.

Shale Less Intrusive than CSG

***The Australian*, Aug. 8, 2012**

Mining shale gas causes less damage to the environment than extracting coal-seam gas (CSG), said Scott Tinker of the University of Texas. "The big challenge with unconventional gas such as these two is how it affects water, but shale gas is extracted from considerably deeper than coal-seam gas," he told the 34th International Geological Conference. "The water you're extracting with coal-seam gas is often part of the aquifer system, and that can affect water systems."

Michelle Foss

Study Links Wells to Very Small Quakes

***New York Times, Reuters, BusinessWeek* et al., Aug. 6-7, 2012**

Most recent earthquakes in North Texas happened close to injection wells used to dispose of wastewater from oil and gas drilling in the region, according to a two-year study by UT Austin published in *Proceedings of the National Academy of Sciences*. "You can't prove that any one earthquake was caused by an injection well," said Cliff Frohlich of the Institute for Geophysics, who conducted the study. "But it's obvious that wells are enhancing the probability that earthquakes will occur."

GeoFORCE Introduces Students to Alaska Geology

***Fairbanks Daily News-Miner*, July 28, 2012**

Students from Barrow and villages Kaktovik and Nuiqsut performed a slapstick skit about the inner workings of Mount Drum stratovolcano that just a week before they knew nearly nothing about. The students just completed the first season of GeoFORCE Alaska, a program aimed at introducing rural and minority students to science through hands-on field trips. The program is the first expansion of the six-year-old GeoFORCE Texas, brought to Alaska by the Jackson School with support from industry.

How D-Day Shaped Geology of Omaha Beach

***Reuters, Wall Street Journal, Daily Mail* (U.K.), May 26-June 6, 2012**

Earle McBride, a professor emeritus of geology in the Jackson School, analyzes sand as a hobby — taking samples from places he visits. In the late 1980s, he took some samples from Omaha Beach and found 4 percent of the sand is made up of bits of shrapnel from the D-Day invasion. (For more on this story, see our feature article on page 59.)

U.S. Groundwater Use Concerns Hydrogeologists

***Christian Science Monitor, UPI, NPR*, May 28-June 4, 2012**

The depletion of groundwater for agriculture in dry regions of Texas and California could threaten food security in the U.S., researchers say. Scientists said they've ana-

Dunes and sea grass on Mustang Island.

lyzed the depletion rates caused by pumping groundwater for irrigation in California's Central Valley and the High Plains. "We're already seeing changes in both areas," said study author Bridget Scanlon of the Bureau of Economic Geology.

Repsol Comes Up Dry in Cuba

***Reuters*, May 29, 2012**

Repsol announced plans to abandon exploratory drilling in Cuba after the Jagüey offshore well came up dry. The announcement is "disappointing but not unexpected," said Cuban energy expert Jorge Piñón, a research fellow at the Jackson School. "The challenge for Cuba is to attract investors when there are other places whose risk-reward profile are much more attractive and politically less contentious vis-à-vis US-Cuba relations," said Piñón.

Jorge Piñón

Mustang Island Sees Lower Erosion Than Other Areas

***Corpus Christi Caller-Times*, May 24, 2012**

Nueces County's Mustang Island is more prepared for major storms than other coastal communities in Texas, according to research from the Bureau of Economic Geology. Nueces County has had about 11 inches of erosion on average annually since 1938, compared with 15 inches in Galveston. A lower density of structures on the beach, combined with natural accumulation of sea grass, appears to mitigate, but certainly not eliminate, erosion on Mustang Island.

Lawmakers Contend With Global Helium Shortage

***New York Times*, May 17, 2012**

At Wally's Party Factory, a 32-store chain based in the North Texas town of Ennis, balloons no longer contain 100 percent helium. Such adjustments are one of the indicators of a worldwide helium shortage. Experts say the scarcity could have significant implications for the space, high-tech and medical industries. In a worst-case scenario, which is unlikely, the world could run out of helium in a century, said Charles Groat, a geology professor at the Jackson School.

UTIG Program Pieces Gulf of Mexico Puzzle

***AAPG Explorer*, May 2012**

Despite the Gulf of Mexico's long production history, much remains to be learned about its geology, and an ongoing industry-funded program conducted by the Institute for Geophysics at the Jackson School is proving to be a rich information resource. The 17-year-old Gulf Basin Depositional Synthesis (GBDS) project is based on the premise that the GOM basin is a natural laboratory of sedimentary processes. Its objective is to assemble and synthesize well, seismic and other data to establish basin-scale depositional history of the Gulf, according to John Snedden, the newly named director.

John Snedden

Bone Spring Gains Prominence

***Platts*, April 9, 2012**

The U.S. Delaware Basin's Bone Spring oil play has received a lot of buzz lately, but the emerging sandstone play in far west Texas and southeast New Mexico is complex. Bone Spring consists of three distinct sands. The third and deepest appears right now to be the most productive of the three, said Seay Nance, geologist at the Bureau of Economic Geology. "But actual producing zones are relatively thin—maybe 30-40 feet of material in the whole thing," Nance said.

Study Shows Antarctic Ice Shelves Tearing Apart

***CNN, Huffington Post, Climate Wire*, Mar. 28-29, 2012**

A new satellite study of ice shelves in West Antarctica has revealed they are steadily losing their grip with adjacent land and

Julia Clarke

could intensify the acceleration of ice loss in the area. The ice shelves in the eastern Amundsen Sea Embayment are fracturing at their margins on rocky bay walls, according to glaciologists from the University of Texas at Austin's Institute for Geophysics (UTIG). "Typically, the leading edge of an ice shelf moves forward steadily over time, but that is not what happened along the shear margins," said lead author Joseph MacGregor.

Feathers Set for Signaling

***New York Times, National Geographic, AFP*, et al., March 8-9, 2012**

Sexual drive, not flight, may have been the main reason for the feather color and pattern of Microraptor, a four-winged dinosaur that lived some 130 million years ago in what is now northeastern China. Co-author Julia A. Clarke, a paleontologist at the Jackson School, noted many experts continue to interpret dinosaur feathering strictly in aerodynamic terms. "But as any birder will tell you," Clarke said, "feather colors and shapes may also be tied with complex behavioral repertoires and, if anything, may be costly in terms of aerodynamics."

Geologist Explains Japan's Massive Earthquake

***San Angelo Standard-Times*, March 1, 2012**

Nearly a year ago, water levels in wells on the Edwards Aquifer near San Antonio "sloshed" as seismic waves from the magnitude-9 earthquake that struck Japan traveled across the planet, as Jackson School Professor Mark Cloos shared at a meeting of San Angelo Texas Exes. Cloos explained the basics of plate tectonics and how the theory accounts for the quake, the largest in Japan since 869 A.D. "What happened was about 500 years of plate convergence was released in about one minute," said Cloos.

Boom Times Back in OK

***CBS Evening News*, Feb. 23, 2012**

The oil and gas boom times are back in Oklahoma. Will the bottom drop out? Eric Potter, an energy researcher at the Bureau of Economic Geology, said all rushes, "whether they're Gold Rushes or oil rushes or booms, have a beginning and ultimately they have an end. So the question is what will the end be like?" Producers in Oklahoma are predicting the boom could last longer than expected and significantly curtail U.S. reliance on imported oil.

Eric Potter

Mark Cloos

Energy Institute: No Special Link Between Fracturing and Groundwater Contamination

***New York Times, Wall Street Journal, Reuters*, et al., Feb. 17, 2012**

In news widely covered around the world, a study from the UT Austin Energy Institute looked at available data from three major U.S. shale plays and found nothing to suggest hydraulic fracturing had a unique problem that contributed to groundwater contamination. Contamination events arising from shale gas exploration are just as likely to afflict other types of oil and gas drilling operations, reported the authors at the annual American Association for the Advancement of Science (AAAS) conference in Vancouver. Charles Groat, associate director of the Energy Institute, led the study, which looked at the Barnett, Marcellus, and Haynesville shales. "The bottom line conclusion is that in the states we investigated, we found no evidence that hydraulic fracturing itself, the practice of fracturing the rocks, had contaminated shallow groundwater," he told the AAAS meeting.

Editor's note: *In July, a* Bloomberg *report on the Energy Institute study noted that Groat had failed to disclose his board membership with Plains Exploration & Production Co., an independent oil and gas company whose asset areas include the Eagle Ford and Haynesville shale plays. The report did not question the science behind the study, but as a result of its questions, the university commissioned a panel of "independent researchers, recognized nationally as people who understand repu-*

table science and how it is delivered," to review the study, announced Provost Steven Leslie. Results of the inquiry had not been released when the Newsletter *went to press.*

UT Forum Assesses Drought

***Austin American-Statesman*, Feb. 14, 2012**

In an effort to have organized discussions among different water stakeholders, UT's Center for Integrated Earth System Science forum hosted representatives from Central Texas water providers, state agencies and researchers to discuss the 2011-12 drought's impact on water supply and what Texas should do to address future needs. "One thing that we're proposing is a unified understanding of the hydrological cycle at the level of the State of Texas," said Cedric David, a postdoctoral fellow at the Jackson School who organized the event, which drew about 100 people and featured presentations from several Jackson School scientists.

Opinion: Spotlight Energy Education

***Chronicle of Higher Education*, Jan. 22, 2012**

"Today, for the most part, higher education for students interested in energy lacks the cross-disciplinary curriculum that they critically need," wrote Michael Webber and Sheril Kirshenbaum of UT Austin's Center for International Energy and Environmental Policy. "And so we propose the adoption of energy departments on college campuses, departments that would tie seemingly disconnected fields of the sector together." Webber's and Kirshenbaum's essay outlines the positive steps toward unified energy programs pursued at UT Austin, MIT, and Duke, while proposing a new approach to energy education nationally that "would bring professors together from a variety of disciplines across campus to develop an organized energy curriculum."

Regs Disclose Fracturing H_20

***New York Times/Texas Tribune*, Jan. 14, 2012**

Starting Feb. 1, drilling operators in Texas have to report many of the chemicals used in the process known as hydraulic fracturing, but also the amount of water needed to "frack" each well. A June 2012 study prepared for the Texas Water Development Board suggested that less than 1 percent of the water used statewide went into fracking. Jean-Philippe Nicot, a research scientist with the Bureau of Economic Geology and the main author of the study, noted many drillers already reported water usage to the Texas Railroad Commission. Nicot would like to see more information about whether the water comes from aquifers or reservoirs, or has been recycled from other fracking operations.

Texas Can Lead on Offshore Carbon Storage

***Carbon Control News*, Dec. 11, 2011**

A new Department of Energy-funded report by the Environmental Defense Fund finds that a carbon capture and sequestration (CCS) demonstration project off the Texas coast that will likely be a model for California and East Coast offshore projects can be done in a way that protects the environment. The new report was conducted by EDF under a subcontract to the Bureau of Economic Geology, which won a three-year grant from DOE to find and propose sites able to safely accommodate up to 30 million tons of CO_2 in the Gulf of Mexico off Texas.

Wyoming Shale Has Distinct Geology

***The Wall Street Journal*, Dec. 9, 2011**

Chemicals found in a Wyoming town's drinking water likely are associated with hydraulic fracturing, said the Environmental Protection Agency, but experts caution that the situation is not generalizable across the country. Many of the well casings used in the Wyoming town were old and deteriorating, but the key differentiators are geological. Unlike shale-gas formations such as the Marcellus in Pennsylvania and Barnett in Texas, Wyoming's don't have a geologic barrier that sits atop the gas reservoir. "It is not something we can say, 'If it's happening here it can happen anywhere,'" said Ian Duncan, a research scientist at the Bureau of Economic Geology. "There is such a large difference in the amount of rock between where the fracking is going on and where the water is."


Britney Schmidt

Europa Holds Watery Promise

***Washington Post, BBC, USA Today, Sydney Morning Herald*, et al., Nov. 16-17, 2011**

Of all the geological mysteries of the solar system, perhaps none hold as much intrigue as huge piles of jumbled-up icebergs strewn across the cracked and mottled surface of Europa, Jupiter's ice-locked moon. A new theory explains these vast "chaos terrains" as the tips of subsurface lakes created by rising plumes of relatively warm water ice. The existence of such lakes would thrill scientists seeking life beyond Earth. "Europa has the best chance of having life there today," said Britney Schmidt, a postdoctoral fellow at the Jackson School who led the new study appearing in the journal *Nature*.

Promise, Pitfalls of New Energy Reserves

***New York Times*, Nov. 14, 2011**

Exuberant declarations about U.S. unconventional oil and gas production may reflect the optimism of an industry that not long ago seemed on the defensive and in decline, but there is nothing irrational about them. "It's almost not worth calling it unconventional at the moment because so much of it has become the norm," said Eric Potter, program director for energy research at the Bureau of Economic Geology. "Although we've only begun to scratch the surface of what it's going to take to extract these resources."

Energy Quality Contributes to Likelihood of Recession

***Scientific American*, Oct. 18, 2011**

According to many, downturns in the U.S. and European markets are primarily the result of unsustainable behaviors in the financial industry. But some critics are asking – was declining energy quality a major contributor to these negative turns? According to Dr. Carey King, a research associate at the Jackson School, the answer to this question is likely "yes," and King is not alone in his opinion.

Experts Promote Shale Gas to Europeans

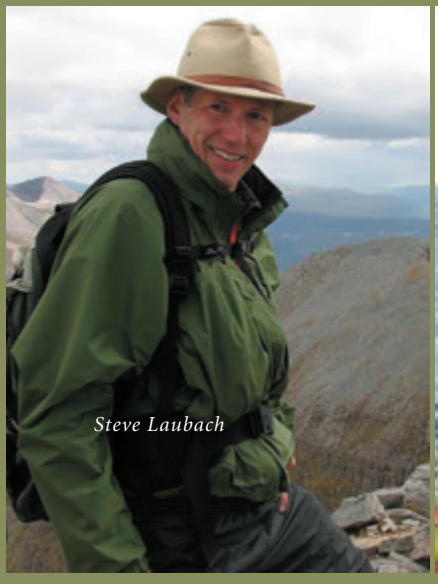
***New York Times*, Oct. 13, 2011**

Experts at the Oil and Money conference in London suggested Europe could lower its dependence on imported oil by facilitating exploration and production of shale gas. The outlook for shale remains mixed in Europe due partly to regulatory uncertainties, but Michelle Foss at UT Austin's Center for Energy Economics said companies were moving forward anyway. "You go where you can go, and Eastern Europe seems to be more the place where everybody can go right now," Foss said. "The question will be whether they get enough drilling and commercial success in Poland and other places to make it worthwhile."

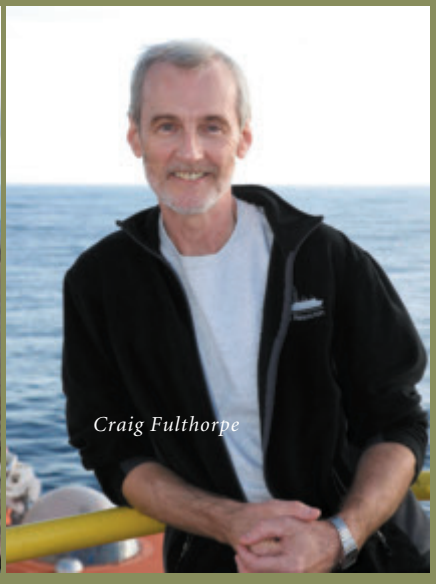
New Boom Hits North Dakota

***National Public Radio*, Sep. 25, 2011**

Two years ago, America was importing about two thirds of its oil. Today, it imports less than half. And by 2017, Goldman Sachs predicts the U.S. could pass Saudi Arabia and overtake Russia as the world's largest oil producer. Places like Williston, North Dakota are the reason. But for residents of Williston, the boom brings unexpected changes. "It's the old boom-town syndrome," says Charles Groat says, professor of energy and mineral resources at the Jackson School. And it's happening in spots all across America, fueling boom towns in Texas, Louisiana, and Colorado.



Steve Laubach



Craig Fulthorpe

Laubach, Fulthorpe Tour as Distinguished Lecturers

Craig Fulthorpe, senior research scientist at the Institute for Geophysics, spoke around the country in 2011 as the Consortium for Ocean Leadership's U.S. Science Support Program Distinguished Lecturer. Drawing on his experience leading deep sea drilling expeditions, Fulthorpe spoke on "Deciphering the Long-Term History of Global Sea-Level Change." In order to predict future changes in global sea level and shoreline location, it is vital to constrain the range of past variability. According to Fulthorpe, one way to do this is to investigate the thick sediment accumulations beneath continental shelves and slopes through scientific ocean drilling of globally coordinated borehole transects across continental margins. In his talks, he shared information that continuous coring provides on sediment ages, depositional environment and paleowater depths during multiple sea-level cycles spanning millions of years.

As a 2011-12 AAPG distinguished lecturer, Steve Laubach, a senior research scientist at the Bureau of Economic Geology, explained the emerging study of structural diagenesis. Structural diagenesis is the study of the relationships between deformation or deformational structures and chemical changes to sediments. In shale resource plays, tight gas sandstones, and many other rocks the cross disciplinary structural diagenetic approach to fracturing, fault growth, compaction and other mechanical processes is a key to unlocking scientific knowledge about a part of the Earth's interior that is of great intrinsic and practical interest. Using examples from core-based studies of shales and tight gas sandstones from Texas, Colorado, and Argentina, and outcrop examples from NW Scotland, Laubach's lecture shows the value of the approach for understanding fractures and predicting their characteristics.

AWARDS & HONORS 2011-2012

Abbreviations:
AAPG = Amer. Assoc. of Petroleum Geologists
GSA = Geological Society of America
SEG = Society of Exploration Geophysicists

Faculty & Researchers

Eric Aiello
Outstanding Staff Award, UTIG

Mead Allison
Director's Circle of Excellence, UTIG

William Ambrose
Tinker Family Publication of the Year Award, BEG

Jamie Austin
Career Service Award, International Ocean Drilling Program/European Consortium for Ocean Research Drilling

Jay Banner
First person certified as a Board Certified Environmental Scientist, American Academy of Environmental Engineers and Scientists; Texes Exes Teaching Award (Professor), Texas Exes

Philip Bennett
G. Moses and Carolyn G. Knebel Distinguished Teaching Award (Graduate), JSG

Don Blankenship
Outstanding Researcher Award, UTIG; Director's Circle of Excellence, UTIG

Bayani Cardenas
2011 Hydrologic Sciences Early Career Award, AGU; Kohout Early Career Award, GSA Hydrogeology Division

David Carr
Tinker Family Publication of the Year Award, BEG

Ginny Catania
Director's Circle of Excellence, UTIG

Gail Christeson
Director's Circle of Excellence, UTIG

Julia Clarke
G. Moses and Carolyn G. Knebel Distinguished Teaching Award (Intro to Geology), JSG

Sigrid Clift
Outstanding Service Award, JSG

Eddie Collins
Distinguished Service Award, Austin Geological Society

Tim Dooley
Top 10 Poster Award (co-recipient), AAPG

William Fisher
Joseph C. Walter Jr. Excellence Award, JSG

Peter Flemings
Director's Circle of Excellence, UTIG

Sergey Fomel
Best Poster, SEG Annual International Meeting

Craig Fulthorpe
Distinguished Lecturer, Consortium for Ocean Leadership

Tucker Hentz
Tinker Family Publication of the Year Award, BEG

Mark Helper
G. Moses and Carolyn G. Knebel Distinguished Teaching Award (Undergraduate), JSG; Outstanding Educator Award, JSG

Jack Holt
Director's Circle of Excellence, UTIG

Brian Horton
Outstanding Research Award, JSG; Director's Circle of Excellence, UTIG

Michael Hudec
Landmark Publication of 2011, BEG; Top 10 Poster Award (co-recipient), AAPG

Martin Jackson
Top 10 Poster Award (co-recipient), AAPG; Landmark Publication of 2012, BEG

Carey King
Rosenfeld Award, Environmental Research Letters; Best Paper of ASME Energy Sus-


Carey King


Sigrid Clift

Sigrid Clift Receives 2011 Service Award

Dean Mosher's comments on Sigrid Clift, drawn from the nominations of Clift as winner of the 2011 Outstanding Service Award: "As the Bureau's Public Information Geologist for more than 2 decades, Sigrid Clift has consistently provided excellent service, information, and resources to JSG and UT staff, to professional geoscientists, to landowners, to legislators, and to teachers and students in Texas. Sigrid has led field trips for industrial associates, students, teachers, and Girl and Boy Scouts, spoken at schools, and forged relationships with a wide variety of private-sector and local, state, and national professionals. She has also been active in the annual Texas Conference for the Advancement of Science Teachers (CAST). Through Sigrid's efforts, the BEG continues to sell its wildly popular Texas Rock Kit to Texas schools and school districts. Sigrid has aided the Austin Geological Society and the Gulf Coast Association of Geological Societies (GCAGS), helping to plan events, meetings and conventions, including the upcoming GCAGS 2012 in Austin, and served as the Petroleum Technology Transfer Council's regional lead organizer. But Sigrid's most outstanding service contribution has been as organizer and host of the annual Earth Science Week (ESW) Career Fair at the PRC Commons, which she has managed for over 10 years, benefitting literally thousands of middle school students and hundreds of teachers in Austin. Sigrid has a strong service ethic and deep commitment to the contributions that the Bureau, Jackson School, and UT provide to the citizens of Texas, the nation, and the world."

tainability Conference, American Society of Mechanical Engineers

Stephen Laubach
Distinguished Lecturer, AAPG

Joe MacGregor
Director's Circle of Excellence, UTIG

Art Maxwell
Hall of Distinction, JSG

Kirk McIntosh
Director's Circle of Excellence, UTIG

Lynda Miller
Outstanding Staff Award, UTIG

Eleanor Picard
Eleanor Picard Excellence Award, UTIG

Tim Shanahan
2nd Place, Best Represented Research Group, JSG 1st Annual Research Symposium, JSG/ConocoPhillips

Jack Sharp
Presidential Award for Outstanding Service, International Assoc. of Hydrogeologists

Jeff Sprowl
Tinker Family Publication of the Year Award, BEG

Daniel Stockli
1st Place, Best Represented Research Group, JSG Research Symposium

Paul Stoffa
Career Researcher Award, UTIG

Harm Van Avendonk
Distinguished Lecturer, GeoPRISMS

Mark Wiederspahn
Staff Excellence Award, JSG

Duncan Young
Outstanding Young Researcher Award, UTIG; Director's Circle of Excellence, UTIG

Leadership Positions

Chris Bell
Secretary, Society of Vertebrate Paleontology

Bayani Cardenas
Associate Editor, *Reviews of Geophysics*, AGU; Associate Editor, *Water Resources Research*, AGU; Associate Editor, *Hydrogeology Journal*, Springer

Kerry Cook
Editor, *Journal of Climate*, American Meteorological Society

Michelle Michot Foss
Board of Advisors, Consumer Energy Alliance

Bob Hardage
President, SEG

Stephen Laubach
Editor, AAPG

Sharon Mosher
President Elect, AGI

Scott Tinker
AAPG Past President, Nominating, AAPG Advisory Council

Promotions

Marcy Davis
Research Scientist Associate IV, UTIG

Dan Duncan
Research Scientist Associate IV, UTIG

Kenneth Edwards
Facilities Manager, BEG

Sergey Fomel
Professor, DGS

Patrick Fulton
Research Scientist Associate V, UTIG

JSG Presidents of National Geoscience Societies*

Milo Backus
SEG (1979)

Bob Boyer
AGI (1983-84)

William Carlson
Mineralogical Society of America (2000)

Robert Dickinson
AGU (2002-04)

Bill Fisher
AAPG (1985-86), AGI (1991-92)

Peter Flawn
GSA (1978), AGI (1988-89)

Bob Hardage
SEG (2011-12)

Art Maxwell
AGU (1976-78)

Sharon Mosher
GSA (2001), AGI (2012-13)

Jack Sharp
GSA (2007)

Scott Tinker
AAPG (2008-09)

*Among living faculty, research scientists, and emeriti.

Service in National Societies Opens Doors for School and Its Students

With Dean Sharon Mosher starting her term as president of the American Geosciences Institute (AGI) while Bob Hardage completes his term as president of the Society of Exploration Geophysicists (SEG), the Jackson School enters another year with its scientists leading one of the major scientific societies. This is nothing new for the school. For decades, geoscientists at UT Austin have had a tradition of leadership in national and international scientific societies. At least eleven of the current faculty, research scientists, and emeriti have led one of the major scientific societies, with scores more serving as presidents of regional societies and select professional organizations.

Jackson School faculty members even have a penchant for serial leadership. This year Mosher joins Bill Fisher, the late John Maxwell, and Peter Flawn as UT Austin faculty members who have led at least two of the major scientific societies, and Bureau of Economic Geology Director Scott Tinker has led the American Association of Petroleum Geologists (AAPG), the Association of American State Geologists, and the Gulf Coast Association of Geological Societies.

But why would a busy professor or research scientist, let alone a dean, embrace the added responsibilities of heading a national society?

Mosher, a past president of the Geological Society of America (2001) and chair of GeoscienceWorld (2004-06) and the Council of Scientific Society Presidents (2004), takes on the extra work because she recognizes the tremendous impact the societies have on the advancement of science.

The primary value, she says, is promoting the exchange, dissemination and debate of scientific ideas, but she also notes their important role in nurturing young scientists, instilling ethics, and bringing scientists together to work toward a better public understanding of science and better science education.

"Service to societies is not just something that rounds out your vita—it is very rewarding personally as well as professionally," says Mosher. "Strong friendships, good times, broadening of one's perspective, personal growth and new skills, exposure to new fields of science—all of these come from giving of your time to your society." And these are also reasons, she notes, that the school strongly supports professional society involvement for graduate students.

Without doubt, there's also a reputational benefit for the school and its related units, getting the word out about the Jackson School. For Hardage, service at SEG (where he will soon complete six years on the Executive Committee, the longest tenure in the organization's history) has been an especially good platform for letting students know about UT Austin.

"SEG emphasizes student education, training, and development in applied geophysics, with more than one-third of our membership being students," notes Hardage. "Because of the global breadth and student emphasis of SEG, I have been able to expose the Jackson School to many people and students who knew little about us."

Leaders like Hardage also build the Bureau's reputation for research leadership, "which is paramount not only to our success, but to our survival," says Tinker. "Serving as president of the SEG such as Bob has done, or any international professional society, affords precisely this kind of reputational benefit."

From his own experience, Tinker counsels others to work actively in the scientific societies: "I can testify to the horizons that it broadens and the doors that it opens. It is a lot of work, but very little is more rewarding professionally."

Tinker is one of at least 14 members of the Jackson School community (counting alumni, Advisory Council members, and faculty) who have served as president of AAPG.

One reason for the school's prolific creation of society leaders, Mosher believes, is the Jackson School's culture of service to the geoscience community and public. When she meets with representatives of scientific societies and industry, Mosher says ironically they often cite Jackson School activities—like GeoFORCE, the Hot Science – Cool Talks Outreach Lecture Series, and Earth is Calling—as examples of successful efforts in meeting the goals of scientific societies.

Over the coming year, Mosher is particularly pleased to work with AGI because of its unique role in representing the numerous small and large geoscience societies.

"AGI is the place where all the geoscience societies come together," says Mosher. "It provides a united voice for the geosciences." As an added incentive, Mosher just needs to look at the portraits of past presidents in the AGI conference room. She will be only the fifth woman to hold the office (out of 59).

"It's very important for young women in particular to see female role models in these positions," said Mosher.

L to R: Toby Carleton, Robbie Gries, and Will Green are three of at least 14 members of the Jackson School community who have served as AAPG presidents.

Sean Gulick
Research Associate Professor, UTIG

Jack Holt
Research Professor, UTIG

Brian Horton
Professor, DGS

Joe MacGregor
Research Scientist Associate V, UTIG

Britney Schmidt
Research Scientist Associate V, UTIG

Hongliu Zeng
Senior Research Scientist, BEG

Students

Benjamin Bass
2011 Oustanding Student, Groundwater Field Methods Course (co-recipient), JSG

Kenny Befus
1st place Grad Petrography Contest, JSG; 2012 Oustanding Student, Groundwater Field Methods Course (co-recipient), JSG

Paul Betka
Outstanding TA, JSG

Curtis Bixler
Best M.S. Tech Session Speaker (Spring 2012), DGS

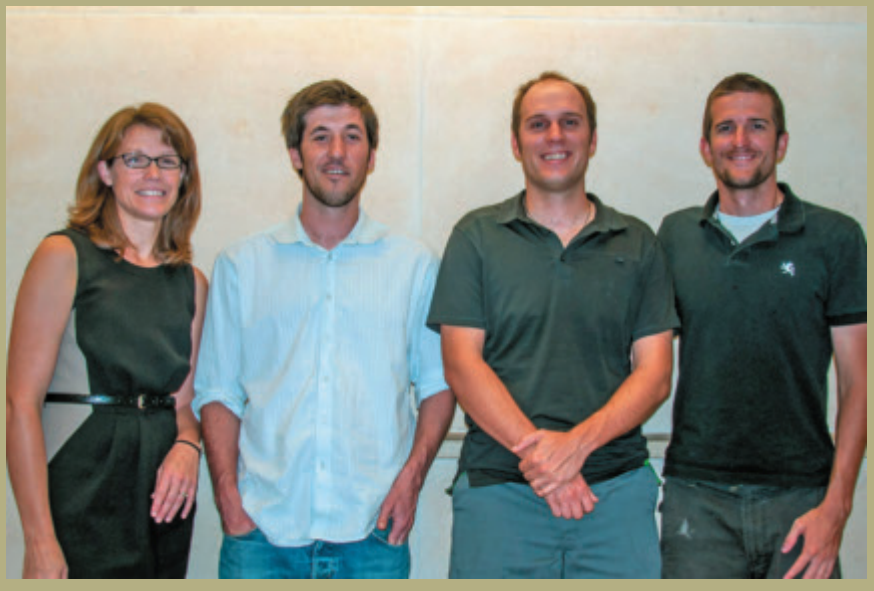
Charles Brothers
1st Place, PhD student, JSG 1st Annual Research Symposium, JSG/ConocoPhillips

Rudra Chaterjee
Outstanding TA, JSG

Josh Dixon
Outstanding TA, JSG

Justin Fitch
2nd Place, 2nd-year M.S. student, JSG 1st Annual Research Symposium, JSG/ConocoPhillips

Guy Fitz
Outstanding Student Paper Award (Fall 2011 AGU Meeting), Tectonophysics Section



Geothermal Team Makes National Finals

The U.S. Department of Energy (DOE) selected a team of four students from the Jackson School to compete against seven other universities in the 2012 National Geothermal Energy Student Competition.

The Jackson School team scored highly but in a close field, students from Idaho State were the national champions.

"I'm so proud of how close we came," said Suzanne Pierce, the research assistant professor at the Jackson School who advised the team.

To select the eight finalists for the national competition, three geothermal industry experts selected the proposals from a pool of national candidates. The DOE gave each team $10,000 in technical assistance to carry out their selected proposals.

The competition challenges teams at universities across the country to conduct research in geology, geoscience, engineering, and chemical and bio-molecular energy that could lead to breakthroughs in geothermal energy development. For the 2012 finals, teams analyzed the economic feasibility of developing clean, renewable geothermal energy in Snake River Plain, Idaho.

The Jackson School team included three graduate students in the Energy and Earth Resources (EER) program—Reed Malin, Daniel Noll, and Matthew Uddenberg—as well as undergraduate Katherine Markovich in the geoscience honors program.

