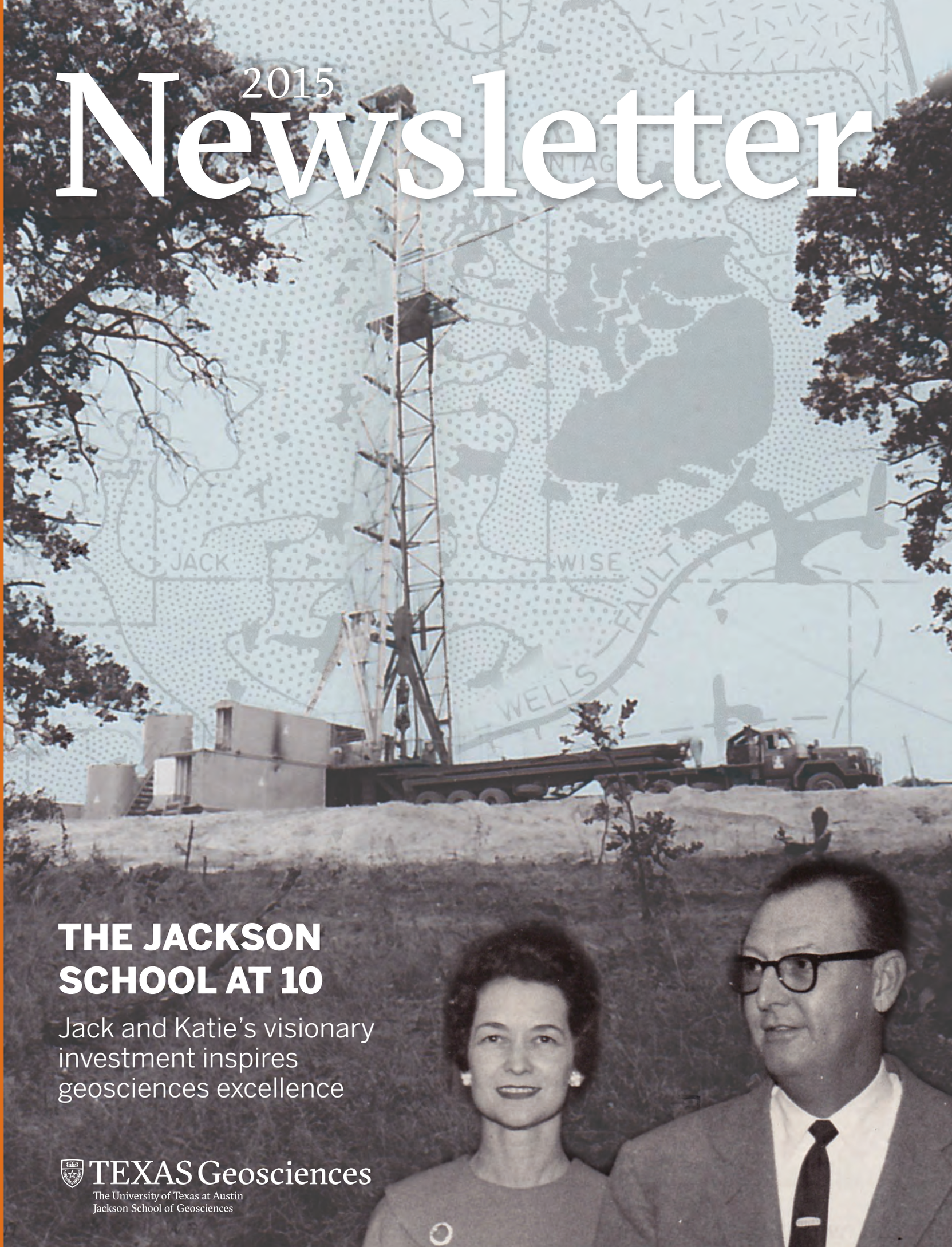
THE UNIVERSITY OF TEXAS AT AUSTIN · JACKSON SCHOOL OF GEOSCIENCES · 2015 NEWSLETTER

2015

Newsletter



THE JACKSON SCHOOL AT 10

Jack and Katie's visionary investment inspires geosciences excellence

TEXAS Geosciences
The University of Texas at Austin
Jackson School of Geosciences

"Jack and Katie chose to invest in Texas geosciences and education because of its critical importance to the citizens of Texas."

COVER: A PICTURE OF JACK AND KATIE JACKSON SUPERIMPOSED ON A PICTURE OF THE WISE COUNTY OPERATIONS FROM JACK'S PERSONAL COLLECTION. THE BACKGROUND IS A GEOLOGICAL MAP OF THE LOWER ATOKA HYDROCARBON RESERVES IN THE FORT WORTH BASIN. PHOTO ILLUSTRATION BY SASHA HAAGENSEN. ABOVE: THE HIGH ANDES OF SOUTHERN PERU.

Dear Alumni and Friends

Time certainly has flown by. It has been 10 years since the Jackson School was elevated to a college-level school, and I can think of no better way to commemorate the milestone than recognizing Jack and Katie Jackson's visionary investment in this school and the future of Texas.

You will find several touches on the theme in this year's *Newsletter*. The cover features the Jacksons and the Wise County gas fields Jack helped pioneer. There's also a story on page 60 detailing Jack and Katie's journey from their youth to becoming founders of one of the largest and most prestigious schools of geosciences in the world, and a story on page 34 about Katie being inducted into the Jackson School Hall of Distinction.

I hope you can attend the 10-year symposium on Jan. 22, where we will showcase some of the school's accomplishments. But even as we take some time to look back, we need to focus firmly on the future. The last 10 years have been great. I think we all share the goal of making the next 10 years even better.

We are currently working on a new five-year strategic plan to help guide the school in the coming years, and I look forward to sharing the details with the Jackson School community soon. My vision is to continue to integrate research and education, especially interdisciplinary, transformative research that advances the geosciences and benefits society.

You will find great examples of exciting research with a positive impact on society throughout the Research Highlights and rest of this issue. I'll mention just a few — a feature on water resources on page 56, a story on pipeline safety on page 74, and a story on slow slip tectonic research on page 68. All highlight work that holds tremendous value for Texas and the world.

I think it is important to point out the aspect of social relevance because the emphasis fits in perfectly with the Jacksons' vision. Jack and Katie chose to invest in Texas geosciences and education because of its critical importance to the citizens of Texas. With your continuing support, we will carry on that legacy and continue the mission of making the Jackson School the best school of geosciences in the world.

Sharon Mosher, Dean

FEATURES

DELVING INTO YELLOWSTONE'S VOLCANIC PAST

GEOFORCE GOES TO WASHINGTON

TRACKING THE CREEPING QUAKES OF NEW ZEALAND

NEWSLETTER HIGHLIGHTS

IN EVERY ISSUE

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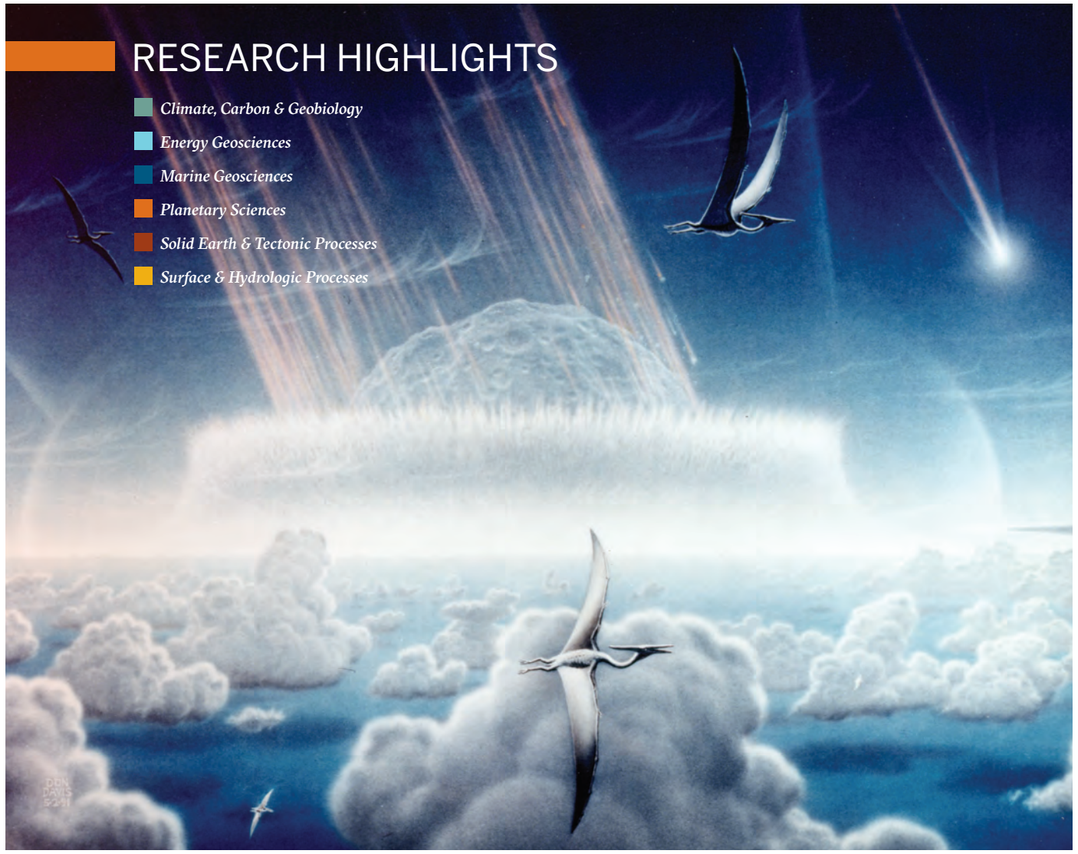


IMPACT PAINTING: DONALD E. DAVIS. TAPPING CORALS: KAUSTUBH THIRUMALAI. CO2 IMAGE: SANDIA NATIONAL LABORATORIES.

Drilling into Dinosaur Extinction

AN ARTIST'S IMPRESSION OF THE CHICXULUB ASTEROID IMPACTING THE YUCATAN PENINSULA AS PTERODACTYLS FLY IN THE SKY ABOVE.

Marine Geosciences

An international research team is formalizing plans to drill nearly 5,000 feet below the seabed to take core samples from the crater of the asteroid that wiped out the dinosaurs. The expedition is planned for spring 2016.

Dinosaurs and other reptiles ruled the planet for 135 million years. That all changed 65 million years ago when a 9-mile-wide asteroid slammed into the Earth, triggering a series of apocalyptic events that killed most large animals and plants, including non-avian dinosaurs and large marine reptiles. The event set the stage for mammals — and eventually humans — to take over. Yet, we have few geologic samples of the now buried impact crater.

Sean Gulick, a researcher at the Institute for Geophysics (UTIG), and a team of scientists from the U.K. and Mexico are working to change that. The team is planning to take the first offshore core samples from near the center of the impact crater, which is called Chicxulub after a nearby seaside village on the Yucatán Peninsula.

The team, led by Gulick and Joanna Morgan of Imperial College London, will be sampling the crater's "peak ring" — an enigmatic ring of topographically elevated rocks that surrounds the crater's center and has been buried during the past 65 million years.

By sampling the Chicxulub peak ring and analyzing its key features, researchers hope to uncover the impact details that set in motion one of the planet's most profound extinctions, while also shedding light on the mechanisms of large impacts on Earth and on other rocky planets.

The roughly $10 million in funding for the expedition has been approved and scheduled by the European Consortium for Ocean Research Drilling and the International Continental Scientific Drilling Program.

"The sediments that filled in the [crater] should have the record for organisms living on the sea floor and in the water that were there for the first recovery after the mass extinction event," Gulick said. "The hope is we can watch life come back."

PH.D. STUDENT KAUSTUBH THIRUMALAI IN THE WESTERN PROVINCE OF THE SOLOMON ISLANDS. BOTTOM LEFT: THE TERRACED CLIFF IS A SIGN OF UPLIFT. EACH NOTCH WAS FORMED BY SEA EROSION.

Tapping Coral for Evidence of Earthquakes

Solid Earth & Tectonic Processes

Researchers have found that parts of the western Solomon Islands, a region thought to be free of large earthquakes until an 8.1 magnitude quake devastated the area in 2007, have a long history of big seismic events.

The findings, published online in *Nature Communications* in June 2015, suggest that future large earthquakes will occur, but predicting when is difficult because of the complex environment at the interface of the tectonic plates.

The team analyzed coral for the study. The coral, in addition to providing a record of when large earthquakes happened during the past 3,000 years, helped provide insight into the relationship between earthquakes and more gradual geological processes, such as tectonic plate convergence and island building through uplift.

"We're using corals to bridge this gap between earthquakes and long-term deformation, how the land evolves," said lead researcher Kaustubh Thirumalai, a doctoral student at the Institute for Geophysics.

The 2007 event was the only large earthquake recorded in 100 years of monitoring the region that started with British colonization in the 1900s. The researchers found evidence for six earthquakes in the region during the past 3,000 years, with some being as large as or larger than the 2007 earthquake.

"If we have 100 years of instrumental data saying there's no big earthquakes here, but we have paleo-records that say we've had something like five giant ones in the last few thousand years, that gives you a different perspective on hazards and risk assessment," Thirumalai said.

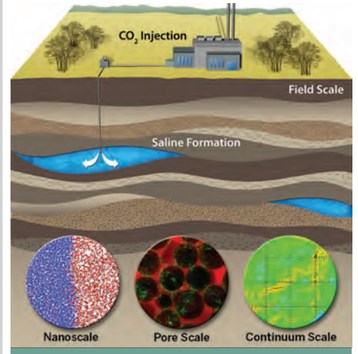
The Fate of CO_2

Climate, Carbon & Geobiology

Reducing carbon dioxide emissions by capturing them and storing them deep underground can decarbonize energy generation from fossil fuels, but there are many unknowns.

Chief among them is what happens to the CO_2 over time. A study led by Jackson School of Geosciences researcher Kiran Sathaye that was published Oct. 28, 2014, in the *Proceedings of the National Academy of Sciences* sheds light on the issue.

The team, which also included the Jackson School's Marc Hesse and Daniel Stockli, studied the fate of naturally occurring volcanic CO_2 in New Mexico's Bravo Dome. The Bravo Dome has safely stored 1.6 gigatons of CO_2 for more than a million years. The team found that 20 percent of the original CO_2 has dissolved into the briny water of the Bravo Dome. These results provide important conceptual support for simulation studies used to predict the long-term evolution of geological CO_2 storage.



CARBON SEQUESTRATION STORES CO_2 UNDERGROUND BY INJECTING IT INTO SALINE AQUIFERS.

ABOVE: LEAD RESEARCHER JAMIN GREENBAUM. RIGHT: THE TOTTEN GLACIER CATCHMENT (IN BLUE) IS A COLLECTION BASIN FOR ICE AND SNOW THAT FLOWS THROUGH THE GLACIER.

Ocean may be Melting Glacier

Surface & Hydrologic Processes

Researchers at the Institute for Geophysics (UTIG) have discovered two seafloor gateways that could allow warm ocean water to reach the base of Totten Glacier, East Antarctica's largest and most rapidly thinning glacier. The discovery, reported in the March 16, 2015, edition of the journal *Nature Geoscience*, probably explains the glacier's extreme thinning and raises concerns about how it will affect sea level rise.

Totten Glacier is East Antarctica's largest outlet of ice to the ocean and has been thinning rapidly for many years. Although deep, warm water has been observed seaward of the glacier, until now there was no evidence that it could compromise coastal ice. The result is of global importance because the ice flowing through Totten Glacier alone is sufficient to raise global sea level by at least 11 feet, equivalent to the contribution of the West Antarctic Ice Sheet if it were to completely collapse.

"We now know there are avenues for the warmest waters in East Antarctica to access the most sensitive areas of Totten Glacier," said lead author Jamin Greenbaum, a UTIG Ph.D. candidate.

The ice loss to the ocean may soon be irreversible unless atmospheric and oceanic conditions change so that snowfall outpaces coastal melting. The potential for irreversible ice loss is due to the broadly deepening shape of Totten Glacier's catchment, the large collection of ice and snow that flows from a deep interior basin to the coastline.

"The catchment of Totten Glacier is covered by nearly 2½ miles of ice, filling a sub-ice basin reaching depths of at least one mile below sea level," said UTIG researcher Donald Blankenship.

Greenbaum and Blankenship collaborated with a team from the United States, Australia, the United Kingdom and France.

Because much of the California-sized interior basin lies below sea level, its overlying thicker ice is susceptible to rapid loss if warm ocean currents sufficiently thin coastal ice. Given that previous work has shown that the basin has drained its ice to the ocean and filled again many times in the past, this study uncovers a means for how that process may be starting again.

"We've basically shown that the submarine basins of East Antarctica have similar configurations and coastal vulnerabilities to the submarine basins of West Antarctica that we're so worried about, and that warm ocean water, which is having a huge impact in West Antarctica, is affecting East Antarctica, as well," Blankenship said.

The deeper of the two gateways identified in the study is a three-mile-wide seafloor valley extending from the ocean to beneath Totten Glacier in an area not previously known to be floating. Identifying the valley was unexpected because satellite analyses conducted by other teams had indicated the ice above it was resting on solid ground.

Seafloor valleys that connect this deep, warm water to the coast can especially compromise glaciers, a process previously known to be occurring along the coast of the West Antarctic Ice Sheet. Complete collapse of the Totten Glacier catchment may take many centuries. The timing is the subject of intensive research.

The UTIG team collected the data during five Antarctic field campaigns using aircraft loaded with equipment to analyze the ice and seafloor in regions that even icebreakers are unable to reach. The airplane was outfitted with radar that can measure ice several miles thick, lasers to measure the shape and elevation of the ice surface, and equipment that senses the Earth's gravity and magnetic field strengths, which are used to infer seafloor shape.

PENGUIN PHOTO AND ANTARCTICA MAP: JAMIN GREENBAUM. GREENLAND: MATTHEW HOFFMAN. FROHLICH: BEG.

UT Pitches in $7.5 Million for Bureau Modernization

Energy Geosciences

The Bureau of Economic Geology (BEG) is in the midst of an ongoing effort to modernize the extensive laboratories and other facilities in Building 131, and to construct a new core viewing facility for researchers and graduate students. The effort received a huge boost in spring 2015 when then University of Texas at Austin president Bill Powers approved a university investment of $7.5 million in the project.

"President Powers recognized that the bureau has been delivering outstanding research and reputational benefit for the university," said BEG Director Scott Tinker, "and that we are doing fundamental work related to energy, the environment, and the economy that is core to the university mission. He feels that upgrading our laboratory infrastructure is a great investment, and we are very grateful for his confidence in our research capabilities."

The campaign to raise the additional funding required to complete the project will continue.

Cliff Frohlich

Regional Seismic Variation

Solid Earth & Tectonic Processes

The Williston Basin in the north central U.S. produced fewer earthquakes caused by wastewater injection than Texas, suggesting the link between seismicity and production activities may vary by region. The findings were published in the journal *Seismological Research Letters* in February 2015.

Ongoing since the 1950s, petroleum and gas production in the Williston Basin, underlying parts of Montana, North Dakota, South Dakota and Saskatchewan in Canada, changed in recent years to include hydraulic fracturing and horizontal drilling. Scientists from The University of Texas at Austin took advantage of new monitoring data to explore the connection between seismicity and petroleum production near the Bakken Formation, an area of historically low seismicity, but with a recent history of increased hydraulic fracturing and wastewater disposal.

"Why are earthquakes triggered in some areas and not in others? It's an important question for regulators and the scientific community," said Cliff Frohlich, lead author of the study and associate director of the Institute for Geophysics. "Some answers are emerging."

A VIEW OF THE RESEARCH SITE ON THE GREENLAND ICE SHEET.

Slowing Greenland's Ice Sheet from Below

Surface & Hydrologic Processes

A team led by scientists from the Institute for Geophysics has for the first time directly observed multiple parts of Greenland's subglacial plumbing system and how that system evolves each summer to slow down the ice sheet's movement toward the sea.

These new observations could be important in accurately modeling Greenland's future response to climate change.

"Everyone wants to know what's happening under Greenland as it experiences more and more melt," said study coauthor Ginny Catania, a research scientist at the institute and an associate professor in the Jackson School of Geosciences.

Each summer, the surface of the Greenland ice sheet melts as temperatures warm, sending meltwater into channels that drain to the bottom of the ice sheet, lubricating the underside and speeding up the ice sheet's flow toward the sea. These new observations clarify scientific understanding of how this plumbing system evolves each summer and how it may change in the future as the climate continues to warm.

The findings, published Oct. 2, 2014, in *Nature*, describe an efficient drainage system in which meltwater from the surface drains into moulins, naturally formed pipes that drain water through more than half a mile of ice to passageways between the bedrock and overlying ice.

The scientists found that while the extra meltwater does cause a rapid daily speedup of the ice sheet, the ice gradually becomes less and less sensitive to melting over the course of the summer season. This behavior suggests that a component of the subglacial plumbing system is adapting to the increased meltwater, said lead author Lauren Andrews, a doctoral student at the Jackson School.

LEFT: GRADUATE STUDENT PETER ZAMORA (CENTER) AND FILIPINO SCIENTISTS TAKE WATER SAMPLES. RIGHT: PROFESSOR PHIL BENNETT.

Nature's Fury Fouls Drinking Water

Surface & Hydrologic Processes

In research of significance to the world's expanding coastal populations, scientists have found that geology and infrastructure play key roles in determining whether aquifers that provide drinking water are inundated with seawater during a typhoon or hurricane and how long the contamination lasts.

In 2013, Typhoon Haiyan devastated the Philippines, killing more than 6,000 people and destroying nearly $3 billion worth of property. While the country was in the midst of recovering from the storm, Jackson School of Geosciences scientists conducted research that found that an aquifer on the island of Samar inundated with salt water by the typhoon's storm surge could remain undrinkable for up to 10 years. In contrast, a second aquifer on the island that was also inundated has recovered much more quickly.

The research was published online April 14, 2015, in the journal *Geophysical Research Letters*. It focused on aquifers used by the village of San Antonio on the island of Samar.

The difference in recovery time is due to the two aquifers' surrounding geology, said associate professor Bayani Cardenas, who led the research team. The shallower of the two aquifers is made up of beach sand about 10-15 feet deep, which allows salt water soaked up from the surge to percolate to the water table and move through the aquifer for years to come. In contrast, the other aquifer is largely shielded from seepage because of its depth and possibly an overlying layer of volcanic rock.

The University of Texas at Austin team also included geosciences professor Philip Bennett and graduate students Peter Zamora, Kevin Befus, Matt Kaufman and Aaron Jones. Sponsored in part by the Jackson School's rapid response program, a fund that supports research in areas recently affected by natural disasters, the researchers arrived in the Philippines two months after the storm struck.

NATURE'S FURY:: BAYANI CARDENAS. CORING: BEG. MONSOON: TIM SHANAHAN. CURIOSITY ROVER: NASA.

Coring the Gulf

Marine Geosciences

In February 2015 the Bureau of Economic Geology's Tip Meckel led a coring operation to the inner Texas shelf off the shore of Galveston Island.

Meckel's team previously imaged the site in 2013 using the bureau's high-resolution 3-D seismic technology (P-Cable). Seismic interpretations indicated a deep-seated gas chimney and identified a suite of shallow seismic anomalies 10 to 40 meters below the seafloor, interpreted to be shallow free-gas accumulations.

The goal of February's core sampling was to determine if the gas anomalies can be resolved with the fine spatial detail that is imaged in the seismic data. Twenty-three piston cores were located on and off the shallow seismic anomalies, with an average penetration depth, limited by the presence of a stiff clay layer, of 1.85 meters. The lowermost sediments from piston cores will be processed for any gas content.

Six cone penetrometer (CPT) profiles were obtained at similar depths for a subset of the piston-coring sites. CPT data provide tip resistance and friction, which can be used to infer fine-scale stratigraphy. The data set also provides important information for developing monitoring strategies for potential offshore storage of CO_2 beneath state waters.

A BEG CORING OPERATION OFF GALVESTON ISLAND

THE GLAD800 DRILLING PLATFORM TAKING LONG SEDIMENT CORES FROM THE LAKE BOSUMTWI IMPACT CRATER.

Understanding the Future of the African Monsoon

Climate, Carbon & Geobiology

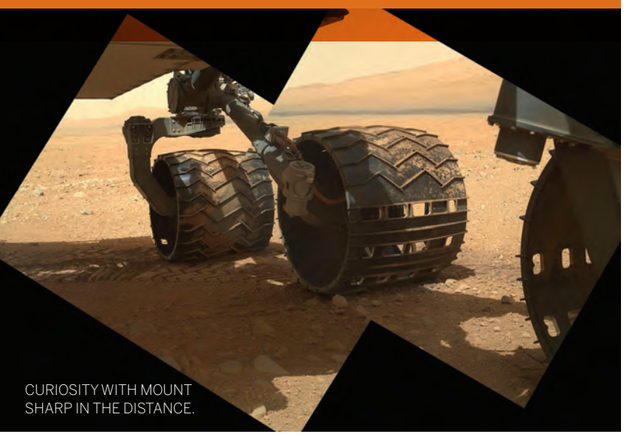
The Sahara conjures images of a vast desert landscape, but for a period of about 10,000 years the Sahara was characterized by lush, green vegetation and a network of lakes, rivers and deltas.

This "green Sahara" occurred between 14,800 and 5,500 years ago during what is known as the "African Humid Period." Why and how it ended is the subject of scientific study that holds important information for predicting the region's response to future climate change.

In a study published Jan. 26, 2015, in *Nature Geoscience*, a team of researchers provided new insight into the behavior of the African monsoon at the end of the African Humid Period and the factors that led to the region's desertification.

"Our work suggests that the African monsoon's response to climate forcing is more complicated than previously understood," said lead author Timothy Shanahan, assistant professor at the Jackson School of Geosciences. "Really big forcings like a collapse in the circulation of the Atlantic can cause synchronous drought across North Africa."

Africa's tropical rainbelt supplies about 60 to 90 percent of northern and equatorial Africa's annual moisture, the study noted. As a result, changes in the timing or intensity of seasonal rainfall influence food and water security for more than 150 million people.



CURIOSITY WITH MOUNT SHARP IN THE DISTANCE.

Driving Curiosity

Planetary Sciences

In September 2014, two years after it first arrived on the Martian surface, NASA's Curiosity rover completed its 5-mile trek to its primary destination: Mount Sharp, officially called Aeolis Mons.

Among those behind the proverbial wheel of the rover was Mackenzie Day, a doctoral student at the Jackson School of Geosciences and a Keeper of the Plan for the Curiosity mission—a title that says she gets to help tell the rover what to do.

"It's not a joystick in a box," Day said about driving. "All commands are sent using code."

Each day she attends a conference call between NASA personnel and international collaborators to discuss what Curiosity will do and what samples it will take; she's especially partial to pit-stops for transverse aeolian ridges, a wind-sculpted sand formation found only on Mars and a major player in her dissertation comparing aeolian processes on Earth and Mars.

Day then takes the mission team's commands and prepares them for transmission to the rover.

Now that the rover has reached the base of Mount Sharp, Day will be driving the rover farther up the Mount Rainier-sized mountain to document and sample the 3 billion years of Martian geology recorded in its sedimentary layers. She said seeing and sampling Mars through the rover is awe-inspiring. But she has hopes to experience the Martian vista in person one day. After earning her doctorate, Day plans to apply for the NASA astronaut program.

SCOTT PETTY CHRISTENS THE JACKSON SCHOOL'S NEW COASTAL RESEARCH VESSEL.

Two-Thirds of the Earth is Covered by Water – and the Jackson School is there

Marine Geosciences

The Jackson School of Geosciences christened a new coastal research vessel on April 22, 2015.

"It will be used in the next decade for research, as well as more teaching and our rapid response program, where we go out and look at what catastrophic processes happen when you have a storm or a hurricane," said Dean Sharon Mosher.

The 26-by-8-foot R.V. Scott Petty, named by Scott and Eleanor Petty of the Scott Petty Foundation, was put to use almost immediately. Professor David Mohrig and his research group took it to Louisiana in May to conduct research on the Wax Lake Delta system, and the boat was used for the Jackson School's marine geology and geophysics field course.

Since the majority of geophysical phenomena happen in parts of the planet covered with water, a research vessel is an essential tool for improving our understanding of the planet, said Terry Quinn, director of the school's Institute for Geophysics.

The vessel was a gift from the Scott Petty Foundation. It is also supported by ConocoPhillips, which provided funding for scientific equipment, and ExxonMobil, which is funding a safety program for the vessel.

"Geophysics has been our life, and I hope it will be for some of you all as well," said Scott Petty. "We've come a long way."

First Peer-Reviewed Eaglebine Play Study

Energy Geosciences

In the December 2014 issue of the *AAPG Bulletin*, Bureau of Economic Geology (BEG) research scientist associate Tucker Hentz and co-authors William Ambrose and David Smith, also of BEG, presented the first study of the Eaglebine play published in a peer-reviewed journal. This emerging play in northeast Texas represents the northern extension of the phenomenally prolific Eagle Ford shale play. The Eaglebine has generated considerable interest because of its potential for new hydrocarbon production from both sandstone and mudrock reservoirs of the Woodbine and Eagle Ford Groups. The article by Hentz and his colleagues addresses the play's stratigraphic and depositional relationships, which are complex and directly related to the play's exploration challenges. The study, integrated with a 2009 award-winning *AAPG Bulletin* article by the same authors, also presents for the first time a basinwide chronostratigraphic framework for the Woodbine Group.

Tucker Hentz

BOAT CHRISTENING: JACKSON SCHOOL. GLACIER: TIMOTHY BARTHOLOMAUS. GREENLAND GRAPHIC: NASA. TUCKET HENTZ: BEG.

A New Method for Tracking Glacial Melt

Surface & Hydrologic Processes

Institute for Geophysics (UTIG) researchers have developed a method to track meltwater flowing though seaside glaciers into the ocean, an essential step to understanding the future of the world's largest glaciers as the climate changes.

The study was led by Timothy Bartholomaus, a postdoctoral fellow at UTIG, and published in the journal *Geophysical Research Letters*.

Originally, the team went to Greenland and Alaska to study "icequakes," earthquakes caused when chunks of ice break off glaciers in a process called "calving." In a serendipitous twist, they discovered that their seismic equipment registered vibrations made by meltwater as it percolated through the glacier.

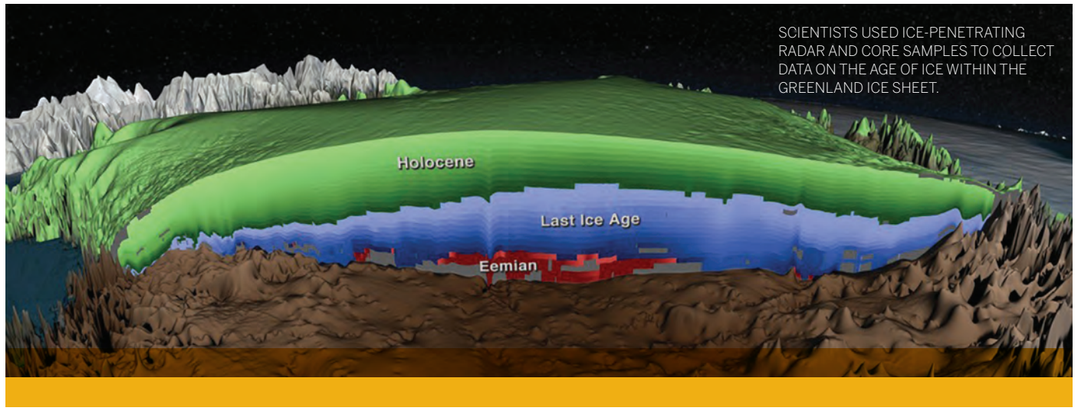
Previously there had not been a method to track meltwater in glaciers that end at the sea.

Meltwater can destabilize a glacier in a number of ways: The water can speed the glacier's flow toward the sea; move debris toward the terminus of the glacier; and expedite melting by bringing ocean water into contact with the glacier.

"All of the biggest glaciers in Greenland...in Antarctica, they end in the ocean," Bartholomaus said. "We need to understand how these glaciers are moving and how they are melting...If we want to answer those questions, we need to know what's occurring with the meltwater being discharged from the glacier."

UTIG research associate Jake Walter worked on the study. The team also included researchers from USGS and universities in Alaska.

ALASKA'S YAHTSE GLACIER.



SCIENTISTS USED ICE-PENETRATING RADAR AND CORE SAMPLES TO COLLECT DATA ON THE AGE OF ICE WITHIN THE GREENLAND ICE SHEET.

A 3-D View of the Greenland Ice Sheet

Surface & Hydrologic Processes

Scientists using ice-penetrating radar data collected by NASA's Operation IceBridge and earlier airborne campaigns have built the first comprehensive 3-D map of layers deep inside the Greenland ice sheet, opening a window on past climate conditions and the ice sheet's potentially perilous future.

This new map allows scientists to determine the age of large swaths of the second largest mass of ice on Earth, an area containing enough water to raise ocean levels by about 20 feet. This study was published online on Jan. 16, 2015, in *Journal of Geophysical Research: Earth Surface*.

"This new, huge data volume records how the ice sheet evolved and how it's flowing today," said Joe MacGregor, the study's lead author and a glaciologist at the Institute for Geophysics.

Greenland's ice sheet has been losing mass during the past two decades, a phenomenon accelerated by warming temperatures. Scientists are studying ice from different climate periods in the past to better understand how the ice sheet might respond in the future.

Scientists are interested in knowing more about ice from the Eemian period, a time from 115,000 to 130,000 years ago that was about as warm as today. This information will be helpful for evaluating the more sophisticated ice sheet models that are crucial for projecting Greenland's future contribution to sea-level rise.

Tectonic Explosion of Life

Solid Earth & Tectonic Processes

A geological analysis by Ian Dalziel of the Institute for Geophysics published in the November 2014 issue of *Geology* suggests a major tectonic event may have triggered the rise in sea level and other environmental changes that accompanied the Cambrian explosion, an apparent burst of life that occurred about 540 million years ago.

The Cambrian explosion is one of the most significant events in Earth's 4.5-billion-year history. The surge of evolution led to the sudden appearance of almost all modern animal groups. But its cause has been a mystery. The sudden burst of new life is also called "Darwin's dilemma" because it appears to contradict Charles Darwin's hypothesis of gradual evolution by natural selection.

TRILOBITES FIRST EVOLVED DURING THE CAMBRIAN EXPLOSION. OVER 20,000 SPECIES HAVE BEEN RECORDED.

Beyond the sea level rise itself, the ancient geologic and geographic changes probably led to a buildup of oxygen in the atmosphere and a change in ocean chemistry, allowing more complex lifeforms to evolve, Dalziel said.

"I'm not claiming this is the ultimate explanation of the Cambrian explosion," Dalziel said. "But it may help to explain what was happening at that time."

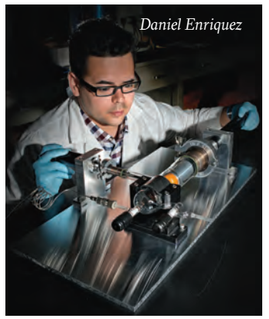
Measuring Volatiles in a Core

Energy Geosciences

Daniel Enriquez, a research scientist associate at the Bureau of Economic Geology and gas geochemistry laboratory technician, invented a device to solve a long-standing problem of core analysis.

The study of in situ fluid compositions under shale reservoir conditions is problematic because volatiles can be easily lost during core drilling and post-core transport. To retain volatiles contained in the sample cores, dips and coatings such as waxes and plastics are used when cores will not be tested within a few hours or days, and when the material will be transported over long distances or requires added mechanical integrity.

Accessing and accurately measuring the volatiles within the cores has been difficult. Enriquez's invention solves the capture and measurement problem by using a cutting blade inside a vacuum chamber to efficiently pierce the core plug's thick coating and capture gasses for analysis. The instrument was created in collaboration with The University of Texas at Austin's Applied Research Laboratories and the chemistry department. Enriquez is a graduate student at the Jackson School of Geosciences and an alumnus of the school's GeoFORCE program, where he was instructed by bureau researchers Jeffrey Paine, Sigrid Clift and others. The program left a lasting impression on him, strongly influencing his decision to pursue his studies in geology and a career at the bureau.



Daniel Enriquez

Ice on Mars

Planetary Sciences

Hidden glaciers on the surface of Mars contain enough water to blanket the Red Planet in a layer of water over two meters deep, found Joe Levy, a research associate at the Jackson School of Geosciences, and researchers from Mount Holyoke College and Brown University.

Their findings were published in the *Journal of Geophysical Research: Planets* in August 2014.

Debris-covered glaciers are a type of glacier with ice that is insulated by layers of surface rock and sand. The researchers used satellite images and laser altimeter data from the Mars Reconnaissance Orbiter to search for topological indicators of debris-covered glaciers, such as downslope, concentric lineations, convex-up topography, and complex ridges called "brain terrain."