Rattanaporn Fongngern
4th place Best Student Poster, 2012 AAPG Annual Meeting, AAPG

Aaron Hantsche
1st place Undergrad Petrography Contest, JSG

Kelly Hereid
Outstanding Student Paper Award, AGU (Paleoceanography and Paleoclimatology Section); Best Tech Session Ph.D. Speaker (Spring 2012), DGS

Qinjian Jin
1st Place, 1st-year M.S. student, JSG 1st Annual Research Symposium, JSG/ConocoPhillips

Bryant Kopriva
1st Place, 2nd-year M.S. student, JSG 1st Annual Research Symposium, JSG/ConocoPhillips

Ethan Lake
2nd Place, PhD student, JSG 1st Annual Research Symposium, JSG/ConocoPhillips

Jack Sharp judging at the 2012 JSG Research Symposium.

Maureen LeVoir
2nd place, 1st-year M.S. student, JSG 1st Annual Research Symposium, JSG/ConocoPhillips

Ann Marchock
Thelma Lynn Guion Library Staff Award, JSG

Lisa Meyer
GSEC Award, JSG

Cornel Olariu
Gheorghe Munteanu-Murgoci Award in Geosciences, Romanian Academy of Sciences

John Alex Parker
2nd place team, 2012 Gulf Coast Region Imperial Barrel Award (IBA) competition, AAPG

Lacey Pyle
Honorable Mention, 2012 NSF Graduate Research Fellowship Program, NSF

Kristie Ramlal
2nd place team, 2012 Gulf Coast Region Imperial Barrel Award (IBA) competition, AAPG

Wendy Robertson
Outstanding Student Paper Award, Hydrology Section, AGU

Reed Roush
Estwing Hammer Award, JSG

Julia Schneider
Best PhD Student Speaker, Tech Sessions (Fall 2011), DGS; Best Paper Award, DGS

Spencer Seman
2nd place Grad Petrography Contest, JSG

Jeff Senison
2012 Outstanding Student in Hydrogeology Field Methods (co-recipient), DGS

Andrew Smith
Best Student Presentation, Gordon Research Conference on Natural Gas Hydrate Systems 2012; Outstanding Student Paper Award, AGU Ocean Sciences Section; Best M.S. Tech Session Speaker (Spring 2012), DGS

Gordon Smith
2nd place team, 2012 Gulf Coast Region Imperial Barrel Award (IBA) competition, AAPG

Isaac Smith
2012 Stephen E. Dwornik Planetary Geoscience Student Paper Award (Graduate Poster), Geological Society of America; Outstanding Grad Student Paper, JSG

Pamela Speciale
Distinguished College Scholar, UT Austin Honors Day, UT; Outstanding Student, Houston Geological Society

Elisabeth Steel
Estwing Hammer Award, JSG

Richard Steel
Outstanding TA, JSG

Vera Stoynova
Outstanding TA, JSG

Ray 'Ryan' Velazquez
2013 Outstanding Student in Hydrogeology Field Methods (co-recipient), DGS

Benjamin Wagman
Best M.S. Speaker Award, Tech Sessions (Fall 2011), JSG/BP

Goodwin Wharton
Texas Exes Teaching Award (Graduate Instructor), Texas Exes

Quinn Wenning
1st Place undergraduate, JSG 1st Annual Research Symposium, JSG/ConocoPhillips

Corinne Wong
Philanthropic Educational Organization Scholar Award, Philanthropic Educational Organization

Stephanie Wood
2nd place team, 2012 Gulf Coast Region Imperial Barrel Award (IBA) competition, AAPG

Robert Zinke
2nd place undergraduate, JSG 1st Annual Research Symposium, JSG/ConocoPhillips

Ian Yeats
2nd place Undergrad Petrography Contest, JSG

Lei Yin
Outstanding Poster Presentation, WCRP Open Science Conference, World Climate Research Programme

LIBRARY REPORT

By Dennis Trombatore

It has now been 10 years since the Walter Library's complete renovation / renewal. The collection is now twice the size it was in 1985, and without actively transitioning to electronic journal delivery, the physical collection would be at least 20 percent larger than that. Nevertheless, the space is effectively full, with one third of the print collection in storage, and more going every month to make room for new materials.

It is time to turn our attention to the future. What will the library look like in ten years, and how will it best serve the Jackson School and the broader university community? With the new JSG Student Center opening, e-journals and e-books reaching the tipping point, and more and more people housed away from JGB, what is the best way to provide information services, and what is the best way to utilize the library space?

While the Jackson School is growing, overall UT Library staff has fallen about 20 percent in the past three years. The Walter Library has lost one half-time position, leaving no one to manage the map collection. Continued reductions are likely, as is the erosion of journal subscriptions to help control cost inflation. Meanwhile, both the program and the range and complexity of information resources continue to expand. New students coming in have little experience with print-based research, but their online search skills are not generally up to speed either. Likewise, more senior researchers are finding the ground shifting underfoot, and we all struggle to keep up with the new world of digital rights management, multiple commercial platforms, and the general instability of web-based publishing. Acquiring information, helping people discover the information we have, and teaching new information technologies are all more complex tasks now, and managing that in an era of declining resources will be a significant challenge for years to come.

Meanwhile, our Virtual Landscapes of Texas site (www.lib.utexas.edu/books/landscapes) continues to grow, this year including early BEG *Reports of Investigations*, and Tom Barrow's 1954 Stanford dissertation on the East Texas Basin, which we are currently digitizing. We have also added several UT geology theses and dissertations from earlier years to our UT Digital Repository (repositories.lib.utexas.edu), and we hope to continue to get permissions from alumni to add these important legacy materials.

On the gifts front, we continue to get substantial gifts and exchanges, and we are focusing on the UNOCAL materials now. Our new GRA, Kara Scott, is hard at work; we have about one pallet remaining to catalog. We are done reviewing the books and journals, leaving four pallets of maps. Since we have no one to catalog maps now, we are concentrating on determining which ones are unique to us, and we will find a way to catalog them later. For this work, we have hired Rattanaporn Fong-Ngern, a geology graduate student, though she will take off the summer field season.

Changes in campus licensing for ESRI's ARC-GIS product will bring the software to library work stations this summer, and our proposal to acquire a new map scanner to help support that has been accepted by the UT Libraries. The several librarians at UT who work with maps are trying to focus attention on the need for overall improvement in our capability to help with GIS work. We are also acquiring a new document scanner, which will allow us to soon begin offering faster, more comprehensive desktop delivery of materials to our campus users.

AGI's GeoRef database service now has four indexers working in our collection. JSG alumna Elke Baitis recently joined the team, to focus on German language materials among other things. AGI also donated some foreign materials they have indexed to our collection, to help ensure they will be available for researchers. Dennis Trombatore remains Chair of the AGI/GeoRef Advisory Committee, and has been selected to receive AGI's Heroy Service Award at GSA in October.

In staff news, Calla Smith-Dowling, unit manager and webmaster, continues to manage our Facebook page, posting interesting news items about the earth sciences, libraries, and higher ed for our followers. Please join us! Meredith Bush, last year's GRA, completed her MSIS in the School of Information, and was admitted to the JSG doctoral program. Our undergraduate workers are doing exciting work in school. We're fortunate to have a hardworking and adventurous team!

Untangling Knots:

WHITNEY BEHR TACKLES SOME TOUGH STRUCTURAL PROBLEMS

The snow covered Sierra Nevada of southern Spain, which despite being the highest topographic feature in the region, is actually crustal rock sourced from very deep—it was brought down to about 50 or 60 kilometers depth, then exhumed back to the surface, all in a very short amount time. Photo by Whitney Behr.

It's the nightmare scenario: A magnitude 7.8 earthquake begins at the southern end of the San Andreas Fault and the rupture continues moving northwest 200 miles along the fault to a spot about 50 miles north of Los Angeles. Buildings collapse, wildfires spark, and electric power and water systems are damaged. Experts project such an event would kill 1,800 people, leave many thousands homeless, and cost the region $200 billion. It formed the basis of the 2008 "Great Southern California ShakeOut," a regional emergency response and preparedness drill.

But could it really happen?

Whitney Behr is a structural geologist trying, among other things, to better understand earthquake hazards in southern California. She says there's a potential bottleneck for this would-be horde invading the Greater Los Angeles area from the southeast.

About half way along this imagined march of destruction, at a place called San Gorgonio Pass, the usually clear and distinct path of the San Andreas becomes a confusing mess. Like a hiking trail covered with new fallen snow, the path disappears and reappears. Or maybe it's more like a bowl of pasta that's been poured onto the floor. To get technical, the fault changes from a single, right-lateral strand to an intricate network of right-lateral-reverse faults.

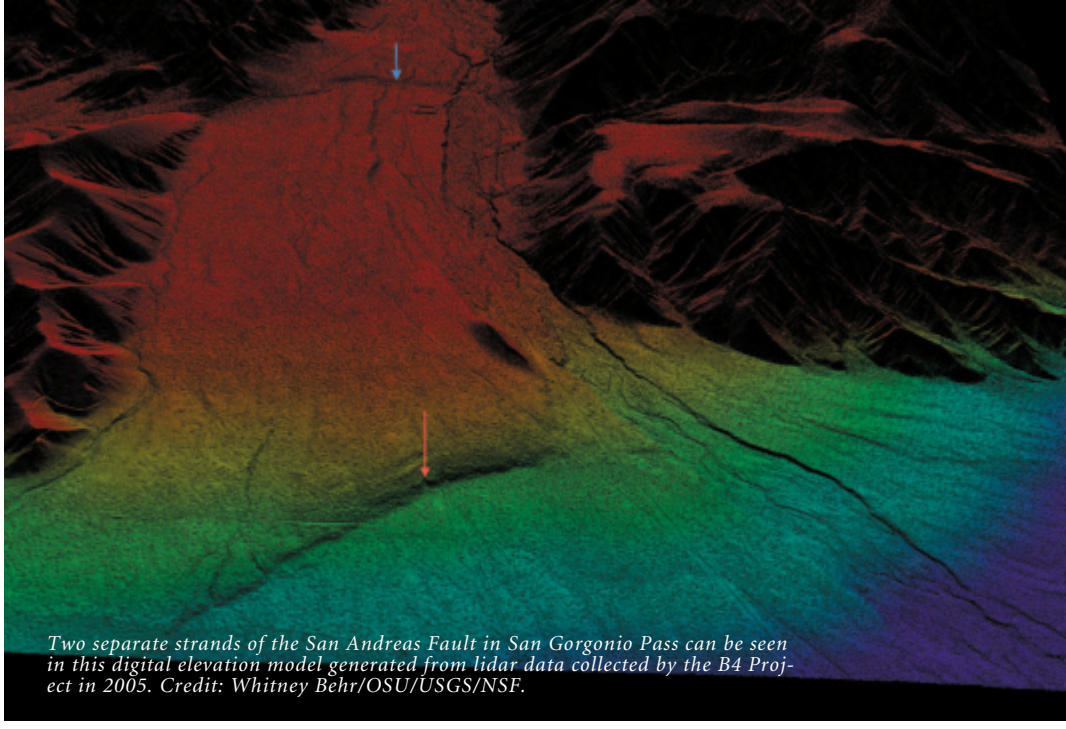
The question that has geologists and emergency planners knotted up is can a rupture on one side of San Gorgonio Pass get through this mess to the other side?

"There are something like five or ten diffuse strands [at San Gorgonio Pass]," says Behr. "Are they connected into one at depth? We don't know the deep fault structure."

To help determine how connected those little diffuse strands are to the main segments of the San Andreas, Behr is measuring how fast the faults are moving at various points. If the slip rates are much higher to the southeast of the pass than within the pass or northwest of it, for example, that might suggest it's a kind of structural knot preventing the spread of ruptures. If the slip rates match up, it might suggest a strong connection and a real threat of propagation.

Behr is currently leading a project funded by the Southern California Earthquake Center to measure the slip rate for the San Andreas just 2 kilometers southeast of San Gorgonio Pass. This follows from research she participated in several years ago as an undergraduate research assistant at

Whitney Behr



Two separate strands of the San Andreas Fault in San Gorgonio Pass can be seen in this digital elevation model generated from lidar data collected by the B4 Project in 2005. Credit: Whitney Behr/OSU/USGS/NSF.

California State University Northridge. She says studies relating to natural hazards get a lot more attention than most basic research and that the added attention comes with added responsibility.

"You're really thinking about people's lives, so you're a lot more cautious and put a big emphasis on quantifying the uncertainties," she says.

From Music to Geology

She wasn't always interested in what's going on underground. At the end of her first year of undergraduate study at Pasadena City College (PCC), Behr was looking for a way to quickly finish her minimum science requirements so she could get on with the real meat of her degree—music. So she signed up for an intensive two week field course in Baja, California with a biologist and a geologist. The biology majors were fascinated by the critters in the tide pools. Behr found the geology more appealing, especially when the instructor gave her a new perspective on a place she had visited often while growing up with her family.

"There were things I didn't notice as a kid," she says. "It made a big impression on me to revisit it and see everything with a scientist's eyes."

Before the trip was over, she decided to switch majors to geology.

After transferring to California State University Northridge and completing her undergraduate degree there, Behr went on to the University of Southern California to work on a Ph.D. in structural geology and active tectonics. In addition to working on slip rates and seismic hazards on the southern San Andreas Fault, the last three years of her Ph.D. focused on how rocks deform in the deeper parts of continental plate margins. For her dissertation, she tackled two questions that have plagued geologists for decades: First, what's the relative strength of different layers in Earth's rocky outer shell, or lithosphere? And second, if you stood on a fault at the Earth's surface and you could follow it down below your feet, would it become narrower or wider, or would it alternate widths at different depths?

The answers affect how stresses are transmitted from the margin of a continent to the interior and from the base of the continent to the surface. They might also affect earthquake hazards. She conducted extensive field and analytical work along the Whipple Mountains in eastern California and the Betic Cordillera of southern Spain.

In both southern California and Spain, she determined that the middle part of the crust is very strong, meaning it can accommodate high stresses. She's now assessing the strength of the upper mantle in those areas, which will allow her to determine which of the layers in the lithosphere have the highest strength.

To address the second question, she looked at the Whipple Mountains, where an ancient ductile shear zone, originally formed at depth, is now exposed at the surface. A ductile shear zone is a broad region of rocks warped by parallel forces moving in opposite directions. Behr found evidence that as you go down from the surface, the shear zone remains narrow in the middle crust, but widens dramatically at a depth of 20 to 30 kilometers. Some further theoretical calculations she made suggest that fault zones cutting through continental lithosphere widen to as much as 180 kilometers in the mid-to lower crust, pinch down to just a few meters at the base of the lower crust and uppermost mantle, and then widen rapidly again in the deepest part of the lithosphere.

"My niche is in trying to link field-based geology with geophysics," she says. "I like to give modelers, seismologists, and experimentalists naturally constrained data that they can use to better tune their models or interpret their observations."

Field Work in Spain

Completing her Ph.D. in 2011, Behr has continued her work in Spain. Her dissertation research there focused on understanding the strength and character of the middle crust, but since then she's switched focus slightly to examining crustal rocks that have come up to the surface from much deeper.

For millions of years, Africa has been moving north, slowly colliding with Europe. Southern Spain is right on the border of this collision. Along this battle zone, continental fragments have been dragged down 60 or 70 kilometers, only to resurface millions of years later, as if riding along on a grand conveyor belt. Behr is trying to understand what these rock fragments were like before this all started, how they got back up to the surface, how fast they came up, and how they changed along the way. She says in some ways, it's like a mini version of the granddaddy of all continental collision zones, Tibet.

"But it has better wine and beaches," she says. "We address some of the same problems, but by looking at a smaller area."

As the two continents approach each other, the lithosphere between them thickens into a heavy block and sinks downward like the goo in a lava lamp. Scientists have suggested that some of that heavy block beneath southern Spain has either broken

off or been eroded away by the hotter, convecting material that surrounds it. Behr is part of an international collaboration called PICASSO (Program to Investigate Convective Alboran Sea System Overturn) studying these processes. She has submitted a new proposal to *National Geographic* to continue this work.

"We'll do more field work and some geochronology, trying to get the timing of events," she says.

In addition to the important scientific data she's collected, she's learned that geologists in southern Spain do not camp. Actually no one does.

"I suspect if you were discovered wandering on your own and sleeping in a tent, someone would try to offer you shelter in their house," she says.

Spaniards are also more tolerant of trespassing researchers than Californians.

"In Spain I was frequently doing field work on private property, often without realizing it," she says. "Rather than people shooting at me and telling me to leave, they would ask me if I wanted a cerveza. It's a great place to work in that sense."

After her Ph.D., Behr was a postdoctoral researcher at Brown University for a year. She worked at the university's world-class experimental rock deformation lab, subjecting ordinary rocks to extreme temperatures and pressures and then comparing them to rocks that had undergone various natural transformations in the mantle. It was a big change from her heavily field-based Ph.D. work.

Now she's starting her first year as an assistant professor at the Jackson School. She's currently writing grant proposals, writing up papers from past research, helping students begin their research projects, attending conferences, and preparing to teach two graduate courses this spring.

Behr says one of the big attractions of the Jackson School was its extensive lab facilities.

"As a grad student, I used a lot of analytical tools, but most of them weren't at my home institution," she says. "I had to do a lot of networking and traveling to other places to use analytical facilities. It will be a treat to use all these in-house instruments." ✷

Kevan Moffett

Opening the Black Box:

KEVAN MOFFETT WORKS AT THE INTERSECTION OF LAND, WATER, AND LIFE

With her research interests and enthusiasm flowing forth like a raging river when she speaks, it's no surprise that Kevan Moffett studies the dynamic role of water in the geosciences. As she begins her career at the Jackson School, Moffett will focus on the fields of hydrogeology and ecohydrology, exploring the relationships between groundwater and surface water and between water and ecological systems.

"Water is everywhere but we often take it for granted. We can't live without it, yet we still have a lot to learn about how hydrologic systems work," Moffett says. "Although we're pretty good at moving water around for the benefit of humans, there's still a lot we don't understand about how water moves through natural systems and the sometimes under-appreciated functions it serves along the way."

Moffett's passion for water dates back to her childhood in Shaker Heights, Ohio, where she was frequently found stomping around in creeks. She channeled her interests into a degree in environmental engineering at Yale University, where a professor encouraged her to study hydrology. After working for a few years on the management of New York City's drinking-water supply with a private engineering firm, Moffett decided to return to school for a graduate degree. She received her doctorate from Stanford University in 2010, using her dissertation to explore the complex interactions between groundwater movement, surface water dynamics, vegetation patterns, and wetland functions in an intertidal salt marsh in the San Francisco Estuary.

Now, Moffett is ready to get her feet wet at The University of Texas at Austin, focusing on the links between the groundwater, surface water, and ecology of wetland systems. She'll be teaching courses and leading research in hydrogeology, which focuses on groundwater dynamics and water use, and the emerging interdisciplinary science of ecohydrology, which connects soils, water, vegetation, and the atmosphere.

"I'm really interested in the organization of landscapes and what causes spatial patterns in water flow and in vegetation," Moffett says. "Wetland organization, in particular, is not well studied."

Dynamic Wetlands

The organization of dryland environments has been more widely researched, partly because the flow pathways of scarce water are relatively easy to track and because sparse plant life makes vegetation patterns relatively obvious. In contrast, the lush

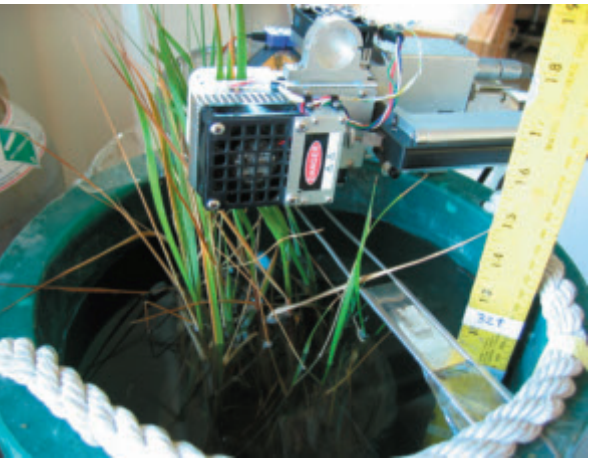
Above. Moffett conducted field work in the Palo Alto Baylands salt marshes, in southern San Francisco Bay. Below: A plant gas analyzer clipped to a cordgrass leaf records water loss and carbon uptake when the plant is flooded with seawater. Photos by Kevan Moffett.

mix of plants and the subtle movements of water in wetlands are more difficult to decipher. Not to mention, in the coastal systems Moffett has studied so far, continuous tidal flooding and saltwater exposure is brutal on stainless steel instruments (and field researchers), making field studies particularly challenging.

Moffett and others are only beginning to recognize and interpret the patterns in coastal wetland water movement and vegetation and how factors such as surface water-groundwater interactions, salinity, submergence, and water stress shape these environments.

Society has learned to value wetlands in recent decades for the benefits they provide in filtering pollution, maintaining water quality, and providing important fish and wildlife habitat. In the United States, the Clean Water Act protects wetlands to precisely preserve these important functions. Yet despite—and perhaps partly because of—their protected status, there has been a historical tendency to think of swampy landscapes as messy areas to be avoided, Moffett points out. This has ironically led wetlands to often be treated as "black boxes," the internal functions of which are surprisingly not well understood.

"Now there's a resurgence in wanting to get in there and get dirty," she says, and to really understand what makes wetlands function.



Agro-Eco

Moffett is excited to get dirty while contributing to the fields of hydrogeology and ecohydrology. Her research group will conduct fieldwork in diverse environments, ranging from coastal to agricultural wetlands. Moffett also uses remote sensing image analysis and coupled surface water-groundwater numerical modeling to better understand these dynamic systems. Calling systems such as coastal and agricultural wetlands "natural laboratories," she says the predictable cycle of tides or irrigation offers regular and repeated intervals for observing and studying the systems' processes and responses.

With that in mind, she plans to establish a new network of wetland field sites along the Texas Gulf Coast. This network of sites will enable Moffett, colleagues, and graduate students to study plant-water interactions, groundwater and surface water movements, and the processes that control how coastal wetlands operate. With stations spanning the north-to-south and wet-to-dry climate gradient of the Gulf Coast, the network could be used to advise managers how to prepare for potential changes due to warming trends.

The hydrology and ecology of the sites could also be compared to coastal wetlands in other areas, such as the San Francisco Estuary where Moffett has worked for the past eight years. This pool of research could inform the creation of engineered wetlands for water treatment and habitat restoration and the management of existing wetlands for coastline protection and biodiversity.

Moffett's interests in wetland dynamics also extend to studying the agricultural landscapes that produce rice and other staple crops that feed much of the world's population.

"On a very practical level, we've known how to farm rice for thousands of years," she says, "but, on a scientific level, we're still learning a lot about what is actually going on physically, chemically, and biologically with the water and vegetation in the rice paddies. There are a lot of opportunities to peel back the layers of these well-known, but not well-understood, systems."

The approach of studying the water and vegetation of farmed landscapes as if they are natural environments is a growing research frontier, called agro-ecohydrology. By applying her earth-systems perspective to these human-designed landscapes, Moffett expects to gain a new context for understanding connections between natural and irrigation flood events, groundwater fluctuations, land-atmosphere interactions, and crop productivity in wet farmland areas. Irrigation efficiency improvements, perhaps made in real-time using remote sensing information, could be another upshot of such research with global applications.

"Water use in agriculture is one of the tremendous challenges that humans face in the next couple of decades," Moffett says, "so a deeper understanding of how these wetland agricultural-ecological systems work and how much water they really require is hugely important."

In addition to her assistant professor position in the Jackson School, Moffett will hold a courtesy appointment in the Cockrell School of Engineering. The dual post will allow her to build connections between the schools and their disciplines. She sees many opportunities for partnerships, particularly on wetland restoration projects and remote sensing innovations. Collaborations with the University of Texas' Marine Science Institute, located in Port Aransas, should also prove valuable in launching research projects along the Gulf Coast.

As she adds to the hydrogeology expertise and brings a new focus on ecohydrology to the university, Moffett is excited to work with students and colleagues on a wide breadth of issues in the geosciences.

"As a hydrogeologist, I always come back to wanting to better understand how water gets into and comes out of the ground, and where it goes in between," Moffett says. "With my interest in ecohydrology, I also want to figure out what physical, chemical, and biological mechanisms organize wetland systems. There are all sort of interesting feedbacks that operate in wetlands and in the near-surface zones of the earth that we're just on the cusp of discovering." ✶

Meet more faculty & research scientists

The Jackson School has hired 21 faculty members since 2008 in pursuit of its goal of becoming the country's preeminent geoscience program. You can find profiles of all hires since 2005 along with features on other faculty and research scientists on our website.

Rising to the Top:

FULBRIGHT SCHOLAR EXPLORES MYSTERIES OF UNDERSEA GAS VENTS

Andrew Smith studies undersea gas vents, large volcano-like features on the seafloor that spew plumes of oil and gas into the ocean. Scientists have long been interested in them because many contain large amounts of gas hydrate, an icy substance made of natural gas and water. Gas hydrates might be mined someday as an alternative energy source, though some experts warn of their potential to cause submarine landslides and maybe even accelerate global warming.

As a master's degree candidate at the Jackson School, Smith focused on a vent in the Gulf of Mexico 130 miles (210 kilometers) from the coast and 3500 feet (1 kilometer) below sea level. In a paper submitted to the journal *Nature Geoscience*, he and his colleagues estimate that about a fourth as much oil and gas naturally seeps from the floor of the Gulf each year as was released by the entire 2010 Deepwater Horizon oil spill. That's about 100 times larger than previous estimates of natural background seepage. Many experts now believe these natural seeps helped dramatically blunt the effects of the oil spill by supporting a community of hydrocarbon-degrading bacteria ready to quickly break down the oil.

"This paper is significant because it estimates the natural hydrocarbon flux in a way that no one has done before," says Peter Flemings, Smith's graduate advisor and co-author. "This technique can be applied to other places such as the Arctic where people are especially concerned that these vents could act as a feedback to global warming."

The model that Smith and his colleagues developed uses temperature and salinity measurements taken at a range of depths within the vent by other researchers. Taken separately, the way the temperature and salinity change as you move up through the vent provide two different estimates of the amount of fluid flow from the vent. Taking advantage of the fact that both hydrocarbons and water carry heat but only water carries salt, the scientists can estimate what portion of the flow is made up of hydrocarbons. The team multiplied that flow by the hundreds of known gas vents in the Gulf to get a rough estimate of total seepage in the Gulf.

Now Smith, who completed his master's degree in May, is in Norway on a year-long Fulbright Student Award to study undersea gas vents in the Arctic and to serve as a kind of scientific and cultural

Above left: Smith began his Fulbright Fellowship in Norway by presenting his research on methane hydrates at the Nobel Institute in Oslo. Above right: Smith on a hiking and climbing trip with new friends in Norway.

ambassador. The Fulbright program is extremely competitive. Only about 1 in 5 applicants are accepted.

He will work with scientists at the University of Tromsø to map submarine vent systems, document past and present fluid leakage, and use computer modeling to better understand the process of venting.

In the Gulf of Mexico, Smith's interest and that of many other scientists concerns how these vents relate to economically valuable hydrocarbon deposits far below the seafloor and their ability to unleash submarine landslides.

In Norway, there are additional motivations to the work. As the temperature of the global oceans continues to rise, scientists are concerned that gas hydrates in Arctic gas vents could become unstable and release large amounts of methane into the ocean and possibly the atmosphere, where it would act as a potent greenhouse gas and accelerate global warming. The Arctic is considered more vulnerable because global temperatures are rising faster there than in temperate or tropical locations.

Smith will try to find time for a little fun in Norway. He's looking forward to immersing himself in Norwegian culture, seeing the northern lights during the roughly two months of complete darkness, and running the Midnight Sun Marathon.

Smith, who says all he thinks about these days is deep water gas vents, hardly knew what they were before he came to the Jackson School. He hadn't even taken a marine science class. But then he encountered Flemings' infectious enthusiasm.

"And I knew it was exactly what I wanted to do," he says. "Not just work on that specific project and try to solve that particular problem, but I knew I wanted to work with Peter and we'd work well together and he was going to put me on a good project and give me all the support I needed."

He says it was also a very practical choice. The research would give him experience working with industry seismic data, which would allow him to go work in the energy industry if he wanted to. It's also a topic of great interest in the academic community, so he could instead go in that direction.

Smith said one of his top two reasons for choosing the Jackson School was the Jackson Fellowship, which gave him full funding for his master's, without the need to work as a teaching assistant or research assistant. The other was the wide range of advisors and research areas he could choose from.

"Because it's the largest geoscience program in the country, I could come and choose from hundreds of different advisors," says Smith. "And because of the depth and breadth of the program, I could study literally anything I wanted in the geosciences." ✷

Meet more graduate students

Andrew Smith is one of several graduate students profiled on our website. Go to Education > Student Views for more.

Northern lights in Tromso, Norway. Credit: Bjorn Jorgensen/ Innovation Norway.

Leon Long leading an undergraduate field trip in 2006.

Captain Geo:

DISTINGUISHED TEACHER LEON LONG RETIRES AFTER 50 YEARS

The crowd of about 75 people milled about beneath the giant Texas pterosaur skeleton in the stately polished marble main hall of the Texas Memorial Museum. Display cases filled with gems, fossils and other natural history curiosities lined the walls. In attendance were university professors, staffers, and students, as well as friends and family members.

Having co-taught the large introductory geology course for non-majors (GEO 303) nearly every semester for more than 40 years, Leon Long was accustomed to standing in front of large groups of people, lecturing about geology. Now he sat in front of a large group of people as one after another rose to talk about him. They were there to celebrate his retirement after 50 years in the Department of Geological Sciences.

Many of them spoke of the special connection he forged with students, hundreds of them each semester for more than 40 years.

Dan Barker, emeritus professor in the Jackson School, spent 32 of those years in an office facing Long's, their doors often open.

"And I always marveled at the time Leon spent talking to students," said Barker, "until I realized one day, he wasn't *talking* to them. He was *listening* to them."

Rich Ketcham, an associate professor in the Jackson School who co-taught GEO 303 with Long, and who now is lead instructor of the course, said he learned a valuable lesson from him about how to treat students.

"A huge part of teaching, especially at the introductory level, is meeting the students where they are, actually treating them like individuals, treating them like thinking people," said Ketcham.

Laurie Duncan, an adjunct assistant professor in the Jackson School who has twice co-taught GEO 303 with Long, and who was a graduate student TA for the course in 1995, noted that each semester dozens of the 400 students in GEO 303 write to Long to ask whether their final course grade can be adjusted for the better.

"And Leon personally writes each of these students a very nice and very heartfelt email that addresses the question, and then goes on to say that this is what happened in this class and this is your life and these two things are not the same," she said. "It can influence your life, but it's not everything."

Birth of a Tradition

It was the early 1960s and Long was a post-doctoral researcher at Oxford University when his Ph.D. advisor from Columbia told him about a job in Texas. Texas seemed like a foreign country. They spoke Texan. But his advisor told him the



Left to right: Long (2nd row, 2nd from right) as a young faculty member in 1960s; receiving his distinguished teaching award from President Larry Faulkner; sporting his Captain Geo hat.

University of Texas had money. There were letters back and forth. Finally, the university offered him a position and he accepted. It was an extraordinary leap of faith on both sides.

"I didn't know what the geology program offered here," says Long. "I didn't know if they had advanced degrees. I didn't know anything. I just walked in."

He had never met the department chair, Stephen Clabaugh. There was no interview. He arrived with little more than the slight British accent he'd picked up as a post doc.

That first semester, Clabaugh asked him to teach an introductory geology course for 220 students. He had no teaching experience, but he said yes.

"There were 200 students sitting there," he recalls. "And I was so scared. My knees were knocking together. I could hear myself talking, but I was just babbling on and I felt like I wasn't in control. I was petrified."

The second time around, he figured out how to organize the material. He found his confidence and started having fun.

Just a few years later, the university revised the science course requirements for all undergraduates. Before then, every student had to take one of two science tracks: either a full year of biology and geology or a full year of chemistry and physics. Now they would be able to choose any combination of science courses "cafeteria style." The geology faculty decided if they were going to be competitive they had better put together a course that would be broad in scope and of great appeal to general students. And thus GEO 303, the whole of geology boiled down into one semester, was born.

Long and Al Scott, a former professor who retired from the Department of Geological Sciences in 1985, developed and taught the new course. They decided to offer two sections of the course, but rather than each take one section, to co-teach both.

"Al said to me, this course shall be team taught," said Long. "He was older, much bigger and much more impressive than I was and I said, yes sir! And that's the way it's always been and it's been a wonderful time for me."

Long reckons he has co-taught the course a staggering 162 times to 31,400 students.

"What stands out the most is his deep passion and almost childhood-like excitement for science and geology," says Kyle Nelson, an undergraduate student in petroleum engineering who took GEO 303 in 2011. "I would say he is a textbook example for somebody who practices the ages-old adage that in order to be truly happy, one must do what he loves."

Each semester, when it's time to talk about the evolution of tetrapods, Long climbs up on a table in front of the class and lies prone like a slithery sea creature.

"My most significant memory of Dr. Long is him laid out face-down on a fold-out table, flailing his arms and legs about, imitating what would have been the transportation mode of some ancient creature on its way towards evolving arms and legs," recalls Nelson.

Calvin Lee (BA '02), a physician in Massachusetts, says Long inspired him to change his undergraduate major to geology and ultimately choose a career in which he could care for other people. But more than that, he's grateful to Long for friendship. For years after Lee took GEO 303, Long continued to check in with him, giving him support and encouragement.

"Dr. Long taught me a valuable lesson about relationships—never prioritize any job, goal or task above my relationship with another person," wrote Lee in a recent letter to Long.

In the early 1970s, McGraw-Hill publishers asked Long to write a general purpose geology textbook. Now in its 15th edition, the book titled simply *Geology* has been used by thousands of GEO 303 students. Proceeds from the sale of the book go to charity.

In addition to GEO 303, Long spent many years leading two essential field courses in the department: GEO 660—the transformative summer field camp experience for geoscience majors—and GEO 320L—the introduction to field methods for non-majors, many of whom plan to be science teachers. He has also taught graduate courses in isotope geochemistry, his research specialty.

In the late 1980s, some students in a field course got him a white baseball cap with the words "Captain Geo" stitched in


Left to right: Long teaching an MSEA (Mathematics, Science, Engineering Academy) student; with Rich Ketcham and Laurie Duncan at his retirement party; on the future site of Leon Long Grove, donated by the famly of Allison and Bryan Wagner.

orange. He wore it so long that it began falling apart. His daughter eventually had a replacement made for him.

In 1999, Long became the first professor in the Department of Geological Sciences to be inducted into the university's Academy of Distinguished Teachers. (Since then professors Bill Carlson and Jay Banner have also been inducted.) Among several other awards, in 2001 he received the Chancellor's Council Outstanding Teaching Award, given to only one recipient each year.

A Geochemist at Heart

For most people, Leon Long's name is perhaps synonymous with GEO 303 or teaching in general. But his research has also contributed much to the field of isotope geochemistry. When he arrived at The University of Texas at Austin, he had a National Science Foundation grant to build the university's first isotope geochemistry lab. He and an undergraduate student in engineering built a mass spectrometer. Long says this was at a time when he couldn't buy a system off the shelf that would do the specific kinds of analyses he wanted to do.

He showed for the first time the potential of a geologic dating technique based on the radioactive decay of rubidium into strontium. In his paper, which has been widely cited, Long used rocks in Scotland (analyzed in his Oxford days) as an example of a procedure to unravel a complicated history of development.

In the past few years, isotope geochemistry has greatly expanded at the Jackson School. The school has hired several new faculty, including John Lassiter, Jaime Barnes, Dan Breecker, Tim Shanahan, and Daniel Stockli, and built major new facilities.

If he was a newly minted Ph.D. just starting out today, would Long have chosen isotope geochemistry? Yes, he says. He would have probably just been more productive.

"It was heroic in those early days to get even single data points," he says. "So much work. Now it's much easier. They've got pretty fancy stuff, much of which is automated in its operation. So they can spit out data."

Long is now officially retired, although he does plan to come back to co-teach GEO 303 in spring 2013 with Laurie Duncan. He also plans to focus more on writing up old research, and travel.

He hopes to finish a long-simmering research project with a former Ph.D. student from Egypt to reconstruct the history of volcanic rocks along the coast of the Red Sea. In another project, he's working with a former UTeach master's student to reconstruct the ancient landscape of the Llano region of Texas that was later covered over by the Cretaceous sea.

Long has been to every continent, save one: Antarctica. He plans to rectify that with a trip this December, co-led by Ian Dalziel of the Institute for Geophysics.

Speaking at Long's retirement celebration, colleague Mark Cloos recalled how student enrollments plummeted in response to the crash in the oil and gas industry in the 1980s. For several years afterwards, he surveyed students in a senior level geology course about why they became geology majors. He said about a quarter responded that they were inspired by Leon Long.

"He lit their fire and they came even though they knew full opportunities were going to be limited for a good period of time," said Cloos. "They just thought this was interesting because they had the honor to learn from Captain Geo."

Sharon Mosher, dean of the Jackson School, remembered meeting Long when she arrived in Austin in the summer of 1978. She had given her final Ph.D. defense the day before and was then whisked away to teach the summer field course with Long. He and his wife took her into their home, helped her find a place to live, and gave her critical advice on how to be a faculty member.

"They got me firmly set on my feet and ready to move forward and I have always, always valued that from him," said Mosher. "I think it is that ability to nurture young people and understand what they need to know to succeed that made Leon such an incredible teacher and advisor. He has impacted more faculty and students than anyone else in the Department of Geological Sciences or the Jackson School." ✶

RENOVATIONS

School Unveils New Holland Family Student Center

Funded entirely with private support from more than 355 donors, the Jackson School's new Holland Family Student Center opened June 15 during a ribbon-cutting ceremony at the school. A second grand opening event was held for students and the rest of the school at the start of the fall semester.

"We are here today to celebrate something amazing that all of you have done," Dean Sharon Mosher told the assembled donors at the June event. "During a challenging economic time, you looked at an institution that was striving to be the best, to go to the highest level, and to attract the world's best students. And you supported that vision."

About one hundred supporters and friends of the school celebrated the opening, including lead donors Jacque and David "Scotty" Holland (B.S. '57). The Hollands' $3 million contribution put the fundraising campaign over the top last fall.

BHP Billiton contributed $500,000 to purchase one of the highlights of the new space, the BHP Billiton Magic Planet Globe, a six-foot diameter interactive display. The globe shows a wide-range of earth systems phenomena, from hurricanes and tsunamis to plate tectonics. It will be used for instruction, public outreach, and visualization of research projects.

The heart of the new 11,600-square-foot space features a public commons area with a coffee bar and study area, flanked by student service rooms for advising, tutoring and career placement, and meeting spaces for students, faculty and research scientists.

The goal of the center was to create a central hub for the geosciences on the main campus, and a place for students to gather, collaborate, and meet with scientists.

The space will also help the school continue to attract the best and brightest students.

"This space is a great advertisement for the geosciences in general, and for the Jackson School as a leader in the geosciences," said Mosher. ✷

This page: Photos from the opening of the Holland Family Student Center. Opposite page: Photos before the center was open to the public, except for top left, where Scott Tinker (left) and Terry Quinn (right) welcome BHP Billiton executives at the opening.

SUMMER FIELD CAMPS

Scenes from Geo 660, Hydrogeology, and Marine Geosciences & Geophysics Field Courses

This page: Surveying the Jemez River inside Valle Grande in New Mexico; folds in the lower Silver Hills formation, Hecla, Montana; panorama, Big Belt Mountains, Wyoming.

Opposite page: the 2012 MG&G instructors and students; the MG&G volleyball collection (a new ball is signed by students each year); a well executed group jump by the hydrogeology students; Mark Helper teaching in the field on Geo 660.

Photos courtesy Marci Davis, Sean Gulick, Bayani Cardenas, Mark Helper and Ethan Lake.

SUMMER FIELD CAMPS

Saving the Delta

Research Generates New Optimism About Saving the Mississippi Delta from Erosion

Gumbo and jazz, beignets and accordions, tipsy revelers festooned with plastic beads. The city of New Orleans evokes zesty images. Add to your mental slideshow two more images: that of a major economic crossroads — it's part of the largest port complex in the country, handling more cargo than the next two largest ports, Houston and New York, combined — and that of a thriving coastal fishery that supports a $3.5 billion a year commercial and recreational fishing industry. Culturally and economically, it's one of the great cities of the world.

Yet a perfect storm is brewing on the horizon.

It took thousands of years for the Mississippi River, a continent-crossing artery bearing a broth of sand, mud and water, to pile up the massive bird's foot-shaped Mississippi River Delta. In the past century, the delta has shrunk by about a quarter, an area roughly the size of Delaware. And a bit more land slips away each day.

The delta is literally drowning as the sea rises in response to a warming planet and the land itself sinks from the compaction of the thick sediment pile and the pumping out of water, oil and gas from beneath it. If the Mississippi River were a natural system, it might be able to keep the delta's head above water by depositing fresh sediment. Unfortunately, the river has been massively re-engineered to prevent flooding or shifting course. Dams in the upper reaches have cut the sediment load in half, and levees have turned the river into what one recent scientific review paper calls "a superefficient pipeline channel" shuttling what sediment remains straight into the Gulf of Mexico.

With the rapid disappearance of its protective buffer of wetlands, New Orleans is becoming more vulnerable to storms every year. But recent research at The University of Texas at Austin has revealed some important clues about how to shore up these vanishing wetlands and has generated new optimism about saving the delta.

"With the insights we gain, it might be possible to dramatically reshape the U.S. Gulf Coast," says David Mohrig, a professor at

By Marc Airhart

The Mississippi Delta and its environs. NASA.

the university's Jackson School of Geosciences. "For example, we might learn how to create hundreds of square kilometers of productive new wetlands and help protect New Orleans from future storms."

Wax Lake Delta

Mohrig is learning the art of building land in the shrinking Mississippi River Delta at the foot of the master — nature.

While most of the Louisiana coast is receding, there are a couple of bright spots. One of those is Wax Lake Delta, a broad lobe of fresh wetlands that began poking up out of the water in the 1970s near Morgan City. It's growing because the Army Corps of Engineers frequently opens a spillway about 200 miles upstream from New Orleans and diverts about 30 percent of the Mississippi's flow into the Atchafalaya River. Wax Lake Delta receives about half of that diverted flow. All of that water carries sediment with land-building potential.

The phenomenal success of Wax Lake Delta, a happy byproduct of flood prevention, inspires scientists and engineers to dream big: Perhaps one day river diversions below New Orleans expressly designed for the purpose could shore up the dissolving delta and strengthen the city's natural defenses against storms such as 2005's devastating Hurricane Katrina.

This fall Mohrig and his colleagues will begin setting up a network of automated sensors across Wax Lake Delta to continuously monitor water conditions such as flow, sediment concentration, temperature and salinity. The data they collect will be fed to scientists across the country in real time.

"This is the first real time sensor network that will tell us about the physical and biological state of a delta," said Mohrig.

It's part of a $5 million National Science Foundation-funded collaboration between The University of Texas at Austin and seven other universities directed by Mohrig. His two UT Austin co-principal investigators are Wonsuck Kim, assistant professor in the Jackson School, and Paola Passalacqua, assistant professor in the Cockrell School of Engineering.

Using drone aircraft outfitted with cameras and other devices carrying laser and acoustic altimeters, the researchers will periodically map the topography of the delta and take high-resolution snapshots of the plant communities that form an integral part of the wetlands. Biologists will conduct on-the-ground surveys of the types and densities of plants and their relationships to the physical land surface.

The ultimate goal of the collaboration is to build a comprehensive set of computer models that can reliably predict the physical and ecological evolution of river deltas. These models could help evaluate different proposed delta restoration projects.

Mr. Sandman

Most experts agree that if you want to build new land in the delta, you need sand — and a lot of it. Sand makes up half of actively growing deltas. The rest is fine-grained mud and silt. It's thought

David Mohrig (pictured), Wonsuck Kim and others are building a sensor network in Wax Lake Delta to learn what factors promote land-building along the coast.

Top left: Scientists hope to restore land to protect New Orleans from flooding caused by storms like Katrina in 2005. Credit: U.S. Coast Guard.

Bottom left: JSG graduate student Anastasia Piliouras (right) is growing deltas from sand and water in the lab. Alfalfa sprouts represent plant communities that stabilize deltas. Photo by Marc Airhart.

Top right: Wonsuck Kim of the Jackson School at Wax Lake Delta. Kim and Mohrig called attention to its land building abilities in a 2009 EOS article suggesting it was feasible to build new land in the delta.

that rough, course-grained sand forms a stable template for the mud to stick to. Without that template, the mud slips into the deeper reaches of the Gulf where it becomes useless for land building.

The real challenge is getting enough sand where it's needed. Sand makes up less than a quarter of the sediment flowing down the Mississippi. Much of it comes in pulses during big flood events such as last year's torrent on the Mississippi. In many stretches of the river, sand tends to hug the bottom of the riverbed. Yet because deep diversions are costly to build, all of them built to date decant water from just the top few meters.

Mohrig says effective diversions need to coincide with big flood events, be located in areas with naturally high sand concentrations, and be engineered to extract as much sand as possible. But it's a fine balancing act.

"Basically the idea is to maximize sediment and minimize water going through the diversion," says Mead Allison, a senior research scientist in the Jackson School's Institute for Geophysics.

Formerly a professor at Tulane University who moved to Austin after Hurricane Katrina, Allison has studied how sediments move through the river system for more than a decade.

He says too much freshwater or nitrates from fertilizer runoff may damage marsh ecosystems and fisheries. He also says removing large volumes of water can create shoals, or piles of sediment, in the main river channel downriver of the diversion that may affect navigation. His observations will help calibrate and validate computer models that he and his colleagues are using to examine how much water can be withdrawn before significant shoaling occurs.

"It's a wonderful opportunity to learn about a basic science process—how sediment transport works in the lowland reach of major rivers," says Allison, "while at the same time having a direct, and observable, impact on the development of a coastal management plan to save the wetlands and infrastructure and unique way of life of the Mississippi Delta."

Sprouts

Besides sand, another key ingredient for growing deltas is plants.

They play a critical role in capturing fine sediments, producing organic soil, speeding delta growth and making deltas more resilient in the face of storms and floods. But no one really understands which combinations of plants and which densities are optimal for land building. The work at Wax Lake Delta will try to answer these questions by correlating changes in plant communities with changes in the physical shape of the delta itself over several years.

Scientists are also tackling the problem in the lab. Anastasia Piliouras, a Ph.D. student working with Wonsuck Kim, is spending her summer growing deltas from scratch in a glass-walled tank

that's big enough to park a small car. Everything is downsized and sped up to allow researchers to get their hands around natural processes that would otherwise be too big and slow. Water flows gently into a channel at one end of the tank at a steady rate for weeks. Once a week, for one hour, the water flow is cranked up and sand is added to mimic a big flood, piling up a lobe of sand. Then alfalfa seeds are cast on top of the fresh delta surface. The little sprouts that form represent much larger plants on the real delta.

One hypothesis she's testing is that the shape and general stability of the delta depends on two factors: how quickly the ecosystem (alfalfa) grows and how quickly the delta itself (sand pile) grows. Specifically, if the ecosystem grows quickly relative to the delta, then she predicts the delta will form stable channels and be shaped like the branches of a tree. On the other hand, if the delta grows quickly relative to the ecosystem, then she predicts the delta will be fan shaped, with channels that migrate sideways over time. Piliouras says the tree-shaped delta would probably be more resilient against waves and storms.

So far — about a third of the way through their latest 12-week run — Piliouras' delta is looking less like a tree and more like half of an extra-large one-topping pizza with alfalfa. Still, she says it could all look very different by the end of the experiment.

Eventually, she plans to take her results out into the field to see whether they match up with how Wax Lake Delta evolves.

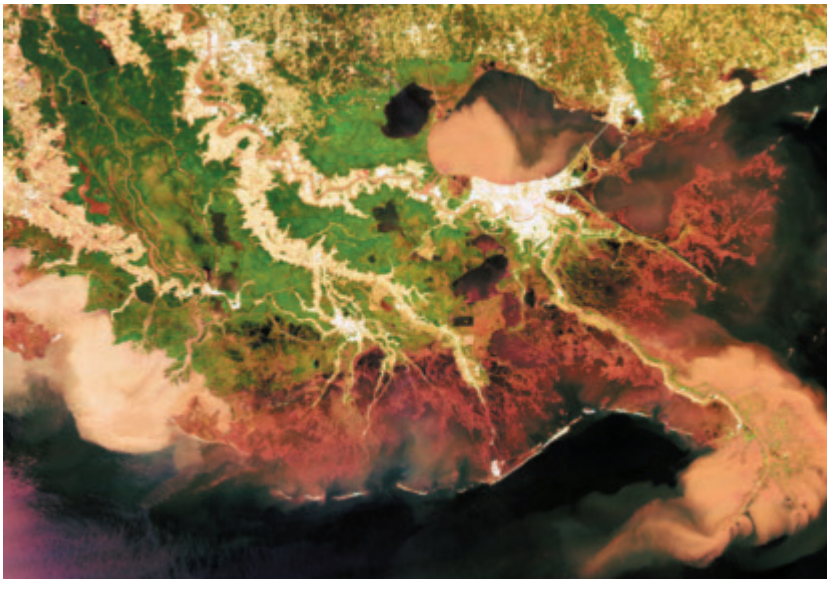
Losing Battle?

Just a few years ago, some critics asserted that dams in the upper reaches of the Mississippi River had reduced sediment flow so much that there wasn't enough raw material left to rebuild the delta. They also argued that sea level rise and land subsidence would take away land faster than anyone could ever hope to replace it.

Then in 2009, Kim and Mohrig published results of a computer simulation showing that if a proposed diversion were built 93 miles downstream from New Orleans, it would offset nearly half the area of land expected to disappear from the delta during the next century. That study showed that well-planned diversions of water and sediment could help turn the tide on land loss.

Then, last year the Mississippi River swelled to levels not seen since 1927. The U.S. Army Corps of Engineers opened a spillway 19 miles west of New Orleans to prevent flooding. Jeffrey Nittrouer, a University of Texas alumnus and postdoctoral researcher at the University of Illinois, discovered that even though only about 10 to 20 percent of the river's flow was diverted, about 31 to 46 percent of the entire sand load carried by the river during those six weeks was carried through the spillway. It turns out the twisty shape of the river at that location stirred up shallow sand from a sandbar next to the spillway.

"A tremendous amount of sediment made its way out from this diversion, indicating that if the sites of diversions are properly located," says Mohrig, Nittrouer's former Ph.D. adviser, "there's the real opportunity to produce much more land than any of us were predicting." ✷



The 2011 flood generated three large sediment plumes emerging from the Mississippi and Atchafalaya Rivers and Lake Pontchartrain via the Bonnet Carré Spillway. JSG alumnus Jeffrey Nittrouer showed how local river conditions promoted diversion of land-building sand during the opening of the spillway. Image: NASA/Aqua MODIS.

Restoration on a Budget

Okay, if river diversion can save the Delta, how much will it cost? And how can society build the most land for the money? Are there meaningful economies of scale?

To answer these questions, Mohrig and Wonsuck Kim have been working with Melissa Kenney, an environmental economist at Johns Hopkins University, to figure out how to get the biggest bang for a buck with river diversions. For example, is it better to build one large diversion or several small ones?

The researchers built a set of computer models that relate the width and depth of a diversion structure with the amount of land it builds and the costs of construction. Through a series of trial runs, they were able to determine structure sizes that gave the best balance between land built and cost. In a paper currently under review with the journal *Water Resources Research*, they found that if the goal is to build a large amount of land over the next 50 years (as stated in Louisiana's 2012 coastal restoration master plan) one or a few large diversions would achieve the best balance of land building and cost.

Fueling a tanker in Qatar, the world's largest producer of LNG.

Making the SWITCH

Documentary Film Wins Praise for Charting A Course Toward Our Energy Future

Abundant energy is essential to modern life, but where will future sources of energy come from? Can we continue to rely on coal and oil, which have powered our homes, cars, and factories for the past 150 years? How can we move to cleaner forms of energy with lower greenhouse gas emissions?

In his feature-length documentary film *Switch*, Scott Tinker, director of the Bureau of Economic Geology and professor at the Jackson School, sets out to answer these questions, working with Austin-based documentary filmmaker Harry Lynch. Tinker and Lynch explore the world's leading energy sites, from coal to solar, oil to biofuels, and seek straight answers from the people driving energy today, international leaders of government, industry, and academia.

The film, winner of "Best of the Fest" at the 2012 Colorado Environmental Film Festival, has been drawing high praise around the country for presenting an accessible, balanced potrait of the energy situation. Michael O'Sullivan of the *Washington Post* calls the movie "refreshingly free of hot air," praising it for avoiding the kind of "issue advocacy made commonplace by filmmakers Michael Moore" and others. "Rather, the film asks in a pragmatic, scientific way what it will take to get to the point where we have weaned ourselves off our coal and oil dependency," writes O'Sullivan, "not entirely, but just enough so that they are no longer the world's major source of fuel."

Leslie Finlay of *Cinespect*, who calls the movie "rehab for energy addicts," likewise praises *Switch* for avoiding agenda-driven journalism and instead acknowledging "that making the switch isn't as easy as turning off our addiction. Lynch and Tinker remain faithful to their role as documentarians—they offer up the facts, line up the challenges, and encourage both awareness and a change in attitude, without being preachy or employing scare tactics."

Even the few critical reviews of the film vindicate its approach, since the critics typically lament that *Switch* is not more histrionic and hand-wringing about the imminence of peak energy and environmental collapse. In her positive review for the *Village Voice*, Michelle Orange makes the point that Switch is "more persuasive" than many other films tackling energy issues precisely because the movie is "less excitable." Or, as O'Sullivan writes, "there are no villains here," just facts, figures, and sobering realities.

At the end of *Switch*, Tinker lays out a path to our energy future that can move the world toward cleaner forms of energy while pragmatically sustaining the growth that has fueled the modern world.

Viewers can continue to catch screenings around the country this year—see the schedule at the *Switch* website (www.switchenergyproject.com/). You can also view short clips online put together as part of *Switch*'s companion educational project.

In the following Q&A, Tinker and Lynch talk about their aims with the project.

Q&A with the Filmmakers

Why was it important for you to make Switch?

Harry Lynch (director, co-producer, co-writer): Basically, because energy makes modern life possible. It's the most important and pervasive commodity in the world.

Scott Tinker (narrator, co-producer, co-writer): And energy is in a crucial transition period. We're beginning a shift not only to renewables, but to unconventional oil and gas from shales and sands that require hydraulic fracturing, a politically controversial issue. After Fukushima some countries are re-evaluating nuclear. At the same time, global population is growing and modernizing, meaning ever-growing demand. How will we meet that? With what energy types? These are all issues we explore in Switch.

How is this film different from other energy documentaries?

Tinker: While many other energy films set out with an agenda, then advocate for one energy type or another, Switch is different. We started with a question, then went out to find the answers, working hard to remain unbiased and open to new ideas. I've been studying our energy transition for 10 years and working in energy for nearly 30 — and I learned many, many new things on our journey. And they're in the film. It's based on practical, realistic evidence from the field. Its controversy is in its balance and candor. In that respect, there is no other energy film like this.

Lynch: With our preview audiences, we've seen that people from left and right, young and old, fossil and renewable, energy companies and environmental groups, are all positive on the balanced message and on the conversation it could help start. And really that's our goal — to start a balanced national energy conversation with this film. We need that badly.

Tinker: Basically, we want to change the way the world thinks about energy.

Where did you go, and why?

Lynch: Visually, we had an opportunity to bring viewers something truly extraordinary. Energy sites are almost completely unknown to people and often in remote and exotic places.

Tinker: And it was the most powerful way to investigate the subject — to actually explore energy, to understand how it's made, so we can better understand how it is used and its future role. So we take people to Iceland for geothermal. Two hundred miles into the Gulf of Mexico to the deepest oil platform in the world. To the Andalusian high plateau for concentrating solar. Inside a mountain in Norway for hydro. Twenty-six spectacular energy locations in all.

The film uses an interesting way to measure energy, showing how many people can be powered by an energy source. Can you explain that?

Lynch: We realized there was no way for the viewer to really compare the different energy types and sites. Trying to rate them in megawatts or BTUs doesn't help, because those units mean nothing to the average energy consumer. We finally realized that was the unit: the average energy consumer. We would measure each energy source by how many people it could power in a year.

Tinker: So we added up the total energy consumption for an average global citizen for a year: their gasoline, electricity, then all the energy that goes into making and shipping all their food and products. Then, their share of all their governments' energy, public buildings, roads. It came to an enormous figure, 20 million watt-hours per global citizen per year. Then we divided the annual output of our energy sites by that.

Lynch: But again, those millions of watt-hours don't mean anything to most viewers. So we just call that amount of energy "1." One person's energy use per year.

The film seems balanced in the way it views the different energy sources, looking openly at everything from coal to solar.

Tinker: Absolutely. That was a must from the beginning. Every energy source has pros and cons, benefits and challenges. We wanted to present those as fairly as possible so viewers could understand what roles the different resources play and how they fit together, today and in the future. A responsible future requires a balance of energies — there are no silver bullets.

The Solucar Concentrating Solar Station, outside Sevilla, Spain, focuses the sun's heat on a receiver at the top of the tower.

Standing on 600 milllion people-years of nuclear waste, at La Hague nuclear recycling center.

Is there one overarching energy issue that came out of the movie?

Lynch: Scale. Just the sheer hugeness of everything in energy — the sheer size of energy facilities, the huge, huge processes involved in simply supplying mankind with energy.

Tinker: That's right. And scale introduces many challenges: Infrastructure is very large, therefore very expensive, therefore built to last for decades, therefore slow to turn over. New technologies take decades to grow to a level of saturation to make a meaningful difference. Emissions are at such a volume that they can affect global climate and ecological systems. We demand extraordinary amounts of energy.

Lynch: And that's why there's also one key answer to scale.

So, what is the answer to scale?

Tinker: Efficiency. Energy demand is enormous, because humanity is even more so. How, and how much, energy we choose to use is the way that each of us can impact the seemingly untouchable challenges of scale.

Lynch: Efficiency is easily the most important learning of the entire project. If we work on efficiency, all of us, we can make a difference at scale. And we do this through education — like this project — and through changing our culture. If we can create a culture that places value on energy efficiency, we will see huge gains.

Tinker: Efficiency makes everything better. It plays across every sector and every energy type. And it's doable right now. Efficiency is the place to start, and we need to start today.

The film ends by revealing a pathway to our energy future.

Lynch: It was very important for us to offer a solution — a workable, real solution. Not just to point out problems. Not to aspire to an ideal, but unrealistic, vision. If we're going to take viewers around the world and investigate the pros, cons and future of different energy types, we'd better show how it all fits together to form our energy transition, and exactly how and when that could happen. So we worked very hard on that forecast, based on Scott's years of data, lots of new learning from the field, the International Energy Agency, the Department of Energy, the Bureau of Economic Geology and other forecasts.

Tinker: It's still just a forecast, but you see in the film the rationale it's based on. Nearly everyone, from all along the energy spectrum — fossil, renewable and environmental — has found it reasonable. Many find it hopeful, in that if we work together, we can supply the world's growing demand for energy. Others find it sobering in that the switch doesn't happen as fast as they hoped it could, but that makes them motivated to do more. And we all need to do more, and I want to emphasize this again, in efficiency. We can be more efficient, smarter about how we use energy in every facet of our lives, without really even changing the way we live. What each of us does, matters. ✷

Praise for *Switch*

"Must-see entertainment for every person in America." *—DC Film Review*

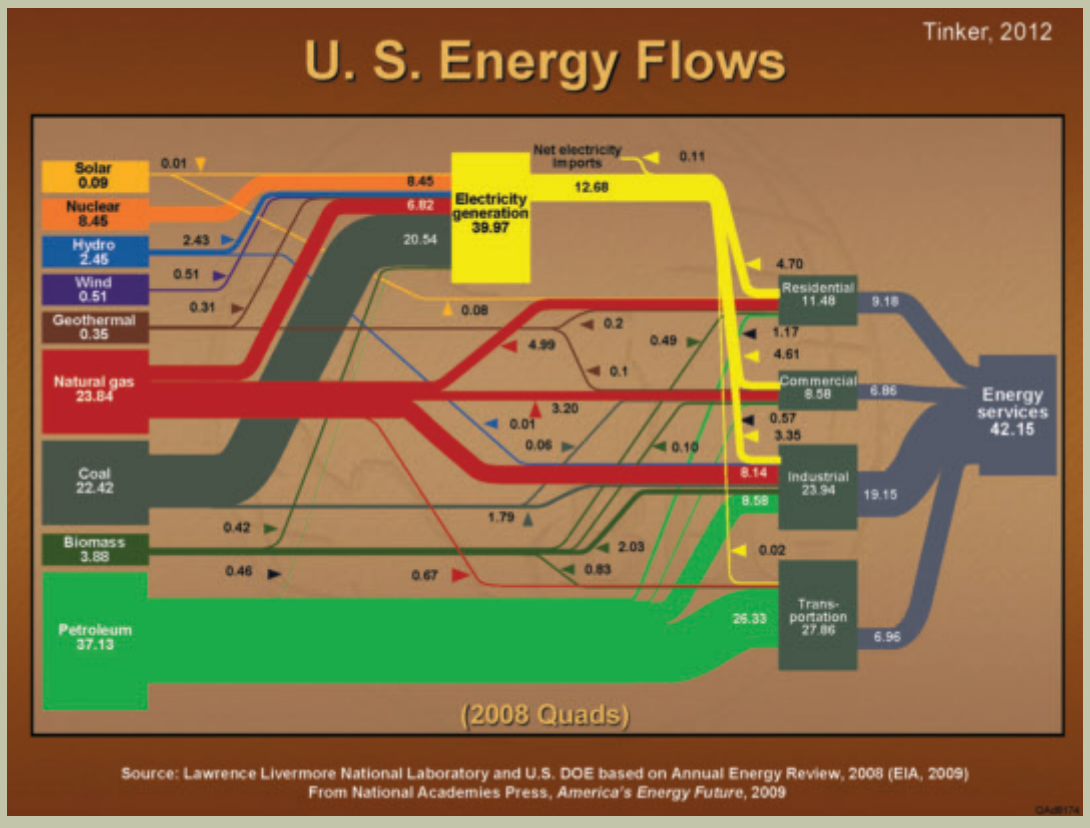
"Every person in America should see and digest this film." *—Douglas Johnson, Statoil*

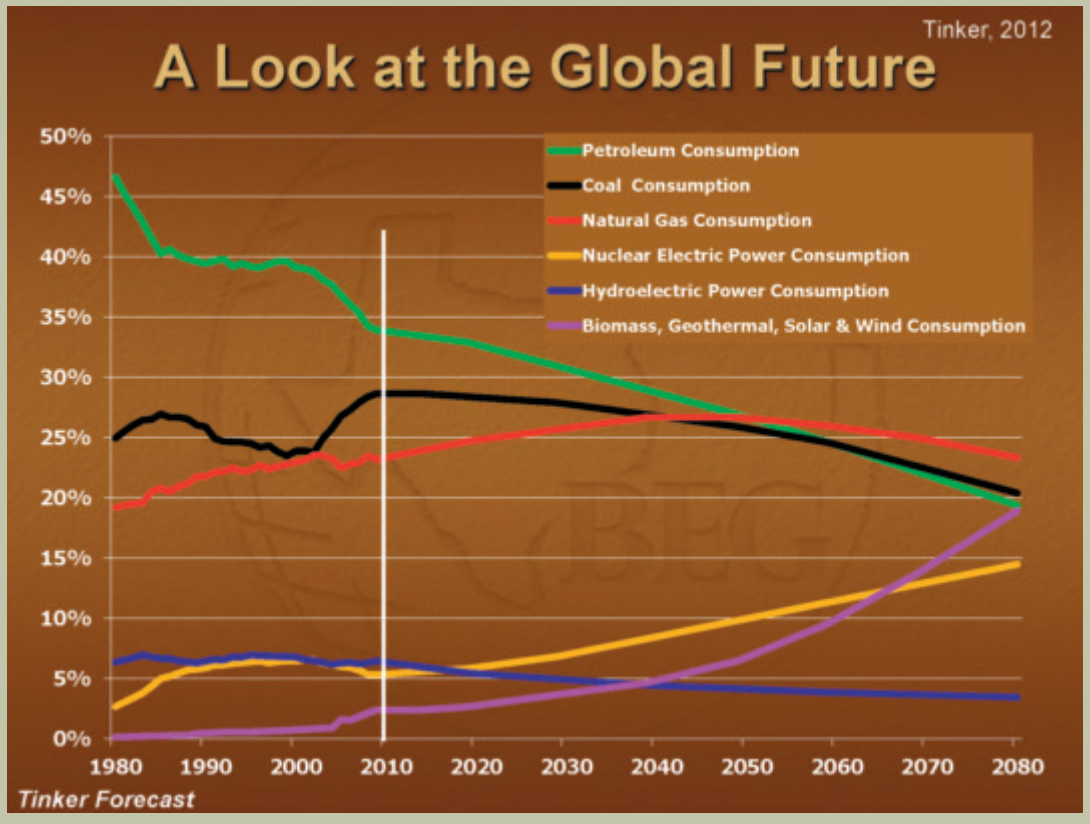
"Over the 30 years I've been working in renewable energy, *Switch* is the most balanced documentary on our world energy situation I've ever seen." *—Phil Dutton, GL Garrad Hassan North America*

"... thorough and sober-minded ... pragmatic, scientific, balanced ...[a] documentary of the old school." *—Michael O'Sullivan, Washington Post*

Dr. Tinker's Diagnosis and Forecast

As *Switch* screens around the world, Tinker continues to reach ever wider audiences with his public lectures on how the world can transition to its energy future. In two of the more arresting slides from his current presentation, Tinker shows our energy present (above) and his forecast for the future (below). The present scenario charts the global inflows of energy from all major sources in quads (a unit of energy equal to a quadrillion BTU). The slide traces energy from its sources (left) to its consumption (right). In a forecast of the global energy mix below, Tinker pre¬dicts the percentage decrease in global consumption of petroleum and coal over the next 70 years as use of natural gas, followed by nuclear and renewable sources rises.