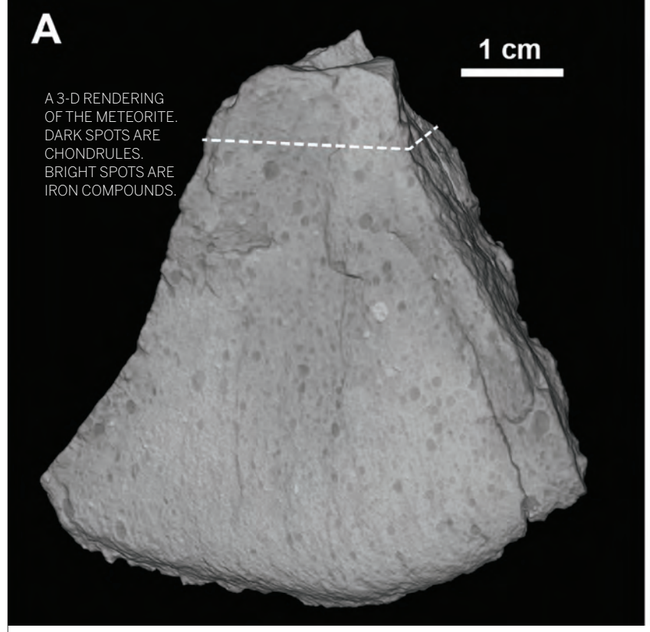
"It appears that [debris-covered glaciers] are everywhere," said Levy, who led the research team. "If you melted them all down it would be a global ocean on Mars."

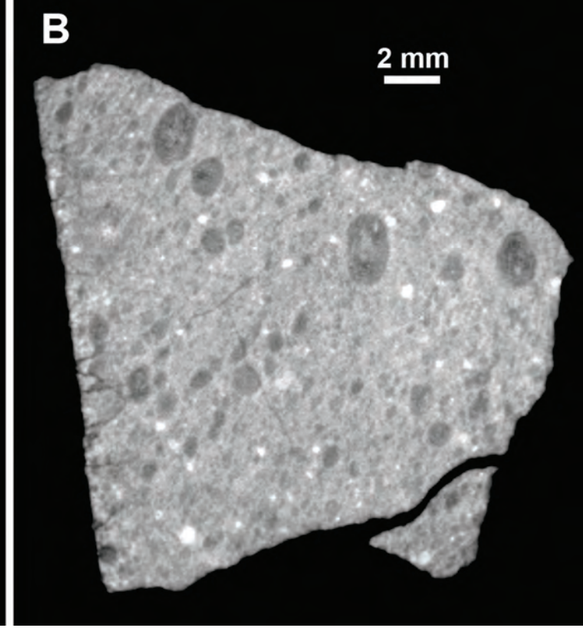
The debris-covered glaciers give clues into Mars' past climate conditions and indicate that the past climate was very different from today, supporting extended periods of ice deposition that enabled the glaciers to build up ice hundreds of meters thick.

But debris-covered glaciers are not only a Martian phenomenon. Levy and Jack Holt, a research associate professor at the Jackson School, study them on Earth, too. In the summer of 2015 they led a class of graduate and undergraduate students to study and map a debris-covered glacier in Wyoming.

"What makes this field course different is it's really experimental," Levy said. "Students get a handle on what it's like to explore a landform that very little work has been done on…and leave with a very specialized knowledge about how you use tools…and design experiments."

TRILOBITE: NPL. DANIEL ENRIQUEZ: DAVID M. STEPHENS. METEORITE: ROMY HANNA.





A Meteorite Under Microscope

Planetary Sciences

Researchers from the Jackson School of Geosciences have improved the understanding of planetary formation processes by analyzing the microstructures of a primitive meteorite on loan from the Smithsonian Institution.

The meteorite is a valuable scientific specimen because it's a leftover from the earliest stages of planet formation in our solar system when dust orbiting the sun was beginning to coalesce, said Romy Hanna, a doctoral student who led the research.

"It's original solar nebula material that never melted [into a planet]," said Hanna, who is also a NASA Earth and Space Science fellow.

Using X-ray computed tomography (CT) at The University of Texas at Austin High Resolution X-ray CT Facility in the Jackson School, Hanna found that the specimen's chondrules, millimeter-sized spherical grains present in primitive meteorites, defined a foliation fabric. By analyzing their 3-D structure and characterizing their microstructures using electron microscopy techniques, Hanna determined that the chondrules likely underwent low energy, brittle deformation as a result of impacts on the parent asteroid body. This finding is in contrast to current knowledge that assumes chondrules are deformed by high energy, plastic deformation during impact.

The research was conducted in collaboration with Whitney Behr, assistant professor, and Richard Ketcham, interim chair of the Department of Geological Sciences and director of the X-ray CT facility.

Hanna presented the findings at the annual meeting of the Meteoritical Society in Morocco in September 2014 and received the Gordon A. McKay Award for the best student oral presentation at the meeting. A paper detailing the research is currently under review in *Geochimica et Cosmochimica Acta*, the journal of the Geochemical Society and the Meteoritical Society.

Tracking Earthquakes in Texas

Solid Earth & Tectonic Processes

Texas Gov. Greg Abbott signed legislation in June 2015 authorizing $4.47 million in funding for the TexNet Seismic Monitoring Program, an initiative led by the Bureau of Economic Geology. TexNet will enhance the ability of the state to gather information about subsurface seismic activity by placing seismometers throughout the state and analyzing data resulting from any future seismic events.

The mission of TexNet is to provide transparent access to data and information regarding the understanding of earthquake activity in Texas, both natural and potentially induced by human activity. TexNet will acquire and install at least 22 permanent seismometers in key locations, augmenting the 16 existing seismometers currently in place in Texas. Another 36 portable seismometers will be staged in bureau facilities across the state, ready to rapidly deploy to investigate key future earthquake activity.

TexNet's goals are to monitor, locate and catalog seismic activity with magnitudes of 2.0 and larger, and to improve the state's ability to rapidly investigate ongoing earthquake sequences in Texas. The funding will also support objective research that should provide the residents of Texas with answers to many of their important questions about earthquake activity in the state.

THE COLORADO RIVER IS THE HABITAT OF MANY SPECIES OF FRESHWATER MUSSELS.

Sharing Water with Mussels

Surface & Hydrologic Processes

Texas water supplies, often stressed by drought, could be further affected by the federal listing of five freshwater mussel species under the Endangered Species Act, but most of the potential impacts could be mitigated by innovative water strategies, according to a study by the Bureau of Economic Geology (BEG).

The study in the October 2014 edition of the *Journal of the American Water Resources Association* addresses an issue that has concerned water managers in drought-prone Texas since 2011, the year when the U.S. Fish and Wildlife Service determined that five species of mussels warranted protection under the federal Endangered Species Act.

The five species – Texas fatmucket, Texas pimpleback, golden orb, Texas fawnsfoot and smooth pimpleback – have not been listed as endangered yet. If the species were listed and critical habitat designated, the federal law could affect environmental flows (water flows required to sustain freshwater ecosystems) in certain streams and rivers, especially in Central Texas, where the most mussels are found.

"Modeled changes in water availability following possible federal listing of the mussels are minimal when we are not in a drought," said lead author Brad Wolaver, a BEG research associate.

But during times of drought, disruptions to water supply could be significant in areas that already have shortages. They include: Bexar County, particularly in San Antonio's power generation sector; Tom Green County, where San Angelo has long-standing supply issues; and Wharton County, where existing agricultural water supply issues could be exacerbated.

THE LONG-NECKED ALAMOSAURUS TOWERS ABOVE OTHER DINOSAUR EXHIBITS AT THE PEROT MUSEUM OF NATURE AND SCIENCE.

Tons and Tons of Fossils

Climate, Carbon & Geobiology

The Vertebrate Paleontology Lab (VPL) has received three major collections since the beginning of 2014, adding to one of the largest fossil collections in North America.

Among them are the Cretaceous sauropod dinosaur *Alamosaurus* bones the VPL loaned out several years ago. The bones were used to create the massive *Alamosaurus* display in the Perot Museum in Dallas. The fossils, which represent about one-third of the complete dinosaur, were discovered by noted University of Texas paleontologist Wann Langston Jr. in the early 1970s and weigh about 12,000 pounds.

The second major collection was compiled over the course of about 30 years by biology professor Jon Baskin of Texas A&M University-Kingsville. It includes about 10,000 pounds of Pleistocene fossils, including mammoths, bison, horses, turtles and sloths.

The third large collection was made by Ken Barnes, an educator from west Texas, and includes Cretaceous dinosaur fossils, including a partially complete hadrosaur skeleton and a juvenile ceratopsian.

VPL researchers have also continued to conduct field work, collecting specimens for the lab from sites in Texas, New Mexico and other areas. In total, about 25,000 pounds of fossils have arrived since the beginning of 2014 for permanent curation in the facility.

RIVER: NICOLAS HENDERSON. DINOSAUR: MARK KNIGHT PHOTOGRAPHY. CRAB: NPL.

Genetic Toolkit for Feathers Existed Long Before Dinosaurs

Climate, Carbon & Geobiology

Julia Clarke, a researcher at the Jackson School of Geosciences, and collaborators have found that genes that regulate feather development are much older than the dinosaurs, a group that includes modern birds as well as ancient reptiles.

Their findings were published in the journal *Molecular Biology and Evolution* in November 2014.

According to their work, 86 percent of genes regulating feather formation, and 100 percent of non-keratin protein genes required to build feathers were present in the ancestors of archosaurs, the taxonomic group from which dinosaurs evolved.

The researchers discovered the presence of the genes by comparing the whole-genome sequence of a chicken — technically a living dinosaur — with whole-genome sequences from 19 other animals representing various evolutionary lineages. Genes controlling feather development and production in chickens were found in lineages much more ancient than archosaurs, with regulatory genes spiking in ancestors to amniota, the taxonomic group where hard-shelled eggs and internal embryo development first evolved. The spike in protein-encoding genes for feathers didn't occur until much later, with the evolution of dinosaurs, and later modern birds, from archosaur ancestors.

These findings indicate that regulatory genes required for feathers could be a "flexible toolkit" that controlled the development of many structures, such as hair, as well as feathers. The presence of the regulatory genes in taxonomic groups older than archosaur could also mean that feather precursors may have existed more than 100 million years before more modern-looking feathers appeared in dinosaurs.

THIS CRAB WAS ONE OF MANY FOSSILS THAT WERE UP FOR "ADOPTION" DURING THE NPL FUNDRAISER.

Climate, Carbon & Geobiology

Invertebrate Fossils Go Digital, Get Adopted

Over the past hundreds of millions of years Texas has been home to a menagerie of now extinct creatures, from trilobites to sea lilies. The Jackson School of Geosciences Non-Vertebrate Paleontology Lab (NPL) is improving the on-site and digital preservation of its over four million specimens from Texas and elsewhere thanks to a successful "Adopt-a-Fossil" fundraising campaign and a grant from the National Science Foundation (NSF).

The fundraising money will be used to buy a 3-D laser scanner and to support the scanning of 25 specimens that represent the major branches of invertebrate life, such as corals, sponges, mollusks, arthropods and echinoderms. Supporters will receive gifts related to their adopted specimen, such as a certificate of adoption, a glossy print of their fossil and a 3-D printed model of it, depending on their level of contribution.

The NSF grant will fund more 2-D and 3-D specimen scans, as well as the development of a digital interface so people can access images of the scanned specimens and other related data online. The NPL is collaborating with researchers from the university's Texas Advanced Computing Center to design the interface. The grant also covers upgrades to NPL facilities, such as improved archival cabinets for specimens.

"It's a combination of improved physical and virtual accessibility," said Ann Molineux, curator and collection manager of the NPL, about the NSF grant.

The fundraiser exceeded its goal of $15,000, raising a total of $17,119. The NSF grant will provide the lab with $495,880 over three years.

IN THE NEWS

Following is selected media coverage of the Jackson School of Geosciences. Find more at www.jsg.utexas.edu/news/in-the-news.

PENGUINS AT THE LONDON ZOO PREPARE TO WALK ALONG A CORRIDOR THAT MEASURES FORCE DISTRIBUTION. BOTTOM RIGHT: SMOKE FROM THE 2010 WILDFIRE SHULTZ FIRE.

THE NEW YORKER, MARCH 12, 2015

How the Penguin Got Its Waddle

James Proffitt, a Ph.D. student at the Jackson School of Geosciences, and the University of London Royal Veterinary College's John Hutchinson studied penguins at the London Zoo to figure out how they, and their distinctive gait, evolved from ancient seabirds.

The scientists used two tripod-mounted cameras to capture a complete biomechanical picture of the penguins as they walked. The penguin's waddle appears very inefficient, making the evolution of the flightless bird's gait a mystery.

"Their body is very weird for a bird," Proffitt said. But, he noted, during the Antarctic winter emperor penguins can walk some 50 miles to their nest sites; they scramble over cliffs, jump over obstacles, and scale sheer surfaces: "They're clearly doing something right."

KUT, DEC. 12, 2014

CO_2 and the History of Weighing Smoke

How do we keep track of the CO_2 we're releasing? And just how do we weigh something that floats in the first place? A KUT article answered this question with historical flair by comparing the answer of Sir Walter Raleigh, a 16th century explorer and guest of Queen Elizabeth I's court, to chemical reality.

"The difference between the weight of the tobacco and the weight of the ashes must be the weight of the smoke!" Raleigh said, according to an early American folk story.

In reality, smoke is heavier than the weight of the combusted material because carbon bonds with oxygen during the combustion process — creating CO_2, a molecule heavier than carbon alone and invisible to humans.

"If we could see it, it would be... super red," says Susan Hovorka, a research scientist who works with CO_2 at the Bureau of Economic Geology. "It's infrared. It's some incredibly more than red color. And you could drive around and see it coming out of every combustion source." So, if you know the amount of fuel you're burning and its carbon content, you can add the weight of the oxygen, and you have a sense of how much CO_2 you've created.

PENGUINS: JAMES PROFFITT. WEIGHING SMOKE: MIKE ELSON. BIG WATER PROBLEM: BAYANI CARDENAS.

RIGZONE, FEB. 23, 2015

UT Jackson School of Geosciences Aims to Enhance Research in Mexico

The University of Texas at Austin Jackson School of Geosciences and the National Autonomous University of Mexico have strengthened collaborations with each other in the fields of energy, environment and sustainability.

The new partnership will enhance the mutual academic opportunities created by Mexico's recent energy reform.

"In the next two to three years, because of the opening by the energy reform, we are going to have a large number of oil companies that are going to require national engineers and geologists," Jorge R. Piñon, director of the Jackson School of Geosciences Latin America & Caribbean Program, told *Rigzone*.

THE CHRISTIAN SCIENCE MONITOR, APRIL 12, 2015

Scientists to Dig Deep into Dino-Killing Impact Crater

The catastrophic asteroid crash blamed for the demise of the dinosaurs also left a gaping scar in the Earth. That sprawling crater made 65.5 million years ago may hold the answers to many mysteries surrounding the space-rock event.

"The Chicxulub impact crater has been a remarkable scientific opportunity for the 20 years since it's been discovered," said Sean Gulick, a research associate professor at the Institute for Geophysics.

For the first time, scientists have subsurface images from the offshore part of the crater, so they can pinpoint a spot for sampling. They chose a spot along the crater's peak ring — a ring of mountainlike structures around the center of the crater. By sampling there, the researchers can get a clearer picture of ancient biological and geological processes.

SCIENTIFIC AMERICAN, FEB. 3, 2015

Peering Inside Greenland's Ice Sheet in 3-D

Researchers have created a new 3-D map and animation of the Greenland ice sheet that allows them to study layers of ice tens of thousands of years old. The tools will help scientists better understand how Greenland may respond to climate change by revealing how the ice sheet responded to past changes in climate.

The map will "give people that gut-level feel of what an ice sheet looks like on the inside," said Joe MacGregor, a research associate at the Institute for Geophysics and one of the project's leaders.

PHIL BENNETT SAMPLES A HAND TUBE WELL IN SAMAR, PHILIPPINES.

BLOOMBERG, APRIL 15, 2015

For Tropical Island, a Brief Storm Surge Fuels Big Water Problem

Storm surges caused by massive tropical storms can destroy communities and take lives, but they can also contaminate groundwater that people depend on for drinking.

That's the case on Samar, an island in the Philippines. Long after Typhoon Haiyan devastated the area in 2013, an aquifer is still at risk of contamination as saltwater from the surge continues to seep through the ground above it. These findings were published in *Geophysical Research Letters*, a journal of the American Geophysical Union.

"During the storm they didn't have any water, and all the wells were salty," said Bayani Cardenas, an associate professor at the Jackson School of Geosciences and the lead author of the paper. "They drank coconuts for the first three days. It may take five to 10 years to flush out the seawater."

2015 STEMFORCE STUDENTS ON A GLASS-BOTTOM BOAT AT JOHN PENNEKAMP CORAL REEF STATE PARK IN FLORIDA.

FORBES, JULY 6, 2015

STEMFORCE: Building the Next Generation of Geoscientists

By Bridget Haby, coordinator for GeoFORCE, a high school outreach program in the Jackson School of Geosciences.

The ever-growing age gap within the oil and gas industry workforce is a phenomenon that companies are all too aware of. It is projected that within five to seven years, roughly 50 percent of the industry's workforce will be retired. STEMFORCE, funded in part by Drillinginfo and founded by the organization GeoFORCE Texas, is a new program that aims to encourage students to pursue careers in the geosciences by exposing high school students to geologic fieldwork.

Last week I took our first STEMFORCE cohort of 36 students from the Dallas and Austin areas to Florida to learn about river and coastal processes. For many of these students, this was their very first time on an airplane as well their first time travelling to another state. Over the first two days of the trip I could tell that many students were having trouble grasping the "big idea" concepts of geology, such as the processes that change the Earth's surface. Once we were out in the field however, and the students were able to physically see modern beach processes occurring on the Florida coast, I began to see my students having "Aha!" moments as they connected the dots. Showing the students how the Earth's surface is constantly changing and how these processes are reflected in the rock record is fundamental to their understanding of the foundations of geology.

AUSTIN AMERICAN-STATESMAN, NOV. 16, 2014

Bureau of Economic Geology Named Top Workplace

After surveys of more than 22,000 workers at 159 companies, the Austin American-Statesman's 2014 Top Workplaces of Greater Austin project narrowed it down to 100 Central Texas employers worthy of earning Top Workplaces designation.

The Bureau of Economic Geology ranked No. 15 among midsize employers.

STEMFORCE: BRIDGET HABY. METHANE HYDRATE: USGS.

THE WASHINGTON POST, MARCH 16, 2015

The Melting of Antarctica was Already Really Bad. It Just Got Worse.

Totten Glacier, a massive glacier in East Antarctica, is losing mass because warm ocean water is flowing underneath it and compromising its ability to hold back a flow of ice, a study led by Jamin Greenbaum of the Institute for Geophysics found. The findings are "alarming, because the glacier holds back a much more vast catchment of ice that, were its vulnerable parts to flow into the ocean, could produce a sea level rise of more than 11 feet — which is comparable to the impact from a loss of the West Antarctica ice sheet." The researchers used gravitational measurements, radar and laser altimetry during their flights to study what is occurring underneath the massive glacier.

CLIMATE.GOV, APRIL 20, 2015

Early Years of California's Drought May Be Linked to Lingering Effect of La Niña

On average, La Niña — the cool phase of a natural climate pattern in the tropical Pacific — leads to somewhat dry winters in California. But a new analysis of historical data from scientists in the Climate Program Office of the National Oceanic and Atmospheric Administration suggests that dryness often deepens into drought the following year, even if the tropical Pacific has technically shifted back to "neutral" conditions. Consistent with that pattern, California's ongoing drought began in 2011-12, during the second year of a La Niña phase, and it persisted into the "neutral" years of 2012-14. Yuko Okumura, a research associate at the Institute for Geophysics, was part of the team that conducted the analysis.

THE DALLAS MORNING NEWS, MAY 28, 2015

Texas Budget Includes $4.5 Million for UT Quake Research

The state of Texas has agreed to fund $4.5 million for the Bureau of Economic Geology to study seismic activity in Texas. House lawmakers approved the funding 145-1.

Dallas Democrat Rep. Rafael Anchia secured the money in the state budget, which will be used to buy and deploy seismic equipment.

"Our community is rightfully concerned about the unusually high seismic activity in Dallas, Irving and Farmers Branch. This study should help us get to the bottom of it," Anchia said.

METHANE HYDRATE HOLDS VAST AMOUNTS OF POTENTIAL ENERGY.

HOUSTON CHRONICLE, OCT. 22, 2014

UT Gets Money to Study New Energy Source in Gulf

The University of Texas at Austin has won $58 million to investigate a potentially massive energy resource: methane trapped in ice-like crystals under the Gulf of Mexico and oceans around the world. The U.S. Department of Energy is providing $41.2 million toward the grant, one of the largest government grants ever awarded to the university, with the rest coming from industry and research partners. The university plans to use the funding to harvest and analyze core samples of methane hydrate from sandstone reservoirs thousands of feet under the Gulf — the first time the deposits have been retrieved from U.S. waters. Peter Flemings, a professor and research scientist at the Institute for Geophysics, is the project's principal investigator.

A CASCADE AERATOR AT A WATER TREATMENT PLANT OUTSIDE OF SAN ANTONIO.

Bridge Scanlon

SCANLON: BEG. CASCADE AERATOR: GABRIEL CRISTÓVER PÉREZ. GLOBE GRAPHIC: IAN DALZIEL.

THE TEXAS TRIBUNE, JUNE 15, 2015

Don't Let Texas' Excess Water Go to Waste

By Bridget Scanlon, Bureau of Economic Geology Senior Researcher

The past few weeks have highlighted a challenge for water resource managers in Texas: We have either too much water when we don't need it or too little when we do.

The recent devastating floods have underscored the need for better preparation in not only monitoring but also keeping as much of that water as possible.

One of the main ways of managing water resources in these extremes is to store water in times of excess for use during droughts. Surface reservoirs are the traditional method of storing water, but unfortunately the rate at which we build new reservoirs has slowed dramatically since the 1970s while our population has doubled, halving the per-capita reservoir storage since then. The prime locations for surface water reservoirs have already been developed, and getting permits for new reservoirs is challenging and expensive. So what should we do?

Instead of storing excess water on the surface, where it can evaporate, particularly during droughts, we should store more excess surface water underground using what's known as aquifer storage and recovery, or ASR. The San Antonio Water System has been doing this since 2004, storing water from the Edwards Aquifer during times of excess in the Carrizo Aquifer. This storage has proved beneficial for San Antonio, especially during the 2011 drought.

There are many more opportunities and much more capacity for ASR across the state, and such storage would complement surface reservoirs and off-channel reservoirs.

The Texas Legislature, particularly state Rep. Lyle Larson of San Antonio, is a strong advocate of this approach, and a bill passed last month should advance the use of ASR in the state. The legislation would allow a water right holder to use water from existing permits, such as those for reservoir storage during a flood. The bill is awaiting Gov. Greg Abbott's signature.

This is a good first step, but Texas can do more.

Excess water during flooding could be transferred to aquifers for long-term storage. The heavily depleted Trinity Aquifer near Dallas provides a huge potential storage reservoir for ASR. During the recent heavy rains in Central Texas, excess surface water could have been stored in the saline portions of the Edwards Aquifer in Austin for later use.

Rainwater harvesting is another approach that is expanding, with more households installing systems for nonpotable water use, including lawn watering. The Texas Water Development Board estimates that the city of Austin could collect about 32,000 gallons of water annually using rainwater harvesting, and Austin incentivizes rainwater harvesting through its rebate program.

While storage is one of the key approaches to managing the extremes, monitoring these extremes is also critical. As shown by the recent flooding along the Blanco River, the existing monitoring program is inadequate. We should expand it by considering citizen science and community-based monitoring. When and where flooding will occur is extremely difficult to predict, but smartphones can inform disaster management programs if we develop approaches for handling the data.

Water is one of our most precious resources, and although the recent floods have been devastating, they can teach us critical lessons about preparing for the future.

This is reprint of an article that originally ran in the Texas Tribune.

TEXAS STANDARD, APRIL 2, 2015

Texas Standard Interviews BEG's Scott Tinker on Energy and the Economy

Bureau of Economic Geology Director Scott Tinker appeared on the radio program the Texas Standard to discuss the potential impact of Iran's oil on the world market and the Texas economy, as well as the recent downturn in oil prices.

Tinker said that the amount of oil Iran could export is modest when compared to global consumption habits, so it's not likely to have much sway on prices. He also said that the downturn in oil prices, though painful in the short-term, could end up being a stimulant for economic growth in Texas. With oil costs low, businesses can expand, which should eventually drive the price of oil back up, Tinker explained.

"I'm not one who over worries about it. I think we're in a cycle here in Texas a bit, but Texas is strong and it's going to survive through this downturn and come out the other end probably a little bit more efficient than it was," Tinker said.

NEWS RADIO 1200 WOAI, OCT. 6, 2014

Fracking Uses No More Water Than Traditional Oil Production

Research done at the Bureau of Economic Geology has cleared fracking of one of the most serious allegations leveled against it by environmentalists who oppose the practice — that it uses a disproportionate amount of water and risks depleting water sources for agricultural and residential users, especially in already water challenged South Texas.

But Bridget Scanlon, a senior research scientist at the Bureau of Economic Geology, tells Newsradio 1200 WOAI that claim is not true.

"The water used to produce oil using hydraulic fracturing is similar to the water used in the U.S. to produce oil using conventional techniques," she said. "The reason we're using more water is because we are producing more oil, not because hydraulic fracturing is any more water intensive."

HOUSTON CHRONICLE, JULY 3, 2015

Franks: New Scenes in Cuba Hint at What Could Be

Houston resident and former Reuters bureau chief Jeff Franks' first-person account of travel in a rapidly changing Havana describes economic reform and a thaw in relations with the United States. But things are still difficult in Cuba, Franks writes, pointing to the regular blackouts. He turns to the Jackson School of Geosciences' Jorge Piñon, director of the school's Latin America and Caribbean Energy Program, to explain the situation. The blackouts, Piñon said, are the indirect result of increased electricity demand from the many new businesses. Cuba can't afford to buy more oil, so "they control energy demand by purposely switching the power off."

THE HUFFINGTON POST, NOV. 19, 2014

'Big Bang' of Species May Be Explained by Continental Shift

A University of Texas geologist believes he may finally have an explanation for what some refer to as "Darwin's dilemma": a major shift in the continents, which created ideal conditions for complex new life forms to evolve.

"The reason people didn't make this connection before was because they hadn't looked at all the rock records on the different present-day continents," said Ian Dalziel, a research professor at The University of Texas at Austin Institute for Geophysics and a professor in the department of geological sciences. Dalziel added that his analysis is the first to look at geological evidence from five continents: North America, South America, Africa, Australia and Antarctica.

ANCIENT CONTINENTS BECAME SEPARATED AFTER A DEEP OCEANIC RIFT, SHOWN IN BLUE, FORMED BETWEEN THEM. AN EXPLOSION OF LIFE IN THE FOSSIL RECORD CLOSELY FOLLOWED.

DISCOVERY NEWS, AUG. 17, 2015

Saharan Heat Amped Up by Climate Change

The searing Sahara Desert is getting even hotter, at a rate two to four times greater than the rest of the tropics, say scientists in a new study.

That puts it on par with the Arctic which is also exceeding the global warming average. But whereas the widely studied Arctic "amplification" melts sea ice and permafrost, the Sahara warming could be reducing the huge outflow of dust that blows off Africa and be causing big changes to regional weather — and local people.

"A lot of people live there — three million or so," said researcher Kerry Cook of The University of Texas at Austin who led the study. "And it's adjacent to the Sahel region, which has many more people.

They results were published in the August 2015 issue of *Journal of Climate*.

Just why it is warming faster than other regions is not at all clear, said Cook. One possibility is that the hot arid land simply can't transfer heat up and away, as other, moister lands do.

SAHARA SAND DUNES IN MOROCCO.

SMITHSONIAN.COM, JULY 14, 2015

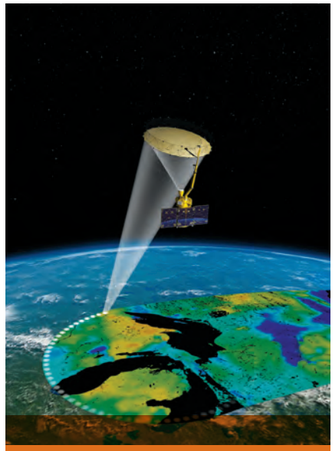
How Can We Keep Track of Earth's Invisible Water?

Life on Earth depends on a lot of water that we can't see, from vapor in the air we breathe to freshwater in deep aquifers used to irrigate crops. The podcast Generation Anthropocene went on a continent-hopping tour of the invisible water that drives planetary processes.

Kaustubh Thirumalai, a doctoral student from the Institute for Geophysics, appeared on the show as part of an ongoing series, "Convos with Kau." Thirumalai recently returned from India, where he was part of a team collecting rocks and sediment from the ocean floor around the Indian subcontinent. Their data should reveal more about the history of the South Asian monsoon and how this major player in the freshwater cycle is being affected by climate change.

"We really want to understand when the monsoon turned on and whether the monsoon turned on simultaneously with when the [Himalayas] were built," Thirumalai said.

SAHARA: ELLIE O. PHOTOGRAPHY. SATELLITE GRAPHIC: NASA



AN ARTIST'S RENDITION OF THE SOIL MOISTURE ACTIVE PASSIVE (SMAP) SATELLITE.

KVUE, FEB. 6, 2015

UT, LCRA Teaming with NASA on $900 Million Satellite

The University of Texas at Austin and the Lower Colorado River Authority (LCRA) will be utilizing data from a new NASA satellite to better forecast droughts and floods. NASA launched the $900 million Soil Moisture Active Passive (SMAP) satellite on Jan. 31, 2015.

The satellite orbits the earth approximately every 90 minutes and is capable of measuring the moisture of soil in the ground. Its mission is to vastly improve forecasting for droughts and floods. The university and LCRA will be working with NASA by working to confirm what the satellite records. The new information comes with a few obstacles.

"It's challenging on a whole bunch of different levels. It's challenging from the fact, this data set, that is going to be the first of its kind, and it's at a fairly large scale and a lot of times we need these estimates, even at a finer scale," said Todd Caldwell, a research associate at the Bureau of Economic Geology.

NICOLA TISATO

By Mark Wangrin

When he was a student, his favorite classroom was cold, dark and damp. A classroom built from rock; different kinds from different eras. It's subterranean and mysterious, the more mysterious the better.

Nicola Tisato loves to explore caves.

"Some of my biggest emotions have been in caves," he said. "When you discover a new cave, and you realize nobody had been there before, you really feel you've discovered something."

French explorer Marcel Siffre says there are three places in this universe that need to be discovered: the outer space, the oceans and the caves.

"Sometimes you have concern because caves are uncomfortable places, but at the same time, you want to continue your journey; you want to explore and discover how the cave formed. There are many secrets hidden there."

Through caving, Tisato wants to unlock rock secrets.

That is what brought him from his native Italy, through Switzerland and Canada, to The University of Texas at Austin.

The 36-year-old would like to continue his passion for cave exploring in Central Texas, but it's his new position as assistant professor of geophysics that will bring him to the Jackson School of Geosciences in January 2016.

Tisato comes to The University of Texas at Austin from the University of Toronto, where he combined experimental rock deformation with computed microtomography to observe what happens inside a rock that is undergoing deformation. Previously, he earned a doctorate at ETH Zürich, after which he was a lecturer and post-doctoral researcher. He also worked in the private sector, including posts as a technician, IT professional, insurance agent and policeman.

"The Jackson School of Geosciences is one of the most recognized schools of geosciences in the world," Tisato said. "There's already a very strong team there. They already do much research. What I hope to add is measuring the physical properties of rocks, which is vital to exploring the subsurface. We don't know much about the subsurface. We know up to a few kilometers, but we need to know more."

His particular focus will be on rheology, the study of how rocks deform while stressed.

"If I take rubber, and I apply force I expect the rubber to flow with time," he said. "(Rocks) have the same type of behavior, which is non-elastic (i.e. viscoelastic). The expectation of energy comes from sources that are located inside."

Tisato plans to work with associate professor Jung-Fu Lin and associate dean and interim chair of the department of geological sciences Richard Ketcham in mineral physics and geochemistry, and with Farzam Javadpour of the Bureau of Economic Geology on problems within shale gas.

"We are excited about his arrival in January because he will, together with professor Kyle Spikes, set up a rock deformation laboratory and an experimental rock physics group within our geophysics discipline," said Ronald Steel, professor in the Department of Geological Sciences. "This, together with his excellent research record and background, is what made him attractive to the Jackson School."

Tisato will study, for instance, the impact of fluid pressure on rock stiffness, or the impact of microbubbles in the absorption of seismic waves.

"There is a quest for understanding the real rheology of geomaterials when they are stressed by seismic waves," Tisato said. "For instance, while traveling through Earth, seismic waves with specific frequencies fade more quickly than others. This can tell us something about the Earth's interior."

> "The Jackson School of Geosciences is one of the most recognized schools of geosciences in the world."
>
> *-Nicola Tisato*

At the Jackson School, Tisato will complement existing research into earthquakes, including their relation to hydraulic fracturing. He plans to work with professor G. Di Toro at the University of Manchester and INGV–Rome, which he says owns the state-of-the art machine for measuring friction, and that will be equipped with new instrumentation that will allow him to measure properties of rocks in faults.

"Another interesting phenomenon that I would like to study at UT is dynamic fluid pressure," he said. "Seismic waves traveling through the subsurface are really able to mobilize the fluid within the porous structure of the rock. Measuring the little variations of pressures occurring in very short periods (microseconds) will allow us to understand better the viscoelasticity of saturated rocks."

This approach can improve imaging of the subsurface because the increased knowledge of the rock's rheology will allow scientists to better and more consistently interpret the actions of the seismic waves used to create a picture of the subsurface.

"We could, for instance, interpret better the position of fluids in the crust, or the natural and induced seismicity, to optimize stimulation," Tisato said. "Stimulation (hydraulic fracturing) is a very hot topic now. Companies should invest more in research done in a rigorous way. We all need energy. We can't live without it."

Tisato enjoys serving as his own lab tech, a byproduct of his adventurous days in the garage of his family's home in Schio, a small wool-producing town near the foot of the Alps. There he dabbled in electricity, electronics, motorcycle rebuilding, radio restoration and other manifestations of his innate curiosity, some of which created no small danger to his often unsuspecting parents.

"I think my mother was very scared," he said. "I was experimenting. I think if you ask her today, she would say, 'Nicola was doing experiments and I never knew what he was doing.'"

Perhaps it was just as well. "Sometimes you use hydrogen," he explained, "and you don't want it to explode."

Aside from the research potential at the university, living in Austin — which he calls "vibrant" and "open-minded" — lured Tisato.

He'll be able to tour the area with his mountain bike, dabble in 3-D photography and explore the high-tech opportunities the region proves. Another of his passions, sadly, will be on indefinite hiatus.

"I think in Austin I will not do cross country skiing," he said with a chuckle.

There's another plus to the job at the Jackson School. Unlike his post-graduate term in Toronto, there's long-term stability in Austin, enough to bring his wife, Maria Luisa, and daughter, Beatrice, from Switzerland to the U.S.

Beatrice, who was born in April 2014, is a budding scientist in her own right.

"She's very keen on going around the house with a magnet, looking for metals," he said. "Now that she's learned to walk, she's got everything to discover."

TISATO STUDIES MINERAL DEPOSITS CALLED SPELEOTHEMS IN ASPERGE CAVE IN FRANCE WITH RESEARCH COLLEAGUES.

TISATO TINKERING: NICOLA TISATO. CAVE: TOMASO BONTOGNALI.

DANIELLA REMPE

By Mark Wangrin

Daniella Rempe brought more than a towel and sunscreen on her visits to Barton Springs when she was an undergraduate at The University of Texas at Austin.

She brought her curiosity.

"It's an exciting place to hang out, but it just isn't relaxing for me. I'm consumed with where the water comes from," she said of the afternoons spent at the revered, spring-fed Austin swimming hole.

There she came to terms with her obsession with water. How it travels through rock. What it picks up along the way. How it transforms the environment around it.

Rempe has spent her academic career seeking answers for those types of questions, a quest she'll continue in September 2016 when she joins the Jackson School of Geosciences as an assistant professor of water science in the Department of Geological Sciences. Rempe comes from the University of California at Berkeley where she is a Ph.D. candidate in Earth and planetary sciences. She also earned her master's degree in environmental engineering from UC Berkeley.