In the summer of 2011, Terry Hash of Garfield, Texas planted 800 acres of cotton, corn, wheat, and sorghum, and almost all of it was destroyed by the drought. Photo: Jay Janner/AMERICAN-STATESMAN.

Stress Test

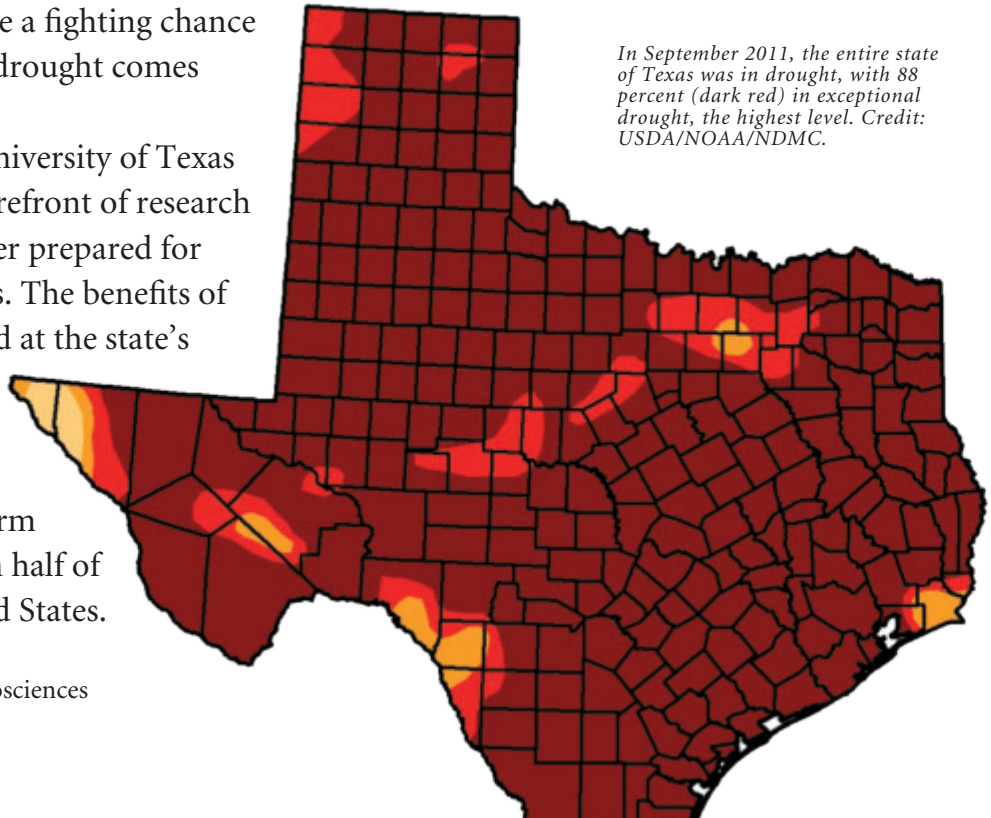
Five Key Lessons (and Challenges) from the Great Texas Drought

by Marc Airhart

Perhaps the only positive thing about the 2011 drought in Texas, the state's worst single-year drought in history, is that it ended up being the mother of all teaching moments. The lessons learned are not pleasant, but addressing them will give the state a fighting chance when the next major drought comes around.

Scientists at The University of Texas at Austin are at the forefront of research to make the state better prepared for future water shortages. The benefits of this research don't end at the state's border. Once most fiercely concentrated in Texas, this year the drought spread its warm embrace to more than half of the continental United States. By early September, 63 percent of the country was in moderate to exceptional drought.

So what have we learned from the 2011 drought? Here are five key lessons.



In September 2011, the entire state of Texas was in drought, with 88 percent (dark red) in exceptional drought, the highest level. Credit: USDA/NOAA/NDMC.

#1 Wake Up,Texas

First and foremost, we learned Texas is not ready for an acute one-year drought, much less several years of drought such as the state experienced in the 1950s.

Most Texans are familiar with the effects of the 2011 drought. Watering restrictions in the big cities may have only been minor hassles, but news images of starving cattle and raging wildfires made it hard to ignore the immensity of the tragedy. Some estimates put agricultural losses at more than $7 billion. Irrigation water for rice farms and agriculture downstream from Austin was cut off by the Lower Colorado River Authority for the first time in more than 70 years. Twenty-three public water systems reported having less than six months' water supply. The town of Spicewood Beach near Austin completely ran out of water and began trucking it in at great expense to keep household taps flowing.

Part of the problem was that the state's water storage infrastructure hasn't grown as fast as its population. Since 1980, per capita water storage in the state has fallen 30 percent.

"We are much more vulnerable because we've less water in storage per capita," says Bridget Scanlon, senior research scientist at the university's Bureau of Economic Geology.

So what can we do?

"Just like your financial portfolio, you want to have your water portfolio diversified," says Robert Mace, who earned his Ph.D. at the university in 1998 and is now deputy executive administrator at the Texas Water Development Board (TWDB).

"We need to broaden our water sources and be more flexible," Scanlon agrees.

She and other scientists at the university work regularly with the TWDB on drought issues. Experts have proposed a range of new water projects, including more surface reservoirs, desalination, and reuse systems. Two of Scanlon's favorite options are conservation and aquifer storage and recovery.

"Conservation is the cheapest solution," she says.

Aquifer storage and recovery (ASR) refers to storing surface water in natural underground aquifers during times of excess and pumping it out during times of scarcity. ASR does not incur losses from evaporation as occurs in surface water. San Antonio has the country's third largest ASR facility. At the height of the drought, the Twin Oaks ASR facility supplied about 20 percent of San Antonio's demand. Scanlon plans to study the feasibility of ASR in the Dallas area, which sits above the heavily depleted Trinity aquifer.

#2 It Can Get Worse

The second lesson is that, to geoscientists, last year's drought was not especially remarkable. Heck, even the six-year drought of the 1950s, used by water planners as the worst-case scenario, was minor compared with the megadroughts typical for the state.

Jay Banner, director of the university's Environmental Science Institute, has been collaborating with colleagues at the University of Arkansas and the Guadalupe-Blanco River Authority on a study using tree rings to reconstruct the history of Texas droughts for the past five centuries. This study, in combination with others in Texas, finds a number of droughts longer and more severe than the 1950s drought. Some lasted 20 or 30 years. Since the 1500s, droughts lasting a decade or more have occurred in Texas at least once a century.

As if that weren't ominous enough, some climate models predict more frequent and severe droughts in Texas during the coming century. Whether you believe those models or not, Banner says it's likely the state will again experience a megadrought unlike anything we've seen in our lifetimes.

"To be truly conservative, I think you have to prepare for the 'worser' case scenario of these 20- or 30-year megadroughts rather than the six-year drought we have in the historical instrumental record," says Banner.

Building that kind of infrastructure may be costly up front, but he warns it's much more expensive to wait until we're in a severe drought to try and secure new sources of water. Still, given how low our current capacity is, Scanlon says a more realistic goal would be to prepare for a repeat of the 1950s.

Jackson School doctoral student Richard Casteel cores a bald cypress tree at Krause Springs, near Spicewood, Texas, using an increment borer. Tree ring studies undertaken with Professor Jay Banner, going back 500 years in Texas climate history, find a number of droughts longer and more severe than the 1950s drought. Some lasted 20 or 30 years. Photo by Jay Banner

Like most of the 250 or so large power plants in the state, Dansby Power Plant on Lake Bryan in Bryan, Texas relies on a steady stream of water for cooling, mainly from lakes and rivers. Photo by Alexey Sergeev.

#3 Cool the Power

Third, we learned our electrical power supply is vulnerable to water shortages.

Most of the 250 or so large power plants in the state rely on a steady stream of water for cooling, mainly from lakes and rivers. Officials with the state's power grid warned that if the 2011 drought continued through 2012, some power plants would have been forced to stop operating.

Thankfully, a wet winter took the edge off the drought in much of the state, and there were no blackouts. Still, peak electric power demand in the state broke records in July 2012. It's not clear how the power supply would have been affected if the drought had persisted at the previous year's levels.

Power plants consume only about 3 percent of the water in the state. That's because most of the water returns to lakes and rivers after passing through the plants, but on any given day, power plants need access to a lot of water to keep things running — about 43 percent of all water withdrawals in the state, according to the U.S. Geological Survey.

Scanlon is analyzing power plants across the state to identify those most vulnerable to drought. She's also looking at the efficiency of different cooling technologies in a study for the state comptroller's office.

"We don't want drought to impact the economy of the state," says Scanlon. "We don't want the plants to run out of water to maintain energy."

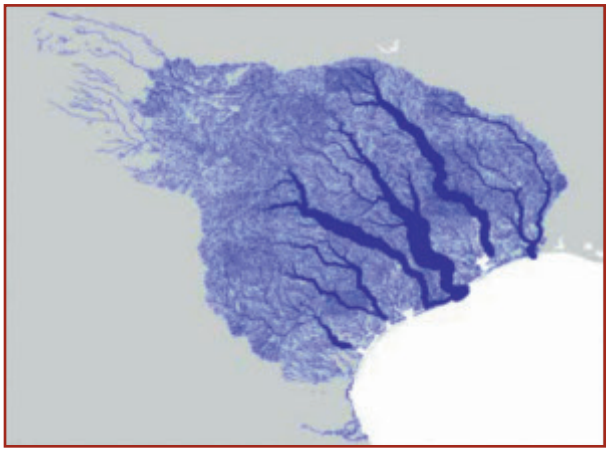
Scanlon says that for the most vulnerable plants, it would make sense to develop alternatives to surface water for cooling. Her preliminary research suggests drilling groundwater wells or using aquifer storage and recovery might be the most cost-effective ways to buffer power plants from extreme drought.

#4 Improve the Models

The fourth lesson is that even the best minds and fastest computers have a hard time forecasting a drought's severity or duration.

In October 2011, experts from the National Oceanic and Atmospheric Administration (NOAA) concluded that Texas was two to three times as likely to have precipitation levels that were below normal through the following May as above normal. But in fact the winter turned out to be extremely wet for many parts of the state.

Jackson School Professor Rong Fu began exploring the reasons for the unexpected rains. Working with researchers in NOAA's Climate Prediction Center, she and postdoctoral researcher Nelun Fernando discovered one reason: an atmospheric circulation pattern



The RAPID computer model is part of a water availability forecast system being developed by UT researchers for use by water planners across the state. Image: David Maidment/Cedric David.

called the North Atlantic Oscillation was positive and unusually strong, blocking cool arctic air from escaping south. That allowed warm, wet air from the Gulf of Mexico to dump rain across Texas.

Fu and Fernando have also discovered a key ingredient for making a run-of-the-mill drought extreme. It turns out that the four worst droughts of the past century all had one thing in common: Each time, summer drought was preceded by warm, dry air blowing from the west into Texas during the spring. It was like leaving a Texas-shaped cookie in an Easy-Bake oven for too long.

Based on these and other insights, Fu is evaluating climate models so policymakers at the state and local levels understand which ones are most reliable for long-term planning.

#5 Improve Water Level Forecasts

The fifth lesson: Water planners and businesses need better long-range forecasts of water levels in rivers and lakes.

Brenner Brown, a member of the state's Drought Preparedness Council, says such forecasts would have helped the council in 2011 identify local water entities that were going to be struggling before the situation got really bad.

"Any kind of forecasting component we can develop to help us anticipate the impacts will definitely improve our emergency response," says Brown.

Liang Yang, a professor in the Jackson School, and David Maidment, a professor in the Cockrell School of Engineering, co-direct the university's Center for Integrated Earth System Science. They are building a set of computer models that will forecast, among other things, surface water availability six to 18 months in advance. With that information, local water systems could decide whether to establish water use restrictions or even cut off some users. Power plant operators could start activating emergency management plans earlier.

This kind of water forecast could also enable something Maidment, Scanlon and others have been talking about lately: a market for trading water rights. Texas uses a system called prior appropriation to allocate surface water. In times of scarcity, the owner of a more senior water right can make a "call" requesting the Texas Commission on Environmental Quality to limit the water usage of more junior rights holders.

"Right now the only policy controls we have are, 'Turn off your pump'," said Maidment. "That's all we've got. And it's a pretty blunt instrument."

He and others have suggested that senior water rights holders should be able to easily sell their rights to more junior rights holders from day to day. It's technically possible today, but the process is slow and cumbersome.

By putting a monetary value on the right to pump itself, market forces might be able to wring out efficiencies more easily than regulators can. Having a robust forecast of water supplies months in advance would help buyers and sellers set a price for water rights.

Last February, Yang and Maidment organized a day-long Water Forum, which brought together 130 experts from across the state including researchers from The University of Texas at Austin and Texas A&M University, local water authorities such as the Lower Colorado River Authority, and scientists and policymakers from an alphabet soup of state agencies including the Texas Water Development Board (TWDB), Texas Commission on Environmental Quality (TCEQ) and Texas Parks and Wildlife Department (TPWD).

Several new research projects and collaborations have sprung from that meeting. For example, Yang and Maidment are now working with John Nielsen-Gammon, Texas state climatologist and a professor at Texas A&M University, to prepare seasonal water balance forecasts for state agencies.

"The drought of 2011 makes me appreciate more that climate and hydrological scientists must work intimately with other scientists and policymakers to address the broad impacts of extreme weather and climate disasters," says Yang. ✷

By the Numbers: The 2011 Texas Drought

14.9 inches Average state rainfall in 2011, officially the driest year on record. Typical rainfall in the state averages 27 inches per year. (National Weather Service)

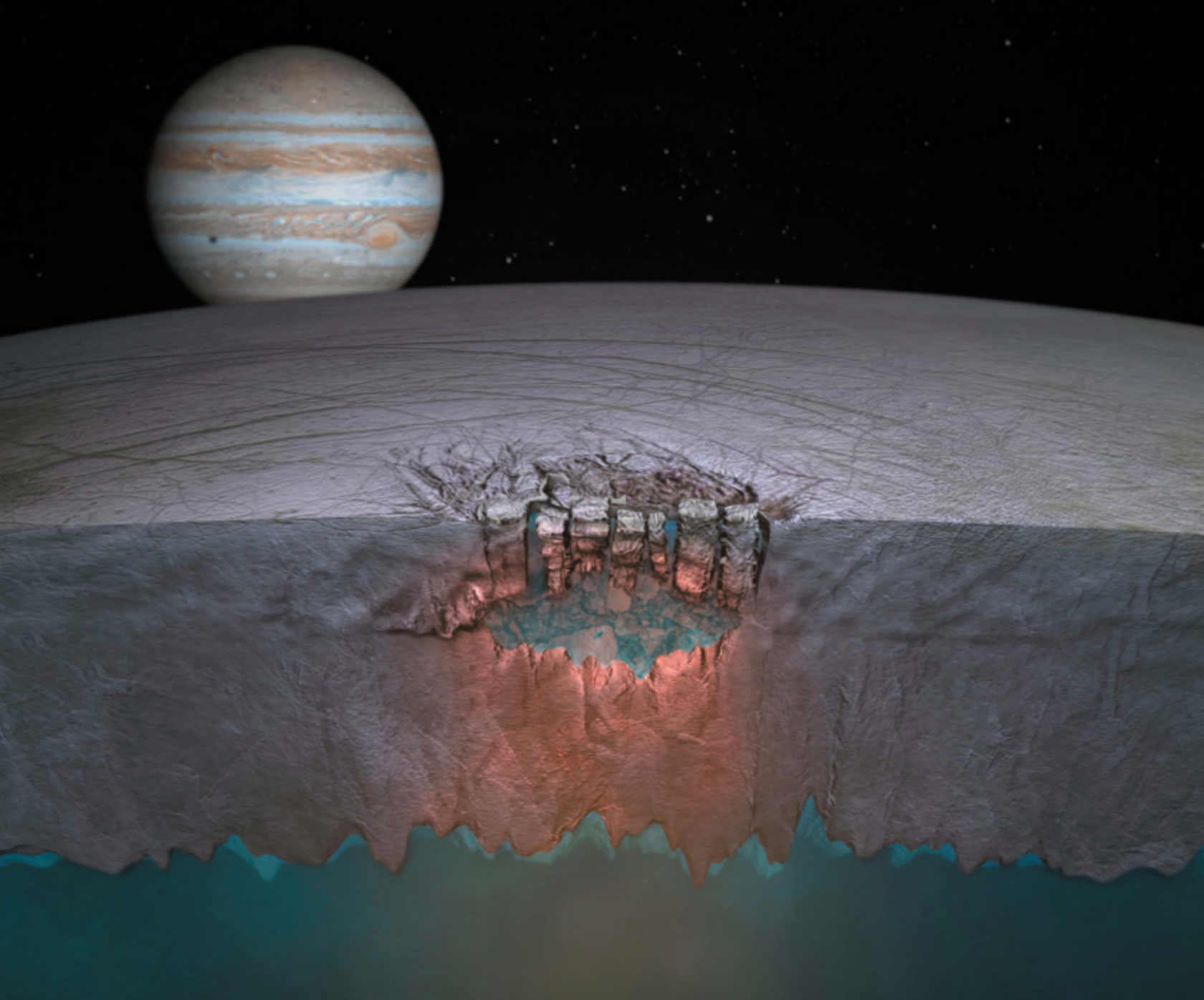
97 percent of the state was categorized as being in extreme or exceptional drought (the two most severe levels) on September 13, 2011. (U.S. Drought Monitor)

21 percent of the state was categorized as being in extreme or exceptional drought a year later, on September 4, 2012. (U.S. Drought Monitor)

$7.6 billion crop and livestock losses to the state. (Texas AgriLife Extension Service)

1.4 million head reduction in Texas cattle herds in 2011, an 11 percent drop, the biggest decline in nearly 150 years of recorded data. (Reuters)

Up to 500 million trees lost in 2011, as much as 10 percent of all trees in state. (Texas Forest Service)



Europa's Great Lake

In Europa's Icy Shell, Scientists Find Evidence for Liquid Water and A Potential New Habitat for Life

Scientists have long suspected that a liquid ocean lay beneath the icy crust of Jupiter's moon Europa. That hypothesis has assured it a place among the top candidates for finding life beyond Earth. In an exciting twist, Britney Schmidt, a researcher at the Institute for Geophysics, and her colleagues announced the discovery last year of what appears to be a body of liquid water the volume of the North American Great Lakes perched inside the ice shell much closer to the surface than the ocean. The water could represent a potential habitat for life, and many more such lakes might exist throughout the shallow regions of Europa's shell, wrote lead author Schmidt in the journal *Nature*.

Further increasing the potential for life, the inferred lake is covered by what appear to be floating icebergs in a part of Europa's ice shell that seems to be collapsing, providing a mechanism for transferring nutrients and energy between the surface and the deeper ice shell, perhaps even to the vast ocean below.

"One opinion in the scientific community has been, 'If the ice shell is thick, that's bad for biology—that it might mean the surface isn't communicating with the underlying ocean,'" said Schmidt. "Now we see evidence that even though the ice shell is thick, it can mix vigorously. That could make Europa and its ocean more habitable."

Chaos Theories

In the 1990s, the Galileo spacecraft snapped images of the surface of Europa that revealed strange, bumpy features dubbed chaos terrains. Scientists struggled to explain how they formed. To complicate things, some bulged up above the surrounding ice while others slumped below. It was hard to imagine one process that could create both flavors of chaos terrain.

Schmidt, along with Don Blankenship, a senior research scientist at the Institute, and others looked at Earthly ice features in places like Greenland and Antarctica for inspiration. Based on similar processes seen here on Earth—on collapsing ice shelves and on lakes sandwiched between glaciers above and volcanoes below—the researchers developed a model to explain how chaos terrains form on Europa.

It starts when heat from deep within Europa warms up the base of the ice shell. The heat causes a plume of warm, pure water ice to rise up through the ice shell, somewhat like blobs rising inside a lava lamp. This process was first suggested for Europa in the Galileo era. In the new model, when that plume gets within a few kilometers of the surface, the temperature and pressure environment

The image on the opposite page, Europa's "Great Lake," appeared on the cover of the Nov. 24, 2011 edition of Nature*—the second Jackson School cover image in* Nature *over the past two years. Scientists speculate many more lakes exist throughout the shallow regions of the moon's icy shell. Credit: Britney Schmidt/Dead Pixel VFX/Univ. of Texas at Austin.*

may combine to melt some of the ice into a liquid lake shaped broad and thin like a lens. Because liquid water takes up less volume than the ice it replaces, the ice sitting above this perched lake starts to slump, breaking up into icebergs and slush. Then over a long period of time, the heat that made the lake possible dissipates. The lake refreezes, and because freezing water expands, it pushes the overlying ice back up and creates a dome with a jumble of icebergs sticking out.

An easy way to visualize what's happening is to imagine a glass of ice water. Initially, the ice cubes are floating on top of a lake. Like icebergs, the ice cubes sit partly underwater and partly above water. If you then stick the glass in a freezer and come back a few hours later, the surface of the now frozen water has bulged up and the ice cubes are standing up even higher than before.

Model Insights

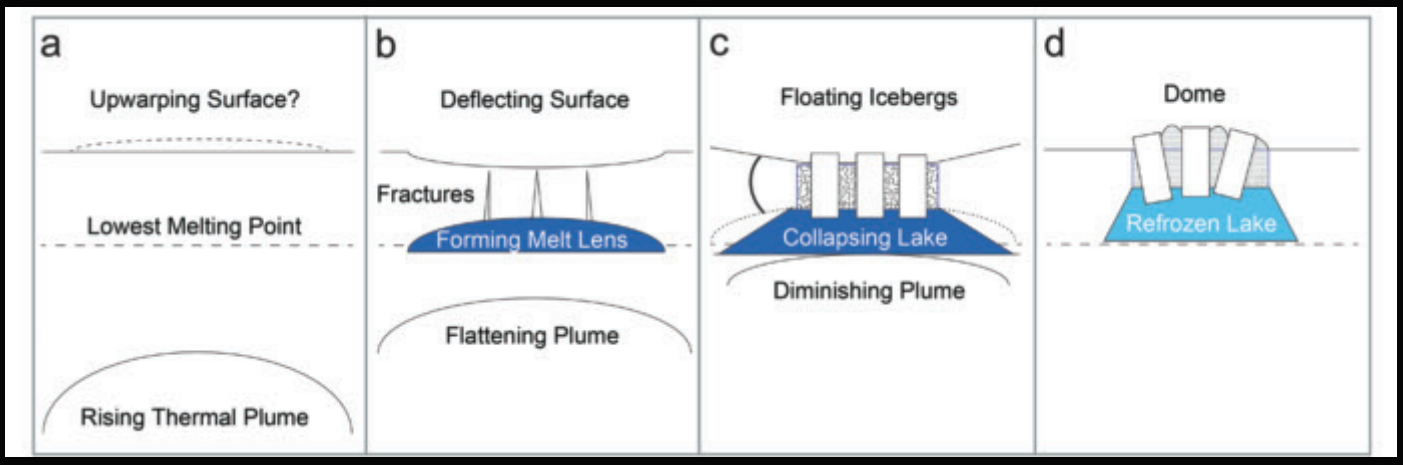
The new model resolves several conflicting observations, some of which seemed to suggest that the ice shell is thick and others that it is thin.

"I read the paper and immediately thought, yes, that's it, that makes sense," said Robert Pappalardo, senior research scientist at NASA's Planetary Science Section who did not participate in the study. "It's the only convincing model that fits the full range of observations. To me, that says yes, that's the right answer."

"It's all the physics that a fifth grader knows about putting a coke can in the freezer," says Schmidt.

Schmidt presented her hypothesis about how chaos terrains form at the Lunar and Planetary Science Meeting in March 2011. She used a domed feature called Conamara Chaos as an example of a feature at the end point of this long process. Another planetary scientist in the audience asked what one of these chaos terrains might look like if it were much

Europa, as viewed from NASA's Galileo spacecraft. Visible are plains of bright ice, cracks that run to the horizon, and dark patches that likely contain both ice and dirt. Credit: Galileo Project, JPL, NASA; reprocessed by Ted Stryk.



How "chaos terrains" form on Europa: (a) heat from beneath the ice shell creates a rising plume of warm water ice; (b) a layer of the ice shell with the lowest melting point melts into a thin lens of liquid water causing the overlying ice to crack and subside; (c) icebergs break off, surrounded by fractured ice and brine; and (d) as the heat from the plume dissipates, the lens of water refreezes and expands, pushing the overlying ice back up and creating a dome with a jumble of icebergs sticking out.

younger, if it still had a liquid lake beneath it. Schmidt described a slumped feature with lots of icebergs and slush.

"She shows me a picture of Thera Macula and it was exactly what I had just described," she recalls. "It was exciting to see that. Here was another test of our hypothesis. We got kind of lucky, because everyone had really ignored Thera Macula because it was sitting next to this weirder, probably much older feature called Thrace Macula. But this little guy turned out to be the most exciting."

So in effect, the team had not only explained how these surface features form and why they seem to be so different from each other, they had also found evidence of a massive liquid lake below Thera Macula. Because the surface was still collapsed down, the team was able to estimate its volume. And the possible existence of that lake has made Europa an even more desirable target in the search for extraterrestrial life.

Because the inferred lake is several kilometers below the surface, the only true confirmation of its existence would come from a future spacecraft mission designed to probe the ice shell. Such a mission was rated as the second-highest priority flagship mission last year by the National Research Council's recent Planetary Science Decadal Survey.

On Earth, radar instruments are used to image similar features within the ice, and are among the instruments being considered for a future Europa mission.

"This new understanding of processes on Europa would not have been possible without the foundation of the last 20 years of observations over Earth's ice sheets and floating ice shelves," says Don Blankenship, Schmidt's co-author and leader of the Institute's airborne radar studies of Earth's ice sheets.

This research focused on Thera Macula and Conamara Chaos, but if confirmed, lakes of similar size could be in many other parts of Europa's ice shell. About half of its surface appears to have been resurfaced in a similar manner. Not all of these locations will still have liquid water; some older features may have long ago refrozen. But it does suggest that much more liquid water could be present in the moon's icy shell than the Great Lake-sized body under Thera Macula.

Europa Europa

For the moment, NASA has no confirmed plans to send a Europa mission. However, the European Space Agency (ESA) is developing the JUICE mission to explore the icy moons of Jupiter, and NASA is participating in instrument development. Schmidt and Blankenship are part of the science team for that mission.

"The ESA mission redefined some of its science objectives and changed the flyby path," says Schmidt. "The original flyby wasn't going over Thera Macula. They've changed the orientation of the flybys to go right over it, so I'm really excited."

The ESA mission isn't slated to launch until 2022. Meanwhile, Schmidt and others are trying to learn as much as they can so that they can develop instruments and an exploration strategy that will yield the most useful information.

For example, Schmidt is leading a project to build an autonomous underwater vehicle that can swim beneath Antarctic ice shelves (floating ice that's attached to the continent) and survey the topography of their undersides. By comparing the actual topography of the bottom of the ice shelves with radar data collected from airborne surveys over the ice, she and her colleagues hope to learn how the water-ice interface affects radar waves. Ultimately, it could help them design a better radar instrument for spacecraft orbiting Europa and provide important information for how to properly interpret the data.

"The end goal is finding the best place to land," says Schmidt. "For me and everyone else, the point of exploring Europa is to land there and look for life. I just want to make sure that when we land, we land somewhere interesting that gives us the best chance to find it." ✷

Schmidt illustrates a point at her NASA press conference. To see an animation of how chaos terrains are thought to form, just Google our "Europa Great Lakes" press release.

by Marc Airhart

Landing ship tanks, landing vehicles, and cargo on a Normandy beach, June 1944. Source: U.S. Navy.

CSI Normandy:

McBride Tracks the Geological Fingerprints of War

Earle McBride and Dane Picard were traveling across France conducting geologic field work in 1988 when they took time out to play tourists at Omaha Beach, site of one of the most ferocious battles during the D-Day invasion more than 40 years earlier. It was a miserably cold and blustery day. They tarried just long enough to scoop a sample of beach sand into a little baggie.

McBride, a professor emeritus in the Jackson School of Geosciences at The University of Texas at Austin, collects sand pretty much any chance he gets. By analyzing sand from modern dunes, beaches and rivers from a wide range of sites around the world, he can link the mineral compositions of ancient sandstones to the kinds of environments that forged them.

A few years after the French trip, he put the beach sand under a microscope and discovered tiny metal shards mixed in with the ordinary bits of quartz and other materials that he expected to see. Those shards turned out to be shrapnel from the famous World War II invasion. On closer examination, he also found iron and glass beads that had resulted from the intense heat unleashed by explosions in the air and sand.

"It is of course not surprising that shrapnel was added to the Omaha Beach sand at the time of the battle, but it is surprising that it survived 40-plus years and is doubtless still there today," wrote McBride and Picard, currently a professor emeritus at the University of Utah, in an article for Earth Magazine last year.

In the early hours of June 6, 1944, more than 160,000 Allied troops poured from planes and ships onto the heavily fortified shores of Normandy, France. Omaha Beach was one of five Allied landing points along a 50-mile (80-kilometer) stretch of coastline.

Earle McBride discovered shrapnel and other microscopic relics from the D-Day invasion more than four decades later on Omaha Beach.

"The battles were bloody and brutal," wrote McBride and Picard, "but by day's end, the Allies had established a beachhead."

It proved to be the turning point of the war. McBride was just 12 years old in 1944.

"We'd hear daily reports on the progress of the war in Europe," he said. "It was all so far away. I knew where France was, but I didn't know where Normandy was."

To analyze the sand, McBride first mixed the tiny grains with a blue epoxy, making what amounted to artificial sandstone, and then sliced it into thin sections. Under an optical microscope operating in transmission mode (in which light passes through the sample), he could see opaque grains. Adding another light source to see reflected light, the grains appeared shiny, an unusual feature for naturally occurring minerals. The shard-like angularity of the grains suggested these were not naturally formed. Ordinary ocean wave action along the shore tends to blunt sharp edges. Other tests showed the metal shards contained large amounts of iron and were magnetic. At this point, he had no doubt these were pieces of shrapnel.

McBride reported that 4 percent of the sand is made up of these bits of shrapnel ranging in size from very fine to course (0.06 to 1 millimeter). Because the beach surface is continually being reworked by wind and waves, a sample taken on another day might have yielded a different abundance. He also found trace amounts of spherical iron beads and glass beads. Some iron beads were broken, revealing hollow centers. Using a scanning electron microscope, he was able to study the shape, texture, and size of all three explosively-produced structure types in greater detail.

McBride and Picard published their full results in the September 2011 edition of *The Sedimentary Record*, a quarterly journal of The Society for Sedimentary Geology (SEPM).

"Today, the only visible indications of the horrific battles fought at Omaha Beach are some concrete casements above the beach and nearby cemeteries that quietly mark the thousands of lives lost," wrote McBride and Picard.

Gone are the wrecks of planes, ships and tanks, the shell casings, the scraps of rotted boot leather, and all the other detritus of war long since spirited away by generations of beachcombers. And so it fell to a pair of geologists to pluck one last relic from the sand, hidden under the feet of thousands of tourists every year.

Unlike the global layer of radioactive fallout from the 1950s atomic bomb tests that geologists and others now use to calibrate their tools for dating geologic materials, the microscopic fingerprint of the D-day invasion probably won't endure long.

McBride says the iron-rich shrapnel shards could probably withstand the scouring action of waves alone for hundreds of thousands of years. But studying the shrapnel grains under high magnification, he observed particles of iron oxide, or rust, created by a chemical reaction between saltwater and iron. Waves churn the iron fragments, which rubs off some of the rust and exposes fresh material, which is more amenable to rusting, which in turn gets rubbed off, and so on.

"The net result is these things will get smaller and smaller and then finally get carried away by storms or hurricanes and be taken out of the beach," says McBride. "So their time is numbered."

"[T]he combination of chemical corrosion and abrasion will likely destroy the grains in a century or so," wrote McBride and Picard, "leaving only the memorials and people's memories to recall the extent of devastation suffered by those directly engaged in World War II." ✷

Few visible signs of war remain on Omaha Beach today. Photo by dynamosquito.

Sand and Forensics

In the 1960s, detectives with the Texas Department of Public Safety brought Earle McBride a sample of sand collected from the pant cuff of a murder suspect. They wanted to know if the suspect had been to the Rio Grande.

Within seconds, McBride could tell that the sand was from the Colorado River near Austin. Some telltale signs: It had pink potassium feldspar grains derived from granite in the Llano region, which are commonly found in the Colorado River but not in the Rio Grande; and there were no sand grains derived from volcanic rocks, something common in sands from the Rio Grande but not from the Colorado.

"Unfortunately, that wasn't the answer the police wanted, so I got dismissed," he said. "That was my first foray into forensic science."

McBride's sand collection is carefully stored in hundreds of bags and bottles in row after row of metal drawers in the basement of the Jackson Geosciences Building.

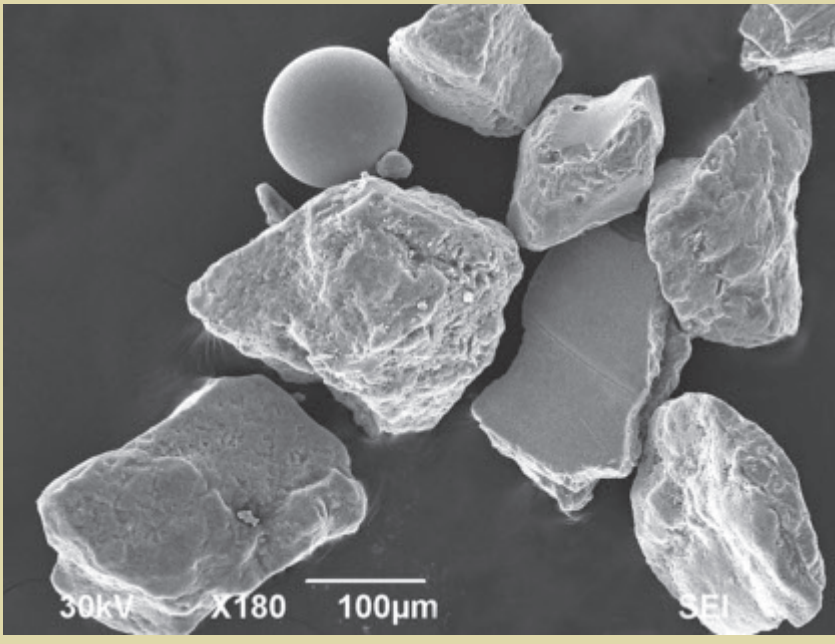
Once, three agents from the FBI's anti-terrorism unit paid him a visit to collect about 100 pea-sized samples from locations around the world.

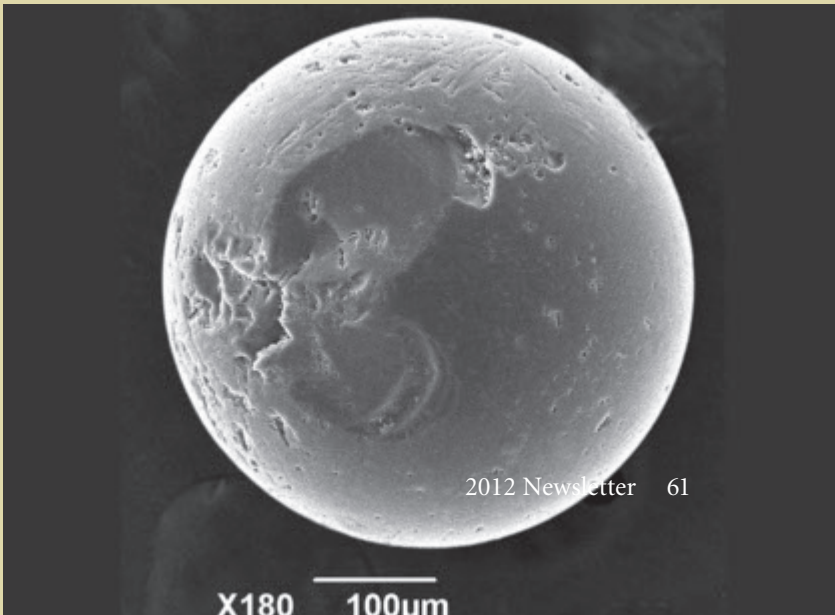
"They wanted to see if they could devise some new black box analytical technique so that if they got sand from the bottom of a shoe of a suspect, could they tell where the suspect came from?" he said.

It all sounds like something out of the TV show CSI. McBride acknowledges there are limitations to what you can learn from a single sample of sand.

"There are some fairly humorous examples I've seen on CSI where they get a little sample from a tire and they say, 'Oh yeah, I know where that came from. That's from 42nd Street and 12th Avenue,'" he deadpans. "It doesn't work that way."

Clockwise from top left (first three images by Earle McBride/Dane Picard): Omaha Beach sand seen through a binocular microscope—rust coated shrapnel grains are visible in the center of the photo; scanning electron microscope image of shrapnel grains and an iron bead, remnants of the D-Day invasion; scanning electron microscope image of a glass bead with divots and scratches; U.S. Army soldiers recovering remains of comrades at Omaha Beach, Normandy, France, June 6, 1944—Library of Congress.





Depth and Breadth

New Organizational Structure Showcases JSG Strengths

In January, the Jackson School rolled out a new organizational structure for research and education that unites the school more cohesively across its units while presenting research strengths in their full depth and breadth.

The structure, visible in a new website design, "cuts across the school boundaries and unites us through our greatest common interests," said Dean Sharon Mosher.

The organization is a matrix model that groups all faculty and research scientists in six broad research themes and nine disciplines. The schemes overlap: all scientists have at least one theme and one discipline. Outsiders can look for Jackson School researchers by either method.

Dual Vision

Why group people two different ways? Because the matrix reflects the way things happen in the geosciences, explains Mosher.

"Having strength in the disciplines is extremely important," said Mosher. "But most major research today truly is multi- or inter-disciplinary." A geophysics student, for example, needs a solid grounding in the discipline, "but their research may be using geophysics to answer questions on anything from tectonics to energy to water-related resources," said Mosher.

The idea for the matrix model came in part from advice of the school's Advisory Council, whose members have wrestled with similar organizational issues in their companies. Many geoscience companies were once organized around disciplines but evolved to organize around cross-disciplinary projects. And yet an exclusively project-oriented approach proved to have disadvantages, because people still needed strong ties to their disciplines for professional development.

"People in a discipline need to interact with others in their discipline in order to grow, but a lot of research requires them to interact across disciplines," said Mosher. "So you need both a disciplinary home and a project home."

Organizing its researchers in themes and disciplines, the school now presents the outside world a better view of its strengths. The Jackson School, for example, has long had many people doing internationally recognized work in geochemistry, but it was hard to see this online, in part because the school's geochemists work on such a wide variety of problems and view themselves in terms of the types of problems they address rather than their discipline.

The new organizational structure resolves this. On the webpage for the new Geochemistry/Thermo- & Geo-chronology discipline, you can find direct links to research pages for the more than two dozen faculty and research scientists in geochemistry, along with related postdocs and staff. Meanwhile the theme web pages show the diversity of project areas in which the geochemists work.

Strategic Structure

Apart from showcasing the school's depth, the organizational structure also provides a new way to plan and implement the school's strategic objectives.

One of the school's major strategic goals is to foster transformative research and education across disciplines. The project-oriented themes are the ideal place to pursue this goal and provide strategic research planning to guide the school's future. The themes highlight interdisciplinary and multidisciplinary research, encourage collaboration, and attract students to research projects. Through grand challenge symposia and research retreats, theme members can focus on the pursuit of transformative research. Built around broad research interests, the themes naturally cross unit boundaries, fostering collaboration within the school—another important goal from the strategic plan.

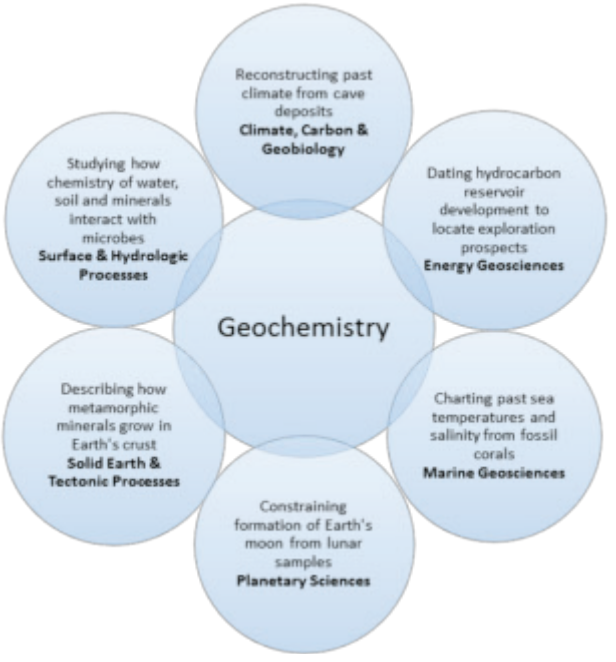
The disciplines, meanwhile, offer the best place to pursue much of the implementation of broad strategic goals. Through the disciplines, the school develops and delivers curriculum and staffs course instruction. Disciplines also help identify infrastructure and support needs, key building blocks for excellence. By strengthening the depth of programs and school-wide skills, the disciplines add to the school's reputation for research excellence.

Seeing It Online

The easiest way to explore the themes and disciplines is by visiting the new Jackson School website, unveiled simultaneously with the new organizational structure. The "Research" section of the site is organized almost entirely around the themes and disciplines, as are key online routes into the school set up for prospective and current students.

One of the key features of the new site is a database behind the scenes that serves up a rich lode of information customized by theme and discipline. The information includes researchers, facilities, research centers, courses, graduate student opportunities, and even a global map of research locations.

A prospective graduate student looking up geophysics pro-



Geochemists, like many faculty and research scientists at the Jackson School, are gounded in a single discipline but work on major projects in a diverse array of research themes.

grams, for example, naturally expects to see a list of the school's researchers in the discipline, which the site delivers, with links to their individual pages. But just one click from the discipline page also shows the incredible array of geophysics equipment and facilities distributed between the Bureau, Institute, and Department of Geological Sciences. Another click shows the school's six dedicated research centers working in geophysics and two related centers elsewhere on campus. The research theme and subtheme pages highlight the major multi- and interdisciplinary research being addressed within the school and provide a different pathway to finding the same type of information as that found through the discipline pages.

The result is a much deeper level of information than can be found on any of the Jackson School's peer school websites. Most schools show researchers by discipline or area, and many show a few facilities or research centers. No one puts the whole package together or offers granular detail with the depth of the Jackson School. Of course, as the largest academic geoscience community in the country, the Jackson School also has more detail to show than just about any other program.

The data-driven approach makes it easier to get useful information to students online. Finding a graduate supervisor, for example, is one of the most important tasks for prospective and current graduate students, but at many large institutions like the Jackson School (and its competitors), it can be a headache just to determine which faculty and research scientists are able to take on graduate students. With a new "Find a Supervisor" page powered by its online database, the Jackson School makes it easy to view all of the prospective supervisors, and categorize them by the theme, discipline, or even the research unit a student is interested in.

Seeing the new organizational structure online also helps resolve an issue that had lingered since the school's establishment as a college-level entity. From 2005 on, the school's major constituent units—the Bureau of Economic Geology, Institute for Geophysics, and Department of Geological Sciences—all continued to maintain their own unique ways of organizing and presenting research. This made it hard for online visitors to get aggregate views of research across the school.

Mosher never saw the different unit taxonomies as a problem, since these simply reflect their distinct business models and missions. The issue, she believed, was the lack of a good, central overlay that reflected the strengths of the school as a whole.

By improving its central organization and presenting it online, the school is now showcasing its strengths more fully, making it easier to find collaborative projects as well as individual experts at the units, and taking a step toward creating a stronger Jackson School community. ✶

Themes
Climate, Carbon & Geobiology
Energy Geosciences
Marine Geosciences
Planetary Sciences
Solid Earth & Tectonic Processes
Surface & Hydrologic Processes

Disciplines
Climate Dynamics
Computational Geosciences
Geochemistry/Thermo- & Geo-chronology
Geophysics/Seismology
Hydrogeology/Glaciology
Paleontology/Geobiology
Petrology/Mineral Physics
Sedimentary Geology/Stratigraphy

More information
www.jsg.utexas.edu/research

Guyana, known for jungles and natural beauty like Kaieteur Falls, is grappling with the implications of its recent energy discoveries. Photo by Bill Cameron.

Southern Potential:

Government and Industry Leaders Seek Common Ground on Sustainable Oil and Gas Development for the Americas

by J.B. Bird

In one of the most high-octane meetings since its launch in 2005, the Jackson School's Latin American Forum on Energy and the Environment drew leaders from nine countries and representatives from across the Americas to Houston last March for a conference dominated by the impact of rising unconventional reserves in the southern hemisphere.

Recent estimates of reserves in Argentina have positioned that country as potentially the next Latin American energy leader. National energy policies across the southern cone, however, remain a question mark for economic development, as several presenters discussed.

Headliners at the seventh forum (the first staged in Houston) included Ambassador Carlos Pascual from the U.S. Department of State, Juan Legisa from Argentina's Department of Energy, and the Honorable Robert Persuad from Guyana's Ministry of Natural Resources and the Environment.

Pascual offered a government perspective on the Summit of the Americas in Cartagena, but he drew the most attention discussing transparency rules that the Securities and Exchange Commission proposed for U.S. energy companies working overseas. According to the rules (proposed at the time and adopted after the forum), all companies listed on the New York Stock Exchange are required to disclose payments to foreign governments for activities related to the exploration and development of oil and natural gas.

U.S. energy companies have complained that the provisions would be costly and would require them to reveal confidential contractual information. Pascual believes that if key European stock exchanges adopted the same rules, they would cover more than 70 percent of all energy companies worldwide.

"Once you start getting that coverage and that kind of comparability in performance, you begin to reduce the space that individual companies can have to violate the rules and operate differently in the energy sector and potentially bring in other kinds of payments and investments and factors that might distort the market," Pascual said.

Ambassador Carlos Pascual

Unconventional Possibilities

No matter what their nationality, speakers found their most common theme was the impact of expanding reserves of unconventional oil and gas.

Legisa offered a snapshot of Argentina's massive potential in unconventionals including shale gas, tight gas sands, coal-bed methane, and shale oil. According to the 2011 Annual Energy Outlook from the U.S. Energy Information Administration (EIA), Argentina has the world's third highest geological potential for

unconventional hydrocarbons, after China and the U.S. In just one area, shale gas, the EIA study estimated Argentina's reserves at 774 trillion cubic feet (TCF), 60 times greater than the country's current conventional reserves.

The presence of vast, untapped reserves like Argentina's led one presenter, Ramon Hernán of Spanish energy giant Repsol, to predict that only gas and renewables will increase their net share of the Latin American energy consumption matrix in the coming decades, with gas consumption increasing by 50 percent. Hernán listed his reasons for forecasting such a dramatic increase for gas: availability, energy security, environmental benefits, slowed growth of nuclear energy, storage issues with renewables, flexibility, and potential use for transportation, particularly in the form of LNG.

Presenters from international oil companies working in Argentina addressed one of their top-of-mind business questions: What will it take to unleash greater international investment in Argentina's energy sector? The answer may seem obvious: higher prices that will allow them to make a profit. But to date, the administration of Argentine President Cristina Fernández de Kirchner has pursued steps to tamp down energy prices. The effect has been to make oil companies wary of investing in a country where low prices curb profitability. Partly as a result, Argentina over the past several years has moved from being an energy exporter to importing fuel from countries as far away as Qatar.

Just a few weeks after the Latin American Forum, Kirchner sent another chill through international markets by expropriating a controlling stake in YPF, the company that Repsol acquired in 1999, and that was previously Argentina's national oil company. With the expropriation this summer, Argentina now owns 51 percent of YPF.

In contrast to Argentina, Columbia has carefully planned market policies that could position it to become the next boom area, explained RoseAnne Franco of Wood Mackenzie. Columbia's pro-expansion policies distinguish the country during a nascent period of resource nationalism.

"Periods of resource nationalism tend to be preceded by periods of rising resource prices," such as the 1970s and 2000s, explained Franco. She foresees Latin American countries now moving toward a new stage of "resource maximization." After a period of reasserting national control over resources, countries experience stabilized or dropping prices and subsequently want to maximize value from their resources. Franco forecasts this process in Latin America will lead to greater reaching out to international energy companies.

Avoiding the Curse

While Argentina grapples with the impact of globally significant gas reserves, Guyana faces the prospect of developing recent discoveries expected to transform this small nation of less than 800,000 residents.

Reserves have long been known to exist offshore from Guyana but maritime border disputes with Brazil and Surinam kept exploration in check until just a few years ago. Today, ten oil companies are active or poised to jump in to the Guyana Suriname basin, which has a proven hydrocarbon system and highly prospective deep water plays that can be drilled in shallow water.

The United States Geological Survey (USGS) has identified the basin as having the second highest resource potential among unexplored oil basins in the world. USGS estimates mean recoverable oil reserves over 15 billion barrels and gas reserves of 42 trillion cubic feet.

For a country with an annual per capita GDP of less than $5,000, these are significant numbers.

According to Energy Minister Persuad, Guyana is determined to avoid the infamous "resource curse" that has plagued so many underdeveloped nations that discover oil and gas reserves. To that end, Persuad and President Donald Ramotar are committed to engaging the Extractive Industry Transparency Initiative, the 36 nation group that aims to reduce corruption and help spread the wealth in poor countries with rich mineral deposits.

In addition to seeking transparent business practices, Guyana must balance environmental considerations. Offshore tourism is one of the country's most successful business sectors. And Norway committed to a plan to transfer as much as $250 million to Guyana over five years in exchange for reforestation projects that maintain or expand jungle preserves.

"We want to be that role model, in terms of pursuing hydrocarbon resources but doing it in a sustainable way," said Persuad, who came to the forum in part to seek advice and counsel.

Guyana in particular needs academic and research expertise, which The University of Texas at Austin could supply.

"I can count on my hands the people in Guyana with experience in the energy sector," said Persuad.

Persuad's presence in Houston epitomized the originally intended value of the Latin American Forum, designed in 2005 to bring together academic, corporate, government, and non-government stakeholders in energy and the environment, creating a space where they could meet regularly and pursue common, balanced solutions to hemispheric needs. ✷

Guyana's minister of energy and environment, Robert Persuad, with Juan Legisa from Argentina's energy ministry and Dean Sharon Mosher.

Mighty Thoughts of Small

Bureau's Advanced Energy Consortium Pursues Nanotechnology for Upstream Applications

by Thomas Smith

Editor's Note: A version of this article appeared in the September 2011 issue of GeoExPro. *We reproduce it here with permission as an example of the research emerging from the Bureau of Economic Geology's Advanced Energy Consotium (see sidebar).*

Something that we are all familiar with, a human hair, is about 50,000 nanometers (nm) in diameter. Over 1,000 times smaller than the human hair, nanoscale materials occur naturally in the environment. Now, scientists and engineers are arranging collections of tens to thousands of atoms to create nanoparticles that can range from 1 to 100 nm in diameter. The important point here is that these nanoparticles can be built to specific sizes and for specific purposes as well as be assembled to perform specific functions. Simply put, nanotechnology is the engineering of functional systems at the molecular scale.

While still a brave new field, nanotechnology is beginning to appear in commercial applications, everything from Eddie Bauer stain-resistant Khakis to new light-weight bumbers for cars. What about applications of nanomaterials and nanotechnology in energy?

Since 2008, one of the main R&D incubators for energy nanotech has been the Advanced Energy Consortium (AEC) at the Bureau of Economic Geology. The AEC was the brainchild of Bureau Director Scott Tinker (who also serves as AEC director).

"The AEC funds research projects of particular value to the industry at universities, labs, and companies around the world," says Tinker. "The primary goal is to develop intelligent subsurface micro and nanosensors that can be injected into oil and gas reservoirs to help characterize these reservoirs and improve recovery."

Big Differences

One of the exciting and challenging aspects of nanoscale particles is that the behavior can be very different from classical physics, following the much more different rules of quantum mechanics. For example, you cannot walk up to a wall and be teleported to the other side, but, at the nanoscale an electron can. Insulators (substances that cannot conduct an electric charge) can become semiconductors when reduced to the nanoscale. Thermal conductivity and other physical properties can change drastically at the nanoscale.

With particle attributes changing at the nanoscale, scientists are experimenting to learn more about their properties and ways to take advantage of them in various applications. We already use many products that employ nanotechnology such as nanoparticles of zinc oxide or titanium oxide in our sunscreens or as a coating on clothing for better UV protection, in scratch-resistant coatings on our cars and eyeglass lenses, and in making tennis rackets lighter and stronger. The oil and gas industry is also embracing this new and exciting technology.

"Nanotechnology is helping in two key aspects of upstream oil and gas production," says Farzam Javadpour, the principal investigator on a Bureau project examining particle transport in porous media.

"One aspect that has become very important for the production of oil and gas from very tight formations such as shale is that this technology gives us a new look and understanding of the reservoir itself and how fluids flow through very small pore space," says Javadpour. "The second aspect deals with new ways to monitor and enhance the reservoir performance."

Topography image taken by an atomic force microscope (AFM) showing nanopores in a shale sample. The entire image is approximately five micrometers across or about 1/10th the diameter of a human hair. Image: Farzam Javadpour.

Shale Gas Reservoirs

Hardly a day goes by without news of a shale gas or shale oil play discovery. New drilling and fracturing technology has helped unlock these resources, but we lack an understanding of where all these resources are coming from. The mudrocks are composed of very fine grain particles with very small pores, so the traditional Darcy permeability equation cannot explain or describe fluid flow from such small pores. For the first time, technology is now imaging these tiny pores and enabling researchers to unlock some of their secrets.

"The physics of gas flow in tiny pores is different from large pores," says Javadpour. "The interaction of gas molecules and the pore inner wall become important, hence molecular interactions should be considered. AFM can measure these force interactions. We are using the measured interactive forces to understand how flow occurs in these very small pores and develop new flow models that will yield better reserve estimation and ultimate recovery."

Reservoir Performance

Along with all the new shale plays, oil companies are trying to squeeze every drop out of the conventional reservoir that they can. The latest secondary and tertiary recovery methods, drilling muds, and ways of connecting pore space over great distances are yielding good results. Nanotechnology is playing a key role and will be everpresent in the future oil or gas field.

"Nanoparticles have a very large surface area relative to their volume," says Javadpour. "The interaction of nanoparticles and

Farzam Javadpour

mineral grains or fluid interfaces in the reservoir is a new field of research. We can inject a certain volume of nanoparticles with specific characteristics into a well and by analyzing the nanoparticle concentration from an observation well, we learn about the geology and reservoir characteristics.

"In this case, the nanoparticles act as tracers. We can also make nanoparticles smart and perhaps bring specific information about pressure or even a fluid sample. Another example is that ferromagnetic nanoparticles can be injected into the well bore prior to petrophysical well logging. The injected particles enhance well-log readings and yield better measurements about the reservoir properties. Because of their large surface area to volume ratio, new nanoparticle-surfaced proppants are being developed that could enhance the effectiveness of hydraulic fracturing treatments." ✷

Participants at the Advanced Energy Consortium's 2012 biannual all-projects review meeting in Cambridge.

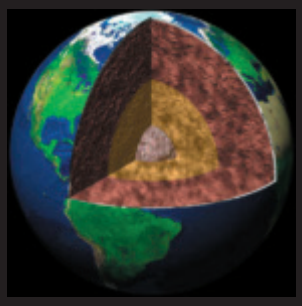
Nano Energy Center

The mission of the Advanced Energy Consortium (AEC) is to "illuminate the reservoir using novel micro- and nanosensing technology developed collaboratively with AEC members and the global community," in the process "pushing fundamental scientific advances, enhancing oil and gas extraction, and creating competitive advantages for member organizations," reports AEC Manager Sean Murphy. The AEC's $38 million, five-year budget makes it one of the largest research consortiums in the country, adds Associate Director Jay Kipper. It distributed $7.6 million in research funds during 2011, with larger outflows forecast for 2012 and 2013.

All of the funded research teams—representing 23 universities, research institutes, and national labs from around the world—converged in Cambridge, Mass., this May at Schlumberger's Doll Research Center to share their most recent results, test methodologies, particles, and design strategies. The two days were divided into the four AEC technology thrust areas: Microfabricated sensors, mobility, nanomaterial contrast agents, and nanomaterial sensor research. Sessions also reviewed the communication and sensing technologies that will be integrated into microfabricated electronic sensors for subsurface application. David Chapman hosted a one-day workshop on Friday, June 1, that included a tutorial on hydraulic fracturing.

For more information on the AEC's sponsored research, visit their website at www.beg.utexas.edu/aec.

Jackson School Research Locations October 2012



Earth's interior

Earth's surface and atmosphere

Earth's Moon

Mars

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ALUMNI NOTES

Graduate students at the first annual JSG Research Symposium in February 2012 send out a thank you to event sponsor ConocoPhillips.

1940s

Walter Belt, Jr. (B.S. '43), resides in Georgetown, Texas where he is retired.

Thurman Geddie (B.S. '45), resides in Austin, Texas and is a general partner at Geddie Oil Co., where he's stilling drilling for oil and gas! He can be reached at tgpgl@aol.com.

Nolan Hirsch (B.S. '44), writes, "Still operating Company and Individual investment to Oil and Gas. Presently participating in 3 wells in West Texas. Have had a few flair ups of old health problems but generally able to still be active in oil plays. Not many of my old friends are still alive. I'm 90 + years old, but luckily my head is still active."

Howard Lowe (B.S. '48), writes, "Sixty-six years have passed since I chose the profession that became my hobby – Geology. It all came about after I returned to UT following service in WWII. Out of curiosity, I enrolled in Jack Wilson's first-year geology course. I was hooked, left my three years of engineering behind, concentrated on getting a BS in geology (July 1948). During the span of all these years, my fascination with geology has grown. It is impossible for a true geologist to ever really retire.

Now in my semi-retirement years I research, study, and write about how and why physical activities of our dynamic Earth affects climate. I created a blog (*Scuttlebutt* – http://energycrsis12.blogspot.com) as a way to address specific energy/climate issues. Within a few weeks, I decided to write an e-book which I completed last December – *The Sky Will NOT Fall – Unmasking the Green Revolution* (Amazon, Barnes & Noble). Not satisfied that I had covered enough bases, I have completed a second e-book – *Beyond Our Control – The Story of a Dynamic Planet*. *Beyond Our Control* is being formatted for publication in early Fall.

I maintain contact with UT on several levels: member of Hill Society, Chancellor's Council, and Littlefield Society. I am also engaged in NROTC alumni activities – graduated Class of February 1944. I maintain my membership in the AAPG and the SPE, although I no longer make the conventions. My wife and I always

Stay in Touch!

Use the enclosed envelope or our online form (linked to the JSG alumni Web site) to let us know what you've been up to and to update your contact information.

look forward to attending activities on campus to see lifetime friends. I also want to express my appreciation for the personal attention I receive from members of the Geology Foundation staff – luncheons with them here in Houston are a real treat.

On approaching 89 years, I am thankful for good health and an active mind, even though walking 100 yards is the extreme limit of my capacity." Howard can be reached at howdyrl@comcast.net.