Rempe's research focuses on how landscapes store water in the shallow subsurface. Much of the Earth's hilly regions are mantled with weathered and fractured rock. Beneath the soil, this rock can sustain forest ecosystems and influence how much water is available to fish in streams. Rempe said her research increases understanding of hydrologic dynamics in the context of landscape evolution and weathering.

She focuses on characterizing weathered rock at the landscape scale and monitoring the water dynamics within it. She has used a variety of geophysical tools and hydrological monitoring instruments to document the hydrology of fractured rock in hillslopes in Northern California.

REMPE: DANIELLA REMPE. GROUP: ALEX BRYK. WEATHERED ROCK: WILLIAM E. DIETRICH.

"It is an incredibly exciting time to study how water, rock and life interact," Rempe said. "Recently, the weathered bedrock zone, along with the overlying soil and vegetation, have been named the critical zone. There is an international, highly interdisciplinary effort underway to understand how physical, chemical, and biological processes within the critical zone influence how water is routed within landscapes."

A native Texan, Rempe makes her long-awaited return to the Jackson School, where she earned her bachelor's in geosystems and hydrogeology in 2008. Her interest in hydrogeology was kindled by fieldwork and course projects during her stay at the Jackson School.

"I'm very excited to join the Jackson School because it's a school that I deeply care about," Rempe said. "Students and researchers have access to opportunities unlike anywhere else. I had such an enriching experience at UT Austin, and I'm very pleased that several students that I worked with at Berkeley chose to pursue graduate degrees at the Jackson School."

California and Texas have been hit hard by severe drought. While recent rains have relieved the drought in Texas, California remains in the throes of a record-setting dry spell.

Recently, Rempe has been involved with the Critical Zone Observatories program with the U.S. National Science Foundation. She is part of an interdisciplinary team that is tackling the question of how the critical zone evolves. At the Eel River Critical Zone Observatory, she studied the hillslope to link water in the rock to the atmosphere, rivers, watersheds, oceans, and terrestrial and aquatic ecosystems.

"Often times the indirect observations that we rely on as hydrologists leave us wondering about what pathway water takes," she said of her work at the Eel River. "But by drilling into the hillslope, we were able to access the rock directly to quantify what we call 'rock moisture,' a term that describes seasonally dynamic moisture in rock and the fractures within it. Through long-term monitoring of both the water and the vegetation, we've shown that the vegetation rely on rock moisture in this seasonally dry climate."

In Texas, Rempe will have a prime opportunity to continue her research on the impacts of water transport in the near surface, but with a local twist. Rempe said, she'll be trading California's actively deforming, steep coastal ranges for the Central Texas carbonate Hill Country.

"New technologies make this work fun and exciting," Rempe said. "We are starting to understand how observations we make on the ground at the pore scale relate to the kilometer scale observations we make from space."

At the Jackson School, she'll be able to tap into the school's relationship with NASA's Soil Moisture Active Passive (SMAP) project to study soil moisture, attempting to extend that capability further into the fractures of the bedrock below. More than 30 of the project's sensors are located around Fredericksburg, providing easy access.

"As hydrologists, we try to account for every drop of water," she said. "In Northern California, the streams and the ecosystems are competing with people, grapes and other agriculture. In Texas, and other places impacted by long droughts, understanding how vegetation and land use interface with hydrology is critical to developing effective water resource management strategies. Researchers at the Jackson School have paved the way, and I'm looking forward to joining their team."

Rempe expects to work with Jack Sharp, Carlton Professor of Geology, and associate professor M. Bayani Cardenas in the hydrology group; professor David Mohrig and assistant professor Joel P. Johnson in the earth surface processes group; and Michael Young, associate director of environmental services at the Bureau of Economic Geology, and Todd Caldwell, a geomorphologist at the bureau

"Coming to UT is a dream," Rempe said. "Not only because I'll have the opportunity to share the mysteries of Barton Springs with my students. I'll be surrounded by researchers with a diverse set of expertise and dig deeper into landscapes to understand how water moves through them."

TOP: REMPE DISCUSSING GEOPHYSICAL SURVEY LOCATIONS WITH COLLABORATORS. BOTTOM: A ROCK REMPE DOCUMENTED TO STUDY THE IMPACT OF WILDFIRE ON WEATHERING.

"Students and researchers have access to opportunities unlike anywhere else. I had such an enriching experience at UT Austin."

-Daniella Rempe

Partnership with Mexico Boosts Research Exchange

Researchers from the Jackson School of Geosciences attended and hosted events in Mexico in the winter and spring of 2015 to promote research exchanges between The University of Texas at Austin and Mexican universities, and the sustainable development of Latin America's energy resources.

In February a group of researchers from the Institute for Geophysics (UTIG) led by Director Terry Quinn visited Mexico City and met with Mexican scientists from academia, the private sector and public institutions to discuss areas of shared interests such as the deep-water Gulf of Mexico.

The researchers came only a week after the university's then provost, now president, Gregory L. Fenves signed one of the three new agreements in Mexico City that strengthen collaboration between The University of Texas at Austin and the National Autonomous University of Mexico (UNAM) in the fields of energy, environment and sustainability.

The agreement promotes the mobility of postgraduate students, researchers and faculty between the institutions. It also helps facilitate conferences, symposia, and joint academic programs and scientific research projects to identify and meet sustainable energy challenges.

"The goal of enhancing collaboration between research scientists at UTIG and our Mexican colleagues in academia, industry and government was advanced via this first round of face-to-face meetings in Mexico City," Quinn said.

Keeping in the spirit of this agreement, the Jackson School hosted in April a Latin American Forum on Energy and the Environment in Mexico City. This event brought together public and private sector decision makers, scholars and scientists for two days to discuss sustainable development of energy resources and environmental issues.

The forum's technical panels were developed with the support and cooperation of UNAM geoscience research centers and Mexico's professional geoscience societies. Forum panel topics included: the role of public and private research in the oil and gas sector, understanding and reducing conflicts around water use in the energy sector, plans to explore the Chicxulub asteroid impact site, the future of potential new fuel source methane hydrates, and the importance of building the next generation of geoscientists and engineers.

TOP: JACKSON SCHOOL DEAN SHARON MOSHER WITH JAIME URRUTIA FUCUGAUCHI, PRESIDENT OF THE MEXICAN ACADEMY OF SCIENCES. BOTTOM: JAMES AUSTIN SPEAKS AT THE LATIN AMERICAN FORUM.

LATIN AMERICAN FORUM: JACKSON SCHOOL; LASER ABLATION: NATHANIEL MILLER.

Argentina Turns to Texas for Shale Advice

A delegation of high-ranking public officials, and oil and gas executives from Argentina visited The University of Texas at Austin twice in 2015 to discuss how to safely and sustainably develop the country's energy resources.

The university's Jackson School of Geosciences and the Kay Bailey Hutchison Center for Energy, Law, and Business hosted the visits on June 3 and August 17.

Argentina holds the world's second-largest technically recoverable shale gas reserves. But the experience of developing the reserves is new to the country, said Argentine Delegate Rodolfo Urtubey, national senator for Salta Province and member of the Energy Senate Committee.

"We're here at The University of Texas at Austin because you have concentrated in this academic institution the different views — the legal views, the technical views, the financial views. We have to know the experiences," Urtubey said.

At both meetings experts attended from the Jackson School, the School of Law, the Energy Institute and the McCombs School of Business. Representatives from the Railroad Commission of Texas, the Texas Commission on Environmental Quality and the private sector were also present.

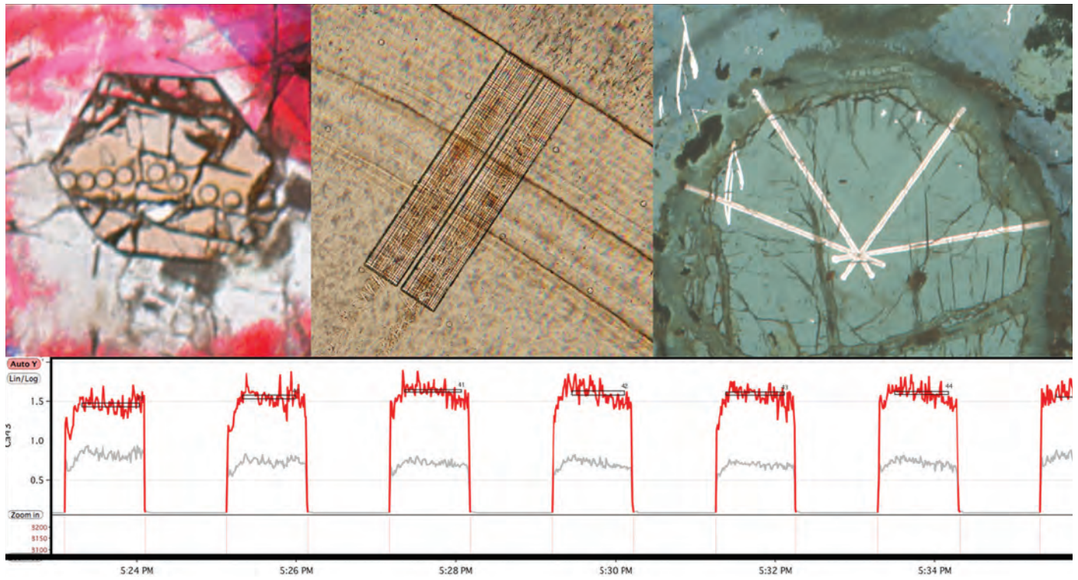
University President Gregory L. Fenves visited the first delegation on his first day in office and emphasized the long and important history between the university and Latin America, and the university's strength as a leading energy research institution.

"We're here at The University of Texas at Austin because you have concentrated in this academic institution the different views — the legal views, the technical views, the financial views. We have to know the experiences."

Rodolfo Urtubey, Argentine national senator

Welcome to the Laser Show

The University of Texas at Austin and Texas Tech University hosted the inaugural North American Laser Ablation Workshop at the Jackson School of Geosciences on May 27 and 28, 2015. The workshop consisted of poster presentations, short talks with moderated discussion, and selected invited presentations. Nathan Miller, the Jackson School's laser ablation and ICP-MS lab manager, was an organizer.



LASER ABLATION MINERAL SAMPLES AND DATA.

THE SECOND CCUS WORKSHOP TEAM.

Catching Carbon in China

A team of scientists from the Bureau of Economic Geology travelled to China in April 2015 to attend and present at a series of meetings and workshops on carbon capture and storage.

The team — made up of Tip Meckel, Susan Hovorka and Jiemin Lu — visited Beijing, Shanwei and Guangzhou. They attended the U.S.-China Carbon Capture Working Group's second-ever workshop on carbon, capture, use and storage (CCUS) to promote carbon capture in the Gulf of Mexico and offshore Guangdong. The team also continued to establish working relationships with various Chinese research groups and industrial partners who are involved in potential offshore CCUS projects in the Pearl River Basin offshore of the Guangdong Province.

The trip was facilitated and hosted by the U.S. Department of Energy.

THE JACKSON SCHOOL'S JORGE PIÑON MODERATING A DISCUSSION AT UT ENERGY WEEK.

Jackson School Talks Energy at UT Energy Week

In February 2015 the Jackson School of Geosciences participated in UT Energy Week, a gathering of experts from academia, industry, non-profit organizations and the news media, co-hosted by The University of Texas at Austin's Energy Institute and student-run Longhorn Energy Club. Jorge Piñon, interim director of the Jackson School's Center for International Energy and Environmental Policy and director of its Latin America and Caribbean Energy Program, moderated a discussion on the expected benefits to Mexico and North America from energy regulatory reform. Michelle Michot Foss, chief energy economist at the Bureau of Economic Geology's (BEG) Center for Energy Economics was on the panel. In addition, BEG Director Scott Tinker and Ian Duncan, a BEG program director, participated in a panel on the impact of hydraulic fracturing moderated by Russell Gold, Wall Street Journal senior energy reporter.

CCUS GROUP: BEG. ENERGY WEEK PIÑON PHOTO AND GRAPHIC: UT AUSTIN.

GEOFORCE DIRECTOR SAMUEL MOORE, FORMER DIRECTOR DOUG RATCLIFF (SECOND AND FIRST FROM RIGHT) AND OTHER HONOREES MEET WITH PRESIDENT OBAMA.

President Obama Honors Jackson School of Geosciences Mentoring Program

IN MARCH 2015 PRESIDENT BARACK OBAMA HONORED THE UNIVERSITY OF TEXAS AT AUSTIN'S GEOFORCE TEXAS PROGRAM WITH THE PRESIDENTIAL AWARD FOR EXCELLENCE IN SCIENCE, MATHEMATICS AND ENGINEERING MENTORING, THE HIGHEST SUCH HONOR FROM THE UNITED STATES GOVERNMENT.

GeoFORCE Texas, an outreach program of the Jackson School of Geosciences, takes high school students from inner-city Houston and rural Southwest Texas on field trips each summer to geologically significant sites across the country for four years. As a result, potential geoscientists are introduced to the profession, and students from disadvantaged areas find a path to college and rewarding careers.

"We are thrilled that the president has honored the program," said Dean Sharon Mosher. "GeoFORCE plays such an important role in shaping and improving young lives, particularly from underserved populations. There is nothing more fulfilling for an educator than helping young people achieve their full academic and personal potential. GeoFORCE is a wonderful example of a program doing just that."

GeoFORCE was the only organization to be recognized with an award. The 14 other recipients were individuals.

GeoFORCE Director Samuel Moore and former Director Doug Ratcliff accepted the award at a dinner hosted by the National Science Foundation on June 17, 2015. The award winners also met with President Obama in the Oval Office.

The White House presents the award to individuals and organizations that mentor academic and personal development of students studying science and engineering — particularly those who belong to groups that are underrepresented in these fields. It also includes $10,000 in support from the National Science Foundation.

Eighty percent of GeoFORCE participants are members of minority groups. Since its inception in 2005, GeoFORCE has been a robust success. It's served more than 1,500 students with 100 percent of students graduating from high school; 96 percent going on to college; and 16 percent majoring in geoscience — more than 50 times the national average.

"These educators are helping to cultivate America's future scientists, engineers and mathematicians," President Obama said in a press release honoring all of this year's recipients. "They open new worlds to their students and give them the encouragement they need to learn, discover and innovate. That's transforming those students' futures, and our nation's future, too."

The program also supports high school students with SAT and ACT preparation, and guidance in applying for college. It has also awarded more than $2 million in scholarships. After high school, GeoFORCE continues to mentor students through college, into internships and the workforce.

TOP: 2015 GEOFORCE STUDENTS. BOTTOM: MOORE AND RATCLIFF RECEIVE THE AWARD FROM OSTP DIRECTOR JOHN HOLDREN AND NSF DIRECTOR FRANCE A. CÓRDOVA.

OVAL OFFICE: PETE SOUZA. GEOFORCE: JODY HORTON PHOTOGRAPHY. AWARD: NATIONAL SCIENCE FOUNDATION.

Austin Geological Society Celebrates 50 Years

In 1965 the Austin Geological Society was founded by a small group of geologists looking to promote professional communication between members of the Austin's geosciences community. Among that group was the society's inaugural president Peter Flawn, then the director of the Bureau of Economic Geology and future University of Texas at Austin president.

In October 2015 the AGS officially celebrated 50 years as Austin's geoscience hub. And in the half century since Flawn helped found and lead the society, the relationship between AGS and the university has only gotten stronger.

University staff, faculty and alumni have consistently held leadership positions within the AGS over the years. Its current president Rebecca Smyth is a project manager at the Bureau of Economic Geology. Since the Jackson School of Geosciences was established as a college in 2005, half of the society's presidents have been faculty or staff. Starting from most recent, they include Jack Sharp (2014-15), Dennis Trombatore (2013-14), Dallas B. Dunlap (2010-11), Ann Molineux (2009-10), and Ernest Lundelius (2006-07).

The society has brought the university and Austin geology community together in more than one way. At monthly meetings, invited speakers give talks about topics in science and business important to the geosciences community. And AGS' connection with other societies enables its members to get involved with other geoscience groups. The AGS is both an affiliate of the American Association of Petroleum Geologists and a member of the Gulf Coast Association of Geological Sciences.

The society is also a prolific publisher of guidebooks authored by members describing Austin and Central Texas geology. Over 30 have been published since the AGS' founding. One in particular succinctly states the connection of the society to the university through its title: "Rocks, Resources, and Recollections: A Geologic Tour of the 'Forty Acres' — the University of Texas at Austin campus."

AUSTIN GROUP austin geological Society

For more about the AGS, including guidebooks and monthly meetings, visit: www.austingeosoc.org.

Five Graduate Students Receive NSF Fellowships

In spring of 2015 the National Science Foundation (NSF) selected five students from the Jackson School of Geosciences for its prestigious Graduate Research Fellowships Program: Douglas Edward Barber, Rachel Eleanor Bernard, Laura Estelle Lindzey, and Kimberly Alison McCormack.

The NSF graduate fellowship program recognizes and supports outstanding graduate students in science, technology, engineering and mathematics who are pursuing research-based graduate degrees in the United States. Since the program's inception in 1952, the NSF has provided fellowships to individuals selected early in their graduate careers based on their academic achievements and potential for significant achievements in science and engineering.

Hall of Distinction Adds Two New Members

The Jackson School of Geosciences' Hall of Distinction added two new members in spring 2015: Katherine G. "Katie" Jackson, a teacher and Jackson School co-founder along with husband John A. "Jack" Jackson, and Munib Masri, a Palestinian businessman, statesman and philanthropist.

Katie Jackson graduated from Southwest Texas State Teachers College in San Marcos in 1939 and went on to teach students across the state in Marble Falls, Temple and Alice. In partnership with her husband Jack Jackson, she helped establish the Jackson School through an endowment that transformed the university's Department of Geological Sciences, Bureau of Economic Geology and Institute for Geophysics into a school in their own right.

Jackson also served on the Board of Regents at Texas Lutheran University in Seguin for 20 years and was a trustee of Texas Health Presbyterian Hospital Dallas. She died in 2001 at the age of 83. In honor of her induction, the Jackson School established the Katie Society, which recognizes individuals and organizations that have given $500,000 or more to the Jackson School.

Munib Masri has had a distinguished career in business, government and philanthropy. But first he was a Longhorn, graduating with a bachelor's degree in geology in 1955. He began his career working in the oil and gas industry with Phillips Petroleum Company, a position that led to his appointment of Minister of Public Works in Jordan in 1970. Afterwards, he spent decades in the energy and water sectors before founding Edgo, an oil and gas services company that operates throughout the Middle East. Masri has maintained a strong connection to his Palestinian homeland, and has dedicated the past four decades to working toward creating a peaceful two-state solution between it and Israel through foundations and organizations that promote development of industry and well-being in Palestine and the wider Middle East.

The Hall of Distinction honors individuals who have made exceptional contributions to the field of geosciences in industry, government or academia, and have a strong connection to the Jackson School. The hall was started in 1980 and has 32 members, including Jackson and Masri.

Two Undergrads Selected for Prestigious NSG/USGS Internships

Jackson School of Geosciences undergraduate student Taylor Canada (top photo) and recent graduate Tyler Fritz have been selected as interns at the U.S. Geological Survey (USGS) / National Association of Geoscience Teachers Cooperative Summer Field Training Program. The program pairs interns with USGS mentors, with whom they conduct field work.

Canada will be studying surface water and ground water networks with Gerard Butch, supervising hydrologist at the USGS New York Science Water Center, in Troy, New York.

Fritz will be developing new devices and methods for analyzing the stable isotopes in geological, hydrological and biological materials with Craig Johnson and Matthew Emmons, a research geologist and physical scientist at the USGS Crustal Geophysical and Geochemistry Science Center, in Denver, Colorado.

MASRI: MUNIB MASRI; JACKSON: JACKSON SCHOOL; CANADA: TAYLOR CANADA; FRITZ: TYLER FRITZ; ELLINS PHOTO: KATHERINE ELLINS; AUSTIN: JAMES AUSTIN; FISHER: JACKSON SCHOOL; KERANS: JACKSON SCHOOL.

Ellins Receives Fulbright to Teach in Jamaica

Katherine Ellins, the program manager for geoscience education research at the Jackson School of Geosciences, received a Fulbright award to teach at the University of the West Indies in Kingston, Jamaica, and to establish an educational seismic network on the island.

Ellins, who was born and grew-up in Jamaica, received the award through the U.S. Fulbright CORE Scholar Program. She'll begin her six-month fellowship in January 2016.

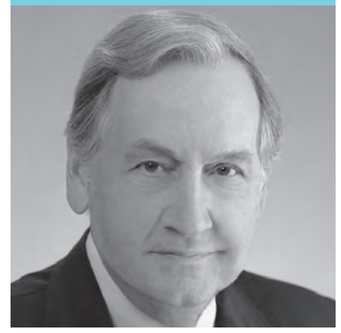
Jamaica experiences more than 200 earthquakes every year because of the island's location in the boundary zone between the North American and Caribbean tectonic plates. Ellins says she is planning her course to focus on seismic risk and other geoscience issues of concern to the island, such as water resources and climate change. The seismic network will complement the country's existing seismic monitoring program, as well as serve as an educational tool for students across the island. Working with IRIS, a global coalition of 120 universities, Ellins will deploy a suite of research-grade seismometers across the island's universities, technical colleges and high schools.

UTIG Researcher Selected for International Scientific Leadership Role

James Austin, a senior research scientist and associate director of international relations at the Institute for Geophysics (UTIG), has been selected as forum chair of the International Ocean Discovery Program (IODP), a coalition of 26 countries dedicated to studying some of the planet's most important environmental and earth science topics by sampling sub-seafloor environments.

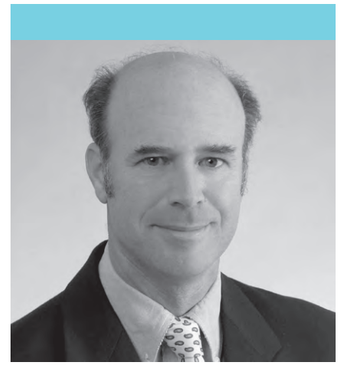
The international consortium uses data recovered from sub-seafloor sediments and rocks to improve scientific understanding of changing climate conditions, risks posed by geohazards such as earthquakes and tsunamis, the origins of ancient life, and the structure and processes of the Earth's tectonic plates and uppermost mantle.

As chair, Austin will serve as the face of the scientific ocean drilling program, representing the IODP at scientific meetings, and attending its facility board meetings and proposal evaluation panel meetings. Austin will also preside over the IODP's annual forum meeting. Austin began his two-year term on Oct. 1, 2015



Fisher Receives Alumni Achievement Award

The College of Liberal Arts & Sciences at the University of Kansas has selected William Fisher, inaugural dean of The University of Texas at Austin's Jackson School of Geosciences, to receive its Alumni Distinguished Achievement Award for 2014-2015. The award is the highest recognition the college bestows upon its graduates.



Kerans: Pettijohn Medal

Charles Kerans, the Robert K. Goldhammer Chair in Carbonate Geology and BEG senior research scientist, has been awarded the Francis J. Pettijohn Medal from the Society for Sedimentary Geology. The medal recognizes "excellence in sedimentology and stratigraphy."

Scanlon: AGU Fellowship

The American Geophysical Union (AGU) named the Bureau of Economic Geology's Bridget R. Scanlon a 2014 AGU Fellow. This prestigious distinction is given to AGU members who have made exceptional scientific contributions and attained acknowledged eminence in the fields of Earth and space sciences. By AGU bylaw, no more than 0.1 percent of the total membership of AGU can receive the award annually. Scanlon leads the bureau's Sustainable Water Resources Program.

Milliken Honored with AAPG Research Award

Kitty L. Milliken, a senior research scientist at the Bureau of Economic Geology (BEG), received the AAPG's 2015 Robert R. Berg Outstanding Research Award.

The award is given in recognition of a singular achievement in petroleum geoscience research. For Milliken, the award recognized her contribution to improving the understanding of how diagenetic processes convert sediments to sedimentary rocks

Milliken was also the co-recipient of the Wallace E. Pratt Memorial Award, a recognition that honors the authors of the best AAPG Bulletin article published each year. Tongwei Zhang, a research associate at the BEG, was among the co-authors.

SEG Awards Sen Honorary Membership

Mrinal Sen, an Institute for Geophysics professor and Jackson Chair in Applied Seismology, was awarded the place of Honorary Membership in the Society of Exploration Geophysicists (SEG) in spring 2015.

Honorary Membership is bestowed on individuals who "in the unanimous opinion of the Honors and Awards Committee and the Board of Directors, have made distinguished contributions, which warrants exceptional recognition, to exploration geophysics or a related field or to the advancement of the profession of exploration geophysics through service to the Society."

Awards

Common Abbreviations:

AAPG	American Assoc. of Petroleum Geologists
AIPG	Amer. Institute of Prof. Geologists
AGS	Austin Geological Society
AGU	American Geophysical Union
BEG	Bureau of Economic Geology
DGS	Dept. of Geological Sciences
GCAGS	Gulf Coast Assoc. Geological Soc.
GSA	Geological Society of America
SEG	Soc. of Exploration Geophysicists
SEPM	Society for Sedimentary Geology
UTIG	Institute for Geophysics

Faculty and Researchers

BILL AMBROSE
Certificate of Merit, AAPG Division of Environmental Geosciences

JAIME BARNES
Faculty Annual Evaluation Award, Assistant Professor, DGS

WHITNEY BEHR
Knebel Teaching Award, Graduate

BAYANI CARDENAS
Faculty Annual Evaluation Award, Associate Professor, DGS

ELIZABETH CATLOS
Knebel Teaching Award, Intro Course

GAIL CHRISTESON
A. I. Levorsen Award

SHIRLEY DUTTON
Doris Malkin Curtis Medal, GCAGS

KATHERINE ELLINS
Fulbright award

WILLIAM FISHER
Alumni Distinguished Achievement Award, University of Kansas, College of Liberal Arts and Sciences

William L. Fisher Endowed Chair in Geological Sciences established and endowed by Jackson School of Geosciences through support of friends, University of Texas at Austin

Doctorate of Sciences, Honoris Causa, Flinders University, Adelaide, Australia

Chairman's Award, AAPG Foundation

Elected Trustee Emeritus, American Geosciences Institute

ALL PHOTOS: JACKSON SCHOOL.

PETER FLEMINGS
Tinker Family BEG Publication Award

CRAIG FULTHORPE
Thomas A. Philpott Excellence of Presentation Award, 2nd Place, GCAGS

WILLIAM GALLOWAY
Thomas A. Philpott Excellence of Presentation Award, 2nd Place, GCAGS

PATRICIA GANEY-CURRY
Thomas A. Philpott Excellence of Presentation Award, 2nd Place, GCAGS

MICHAEL HUDEC
Tinker Family BEG Publication Award

AKAND ISLAM
BEG Publication Award, Most First-Author Publications in 2014

CHARLES KERANS
Francis J. Pettijohn Medal for Sedimentology, SEPM

WONSUCK KIM
Faculty Annual Evaluation Award, Assistant Professor

ROBERT LOUCKS
Journal President's Award for Outstanding Paper, GCAGS

JERRY LUCIA
Journal President's Award for Outstanding Paper, GCAGS

KITTY MILLIKEN
Robert R. Berg Outstanding Research Award, AAPG

Wallace E. Pratt Memorial Award, AAPG

DAVID MOHRIG
Knebel Teaching Award, Undergraduate

SHARON MOSHER
Invaluable Service to GeoScienceWorld Award, 10th year anniversary

JEAN-PHILIPPE NICOT
Certificate of Merit, AAPG Division of Environmental Geosciences

Fellow, GSA

MARIA NIKOLINAKOU
Tinker Family BEG Publication Award

IAN NORTON
A. I. Levorsen Award, GCAGS

JASON SANFORD
A. I. Levorsen Award, GCAGS

BRIDGET R. SCANLON
2014 AGU Fellow

MRINAL SEN
Honorary Membership, SEG

JOHN SNEDDEN
Thomas A. Philpott Excellence of Presentation Award, 2nd Place, GCAGS

A. I. Levorsen Award, GCAGS

DANIEL STOCKLI
Faculty Annual Evaluation Award, Full Professor, DGS

SCOTT TINKER
AAPG Honorary Member Award

TIMOTHY WHITEAKER
Thomas A. Philpott Excellence of Presentation Award, 2nd Place, GCAGS

TONGWEI ZHANG
Wallace E. Pratt Memorial Award, AAPG

Students

LAUREN ANDREWS
Technical Sessions Best Speaker, Fall, Ph.D.

RACHEL BERNARD
Graduate Research Fellowship, NSF

REETAM BISWAS
Schlumberger Ocean Competition, 3rd Place

EMILIE BOWMAN
Folk/McBride Petrography Contest, 2nd Place Undergraduate

AMANDA CALLE
Marta Sutton Weeks-Wulf, AAPG

Off-Campus Research Award, JSG

TAYLOR CANADA
USGS/NAGT Internship

SEBASTIAN CARDONA
Ronald K. DeFord Field Scholarship

Norman H. Foster Memorial Grant, AAPG

Research Grant, Clay Minerals Society

Student Grant, 7th International Symposium on Submarine Mass Movements and Their Consequences, New Zealand

TOMAS CAPALDI
Outstanding TA Award, DGS

MIGUEL CISNEROS
Folk/McBride Petrography Contest, 2nd Place Graduate

DAVID CONWELL
Technical Sessions Best Speaker, Spring, MS

LAURA DAFOV
Undergraduate Best Poster Award, Honorable Mention, Jackson School Research Symposium

DEBANJAN DATTA
Schlumberger Ocean Competition, 3rd Place

RATTANAPORN FONG-NGERN
2015 Outstanding Student Award, Houston Geological Society

Late-Career Ph.D. Best Poster Award, 2nd Place, Jackson School Research Symposium

TYLER FRITZ
USGS/NAGT Internship

EMILIE GENTRY
Undergraduate Best Poster Award, 1st Place, Jackson School Research Symposium

SARAH GEORGE
Graduate Research Fellowship, NSF

Garth W. Caylor Memorial Grant, AAPG

Graduate Student Research Grant, GSA

Graduate Student Grant, SEPM

GAIL GUTOWSKI
Outstanding TA Award, DGS

ROMY HANNA
NASA Earth and Space Science Fellowship

Gordon A. McKay Award, Best Student Oral Presentation, the Meteoritical Society

SCARLETTE HSIA
Mineralogical Society of America Undergraduate Prize

MATT KAUFMAN
Graduate Groundwater Field Methods Award

LUCY TINGWEI KO
Best Poster Award, Houston Geological Society Mudrocks Applied Geoscience Conference

WOONG MO KOO
Late-Career Masters Best Poster Award, 1st Place, Jackson School Research Symposium

CHELSEA MACKAMAN-LOFLAND
Research Grant, GSA

Research Grant, AAPG

EDWARD MARSHALL
Folk/McBride Petrography Contest, 1st Place Graduate

Graduate Student Research Grant, GSA

ANDREW MCPEAK
Estwing Hammer

Folk/McBride Petrography Contest, 2nd Place Undergraduate

Undergraduate Best Poster Award, 2nd Place, Jackson School Research Symposium

ALEKSANDR MONTELLI
Late-Career Masters Best Poster Award, 2nd Place, Jackson School Research Symposium

KATHERINE NEWMAN
Austin Geological Society Scholarship

MICHAEL O'CONNOR
Outstanding GSA Grant Award

DANIEL ORTEGA-ARROYO
Folk/McBride Petrography Contest, 1st Place Undergraduate

MICHAEL PATSON
GSEC Student Service

NICHOLAS PEREZ
JSG Best Graduate Paper

Late-Career Ph.D. Best Poster Award, Honorable Mention, Jackson School Research Symposium

ERIC PETERSEN
Early-Career Graduate Best Poster Award, Honorable Mention, Jackson School Research Symposium

TIM PRATHER
Early-Career Graduate Best Poster Award, 2nd Place, Jackson School Research Symposium

EDGARDO PUJOLS
Folk/McBride Petrography Contest, 2nd Place Graduate

NATALIE RAIA
Geoscience Leadership Organization for Women Award, JSG

QI REN
Schlumberger Ocean Competition, 3rd Place

MITCHELL RIEGLER
Austin Geological Society Scholarship

REED ROUSH
Late-Career Masters Best Poster Award, Honorable Mention, Jackson School Research Symposium

NIKKI SEYMOUR
Folk/McBride Petrography Contest, 2nd Place Graduate

REBEKAH SIMON
Technical Sessions Best Speaker, Fall, MS

PAM SPECIALE
Early-Career Graduate Best Poster Award, 1st Place, Jackson School Research Symposium

KAUSTUBH THIRUMALAI
Sedimentologist for IODP Expedition 353

Ewing-Worzel Fellowship, UTIG

USSSP PEA Award

KELLY THOMSON
Graduate Student Research Grant, GSA

Statoil Graduate Fellowship

XINYUE (DENNIS) TONG
Outstanding TA Award, DGS

East Asia and Pacific Summer Institute (EAPSI) Fellowship, NSF

Graduate External Research Grant Matching Funds, DGS

DOLORES VAN DER KOLK
Cordilleran Section Travel Grant, GSA

STEPHANIE WAFFORN
Late-Career Ph.D. Best Poster Award, 1st Place, Jackson School Research Symposium

WYLIE WALKER
Undergraduate Groundwater Field Methods Award

MAUREEN WALTON
Ewing-Worzel Fellowship, UTIG

JING YANG
Ronald K. DeFord Field Scholarship Fund, Jackson School of Geosciences

DANIEL YOUNG
Folk/McBride Petrography Contest, 2nd Place Undergraduate

GANG ZHANG
Outstanding TA Award, DGS

Staff

MELISSA GARCIA
President's Outstanding Staff Award

ADRIAN HUH
DGS Staff Excellence Award

JESSICA HUST
UT's 2015 Vick Academic Advising Award

MANDY LANCASTER
Guion Library Staff Honors

LAURA MATTYS
Guion Library Staff Honors

JESSIE ZEHR
DGS Staff Excellence Award

SYMPOSIUM PHOTOS: JACKSON SCHOOL.

RESEARCH SYMPOSIUM PARTICIPANTS.

RESEARCH SYMPOSIUM SHOWCASES WORLD-CLASS KNOWLEDGE

In February 2015 the Jackson School of Geosciences held its 4th Annual Research Symposium.

The day-long poster competition occurs every spring semester and allows students to present their research to a panel of judges composed of faculty, research scientists and industry representatives. Alumni and interested members of the public are also invited to attend. Winners and honorable mentions are as follows:

(FROM LEFT TO RIGHT) THE THREE WINNERS OF THE LATE-CAREER PH.D. BEST POSTER AWARD WITH SYMPOSIUM ORGANIZER EMILY HERNANDEZ GOLDSTEIN AND A REPRESENTATIVE FROM CONOCOPHILLIPS.

LATE-CAREER PH.D. BEST POSTER AWARD

1st Place: Stephanie Wafforn, Magmatism and hydrothermal fluid flow in the Ertsberg-Grasberg Mining District, Papua, Indonesia: Insights from zircon U/Pb and trace element analysis

2nd Place: Rattanaporn Fong-Ngern, Clinoform growth in a Miocene, Para-Tethyan deep lake basin: thin topsets, irregular foresets and thick bottomsets

Honorable Mention: Nick Perez (now an assistant professor at Texas A&M University), Punctuated upper-crustal shortening, exhumation and basin subsidence during flat-slab subduction in southern Peru

LATE-CAREER MASTERS BEST POSTER AWARD

1st Place: Woong Mo Koo, Coupling of basin-floor fan behavior with shelf-margin processes: Maastrichtian Washakie Basin, Wyoming

2nd Place: Aleksandr Montelli, Late Quaternary history of Bering Glacier dynamics and sedimentation

Honorable Mention: Reed Roush, Hierarchical cluster analysis of a high-resolution XRF-dataset from the Cline Shale, Midland Basin, Texas

EARLY-CAREER GRADUATE BEST POSTER AWARD

1st Place: Pamela Speciale, Evaluating the consistency of experimental paleopiezometers using naturally deformed rocks

2nd Place: Timothy Prather, A combined stratigraphic, architectural and ichnologic analysis of the Loyd Sandstone (late Cretaceous) near Rangely, Colorado

Honorable Mention: Eric Petersen, An ice flow modeling approach to understanding regional and aspect-dependent differences between debris-covered glacier lobes in Deuteronilus and Protonilus Mensae, Mars.

UNDERGRADUATE BEST POSTER AWARD

1st Place: Emilie Gentry, Pseudotachylites in the footwall of the Whipple detachment: implications of seismicity along low angle normal faults

2nd Place: Andrew McPeak, Seamount arrival into the Franciscan Subduction Complex at 100 + 2 Ma: Marin Headlands, San Francisco Bay, California

Honorable Mention: Laura Dafov, Provenance of Adriatic turbidites (Alps-Apennines system)

BEST REPRESENTED RESEARCH GROUP

1st Place: Sergey Fomel's Research Group

2nd Place: Jack Holt's Research Group

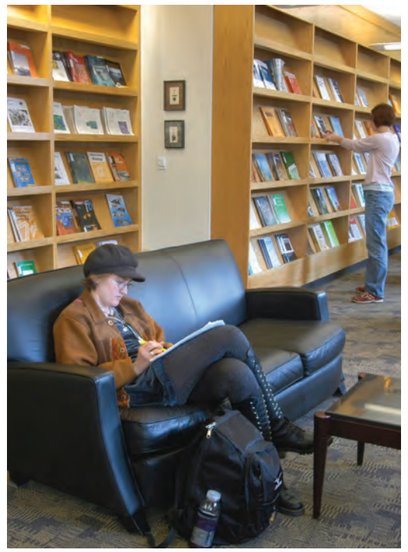
Walter Geology Library Looking to the Future

This year, the first children born in the 21st century turn 15 years old. Soon they will be on campus, bringing a decisive break with the 20th century. How they seek and use information, and when and why and how they do so, will drive a lot of changes in libraries (and classrooms) in the coming years.

Our younger users are not native print users; for most of them it is an artifact or last resort. Thus it is imperative to have a print and digital collection that closely reflects their real needs. It's also important to develop strategies for introducing them to the existence of print resources and the methodologies for interacting with them. Breaking down their assumptions about print is not a trivial exercise, but without those skills, their full education as geoscientists will be shortchanged.

To that end, this past year has been full of back-office projects, with plenty more to come, as we deal with encroaching space and access issues, funding for collections and services and evolving technology. We outsourced about 1,000 items for processing, allowing us to eliminate 18 shelves of partially cataloged items in our collection and much of our gift backlog. We also did a complete rebuild of the library's web pages (www.lib.utexas.edu/geology) to make them more consistent and consolidated, as well as to improve maintenance, and make room for some new features. Next year we will complete a rebuild of the UT geology thesis index to integrate the several files and improve their utility. You can also now find us on Facebook.

The UT Libraries hired its first ever map cataloger, who we are hoping will also help lead us into Geographic Information Services. We put in storage most of our United States Geological Society print holdings, since the USGS Publications Warehouse now offers about 90 percent of them in digital formats. The 200-plus shelves freed up by that major decision give us several years of growth space. Ultimately, we will be reducing the total amount of material on site by storing little-used resources and print journals with reliable digital access, and removing duplicates within and between collections.



WALTER GEOLOGY LIBRARY.

Looking ahead, the UT libraries have been approved for a new library storage facility at the university's J.J. Pickle Research Campus, LSF-3. And we are already planning for LSF-4, as more and more of the physical collections are being moved to storage, creating space for new materials and new opportunities for interaction, collaboration, and online user space. Most journals are now in online-only formats, or "E-formats," and we are increasingly acquiring E-books, though the platforms and business models are still maturing.

On other fronts, Virtual Landscapes of Texas and our thesis scanning project both continue to grow. We also were caught up in the building closure when the old wing of the Jackson Geological Sciences Building got a complete HVAC and power supply overhaul. Since most of the building was closed, the library was not open to the public this summer. But we ensured continued collection access by camping on folding tables in the entrance areas and handling material requests by scanning pages, and offering delivery of books to other libraries for pickup. Special thanks to the Jackson School for providing temporary air conditioning and humidity control for the collection during this project, and working with us to ensure continued services!

In staff news, Calla Smith-Dowling got married in April and has resigned to pursue other opportunities just shy of her seventh anniversary. She has been replaced by Stacy Ogilvie, formerly evening supervisor in the Life Sciences Library. Best wishes to Calla and welcome to Stacy! Six student workers graduated this year, Shakera Guidry, Hannah Johnson, Taylor Brunner, Laura Mattys, Madeline Guy and Sandra Ogenche. This year's winners of the Guion Service Award were Graduate Research Assistant Laura Mattys and Amanda Lancaster from the cataloging department. They were recognized with the award for all their work on our big cataloging project. Dennis Trombatore attended the Geological Society of America meeting in Vancouver, the American Institute of Archeology meeting in New Orleans, and continued to serve as chair of the American Geosciences Institute GeoRef advisory committee. He joined with a classics faculty member to do a demonstration on clay technology and clay tablets in the ancient word for Explore UT.

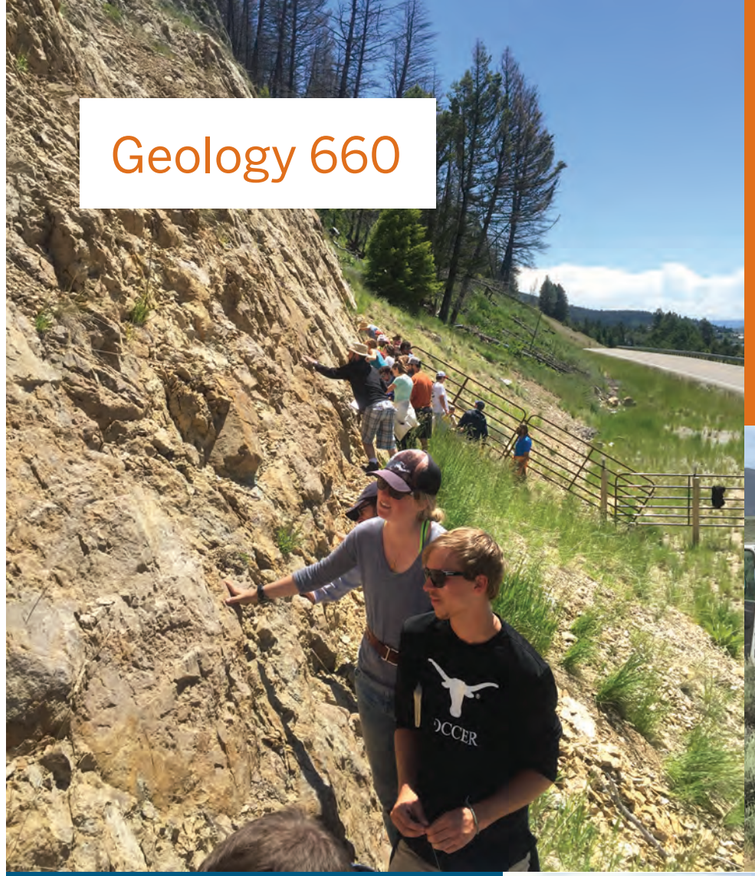
-Dennis Trombatore, Librarian

FIELD CAMPS

Fieldwork is an integral part of the Jackson School of Geosciences experience. Each summer, field camps led by Jackson School faculty enable geoscience students to literally get their hands dirty and feet wet as they study the processes that shaped the landscapes that surround them. Being primarily for undergraduates, these courses are many students' first introduction to geosciences outside of the classroom.

GEOLOGY 660 AND MARINE GEOLOGY: JACKSON SCHOOL. HYDROLOGY: KATHERINE FLORES.

Geology 660



This six-week summer field course brings geoscience majors to geologically significant sites in West Texas, New Mexico, Colorado, Wyoming, Montana, Idaho and Utah for projects that focus on field description and interpretation.

"Field camp is where the pieces click together — tectonics, glaciation, modern alluvial deposition volcanics. All layered together and for the first time it is our job to separate them, understand how one process affects another. We must read what is exposed on the surface and tell the story!"

Natalie Raia

TOP LEFT: CONNER EVERTS AND ASSISTANT INSTRUCTOR MEREDITH BUSH EXAMINING THE FAULT SCARP OF THE 1959 HEBGEN LAKE EARTHQUAKE IN SOUTHWEST MONTANA. TOP RIGHT: PROFESSOR RON STEEL AND STUDENT MITCHELL RIEGLER EXAMINE A MAP NEAR MINNIE'S GAP, WYOMING. ABOVE: GROUP PHOTO IN THE BIG BELT MOUNTAINS, MONTANA. OTHERS: GEOLOGY 660 PARTICIPANTS IN THE FIELD.

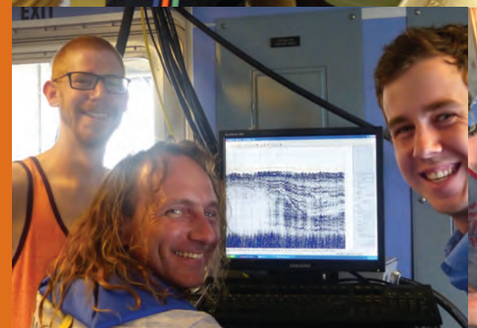
Marine Geology and Geosciences

ABOVE: RECOVERING THE CHIRP SONAR TOWFISH FROM THE R.V. MANTA. MIDDLE: WATCHSTANDING DURING THE GEOPHYSICAL SURVEY ABOARD THE R.V. MANTA. BOTTOM RIGHT: CELEBRATING A SUCCESSFUL WEEK OF SURVEYING WITH A CRAWFISH BOIL. BOTTOM LEFT: MICHAEL SANDERS, SEAN GULICK AND ANDREW HARRIS QUALITY CHECKING THE CHIRP SONAR DATA IN REAL-TIME.

"I loved this course. I don't know what I was expecting, but I was really impressed by how realistic an experience the instructors managed to create while compressing the lifecycle of a research project into three weeks."

Laura Lindzey

In 2015, the Marine Geology and Geosciences field course went to Freeport for the first time. The class examined the lower Brazos River and adjacent fluvial systems as well as the ancestral versions of these river systems where they carved into the Texas shelf during the last sea level low stand. During the course, the Brazos River went into flood stage due to the major rainfall in May, providing opportunities for the students to study sedimentary processes in action.



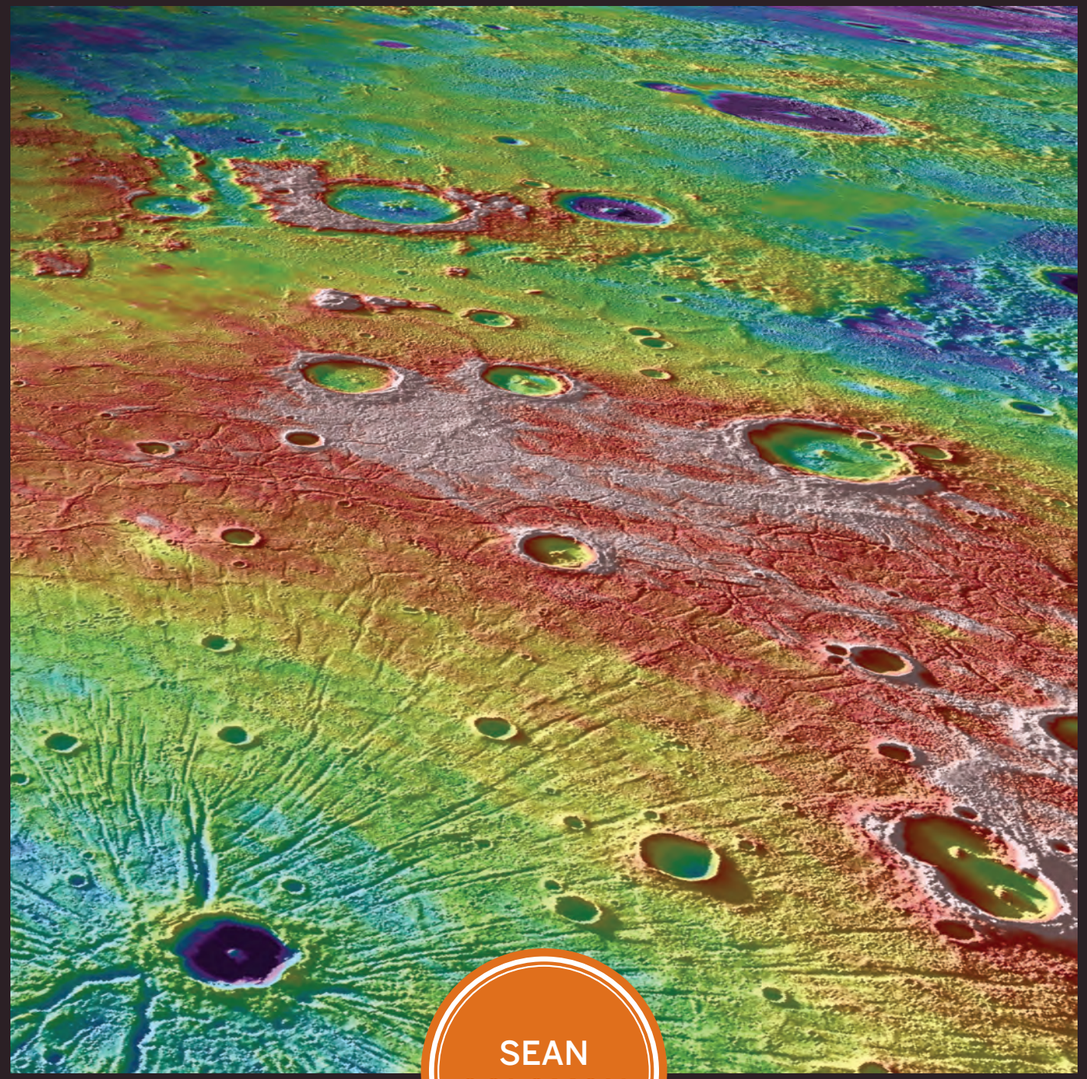
Hydrology

The hydrology field class brought 15 students to the Valles Caldera preserve in the Jemez Mountains for a week of studying mountain hydrology and shallow groundwater processes. The students conducted field work such as stream gauging, a dye trace, water sampling, ground-penetrating radar and slug tests. They also conducted a 24-hour pump test in Hornsby Bend in Austin.

TOP RIGHT: MAGGIE FLANNERY TAKING A BREAK AT THE WELL FIELD. MIDDLE: LEE BOBBITT, IAN HANES AND PETER CARLSON SETTING UP THE DYE/SALT TRACE. BOTTOM LEFT: KELLI WOLF AND RICHARD BAGANS STREAM GAGING. BOTTOM RIGHT: MAGGIE FLANNERY AND EMMA HEITMANN TAKING E-LINE MEASUREMENTS DURING THE PUMP TEST.

"It was an absolutely incredible experience. Despite being unfamiliar with most [people in] the class, the vast and beautiful landscape instilled a unique sort of camaraderie amongst us all."

Ian Hanes



SEAN SOLOMON

MESSENGER FINDS INGREDIENTS FOR LIFE ON MERCURY

Mercury, the closest planet to the sun, was long thought to be a blazing, desiccated world containing not much more than an iron core surrounded by a thin, silicate crust.

Sean Solomon, director of the Lamont-Doherty Earth Observatory of Columbia University, an Edwin Allday Lecturer, and principle investigator for NASA's MESSENGER mission, challenged that perspective in a February 2015 talk at the Jackson School that presented findings from MESSENGER, a Mercury probe.

Instead of a bleak iron world, Solomon said MESSENGER showed that the surface of Mercury contained volatile elements, as well as traces of carbon and frozen water that were delivered by comets. They are findings that could shed light on the origins of life on our planet.

"We're left with the intriguing notion that there is a record on the planet closest to the sun, on the planet with the largest range of diurnal temperatures, of the delivery to the early solar system of H_2O and some of the building blocks of life," said Solomon.

It's unlikely life exists or ever existed on Mercury, Solomon said; there's no evidence that water was ever in its liquid state. But finding that comets with carbon and water made it to Mercury helps support the idea that life on Earth was seeded by comet material billions of years ago. A sample of what that material contained is on Mercury right now, Solomon said.

"If we think that these building blocks delivered to Earth and possibly other bodies were factors in the origin and evolution of early life on our planet, there's a place we can go in the solar system — not the place we thought of — where there's a witness...to at least the recent delivery of these compounds to the solar system," Solomon said.

These insights were made possible because of readings taken by MESSENGER, a spacecraft launched in 2004 to orbit and study Mercury. Solomon began his talk explaining the engineering challenges that scientists faced while building the probe, such as guiding it into Mercury's orbit and protecting its electronics from the extreme heat. The remainder of his talk focused on explaining how data collected by MESSENGER challenged prior assumptions scientists had about Mercury's environment.

Before MESSENGER, scientists thought that Mercury's volatiles would have evaporated during the planet's formation due to high temperatures caused by a large asteroid impact or the sun's rays, Solomon said. But data from the probe's X-ray and gamma ray spectrometers told a different story: Mercury's surface contained ten times the amount of sulfur as Earth; about the same amount of potassium as the Earth; and about the same amount of chlorine as Mars.

"These volatile elements are much more abundant than predicted by any of the formation models prior to our mission that call for extended periods of high temperatures," Solomon said. "So the formation of Mercury, and by implication the formation simultaneously of all the inner planets, is being rethought."

SEAN SOLOMON IS THE PRINCIPAL INVESTIGATOR FOR THE MESSENGER MISSION TO MERCURY. HE IS ALSO A NATIONAL MEDAL OF SCIENCE LAUREATE.

In addition to chemical analysis, the MESSENGER probe provided pictures of Mercury's surface. These pictures showed evidence for past volcanic eruptions on Mercury, including lava flows and pyroclastic deposits. They also gave scientists a closer look inside the planet's many impact craters, Solomon said, mentioning the discovery of depressions inside craters called "hollows." Analysis by MESSENGER instruments indicated that they were formed when underground volatiles, brought close to the surface by the force of an impact, evaporated into space.

It was also inside craters where MESSENGER found water in the form of ice, Solomon said. Since Mercury's axis of rotation has no tilt, parts of the poles have been void of direct sunlight for billons of years, making them a much cooler environment than most other regions of the planet. Observatories on Earth first detected the ice as "bright spots" on radar readings. Instruments on MESSENGER confirmed the radar data, while finding that the ice was covered by an insulating layer of carbonaceous material about 20-30 centimeters deep.

At the time of the talk, MESSENGER was about two months away from running out of fuel. Solomon ended his presentation by assuring the audience that the probe would continue to do science until the end.

"This mission only has two months to go, but it will be a very interesting two months where we are making chemical measurements, taking pictures, making other measurements...at a closer range than ever before," Solomon said. "Stay tuned."

MESSENGER met its end on April 30, 2015, when it crashed into Mercury's surface.

— Monica Kortsha

LEFT: A VIEW OF MERCURY'S CALORIS BASIN, AN IMPACT DEPRESSION FORMED SEVERAL BILLION YEARS AGO. MERCURY SURFACE: NASA. SOLOMON: LAMONT-DOHERTY EARTH OBSERVATORY.

PIERS SELLERS

A REVOLUTION IN EARTH SCIENCE

Astronaut and NASA researcher Piers Sellers gave a digital tour of the Earth's biosphere in a February 2015 talk at the Jackson School of Geosciences that highlighted the causes and effects of climate change.

In his talk, Sellers, who is deputy director of the Sciences and Exploration Directorate at NASA's Goddard Space Flight Center, used computer graphics generated from satellite data to illustrate an array of phenomena happening on planet Earth, from the winding flow of ocean currents to electric nodes of cities seen from space.

"It's a revolution in Earth science, an absolute revolution," Sellers said after explaining the many parameters that satellites constantly monitor as they orbit the globe.

The topics he focused the most on were the state of the planet's ice sheets and atmospheric CO_2 concentration.

The Arctic ice sheet has undergone dramatic change over the past 30 years, Sellers illustrated using a graph and model. The multiyear ice is almost all gone, and the area of the ice sheet has shrunk by half since 1979.

"If you believe the models, it means in 30 years you'll be able to kayak over the top of the world...over an ice-free ocean," Sellers said. "It's quite a remarkable change here."

The reason for the extreme and rapid loss is complex, Sellers said, with factors as varied as winds pushing ice, and the self-catalyzing albedo effect — a process where dark ocean water absorbs heat, melts ice, and perpetuates the process by revealing more water.

"It is not a straightforward problem. It's not just heat in, melt out," Sellers said. "There's other stuff going on."

However, based on measurements from scientific instruments, from LIDAR deployed on planes and monitoring devices on satellites, the net state of ice on the planet is in decline, Sellers said. And although the Arctic is experiencing the most dramatic decline, the ice sheets of Antarctica and Greenland are also experiencing changes. In both regions, the rate glaciers are moving toward the sea is accelerating, with Greenland's rate doubling in speed since first being recorded 20 years ago.

While sea ice is decreasing, carbon dioxide is on the rise, Sellers said.

Using a graphic indicating atmospheric carbon dioxide concentration from 2004-2014, Sellers showed how the concentration of carbon in the atmosphere is increasing overall, while still cyclically rising and falling as carbon is released by industry, volcanoes and fires, and absorbed by oceans and plants. A progressively thickening band of CO_2 across the northern hemisphere is the result of industry activity, Sellers said.

"There is a constant gradient between the northern hemisphere and the southern hemisphere because all the release is up there," Sellers said.

PIERS SELLERS, A NASA ASTRONAUT AS WELL AS A NASA DEPUTY DIRECTOR, HAS BEEN ON THREE SPACE SHUTTLE MISSIONS AND HAS DONE SIX SPACE WALKS.

Years of data combined with mechanistic knowledge have enabled models of the whole planet accurate enough to save lives by predicting the paths of storms, such as Hurricane Sandy in 2013, Sellers said. However, in the long term they paint a bleak picture of global temperature rising with CO_2 levels.

The models are reliable at predicting the impacts of a 4-degree temperature increase. After 4 degrees is when things become uncertain for the models, as well as the planet, Sellers said.

"When we get into a 4-degree world it's rough. It may be a different kind of planet," Sellers said.

Despite the model projections, Sellers said he believes it's possible to turn the future around.

"We have an example that should give us a course for optimism," he said. "The ozone hole."

Through an international effort started when the hole was first detected in the 1980s, humans have been able to halt the hole's widening, and create an environment where the ozone layer may be able to recover to its baseline state, Sellers explained.

"It was policy that was advised by scientific data and predictions that gave a good example of a happy ending."

Sellers said that he has similar hopes for humanity when it comes to tackling climate change.

"Every person who arrives on the Earth not only comes with their own demands, but their own talents and creativity and what they want to contribute," Sellers said. "And so the people who arrive are going to be part of the solution to get us out of trouble, and that includes all of you younger people here."

— Monica Kortsha

LEFT: A SCIENTIFIC VISUALIZATION OF THE EARTH'S OCEAN CURRENTS. OCEAN CURRENT GRAPHIC AND SELLERS PHOTO: NASA.

VIEW OVER THE CLOUD FOREST OF THE EASTERN ANDES MOUNTAINS INTO THE AMAZON BASIN FROM TRES CRUCES PEAK (3,650 METER ELEVATION) AT MANU NATIONAL PARK, SOUTHERN PERU.

STUDENTS AND FACULTY TAKE TO THE FIELD AROUND THE WORLD

Amazon-Andes Interactions

Brian Horton, a DGS professor and UTIG research professor, and Ph.D. students Lily Jackson and Sarah George travelled to southern Peru in July 2015 for a short field course on the relationship between the evolution of the Andes mountains and biodiversification of the Amazon rainforest.

The uplift of the Andes over time has greatly influenced Amazon climate and hydrology. The team, collaborating with a group of international researchers, sought to understand how these geophysical factors have influenced the diversification of plant and animal species in the rainforest.

The Jackson School team focused on studying Cenozoic tectonics and basin evolution in the Andes and foreland region of Peru and Ecuador.

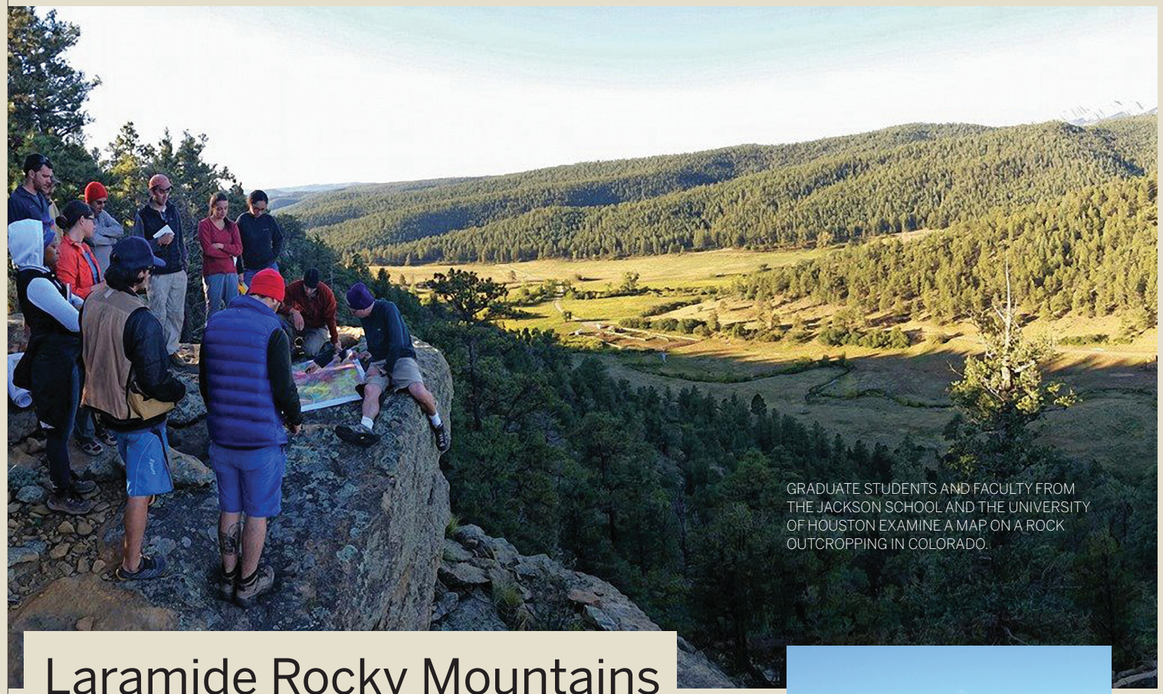
The course spanned a diverse range of geologic, climatic and biologic settings, from the high plateau of the Altiplano to the remote Amazon lowlands of Manú National Park. The course had over 20 participants, which included international faculty, graduate students and postdocs representing 11 universities, as well as a journalist and photographer from *Science* magazine.

The field work offered a rare opportunity to be immersed in interdisciplinary research while in the field, sharing ideas and insights — while on the outcrops, in the trees, floating the rivers — with experts in ecology, molecular genetics, geology, paleontology, hydrology, paleoclimate, climate dynamics and Earth system modeling.

The course is part of a five-year, $4.5 million project between a group of over 20 geologists, climatologists, and biologists from universities and institutes across the U.S. and South America. Horton is a principle investigator on the project. It is funded by the National Science Foundation's Frontiers in Earth System Dynamics program.

TRES CRUCES: CHRIS DICK. ALTIPLANO AND AMAZON: WOUT SALENBIEN. OUTCROP AND LARAMIDE: SARAH GEORGE. ESPANOLA BASIN: LILY JACKSON.

TOP: SUNRISE OVER THE AMAZON RAINFOREST. BOTTOM: VIEW OF THE ALTIPLANO IN SOUTHERN PERU.



GRADUATE STUDENTS AND FACULTY FROM THE JACKSON SCHOOL AND THE UNIVERSITY OF HOUSTON EXAMINE A MAP ON A ROCK OUTCROPPING IN COLORADO.

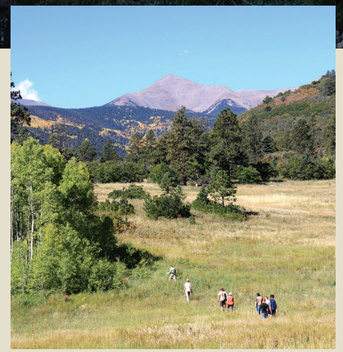
Laramide Rocky Mountains and Rio Grande Rift

In fall 2014, 16 graduate students from the Jackson School of Geosciences and the University of Houston embarked on a week-long field trip to the Laramide Rocky Mountains, Colorado Plateau, and Rio Grande Rift of northern New Mexico and southern Colorado.

The adventure began with a regional overview of the depositional, structural and volcanic history of northern New Mexico in the late Paleozoic through Cenozoic. Students mapped, described and measured geologic formations, focusing on angular and cross-cutting relationships among various structures and stratigraphic units. The trip included a visit to the iridium-bearing Cretaceous-Paleogene boundary horizon within the Raton Basin.

The pattern of ancestral Rocky Mountain uplift, Laramide shortening, basin and range extension, and late Cenozoic volcanic activity unfolded during these exercises. This provided insight into the western interior geologic province of North America and contemporaneous landscape evolution over the past 300 million years.

This field trip represented a unique opportunity for students to work closely with professors and other fellow graduate students in the field to develop an understanding of the tectonic evolution and sedimentary character of New Mexico and Colorado, in addition to developing lasting collaborations and friendships.



TOP: STUDENTS HIKING IN THE LARAMIDE FORELAND BASIN IN SOUTHERN COLORADO.
BOTTOM: JOEL SAYLOR (UNIVERSITY OF HOUSTON), BRIAN HORTON (JACKSON SCHOOL), AND MIKE MURPHY (U OF H) STAND ABOVE THE ESPANOLA BASIN IN THE NEW MEXICO DESERT.

A Sedimentologist at Sea in the Indian Ocean

In November of 2014, I embarked on a tremendous journey in my geoscientific career as I flew to Singapore to be a part of the International Ocean Discovery Program (IODP) Expedition 353. In Singapore I boarded the JOIDES Resolution, the IODP flagship, and began two months in the Indian Ocean drilling sediments in the Bay of Bengal.

The main goal of Expedition 353: Indian Monsoon Rainfall was to understand how the Indian monsoon evolved over the last several tens of millions of years. We did this by retrieving land-based sediments transported by rivers and wind to the Bay of Bengal, where they settled on the seafloor.

We use sediments to look deep into the past to learn about monsoons because we only have perhaps 100 years of instrumental measurements of rainfall over India — a geological instant.

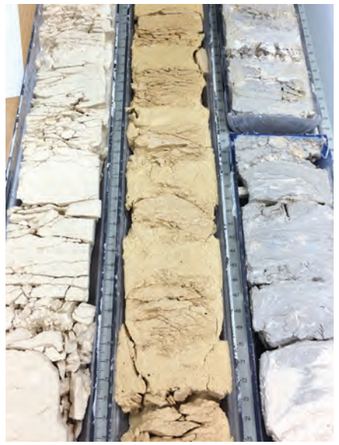
I sailed as a sedimentologist. There were nine of us, and it was our job to document the cores using the SHIL and SHMSL: two imaging instruments that take high-resolution photographs, and make color-based and magnetic susceptibility measurements.

After these scans were finished, the fun began. Using tried and tested tools, we described the makeup of the mud. We documented the colors using Munsell charts, noted the texture of the sediments using the spatula, and examined interesting features using our hand-lens. We also documented how the drilling process might have disturbed the recovered cores, and made smear slides, where a small amount of sediment is placed on a glass slide for observation under a powerful microscope.

On Expedition 353, we drilled about 4.4 kilometers and described every meter in detail. These two months at sea helped solidify my love for climate and oceanic sciences. I learned a lot and had the opportunity to interact with experts from around the world. In October 2015, we will sample all the cores we collected, which are currently housed in Kochi, Japan. These sediments will form the basis of my scientific research for the coming few years and I am very eager to work with them.

— Kaustubh Thirumalai, Ph.D. candidate

TOP: KAUSTUBH THIRUMALAI AND KATE LITTLER, A PALEOCLIMATOLOGIST AT THE UNIVERSITY OF EXETER IN THE U.K., DISCUSS DRILL SAMPLES. BOTTOM: SEDIMENTS EXTRACTED FROM THE SEAFLOOR OF THE BAY OF BENGAL.



LITTLER AND THIRUMALAI: LIPING ZHOU. SEDIMENT SAMPLE: KAUSTUBH THIRUMALAI.

EER: BUILDING WELL-ROUNDED PROFESSIONALS FOR A DEMANDING INDUSTRY

by Monica Kortsha

Private companies and government organizations face a growing need for professionals in the energy and resources sectors that can plan, evaluate, and manage complex projects that are often international in scope and include partners with interdisciplinary professional backgrounds.

The Jackson School of Geosciences Energy & Earth Resources Graduate Program (EER) is meeting this need by preparing students for careers in these diverse industries. The program offers classes that touch on all facets of the energy and resources sectors, including geosciences, engineering, management, finance, economics, law and policy.

Dual-degree offerings in public affairs, global policy studies and business administration allow students to specialize within the program. The result is a program that attracts curious people with a wide array of work backgrounds and career goals. We are pleased to introduce you to a few of them.

Kyle Gabb

The decision to tap an oil and gas reservoir begins with insight from geologists and geophysicists about its estimated output. But a successful business won't even consider drilling unless the project makes economic sense.

Kyle Gabb is equally comfortable talking oil and gas from both perspectives.

As a dual EER and MBA student in The University of Texas at Austin McCombs School of Business with a focus on energy finance, Gabb is learning to approach drilling decisions using scientific metrics while simultaneously considering the financial impacts.

"A discipline like finance is generally not specialized, so energy companies are very interested in understanding what it is that excites you about working in the industry," Gabb said. "Being able to discuss my previous energy-related work experience and the technical background that I have developed from the Energy and Earth Resources master's degree effectively demonstrates my passion for the industry."

Before enrolling at the university, Gabb earned his bachelor's in Earth and ocean sciences from Duke University and worked as a landman for Oklahoma City-based Chesapeake Energy. He gained a first-hand appreciation for the interconnectivity of business, legal, geologic and engineering decisions, and their importance to the development of successful assets. He decided to enroll in the EER program in 2013 and a year later in the McCombs School of Business to better understand the science-business nexus.

Gabb's science and finance experience has made him an asset in prestigious industry-sponsored university competitions that challenge teams of students to solve real-world inspired problems faced by major oil and gas companies.

He was selected to be on both the Jackson School's and the McCombs School's teams for their respective energy competitions. At the Jackson School, the team competed in the 2014 Imperial Barrel Award competition, which presents teams with geological datasets and chooses a winner based on their exploration recommendations. At McCombs, it was the 2014 National Energy Finance Challenge, which presents the teams with a scenario of financial and operational issues and selects a winning team based on the strategic plan it develops. Gabb's team took first place in the National Energy Finance Challenge, winning the $10,000 prize and lighting the university tower orange in recognition of the achievement.

Gabb will be interning in the finance department at Chevron's corporate headquarters in San Ramon, California, over the summer of 2015. In the fall he will return to the Forty Acres to complete his final year of the dual-degree program.

Xinggang "Chris" Liu

Xinggang "Chris" Liu entered into EER a well-trained and well-travelled engineer and researcher.

After earning both his bachelor's and master's in petroleum engineering he worked as a reservoir engineer in China and Texas and a petroleum researcher in New Mexico.

What brought him to EER was the desire to understand the oil and gas industry on a more holistic level.

But the program brought more than a broadened perspective; it put him on track for a new career path. After receiving his master's from EER in the summer of 2015, Liu plans to earn a law degree from the university with a focus on mineral rights and carbonate reservoir characterization. His ultimate goal is to be a professor with expertise in law as it relates to geology and the oil and gas business.

His interest in geology's legal questions stem from his EER classes in policy, law and economics. Liu said the classes helped him realize that a financially successful reservoir is not built on science and engineering alone.

"The benefits of technological advancements could not be maximized, or even might be trivialized, if the potential capacity and political risk of a reservoir are poorly investigated," Liu said.

The mentorship Liu received throughout the program, particularly from EER Director William Fisher, is what inspired him to pursue a career as a professor.

"So many opportunities I had were from him," Liu said, crediting Fisher's guidance and support to introducing him to people and positions, such as a teaching assistant job, that helped grow his knowledge in geology and confidence at the same time.

"It was Dr. Fisher's mentorship and teaching that made me a more independent thinker, strategic debater and, most importantly, a more compassionate person," Liu said, adding that he hopes one day to provide the same sort of support to students as a professor.

"My determination in pursuing a doctoral degree was not only driven by my strong interest in geology but also influenced by Dr. Fisher's mentorship," Liu said. "He gave me inspiration to pay it forward by getting a Ph.D. and having the opportunity to mentor other students."

Allison Pace

Geologist. Teacher. Quilter.

Allison Pace is all of the above. And through the EER program, she was able to be all three while learning the skills and knowledge needed to pursue a career as an exploration geologist.

Between taking classes in geology, engineering and law, writing her thesis on sediment transport and canyon preservation, and teaching assistant responsibilities, she's learned that geology is much more than the study of the Earth.

Consideration of geopolitical concerns, a company's particular business goals, and available technical prowess make it so that "a rock is never just a rock," Pace said.

She earned her master's degree from the program in the summer of 2015 and has since moved to Midland to stake out a job in the oil and gas industry.

Before enrolling in EER, Pace earned her bachelor's in geosciences and then her master's in teaching with a focus on science education from The University of Texas at Dallas and held various teaching positions. After moving to Austin, she was able to continue to apply her experience as an educator by teaching 5th grade science once a week in two Round Rock elementary schools. Pace has been teaching at the schools as part of the Scientist in Residence Program, a joint Jackson School-College of Natural Sciences initiative in the Environmental Science Institute that pairs graduate students in science with K-12 teachers in the classroom.