Jule Moon (B.A. '40; M.A. '41), writes, "Although I returned to Fairhope, Alabama to retire, I am proud of my 52 years studying and working in Texas, particularly the two as instructor in invertebrate paleontology, in which laboratory classes World War II veterans attending the University were in the majority. I am grateful for the ten years unique experiences as a psychiatric social worker in five of the Texas State Hospitals. My book, SHERDS A MEMOIRE published in October, 2011 contains chapters describing these adventures, as well as other experiences in the academic and mental health arenas."

1950s

Jim Adams (B.S. '51), writes, "Now retired and living in Manor Park. Still active in West Texas Geology Society and Exxon-Mobil retirees club. Drop in if you come this way and bring rain with you!" Jim can be reached at slatsjacobs@att.net.

Robert Brandt (B.S. '57), resides in Houston, Texas and is retired from being a professor at Houston Community College.

A.T. (Toby) Carleton (B.S. '51; M.A. '52), writes, "I entered the University in 1947 and earned my BS in Geology in 1951. I earned my MA in Geology in 1951. I am currently a member of the Geology Advisory Council." Toby lives in Midland, Texas and can be reached at tobycarleton@tocor-inv.com.

Dwight Cassell (B.S. '55; M.A. '58), writes, "Continue exploitation of older Eocene Reklaw and Midway Poth fields in central Texas. Travel as much as possible, always at least once a year to visit daughter and family in France. Active in SIPES, AGS and bi-monthly gatherings of old UT grads. Made the rank of octagenerian and going strong."

Victor King (M.A. '57), writes, "Been retired from Shell Oil here in Bakersfield, Ca. for about as long as I worked. I'm a '57 graduate of UT Austin. My how that area has changed since then. Would like to hear from some of my fellow grads if any of you are still around. Vic King."

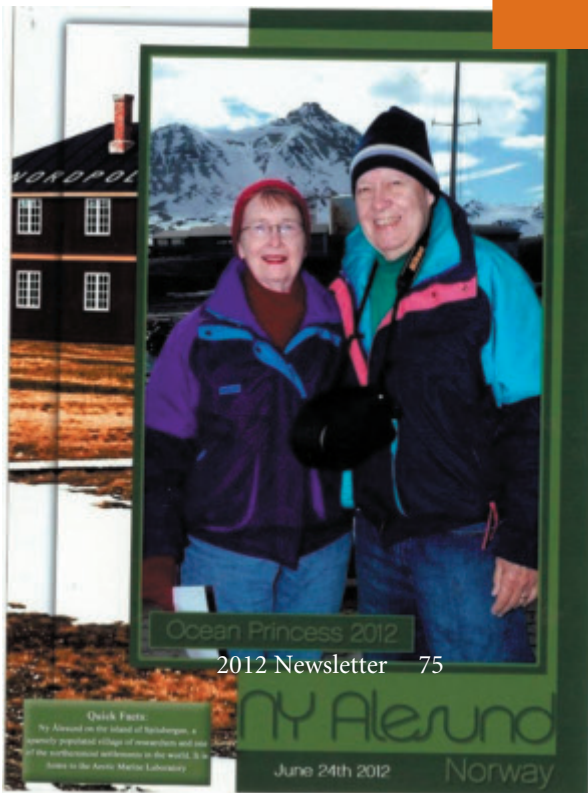
H. Lee (B.S. '54; M.A. '58), writes, "Was fortunate on a recent trip to England with Dwight Cassell (B.S. 55; M.A. 58) to visit the Earth Sciences Department of Cambridge University. The high point of the visit was the Sedgwick Museum. On display were many of the fossil and mineral specimens from Darwin's 1831-1836 voyage of HMS Beagle. (www.sedgwickmuseum.org/exhibits/darwin) Meanwhile here at home in Austin, I still do some consulting for clients exploring Louisiana offshore and the horizontal drilling resource plays."

Nancy Lister (B.A. '55), writes, "My husband Ray and I enjoy doing things with our 3 sons and 3 grandchildren. We travel to Estes Park, Colorado each year to go on hikes in Rocky Mt. National Park and to enjoy the beauty all around us. We love to go to events at the YMCA of the Rockies! We travel to Rockport, TX several times a year to fish and just relax. We all go to Falfurrias, TX to hunt quail and do as much as possible. We're a very busy family, and Ray and I are really enjoying our retirement years! Best wishes to all! I love learning news about my fellow geology students. I received my BA in geology in 1955."

Wayne Miller (M.A. '57), writes, "Not much change in the past year. Continuing with full time consulting. Also, have been able to get a few more wells drilled on some old producing areas. Hope to attend the next reunion. Everyone's doing okay here in Midland." Wayne can be reached at wdmillergeol@aol.com.

Howard Lowe (B.S. '48) photographed in 1949 at Rub' al-Kahali in Saudi Arabia, west of the discovery well at Ain Haradh (the south end of Ghawar Field)

Jimmie Russell (B.A. '52; M.A. '54), writes, "No exciting trips this year, but still relishing the one to Italy last year lead by Professor Earle McBride. Just the mostly routine things a working person who is a homeowner does. Hold it!, we are almost finished remodeling the bathroom. Yes, it is about 10 times harder fixing something than doing it right the 1st time! I will shortly commence my 16th year working with Emotionally Disturbed middle- & high school Special



Walt Boyle (B.S. '54, M.A. '55) and wife Vada on vacation in Norway.

Gipson Wins Drake Award

In March, Bill Gipson (BS '48, MA '49), an honorary life member of the Geology Foundation Advisory Council, received the Edwin L. Drake Legendary Oilman Award from the Petroleum History Institute (PHI). The Drake is the PHI's highest award, "directed to those persons who during their worthy careers have materially contributed to the process of finding, producing, transporting, and refining crude oil and natural gas. These recipients have enriched the oil and gas industry by contributing to its store of knowledge, technology, and history."

Needs students." Jimmie can be reached at ritalrussell@gmail.com.

Floyd Sabins (B.S. '52), writes, "My Company "Remote Sensing Enterprises" has completed 11 Mineral Exploration Projects in Afghanistan that were sponsored by the Task Force for Business Stability of the U.S. Department of Defense. We digitally processed and interpreted satellite and aircraft images to identify targets for future exploration. We used various combinations of multispectral, hyperspectral and thermal IR data. I still refer to photogeologic methods I learned from Professor Sam Ellison at UT in the early 1950s."

Eugene Scott (B.S. '57), is still a consulting Petroleum Geologist in Corpus Christi, Texas.

Earl Shahan (B.S. '56), writes, "Still live in San Angelo; hunting, fishing, and playing golf. Hot and dry right now. Enjoy the news from the newsletter. Miss the old friends."

Samuel Sims (M.A. '57), writes, "I continue to do consulting work at local stone operations; however, I am rapidly approaching the status of full-time retired. Health is commensurate with age, i.e., usual aches and pains, but nothing onerous. Regards to those of you who remember me." Samuel lives in Bethlehem, Pennsylvania and can be reached at sims1961@ptd.net.

Theodore Stanzel (B.S. '56), writes, "I am pretty much at leisure to do the projects I want to do, although I stay active with Family Foundation responsibilities; I have opportunity to play golf more now and travel again as I once did. My life status has changed since June 2011 when I married and have been enjoying life to a much greater extent. We both do most everything necessary to maintain good health. That means eating right and exercise. Yes, life can be beautiful in later years." Theodore can be reached at tedstanzel@verizon.net.

Robert Travis (B.A. '57), writes, "My daughter and all my grandkids decided to move to Austin. So, Peggy and I decided to follow them. Why Not! We both love Austin anyway. So far the transition has been easy. There are many people who have recently moved to Austin, and they are trying to fit in also. Finding new friends and activities has been easy."

Robert Williams (B.S. '54), resides in Dallas, Texas where he is retired at age 81.

1960s

Robert (Sam) Singer (B.S. '61), writes, "Still working as Reserve Consultant after 47 Years."

Hugh Balkwill (Ph.D. '69), resides in Radium Hot Springs, British Columbia and is retired.

Charles (Chuck) Caughey (B.S. '69; M.A. '73), writes, "Working international new ventures for Noble Energy in Houston."

Robert Fakundiny (M.A. '67; Ph.D. '70), writes, "I'm still working on several geological projects, including writing a paper on a late Pleistocene/Early Holocene landslide, just south of Syracuse, NY, which may be the largest in the eastern U.S. (2.5 miles long, >.1 mi^3 in volume); completion of geologic mapping in the High Peaks of the Adirondack Mountains; and correlation of tectonic units in the northeastern Adirondacks. I'm also consulting with New York state on the decommisioning of a nuclear-fuels reprocessing facility and associated radioactive-waste burial sites." Robert lives in Rensselaer, New York and can be reached at fakandannie@earthlink.net.

J. Phil Jones (B.S. '64), writes, "Greetings from Oklahoma. I've retired and am busy with travel to NY to visit grandchildren and to MT/WY to visit brother and spend a week in Yellowstone with son, son-in-law, grandson Clay and friend Will, and 1st time visitor to YNP, grandson, Jake. Had a wonderful time. I would love to hear from grads from the 1964 era or any whose paths I have been favored with in the past. My wife and I greatly enjoyed the Kansas football game from last year and the opportunity to visit the ever-growing campus. Best Regards to All and Keep Up the Good Work, J Phil."

Rubin Schultz, Jr. (B.S. '61), writes, "Not a lot new here. Still enjoying retirement, visiting grand kids, traveling, etc. Nanny and I spent some time in the Provo and Park City area of Utah in June. Enjoyed some cool mountain air. Would love to see some of my old class mates. If any visit the Corpus Christi area, give me a call or an e-mail. " Rubin can be reached at schultz.331@att.net.

William Feather Wilson (B.S. '60; M.A. '62), writes, "working on Texas Geology as an oil and gas and groundwater consultant and generating prospects. Some limited European consulting as well." William can be reached at featherg@hctc.net.

1970s

Charmaine Bentley (B.S. '77), writes, "Still teaching." Charmaine lives in Plano, Texas and can be reached at cbentley@dallasisd.org.

Patrick Abbott (Ph.D. '73), writes, "Geology still fills my life. I enjoy: teaching classes, especially in large lecture halls; working on the 9th edition of my Natural Disasters textbook; lecturing on cruise ships; and being a regular performer on the new Deadliest Planet TV series on the History Channel." Patrick lives in San Diego, California and can be reached at professor_pat_abbott@yahoo.com.

Kelton Cloud (B.S. '73), writes, "It has been a busy year with a lot of rigs running. XTO is still operating about the same (since Exxon Mobil bought us in 2010). I am continuing to work the Arkoma Basin. Jo Beth retired from school teaching last year and I may join her in a couple of years. It has been fun watching our grandsons getting older (now 7 and 3). Hook-em Horns!" Kelton can be reached at kcloud@wildblue.net.

Frank Cornish (M.A. '75), writes, "I'm continuing to work with SV Energy in Corpus Christi. In two weeks we will spud my first well in 4 years. I have six shallow yegua oil prospects to drill, and hopefully more to come. I am currently working on two 3D's in South Texas looking for oil and high liquid gas in Yegua and Wilcox. I will be presenting a paper at GCAGS this October entitled Do Upper Wilcox Incised Valleys Support Paleogene GOM isolation? I am an AAPG delegate and attended the Long Beach convention and will be in PA for the one next year. I also went to Maine for the SIPES convention. One of the most enjoyable of my activities is being the Alumni rep in Corpus for the UT JSG because of the continued contact with the school, profs, and all of us alums. Along those lines I hired Jeffery Peralbo, an undergraduate UT geology student from Corpus for the summer, along with two UT business majors."

Chairman and CEO Randy A. Foutch (center) of Laredo Petroleum rings the opening bell at the New York Stock Exchange on December 16, 2011 in honor of Laredo's IPO.

"One of the most enjoyable of my activities is being the Alumni rep in Corpus for the UT JSG because of the continued contact with the school."—*Frank Cornish*

Patricia Dickerson (B.A. '70; Ph.D. '95), writes, "Fall brought further field work in the Marathon Basin (West Texas). Productive and pleasurable research with TCU friends/colleagues has resulted in an excellent thesis by our student cohort, as well as co-authored GSA presentations this year at a sectional conference and at the upcoming annual meeting. Spring found me on the road to Alpine for both that GSA section meeting and the West Texas Historical Association conference.

For the 100th anniversary celebration of the founding of Brewster Co. and Alpine, I was invited to talk about the geologic history of the territory, fun to note how the geologic heritage has shaped the human history.

At NASA - Johnson Space Center, an oak honoring Bill Muehlberger was planted in the memorial grove; it was a privilege to take part in the dedication. At the same time two textbook chapters, one co-authored by Bill and me and one by me were published. Joe Reese (JSG Ph.D.), Dennis Trombatore and I are converting Bill's selected slides, taken by astronauts aboard Shuttle and Space Station, into topical suites of digital images that will be publicly available teaching resources. Farther afield was a Road Scholar geological excursion through New Mexico in April. A visit to AGI in Alexandria, VA permitted me to work directly with my coworkers there during spring on the Potomac. The coming spring will be full as well, JSG hosts the GSA South-Central Section meeting here. I'm co-chairing a theme session and have proposed a field trip on Big Bend tectonics.

Work with GeoRef (AGI) keeps me in the fine UT geology library and in daily contact with stimulating researchers and ideas, most recently affording new insight into an enigmatic Ordovician formation in the Marathon mayhem."

Paul Hoffman (B.S. '75), writes, "Tina & I really enjoyed visiting with UT alums at Long Beach, especially good times with Frank & Diane Cornish. Still in conventional exploration; we even sold two gas prospects this spring! Looking forward to having Rick & Jeanne Hart as weekend neighbors at Lake Livingston! Our 6th

Robertson Honored as a Legend of Unconventionals

In January, the Houston Geological Society honored four legendary "unconventional wildcatters" of the Barnet, Eagleford, Bakken, and Marcellus Shale plays, including former student Gregg Robertson. After attending UT Austin the 1979 and 1980, Robertson returned to Corpus Christi to join in the family business, First Rock, Inc., which has operated production across all of South Texas and participated in several joint ventures with larger independents as a consultant and non-operator.

grandchild was born in mid-July, and the oldest is 2 1/2! We're loving it. Could the best be yet to come?!"

Melody Holm (B.A. '75), writes, "I'm enjoying a change in career emphasis from oil and gas—first in private industry and more recently in federal land management—to directing a U.S. Forest Service national staff overseeing management of geologic resources and geologic hazards on National Forest System lands. One never knows where a career path might lead! Husband Stan Cadwell and I continue to enjoy the Rockies, though Texas becomes pretty attractive about the end of January!"

Janie Hurley (B.S. '78), writes, "My husband Steve and I have started our own company, Perfecta, after his recent retirement from Hunt Oil. We are mainly involved in oil and gas industry investments, however, nothing is off limits. I wish all of my 1978 buddies all the best and remember all of our great times."

John Irvin (B.S. '79), resides in Midland, Texas and owns LAMA Energy, LLC.

Alan Joyce (B.S. '74), currently resides in Frisco, Texas.

Bob Kent (B.S. '72), writes, "We are both (Suzie and Bob) retired and living on the Brazos River below Granbury. I am staying busy doing research on historical water systems, traveling, a few papers presented at conferences and doing a lot of fishing. Lots of room so if you are in the area, stop by. " Bob can be reached at sbkent@charter.net.

David Kirchner (B.S. '74), writes, "I am still living in Phoenix. And still working/consulting for food; still a member of the esteemed Advisory Council of the UT Geology Foundation. My lovely wife/geologist, Kathy, is retired and helping to support The Orme School in Central Arizona. Our sons Kory and Kody are attending Northern Arizona University in Flagstaff. Kory will graduate in May, 2012, with a Bachelor's Degree in Geology; he plans to continue his education in geology; he has applied to graduate school at The Jackson School of Geosciences, Colorado School of Mines, and the University of Wyoming. Our youngest son Kody is majoring in Mechanical Engineering. Life is good. Please come visit us. It's not even hot during the summer." David can be reached at kirchner@basin-and-range.com.

"Am looking forward to the GSA-Jackson School Antarctic Trip."—*Bob Merrill*

Chris Kreitler (M.A. '72; Ph.D. '74), writes, "Semi-retired (only doing the fun stuff) and teaching a course on Groundwater Resource Evaluation in the Energy and Earth Resources (EER) program in the Jackson School (UT). " Chris lives in Austin, Texas and can be reached at ckreitler@sbcglobal.net.

John Kuykendall (B.A. '75), resides in San Antonio and is a Project Geologist at PSI, LNC; he can be reached at jscottcts@grandecom.net.

Ray Leonard (M.A. '77), writes, "After a 13 year stretch overseas in Kazakhstan, Russia, Hungary and Kuwait, I finally came home in 2009. The past year was spent living in Houston as President and CEO of Hyperdynamics, a NYSE-listed Oil and Gas Exploration Company drilling in deepwater West Africa. I am very happily married with my three children living and working in Argentina (Anya), Alaska (Dan) and Houston/Angola (Ben). Ben is also a UT Masters Graduate, in Petroleum Engineering working for Chevron. I look forward to seeing old classmates at UT and AAPG functions!" Ray can be reached at rclfioc1@aol.com.

Sharon Maxwell (B.S. '78), writes, "Steve and I celebrated our 30th wedding anniversary, though it seems impossible that we've been blessed with that many years! God is good!! Son, Nathan, is doing well in his career. Grandchildren, Jacob (6) & Taylor (2) are the delights of our life.Graduated in May 2012 with a Master of Arts in Christian Leadership. I know God is about to make a career move for me, and it's exciting to know that He is leading me where He needs me to serve. Next year's update should be interesting and fun! All the grad's from 1978 - I'd love to hear from you!"

Bob Merrill (Ph.D. '74), writes, " I've retired after 35 years of teaching Geology at Calif. State Univ. Fresno. I served 12 years as Dept. Chair and 4 years as President of the Faculty Union (CFA). Am now consulting in geology, archaeology, and land-use planning, as well as traveling, kayaking, and art collecting. Oldest son, Cyrus, BA Pomona College, 1993, Fullbright Scholar at McGill, 1994, and MA from University of Texas Austin in Political Science, 1998, now teaches at Harker Preparatory School in San Jose CA, where he also coaches forensics and soccer. Younger son, Than was Top Scholar Athlete for State of California 1996, attended Stanford on football scholarship, graduated Yale 2001, drafted by Tampa Bay in National Football League and played there, and for Chicago Bears. He then built the real estate investment firm CT Homes and Fortune Builders Real Estate in New Haven, Conn.,

In honor of the Summer Olympics, Frank Cornish (M.A. '75) sent these photos from the "coring Olympics" circa the summer of 1974 or 1975. Pictured in the mud at Corpus Christi Bay are (in no particular order) Tom Connally (M.A. '81), Mark Goodrich (Plan II, B.A. '75), Dennis Murphy (Liberal Arts B.A. '75), Mike (Mac) McKinley (deceased), Jon Herber (M.A. '81), Paul Smith (B.S. '84), and Pam Luttrel (B.A. '73, M.A. '77).

and gives real estate seminars nationwide. Than now lives in San Diego, CA. Stepson Alex graduated UC Santa Cruz in Economics and Environmental Science, and now is employed in the solar industry. Wife, Diane, retired as an account executive from Pacific Gas and Electric Company. Am looking forward to the GSA-Jackson School Antarctic Trip."

Larry Miller (B.S. '79), writes, "After Hunt Petroleum was sold to XTO in 2008, we started Peregrine Petroleum, which is owned by some members of the Hunt family. We are active in the Bakken/Three Forks and Wolfberry/Wolfcamp plays. I still make it to most Longhorn football games and enjoy my time in Austin."

Harry Mueller (Ph.D. '75), writes, "My wife, Susan, and I have retired to Fort Collins, CO, where I have helped to form an informal geoscience group (society is too formal a word for this group) that meets every other month for lunch, conversation, and a geoscience presentation.

M. Thompson (B.S. '75; M.A. '77), writes, "Retired in late 2011 after 34 years with ExxonMobil. Keeping busy with the house here in Houston and with the Ranch (and underlying Eagle Ford) in South Texas."

1980s

Carol Baker (B.S. '84), writes, "Rodney and I will be empty nesters all too soon."

Patricia Bobeck (M.A. '85), writes, "After a hectic first year as a doctoral student in hydrogeology, I went to France to 'refresh my French' and look closely at several research topics in Europe. Highlights of the year have been total re-immersion in mathematics, belly-to-the-ground karst excursions, and hydro field camp in the Valles Caldera. I continue to speak about Henry Darcy and his contributions to hydrogeology and society most recently at the International Association of Hydrologists meeting in Quebec in 2011 and coming up at the Niagara Falls meeting in 2012. I am also enjoying the thesis and dissertation writing workshops I teach in the Jackson School, and the number of repeat customers tells me the students also like them.

Steve Carlson (M.A. '84), writes, "I've been working in Maersk's regional deepwater exploration group in the Gulf of Mexico for four years now and am still having fun. Daughter Erin has an undergraduate degree and is working in psychology; daughter Rita will finish her degree in nutrition this fall and will be married next spring; son Russell is headed off to the Colorado School of Mines this fall and daughter Zoe is a high school sophomore. Wife Jenny is expanding her psychology expertise into neuropsychology and is hopeful her private practice will expand accordingly."

Dedication of Muehlberger Memorial Tree
NASA – Johnson Space Center • March 16, 2012

On a fine spring day, friends and family of Bill Muehlberger gathered in the memorial grove at NASA – Johnson Space Center for the dedication of a live oak tree, planted there in his memory. Dean Eppler (NASA – ARES Directorate, Surface Science Operations) organized the thoughtful tribute and presided at the ceremony. Dean spoke of Bill's inspiration – first, through his scientific work in New Mexico, then through his highly effective astronaut field training, beginning with the Apollo program.

Duane Ross (NASA – Manager, Astronaut Selection and Training) assisted in organizing the event, while continuing to screen 6373 applications for the 2013 astronaut class. In charge of logistics on Bill's geological/geophysical field trips in New Mexico since 1995, Duane described the impact of Bill's geological knowledge, enthusiasm, and accessibility on scores of astronauts.

Ross then invited a comment from Patricia Dickerson (AGI/JSG), who co-led the New Mexico field trip with Bill and introduced geophysical training. She spoke of his role as a bridge from orbit to Earth for legions of people. In his countless public lectures Bill showcased the mind-stretching images of the planet, taken by his protégés during Apollo, Space Shuttle, and Space Station missions.

Pat Forrester, crew member of Space Shuttle missions STS-105, STS-117 and STS-126, spoke on behalf of the Astronaut Office. He emphasized that Bill had changed the way in which he and generations of NASA and international astronauts view the Earth. The legacy of Bill's teaching is there in their public presentations, as well as in the many large photographic prints hanging throughout the building housing the Office.

Eric Muehlberger described his and Karen's awe and admiration, as youngsters meeting the space explorers introduced to them by their father. Eric provided their unique perspective on the space program and on experiences that helped to shape both their careers in science and engineering fields.

Dean gratefully acknowledged the contributions of Muehlberger family and friends toward the purchase of the tree and stone/bronze marker. Funds that were received in excess of the cost of the tree have been donated to the Muehlberger Field Scholarship Fund of the Jackson School.

What finer tribute to Bill Muehlberger than the tree at NASA-JSC? Rooted in Earth. Reaching toward space.
—Patricia Dickerson

Muehlberger Fellowship, Scholarship Funds

To assure Bill's legacy endures, two funds were created to honor his contributions to the geosciences: the William R. Muehlberger Graduate Fellowship in Structural Geology/ Tectonics and the William R. Muehlberger Field Geology Scholarship Fund. Gifts are accepted by the Geology Foundation from the "Make a Gift" link on our website Or mail the envelope enclosed with this publication. If you have any questions about these or other funds of the Geology Foundation, please contact us at 512-471-1282.

Richard Carroll (B.S. '80), writes, "Still employed and hoping for higher oil prices. Two wonderful sons, one at the McCombs School at UT starting his sophomore year after a summer as an intern at Texas Monthly, and another starting his senior year in high school and the head drum major for the band. Very proud of my sons and my school. Hook'em!" Richard lives in The Woodlands, Texas and can be reached at richard_f_carroll@utexas.edu.

Daryl Chicken (B.S. '88), Daryl resides in Magnolia, Texas,where he works as a Sales Manager for Scout Downhole, INC.; he can be reached at dchicken@scoutdownhole.com.

David Chow (B.S. '85), writes, "I took second place for my age group in long jump and a 10 event deca challenge at the Texas Senior Games. I run 5K to half marathon road race distances and play pickup soccer and basketball. I have attended more Cougar than Longhorn sports events recently. My daughter is in the business school at the University of Houston."

Stephen Chung (B.S. '84), writes, "I am a Senior Legal Counsel for Transcanada, primarily working environmental matters related to natural gas transmission pipelines as well as the Keystone XL project. It is a challenging and interesting time in the energy industry and I am enjoying applying my technical knowledge to the legal implications of pipeline construction. I ran into and had lunch with Stewart Laufer '84 a few months ago after I saw him on the street; Mike Stinson '83 after working with him for a few years at ConocoPhillips. I have also used Linked In and Facebook for several others. Otherwise, I am enjoying married life in the suburbs raising 2 young girls, Natalie, 11, and Kendall, 7 and watching them grow up. They are definitely little Longhorns even through their cousins and friends are pretty much all Aggies." Stephen can be reached at stephen_chung@transcanada.com.

Michael Clark (B.A. '89), writes, "Looks like we'll be going into a family vineyard business. Turns out, rock and soil types are very important for site selection. Never thought I'd be using geology this way." Michael lives in Georgetown, Texas and can be reached at mjc@compuserve.com.

Tom Connally (M.A. '81), writes, "Enjoying retirement, fall & winter in Austin, spring & summer in Italy. Found souvenirs made from Dr. Folk's Portoro dolomite in Portovenere, with Julie Kupecz and Jeff Copley this fall. Portoro quarries depleted, according to the shopkeeper. Still take short term consulting gigs in Arabia and Oman. Look me up if you are in northern Tuscany."

Don Dean (B.S. '83), resides in Dallas, Texas currently and works for Kosmos Energy as a Senior Geophysicist.

Joseph Ebeniro (M.A. '81; Ph.D. '86), writes, "I have been pretty busy with my students. We have been researching on the location of by-passed petroleum and the use of surface waves in exploration. We are really excited with the preliminary results we are getting. We are also trying to develop the method of using GPR system to determine the depth of pavements below a filled borrow pit. SPDC has always been our benefactor and are happy with our results." Joseph lives in Nigeria and can be reached at joseph_o_ebeniro@yahoo.com.

Steve Germiat (M.A. '88), writes, "Still a partner with Aspect Consulting, doing the environmental consulting gig in Seattle area. One daughter in college, one in high school. All are healthy and doing well. I need to get back to Austin…" Steve can be reached at sgermiat@aspectconsulting.com.

Linda Grace (B.S. '81), currently resides in Galveston, Texas.

Karen Havholm (M.A. '86; Ph.D. '91), writes, "Some graduate school colleagues from the mid-1980s will remember babysitting for my baby daughter. She is now a mining geologist, just married, and starting graduate school this fall. Thanks to all who helped give her a good (geological) start."

Bill Howard IV (B.S. '82), resides in Houston, Texas and is President of Flare Resources Inc.; he can be reached at bhoward@flareresources.com.

Daniel Huston (M.A. '87), writes, "Our consulting business (Hunter 3-D, Inc.) celebrated 16 years as an independent geophysical company in April of 2012. Our oldest daughter Lana is headed to Purdue this fall majoring in BioChem. We run a Grand Banks 42 on Galveston Bay for fun on the weekends. Hook em. - Dan." Dan can be reached at hunter3d@wt.net.

Charles Johnson (B.S. '83), writes, "We are continuing to exploit opportunities in old fields. Over the last couple of years we have made some significant acquisitions in the Oligocene/Miocene trends of Texas and South Louisiana. At home, we are still working on rearing five children, and hope to have the oldest out of college soon.... hoping....hoping."

Mark Kasmarek (B.S. '82), writes, "Completed my 3rd MODFLOW groundwater model 'Hydrogeology and Simulation of Groundwater Flow and Land-Surface Subsidence in the Northern Part of the Gulf Coast Aquifer System, Texas' that not only simulates gw flow in the Chicot, Evangeline, and Jasper aquifers and the Burkeville confining unit, but also simulates land-surface subsidence. The modeling task was a 2 year effort, and the model and Scientific Investigations Report documenting the creation and calibration of the model was USGS approved and can be viewed or downloaded from persistent URL: http://pubs.usgs.gov/sir/2012/5154/. Additionally, our annually produced Scientific Investigations Map (SIM) report 'Water-Level Altitudes Water Year 2012 and Water-Level Changes in the Chicot, Evangeline, and Jasper Aquifers and Compaction 1973 - 2011 in the Chicot and Evangeline Aquifers, Houston-Galveston Region, Texas' has been completed and should be approved for publication within weeks. The report series began with the publishing of water-level altitudes of the Chicot and Evangeline aquifers in 1977. The 2011 SIM 'Water-Level Alti-

ExxonMobil Features Darwin in Science Video

In one of a series of videos saluting the critical role teachers play in science- and math-related careers, ExxonMobil featured Pam Darwin (M.A. '84), vice president for exploration and senior geologist at ExxonMobil. Through programs like the Fortune Most Powerful Women Summit, Darwin is a dedicated mentor encouraging young women to pursue careers in math and science. She's also an avid supporter of the school, funding (with her husband Barnes) the first formal endowment for GeoFORCE Texas. The Darwin Family GeoFORCE Texas Fund helps assure the long term availability of resources so students admitted to the program can continue their geosciences journey throughout high school.

tudes Water Year 2011 and Water-Level Changes in the Chicot, Evangeline, and Jasper Aquifers and Compaction in the Chicot and Evangeline Aquifers, Houston-Galveston Region, Texas' can be viewed or downloaded from http://pubs.usgs.gov/sim/3174/. The woods are lovely, dark and deep.But I have promises to keep, And miles to go before I sleep, And miles to go before I sleep. (Robert Frost, circa 1923)." Mark can be reached at mckasmar@usgs.gov.

Scott Kelley (B.S. '86), resides in Weatherford, Texas where he works as Manager of Geology Fort Worth Basin for XTO / ExxonMobil. Scott can be reached at scott_kelley@xtoenergy.com.

John Kuehne (M.A. '89; Ph.D. '96), writes, "I am working at McDonald Observatory making telescopes rotate the opposite direction to the earth, which turns out to be an interesting twist to my work on earth rotation with Clark Wilson. Turning 50 was an eventful year: I spent a week in London with my mother and my daughter Alexandra (who is now 18), and I become a grandfather."

Sheri Larson (B.S. '84), writes, "I have tried to find my classmates on line over the years, but not many are out there, I would be happy to hear from you if you see this post!" Sheri lives in Richardson, Texas and can be reached at sheri@parkerleigh.biz.

Janet Manchester (M.A. '89), resides in Troy, New York where she works as a Cartographer for the New York State Museum in Albany, New York.

Katie-Joe McDonough (B.S. '80), writes, "I've been busy building my thriving consulting business (see KJM Consulting for all your Seismic and Sequence Stratigraphy needs!) while raising and now trying to launch our 3 boys. All welcome to escape the heat to our home in the mountains above Denver!" Katie-Joe can be reached at kjoemcd-consulting@yahoo.com.