"It keeps me excited about my research because one of the major aspects is you share your research with the students," Pace said. "It's been fantastic. A lot of work, but really rewarding."

Pace's lessons often show how major concepts in science are applied within exploration geology. But in one instance, Pace turned a lesson on calculating area and perimeter into an applied exercise in quilting — a passion of hers. Her students did the math and Pace the sewing of a science-themed quilt for each school. The handiwork now hangs in their classrooms.

"I wanted to show them that a concept is just an idea until you can use it in a meaningful way to actually accomplish something," Pace said.

Stevenson Bunn

Before enrolling in the EER program Stevenson Bunn worked for the National Council for Science and the Environment, an environmental policy firm in Washington.

The work provided a unique combination of environmental and business-related challenges. However, the experience made him realize his true passion was geology — the subject Bunn earned his bachelor's degree in after being first captivated by the topic in an undergraduate course at Washington and Lee University in Virginia.

Bunn selected the EER program specifically to improve upon his geologic background and understanding while continuing to build on his previous work experience.

"It was a program where I could base my experience on geology while supplementing my degree with interdepartmental classes in the kind of environmental and business aspects I was able to handle in D.C.," Bunn said.

Bunn turned back to geology through his research, a requirement of the EER program, with program Director William Fisher introducing him to Lesli Wood at the Bureau of Economic Geology. There he focused his research on using Petrel software to model depositional processes and the impact of architectural elements in tidally influenced systems, specifically looking at the Sego Sandstone in the Book Cliffs of Utah.

The work became the topic of his thesis and the topic of a poster presentation he gave in the summer of 2015 at the annual member meeting of the American Association of Petroleum Geologists, the premier international group for petroleum geologists with over 40,000 members in 129 countries.

Bunn says Fisher's mentorship in classes, career path and research was a major highlight of his EER experience.

"I think that working with Dr. Fisher was one of the best experiences I had in the EER program," he said. "He took several of us who were interested in petroleum geology under his wing."

Bunn earned his master's in EER in spring 2015. He now lives in Houston and works as an exploration geoscientist for the Apache Corporation, a company he interned with while in the program.

ALL PROGRAM SPOTLIGHT PHOTOS: SASHA HAAGENSEN.

DROUGHT & DELUGE

Water is the most precious resource on Earth, but there always seems to be too little or too much of it in Texas. Research at the Jackson School is tackling the challenges posed by these extremes.

By Anton Caputo

DROUGHT: TEXAS PARKS AND WILDLIFE. FLOOD: KUT.

In 2011 most of Texas was gripped by a brutal drought that rivaled the worst in the state's recorded history. Rivers and streams dried up, and reservoirs fell to record lows. Farmers and ranchers were devastated, and some communities were forced to take expensive emergency measures to ensure their citizens had water until heavy rains finally broke the drought in 2015.

At the same time as the drought, deadly floods periodically ravaged communities, with some occurring in the most parched areas of the state.

Providing water during droughts and dealing with floods is challenging in a fast-growing, geographically diverse state like Texas. The Jackson School of Geosciences is working on solving these issues with wide-ranging research. The methods include new forecasting techniques, intricate climate models, studies to determine how to better store water underground and projects to measure water more accurately from space.

The overarching goal is to provide the tools and knowledge to better manage this precious resource.

"This is the type of science that will benefit people throughout the state and beyond," said Jackson School Dean Sharon Mosher. "This work fits in perfectly with the school's mission: to advance understanding of the Earth, its resources, systems and environment, for the lasting benefit of humankind."

Under Our Feet

It's not hard to understand why 2011 devastated the state's water supply. The blistering summer was the hottest and driest in Texas history. On average, only 14.89 inches of rain fell that year, beating a low mark set in 1917. October 2010 through September 2011 was the driest period ever on record, with average rainfall of only 11.18 inches.


Todd Caldwell

The scorching weather drove up water demand. There were 90 days of 100 degrees or more recorded in Austin that year and 71 recorded in Dallas. And the lack of rain only exasperated the issue. As a result, rivers and streams dried up, and reservoir levels plummeted.

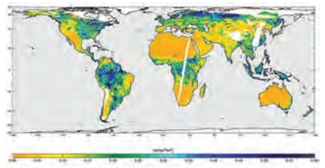
The rains returned more or less to normal in much of the state in 2012 and 2013, but it didn't seem to help the rivers or reservoirs much, which puzzled and frustrated many Texans. Todd Caldwell, a researcher at the Bureau for Economic Geology, sums up the reason why water sources remained low in two words: soil moisture — or more accurately, the lack of it.

Simply put, parched soil can soak up a lot of rain water before it runs off into lakes and rivers or recharges aquifers.

"Soil is like a sponge," Caldwell said. "When it's dry, you can drip a lot of water on it before it starts to drip out the sides."

But once that soil is filled to capacity, rain will run off quickly, sometimes with disastrous effects as happened in the deadly flooding in Austin in 2013 and in Wimberley in 2015.

"Wimberley received 6 to 8 inches of rain in the watershed that day, which is a lot of rain, but it's happened before [without flooding]," Caldwell said. "But that 6 to 8 inches came after it had rained consistently for several months. It just kept building up and building up [in the soil] and all of a sudden it was full. The intensity of this flood was really linked to soil moisture."

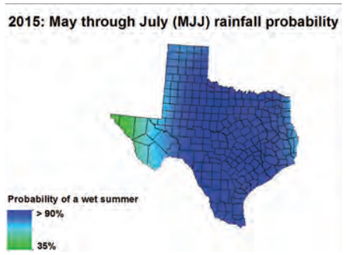

GLOBAL SOIL MOISTURE MAP CREATED BY NASA'S SMAP SATELLITE.

Because soil plays such an important role in water supply and floods, the Bureau of Economic Geology created the Texas Soil Observation Network (TxSON), a network of underground sensors in the Texas Hill Country designed to measure the moisture in the soil and upload the data online for anyone to view. The system became fully operational in December 2014.

The data can help fill a tremendous gap in the state's water supply knowledge, Caldwell said. For example, university researchers estimate that there was a total water deficit in Texas in 2011 of 50 million acre-feet, nearly three times the annual water use of the entire state. (An acre-foot of water is the amount needed to fill one acre of land with one foot of water.) The amount of the 2011 shortage accounted for by soil moisture was estimated to be anywhere from 20 percent to 100 percent, a range that highlights the uncertainty in knowledge.

Currently, the network consists of 36 soil moisture monitoring stations that are supplemented by seven stations from the Lower Colorado River Authority's Hydromet system that have been outfitted with soil moisture sensors. Caldwell is looking to increase that number and has become something of an evangelist for the system. He's been on the road for much of the past year looking for partners, talking to river authorities, water districts, utilities and others interested in water supply.

Participants include the Hill Country Underground Water Conservation District, the Blanco-Pedernales Groundwater Conservation District, Lower Colorado River Authority and NASA's Jet Propulsion Laboratory (JPL).



A NEW FORECAST METHOD CREATED BY THE JACKSON SCHOOL ACCURATELY PREDICTED A WET LATE SPRING AND EARLY SUMMER IN 2015.

JPL partnered with TxSON to ground truth its new state-of-the-art Soil Moisture Active Passive (SMAP) satellite, launched Jan. 31, 2015. The satellite measures soil moisture worldwide every three days, providing data that will enhance the ability to predict weather on a global scale days or weeks ahead of time and improve forecasts of drought, floods, wildfires and severe weather.

"The water that's stored in the soil can either exacerbate or mitigate dry or wet weather," Caldwell said. "The amount of water near the Earth's surface either consumes or radiates the sun's energy. If there's moisture, water evaporates and the land doesn't heat up. If there isn't, the land and air warm up, causing the winds to blow and water vapor to move. If we know the amount of water, our weather forecasts can really be improved."

The satellite measures water in the top two inches of soil with a radiometer that measures radiation emitted by the soil. SMAP was also outfitted with a radar sensor, but that equipment is no longer working after it malfunctioned in July 2015.

Understanding Fundamentals and Predicting the Future

Even with the assistance of satellites, forecasting what's going to happen to the water on Earth is a difficult task. Scientists spend years building complex computer models to make predictions and then years more to improve them, fine tuning the science to better understand how water cycles through the land, ocean and atmosphere.

"This is fundamental," said Jackson School Professor Zong-Liang Yang, Director of the Center for Integrated Earth System Science (CIESS). "Understanding these connections can directly be translated to the predictive skill we build into models."

Yang's group of graduate students, postdocs and research scientists specializes in models that help monitor water resources, predict floods and droughts, and improve the understanding of water-cycle mechanisms. Their work has been used by leading national centers including the National Center for Atmospheric Research and National Centers for Environmental Prediction, but much of the group's efforts are also directly aimed at improving knowledge of the Texas water supply.


Zong-Liang Yang


Rong Fu

The group is currently developing a model to more accurately predict seasonal streamflow throughout Texas, which could greatly improve water supply forecasting. They are also working to determine where the rain in Texas originates.

So far, their analysis shows that the Gulf of Mexico is the largest contributor, providing nearly 46 percent of the state's rainfall over an average year. The Eastern Pacific Ocean is second with more than 17 percent, and Mexico and Latin America are third with almost 12 percent combined.

But the situation is not static. For example, Jiangfeng Wei, a research scientist working with Yang has found that the percentage of rainfall in Texas that originates in the Eastern Pacific grows significantly in the colder months. With more research, this type of fundamental knowledge about moisture cycling can help predict floods and droughts, Yang said.

"You want to understand how the atmosphere is connected to oceans and connected to the local hydrology because the models we develop are based on the interactions between these different components," he said.

But even the best models have their limitations.

For instance, large-scale climate models are no more accurate than a coin toss at predicting rainfall in Texas in the late spring and early summer months — a time period that's essential for influencing how a summer drought will play out. A good rain can keep the state from turning into a dustbowl, while dry, hot months can turn a mild drought into a severe one, as it did in 2011.

But the odds are getting better thanks to research conducted by Jackson School Professor Rong Fu and former Jackson School postdoc Nelun Fernando, who is now working with the Texas Water Development Board.

Their new prediction method boosts the accuracy of rain prediction to about 70 percent, with work ongoing to improve that number.

The new method is a statistical forecast model that uses more localized data — like atmospheric pressure and land surface conditions — than the larger-scale dynamic climate models.

"That's because in summer the rainfall is determined by more local, smaller-scale processes," Fu said.

The localized model also uses historical data on Texas weather to help inform rainfall predictions.

"We can show that there is an empirical relationship between spring drought conditions and summer drought that gives a better prediction than the dynamic model," Fu said.

The team successfully tested the new method in 2014. In 2015, with the prediction enhanced with measurements from the SMAP satellite, the forecast showed that most of the state had a high likelihood for greater than average rainfall. This was proven correct when heavy rain swept across much of Texas during that period, ending the drought.

The Water Development Board is making the new forecast available to water utilities, water managers and decision makers. Fu said the team will work to make the predictions more accurate and available earlier in the year if funding can be secured.

Living with Reality

No matter how good scientists get at predicting the future, Texas is going to have to learn to live through extreme dry spells, said Bridget Scanlon, who leads the bureau's Sustainable Water Resources Program.


Bridget Scanlon

Because of the booming population, reservoir capacity per capita has fallen by 70 percent in Texas since the 1970s. There are some new off-channel reservoirs being built in Texas, but it would be extremely challenging to expand surface reservoir capacity enough to cope with these extremes, she said.

"It's very difficult to get a permit to build any new surface reservoirs, and the prime sites for reservoirs have already been taken," Scanlon said.

The future will likely entail a variety of water supply solutions. A strategy that Scanlon champions is aquifer storage and recovery. This entails moving water during wet times into partially depleted underground aquifers, where the water is stored for use during droughts. (For more information, see Scanlon's op-ed on page 20, titled "Don't let Texas excess water go to waste.")

She is also working with the Texas Water Development Board to look at the potential of capturing water flowing down the rivers to the Gulf of Mexico during floods and using it for water supply.

Scanlon has spent years studying drought throughout the world, particularly in Australia, which endured roughly 15 years of crippling drought starting in the mid-1990s. She has also worked in California recently, which is in the middle of one of its most severe droughts on record. Both hold hints at what the future may hold for Texas.

"In the future we are going to have to consider all possible water sources," Scanlon said. "Look at what L.A. is doing now — using stormwater, municipal wastewater, imported water, storing water in aquifers. Having a much broader portfolio increases drought resilience."


SOIL MOISTURE SENSORS INSTALLED BY THE JACKSON SCHOOL WILL PROVIDE DATA TO MORE ACCURATELY PREDICT DROUGHTS AND FLOODS IN TEXAS AND HELP A NEW NASA SATELLITE PREDICT WEATHER ON A GLOBAL SCALE.

WORLD GRAPHIC: NASA. TEXAS GRAPHIC: TEXAS WATER DEVELOPMENT BOARD. YANG AND FU HEADSHOTS: JACKSON SCHOOL. CALDWELL AND SCANLON HEADSHOTS: BEG. TXSON: RICHARD CASTEEL.

THE MAN BEHIND THE SCHOOL

By Anton Caputo

LEFT: PORTRAIT OF JACK JACKSON WITH A PHOTO OF HIS LATE WIFE, KATIE, AT HIS SIDE.

When Jack Jackson decided to leave his fortune to The University of Texas at Austin, it forever changed the face of geosciences at the university, the state and beyond.

The university already had a long and storied history in geology and the geosciences dating back more than a century. The Department of Geology was formed in 1888 and the Bureau of Economic Geology in 1909. The Institute for Geophysics, by far the baby of the group, dates back to 1972.

The Jackson estate gave the university the ability to tie the units together, first as a school in 2001, and later as a college in September 2005. What resulted was the formation of one of the largest and most prestigious schools of geosciences in the world.

Jack's choice to leave his estate to the university was a gesture to an institution he loved and credited with playing a large role in his success. He and wife Katherine, or Katie, for whom the school is also named, never had children. In a way they adopted the university, said Bill Fisher, first dean of the Jackson School of Geosciences.

"The university became their children," Fisher said. "Jack loved this place. He had fond memories of geology here."

Beyond loving the university, those close to Jack said he was devoted to the state and people of Texas and held a bedrock belief that education and the understanding of the Earth were paramount to ensuring they thrived in the future. His Feb. 27, 2002, letter making his plans official underscored that belief:

"The resources of the Earth have been very important to me and to what Katie and I have been able to achieve. The continued study and understanding of geology and the resources and environment of the Earth will be important to The University and the citizens of Texas in the future. Our intent to commit the residue of the estate is in that spirit."

Despite the generosity of Jack's actions and the size of the estate — it was conservatively estimated to be worth $150 to $200 million in 2002 and is now valued at greater than $300 million — he did not view it as a gift.

"He made that very clear," said Scott Tinker, director of the Bureau of Economic Geology. "Jack said, 'I'm not giving you this money. We're investing in The University of Texas.' "

Fisher, as director of the Geology Foundation, worked closely with Jack for almost 20 years. He and Tinker were among a group of five university administrators that Jack became close to in the later years of his life. The others — then president Larry Faulkner, former president Peter Flawn, and then dean of the College of Natural Sciences Mary Ann Rankin — rounded out what Jack would sometimes refer to as his university family.

"Honestly, it's hard to convey what an interesting and funny and truly lovely man he was," said Rankin, who is now Provost of the University of Maryland. "I still miss him."

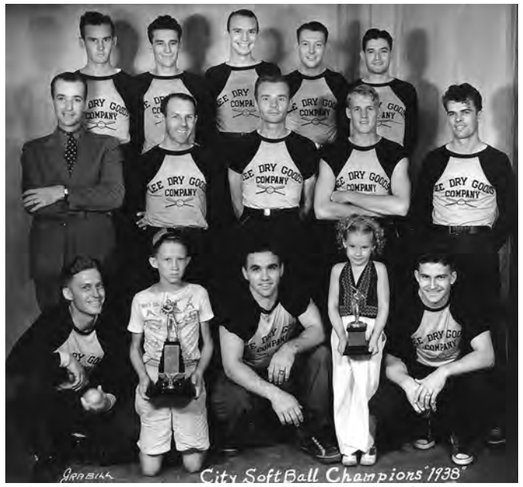
HUMBLE BEGINNINGS

The Jack those at the university came to know in his later years was a very wealthy man thanks to his success in the gas fields of Wise County and astute real estate investments in the Dallas area. He was every bit the independent oilman — shrewd, hard-working and affable, yet tough when he needed to be. He was a great storyteller by all accounts. But he was unlike the Hollywood portrayals of oilmen from the era.

Absent were the oversized cowboy hats or big cigars. He did not live large or ostentatiously — although in later years he did like to play golf with his friend Byron Nelson and other celebrities during fundraising events for charities that Jack supported.

He lived well, in a nicely kept ranch-style home in North Dallas that his friends describe as solidly upper-middle class or the type of home you might expect a college professor to live in. He drove Cadillacs — but he kept them for a decade or more. He liked to eat out, but his standby meal was chili from Jason's Deli. When he occasionally went more upscale, it was often the Olive Garden.

PREVIOUS PAGE, FEATURE PHOTO: DICK CLINTSMAN. CHRISTMAS: JACKSON SCHOOL. LONE STAR STEEL COMPANY; JACKSON SCHOOL. CLOCKWISE FROM TOP LEFT: JACKSON SCHOOL, THE UNIVERSITY OF TEXAS AT AUSTIN.



CLOCKWISE FROM TOP LEFT: KATHERINE ELIZABETH GRAETER BEFORE SHE WAS KATIE JACKSON; (TOP ROW) ELLISON MILES, JACK, (BOTTOM ROW) GEORGE MITCHELL, MARK BURLINGAME AND R.E. "BOB" SMITH AT THE WISE COUNTY OIL AND GAS DAY CELEBRATION; (LEFT TO RIGHT) UNIVERSITY PRESIDENT LARRY FAULKNER, JACK AND JACKSON SCHOOL DEAN WILLIAM FISHER IN 2001; JACK (TOP ROW, SECOND FROM RIGHT) WITH SOFTBALL TEAM; A YOUNG JACK; (LEFT TO RIGHT) SCOTT TINKER, BEG DIRECTOR; WILLIAM FISHER, FIRST JACKSON SCHOOL DEAN; PETER FLAWN, UT PRESIDENT EMERITUS; MARY ANN RANKIN, THEN DEAN OF THE COLLEGE OF NATURAL SCIENCES; ANNA LOUISE GRAETER, KATIE'S SISTER-IN-LAW; JAMES LANGHAM JR., JACK'S ACCOUNTANT/FRIEND, AND LARRY FAULKNER, UT PRESIDENT EMERITUS AT THE GEOSCIENCES BUILDING DEDICATION.

He had a lifelong love affair with his wife Katie. In fact, Jack left geology and the oil business flat in 1960 when Katie, who was tired of his long absences in the oil fields, reportedly said she would have been better off marrying a shoe salesman. He would later tell his friends that he never spent another day apart from Katie until her death in 2001.

Katie seems to be the one instance where Jack would abandon his Depression Era spending sensibilities. Rankin remembers several times in Jack's later years when he would become sentimental talking about Katie, and would show Rankin the closet full of couture gowns he bought for Katie or take her to the bank to look at the jewelry he bought his beloved wife.

"It meant a lot to him that he had bought that for her even though they clearly didn't spend a lot of money on their home or anything like that," Rankin remembers.

Katie, in classic Jackson fashion, rarely wore the jewelry, instead choosing to wear duplicates that Jack had made for her.

But like many members of the Greatest Generation who would achieve remarkable success, Jack did not come from wealth.

"Jack started as a regular, poor kid," said Jim Langham, Jack's longtime accountant. "He didn't have any money ... Jack was successful because he worked, he was smart, he saw the opportunity and he took advantage of it."

Born in East Texas in 1913, Jack lost his father to influenza at the age of three. He was raised by his mother, a talented woman who became director of public welfare for the City of Dallas.

Jack grew up working. Selling newspapers, bagging groceries and later working in a cotton gin and a department store, were a few of his endeavors. At one point in high school he even branched out into small business by selling his own brand of pomade while delivering newspapers.

He was an exceptionally good baseball and fast-pitch softball player and a top-notch southpaw pitcher. This skill would prove to be a valuable professional asset when Jack was a young man looking for employment in an era when companies would often field semi-professional teams and engage in national tournaments. His ball-playing prowess was instrumental for obtaining one of his early jobs at Arkansas Fuel.

By the time Jack graduated high school, the Depression gripped the country. Luckily, oil production was booming in East Texas, and an older cousin, John Atkins, agreed to put Jack to work at his gasoline plant. Jack learned the operations from the ground up — digging ditches, working on pipelines, and even spending time in the chemistry lab. His wage was 25 cents an hour.

Jack's cousin would eventually let him go, letting the young man seethe for a little while under the impression that he had been fired before explaining that Jack had learned all he could at the gas plant and that he was going to help him pursue a higher education.

COLLEGE AND WAR

Jack chose The University of Texas at Austin to pursue a degree. However, his first foray into academic life during the fall of 1935 didn't go well. He was determined to pursue his degree, but simply hadn't yet developed the academic skills necessary to succeed at the university.

On the advice of Assistant Dean of Men Arno "Shorty" Nowotny, Jack transferred to Temple Junior College to improve his academic skills before reentering the university.

> **"The university became their children. Jack loved this place."**
>
> *Bill Fisher, first dean of the Jackson School of Geosciences*

"He learned how to study is what it really comes down to," Langham said. "It's like a lot of those guys that needed to get into the regimentation that it takes to get a professional degree. That's what he needed to do and that's what he did."

The move to Temple Junior College would prove pivotal in Jack's life. It was during this time that he would meet Katherine Elizabeth Graeter, his future wife and lifelong partner. It was also one of those life experiences that seemed to color Jack's view of education.

"Because of his own path, Jack knew that young people are not just programed to succeed," Faulkner said. "They haven't necessarily had the right set of experiences at any given moment in life and you need to be open-minded about giving them a chance about getting those experiences together."

Jack eventually returned to The University of Texas at Austin. He graduated with a geology degree in 1940 and took a job at Arkansas Fuels. World War II broke out soon after and he enlisted in the Navy, but the War Department had other ideas.

The nation, gearing up for a war it was not prepared for, desperately needed aluminum for planes and other equipment. Jack soon found himself assigned to the bauxite district of Arkansas to help find deposits of the precious ore.

Jack would spend the war doing just that. The experience proved invaluable for a geologist starting his career and would play a pivotal role in his later success.

PHOTOS: JACKSON SCHOOL OF GEOSCIENCES.

LEFT: JACK AND KATIE SEATED AT THE HEADS OF THE TABLE ENJOYING A DINNER PARTY WITH FAMILY. RIGHT: JACK AND KATIE STANDING WITH HER PARENTS, AUGUSTA M. AND OTTO A. GRAETER, SR., AND JACK'S MOTHER, EDNA ELIZABETH BLAKEY JACKSON, AT HIS SIDE.

WISE COUNTY

When the war ended, Jack went back to work for Arkansas Fuel, but was hired away by independent oilman Jay Simmons and oil investor Arthur Cameron. For six months, Jack's role with the duo entailed promoting events and entertaining celebrities and potential investors as much as it did geology.

But Simmons eventually sent Jack to Wise County to check on the claims of a rancher — former British Colonel Jimmy Hughes — who was convinced he had oil under his land. Jack saw enough potential in the well logs the rancher shared with him to start an investigation of his own that would eventually lead to the Wise County gas fields.

"Everybody thought Jack went out there and found this oil and gas and he was rich. It didn't work like that," Langham said. "It took a long time. It took them seven or eight years to get that thing going."

Jack spent almost two years pulling together logs, maps and whatever information he could find on the geology of the area. Ultimately, it was his experience gained during the war working the bauxite deposits in Arkansas that brought the geology into focus, as Jack explains in his biography:

"The only difference between a bauxite deposit and a porous conglomerate in the Fort Worth Basin is that the weathering of the former dissolved out the silica and concentrated the alumina content. The weathering of the latter reduced silica and formed holes (porosity) which were ultimately filled with oil or gas rising up from the interbedded gray shales. It was that simple. The trick was to learn the pattern of deposition. Once that was established, the rest was mechanical. And I had learned the sedimentation pattern in the Arkansas bauxite 'field laboratory' during the war. Core drilling and seismic maps were used to locate the subsurface ridges and valleys there. The thick bauxite deltaic deposits occurred in and along the valleys where the deltas had built rather than on the crests.

The conglomeratic pattern in the Fort Worth Basin was very similar. So I transferred my bauxite knowledge over to the Fort Worth Basin. Nobody working Wise

THE JOHN A. & KATHERINE G. JACKSON SCHOOL OF GEOSCIENCES

County had the kind of background that I had, so they didn't have the geological insights I did. I could look at a map and see 6,000 feet into the ground. The area looked like a room full of sawdust filled with thousands and thousands of cups and saucers and platters and bowls scattered throughout. You did not need a geophysical map which would reflect the valleys and ridges. There was no such map of the entire county, but after months of painstaking detail work I was able to put together numerous seismic maps of small areas like a jigsaw puzzle. All of the sudden the entire area came into focus—the same pattern of ridges and valleys found in the Little Rock bauxite field."

HITTING IT BIG

Jack's theories were proven out by test wells drilled in 1950, but he couldn't get his employers, who were preoccupied with oil plays elsewhere, to pay attention. So Jack quit and set out on his own, working as a geologist in the oil fields to pay his bills while pursuing his own geological work in Wise County's Fort Worth Basin.

The fascinating series of events that took Jack from scratching out a living in the oil fields to hitting it big in Wise County is detailed in Jackson's own book "Wise County: 25 Years of Progress" and his 2005 biography commissioned by the Jackson School titled "The Jack Jackson Story-Reflections of a Geologist."

But it was a 1952 chance meeting with a landman in a Lubbock coffee shop that really got things moving. The landman mentioned Jack's deal to a friend in Denver, who passed it on to an associate in Tulsa, who then contacted a Chicago bookie known to frequent a well-known casino in Galveston. The bookie mentioned the deal to a card dealer whose son, as fate would have it, worked for Jonny and George Mitchell. George, of course, would later gain fame as the father of hydraulic fracking and the current shale gas and oil boom that has done much to reshape the country's domestic energy supply.

"I think one of the great stories about the Fort Worth Basin is that Jack's vision drew George Mitchell in, and George Mitchell's activity there lead ultimately to the development of horizontal drilling and fracking," Faulkner said. "Those two guys together, those were tremendous visionaries."

The fortuitous series of events quickly brought Jack into contact with a group of investors with enough capital to pursue Jack's plans and enough knowledge to see the sense in them. The group originally offered to put Jack on the payroll as the project's geologist for $50,000 a year. But Jack declined, saying he didn't want to be an employee.

After discussing the situation with Bob Smith, who was affiliated with the Mitchells and would become Jack's close friend and mentor, Jack took a 3-percent "override" in the venture. This allowed Jack to make income off the venture if and when it produced income without having to make a capital investment he couldn't afford.

During the next several years the group acquired more land and drilled more test wells, with Jack working tirelessly as the exploration geologist. But money from the investment was not forthcoming. The group could not strike a satisfactory deal with Lone Star Gas, which served Dallas and Wise County. They eventually struck a deal with the city of Chicago, but it took a new pipeline, a visit to Chicago Mayor Richard J. Daley, a new gas processing plant and the defeat of a federal lawsuit filed by Lone Star to get gas flowing from Wise County.

Finally, in late 1957, it was all finished. Gas was being piped to Chicago, and Jack's hard work had paid off — handsomely.

LIFE AFTER THE RIGS

Jack continued to work the oil fields hard for a couple years before Katie finally put her foot down about the long hours and time away from home.

Once she did, Jack left the profession quickly. The couple took a two-month vacation to Europe and then settled into life in Dallas, where Katie quickly became a key figure on the social scene.

Jack, on the advice of Bob Smith, invested heavily in real estate in North Dallas. Much of the property would eventually be turned into the North Dallas Tollway, making him another fortune. Jack also worked hard on the political campaign of Dolph Briscoe, becoming something of a kingmaker in Briscoe's run for governor.

> **"Jack had a venturesome mind. He loved geology, and he was interested in new things."**
>
> *Larry Faulkner, former university president*

Jack and Katie were strongly religious and believed in the power of education and medicine to help mankind. They donated heavily to Presbyterian Hospital of Dallas, Texas Lutheran College, Austin College, Temple Junior College and many more causes, including, of course, The University of Texas at Austin. Katie was a member of the Texas Lutheran College's Board of Regents for two decades and an honorary member of the Presbyterian Hospital's Board of Trustees.

But it was Jack's election to The University of Texas Geology Foundation Advisory Council in 1975 that would set the scene for Jack and Katie's ultimate show of philanthropy. Jack had been out of geology for 15 years when he was elected, but the foundation did so at the urging of Samuel Ellison Jr., who helped create the foundation and was chair of the Department of Geological Sciences.

GEOSCIENCES BUILDING; JACKSON SCHOOL OF GEOSCIENCES.

Ellison had known Jack since the Wise County days and was quick to introduce him to Fisher, who in 1970 became director of the Bureau of Economic Geology, and later the chair of the geology department and the Jackson School's first dean.

This relationship, which developed over many years, would lead to the Jacksons donating $15 million for a new wing to the geology building and $25 million to form the new school before Jack made the momentous decision to leave the bulk of his estate to The University of Texas.

There wasn't perfect agreement among Jack's university family after Jack made his decision known. At the time, the geology department was part of the College of Natural Sciences. Fisher and Flawn, who had discussed pulling the university's three major geosciences units together years before, saw this as the opportunity to finally accomplish that mission.

"That had always been a goal of mine, but we never had the capability to do it," Flawn said. "The gift made it possible."

However, Rankin, who was dean of the College of Natural Sciences at the time, thought the department should stay under the college, arguing that it could continue to strengthen the important ties it had made with the other sciences.

"I felt like geology could grow just as much and be as ascendant nationally and not sever the ties with the college," Rankin said. "But there were no terrible choices."

Ultimately, Faulkner, the university president, agreed with Fisher and Flawn that the geosciences should be tied together as a single school and the decision was made.

THE JACKSON SCHOOL

Looking back some 10 years after the Jackson School was formed as a college and almost 15 years after it was first formed as a school, those who knew Jack agree that he would generally be pleased with the results. Although they also said he would likely be anxious to see the Jackson School improve its top 8 national ranking to number 1.

"Jack appreciated that the science of geology was changing, but he didn't want us to abandon the expertise we developed in oil and gas and natural resources," Flawn said. "He wanted us to include the environment too. But mainly, he wanted us to get better."

Tinker too has clear memories about Jack's desires for the school.

"Make sure you work on things that are going to differentiate geosciences and have an impact on the world," Tinker said.

Beyond straight geology, Jack was very interested in water resources, and those who knew him agree that he would be happy about the Jackson School's leading work on the issue.

"He would sit and look out his office window and look out at the Trinity River and say, 'Could you imagine messing up a nice river like that any more than they've done here?' " Fisher remembers. "He was really concerned about that."

And while he never discussed possibilities like conducting geology on other planets, Faulkner has a suspicion that Jack would enthusiastically support the school's work with NASA to explore other worlds.

"I would guess that he would be excited about the otherworldly geology that is being explored," he said. "Jack had a venturesome mind. He loved geology, and he was interested in new things. He would want the school to be in a venturesome position, and I think he would be proud of that."

Ultimately though, the consensus of those who knew Jack is that it would be the work done to improve the state by educating its future generations, and turning them into productive, successful citizens, that would make him smile the most. Several mentioned GeoFORCE Texas, which helps kids from underprivileged and underserved areas of Texas pursue a career and education in the geosciences, as the perfect example of Jack's vision.

"Education is the equalizer. It will overcome all barriers. It is the one thing that will," Langham said. "That's what Jack believed. That's why he gave his money."

WE ALL HAVE A PART TO PLAY

The permanent endowment left by Jack and Katie Jackson created a strong foundation for excellence. It enabled the Jackson School to hire top faculty and research scientists, and build state-of-the-art facilities that increase the depth and breadth of science conducted at the school and enrich student education.

But it was never meant to support the school exclusively.

The Jackson School relies on individual donors to ensure that it can continue its mission of conducting cutting-edge research and offering students a world-class education — just as Jack and Katie intended.

The endowment includes royalties from the estate's wells and leases. And to honor Jack's wishes, the Jackson School is the only institution in The University of Texas System that manages its own mineral rights. However, royalties can be significantly affected when gas and oil prices fall.

The Jackson School relies on thousands of individual stakeholders investing time, money and counsel at a range of levels to continue its path of excellence. Jack and Katie could think of no investment more valuable.

In Jack's words: "We are investing in the future of a countless number of people at The University of Texas at Austin, who will study and will continue to learn of the geology, the earth sciences, and the resources and the environment of the Earth. I know of nothing more worthwhile."

EDITOR'S NOTE: MOST OF THE BIOGRAPHICAL FACTS FOR THIS STORY CAME FROM "THE JACK JACKSON STORY — REFLECTIONS OF A GEOLOGIST," THE OFFICIAL BIOGRAPHY OF JACK JACKSON BY W. KEENE FERGUSON AND SUSANN V. DOENGES. THE BOOK IS AVAILABLE AT THE JACKSON SCHOOL OF GEOSCIENCES DEAN'S OFFICE, 512-471-6048.

SLOW SLIP

UNDETECTED BY HUMANS, SLOW MOTION EARTHQUAKES ARE HAPPENING ALL OVER THE WORLD. UNDERSTANDING THEM COULD HELP PREDICT WHEN DESTRUCTIVE QUAKES ARE COMING.

By Monica Kortsha

SUBDUCTION ZONES — THE PLACES WHERE ONE TECTONIC PLATE BEGINS TO DESCEND BENEATH ANOTHER — PRODUCE THE LARGEST AND DEADLIEST EARTHQUAKES AND TSUNAMIS ON EARTH.

They're also home to a subtler kind of seismic event.

Scientists have recently discovered a class of fault movements akin to earthquakes in slow motion occurring on subduction zones around the world. Called a "slow slip event," the mechanics are similar to those of large earthquakes, but instead of releasing their energy in a few seconds of violent shaking, they happen silently and slowly over a period of days to months.

The only signs of slow slip events at the surface are centimeter-sized shifts in the land that cause it to relax and relieve some previously accrued tectonic stress. They remained hidden until 2001, when a GPS monitoring network deployed by Canadian scientists detected slight movements above the Cascadia subduction zone on the northwest coast of the United States and western Canada. Since that first discovery about 15 years ago, slow slip events have been observed around the world.

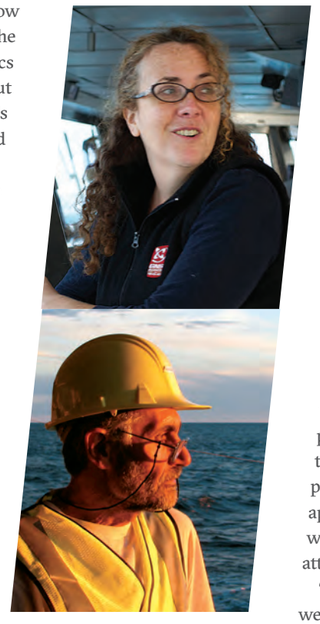
While imperceptible to humans, the gradual movements of slow slip events may hold major sway when it comes to more destructive seismic events. The 9.0 magnitude Tohoku-Oki earthquake that struck off the coast of Japan in 2011 and ultimately led to the nuclear disaster at the Fukushima Daiichi nuclear power plant was preceded by two slow slip events, one occurring three years and the other one month before the quake. Recent research has framed these events as the final straws that set the earthquake off.

On the flip side, it is also possible that slow slip events may relieve stress in earthquake zones and help to prevent such large quakes from happening.

Understanding when slow slip events could signal earthquakes, or potentially prevent them, starts with knowing when and where on the subduction zone they occur, said Laura Wallace, a researcher at the Jackson School of Geosciences Institute for Geophysics (UTIG).

Wallace has been studying slow slip events almost as long as anyone on the planet and is now taking her research to uncharted territory: the bottom of the ocean. Using under-water instruments that measure deformation of the seafloor during very shallow slow slip events, she hopes to understand just where along offshore subduction boundaries slow slip events happen.

Lada Dimitrova, a postdoctoral fellow at UTIG, will also play a key role in the research. She has developed a new method to analyze the onshore GPS data that provides a view of the spatial and temporal evolution of slow slip events in unprecedented detail.



LAURA WALLACE, A UTIG RESEARCH SCIENTIST, AND ANATOLY MIRONOV, A UTIG RESEARCH SCIENTIST ASSOCIATE, AT SEA.