Charles Montero (B.S. '84), writes, "I'm still plugging away in the environmental consulting field. Work is steady. We're looking forward to the possibilities that are developing with Shale Oil/Gas and frack-ing might bring to our industry in the near future. Shout out to all of those that went to the USM field camp in Switzerland in summer of 1984. Still have fond memories of that summer adventure and the weekend beer festivals around Solothurn... eeerr I mean the great learning experience! Can't believe it's been 28 years. Our oldest daughter graduated from UT@Austin recently making her a 5th generation Texas Ex! Our middle daughter begins college this fall and will be playing volleyball (on someone else's nickel for the next several years, wooohooo!). Our baby still has a few more years before we kick her out of the nest... well maybe kick out isn't the right term, more like beg her to stop growing up." Charley can be reached at CAMatRSA@aol.com.

Frank Morgan (B.S. '82), resides in Baton Rouge, Louisiana and works as an Applied Depositional Geosystems Fellow for LSU Department of Geology and Geophysics.

Marian Morris (B.S. '81), resides in Harstad, Norway and works in Exploration for Statoil Petroleum.

Dalia Niederer (B.S. '80), lives in Jackson, Wyoming where she is retired.

Woody Pace (B.S. '85), writes, "Moved over to Talisman in 2011 after 22 years with Marathon Oil. Lived in Calgary for 1 1/2 years and have recently relocated back to Texas based in our Woodlands office." Woody can be reached at wpace@talismanusa.com. Woody is a member of the Geology Foundation Advisory Council.

Joseph Patterson (M.A. '83), writes, "I've been with ExxonMobil since UT graduation (MA'83)... although by assimilation via Superior Oil & Mobil Oil mergers; resistance was futile. I've been a geologic modeler since 2003, currently working offshore Angola. It's been an interesting ride ... Denver (6yrs-Paradox, Williston,Overthrust), Bakersfield (7yrs-SJV Heavy Oil Steam Floods...enough said), Dallas (3yrs-Offshore Nigeria), Houston (7yrs-Nigeria, Chad, Sakhalin), Melbourne (3yrs-Bass Strait) and back to Houston (2yrs-Angola). It only took 20-25 years for the job market to pick up ... about time ... hope it lasts." Joseph can be reached at joe.e.patterson@exxonmobil.com.

Gene Pisasale (M.A. '80), writes, "To the Geology Grad School Class of 1980: I've been working for the last two years at two jobs - Director of Marketing for GG- One Software, a family business and as an author/lecturer after retiring from the investment industry in 2010. I've given over 100 lectures on historic topics and written four books, including two historical novels of the Philadelphia area, *Lafayette's Gold-The Lost Brandywine Treasure* and *Abandoned Address-The Secret of Frick's Lock*. *Lafayette's Gold* is about George Washington, Lafayette and the Battle of the Brandywine; *Abandoned Address* is about the Industrial Revolution in America. I'm now working on my fifth book, which will focus on the War of 1812 and real life mysteries surrounding the Star-Spangled Banner. It should be out by year-end 2012. I'll be visiting Austin, Texas on November 8th-10th, 2012 for a friend's wedding and will be stopping in to see Dr. Luigi Folk and Dr. Earle McBride. I'm treating for beers and Mexican food (or perhaps barbecue at a good spot), so any alumni who want to join us, please let me know!! We'd love to see you. E-mail: Gene@GenePisasale.com; www.GenePisasale.com All the best, Gene." Gene can be reached at Gene@GenePisasale.com.

Robert Reed (B.S. '85; Ph.D. '99), currently resides in Austin, Texas.

Cory Richards (B.S. '85), writes, "Busy drilling horizontal oil wells in several Pennsylvanian sands in the Anadarko Basin. Our most successful play has been the Marmaton sand where we have seven out of seven wells with initial rates over 500 barrels of oil per day and over 50 additional locations to drill. Hoping to sell the assets of the company later this year and take a little time off before starting again. Hosted 7 interns with this company trying to encourage them to try geology.Both daughters are nearly finished with college and Amy and I enjoy travelling together when time allows. Hi to all the geo dogs from '85. I stopped by Sipapu last week while in N.M." Cory can be reached at crichards@planopetro.com.

Jerry Schwarzbach (B.A. '83), writes, "My son is studying Mechanical Engineering at UT. Read with great interest about the passing of Dr. Clabaugh (was a member of my father's Master's Thesis Committee) and Dr. Muehlberger (was an instructor of my father and myself, very fond memories of time spent with him). Physician in Tyler, still enjoying flying."

Matt Sjoberg (B.S. '86), writes, "Although I've been practicing oil and gas trial law throughout Texas for over twenty years, I still consider myself a Geologist with a law degree as oppose to the converse!"

Stephen Speer (M.A. '83), writes, "Still hanging out in the wonderful Lowcountry of SC with my lovely Therese. Got a visit from fellow Dirty Dozeneers Dave Noe and Barb Luneau and their better halves this spring.....too much fun. We decided that it would be a good idea for the Dirty Dozen extended family to all try to make the All-Alumni meeting in Austin next April as it will somehow be 30 years since all of our fun, pain and suffering at the campus basically ended and we moved on to the next phase of pain and suffering (at least for some of us....some liked it more than others and chose to hang a bit longer, but who's counting?). So, all you Dirty Dozeneers.....you are hereby notified of a party next spring. Be there...." Stephen can be reached at speerex@comcast.net.

Burgess Stengl (B.S. '85), writes, "In June 2012, I celebrated my 10th year with Allied Waste/Republic Services. Angela and I also recently celebrated the wedding of our daughter Susan, and the birth of our third grandchild, Ethan Aaron. Her family is living in the Houston area, as are we. Angela continues to teach in the Klein school district, and our son Kyle will be starting high school in the fall. Kyle attended UT band camp in Austin earlier this summer, and it was good to be back walking on campus. Our daughter Shara is living in Hutto, Texas (home of the Hutto Hippos), and has two children. I have not made it to any of the alumni events, but hear good things about them from Walt Boyle at church. I'd like to say hello to Jimmy Russell, Will Green, and everyone in the Class of '85." Burgess can be reached at bstengl@republicservices.com.

Bruce Swartz (B.S. '82), writes, "Still kicking around in West Texas. Not involved in the shale plays. Purely conventional ." Bruce can be reached at bruce.swartzoil@gmail.com.

Galen Treadgold (M.A. '85), writes, "Four years ago the little company I had worked for since 2000 was purchased by a larger seismic company - Global Geophysical. I'm spending a lot of time looking at unconventional plays in the US and trying to make sense of the well results. I'm traveling a bit more than I'd like but seeing some interesting places." Galen lives in Plano, Texas and can be reached at galen.treadgold@globalgeophysical.com.

Amy Vanderhill (B.S. '83), writes, "Busy planning wells in the Eagle Ford Shale play for PXP. Ceili graduated from A&M and is now a Chemical Engineer for Mars Chocolate in Kansas. Shannon is a Senior in Design and Meagan is a Sophomore in Advertising at UT. Jim and I have been enjoying competitive NSCA Sporting Clay tournaments." Amy can be reached at avanderhill@pxp.com.

James (Jim) Vanderhill (Ph.D. '86), writes, "Continue to work at ExxonMobil as Advisor in Production Company. Ceili graduated from A&M and is now a Chemical Engineer for Mars Chocolate in Kansas. Shannon is a Senior in Design and Meagan is a Sophomore in Advertising at UT. Amy and I have been enjoying competitive NSCA Sporting Clay tournaments." Jim lives in Bellaire, Texas and can be reached at jim.b.vanderhill@exxonmobil.com.

Joseph Versfelt (B.A. '84), writes, "I joined Apache in 2010, working 2 years in Buenos Aires, Argentina as its Region Exploration Manager. After 2 years, I have been transferred to Cairo Egypt in a similar capacity, Region Exploration Manager. I also met Tony Matthews (UT Austin, Petrol. Eng.

1983) here at Apache. If you are ever in Cairo, give me a call. If not, it would be great to hear from you still (Geo - Class of '84)." Joseph can be reached at jversfelt@comcast.net.

Mark Walker (B.A. '81), writes, "I am head of the El Paso office of the Cox Smith Matthews law firm, where I lead a diverse litigation practice, including recent high profile defense of El Paso's mayor in a recall election and a acity representative during municipal elections. Kathleen Walker, another UT Law grad and wife of 25 years, is a national leader in immigration law and former national President of the American Immigration Lawyers Association. Son, Lee, is a junior in high school and considering his options, including UT's JSG. When not practicing, I travel to beautiful places to fly fish." Mark can be reached at mwalker@coxsmith.com.

Leslie Warren (B.S. '85), writes, "Shout-out to all the '85 GeoDogs! Scott and I are still living in Katy but as empty nesters now. The adjustment has not been easy, but we are finding it easier to actually enjoy our Lake House instead of pulling teens around on wakeboards and tubes - but I do miss the chaos at times. I've been with Schlumberger for 22 years which is quite amazing for a UT Grad who survived the Pat Biggs well log analysis courses. For those of you who don't remember - he was an ex-SLB employee and as far as I was concerned I never wanted to work for a company filled with Petroleum Engineers like him! Obviously I have been pleasantly surprised and have so enjoyed the people I have worked with. I recently transferred to a new position to build a Project Management training program that will be offered internally to SLB as well as our clients. This is quite exciting as I have been what could best be called a 'Project Management Champion' within SLB for nearly 15 years now! Hope everyone is doing well, Leslie." Leslie can be reached at warren6@slb.com.

1990s

Kenneth (Keg) Alexander (M.A. '90), writes, "After 4 years in New Zealand, we have moved back to the San Francisco area. I am working as a geothermal exploration geologist for Geologica, a small environmental and geothermal consulting firm in the city. We provide geothermal exploration and development expertise at various US and international project locations including Turkey, Chile, Indonesia, and Nicaragua." Kenneth can be reached at keg.alexander@gmail.com.

Mark Gordon (Ph.D. '90), writes, "At the beginning of the year I moved from the Shell Research Lab to exploration and production. I now work in a technology team supporting shale oil and gas production."

Hector Becemberg Lippo (B.S. '93), resides in San Juan, Puerto Rico currently and works as Vice President for Banco Popular de Puerto Rico.

Amy Campbell (B.S. '97), writes, "After a successful year transitioning my clients to UBS, I founded a home decor import business to combine my passion for far-flung travel and modern-day treasure hunting. Our mantra is to seek the most unique items, make connections with the artists and then connect the artists to our customers. Brilliant Imports celebrates the beauty of craftsmanship and the daily pleasure it brings ~ www.brilliantimports.com." Amy lives in Austin, Texas and can be reached at amy.campbell@ubs.com.

Danielle Carpenter (M.A. '96), resides in Covington, Louisiana and works as Bay Marchand Team Leader for Chevron.

Colby Drechsel (B.S. '94), writes, "I got married to a fantastic woman, Michelle, November 2011, and we are expecting our first child, Jan 2013!! Buying and selling crude oil in the Rockies these days but keeping my technical skills honed on other endeavors related to energy resource extraction. Still living comfortably in Casper, WY."

Douglas Gale (B.S. '97), writes, "Joined UBS in November 2011 focusing on providing capital to upstream, midstream and service companies. Two daughters keep me busy outside of the office (ages 1 and 14)."

Christi Gell (B.S. '96), writes, "Expanded my love of music to a new business teaching early childhood (0-5 yrs) music classes. Crescendo Family Music got started with the idea that families deserve a way to bond together, enjoy music as a family, and to have just plain ol' fun making music together. Check out the website: www.crescendofamilymusic.com. Classes are on Saturday afternoons, so if you live in Houston, shoot me an email and come check out the classes! I still work at Landmark/Halliburton in Houston for my real job as a Sr. Account Manager. Charlie (MS '96 - also at Landmark/Halliburton as a Global Account Manager) and I have two kids - Kat (3 yrs) and Erik (2 yrs)." Christi can be reached at christigell@utexas.edu.

Brian Hunt (B.S. '96; M.S. '00), resides in Austin, Texas and is a Senior Hydrogeologist at Barton Springs/Edwards Aquifer Conservation District; he can be reached at brianh@bseacd.org.

Karen Jarocki (B.S. '92; M.A. '94), resides in Albuquerque, New Mexico and works as a Project Manager/Operations Lead for CH2M HILL.

Glenn Klimchuk (M.A. '93), resides in Aspen, Colorado and works as a Senior Executive Advisor for TPG Capital.

Dan McConnell (B.S. '95), writes, "Last year was a milestone - it marked the sale of the consulting company, AOA Geophysics, to Fugro, where I had worked previously. I am enjoying being back at Fugro. Our group of geoscientists and geotechnical engineers specializes in high resolution seafloor mapping, geomorphometry, soils characterization, and soils engineering in support of deepwater oil and gas exploration and development around the globe. We have a good UT Austin contingent in our group with Dr. Jim Gharib (B.S. 94) and Hunter Danque (B.S. 03, M.S. 06). We have shared some adventures in Madagascar, Indonesia, and other far reaches, with more to come. It has been fun!" Dan can be reached at dan.mcconnell@utexas.edu.

Timothy McMahon (Ph.D. '94), resides in Katy, Texas and works as GOM Regional Geoscience Supervisor for ConocoPhillips; Timothy can be reached at timothy.p.mcmahon@gmail.com.

Christopher Swezey (M.A. '91; Ph.D. '97), writes, "I am still working for the U.S. Geological Survey (USGS), mostly mapping in South Carolina and Georgia these days. Selene and I live in Louisa County (Virginia) near the epicenter of the M 5.8 earthquake that occurred on August 23, 2011. The devastation near the epicenter was extraordinary, but there was very little coverage in the media. Our chimneys came down, smashed large holes in the roof, and broke rafters and joists. Aftershocks (preceeded by loud rumbling sounds) continue to occur almost a year later, and we have had fun trying to estimate the aftershock magnitudes before they are posted on the USGS web site." Christopher can be reached at cswezey@usgs.gov.

Jennifer Truax (B.S. '92), resides in Rowlett, Texas and works as a Substitute and as a full-time Mom.

Cengiz Vur (M.A. '99), resides in Ankara, Turkey and works as a Senior Geologist for TPIC.

James White (M.A. '95), resides in The Woodlands, Texas and works as a Manager for ExxonMobil.

Kirby Wynn (B.S. '92), writes, "In 2011 I accepted a position as the Oil and Gas Liaison for Garfield County Colorado. Really a unique opportunity to utilize my passion and skills for stakeholder relations work. In this role I work closely with Piceance Basin industry folks, residents and local, state, and federal agencies. Primary focus is to help these groups understand and resolve permitting, social, and environmental issues associating with exploration and production amongst developed subdivisions and on the rural landscape. Never a dull moment. Bess moved from Chevron E&P to Bill Barrett Corp. We continue to enjoy all that western Colorado has to offer." Kirby can be reached at Kirby@kirbywynn.com.

Justin Zumbro (M.S. '99), resides in Irvine, California and works as an Assistant Project Geologist for GeoPentech; Justin can be reached at justin.zumbro@gmail.com.

2000s

Taylor Bartholomew (B.S. '06), writes, "After working on the Atlantis asset in the GOM JIU, I have joined the Shenzi production unit where I have served as team lead on the planning and drilling of deep water, water injection wells for over a year." Taylor lives in Houston, Texas and can be reached at leightaylorb@gmail.com.

Leighton Devine (B.S. '01), resides in Corpus Christi, Texas and works as a Geologist for Suemaur Exploration and Production.

Anne Dunckel (B.S. '09), writes, "Currently attending graduate school at the University of Virginia in the Department of Environmental Sciences. I am working with Dr. Aaron Mills on N_2O gas fluxes from nitrate contaminated agricultural streams. I am a DJ on the university station, WTJU 91.1 Charlottesville, Thursdays 12-2 pm ET playing Latin American music."

Alicia Farre (B.S. '09), currently resides in Austin, Texas and works for the Jackson School of Geosciences as a Student Services Administrator.

Blair Francis (B.S. '07 & M.S. '09), writes, "Luke (BS '07) and I (BS '07 & MS '09) welcomed our own future geologist , Molly Francis, in April 2012. Luke completed his MS at the University of Houston and joins me as a geologist at BP."

Roy Fuller (M.S. '03), resides in Mesa, Arizona where he works as General Counsel / Environmental Compliance for MJI Resources; Roy can be reached at roywfuller@yahoo.com.

Laurel Gandler (M.S. '06), resides in Houston, Texas currently and works as a Senior Geologist for Hess Corporation.

Future Longhorn, Jackson School graduate, and geoscientist extraordinaire Molly Francis was born this summer to parents Blair Francis (B.S. '07, M.S. '09) and Luke Francis (B.S. '07). Molly's grandmother, Sara Avant-Stanley (B.S. '78), and her late greatgrandfather, Joseph Avant (B.S. '51), were also UT geology grads, queueing her up to be a fourth generation Jackson School graduate.

Jennifer Harold (M.A. '09), resides in Houston and is the Manager of the Petroleum Services Group at Deloitte Services, LP.

Guadalupe Hernandez (B.A. '00), resides in Houston, Texas and works as a Data Quality Manager at Morningstar.

Tamara Kahn (B.S. '05), writes, "I am relishing life traveling around the world as a Senior Field Geophysicist for EMGS. While temporarily stationed in our Rio de Janeiro office I am enjoying the views of beautiful granite outcrops, but hope to make it home to attend at least one Longhorn football game this season."

Keri Kelley (B.A. '04), resides in Austin, Texas currently where she works as a Business Development Manager for Texas Association for the Gifted and Talented; Keri can be reached at kerikelley@hotmail.com.

Richard Kilby (M.S. '05), resides in Castle, Colorado currently and works for Source Energy Partners as an Evaluation Manager.

David Kilventon (B.S. '06), resides in Round Rock, Texas and works as a fire fighter for the Pflugerville Fire Department.

Kevin Labbe (B.A. '04), resides in McKinney, Texas and works as a Petroleum Geologist for Petro Harvester Oil & Gas LLC; he can be reached at kevin.labbe@petroharvester.com.

Joel Le Calvez (Ph.D. '02), writes, "Currently residing in Houston managing the Hydraulic Fracture Monitoring US Land processing group for Data and Consulting Services while providing worldwide support as needed."

Jaewon Lee (M.A. '08), currently works for LNG Purchase Team for Korea Gas Corporation.

Ana Manzolillo Ramirez (B.S. '06), writes, "After six years at Repsol USA working deepwater Gulf of Mexico, I have recently accepted a position as a geologist at Maersk Oil Houston where I am working offshore Angola. I enjoy life outside of work with my husband David (also a proud Longhorn, B.A. 2004) and two year-old, Elias (future Longhorn)."

James McGuire (M.S. '03), writes, "After five years of practicing environmental law at a large Texas-based law firm, I joined the City of Dallas as its in-house environmental attorney in October 2011. I look forward to continuing to apply the knowledge and skills I've gained as a geology student at The University of Texas at Austin in my new capacity with the City. I am also an active mineral collector and make an effort to get out into the field as often as possible."

Rosalba Mendoza-Veloza (M.S. '07), currently resides in Houston and works as a Senior Geologist for BP America Inc.

Daniel O'Dell (B.S. '05), writes, "Worked 2 years at Paradigm supporting their Geolog software package, jumped ship to Statoil to be a petrophysicist for a while, then finally had enough money saved up to try my hand at music for a year. Even though I was able to finish an album of original music, I found out I was not a very good boss of myself and I missed having a steady paycheck, so I took Paradigm up on their offer of employment when they came calling a year after I left Statoil. After all that time in Houston, I took an opportunity to work for Paradigm in Brisbane, Australia, where I currently reside. Contemplating my next adventure." Daniel can be reached at daniel.odell@pdgm.com.

Marel Sanchez (M.S. '01), resides in The Woodlands, Texas currently and is a Senior Geophysicist for Repsol; Marel can be reached at marelsanchez@yahoo.com.

Gretchen Stieren (M.A. '08), resides in San Antonio, Texas currently and works as a Landman for Abraxas Petroleum Corporation.

Thomas Thacker, Jr. (B.A. '08), writes, "Oil & Gas Exploration - Permian Basin, East Texas, North Texas, Southern Arkansas, and Northern Oklahoma."

Nina Triche (M.S. '03; Ph.D. '07), writes, "I have recently moved to Perth, Western Australia and am working for the state government in oil and gas regulation. I will be married in November and until then am spending my time avoiding sharks at all the stunning beaches."

Andrew Turner (B.S. '09), resides in Houston, Texas and works as an Operations Geologist for BP; he can be reached at andrew.turner@utexas.edu.

Caspar van der Sar (M.A. '08), resides in The Netherlands and works as a Development Partner for Shell.

Patrick Wheatley (M.S. '04), resides in Burke,Virginia and works as a Project Scientist for the Department of Defense.

Cengizhan Yenerim (M.A. '07), resides in Houston, Texas and works as a Sr. Quantitative Analyst for GDF SUEZ.

2010s

Samantha Abbott (B.S. '11), currently resides in Austin, Texas and works as a Staff Geoscientist for Tetra Tech, Inc.

Thad Bay (B.S. '11), currently resides in Houston, Texas.

George Becker (B.S. '10), resides in Elko, Nevada currently and works for Newmont Mining Corporation as a Geologist.

Margaret Behnke (B.S. '12), resides in Austin, Texas and works as a Geologist in Training for ACI Consulting.

Casey Corbin (B.S. '10), currently resides in Dallas, Texas.

Hillary Cuda (B.S. '11), resides in Houston, Texas and works as a Data Management Consultant for Halliburton.

Kara Dias (B.S. '11), writes, "Entering my second year of graduate school at Stony Brook University."

Autumn Eakin (Kaylor) (M.S. '11), writes, "Was married in December '11! New last name for the alumni records :)"

Erin Eastwood (Ph.D. '11), writes, "I defended my PhD Sept 2011, started work with Shell in Oct 2011, graduated from UT in Dec 2011. I got married to Andrew Smerek in April 2012 - I am now Erin Smerek!"

Luke Fidler (M.S. '11), resides in Boulder, Colorado and works as a Geological Associate for Newfield Exploration; Luke can be reached at luke.j.fidler@gmail.com.

Nick Freidberg (B.S. '12), resides in Austin, Texas and is a medical student at University of Texas Health Science Center at San Antonio.

Andres Gallardo (M.A. '11), resides in Austin, Texas and works as a Market Analyst for IMS Research.

Bart Krishnamoorthy (M.A. '10), resides in Washington, D.C. and works as an

Analyst for Solar Electric Power Association, which is a non-profit organization that works mainly with utility companies in the area of solar energy.

Jasmine Langston (B.S. '11), resides in Houston, Texas and works as a Core Analyst for Core Laboratories, Inc. Advanced Technology Center.

Julia Mechler (B.S. '10), writes, "In January I received my Geoscientist-in-Training (GIT) certification from the Texas Board of Professional Geoscientists!"

Megan Monteleone (M.S. '10), resides in Zelienople, Pennsylvania and works as a Geologist for EXCO Resources, LLC.

Kelly Mortensen (B.S. '11), resides in Midland, Texas and works as a Geologist for Arcadis; she can be reached at KellyAMortensen@gmail.com.

Sarah Peters (B.S. '12), currently resides in Austin, Texas.

Audrey Rozsypal (M.A. '11), resides in Houston, Texas and works for Plains Exploration and Production Company.

John Singleton (Ph.D. '11), resides in Fairfax, Virginia where he is an Assistant Professor at George Mason University.

Silvia Solano (M.A. '10), resides in Fishkill, New York currently.

Faculty, Staff & Friends

William Woods resides in Austin, Texas and is retired.

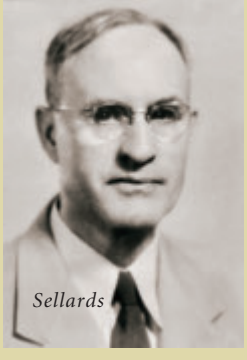
David Grimes resides in Midland and is an Independent Geologist.

Hall of Distinction:

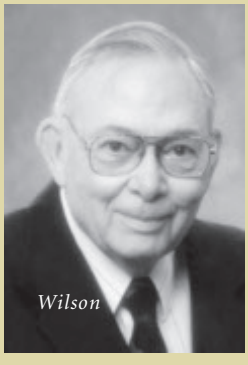
Jackson School Honors Three Geoscience Legends

Last spring, the Jackson School proudly inducted three legends into its Hall of Distinction. They were selected for their high-level accomplishments in academia, industry or government, as well as a strong affiliation with the Jackson School.

Elias Sellards served the university as director of the Bureau of Economic Geology (1932-1945) and director of the Texas Memorial Museum (1938-1957). He also served for many years as a professor of geology and a staff geologist for the Bureau. Early in his career, he settled a dispute between Oklahoma and Texas over the state boundary along the Red River. He wrote a two-volume compendium on the stratigraphy and structure of Texas, with accompanying geologic and structural maps of the state, and a book on "Early Man in America." During the Great Depression, he directed a paleontological survey which assembled an outstanding collection of Pleistocene fossil remains.


Sellards

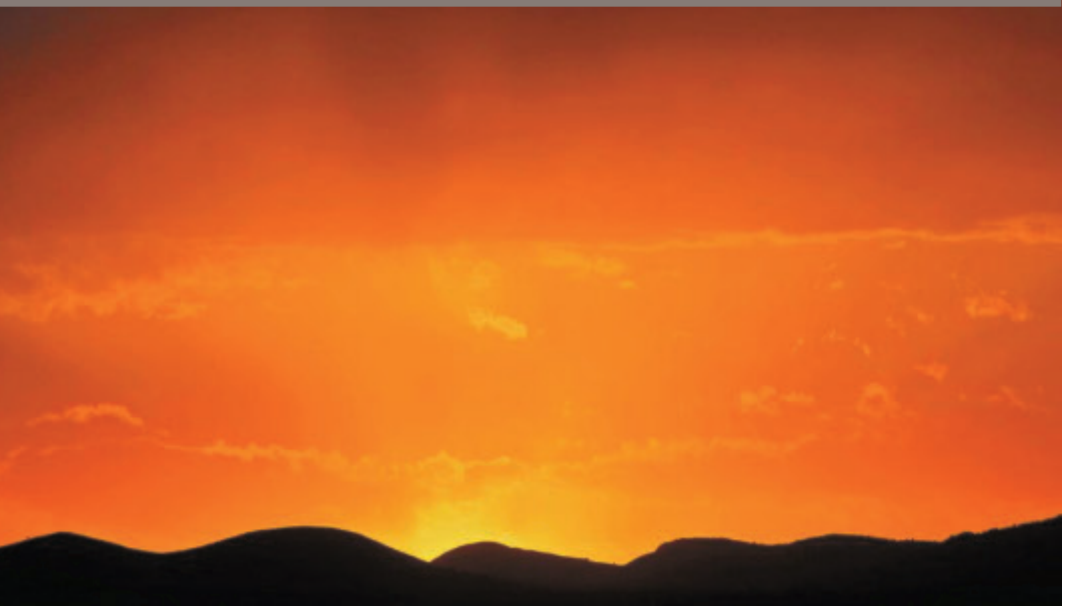
James Lee Wilson, internationally recognized expert on the geology of carbonate rocks, was an associate professor at the University of Texas at Austin (his alma mater) from 1949 to 1952. He served on the Geology Foundation Advisory Council from 1964 to 1967. He worked as a research geologist for the Shell Development Company in Houston, the Netherlands, and the Middle East. Later, he was a professor at Rice University, where he was also chairman of the Geology Department, and at the University of Michigan-Ann Arbor. His 1975 book "Carbonate Facies in Geologic History" is still a standard text on stratigraphy of carbonate rocks. Among his many awards, he received the prestigious Sidney Powers Award from the American Association of Petroleum Geologists.


Wilson

Art Maxwell, a leader in deep sea drilling and marine geophysics, served from 1982 to 1994 as the first director of the Institute for Geophysics. His efforts during his 12-year tenure as director helped develop the Institute into one of the leading geology and geophysical research institutions in the world. He co-led an expedition in 1968 with the Deep Sea Drilling Project that collected some of the first direct geologic evidence in support of sea floor spreading and plate tectonics. He served in key positions at critical times during the "institutionalization" of oceanography in the U.S. He is currently living in Santa Fe, New Mexico.

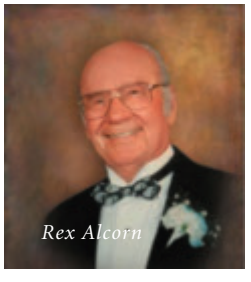

Maxwell accepting his induction award

MEMORIALS



Alumni & Friends

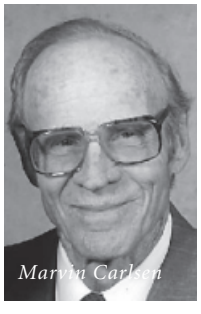
James Munrex "Rex" Alcorn (B.S. '41), 94, passed away peacefully with grace and dignity on April 21, 2011 surrounded by his loving family. Rex was born Oct. 23, 1916, the seventh of eight children born to Minnie and Ezra Alcorn in Little Rock, Arkansas. Upon graduation from high school in Dallas he went to work at Mobile Petroleum Company where he stayed for two years before leaving for the University of Texas at Austin. It was there that Rex learned how to tap dance and performed with a group on weekends earning extra money for college. He was also on the University tumbling team and at one football game entertained the crowd completing 50 flip-flops (back handsprings) across the full length of the football field. Rex graduated from the University in 1941 with a bachelor of science degree in geology. In 1942, Rex enlisted in the Air Force and as a Lieutenant Colonel was sent to England where he became the photography laboratory commander of the Eighth Bombardment Command photo lab. He later became the bomber command photography officer for the Ninth Air Force Bomber Command. While in England, Rex was honored to meet the future Queen Elizabeth and other members of the Royal family. During the war, he also traveled to Germany and France and it was in Namur, Belgium that he met his future wife Bobbi, a professional dancer performing with the United Service Organization, the USO.


Rex Alcorn

Shortly after the war, Rex moved to California for two years and worked for Hal Roach Studios. While there, Rex met many movie stars including George Burns, Bob Hope, Esther Williams, Ingrid Bergman, and dear friend Van Hefflin. Later, he worked for an engineering firm which had a Navy contract in Guam. He had finally come full circle and was back in the business of geology. Upon his return to the States in 1948, he and Bobbi married in Phoenix, Arizona. They then moved to Dallas and Rex began working for Sun Oil Company while Bobbi pursued modeling. In 1951 the couple was transferred to Roswell where Rex was promoted to district geologist. Sons Dennis and David, and daughter Fawn, were all born in New Mexico. Declining another transfer to Texas, Rex became an independent geologist while Bobbi opened her dance studio, the Alcorn Academy of Dance. Rex also taught boys tumbling and acrobatics there for many years. His career was oil and gas, but his heart was in the entertainment industry. Roswellites knew Rex as a gifted Master of Ceremonies as he performed that position for virtually every organization and event in Roswell for 45 years. His most coveted role, however, was to M.C. the dance productions for the Alcorn Academy of Dance. His devotion to Bobbi and his family contributed to the 42 year history of the dance studio.

In his spare time, Rex enjoyed being with his family, playing tennis and traveling. He provided many hours of coaching, wisdom and fun for his children. Above all, Rex cherished and loved his wife Bobbi and was truly a gentleman's gentleman. Rex and Bobbi would have celebrated 63 joyous years of marriage in July. Those who will always treasure his memory include his wife, Bobbi Alcorn of Roswell; son Dennis Alcorn and wife Debby of Prosper, Texas and their children; son David Alcorn of Roswell; daughter Fawn Alcorn-Pierce of Roswell; a large extended family, and many friends.