DISCOVERING SLOW SLIP

Wallace discovered the first slow slip events ever recorded in New Zealand while working at New Zealand's geological research institute, GNS Science. One of her first tasks at GNS was to help design a continuously operating GPS network to monitor New Zealand's Hikurangi margin subduction zone as part of the country's GeoNet project, a geohazards monitoring system. Almost as soon as the network was live, slow slip started to appear, Wallace said. The first sign was a GPS site near the city of Gisborne, New Zealand, shifting by two centimeters eastward over 10 days in October 2002.

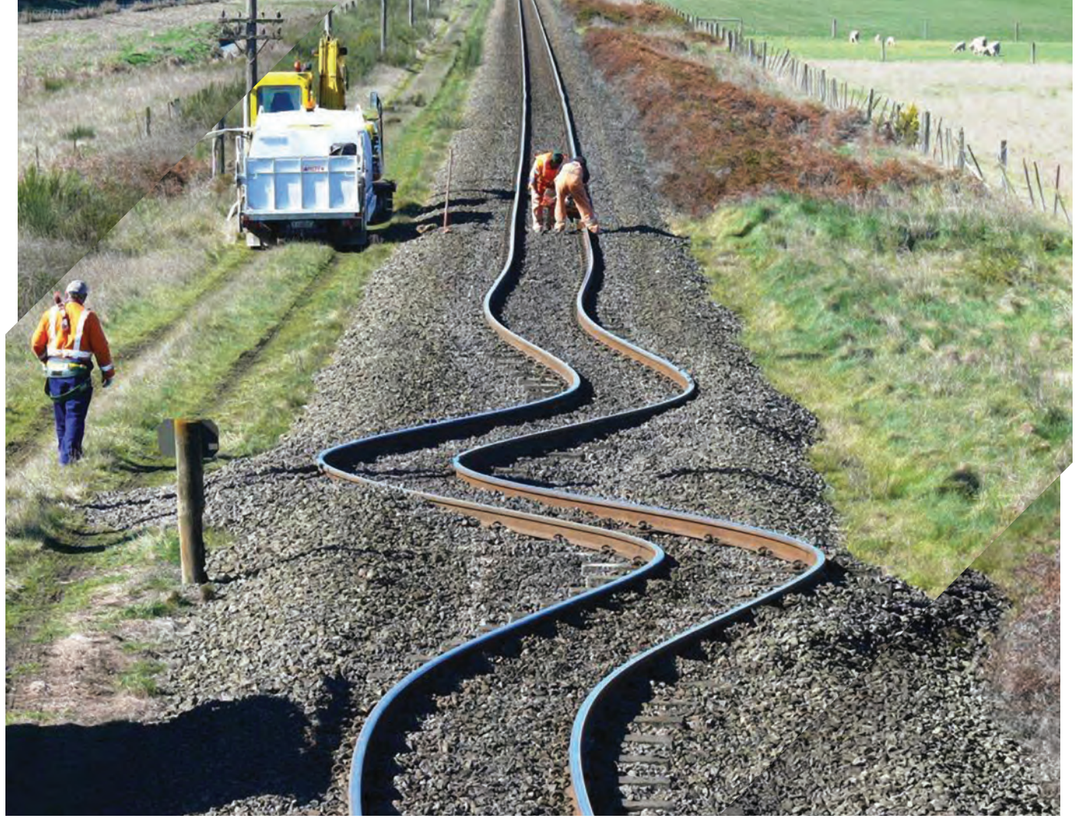
The jump eastward indicated a break in the ongoing tussle between the Australian Plate and the westward subducting Pacific Plate, with slow slip allowing the Australian Plate to slide back into a more relaxed state, like a released spring returning back to its unstretched state. A GPS device captured the period of gradual stress accumulation punctuated by episodic slow slip events at the Hikurangi subduction zone, and over time produced data with a telltale staircase-like appearance. When Wallace saw the first eastward jump in 2002, it immediately caught her attention.

"I looked at the GPS time series plots on the web and said, 'Oh my gosh, that looks like a slow slip event,' " Wallace said.

The slow slip event didn't show up on any of the GeoNet's 10 other devices. There were only about a dozen GPS sites in New Zealand at that time, and they were too far from the GPS site at Gisborne that recorded the event. But data obtained from a local surveyor's GPS base station also detected the event, proving that slow slip also occurs at New Zealand's subduction zones.

Since then, the GeoNet GPS network has expanded to over 150 devices across the country and has revealed slow slip activity all along New Zealand's Hikurangi subduction zone. In parts of the zone monitored by GeoNet, an event occurs about every 18 months, lasts one to two weeks, and causes displacement of up to three centimeters. Some of the recorded events are longer (up to 1.5 years), and have contained about the same amount of energy as a magnitude 7.0 earthquake, larger than the one that devastated

SEA SURFACE JENNY NAKAI. MIRONOV: ANATOLY MIRANOV. WALLACE: LIZ BRENNER. BENT RAILS: MALCOM TEASDALE: COURTESY OF KIWIRAIL.



RAILROAD TRACKS BENT BY THE 2010 CANTERBURY EARTHQUAKE. THE TRACKS CROSSED THE FAULT RUPTURE NEAR ROLLESTON, NEW ZEALAND.

Christchurch, New Zealand, in February 2011, killing 185 people.

However, the capability of GeoNet's GPS monitors ends where the ocean starts. And the Hikurangi subduction zone extends 30 miles into the Pacific Ocean to its place of origin — a trench in the seafloor made by the Pacific Plate as it begins its descent beneath the Australian Plate. So, funded by the National Science Foundation, Wallace led a team of researchers on a 2014 mission that extended slow slip tracking capabilities into the ocean by dropping monitoring devices along parts of the subduction zone out of GeoNet's reach.

Officially called the Hikurangi Ocean Bottom Investigation of Tremor and Slow Slip, the mission goes more frequently by its Tolkien-inspired nickname "HOBITSS," a fitting choice for research based in New Zealand, the country where "The Lord of the Rings" movies were famously filmed. The mission brought together researchers from seven institutions in the U.S., Japan, and New Zealand, to drop 32 seismic and pressure-recording instruments to the bottom of Poverty Bay on the North Island's southeastern coast.

Since deployment, the devices have been continuously recording movements and seismicity at the Hikurangi subduction zone, where slow slip occurs only five to 15 kilometers below the Earth's surface. The data will provide the first comprehensive look at slow slip along the offshore reaches of a subduction zone, where the plate boundary nears the seafloor. Prior to now, studies of slow slip have been restricted to deeper slow slip events (greater than 20 kilometers beneath the earth) where land-based networks are able to detect them.

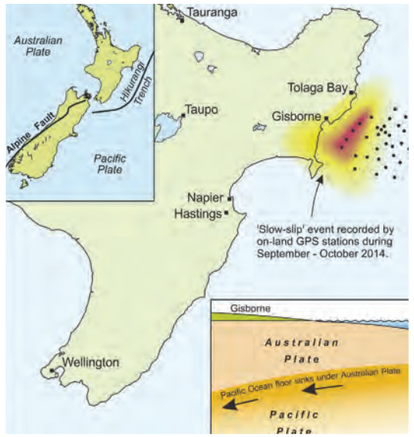
BETWEEN A ROCK AND HARD PLACE

According to Wallace, the scientific community's current understanding of why slow slip events occur and their relationship to large, damaging earthquakes is still in its infancy. But a working theory is that the slow slip environment is a transitional zone between two other subduction zone regions: the deeper aseismic zone where the plates move smoothly past each other without getting stuck, and the shallower seismic zone, where frictional hang-ups between the plates cause earthquakes.

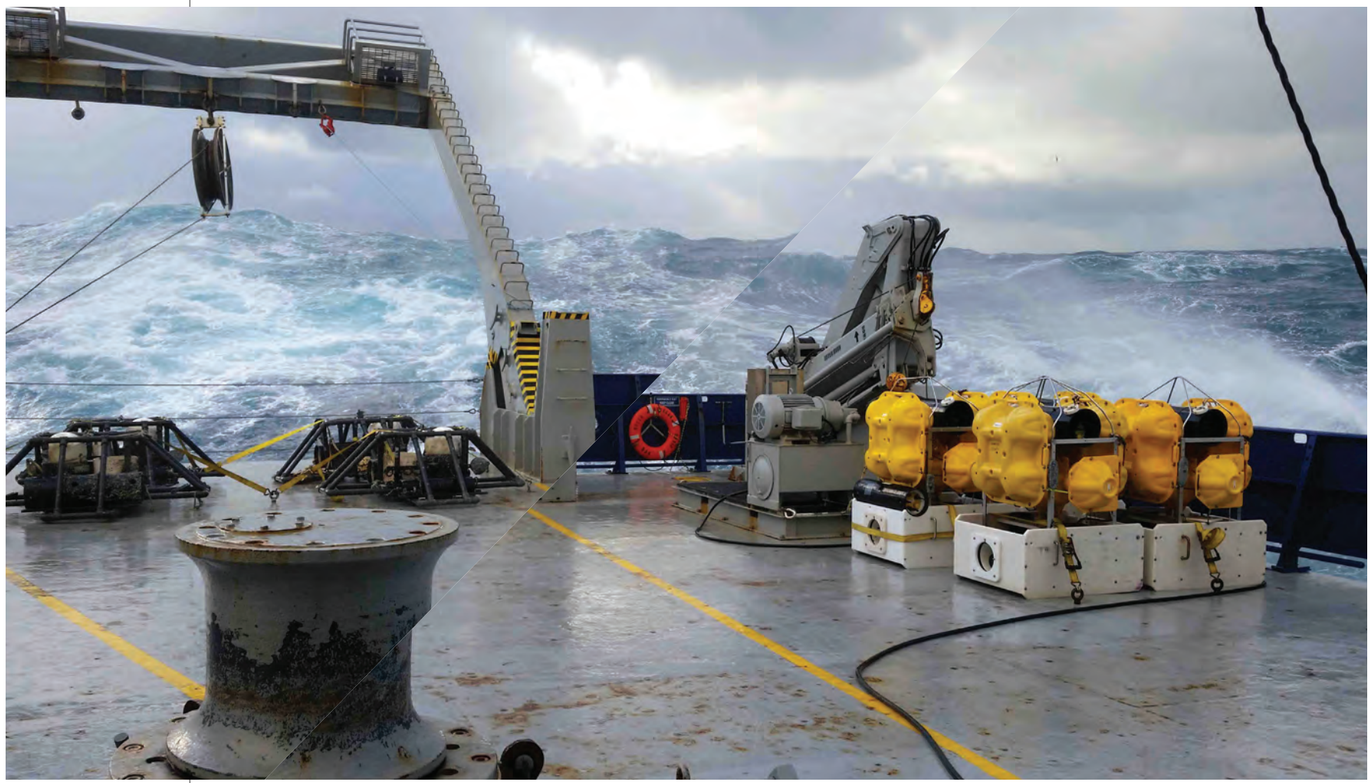
"Many of the world's slow slip event zones seem to straddle a transition between the area where earthquakes are produced, and the steadily creeping part," Wallace said. "So it looks like slow slip may be related to some sort of transitional frictional behavior."

Many studies also suggest that abundant water in slow slip zones may help build up high fluid pressures in the fault zone, and that this could promote slow slip behavior. It is likely that a combination of abundant fluids and the frictional properties of the rocks in seismic zones enables stress between plates to be released more gradually as slow slip events rather than as quick jolts that cause earthquakes.

Scientists are also interested in the relationship between slow slip events and more typical, "fast slip" earthquakes. There are clear



THE HOBITSS RESEARCHERS ON THE FIRST CRUISE TO PLACE SLOW SLIP SENSORS ALONG THE HIKURANGI TRENCH.



LEFT: A GRAPHIC ILLUSTRATES SEISMIC ACTIVITY IN NEW ZEALAND. RIGHT: BRIGHT YELLOW BPRS FACE ROUGH SEAS BEFORE DEPLOYMENT.

NEW ZEALAND GRAPHIC: GNS SCIENCE. HOBITSS RESEARCHERS: JENNY NAKAI. WAVE AND BPRS: JUSTIN BALL.

spatial and temporal linkages between slow slip and earthquakes observed at many plate boundaries, including Japan, New Zealand and Cascadia, but these relationships are not yet well understood.

Since slow slip events are often observed along the boundaries of the area where large earthquakes happen, they may be useful for helping to forecast the locations of future large tremors.

"If slow slip does delineate the locked zone, you could potentially use the distribution of slow slip events as further evidence for where the big quake ruptures are going to be," Wallace said.

DIY ENGINEERING

Recording the slow slip events offshore rests on the ability of bottom pressure recorders, or BPRs, at the bottom of the ocean to detect subtle changes in pressure due to movement of the seafloor during the slow slip events. It is a new role for the devices that have previously been used in studies of tsunamis and submarine volcanoes.

For the HOBITSS experiment, UTIG built five BPRs. Anatoly Mironov, UTIG's resident electronics engineer, is the man behind the design and construction of the devices.

"This is my specialty," Mironov said. "All my life I have been designing different equipment."

At UTIG, Mironov engineers scientific devices that need to be built or modified. He's provided technical support for the ice-penetrating radar system used by UTIG researchers Donald Blankenship and Ginny Catania to survey features beneath Antarctica, and has built and upgraded many ocean bottom seismometers for various UTIG projects.

Mironov started his geophysics career in the former U.S.S.R, his homeland, as a technical leader in the Russian Arctic and Antarctic expeditions in 1985. It was in Antarctica where he met Blankenship and learned about UTIG, the institution he would join 15 years later.

"In Antarctica people really get to know each other," Mironov quipped.

Each device Mironov makes comes with its own challenges. For the BPR, the main issues to be overcome were keeping the electronics running constantly for two years and keeping them dry. He learned first-hand about the challenges of the second point years ago when the casing for an ocean bottom seismometer he designed sprung a leak. He now keeps the device, its corroded and salt-crusted motherboard exposed, on his desk.

"It's on my desk to remind me that there are no minor things when you design or prepare equipment for deployment," Mironov said. "Any mistake, and you lose the instrument, you lose the data, and eventually many years of your work are thrown in the trash."

Wallace's BPRs underwent a strict sealing protocol inside a pressure-resistant case.

However, Wallace and Mironov won't know the state of the devices and their data until they're retrieved.

Bringing the BPRs back is also a risky task that depends on all of the components working properly. A release code transmitted to a BPR makes it drop anchor and float to the surface, while a radio beacon, a strobe light and old-fashioned flag on the BPR help guide researchers to it. And just in case someone else finds it first, Wallace's contact information is on each device, too.

RECOVERY AT SEA

At the time this article was written, Wallace, Mironov and other members of the HOBITSS research team had recently recovered the data from the BPRs at the bottom of the sea. Although it will take months to analyze the data, the initial results look promising, Wallace said.

"I am really excited to say that we have recovered our instruments, and that the vast majority of them have great looking data," Wallace wrote in a blog post for the HOBITSS cruise.

The data recovered from the devices' first year along the subduction zone will help determine where slow slip events occur on the shallowest reaches of the subduction zone plate boundary. The BPR and ocean bottom seismometer data together will help scientists to better understand the spatial and temporal connection between slow slip and earthquakes.

The data will also help pinpoint the areas of interest for Wallace's next research project along the Hikurangi subduction zone: drilling near the plate interface itself.

Wallace is part of a large international team of scientists that is scheduled to use the Integrated Ocean Drilling Program's research vessel JOIDES Resolution in 2018 to investigate the causes of shallow slow slip events offshore New Zealand. They will take core samples from the plate boundary surrounding the slow slip area, and install borehole instruments, such as pressure gauges and fluid flow sensors.

"We'll be monitoring hydrological changes, deformation rate changes, and fluid chemistry changes to try and look at how these properties vary throughout the slow slip cycle," Wallace explained.

In the meantime, while the research team parses data and drilling plans are set in motion, slow slip events will continue to shift subduction zone landscapes at a rate only GPS — and now HOBITSS — can notice.

> *YOU COULD POTENTIALLY USE THE DISTRIBUTION OF SLOW SLIP EVENTS AS FURTHER EVIDENCE FOR WHERE THE BIG QUAKE RUPTURES ARE GOING TO BE*
>
> *Laura Wallace, UTIG research scientist*

By Joshua Zaffos

SORTING SCIENCE FROM DREAD

NEW RESEARCH SHOWS THAT RISK OF SERIOUS PIPELINE ACCIDENTS OVERESTIMATED

On an evening in September 2010, a cloud of fire exploded above a gas station in San Bruno, California, unleashing an inferno with 300-foot-high flames, killing eight people and injuring more than 50 in the nearby neighborhood. The cause: a ruptured underground natural gas pipeline.

The size and spectacle of such explosions and line failures stick in people's minds and stoke their fears about the dangers of underground pipelines. Even some industry analysts treat such accidents as inevitable, while environmentalists portray pipelines as inherently perilous ticking time bombs.

But those anxieties may far overshoot actual risks, said Ian Duncan, a research scientist with the Bureau of Economic Geology. Duncan studies the risks of pipeline failures, and has reviewed and analyzed past accident and fatality statistics to better understand just how hazardous different pipelines are. Along the way, he has reached a reassuring, although perhaps unpopular, conclusion: The chance of a person living near a gas or other pipeline dying from a rupture or explosion is close to the probability of that same individual dying from an airplane landing on them in their living room — which is to say pretty low. Duncan's work suggests that past estimations have overstated risks by up to four orders of magnitude.

"One of the problems in this world is our perception of what's risky and what's not risky is catawampus," said Duncan.

PIPELINE EXPANSION

Duncan's examination of gas pipelines began as a step toward understanding the risks of another proposed pipeline network: carbon-capture lines that could reduce the release of carbon dioxide into the atmosphere and help mitigate climate change.

Carbon capture and storage (CCS) entails separating carbon dioxide from other gases at electricity generation plants, and then transporting the CO_2, usually via pipeline, to be stored underground in geologic formations kilometers beneath the surface. The process has emerged as a promising albeit developing technology to combat greenhouse gas emissions.

Energy companies have used the basic CCS process for decades for enhanced oil recovery — injecting CO_2 underground to extract more oil from marginal or dwindling deposits. President Obama's Clean Power Plan, released this past summer to reduce greenhouse gas releases, included CCS as a possible carbon-reduction strategy for coal plants. But policymakers are still working out whether it will be mandated within the final rule.

PIPELINE: GETTY IMAGES.

Regardless, coal-fired plants are already incorporating CCS. In 2014, the world's first commercial-scale power plant using CCS began operating in Saskatchewan, Canada, sending recovered carbon dioxide to boost oil recovery in North Dakota. Several other U.S. plants are also upgrading to include the technology; CCS systems will be included in two new coal plants being built in Fort Bend County, Texas, and Kemper County, Mississippi, from the outset.

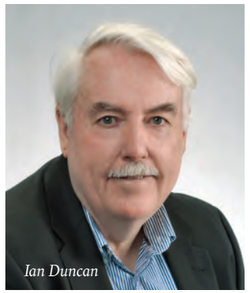
That development means a lot of pipelines. And outside of the power plant infrastructure, the lines are considered the riskiest element of CCS. Some estimates project that every coal plant could need up to 62 miles of pipelines to effectively move carbon dioxide. To accommodate startup of CCS at just the existing U.S. coal plants, the country could need between 5,900 and 20,610 miles of new pipelines and as much as 120,000 miles at full buildout by 2050. Recent studies of pipeline risk by other experts have suggested this is a hazardous proposition, and have pegged fatality risks from CCS pipelines at 1 in 1,000 people to 1 in 10,000 people per kilometer of line per year. That's in the range of the risk of working on an offshore oil platform to driving on the freeway, respectively.

"If you're going to make a policy decision on CCS as a way to deal with climate change, you need to understand the costs and benefits involving alternatives to make a rational choice," said Eric Bickel, a professor in the university's Department of Petroleum and Geosystems Engineering, who has collaborated with Duncan.

Without another comprehensive CCS pipeline to evaluate, however, the estimates have generally relied on engineering assessments and raw data from databases, Bickel said.

"Some people have highlighted the risks of transporting CO_2, but we need to understand just how big those risks are," he said. "Rather than theorizing, Ian's research focuses on actual data from natural gas pipelines or CO_2 pipelines used primarily for oil recovery."

With a $2 million grant from the Department of Energy, Duncan took a closer look at the likelihood of pipeline failures in CCS networks and elsewhere, and reached much different conclusions.



Ian Duncan

"ONE OF THE PROBLEMS IN THIS WORLD IS OUR PERCEPTION OF WHAT'S RISKY AND WHAT'S NOT RISKY IS CATAWAMPUS,"

Ian Duncan, research scientist and program director at the Bureau of Economic Geology

BREAKING DOWN THE DATA

Duncan began by looking at natural gas gathering lines, which carry resources from well pads to processing plants or refineries, and incident reports from those systems as a useful analog. Those lines are distinct from transmission lines, which run from the processing or refining facilities to customer-distribution systems. While gas is much more flammable than carbon dioxide, the size and specs of the gathering-line network provides a useful comparison for the potential CCS pipeline system. After all, there are currently about 240,000 miles of gathering lines across the country, providing a large data set to study. But the task proved to be a complicated one.

In the past, gathering lines were often built to be smaller and withstand less pressure than transmission pipelines. Now, they're often built with larger diameters, in part, to keep up with the volume and pressure of gas flowing out of hydraulically fractured, or fracked, well fields. Regardless of the specs, though, gathering lines are largely regulated by state agencies, not the federal government. The Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHSMA), regulates only about 10 percent of the gathering-line network. When a gas line blew up near Alice in Jim Wells County in 2012 it was a state regulated gathering line. No federal or state agency investigated the rupture, and the company that operated the line never submitted an official incident report.

The number of "significant incidents" reported to PHSMA has increased since 2004. The rising incident trends and the high-visibility consequences of explosions have contributed to people's "dread factor" over pipelines, and led some researchers and critics to say that building out a vast network of CCS pipelines would face public opposition — and maybe rightly so.

But as Duncan sifted through previous studies and the accident reports and data, he picked up how information gaps and glitches were also skewing risk assessments of pipelines.

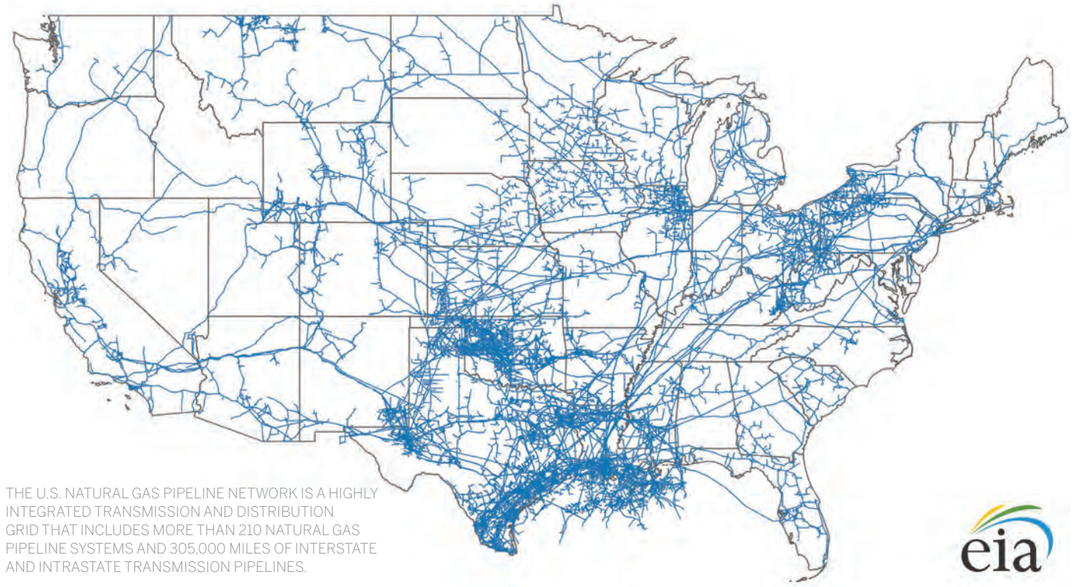
First, while incidents were increasing, so was the overall pipeline mileage. Next, Duncan recognized that federal reporting rules only require operators to report gathering-line incidents that involved a serious injury or death, or cost $50,000 or more. Typically, the largest cost was the value of lost natural gas. So, during a moment when gas prices were peaking, a relatively minor episode causing no human harm but releasing enough gas would show up as a significant incident. Further, while other researchers have interpreted the data to infer all incidents as major ruptures prone to explosions, Duncan's closer look found that 42 percent of reported incidents were leaks and two-thirds of those cases were just pinholes. Only 15 percent of the leaks were caused by punctures.

Past industry and consultant reports have also discounted that pipeline age has significant impacts on pipeline safety and risks of failure. Duncan again found that to be inaccurate, after considering injury and fatality rates as a function of when a pipeline was installed. With advances in materials, building codes and designs, such as increased pipeline wall thickness, one would expect that the failure rate of newer pipelines would decline; Duncan's analysis of the data demonstrated that risks of serious injury and death have, in fact, fallen off. Just based on the age of pipelines, newer infrastructure is less likely to fail.

"You find a systematic trend that as pipelines become older, the risk does actually increase," Duncan said, adding that the industry has been replacing older lines.

Finally, despite the increase in reported incidents, personal injuries and fatalities have actually decreased during the same

IAN DUNCAN: BEG.



THE U.S. NATURAL GAS PIPELINE NETWORK IS A HIGHLY INTEGRATED TRANSMISSION AND DISTRIBUTION GRID THAT INCLUDES MORE THAN 210 NATURAL GAS PIPELINE SYSTEMS AND 305,000 MILES OF INTERSTATE AND INTRASTATE TRANSMISSION PIPELINES.

span. Writing in the peer-reviewed *International Journal of Greenhouse Gas Control* in 2014, Duncan and a coauthor noted, "That incident rates are so poorly correlated with injury/fatality rates demonstrates the problem of using [that] data to represent risk."

By the time he completed his reviews, Duncan determined that past risk studies had overestimated gas line risks by several orders of magnitude. As far as risks from proposed CCS pipelines, those rates were also overstated. Rather than being 1-in-10,000 odds of a harmful rupture, the probability is closer to 1 in 10 million, or the chances of harm from plane debris or a lightning strike. At the same time, Duncan said it is important not to be complacent about pipeline safety, as natural gas is clearly hazardous.

"Some of those previous research studies were using statistics of pipeline accidents without really going in and looking at the details," said Bickel. "A couple of incidents in the database were even practice events for first responders, and other researchers counted those as actual accidents. So, there's a lack of precision that Ian is trying to correct."

Duncan added, "People making these statements were just looking at the incident rates, and once you understand that the rates are bogus and not robust, rigorous measurements of anything, then you have a totally different perspective."

HAZARD VS RISK

Duncan's findings, published in several papers in recent years, have gained attention from industry, state governments and other researchers. Calling his research "informative," Sue Gander, director of the National Governors Association Environment, Energy and Transportation Division, invited Duncan to present his work at the association's 2014 shale gas development forum.

"Ian is addressing the tough decisions in terms of policies surrounding carbon capture and storage," Bickel added, "and he's using an interdisciplinary approach," bringing in geotechnical, engineering, and legal and policy dimensions and working with colleagues who can interpret them. "He's not just focused on a narrow aspect, he's trying to address the whole problem."

And whether we realize it or not, that all comes back to risk, and clearly defining what risk is, and separating the fears associated with pipeline explosions from the statistical chances of pipeline failures that result in accidents.

"Many people, including scientists, don't seem to understand the concept of risk," Duncan said. "They tend to confuse it with hazard. If something's hazardous, it's risky, but that's not the scientific definition of risk."

For the record, risk, in terms of scientists, engineers or insurance companies, is defined as the probability, or likelihood, of an incident occurring multiplied by the consequence of that event. Under that lens, decision makers can choose to define "acceptable risk," or the chance of injury or loss that is considered tolerable by society. A somewhat standard level of "acceptable risk" often used is 1 in 1 million. The U.S. Environmental Protection Agency, for instance, dictates that if a carcinogenic chemical doesn't cause cancer effects in lab tests at that level, it's an acceptable risk to allow its use.

Of course, most people would say even remote odds of a cancer diagnosis — or a nearby pipeline explosion — are unacceptable.

"When you're a member of the general public, what you view as an acceptable risk tends to be governed by human emotion — that 'dread' of something horrible happening — rather than science," said Duncan.

Duncan's research may help ease the dread factor, or at least counter other work that reinforces misperceptions about the safety of both CCS and natural gas pipelines. That will be important in supporting responsible decisions on energy policies, from ongoing gas development to carbon capture and storage, and rooting them in sound science.

"This is largely driven by an interest in public policy," Duncan said, "and we can't have good public policy unless we really understand what the risks are."

UNDER-STANDING THE SHALE BOOM

Research at the Jackson School of Geosciences Bureau of Economic Geology (BEG) into U.S. shale oil gas production and reserves is widely considered to be the most comprehensive public study of its kind. Funded by the Alfred P. Sloan Foundation, a philanthropic nonprofit for supporting science, the bureau's ongoing research into the six major shale plays in the country has become an invaluable resource for government, industry and fellow academics alike who hope to learn more about a subject that is vitally important to the country and the world.

ALL PHOTOS AND FIGURES: BEG.

The interdisciplinary approach taken by The University of Texas at Austin team of geologists, economists and engineers is unique in terms of its depth and complexity. It presents the potential of U.S. shale production on several levels.

Four years into the study, the group has become increasingly adept at uncovering how shale plays may shape the future of the U.S. energy story. Now stakeholders from across the country and the world are seeking insight from the BEG's work.

We sat down with BEG Director and Principal Investigator (P.I.) Scott Tinker, and BEG Energy Economist and Co-P.I. Svetlana Ikonnikova, to find out what makes this study so important.

SCOTT TINKER

SVETLANA IKONNIKOVA

SO HOW DID THE SLOAN STUDIES COME ABOUT?

Scott Tinker (ST) – It was really the brainchild of environmental scientist Jesse H. Ausubel of The Rockefeller University. Ausubel was the first to map the transition in energy fuels from carbon-based entities such as hay, wood and coal, to complex hydrocarbons such as petroleum, to simple hydrocarbons like methane, eventually to a hydrogen economy generally. Jesse called this decarbonization.

Jesse understood before anyone else how important natural gas (methane) was going to become from an energy perspective in the future. He contacted me and Bill Fisher, professor and inaugural dean of the Jackson School, several years ago and asked if the bureau would be interested in considering a research program in methane. That was a very easy question to answer!

We started by organizing a couple of informal workshops and bringing together leaders from industry, government and academia to see what people already knew and where the gaps in knowledge about future resources were. From these workshops it became apparent pretty quickly that we didn't understand shale and our shale reserve future all that well. It was also clear the country at large could benefit a lot from a detailed analysis. After a few months of fine tuning, we put in a funding proposal to do a study focusing on the Big Five gas basins: the Barnett, Fayetteville, Haynesville, Marcellus, and Eagle Ford shale plays (a sixth — the Permian Basin — was added later).

WHY DID YOU CHOOSE THOSE BIG FIVE?

Svetlana Ikonnikova (SI) – At that time, the shale gas resource was still quite new. There was a lot of speculation over the resource and the potential of different plays. Could it be a game changer? Nobody knew for sure. All we knew was that those five plays had already been producing significant shale gas and were growing. There was not much information and research publicly available. So it took us a few months to fine-tune our funding proposal. We had to go back to basic questions like: how much exactly is underground, what are the technologies to extract it, and what could be the key variables affecting future production?

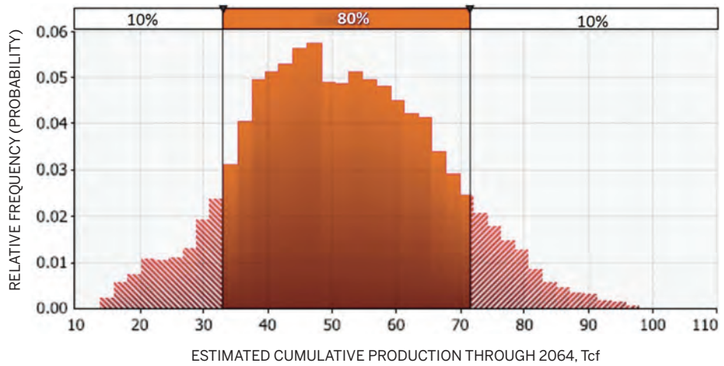


FIGURE 1. DISTRIBUTION OF THE EXPECTED PRODUCTION FROM THE HAYNESVILLE SHALE PLAY WITH RESPECT TO PRICE, TECHNOLOGY AND DEVELOPABLE AREA ASSUMPTIONS (MODIFIED FROM GULEN ET AL., 2015).

YOU HAVE DESCRIBED YOUR METHODOLOGY AS A 'BOTTOM UP' RATHER THAN A 'TOP DOWN' APPROACH. WHAT EXACTLY DOES THAT MEAN?

ST – A 'Top Down' approach would be to assign a well production value to all the wells in a fairly large area based on an overall average performance, with some assumptions about cost and price. In contrast, we took a 'Bottom Up' data-driven approach.

We mapped the geology using logs and core data. Then, we looked at every single well in each field trying to predict each well's future decline. Most of our data was gathered through IHS [formerly Information Handling Services] and Drillinginfo, who both kindly gave us access to their data. Combining geologic attributes and decline estimation for each well, we differentiated geographic areas by their productivity, creating so-called 'tier maps.' Hence, rather than simply showing core and non-core areas, we identify areas ranging from highly productive to poorly productive on a square-mile basis. Each of the fields is really quite heterogeneous. We then run an analysis that adds future wells into the undrilled 'white space' in the field using estimated well productivities from our tier maps. In other words, we take all the data from the bottom and aggregate it up. From that we run the future production scenarios for each play.

SI – With each play our methodology evolves. In the Marcellus study, we differentiate productive areas taking into account more details about well completion, such as lateral length and water used in hydraulic fracturing, that were not incorporated in the original Barnett, Fayetteville and Haynesville studies. In the current low energy price environment, cost management becomes an important part of the analysis. So we use details about completions, factoring in the cost. Prices may vary, and operators may react by changing their completion strategies. So we can't simply forecast the future. What we can do, however, is run a set of scenarios with respect to economic and technical assumptions, informing about a range of uncertainties in future production. We designed a model that feeds in the geologic, engineering and economic field data, assumptions, and descriptions to explain how future play development may unfold.

SO WHERE DID YOU FIRST APPLY THIS NEW APPROACH?

ST – It is ironic, but we started with the Barnett Play, which coincidentally had been developed mostly by George Mitchell, the father of fracking. Mitchell got his original land position in the Barnett from a fellow by the name of Jack Jackson. You can't make this up! So here we were working on something, which in the first instance would be a valuable study with a positive societal impact, but which might also provide increased royalties to the Jackson School of Geosciences through increased production. It all made sense.

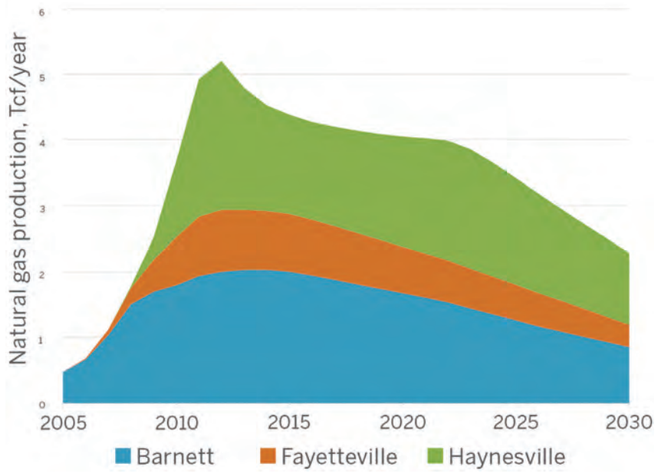


FIGURE 2. A "BASE CASE" SCENARIO ILLUSTRATING AGGREGATED EXPECTED PRODUCTION FROM THE BARNETT, FAYETTEVILLE AND HAYNESVILLE SHALE PLAYS (MODIFIED FROM IKONNIKOVA ET AL., 2015).

THE BEG SLOAN STUDY TAKES AN INTERDISCIPLINARY APPROACH. YOU HAVE ECONOMISTS, PHYSICISTS, GEOLOGISTS AND ENGINEERS ALL COLLABORATING. COMING FROM SUCH DIVERSE BACKGROUNDS, HOW DOES THAT WORK?

ST – Better now than it did five years ago, that's for sure! The group is varied, not just in terms of our academic backgrounds. We are fortunate to have a diverse team in terms of gender, nationality, culture and education as well.

But from the technical side of things there were some challenges. In our very early meetings we'd sit around the table scratching our heads. Each discipline basically has its own language. Over time we saw how collaboration could work. Now it has evolved in the right way. For each new basin we study, our understanding of the geology, engineering and economics gets deeper and more robust and we have a much clearer understanding of our roles.

ON THAT POINT, AS YOU LEARN MORE FROM EACH NEW PLAY STUDIED, DOES IT INFORM YOU ABOUT GAPS IN UNDERSTANDING FROM PREVIOUSLY STUDIED PLAYS?

SI – Each basin has added to our understanding and integration, such that now after our analysis of the Marcellus Play, we feel a strong need to take what we've learned there and reapply it to a second pass through the first three basins.

WHAT IS HAPPENING THAT REQUIRES THESE REVISIONS OF EACH PLAY SO SOON AFTER YOU COMPLETE A STUDY?

SI – This is an incredibly dynamic sector. Technology and hydraulic fracturing practice are advancing rapidly and even more so in times of low prices. So, no sooner than one study has been finished, we find some of the approaches we applied in previous plays have already become too simplistic and are not suitable given the newly emerged practices.

We have looked back at plays like the Barnett and found that technology and performance and development pace have evolved. When we go back to check our work, we see some variables have changed and others now become more prominent owing to economic and technological advances. For instance, in the older plays, like the Barnett, operators apply infill drilling; in newer, like Fayetteville, cluster drilling. Both affect the number of future locations, well economics and, ultimately, field production.

AND WHAT ABOUT THE DIFFERENCES IN EACH PLAY, GEOGRAPHICALLY, GEOLOGICALLY AND ECONOMICALLY?

SI – We have had mini crises each time we begin a new study because our usual approaches need refinement to fully describe the new play. But the more we work in different areas, the more important it becomes to take into account additional variables. Operating practices can vary. The geology itself can also be different, in terms of porosity and rock information. Once we figured out how to factor in all this new info, through statistical analysis, we were able to identify the key drivers of production in each play. Making all those connections has been a true revelation to us. Suddenly we can see in great detail how all these factors connect.

SO WHY IS THIS INFORMATION USEFUL?

SI – The study offers a set of key parameters and variables that should be considered before any decision to drill. We are currently developing an online tool to show people what we do. This is not just about estimating one value or a simple figure for each well's potential. The study is about more than just price. Never before has there been this much detail available to the burgeoning shale gas industry.

THE STUDIES HAVE ALSO GARNERED A LOT OF MAINSTREAM MEDIA ATTENTION, BOTH NATIONAL AND INTERNATIONAL. WHY DO YOU THINK THIS IS OF INTEREST TO THE GENERAL PUBLIC?

ST – This kind of detail is useful to anyone who uses energy, which by the way, is every single one of us. The public is interested because we all benefit tremendously through enhanced energy security and more affordable natural gas. We have found international, national and state governments are interested, as well as industry and other academics. The study is informing the people who need to make decisions in energy and related sectors of the economy.

We have been contacted by about a couple dozen public and private power producers in the last two years alone.

Even many environmental NGOs are interested. They need to understand what the reality of future energy fuels and resources look like before they try to inform government regulatory policies.

WHY ARE FOREIGN GOVERNMENTS AND ENERGY PRODUCERS INTERESTED?

ST – Shale gas resources can be found in basins all over the world, even in places that currently have no domestic energy production of their own. So there are opportunities for others to play in this brave new world just like us.

Those whose current economic condition is bolstered by selling inexpensive conventional natural gas, like Russia and the Middle East, aren't as keen on shale gas...yet. Today it interferes with their margins selling more affordable conventional gas into markets. However, other regions like Australia and South America would love to see their shale developed. And down the road, Russia and the Middle East will develop their source rocks as well.

SO WHAT'S NEXT FOR THE BEG SLOAN STUDIES?

SI – We will be publishing our results from the Marcellus Play in the next six months. In the meantime we are completing the Eagle Ford and starting the Bakken Play analysis.

Then, we will also be looking west: the BEG intends to study the biggest oil basin in Texas, the Permian Basin. We're getting started on that, but it's a complicated play.

We are also in conversation with the Ohio government to help them understand and perhaps consider a similar study in the Utica Play.

> "Whatever research we produce needs to be of the highest quality. That's what's important to us."
>
> *Scott Tinker, BEG director*

Between that, our team finishing the Marcellus, as well as doing a loop back into our other three basins, we're pretty busy.

ST – In addition, we are expanding the study into new areas. With additional funding from the Sloan Foundation and the Mitchell Foundation we are looking into the water resources associated with shale gas and shale oil production. Until recently data on water use in hydraulic fracturing was very sparse. Because of new regulations, operators are now reporting how much water they use. Bridget Scanlon and JP Nicot from BEG are leading the way on that one.

COULD YOU DO MORE STUDIES IF YOU HAD MORE MONEY?

ST – It's not just about resources. It's about balancing and managing the bureau's expertise. We could always expand it by hiring more people but the quality would deteriorate. Whatever research we produce needs to be of the highest quality. That's what's important to us.

– John Holden

EXPLORING EUROPA

EUROPA: NASA.

JACKSON SCHOOL SCIENTISTS PLAY A KEY ROLE IN NASA'S QUEST TO FIND LIFE-SUPPORTING ENVIRONMENTS ON JUPITER'S MOON

By Monica Kortsha and Anton Caputo

LEFT: THE SURFACE OF EUROPA AS SEEN BY NASA'S GALILEO SPACECRAFT IN THE LATE 1990S.

Jupiter's moon Europa is a frozen world covered completely in a thick layer of ice.

The icy coating makes Europa the smoothest surface in the solar system, as well as one of the brightest. Italian astronomer Galileo Galilei was able to first spot the moon using only a simple telescope in 1610. Another Galileo, the NASA spacecraft, improved the view in the late 1990s by revealing a landscape of crisscrossed ice cracks and ridges.

But the most unique feature of the moon may lie beneath its frozen exterior: a liquid ocean capable of supporting life.

NASA is planning to send a spacecraft in the 2020s to scan Europa for signs of water beneath the ice, as well as chemical ingredients needed for life. Announced in the summer of 2015, among the nine instruments onboard the craft will be an ice-penetrating radar developed by the Jackson School of Geosciences Institute for Geophysics (UTIG).

Called REASON (Radar for Europa Assessment and Sounding: Ocean to Near-surface), the radar will allow scientists, for the first time, to peer beneath Europa's smooth shield of ice.

Its development will be overseen by principal investigator Donald Blankenship of UTIG. He and his Texas team are also collaborating with the European Space Agency and Italian Space Agency on their plans for a radar instrument focused on Jupiter's moon Ganymede, the largest moon in the solar system. Since the 1990s, Blankenship has been using a similar ice-penetrating radar system carried by plane to study the substructure of the ice sheets of Antarctica and Greenland.

> "Europa is cold, but it's not totally unimaginably cold. The bottom of that ice shell has the same temperature, the same pressure and possibly the same salinity as the bottom of the ice floating at the grounding lines of Antarctica."
>
> *Donald Blankenship, Senior Research Scientist*

On Europa, the NASA radar will be searching for pockets of water within the ice shell that could serve as passageways to the ocean below for surface-based sulfuric compounds, a chemical building block for life. Under the ice, an environment where life could develop may exist.

"Europa is cold, but it's not totally unimaginably cold," said Blankenship. "The bottom of that ice shell has the same temperature, the same pressure and possibly the same salinity as the bottom of the ice floating at the grounding lines of Antarctica."

In other words, "It's Earth," Blankenship said.

A sign supporting the presence of passageways through the ice is Europa's "chaos" terrain, areas on the surface that resemble toppled icebergs jutting out from the ice. The terrain is thought to be formed by buoyant upwellings of warm ice, called "diapirs," rising from the bottom of the ice toward the surface. As a diapir rises, it melts the surface of the ice, collapsing it and enabling chemicals at the surface to mix with the water from below.

On Earth, portions of floating ice shelves that collapse form similar structures.

The chaos terrain was first observed on Europa by NASA's Galileo spacecraft nearly 20 years ago. Blankenship's radar should confirm whether the terrain marks the locations of passageways to an ocean.

Blankenship has been using radio waves emitted by radar systems to capture the environment beneath Earth's great ice sheets in Antarctica and Greenland for the past 30 years. The REASON system will work the same way. But to ensure effective penetration of Europa's ice, the radar will rely on two frequencies: a longer 9 MHz wave and shorter 60 MHz wave.

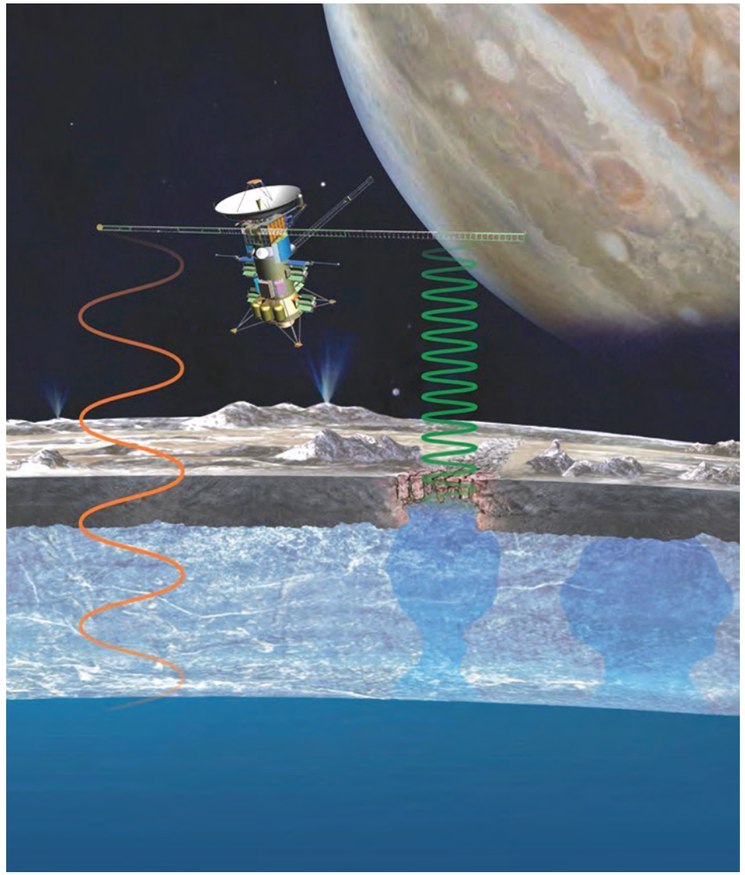
The longer wave can easily pass through Europa's ice before being reflected back to the receiver. However, radio waves emitted by the planet Jupiter interfere with the signal, so it can only be used on the side of Europa facing away from the planet. In contrast, the shorter waves can scan the entire surface because they are unaffected by Jupiter. But they are more susceptible to interference from rough patches of Europa's ice.

"By using two frequencies, the radar can present a more comprehensive and clear image of Europa's ice shell," Blankenship said.

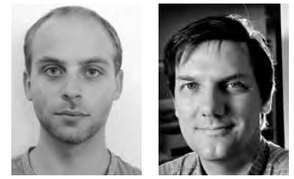
The radar for the NASA mission will be installed on the space craft in a manner similar to the way it's attached to the DC-3 aircraft used by UTIG to study Earth's ice sheets, with radio antennas separated from one another by slightly more than 50 feet. UTIG will oversee the development of the REASON system, with construction being handled by engineers at NASA's Jet Propulsion Laboratory and the University of Iowa.

Blankenship has also organized a 20-person science team to advise on the radar's construction, and its data acquisition and analysis. This team includes scientists from UTIG, NASA's Jet Propulsion Laboratory, the Johns Hopkins Applied Physics Laboratory, Washington University in St. Louis, the Smithsonian Institution, Arizona State University, the University of Iowa, the University of California Santa Cruz, NASA's Ames Research Center, the Planetary Science Institute, Georgia Tech and NASA's Goddard Space Flight Center, as well as German, French and Italian institutions.

SPACECRAFT GRAPHIC: NASA. RESARCHER HEADSHOTS: COURTESY OF EACH RESEARCHER.



LEFT: THE RADAR WILL EMIT COMPLEMENTARY LONG AND SHORT WAVELENGTHS TO IMAGE THE SUBSTRUCTURE OF EUROPA'S ICY SHELL. BOTTOM: (CLOCKWISE) CYRIL GRIMA, DONALD BLANKENSHIP, DUNCAN YOUNG AND KRISTA SODERLUND ARE ON UTIG'S REASON RADAR RESEARCH TEAM.



In 2011, UTIG scientists were among those that found evidence of water being trapped beneath the moon's icy exterior. Studying Europa is not new for UTIG. And in 2013, Blankenship, Krista Soderlund and other UTIG scientists helped develop the blueprint for a possible future NASA lander mission to Europa.

It will be a decade or more before the spacecraft reaches Europa. Because of the long-term nature of the work the team has paired senior scientists with early career ones to ensure a continuity of knowledge throughout the duration of the mission.

"It's a lifetime-scale process," said Duncan Young, a UTIG Antarctic researcher and team member. Soderlund, an expert on planetary oceanography, and Cyril Grima, a planetary radar expert, are other UTIG researchers on the science team.

The REASON system will scan for water under the ice, and also search for signs of it out in space and on Europa's surface. The Galileo probe has found evidence of Europa releasing water as giant, geyser-like plumes that reach into space and then fall back to the surface as snow. If mixing has occurred between surface compounds and water below, signs of the compounds are expected to be present in the plumes or snow.

If the radar detects water and a way for it to mix with material at the surface, it could help jumpstart new research endeavors, such as a future lander mission to Europa's surface and ocean. If life was ever found on Europa, it would indicate that it exists across the universe, said Young.

"If you go to this completely different environment, one that has all the chemistry to support life, and it actually turns out to have life, in the end you've got two examples in one solar system of life emerging," Young said. "It would imply that all those exoplanets that they're finding out there may have something on them as well."

VOLCANO FORENSICS

By Monica Kortsha

Giant Geyser

LEFT TO RIGHT: ROBERT ZINKE (B.S. 2012) AGAINST A WALL OF OBSIDIAN AT LONG VALLEY CALDERA IN CALIFORNIA; JIM GARDNER LEADS A VOLCANOLOGY FIELD CAMP AT VALLES CALDERA, NEW MEXICO; YELLOWSTONE NATIONAL PARK'S GIANT GEYSER; KENNY BEFUS DIGS FOR CHIPS OF OBSIDIAN IN LAYERS OF VOLCANIC DEBRIS IN EASTERN CALIFORNIA.

A 1898 PHOTOCHROM PRINT OF PULPIT TERRACE AT THE MAMMOTH HOT SPRINGS AT YELLOWSTONE NATIONAL PARK.

Millions of visitors flock to Yellowstone National Park each year to see its steaming geysers, iridescent pools and carved, rugged landscape. For the last five years, Jim Gardner, Kenny Befus and a team of undergraduate students from the Jackson School of Geosciences have been among them.

FIELD PHOTOS: KENNY BEFUS. GEYSER: USGS. HOT SPRINGS: LIBRARY OF CONGRESS.

Instead of rushing to Old Faithful on their visits, Gardner, a geology professor and volcanologist, and Befus, then a Ph.D. student at the Jackson School and now a geology professor at Baylor University, would lead the team deep into Yellowstone's backcountry to the remains of ancient lava flows that dominate the park's landscape.

The backcountry lava flows, as well as the tourist-traversed pools and geysers are all signs of a "super volcano" laying in wait beneath the park. Over the past 2.1 million years it has explosively erupted as least three times, spewing more ash, pumice and smoke than any eruption in recorded history, and creating a caldera that takes up one-third of the park's total area. However, the last time a "super eruption" happened Homo sapiens hadn't even evolved yet.

Much more frequently Yellowstone's magma has been exuded in the form of passive, massive lava flows. Since the last violent eruption, about 30 of these flows — which can reach up to 12 miles wide and hundreds of feet deep — have oozed across the land, with the most recent occurring about 79,000 years ago.

It's the traces left by these flows that have brought Gardner and Befus to Yellowstone over the years. By examining the lava, they're working to understand what volcanic conditions caused Yellowstone's magma to steadily effuse, rather than explode, and to add insight into the eruption type that dominates Yellowstone's past and could happen again in the future.

"Our main target was understanding how these things erupt, but don't go boom," Befus said.

AN INTEREST ERUPTS

Gardner grew up near Dallas, safely outside of the range of any volcanoes — save for that aforementioned super eruption. But he took an undergraduate geology class at Southern Methodist University, and he's been studying volcanoes ever since.

"I just basically became homed in on the actual physical nature of the eruption and understanding the processes that occur," Gardner said.

He's studied the ash and pumice that entombed the city of Pompeii, and helped reveal how the pyroclastic flow created by the 1980 eruption of Mount St. Helens came to a stop as it swept down from the peak. Prior to joining the Jackson School in 2003, Gardner worked at The University of Alaska Fairbanks and was on staff at the Alaska Volcano Observatory where he evaluated hazards and the eruptive history of volcanoes across the state. And now, as a volcanology professor, he leads undergraduate students each year to New Mexico to study the Valles Caldera, the first volcano Gardner himself ever visited.

The sites he has studied, while varied, have one thing in common: the eruptions happened well into the past, from decades to hundreds of millions of years ago. Like a forensic detective, it's his job to go to the eruption scene, examine its aftermath and reconstruct the environment that made the volcano blow in the first place.

"BY PROVIDING INFORMATION... ABOUT ERUPTION PROCESSES, MAYBE OTHERS CAN USE IT TO FORECAST ERUPTIONS AND MITIGATE HAZARDS."

- Jim Gardner

"By providing information and understanding about eruption processes, maybe others can use it to forecast eruptions and mitigate hazards," Gardner said.

The key clue to glean from the scene is lava — long solidified into various kinds of rocks by the time Gardner arrives.

GO WITH THE FLOW

The Yellowstone volcano produces rhyolite lava, a silica rich form that solidifies into different types of igneous rock depending on its eruption and cooling conditions. During explosive eruptions, magma is shot into the air, where it instantly solidifies and falls as ash and porous pumice. But during passive eruptions, it quickly cools into other varieties of rhyolite rock that make up the lava flows today.

Obsidian is perhaps the most distinctive rock produced by rhyolite lavas. Pure black, smooth and glassy, its appearance is the result of having cooled so quickly that the silica it's made of didn't have time to arrange into a crystal lattice structure.

Native American tribes in the Yellowstone region valued obsidian outcroppings as a raw material for spear tips, arrowheads and cutting tools — the smoothness made for easy shaping and sharp edges.

Gardner and Befus value its smoothness, too, but for different reasons. It provides an unobstructed view of minerals and gasses that were trapped in the lava during the eruption. These

TOP: MOUNT ST. HELENS EXPLOSIVELY ERUPTING IN 1980. GARDNER HAS STUDIED THIS VIOLENT ERUPTION AS WELL AS MORE ANCIENT ST. HELENS ERUPTIONS. PHOTO: USGS.

microscopic traces are the best clues to what the eruption environment was like, Gardner said.

"These are the quenched products of the magma chamber as it was erupting," Gardner said. "We look at these products to try and reconstruct what was occurring in the magma chamber before the eruption, as well as the dynamics of the system during the actual eruption."

So while other visitors would leave Yellowstone with keychains and mugs, Gardner, Befus and the student researchers would return to the Jackson School with fist-sized samples of shining, black obsidian hammered off nearly a dozen lava flows from across the park.

UNDER THE MICROSCOPE

Volcanic rocks are like tape recorders of the chaotic environment inside a volcano's magma chamber, Gardner said. The minerals and gasses held in them provide a record of variables, such as pressure, temperature and gas concentration, which influence the eruption process.

Gardner references the old-technology of a tape recorder for a reason; a volcanic rock captures its environment by constantly recording traces of new conditions over those left by older ones, like a cassette tape used over and over again. The result is a record that is a collage-like conglomeration of the volcanic environment.

"When we're looking at the products at the surface, we've got the entire record of it, but it's written over each other," Gardner said.

Reading the record is a matter of close analysis. Trace element concentrations, such as iron and magnesium, reveal pressure ranges; microscopic bubbles trap samples of gas from throughout the eruption that can be identified using spectroscopy; and microlite crystals, which rotate and align together in the flowing magma, can give clues on how quickly magma was flowing through the crust toward the surface.

Clues like these gleaned from a close analysis of volcanic rock allow Gardner to reconstruct a timeline of events for a volcanic eruption. And an experimental petrology laboratory lets him to test it by turning volcanic rocks back into magma.

In his simulated magma chamber, Gardner can adjust variables, such as heat, pressure, and gasses present, to model different eruption phases and conditions. However, unlike a real volcano, Gardner can stop the eruption at any point by quenching the magma back into solid rock.

"My tape recorder is not fixed. It's not overwriting itself," Gardner said.

By comparing the final quenched magma to an original sample, the researchers can see if their simulated environment created outcomes comparable to an actual eruption.

"It's a simple matching game really," Befus said. "But it's one of the major techniques we use."

YELLOWSTONE FUTURE AND PAST

The obsidian samples from Yellowstone all hold clues about the particulars of the eruptions that forged them.

Through analysis and the petrology lab, Befus reconstructed the eruption that formed Douglas Knob, a lava dome made by the slow effusion of magma, for a portion of his Ph.D. dissertation.

According to Befus, it went something like this:

On a day roughly 120,000 years ago, rhyolitic magma stored about a mile under the ground at 1,400 degrees Fahrenheit began to rise at a rate of about half a millimeter to 1.3 millimeters per second. Twenty to 70 days later the magma reached the surface and began pouring out of a 1,600-foot-long fissure in the earth. This lasted for anywhere from 17 to 210 days, building a mound of lava in the process.

The shallow depth and slow rise of the magma in the eruption 120,000 years ago bodes well for responding to any future passive eruptions, Befus said. The movement of the magma would likely break rock as it made its way to the surface, creating little earthquakes that would signal Yellowstone's slow stirring. It's also possible that the amount of magma in a pre-eruptive magma chamber could be seismically imaged using techniques similar to those used by the oil and gas industry to search for energy reservoirs.

> "THE MOST RECENT ERUPTIONS HAVE NOT BEEN THE FAMOUS SUPER ERUPTIONS..."
>
> *- Kenny Befus*

"All of these signals mean that people are going to have time to collect the data that indicate that effusive process is going on," Befus said. "There should be warning."

It is comforting knowing that Yellowstone's future eruptions will likely be slow, controlled and well-announced, but a super eruption is still within the realm of possibility. And as of now, it's still an open question on what exactly triggers magma to degas slowly and erupt passively or to let its gas out all at once in a violent eruption.

"We know that one has to go fast and the other has to go slow, but the reason why one is going so fast is something we don't know," Befus said. "That's where I plan to spend my next few years. This idea of an eruption trigger, I'm excited about that."

But even as knowledge about volcanoes and eruptions evolves, Gardner said it's a field of science where chance will be in control.

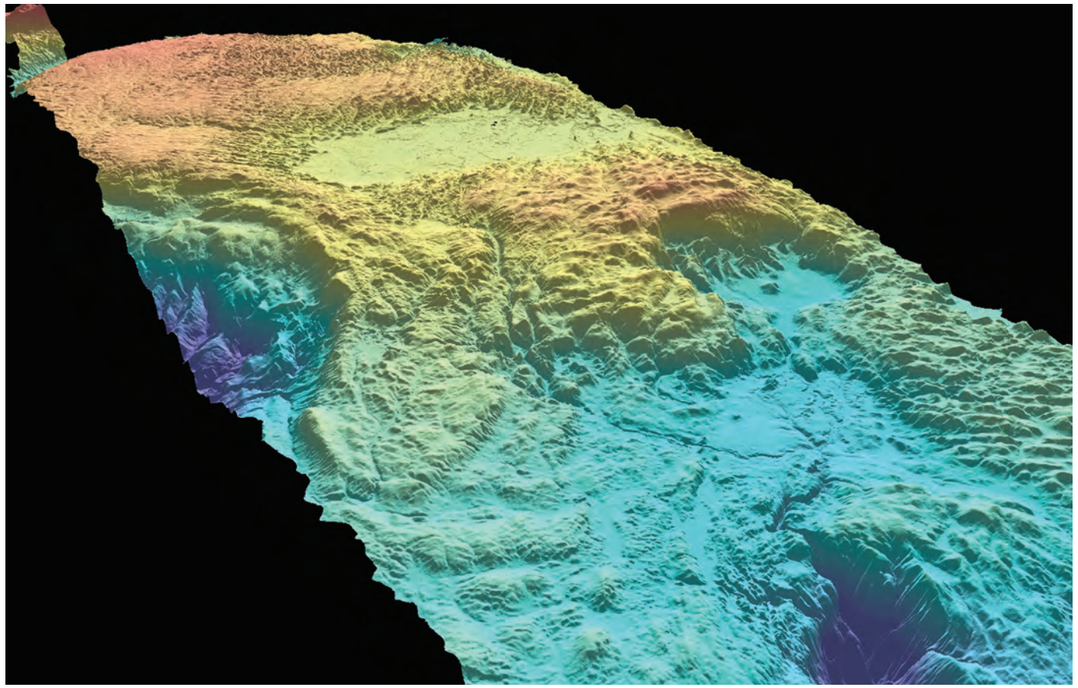
"We don't predict volcanoes. They're too chaotic in nature," he said.

Instead, the reconstructions offer a peek into a future that could be because it has been. For Yellowstone they indicate a future where eruptions would overwhelmingly be lava flows that move so slow they would likely be the latest geothermal attraction at the park, not a danger. Of course, you can't rule out a violent eruption.

But Befus, for one, isn't losing sleep about that.

"The most recent eruptions have not been the famous super eruptions that get press on the news and on the Discovery Channel, but instead it's been these massive lavas," he said. "So people who are cataclysmic types, calm down a little bit. It's most likely not going to do that."

CLOCKWISE: TIM PRATHER, THEN AN UNDERGRADUATE, CHIPS STONE SAMPLES FROM A LAVA FLOW IN YELLOWSTONE. HE IS NOW A GRADUATE STUDENT AT THE JACKSON SCHOOL; JOEY CLEVELAND (B.S. 2014) CONDUCTING FIELD WORK IN YELLOWSTONE AS AN UNDERGRADUATE FIELD ASSISTANT; A DIGITAL ELEVATION MODEL OF A YELLOWSTONE LAVA FLOW. THE MODEL COVERS ABOUT 35 SQUARE MILES AND WAS MADE USING AN AERIAL LASER MAPPING TECHNIQUE CALLED LIDAR.



FIELD PHOTOS AND LIDAR MAP: KENNY BEFUS.

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ALUMNI NOTES

1940s

Howard Lowe (B.S. '48) writes, "Spending my retirement years researching climate change. Have written two books - *The Sky Will NOT Fall - Unmasking the Green Revolution* (an e-book - Amazon, Barnes & Noble) and the recent one not yet submitted for publication - *Beyond Our Control - Debunking Manmade Global Warming*. Make a lot of use of geology to prove my points. Recently I was invited to become a team member of The Right Climate Stuff Research Team, a group of about 50 retired NASA engineers and scientists. The Team is involved in very sophisticated research on climate change. Much of their high-powered physics and math is over my head, so I think I am getting a lot more than I am giving. However the education is great. I hope to arrange for a Forum at the Jackson School for some of the Team members to address students. We have our 15 grandkids and 15 great grandkids + one more due in October. Wife & I stay busy just keeping track of all of them. Plan to make the 75th reunion of the Texas NROTC in Austin in November. I was in the first class."

Jule Jacobson Moon (B.A. '40, M.A. '41) was an instructor in Invertebrate Paleontology from 1947-49. She also earned a Masters in Social Work from UT. She worked as a Psychiatric Social Worker with the State of Texas Mental Health and Mental Retardation Department until retirement in 1992. She is still writing short stories and poems and published "Sherds a Memoire" in 2011. In addition, she contributed to *Fairhope Anthology: A Collected Works by the Fairhope Writers' Group* in 2011 and *Fairhope Anthology: Second in a Series* in 2013.

1950s


WALT (B.S. '54, M.A. '55) & VADA BOYLE

Walter V. Boyle (B.S. '54, MA '55) shares, "in fall 2014, Vada and I continued our world travels with a three-week Tauck land tour of Central Europe to Poland, Hungary, Austria and the Czech Republic. This summer, we completed another three-week Crystal Cruise to Iceland, Russia, Norway and Great Britain. One of the highlights of this cruise was to actually see the Mid-Atlantic ridge exposed at the surface in Iceland and observe rocks from the North American Plate and the Eurasian Plate. Walt stays active attending his investment club meetings, men's book club sessions, church group studies and working in the yard and garden. Vada continues her second year as president of the North Harris County American Association of University Women, and serving as a member of the Board of Directors of the Houston Symphony League. We continue to enjoy attending the Jackson School of Geosciences functions and dinners and seeing old classmates and friends, and attending the University of Texas Leadership Society luncheons. Another highlight of 2015 for Vada and me was being inducted into the Flawn Circle of Excellence and the Katie Society at the Jackson School of Geosciences dinner in March 2015. And finally, we wish continued success to Dean Sharon Mosher and her staff for another great year leading the Jackson School of Geosciences."

Philip Braithwaite (M.A. '58) shares, "Barbara and I are still enjoying retirement in Dallas but have cut back on our travelling these last couple of years. I still do part time consulting for a geophysical company contributing my depositional facies experience."

Leon G. Byerley (B.S. '52) says, "I'm enjoying my retirement while my son runs the family partnership."

Dean L. Callender (B.S. '56) continues to work in the financial industry but says that his heart never left the oil patch. He can be reached at deancallender@comcast.net.

Jack Cleveland Cartwright (B.S. '51, M.A. '55) writes, "Year 2015 marks the 60th year anniversary of several events that occurred in the lives of Jack and Barbara (Wells) Cartwright. Barbara and I met when I returned to UT in the fall of 1953 to start work on my Masters degree. She was this cute girl working in the Geology Library that fall. The spring of 1954 was a busy time that included class work, teaching labs and starting work on my thesis and romancing the girl I fell in love with. After an interruption to our romance, we were engaged soon after I completed my Graduate work in January of 1955. We were married that June and have had a blessed life for the past sixty years. I am so thankful for the great education that the University provided me and also for the love of my life that was there at the right time. Barbara and I were given a family of four children, nine grandchildren and as of now eleven great-grandchildren. We both have very fond memories of our time at UT."


CONNIE DYER (B.A. '58) WITH HUSBAND BYRON DYER

Connie Mayes Dyer (B.A. '58) shares, "Hello to all! We are still in Houston and hanging in there. Our grandchildren are no longer children, except for the 18 month old son of our youngest son John (35), who just finished an MBA at U of H. I must add that our latest proud

grandparent moment came this May, when our granddaughter Sheridan Gabrisch graduated from TCU Summa Cum Laude (4.0!). A couple of weeks later she was notified that she is the recipient of a Fulbright Grant and will be living and teaching in Malaysia for 11 months in 2016. They are all making me proud, but this was pretty special! Byron is doing reasonably well, considering the limitations placed on him by Alzheimer's. Our family is thankful that in his case, progression of the disease has been slow and steady, and he maintains a calm demeanor and a biting sense of humor! I was honored to be awarded Life Member status this June with the Houston Methodist Hospital System Board, so I will not be active as a board member, but will remain on a few committees, as well as the Advisory Council for the Houston Methodist Debakey Heart and Vascular Center. I have enjoyed my service on the Jackson School Advisory Council these past few years, and I'm so proud of our College and all we are doing for the entire field of Geological Sciences. Thanks for the privilege of being a small part of that initiative. Keep in touch, we love to hear from old friends. I'm at connied36@yahoo.com."

Jack Q. Frizzell (B.S. '50) writes, "After attaining the age of 92 years last June 24th, I am pleased to report that I am in good health and enjoying my practice of geological exploration for new oil and gas findings on a daily basis. Still involved with my son, Allan Douglas, in managing our drilling and production company, Enrich Oil Company, and having better than average success in developing new reserves, thanks largely to Allan's expertise in 3-D seismic interpretation of the ever elusive Strawn-age reef anomalies residing in our main target area. My wife Pat and I and our family are mourning the loss of our beloved younger son Lane Patrick earlier this year after a five year battle with Alzheimers disease. We are blessed with our growing family of seven grandchildren and four great-grandchildren. Best wishes to my still standing geology buddies and 1950's grads."


ERNIE LUNDELIUS (B.S.'50)

Ernest Lundelius (B.S. '50) writes, "I now spend most of my time at the Vertebrate Paleontology Laboratory at the Pickle Research Campus and continue to work on changes in the faunas of both North America, primarily Texas, and Australia over the last one or two million years. We are still finding new additions to the Pleistocene fauna of Texas. I also continue to participate in GeoFORCE. I find it very rewarding to see the interest of very intelligent young people in geology and science in general." Ernie can be reached at erniel@utexas.edu.


MUNIB MASRI (B.A. '55)

Munib Masri (B.A. '55) lives in Nablus, West Bank, Palestine and is active with philanthropic efforts in the education, healthcare, culture, and civil society sectors. He was recently recognized by the Jackson School of Geosciences with induction into the Hall of Distinction. He continues to work toward peace and a two state solution in the Holy Land.

Wayne D. Miller (M.A. '57) shares, "Still continuing to consult in the oil business after going independent 35 years ago. With the industry slow down, I have done the same but am keeping as busy as I want to and enjoy keeping active. Family doing fine and am looking forward to the upcoming Newsletter."

Jerry Pitts (B.S. '54) writes, "The Wolfcamp-Spraberry Horizontal plays are extremely exciting. Fun to be a part of it. Amazing we have been drilling through it for years. Have set pipe and attempted completions with very little success prior to advanced technology."

Jimmie Russell (B.A. '52, M.A. '54) writes, "Immediately upon graduating from UT in 1954, I commenced with Stanolind in Midland as a Junior Geologist. After six months, I was drafted and spent two years in the Army — mostly in the infantry, stateside and Korea. Basic Training, and then Advanced Infantry were at Fort Carson, Colorado Springs, CO in the winter. From there, I was sent to Detroit to be a Radar Operator in Anti-Aircraft Artillery. Thence I was sent back to Infantry on a troop ship in Korea. When Honorably Discharged, I returned to the petroleum industry, both domestic and foreign — Venezuela, Argentina, Trinidad, and the Spanish Sahara. Next came a lengthy period with the State of Texas water agencies. There I made directives regarding groundwater protection. Also, I conducted studies of aquifers and testified in hearings. Lastly, I was working in public education in Manor and Round Rock, Texas. I taught bilingual English-Spanish and assisted with special needs students and emotionally disturbed middle and high school students. I began to suffer lower back problems affecting my legs. That and balance difficulties cause mobility to be a major problem. Not being able to meet some of the physical requirements of my position, I retired in May 2013 from the Round Rock (Texas) ISD. For the same reasons, we sold our 2-story home and bought a 1-story townhouse only five miles away, still in Austin. Rita and I celebrated our fiftieth wedding anniversary on a one-week cruise in the Caribbean. The accommodations were much more enjoyable than my only other "cruises" aboard the General Mitchel, a troop ship out of Seattle to Korea and back a year later, both times at Christmas. Since retiring, I have volunteered a few times at local schools. Hopefully more stints of volunteering and more cruises await me.


FLOYD SABINS (B.S.'52)

Floyd Sabins (B.S. '52) shares, "Demand for remote sensing exploration projects for oil and minerals is at a stand-still. Therefore I have expanded my fly-fishing ventures with trips to: Owen's River, California for trout; Espiritu Santos Bay, Mexico for bonefish and tarpon; Twin Bridges, Montana for trout; Kvichak River, Alaska for salmon and big rainbows. Tough work but somebody has to do it. Tight Lines!!"

Jack Steele Sanders (B.S. '57) continues to appreciate field geology, albeit now from roads and ships. He writes, "The messages from ice core research related to global warming need worldwide acceptance without political overprints. I trust that geosciences at UT continues to flourish. I am so fortunate to have graduated with a B.S. and to have been able to pursue field geology. Maybe my small contribution can provide a beer and hamburger for a student."

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

Daniel L. Smith (B.S. '58) is continuing as an explorationist drilling wells, although he says that the oil price plunge is hurting.

Theodore Stanzel (B.S. '56) shares, "In retirement, thinking about a destination we would like to see and planning for that dream trip is important. To that end Wanda and I spent two weeks on the Alaska venture with Texas Exes in July. First on the Alaska Railroad through Denali National Park and a week on the Admiralty Dream cruising the inland waterways of Southeast Alaska."

Bernie Ward (B.A. '55) still goes to his office nearly every day. Business for him is not as swift as it once was. Family is all well. Oldest grandson graduated from UT in 2014 with a B.S. in Biology and is attending medical school at Texas Tech.

Bill D. Watson (B.S. '58) shares, "Jean and I are still enjoying our retirements and our grand children and great grandchildren. We welcomed our third great this last November, Paisley Rae. She is a bundle of joy! I still play my trumpet and play golf as often as I can. The Longhorn Network is great! We never lose! I never thought I would celebrate 30 years of retirement. God is good." He can be reached at bdjewatson1930@gmail.com.