Marvin T. Carlsen (B.S. '52), died May 12, 2011 of complications from COPD and heart disease. He was born Feb. 15, 1917 on the "Home Ranch," Petaluma, California, to Martin Danklef Carlsen and Teresa Ockaline Petersen Carlsen, emigrants from the Friesian Island of Fohr. He attended Bloomfield Grammar School and graduated from Tomales High School in 1936. In the summer of 1937, he began his love of geology, spending three summers mining for gold in the Trinity Alps of Northern California. During the winters, when the snow was too deep, he worked at the Chevrolet plant in East Oakland. Following this period, he secured a civil service job, working for the Navy at Pearl Harbor, Hawaii. Due to health problems, he returned to California just five weeks before the attack on Pearl Harbor. After working a short time at Richmond shipyard, he enlisted in the Army Signal Corps in Fort Logan, Colorado. He attended several radio schools, the last one in Port Arthur, Texas, where, on a blind date, he met his future wife, Mildred Musick. After


Marvin Carlsen

serving four years in the WWII European Theater, England, France, and Germany, he returned to Texas. He and Mildred were married June 21, 1946, in Port Arthur. He attended UC Berkeley, Lamar Junior College in Beaumont, and then graduated from UT Austin. He and Mildred were transferred to Midland in 1955. He also attended Sul Ross in Alpine for his graduate degree. He was a member of First Baptist Church since 1957, the West Texas Geological Society, and Midland Gem & Mineral Society. He taught Science and Math for 13 years in the MISD, and worked many years as a staff geologist for several oil companies. Preceded in death by his parents, and brothers, Iver, Fred, and Henry. Survived by the love of his life, wife Mildred, married 64 years; daughters, Andrea Harris of Midland, Laura Yates (Earl) of Shepherdsville, Ky., and Donna Cahill (Andre) of Garland, Texas; sons, Charles Michael Carlsen of Mont Belvieu, Texas, and Stephen Carlsen (Alice) of Plano, Texas; grandchildren, Adrienne Ward, Augusta, Ga., Melissa and Stephanie Carlsen, Plano, Neal and Katie Budge, Dallas, and Joseph and Sarah Yates, Shepherdsville, Ky.; also survived by sister Anna Barbee, Petaluma, Calif.; sister-in-law, Virginia Musick, Austin, Texas; and numerous nieces and nephews.

James Harrison Davis (M.A. '60), of Houston, passed away peacefully on Dec. 3, 2011. Jim is survived by his loving wife of 51 years, Betty Brown Davis; his daughters and sons-in-law, Debra Ann Davis Robinson and Charles Frank Robinson, Catherine Roberta Davis Bell and Jacob L. Bell, Jr. and Nancy Dalton Davis Keely and John Keely; his grandchildren, Hannah Elliott Robinson, Harrison Davis Robinson, Ryan Elizabeth Robinson, Tyler Virginia Robinson, Carson Roberta Bell, and Jacob L. Bell, III, all of Houston, Texas; and by his brother-in-law, Robert H. Brown and wife Jeanne of Austin. He was preceded in death by his parents, Mr. and Mrs. Morgan J. Davis of Houston and by his brother, Morgan Jefferson Davis, Jr. also of Houston.


James Davis

Born on March 26, 1935 in Roswell, N.M., Jim was brought to Houston in 1936 by his parents. He was educated at The Kinkaid School in Houston, the New Mexico Military Institute, and Washington & Lee University where he was a member of Sigma Alpha Epsilon fraternity. Upon graduation from Washington & Lee, he attended graduate school at The University of Texas at Austin, where he earned his master's degree in geology in 1960. Jim then embarked on a career in oil and gas exploration where he was a geologist with the Humble Oil and Refining Company (later Exxon Corporation) for 16 years. He then was a vice president with First City Bank, but soon returned to oil and gas exploration when he joined Brock Petroleum and later started Mahada Energy where he was president. Jim was a member of the Houston Geological Society, the American Institute of Professional Geologists, the Geological Society of America, and the American Association of Petroleum Geologists. He was also a member of The Houston Country Club, Allegro, Paul Jones, and the Cherokee Nation. Jim also served on many boards including The Museum of Natural Science and was an honorary member of The Garden Club of Houston. He loved Sunday dinners with his family, "making sawdust" in his workshop, multiple generations of summer camp closings, and his extensive group of friends.

A memorial service, to celebrate a life well lived was conducted Dec. 6 at Christ Church Cathedral in Houston, where Jim served as an altar boy in his youth. In lieu of customary remembrances, those wishing to make donations may do so to the University of Texas at Austin Endowment Legacy Project, Morgan J. Davis Centennial Chair in Petroleum Geology, University Development Office, P.O. Box 7458, Austin, TX, 78713; or the charity of one's choice.

Lloyd Ellis Gatewood (B.S. '48), 91, of Oklahoma City, died Sept. 6, 2011. He was born July 1, 1920 in Bixby, Okla., to Charles and Edith Gatewood. The family moved to east Texas during the oil boom in the 1930s. He graduated from Leverett's Chapel High School in Kilgore, Texas, in 1938. He attended Kilgore Junior College. He was enrolled at North Texas State until the U.S. entered WWII. He enlisted in the U.S. Army Air Corps. Lloyd married Jacinto Williams on Oct. 9, 1943. He was sent to Europe in 1944 as a 1st Lieutenant radar, navigator, bombardier on a B-17. He was a POW in Germany from August 1944 to April 1945 and discharged in 1945. He graduated from The University of Texas at Austin with a bachelor's degree in geology in 1948. He worked for Standard of Texas before becoming an independent geologist. He was a consulting geologist for Coastal States and Anadarko. Lloyd was a member of the American Association of Petroleum Geologists, Society of Independent Professional Earth Scientists, and the Oklahoma City Geological Society (OCGS). In 1984, Lloyd was made an Honorary Life Member of the OCGS. He was an OCGS Library Director and initiated the in-house files. In 1960, he was the president of the Oklahoma City chapter of the Texas Exes Club. He was a member of the Church of Christ. Lloyd was preceded in death by his parents, Charles and Edith Gatewood; wife, Jacinto; daughter, Kathy; brother, Charles Gatewood; and sister, Vera Vaughn. He is survived by two children: son, Kent Gatewood and his wife Merle; and daughter, Donna Gatewood; two grandsons, Whit Gatewood and his wife Adrienne, and Hal Gatewood and his wife Emilie; two great-grandchildren, Benjamin Gatewood and Lily Gatewood; and sister, Dorothy Faulkenberry.

Drane Fones Grant (B.S. '43) of La Pryor passed away on June 16, 2010 at The Leaves in Richardson, Texas at the age of 87. She was born on August 12, 1922 in La Pryor, Texas to Bruce William and Jeanie Gar Grant of Lyons, Kansas. She is survived by one niece; Carol Gould and husband, James of Princeton, NJ; one nephew; Bruce Vincent Grant and wife, Cynthia of Tempe, AZ; two great nieces; Claire Gould of Princeton, N.J.; and Natalie C. Grant of Tempe, Ariz.; two

great nephews; Grant F. Gould of Princeton, N.J.; and Bruce Alexander Grant of Tempe, Ariz. She was preceded in death by her parents; and brother; Bruce (Sonny) Grant.

Douglas J. Howard (B.S. '54), 79, went to be with the Lord Feb. 21, 2012 ending his valiant battle with lung cancer. Doug is survived by his loving wife of 55 years, Eloise Howard; son Alan Howard and wife Karen; daughter Allyson Phillips and husband Bob; son Andrew Howard and Glenda. He was also blessed with seven grandsons, Brad, Ross, Douglas, Austin, Carter, Zachary, and Glenn. Doug was born on Aug. 7, 1932 in San Diego, California to James and Kathryn Howard. He lived in Manila, Philippines before moving to Killeen, Texas at 8 years of age. Doug attended The University of Texas at Austin, earning his bachelor of science degree in geology in 1954. He served his country in the United States Army for two years before starting his career in the oil and gas business. He was a staff geologist for a small oil company in Houston for two years before becoming a lifelong independent oil and gas operator. Doug was responsible for several oil and gas discoveries along the Texas Gulf Coast. He was a member of the American Association of Petroleum Geology, Houston Geological Society, and the Gulf Coast Geological Library. Doug was a devoted family man who enjoyed real estate ventures, traveling, golf, watching UT football, grandsons' sporting events, and family gatherings.

Levi Lee Kidd (B.S. '59), 76, of Tyler passed away Dec. 12, 2011, at The Hospice of East Texas in Tyler. He was born Jan. 8, 1935, in Tyler to Hubert Edward and Opal Lowry Kidd. Lee spent a lot of his childhood working at Kidd's Dairy & Ice. He made Tyler his home, following the path of his parents, grandparents, and great-grandparents making the Kidd name a familiar one to East Texas. Lee was a 1953 graduate of Tyler High School. He graduated from The University of Texas at Austin with a degree in geology. Lee was successful in the oil and gas business as well as a real estate investor. A certified petroleum landman, Lee was a member of the American Association of Professional Landmen, the East Texas Association of Petroleum Landmen, and a member of Willow Brook Country Club.

He followed his father as director of First Federal Savings and Loan Association and was currently serving as chairman of the board of First Bank. Lee also served on the board of The University of Texas at Tyler.


Levi Kidd

Lee was a lifetime member of St. Paul United Methodist Church, of which his grandfather was one to have laid the cornerstone.

As a geologist, Lee studied the lay of the land everywhere he went. He was a "true outdoorsman" and an avid fisher and hunter. He could name most every mountain as well as name many plants and trees. Lee loved adventure and would take at least two trips a year to Alaska, as he loved the wild and untamed terrain. He enjoyed hunting and fishing and was always up for a trip to hunt for elk, bear, deer, moose, pronghorn, and many other species.

Lee loved spending time at his ranch in Val Verde County and often said he felt closer to God while he was there. He was an avid collector of Winchester rifles and had a spectacular collection. Lee loved life and everything it had to offer. He enjoyed good conversation, reading a good book by a fire, and a drive along the highway. Working and trading, gambling in oil and gas, a strong drink, turning down bad deals and making good deals were also things that brought enjoyment to Lee.

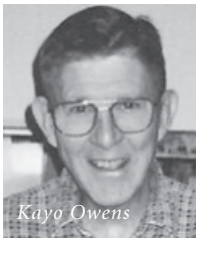
Lee was a patient person who would listen, think, and calculate the conversation before responding. The opinions of his many friends were valued and he enjoyed the fellowship they shared. Lee loved his entire family and was a loving husband, father, stepfather, brother, uncle, grandfather, and great-grandfather. He was compassionate and had a tender spirit who had infinite wisdom. He was the rock and security of our family and will be missed beyond comprehension.

Lee was preceded in death by his parents. Lee is survived by his loving family, including his wife of 40 years, Ann McKellar Kidd of Tyler; children, Lex Kidd and wife Holly of Tyler, Trant L. Kidd of Tyler, Kimberly Kidd Maddox and husband Tim of Tyler, Thomas G. McKellar and wife Marilyn of Tyler, and Richard G. McKellar and wife Heidi of Tyler; siblings, Barbara Kidd Caserta of Tyler, Hubert E Kidd and wife Suzanne of Tyler; his grandchildren, great-grandchildren, in-laws and large extended family.

David J. Leeds (B.A. '39), born on April 13, 1917, passed away on April 18, 2011. David was a resident of Los Angeles, Calif.

Dr. James Lee Martin (B.A. '56), was born in San Antonio on Jan. 20, 1934, and left this world with family and friends surrounding him on March 1, 2012, in Houston. His suffering is now ended and he will live in eternal peace, with the Lord and those who preceded him in death. Memories of his life, endless quest of knowledge, sense of humor and love will surround and comfort us always.

Kenneth Ira "Kayo" Owens (B.A. '54), 81, passed away in Austin, Texas on September 14, 2011. He was born in Fort Worth, Texas to Ira Moody Owens and Edna Booker Owens. Kayo attended Fort Worth public schools. He was taught hunting-fishing-outdoor skills as a child. The happiest time of his life came in the Boy Scouts, 1942-1946, when he participated in paramilitary activities to support the war effort.


Kayo Owens

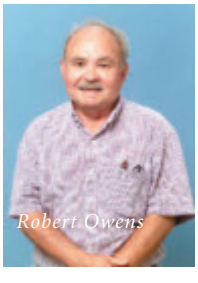
Kayo attended North Texas Agricultural College (Arlington State College/ the University of Texas at Arlington) and transferred to the University of Texas at Austin where he was active in the APO Service Fraternity and received a B.S. in geology in 1954. In 1951, Ken joined the Masonic Lodge and was elevated to the

sublime degree of Master Mason on Sept. 20, 1952. Ken went on active duty as an officer in the U.S. Army in 1954, served in Virginia and Missouri and was assigned to the Engineer Battalion of the 9th Division in Furth, Bavaria, Germany, being honorably discharged in 1956.

Kayo worked as a geologist for Humble Oil (Ecco/Exxon) in Midland, Hobbs, McCamey, Snyder, Denver City, and Wichita Falls from 1956 until oil took a downward turn in 1966. In 1967-68 he worked as an x-ray technician on the F-111 swing wing in Fort Worth. In 1969, he moved to Austin to enter the real estate business. There he met the love of his life, Agnes Ptacek, whom he married in 1971. Ken earned his broker's license in 1974 and worked as an escrow/closing officer until 1976. From 1977 to 1982 Kayo worked as a geophysicist at Geotronics Corp. during the domestic oil boom. From 1983 to 1986 he did consulting, and he and Agnes had several great geological adventures, culminating in the "Boot-heel" of S.W. New Mexico. Kayo took the mantle of "grandfather" as a tutor at the Creative Rapid Learning Center in 1986 and moved on to Austin Community College in 1992. Ken was a lifetime blood donor with 103 pints. He was a diehard UT Austin baseball fan.

Ken is survived by his wife, Agnes Owens; his sister, Ann Owens Gilliland and husband, Jim; his sister-in-law Lois Smith and husband Kenneth; nieces and nephews and cousins. He donated his body to The UT Medical School, Houston, Texas.

Robert Michael Owens (B.S. '51), 85, passed away on June 30, 2011, in Houston, Texas. Bob was born to Dolph Owens and Irene Lemon Owens on Sept. 4, 1925. He graduated from the University of Texas in Austin. Bob is survived by his loving wife, Maxine Weiman Owens; daughter Patricia; daughter Kerry Meadows and husband Mark; daughter Liesl; and grandchildren Clint and Matthew Stockton. He was preceded in death by his parents and best friends Don Krebs and Gilbert Leonardon.


Robert Owens

Robert served in the U.S. Navy during World War II and worked many years as an independent petroleum geologist.

Herman Ellis Roberson (B.A. '55) died suddenly on March 16, 2012, of complications of COPD and fibrosis. He is survived by his beloved family: His wife Jeannette Mansour Roberson; son Christopher, daughter-in-law Tania Staffen, and grandsons Max and Sam; son Matthew, daughter-in-law Gretchen Papazian, and grandchildren Nicholas and Alice; and brothers Raymond and Lee. Herman was pre-deceased by his parents Ida Lee and Eskridge Roberson; and his brother Gary. His family is grateful to special friends Jim and Ina Brownridge, of Binghamton; Jim and Barbara Keahey, of Texas; and Pat (and late husband, Thom) Yium, of California. Herman also leaves behind his loyal poker friends and his colleagues and students at SUNY Binghamton, where he taught for forty-two years in the Geology Department.

Robert B. (Bob) Ross (B.S. '50) passed away Jan. 1, 2012 in his home in Houston. Bob enjoyed a successful career in oil exploration in several states, Canada, and offshore. Bob is survived by his wife of 62 years, two children, five grandchildren, and one great grandchild.

Richard Milton Smith, Jr. (B.A. '70; M.A. '78), was born in Nashville, Tenn. to Margaret and Richard Smith on July 2, 1945. He passed from this life on Oct. 16, 2011 at the age of 66. Richard spent most of his adult life in the central Texas area. He lived in Wimberley. Richard's formal education was at The University of Texas in Austin. He graduated with a B.S. and M.A. in geology. Early on, during his time at UT Austin, he discovered a love for caving. He made many trips to Mexico and around Texas to explore the caves. He formed a strong friendship with a large group of like-minded individuals that he still saw frequently until his death. He also developed a love for bicycling. He was an avid bicyclist and participated in the MS150 several times. He had recently taken up kayaking and was pleased with his improving skill.

During the past 15 years, Richard developed another passion, traveling. He went to Europe 30 times, sometimes as often as twice per year. He spent Christmases in Paris and also visited his brother in Scotland several times while they were residing there. He loved Europe and would take biking trips in the countryside of France, Scotland, and Ireland. Richard was also a giver. He donated almost 4,000 hours of time to record books for the blind and was honored by the mayor for his volunteering commitment.

His distinctive voice could be heard across a room. He told me once that the voice was a mixed blessing because people would react to him thinking he was angry when he was just talking. Admittedly, he was on occasion, a very passionate person about those things he believed in and would work feverishly to persuade you to change your opinion. Richard would refurbish bikes for charity. He was a faithful and loyal friend and brother. Richard was preceded in death by his mother, Margaret Smith and his father, Richard Smith.

He is survived by his older sister Marietta and her husband, Frank Pulkrabek of Friendswood, Texas, his middle sister, Katherine and her husband, Roger Cratin, of Georgetown, Texas, his younger brother, Kennith and his wife, Katy Smith of Decatur, Ala. and his youngest sister, Karen and her husband, Randy Godeau of Friendswood, Texas. He is also survived by many nieces and nephews.

Joseph B. "JB" Teichman (B.S. '39), 93, of Hallandale, Fla., passed away Feb. 21, 2011. JB graduated from The University of Texas at Austin at the age of 16. He went to work for Standard Oil as a geologist and joined the Air Force as a captain in World War II, proudly serving his country. He resumed working as a geologist until he retired in the early 1960s. After retiring to Florida, he attended Miami Law School, where he graduated with an LLM and practiced until his second retirement. JB is predeceased by his wife of 63 years, Dorothy Teichman, and is survived by his six

children: Bruce Teichman (Pat), Anthony Teichman, David Teichman, Sari Addicott (Michael), Dore Teichman (Laura), Harry Teichman(Lynn); grandchildren: Aaron Addicott, Benjamin Addicott, Jacob Addicott, Ethan Addicott, Isaac Teichman, Aviva Teichman, JW Teichman, Ceilia Teichman, Heidi Teichman and Daniel Teichman; and two great-grandchildren, Nina Teichman and Judah Teichman. He will be missed by all, and surely anyone who knew him will have to have a smile as they remember something he said or did.

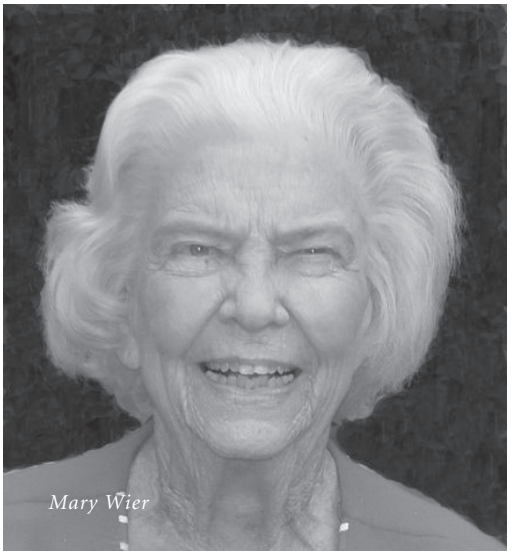
James Ross Underwood, Jr. (M.A. '56; Ph.D. '62), beloved husband, father, grandfather, geologist, professor, and friend to many, passed away on May 16, 2012. He loved his family, his friends, his students, and all the wonders and mysteries of the Earth and heavens. He devoted his professional life to sharing his knowledge of geology and space with others. In addition to his academic contributions, "Granddaddy" was a dignified, gentle giant who loved being a father and grandfather. He had many gifts, one of the greatest being his ability to make everyone to whom he spoke feel like the most important person in the room.

Jim was born May 15, 1927 in Austin, Texas to James Ross and Marion Underwood and was raised in Corpus Christi. He joined the U.S. Naval Reserve upon graduating high school in 1944 and served in the reserves during his tenure at Southwestern University in Georgetown, Texas. He moved on to The University of Texas at Austin, where he was involved in many activities, serving as the Longhorn Band drum major and as a high jumper on the track team. He spent time in Korea with the Navy in the early 1950s before returning to UT Austin to teach and continue his studies. He earned his Ph.D. in geology from UT Austin in 1962.

Jim married Margaret Ann Sanderford on June 10, 1961. Jim's teaching career took them on many adventures, where they made many lifelong friends. Jim taught at The University of Baghdad (1962-65), The University of Florida (1965-67), West Texas State University in Canyon, Texas (1967-74) with a two year leave to teach at the University of Libya, Tripoli (1969-1971), and at Kansas State University (1977-1996). Jim also worked for NASA's Planetary Geology and Geophysics Program beginning in 1972 until his retirement, and was among other things a member of the Viking Lander Imaging Team in 1976. Upon his retirement Jim and Margaret Ann moved to Austin, Texas where they enjoyed close proximity to family, lifelong friends, and their deep Texas roots. Jim was a member of Covenant Presbyterian Church in Austin, and enjoyed many years of participation in LAMP (Learning Activities for Mature People) at UT Austin.

Jim is survived by his wife of almost 51 years, Margaret Ann Sanderford Underwood, their three daughters and their families: Marion Underwood and Andrew Liles and their children Louisa and Sophie; Ann (Andy) and Steve McDowell and their children Emory, Marigrace and Eliza; Beth and Bobby Patterson and their children Joe and Claudia. The family requests that donations be made to the Jim and Margaret Ann Underwood Petroleum Geology Lecture Series at Kansas State University (Dept. of Geology, KSU, 108 Thompson Hall, Manhattan KS 66506-3201, JR Underwood on memo line), Autism Speaks (www.autismspeaks.org), or VITAS Hospice (www.vitas.com).

Norman Neal West (B.A. '50), 88, passed away July 8, 2012 in Burleson, Texas. Norman was born to Charles N. and Martha L. West on March 25, 1924. He graduated from Polytechnic High School in 1941 and graduated from The University of Texas at Austin in 1944 with a degree in geology and civil engineering. He operated a successful oil company and commercial surveying company in Houston. Norman was an accomplished pilot and flew his own airplanes. He was an excellent mariner with small yachts on the Gulf Coast. He raised cattle and horses and loved his dogs. Norman was a salsa dance instructor for Arthur Murray for several years. Survivors: children, Martha Glenn and her husband, Joel, and Bill West and his wife, Barbara; grandchildren, Kimberlee Blaies, Deven Barry, Clifton West and Christa Landa; eight great-grandchildren; and the mother of his children, Martha Frech Johnson.


Mary Wier

Mrs. Mary Elizabeth Wier (B.A. '43) earned a geology degree from The University of Texas at Austin at a time when few women did and became Sun Oil Co.'s first female geologist, working out of the Milam building in downtown San Antonio. She died May 28, 2012 at age 89.

After getting her degree in 1943, she went door-to-door to oil companies to ask for interviews without a resume in hand, said her son, Max H. Wier III. Her efforts eventually landed her a job at Sun Oil Co. Mary Wier worked there for several years and loved it, but her mother didn't approve and gave her an 11 p.m. curfew on the weekends, he said.

She did not go into the field but worked with maps and drilling logs to find oil, said Max Wier, 59. Her boss paid her more than men in comparable positions because she was so efficient, he said.

"She couldn't tell anybody how much she made because he didn't want to get them all mad," Wier said.

As more men returned from World War II, she left her profession but collected rocks for the rest of her life. She later taught at John J. Pershing Elementary School for about six years.

In 1951, she married widower Max H. Wier, Jr. and became the stepmother to his three young children.

"She was the only mother we ever

knew. We never called her 'stepmom,'" said the oldest, Leighton Wier, 68.

Honesty and kindness were important values to her, he said.

"She led by example and taught us to give back to the community," Leighton Wier said.

She was a loyal Republican and a member of many organizations, including St. Monica's Guild, the Junior League, the San Antonio Bar Auxiliary, the San Antonio Country Club, and the San Antonio's Women Golf Association.

"She said hello to everybody, whether she knew them or not," Max Wier said. "There are people that she had known in passing that would recognize her 50 years later."

She took golf lessons from national professionals Bill Rogers and Harvey Penick, and visited Penick's wife when he died in 1995. Penick always charged her just $3 per lesson, the going rate when she started.

Max Wier accompanied his mother on golf trips to North and South America, Europe, and Asia. She kept golfing into her mid-70s, family members said.

She is preceded in death by her parents, Joseph Smith Sheldon and Julie Burns Sheldon; husband Max H. Wier Jr.; and brother Joseph S. Sheldon Jr. She is survived by son Max H. Wier III; stepsons Leighton and Ronald Wier; stepdaughter Vicki Wier, sister Anne Sims; nine grandchildren and three great-grandchildren.

August Leopold Wolff (B.A. '41), passed away, with his wife of 67 years by his side, the afternoon of Monday, February 13, 2012 in Giddings, Texas. A first generation American, he was born in San Antonio, Texas on Feb. 10, 1919 to Rev. August L. Wolff and Elizabeth Koch Wolff. He was baptized on April 6, 1919 at St. John Lutheran Church in San Antonio by his father. He confirmed his baptismal vows on April 6, 1933 at St. John Lutheran Church in San Antonio. His confirmation verse was Psalm 111:10 "The fear of the LORD is the beginning of wisdom: a good understanding have all they that do his commandments: his praise endureth forever."

He graduated from Brackenridge High School in San Antonio and continued his education at Texas Lutheran Junior College in Seguin. He received his bachelor of science degree in geology from The University of Texas at Austin in 1941. In February 1942 he enlisted in the United States Army Air Corps. He served the Army at Bryan Field in Bryan, Texas as a technical photographer until his discharge in December 1945.

On April 9, 1944, he was united in marriage to Lucille Fritsche of Giddings at St. John Lutheran Church in San Antonio with Rev. August L. Wolff officiating. Their marriage was blessed with two children, August, Jr. and Dianne.

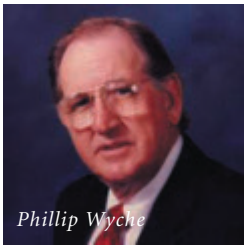
August was employed with the First National Bank in Giddings. Through the years with First National, he worked as a teller, loan officer, senior vice president, and director. He retired in 1982 after 35 years of service.

He has been a member of Martin Luther Lutheran Church since 1946. He served as chairman of the church council, sang in the choir, and was especially active in the Brotherhood organization leading many functions and serving on numerous committees and holding several offices.

August was always active in civic and community affairs. He was a member of the Giddings American Legion Post 276, served as president of the Giddings Area Chamber of Commerce, and held numerous offices in the Giddings Rotary Club.

He was preceded in death by his father in 1949, his mother in 1974, and his daughter in 2009. August is survived by his loving wife, Lucille Wolff of Giddings; their son, August, Jr. & his wife, Judy of Lincoln and their children; their son-in-law, Melvin Zoch of Giddings and he and Dianne's children; his sister, Elizabeth Mohr of Fredricksburg; his sister-in-law, Elvira Pfluger of Austin and also by nieces, nephews, great-granchildren and many friends including the members of Martin Luther Lutheran Church.

Phillip Edward Wyche (B.S. '51), 85, passed away March 17, 2012 after a heart attack. Mr. Wyche was born Sept. 27, 1926 in Pirtle, Texas to Alton and Sibyl Wyche. He served in the U.S. Army during WWII, then attended Kilgore Jr. College and The University of Texas at Austin. He graduated from UT Austin in 1952 with a degree in geology and was immediately employed by Gulf Oil Corp. Mr. Wyche rose through the ranks of Gulf Oil, eventually retiring in 1986 as executive vice president. He and his wife, Mary Ann, enjoyed living and traveling all over the world. After retiring to Lakeway, Texas, he devoted himself to playing golf, working in support of the geosciences at UT Austin, and spending time with the family, especially his beloved grandchildren. He is survived by his wife, Mary Ann Towns Wyche, his son, Pat Wyche and wife, Lelan Daines and daughter, Cathy Bingaman and husband Wade; his five grandchildren, Ginnie Wilcox and husband Keith, Robert Wyche, Michael Wyche and wife Jaime, Conor Bingaman and wife Jessica, and Lt. Kirk Bingaman. He adored his five great-grandchildren: Katy Harvey, Patric Harvey, Faith Wilcox, Payten Wyche and Miles Wyche. He is also survived by his 90 year old sister, Dorothy Wyche Ledbetter of Granbury, Texas. He was preceded in death by his sister Louise Wyche Montgomery. He will be missed dearly by his family, friends and his good golfing buddies.


Phillip Wyche

Faculty & Staff

William (Bill) Rudlof Muehlberger, professor emeritus, died of natural causes Sept. 14, 2011. Our memorial to Dr. Muehlberger ran in the 2011 *Newsletter* and can also be found on the Jackson School website.

Alumni Giving

Most Loyal Longhorns

With 15 x 2015 Campaign

We're setting our sights on the top spot at the University. In 2007, only about 4 percent of geosciences alumni made regular donations to the school. Since then, the rate has risen to an impressive 9.5 percent. The Jackson School now holds the second highest alumni giving rate at the University. We are proud of this deepening involvement.

And we can do better: 15 percent by 2015.

The alumni giving rate is a national benchmark indicating that the people closest to the University, those who have gained the most from the school, are committed to giving back and continuing its success. Your contribution makes a statement to the entire geosciences community that you believe in our programs, mission and vision.

"It's about the power of a team versus the reliance on a few stars," says Richard Chuchla (M.A.'85), chair of the Geology Foundation Advisory Council.

Every gift, every year makes the difference. Whether you make a gift to our stellar field programs, support GeoFORCE and grow a diverse workforce pipeline, or give to an area that has special importance to you, consisent giving across time is how we will succeeed with our 15 x 2015 campaign. Consider making an end-of-year gift, a monthly payment through your credit card, or supporting one of the 200 endowments held within the Geology Foundation. To learn more about the campaign and additional opportunities to show your support, visit: www.jsg.utexas.edu/support.

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- Any of the 200 Geology Foundation Funds: www.jsg.utexas.edu/support

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2012 Jackson School of Geosciences Contribution Form

The support of many drives the success of the Jackson School. Your contributions can touch the lives of students, further our research mission, and help us realize our vision of becoming the preeminent geoscience program in the country.

Contributions are tax deductible and may be mailed to the Development Office, Jackson School of Geosciences, 2225 Speedway, Stop C1160, Austin, Texas 78712-1692. Please make checks payable to The University of Texas at Austin. Stocks and bonds may also be assigned to The University of Texas at Austin. For your convenience, a postage-paid envelope is inserted with this edition of the *Newsletter*.

You may make your donation by completing and returning this form with your gift in the envelope provided. If your employer matches charitable gifts, please obtain the form from your human resources department and enclose it with your contribution. Donors of gifts of $10,000 or more (including cumulative matching gifts) are recognized as members of the Hill Society. Our goal is to raise JSG alumni giving participation to 15 percent, so every gift counts. *P.S. Whether or not you send a contribution, you can use the back of this form to submit alumni news for the next newsletter—please stay in touch!*

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2012 Jackson School of Geosciences Alumni News Update/Submission Form

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All information submitted is confidential and will not be shared outside of The University of Texas at Austin. All fields are optional but we appreciate your effort to help us keep your information accurate and current.

All alumni, including former researchers and staff affiliated with the school's organized research units, are encouraged to submit. If you are not receiving the newsletter in the mail, this form will ensure that you receive future copies.

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