Leslie Pittman White (B.S. '56) writes, "Dianne and I are continuing along in that "no news is good news" phase of life. We are enjoying a little travel and watching the grandchildren grow up. My affection for JSG takes two paths: one, the pride and pleasure of watching it grow and excel; and two, the treasured memories of a chapter of my life spent there."

1960s

Charles A. Caughey (B.S. '69, M.A. '73) writes, " Took advantage of a layoff at Noble Energy to retire (again). Busier than ever, enjoying the freedom, and staying active as co-chair of the AAPG Imperial Barrel Award and working with a couple of other committees."

Jon Philip Jones (B.S. '64) writes, "Greetings from OK. This year has passed quickly. It seems that happens as I age. Since retirement in June 2012, my wife Marilyn and I have had opportunity to travel. With grandkids in NY state, we have greatly enjoyed visiting the many wonders of upstate NY and its scenery. After 8 years working from Bassett Hospital in Cooperstown, Kevin, Rebecca, Jake (11), Allie (9), Katie (7), and Emily (5) have now made the trek from NY to OK to warmer climates. Kevin will be working as a PA from Guthrie, OK. Currently, all (including 1 dog and 2 cats) are living with us in Edmond, OK. We are having great fun with the kids and grandkids getting settled in different schools and making new friends. If you know of anyone seeking a large home on 13 acres near Richfield Springs, please have them checkout Zillow. The property lies close by the Adirondack park and the Catskills. The scenery is world class and filled with geology. If you have opportunity to visit the area, please take advantage of such an opportunity. Visits are recommended for the summer months as winters provide snow and more snow. Beautiful but cold. I've had opportunity also to visit my brother and much fishing last summer. He lives in Gallatin Gateway, close to Bozeman. Nearby is the wonderful Gallatin River, Yellowstone NP and Jackson Hole, not to mention nearby Idaho with excellent fishing everywhere. With kids attending Baylor University, we have had several trips there to admire the new stadium and updated campus. The stadium can be seen upclose and personal from I-35. Congratulation to Dr. Robert Folk on his 90th birthday. Best regards to you all, and if you get as far north as OKC or Edmond, OK, call me at (405) 607-2866 or send me an e-mail at philj1@cox.net."

Joe N. Meadows (B.A. '62) writes, "My bride of forty-nine years has Alzheimer's, but I am still blessed. Love the 'Horns and the LHN helps keep me some what abreast of what's going on."

Tom Patty (M.A. '68) writes, "Since retiring from full-time with Wiss Janney Elstner Associates Inc, after 30 plus years, I still go by the Tom S. Patty Petrographic Laboratory and assist the other petrographer when needed for concrete and aggregate petrography as an Affiliated Consultant. In addition to providing 24/7 care-giving to my wife JoAnn, going on 56 years of marriage, I am able to do some part-time consulting for aggregate producers in the Central Texas area. Our three grown children live in the Austin area and we enjoy being with our eight grandkids every chance we get. My collection of UT Austin yearbooks "The Cactus" has

now grown to 73 volumes dating from 1920, and my collection of UT Geology Newsletters dating from the early 1960s continue to increase each year." Tom can be reached at tspgeorock@gmail.com or tpatty@wje.com.

Peter D. Rowley (Ph.D. '68) writes, "I continue as a consulting geologist, mostly doing geologic mapping (www.geologicmappinginc.com). With colleagues, I found the world's largest gravity slide, in SW Utah. See by googling "Markagunt gravity slides." My wife Dawna and grown kids are fine."

Rubin Amos Schultz, Jr. (B.S. '61) shares, "Not a lot new. Still enjoying retirement. Spent some time in Utah this spring visiting relatives and enjoying mountain air in Park City. Went to grandson's wedding in March. Planning a trip to Branson, MO this fall to enjoy some fall weather and colors."

F. Carlton Sheffield (B.S. '63) shares, "Still traveling in our RV throughout this great country of ours. Enjoying your updates on our alumni. Hope to see some of you at the annual get together next year. My golf game here in the Woodlands, TX could stand some improvement. Any advice would be helpful."

Herbert Samuel Travis (B.S. '60) shares, "Currently I'm retired, however, I still work on my Mobile Home and RV Park located in Gun Barrel City, Texas. My web page is lutherlanervpark.com."

Mark John Valencia (M.A. '68) writes, "ALOHA!! I am semi-retired living in Hawaii. I still travel to Asia for conferences on maritime security issues 4-5 times a year. I also write frequent opinion pieces on Asian maritime affairs in Asian newspapers, particularly regarding the South China and East China seas. Otherwise we — my Malaysian wife Shabariah of nearly 40 years and I — take care of our grandchildren several times a week — and just enjoy life — separately — and together. So far so good!!"

Richard B. Waitt (B.S. '66, M.A. '70) shares, "After nearly 35 years of intermittent work, my book on Mount St. Helens' 1980 told through survivors and other witnesses was published January 2015. Though crafted by a scientist, it's intended as a literary work of first-person stories. The imposed maintitle is schlock, inside much better. "In the Path of Destruction — Eyewitness Chronicles of Mount St. Helens" published by Washington State University Press. In about 1966 at UT, I took Fred Bullard's course Volcanology. Among its still-memorable elements are the first-person stories of St. Pierre survivors of 1902, stories Bullard had reproduced in his book "Volcanoes" (UT Press, 1962). I'm still employed by the U.S. Geological Survey, Cascades Volcano Observatory in Vancouver, Wash. Still researching (mainly in the field, mainly in Pacific Northwest), still publishing papers and occasional maps. An annual pig roast at our place commemorates such a deed done in August 1980, the oven then having been the still-hot ashflows on Mount St. Helens' north flank. Wife Cynthia doing very well, as is daughter Kristin in Seattle and her three daughters — our grandkids."

William Feathergail Wilson (B.S. '60, M.A. '62) writes, "Oil and gas consulting slowing considerably due to low oil prices. Still working steadily in groundwater. UT Geology graduate sons (Clayton & Doug) working in London and Denver."

1970s

Royce Carr (B.S. '76) writes, "I am still actively working West Texas in the Wolfcamp plays and the Eagle Ford in southeast Texas. Deborah and I have recently moved to the lake and I work from there a few days a week and from the office a few days a week."

Patricia Wood Dickerson (B.A. '70, Ph.D. '95) shares, "GSA in Vancouver, amidst brilliant birch, beech and maple trees, was a fine occasion for rousing conversations with many of you. It was a relief that no one threw overripe produce during my talk. A geoarchaeology field trip helped to fuel a fascinating new study in Big Bend that's grounded in my ongoing tectonics research. Winter projects included petrographic and lab work on our samples from Mariscal Canyon and Mountain (Big Bend), though no sleeping-bag-on-bedrock time. Even wrestling grant deadlines has been pleasurable, in collaboration with colleagues/friends in JSG, at TCU and at Texas Tech — reassembling then sundering the venerable Rodinia supercontinent. This spring stood in high contrast to last — exploring the old stone bones of the Scottish Highlands took the place of April field work in Big Bend. Close colleagues in JSG led an excursion for geology honors undergraduate students and invited me to participate. Great group, magnificent geology, and beautiful country! Rugged cliffs, lovely lochs and streams down the valleys, here and there a rocky headland extending into a loch, with castle ruins sitting on the point... The Isle of Skye was windswept and rugged, though its contours had been somewhat softened by Pleistocene ice, then covered by thick moss. Focusing forward now — Smithsonian has asked me to act as study leader for tours to Patagonia, to Chile-Argentina-Brazil, and back to Iceland, so I'm revamping instructional materials. We launch for Patagonia from Buenos Aires — my plan is to arrive there before the group does, to study tango and to dance. Meanwhile, here in River City I continue to enjoy GeoRef work for AGI (constantly learning!), as well as volunteering for Austin Classical Guitar, and dancing both tango and blues."

Marvin "Jack" Droddy (Ph.D. '78) writes, "After 28 years at Baker Hughes, I took the early retirement offer. It looks like a few "down" years are in store for our industry, so I thought it a good time to exit. I brought my petrographic microscope home; my daughter (16) was amazed to see what thin sections of granite, basalt, etc. look like in polarized light. Maybe she will change interest to petrography from fashion design!"

Al W. Erxleben (M.A. '74) and wife Charlotte are retired and enjoying living on their ranch west of Crockett, Texas. They also recently purchased a ranch near Comanche, Texas, and are working and having fun there as well. Al says, "Our time is divided between ranching, children and grandchildren, traveling, hunting, and just simply loafing! Every day is Saturday!! We highly recommend retirement—as early as possible!"

Murray Felsher (Ph.D. '71) writes, "Since leaving NASA HQ as Chief, Geological and Energy Applications, in 1980, I've been consulting for the government and the private sector primarily in fields related to satellite remote sensing of the Earth. At the same time I had maintained an office in the National Press Building in D.C. from which I published three different newsletters. The most "popular" was the "Washington Remote Sensing Letter" (WRSL), which was published from 1981 through 2013 - Volume 1, Number 1 appeared in July, 1981 and Volume 32, Number 42 was published in December, 2013. WRSL — 4 pages per issue — was mailed out four times per month, except in January and August when the federal government goes into slumber here in DC and we published only 1 issue per month; hence the odd number (42) of issues per year. We finally closed the door on WRSL in 2013. When I say "we" that's the "editor" in me speaking — actually I've been "Working Alone" all these years — and hence the title of a book I wrote that was published by Berkley Press (N.Y.) in 1994 — Working Alone: Words of Wisdom for the Self-Employed. It's now out-of-print, but still available from places like Amazon.com. (Note: I get no royalties from these secondary and tertiary sales, of course, but it's good to also note that I still get letters from current readers of the book.) I still am very involved in the consulting business, and have active contracts now mainly with the government and larger aerospace/systems integration companies. It's now 54 years since we arrived in Austin in September, 1961 as newlyweds; two of our children are native Austinites. As the years go by I am constantly reminded of those UTexas years, the friendships we made there, and the thorough and superb education I received at the hands of a willing and worthy faculty. It's a pleasure to see the continuing growth, literally and figuratively, of the department and the Jackson School. My best wishes continue to you all."

Grant Fergeson (B.S. '78) currently resides in Houston and can be reached at grantfergeson@mertzenergy.com.

Edwin "Win" Goter (M.A. '74) shares, "I'm still working full time. Now with PanAtlantic Exploration Co. exploring for oil and gas and drilling wells in onshore Colombia and off shore Romania. Left Shell after 32 years in 2010 and flunked retirement. We have two daughters, both married and living in San Antonio. First grandchild will soon be here. We are all in good health and doing fine. I still feel fortunate to have attended a great geology department at a really good university. Over 40 years ago, whew!"


ROBBIE GRIES (M.A. '70)

Robbie Gries (M.A. '70) writes, "My fun project, working with AAPG Prowess Committee, is research on the History of Women in Petroleum Geology (1918-1988). Amazing stories! Lots of UT women to be proud of! I hope a book can be derived of this work."

John C. Griffiths (B.S. '75) says, "Hard to believe it has been 40 years since I was sitting at Posse East having a beer after Dr. Muehlberger's structural final. If memory serves, I think I was sharing a pitcher with Charley Greene. I left UT and went to work for TXO in Houston. Moved to Lakeway, west of Austin, in 2008. Still having fun looking for places to drill wells in which my company can participate. It's a little different than it used to be. Amazing changes in technology. It has gone from taking a week or more to get hard copy logs, production data and scout tickets to build hand drawn and colored maps to downloading digital data into Petra and Kingdom and generating maps and cross sections in minutes. I have enjoyed doing consulting work with an international engineering group that allowed me the opportunity to see some of the geology of northern Mexico, the Gulf of Thailand and Abu Dhabi, among other places. Let's just say Abu Dhabi is a little different than working the East Texas Basin. Wishing the best of health to my classmates from 1974-1975." John can be reached at jgriff@calvinresources.com.

Paul F. Hoffman (B.S. '75) writes, "Hard to believe it's been 40 years since my days at UT! Now 7 years at the helm of Allen-Hoffman Exploration. Drilling serious wildcats lately — some dry, some great, all interesting, and many with other UT alums! Never imagined 40 years back what a remarkable journey it would be — or that we'd have 9 grandchildren, none yet older than 5! Married 40 years, too, and writing this with Tina beside me and a view of the coast of British Columbia to starboard. Lots to be thankful for!"


DAVID KIRCHNER (B.S. '74)

David Lee Kirchner (B.S. '74) writes, "Hello fellow Longhorns! I am living in Phoenix, Arizona, where I am working as a consultant for BASIN & RANGE HYDROGEOLOGISTS, INC. (since 1987).

My wife, Kathy, is a retired geologist and our two sons have graduated from college. Our oldest, Kory, graduated with his masters degree in Geology from the University of Texas at Austin. Kody graduated from Northern Arizona University with a bachelor's degree in mechanical engineering. I try my best to make it to Austin twice a year to participate in Advisory Council meetings of the Geology Foundation. Please give me us a call whenever you are visiting Arizona. (602) 840-3333 or kirchner@basin-and-range.com."

Dave Lehman (Ph.D. '74) writes, "Patsy and I spent a good part of the past year in Colorado. Our daughter Lisa lives in Denver full time now. I'm still active in the business — sold my second start-up company last year and am getting ready to reload for a third go at it. With oil below $40 at the moment it might be a good time to buy! Hook 'em Horns!"

Ray Leonard (M.A. '77) writes, "I continue to face the challenges of deep-water exploration in a low oil price environment as the President and CEO of Hyperdynamics. We hope to finally test the Fatala Prospect offshore Guinea in early 2016. My family is well, and I welcomed my 5th grandchild this past year."

Mark W. Longman (Ph.D. '76) reports, "2014 was a particularly good year as I finally completed editing and preparing AAPG Memoir #107 on the giant Pinedale gas field in the Green River Basin of Wyoming. The book's 15 chapters total over 500 pages in length and contain abundant color figures that nicely document the geology and reservoir models developed for this important tight-gas sandstone reservoir. The field will eventually produce over 30 TCF of gas, which places it among the top 5 gas fields in the US, and it provides a useful model for how to optimize drilling and production in an environmentally sensitive area." Independently of the memoir, Mark was honored by AAPG with the Association's Distinguished Service Award for his many contributions to the organization since 1971, most notably his 30+ years of work as an Associate Editor for the AAPG Bulletin. He also entered his 10th year of working with QEP Resources in Denver on all aspects of hydrocarbon reservoirs in the Rocky Mountain region.


BOB MERRILL (PH.D. '74)

Bob Merrill (Ph.D. '74) shares, "Recently returned from Japan, with a special side trip to Sendai and examination of the impact of the 2011 tsunami zone. Being on the ground was impressive, especially after reviewing many of the videos of the tsunami and debris as it swept inland. Faculty help from Tohoku Univ. was much appreciated. September will find Diane and I in Newfoundland and Nova Scotia, hoping to examine some of the connections to Scotland that I saw with Ian Dalziel in 2014. I continue doing geoarchaeology work and challenging California politicians on water, drought, and climate change issues. Also find time to spend with grandson, Tyce and his dad, Than Merrill." Bob can be reached at geolbob@gmail.com.


CLAIR OSSIAN (PH.D. '74)

Clair Ossian (Ph.D. '74) shares, "As I approach the age of 75, retirement still suits me well. Life is very comfortable, and I use my days with my gardens and my koi ponds. While I will never see the results, I tend a bonsai tree garden, as well. I'll need to live to at least 150 to finish their growth stage to grand trees. Who knows, maybe I will? I have also developed an unusual style of pottery, which sells well! We have three grandchildren now, both of my children married well and are settled. My daughter is a TV Producer, and my son is an upper level manager in an Austin software company. Eleanor, my wife, still suffers from the accident she received over a year ago. A simple broken tibia turned into horrible infections, and 8 surgeries...so far. She's a tough one, and slowly is recovering. All in all, life is good. We come to Austin frequently and often go to the Geology Building to walk the halls and reminisce. My years at UT were a great gift!"

Stephen L. Shaw (B.S. '71, M.A. '74) shares, "I have moved Firstview Resources office to San Angelo where Nancy and I now live on the banks of Spring Creek. I am still active prospecting and consulting. Nancy and I do most of our travel to visit grandkids (well, and our kids too...) in Austin and Cameron Park (north-central) California. Our best to all." He can be reached at sshaw99@yahoo.com.

Bren Sidereas (B.S. '74) writes, "Retired May 2014 after 40 years of working strictly onshore Gulf Coast geology without ever having to move to Houston. Something to be said for that great achievement. Retired life is keeping up with 4 grandkids and more trips to Austin for sporting and music events. Most of all, retired life is easy. Not so for my wife as she is still working faithfully. She enjoys that. We take one "family" vacation and one much more restful vacation (just us) per year now. That seems to work well." Bren can be reached at bren.sidereas@icloud.com.

Cindy Elliott Swinbank (B.S. '71) writes, "Tom and I still live in Georgetown, TX, with 3 of our kids nearby in Austin, one in Houston and one in Seattle. We have a good time visiting and babysitting for them. Tom still works a couple of days a week, consulting in San Antonio, usually. We were greatly saddened to see the passing of Richard Smith. He was a big brother to me and I have countless good memories of him. Hope you other guys are doing well. We had a great class!"

1980s

Ann Keating Ardis (B.S. '83) worked for the USGS Water Resources Division in Austin for 28 years. She writes, "Currently retired, and thoroughly enjoying our personal 40 acres (& Longhorns). God is good."

Linda R. Balcom (B.S. '87) shares, "The environmental consulting arena continues to be interesting and challenging; currently overseeing Weston's DOD BRAC program and expanding into the DOE asset management program. With a sophomore in college and two in high school, life continues to be jam-packed but blessed in every way. Hope all is well with my fellow grads from '87." She can be reached at linda.balcom@westonsolutions.com.

Fred Herbert Becker (B.S. '83) and Teresa Harkrader Becker (B.S. '82) share, "Fred and I are enjoying our home on the lake in Marble Falls. I am retired and Fred is still working for Shell (but not enjoying the weekly drive to Houston). We have a Viking river cruise planned in October and snow skiing in Colorado with the girls in November. I volunteer one day a week with an Alzheimer's respite group. I also play Mah Jongg, work out at the YMCA and read. We would love to hear from any of our classmates!"

Mark Joseph Berlinger (B.S. '82) currently resides in League City, TX and can be contacted at mb.1305.cb@gmail.com.

Julie Ann Bonner (B.S. '83) writes, "Still working in Houston at Chevron as a Drilling & Completions Team Lead and Drilling Advisor for our Southern Angola Business Unit."

Steven Michael Carlson (M.A. '84) resides in Houston, TX and can be reached at steve.carlson@windstream.net.

Richard F. Carroll (B.S. '80) shares, "I have changed jobs again and just in time for oil prices to fall. I am now working for Caza Petroleum in The Woodlands, Texas, much closer to home. Most of the properties I am now working are in the Permian Basin, but I do still get to do some Gulf Coast geology as well. On the home front, my oldest son, Ian, just graduated from UT Austin with a degree in Marketing and is now working in New York City for a large marketing firm, and my youngest, Austin, is on his way to Colorado to attend school. Hope everyone makes it through this downturn okay." Richard can be contacted at rcarroll@cazapetro.com.

Stephen Chung (B.S. '84) shares, "I am an Associate General Counsel - US Pipelines for TransCanada now and have responsibility for environmental, land, litigation supply chain, pipeline safety and legal operations. We are still trying to get the Keystone Pipeline permitting approved, but it is a long legal and political process, and I'll leave it at that. I keep in touch with some in my class through Facebook, LinkedIn and industry activities but am generally busy working and doing my best to raise two teenage girls." Stephen can be contacted at stephen_chung@transcanada.com.


MIKE CLARK (B.A. '89)

Michael Jamison Clark (B.A. '89) writes, "Finally checked out Alaska early this summer. It is a geologists dream land! Of course, landing on a glacier in an airplane next to Mt. McKinley was priceless."

Joel Mark Coffman (B.S. '84) shares, "Still at US EPA Region 9 in San Francisco but made a major change in jobs a couple years ago. I am now working in the Underground Injection Control Section of the Drinking Water Office, within the Water Division. I issue injection well permits for Class I injection wells in California and oversee the programs on Navajo Lands and in Hawaii. After 20 years working on underground tank issues, it is nice to be back home in the world of deep geology and reservoir engineering. Susan and I are doing great and still in Vacaville, California. We are back to Texas fairly often as we have farm and ranch land in Cochran and Yoakum Counties to see about and the in-laws live in Morton. Our daughters are both also doing great. Shaina is a social worker at the Atlanta Children's Hospital where she works with Cystic Fibrosis patients. Amber is in Los Angeles putting finishing touches on her solo album due out this fall. For a taste of her style, look up Amber Coffman - Get Free. If any class of '82-'85 graduates are in the area, look us up!" He can be reached at longhornrockhound@yahoo.com or coffman.joel@epa.gov.

Alyson Headle Cooper (B.S. '86) currently resides in Juneau, AK and can be reached at alysoncooperak@gmail.com.


FRED CRAWFORD (B.S. '83)

Fred Crawford (B.S. '83) writes, "I am retired! After 25 years with the Lower Colorado River Authority, I took my pension and hit the easy button. In May, I embarked on my childhood dream of hiking the Appalachian Trail. I completed 500 miles before an injury sidelined me. I'll be back on the trail in

the Fall of 2015 and plan to finish the entire 2200 miles by 2016. Sending all my best to the class of '83."

Donald Wayne Downey (B.A. '82) worked 27 years for Gulf and Chevron international exploration and research. He writes, "I retired from Chevron in 2010 and now work with local Pearl Harbor Survivors and other WWII Veterans to capture their life history in video and book form. My sister, Julie Garvin, runs our family-owned oil company, Roxanna Oil, in Houston. Thanks to all the wonderful professors and BEG staff that started me on a wonderful career after graduating with a BA-Geology in 1982!"

Philip Duggan (B.S. '82) writes, "I'm not dead yet....."

Roy E. Easley (B.S. '80) says, "Having a blast living in Fort Worth and enjoying working the Delaware Basin." He can be reached at eeasley@basspet.com.

Charles A. Goebel (B.S. '80) shares, "At this writing WTI is below $43/bbl. Hope the PUF is well diversified! Still Chief Geologist at Banner Resources, and Principal of Santa Rita Energy. Youngest daughter is a Senior at UT Austin this fall; her big brother and sister are already UT Austin grads. Lots of changes at UT and in Austin, but at least the Posse East is still not a fru-fru place!"

Paul Aaron Hardwick (B.S. '83) works at Smith Energy Operating Company in Houston exploring in the Northern Midland Basin. He shares, "Just celebrated 31 years of marriage to Laurie (Waters) Hardwick (B.J. '82) as empty nesters. Our oldest daughter Grace is in her junior year at Trinity University in San Antonio and our second daughter Claire just began her freshman semester on the 40 acres. Hoping to get back up to the Hill Country more this year." Paul can be reached at paulhardwick@earthlink.net.

Jonathan Charles Herwig (M.A. '82) shares, "Annyonghaseyo from the Land of the Morning Calm. Still living 50 miles south of Seoul, part of the program management team constructing the new U.S. base in Pyeongtaek. A little environmental geology and geotechnical, and a lot of facilitating the relationship between one military primarily interested in cost savings (ROK) and the other in quality (US). Always a challenge, but interesting and fun to navigate between two such different cultures. Can read, write, and order beer and soju in Korean, so I have the essentials down. Come visit if you get to this side of the world!" He can be reached at jon.herwig@ch2m.com.

Christoph Heubeck (M.A. '88) has left the Freie Universität Berlin and is now the Professor of General and Historical Geology at the University of Jena, Germany. He is neck-deep in the usual academic activities. His favorite pastime is field work in the Archean strata of the Barberton Greenstone Belt, South Africa; aside, he is still dabbling in petroleum geology. Christoph can be reached at christoph.heubeck@uni-jena.de.

Daniel C. Huston (M.A. '87) shares, "Holly and I are still doing geophysics in Houston but looking forward to spending more time on our boat in Alaska soon. Both daughters are at Purdue University so we have more time to focus on boating, Bonsai, books, backpacking and chilling-out."

Charles Graham Johnson (B.S. '83) says, "Like everyone else, we are adjusting, sometimes painfully, to the lower price environment. We are thankfully not involved in resource plays, but as operators of high water-cut wells, our lease operating costs are not cheap. Most of the revenue lost is profit. We do realize, however, that when there is blood in the streets, there lies opportunity. I continue as chief geologist and acquisitions manager for this large independent producer of crude oil based out of Jackson, Mississippi, and I am constantly evaluating acquisition targets. Our niche is extremely narrow, so most deals do not fit our modus operandi, but I continue looking under rocks, pun intended. Last year, we cracked the top 100 privately-held oil producers. We realize that rankings are not important. I would rather be a profitable number 101 than a money-loser in the top 10. I now officially have two college graduates in biology, one more due to graduate in December 2015 and another on track for 2017. Of course, with my youngest in 5th grade, I will be pulling this plow for a number of years further. Having seen $10 oil twice since graduating UT in 1983, I can say that it has been an interesting, sometimes bumpy, but exciting and rewarding thirty-plus year ride. I hope I get another thirty! Big shout-out to my summer '83 GEO 660 crew members. I have lots of great memories of that last big step at UT Austin! Love to go back to Austin whenever I can, even if just to testify at the RRC. I can't say that it was fun watching the Ole Miss Rebels whoop up on us in 2013, but it was just payback for drubbing them in Oxford in 2012. I would love to see that develop into a new rivalry. We have a lot in common with UM, including a general hatred of Maroon and White, for some reason."

Bill Layton (B.S. '81) shares, "Currently Senior Geologist, Abraxas Petroleum in San Antonio, TX. Jordan and Jessica each gave us a granddaughter in the last year, Nola and Emma. KC and I are well, and adjusting to empty nest life....(really well - Ha!) Big hello to all my 660 buds and remember....the Phantom rules!"


STEVE DREWS (B.S. '82)
BRUNO MALDONADO (B.S. '82)

Bruno Maldonado (B.S. '82) shares, "Hello fellow Longhorns! I have been working in Oil & Gas for the past 33 years. I have worked in several major international and U.S. petroleum systems. I am not quite ready to retire but have recently been asked to.... for the second time. In order to decide for myself when I should retire, I am now available to consult and determine on own when I should retire. Anyone needing a multi-lingual (Spanish, some Brazilian Portuguese) highly technical geophysicist (Seismic Interpretation, Seismic Modeling, Well Log Integration)? Enough of that....on the more personal side, my eldest son, Bruno D., just added another rug-rat to the family. I am now the proud grandfather of two granddaughters. Little Hannah was born on July 22nd around 11:15 pm. Ugh, she is not sleeping through the night yet. Sofia, her 3 year old sister, now will have a little playmate. My youngest son, Armando, is expecting a boy sometime in early October. As for myself, I am still involved with the University as I am currently on the Jackson School FANs (Friends and Alumni Network) Board and loving it. I still enjoy fishing, hunting wild hogs and some deer. Don't worry, I do harvest the meat."

Michael J. Mattalino (B.S. '81) currently resides in Weston Lakes, TX and can be reached at mmattalino@sanchezog.com.

Jamie Nielson (Ph.D. '86) shares, "My wife Mary and I live in Austin with our teenage son. We enjoy the outdoors and have just completed our annual summer trip to a national park (Yosemite this year). I continue to represent oil and gas companies before the Railroad Commission." He can be reached at jamie@nielsonlegal.com.


JAMES MARK NULL (B.S. '87)

James Mark Null (B.S. '87) writes, "I have been promoted to a new post as Hydrologist in Charge, National Weather Service, West Gulf River Forecast Center in Fort Worth, TX. This UT geophysics degree has taken me a long way. 32 countries, retired Naval Meteorologic and Oceanographic Officer, and Federal Executive positions with the Department of Navy, Army Corps of Engineers, U.S. Geological Survey and now the National Weather Service. It has been a fun ride. However, my most proud moment has been following my middle daughter as she completes her B.S. in Geology at UT (expected graduation of Dec 2015). Mark can be reached at jmnull@utexas.edu or mark.null@noaa.gov.

Joseph Elton Patterson (M.A. '83), part of Dr. A.J. Scott's Dirty Dozen, writes, "It's been an interesting 32 years - Superior Oil (assimilated '85), Mobil Oil (assimilated '00), now ExxonMobil. Lived: Denver ('83-'90), Bakersfield ('90-'97), Dallas ('97-'00), Houston ('00-'07), Melbourne, AU ('07-'10), Houston ('10-'15). Worked: Paradox, Overthrust, Williston, Powder River, San Joaquin Valley, Nigeria, Cameroon, Cold Lake/Iron River (Canada), Chad, Sakhalin (Russia), Bass Strait (Australia), Angola. Production and Development. Currently working as a geologic modeler in Exxon-Mobil's offshore Angola group at our new corporate campus in Spring, TX. I'll be moving to Abu Dhabi (UAE) in early 3Q 2015 as a seconded geologic modeler with the Zakum Development Company (ZADCO) - "full circle" back to carbonates. My home and office contacts will be in a state of flux, so my business E-mail is the best contact - joe.e.patterson@exxonmobil.com. I guess I've got one move left in me. Back in 3 years!"

Steven James Rainey (B.S. '84) writes, "I am a tenured member of the geography faculty in the Department of Social Sciences at McNeese State University, with an M.A. in geography from the University of Texas at Austin (1991), and a Ph.D. in geography from Louisiana State University. Although I teach a number of geography classes in a service discipline with no degree program, I advise students who pursue the concentration in geography within the bachelor arts in Liberal Studies administered by the History department. I specialize in human-environment research, with a regional specialty in Latin America, primarily Central America and Brazil. Between 1989 and 2008, my research focused on soil erosion, soil conservation, and broader management of soils by small farmers in Mexico and Guatemala. I am currently conducting research on the impacts of two recently constructed hydroelectric dams (the Santo Antonio and Jirau dams) on riverine (ribeirinho) communities and environments along the Madeira River in Rondonia, Brazil. My research has been supported by two Fulbrights: one student Fulbright for dissertation work in Guatemala in 1996-1997, and one Core U.S. Faculty grant in 2013-2014 for ongoing research in Rondonia, Brazil. A number of university and foundation grants have also supported research in Guatemala and Brazil. I am currently completing nine weeks of fieldwork in Brazil that is being supported by an endowed professorship to the McNeese Foundation that is supported by the Shearman family of Lake Charles." He can be reached at srainey@mcneese.edu.

Michael Robert Rosen (Ph.D. '89) shares, "In June 2015 I was the organizing committee chair of the 6th International Limnogeology Congress (ILIC6) held in Reno, NV. The congress is held every four years and scientists from around the world studying limnology and paleoclimate records of modern and ancient lakes attended the meeting. More than 160 scientists and students (more than 30) attended including John Warden (Ph.D. candidate) from JSG who is studying the microbialites of Lake Clifton, Western Australia. I am on John's Ph.D. committee so it isn't surprising that he attended. The meeting was a success and 4 field trips surrounding the meeting to Pyramid Lake, Lake Tahoe, the Green River Formation and modern and Pleistocene lakes in the western Great Basin were also highly successful. Although there was a considerable amount of work organizing the meeting, it was rewarding to see the variety of work presented at the meeting and the

discussion among scientists planning future work on modern and ancient lakes. The location of ILIC7 has yet to be determined but it could be in either Sweden or Argentina."

Jerry Schwarzbach, M.D. (B.A. '83) shares, "Still living the dream in Tyler, TX. Playing doctor & raising cattle. Still flying. 4 kids but raising almost done."

Christy M. Schweikhardt (B.S. '83) resides in Brenham, TX and can be reached at cmschweikhardt@gmail.com.

Scott Simmons (B.S. '87) shares, "In January of 2015, I left the commercial space and took the position of leading the Standards Program for the Open Geospatial Consortium (OGC). The OGC is an international industry consortium dedicated to creating standards for the use and sharing of geospatial data. My history in geology and mapping has made this a perfect fit and I greatly enjoy the work. It's also fun to bump into old friends and UT faculty who are engaged in the OGC process. I now commute down two flights of stairs in my home in Fort Collins, CO, leaving the rest of my former commute time free for mountain biking or fly fishing." Scott can be contacted at ssimmons@opengeospatial.org.

Traci Trauba Smith (B.S. '85) writes, "Hard to believe I've been out of college 30 years! Where did that time go? I am the Operations Manager for TDECU Real Estate, LLC in Lake Jackson, Texas."

Stephen W. Speer (M.A. '83) writes, "Another year goes by... let's see...I'm more bionic now what with a full knee replacement this spring... seems I'm a bit hard on equipment but I'm almost back up to full speed now. Therese and I are doing well here in the SC Lowcountry, loving it and trying to see who can play the most tennis...she is winning (for now). Sure hope the rest of the Dirty Dozen are doing at least as well as us and we send our greetings and well wishes. Cheers to all!"

Glenn William Storrs (M.A. '81) shares, "I once again spent the summer in the northern Rockies leading the Cincinnati Museum Center dinosaur field program in Montana. This was the twentieth anniversary of CMC excavations in the region and the culmination of successful community involvement in the project. The program has brought community members, including disadvantaged students, to join paleontologists on-site as active participants in the excavation of a Jurassic sauropod bone bed and latest Cretaceous terrestrial faunas. Crews learn the basics of hypothesis construction and testing, data collection, and dinosaur excavation, as well as regional history and ecology. This summer, the team discovered a complete Triceratops skull that awaits collection next year for ultimate exhibit at the Museum. When not hunting dinosaurs, I function as Associate Vice President for Collections & Research at CMC and its Withrow Farny Curator of Vertebrate Paleontology. After leaving UT, I spent nine years at Yale where I received my Ph.D. in Geology & Geophysics and subsequently worked for the Peabody Museum of Natural History there. I moved to England as a research fellow at the University of Bristol Department of Geology for four years prior to moving to Cincinnati to take up my present position in 1995. In spite of my numerous administrative duties, I still manage to pursue research on a variety of vertebrate fossils and have had the good fortune to undertake projects across North America, Europe, Asia and Africa. Even with all the water under the bridge, I normally see Texas friends, colleagues, and classmates annually at the Society of Vertebrate Paleontology meetings. Those reunions are among the highlights of my year and I'm especially thrilled to be returning to Texas this year for the meeting in Dallas where UT alums, staff and students will surely be well represented. Hook 'em horns to all!"

Ted Stout (B.S. '85) writes, "Completed a detail at Carlsbad Caverns this summer. Had a great time visiting Texas kin and exploring one of my favorite places in the world, the Guadalupe Mountains."

Peter R. Tauvers (Ph.D. '88) is currently Principal Exploration Geologist for Shell Ukraine (his second posting in Kyiv). Peter writes, "my wife and I run an art gallery in Kyiv featuring Ukrainian Impressionism in our collection, as well as local artists in exhibition every month. We also host music recitals and art history lectures several times a month — www.tauvers-gallery.com." Peter can be reached at peter.tauvers@shell.com.

Mark C. Walker (B.A. '81) shares, "Last year we lost our most wonderful son, Lee Middleton Hooper Walker, after he completed his first year at UT in the Jackson School and in Plan II. We received tremendous support from the JSG family, not least from Dean Mosher. This spring we devoted ourselves to get the Texas Legislature to pass Senate Bill 1624, which, for the first time, requires Texas colleges to offer incoming students orientation on mental health, depression and suicide prevention. We thank all of our supporters across the state who helped in this effort, and offer in advance our thanks to all who will assist us in our continuing efforts to destigmatize depression and greatly reduce the loss of life among our precious children. With the guidance and leadership of UT's own Dr. Chris Brownson, Director of Counseling and Mental Health Services, we have created a UT System-wide fund for support of student mental health services, research and suicide prevention. You can contribute directly to: links.utexas.edu/cpthrkd."

Leslie Leland Warren (B.S. '85) shares, "Scott and I are now "empty nesters" and actually starting to think about retirement! We still live in Katy, Texas but get to visit Austin quite often as our son is now living there. We divide our time between work and fun at our Lake Livingston getaway and are looking forward to celebrating 30 years together next year. I am still working for Schlumberger (25 yrs), but now as an IT Project Management Office (PMO) Manager. It appears my Geology assignments are over although I still enjoy flipping through my AAPG Explorer! Hope to see more updates from the '85 GeoDogs this year!" She can be reached at warren6@slb.com.

Steve Weiner (M.A. '81) and Kathy Hubby Weiner (B.S. '83) write, "Steve retired from the rat race earlier this year, and he and Kathy moved to New Braunfels. Before they could get settled in though, they celebrated their 30th anniversary with a 6 week cruise vacation to Australia, New Zealand and across the South Pacific. Now that the "trip of a lifetime" has ended, Kathy has been active in the social scene in the new neighborhood, and in making their new house a home. Steve has been focused on improving his health, Spanish and guitar skills. He still hopes to promote a mentoring program between JSG students and alumni, and to teach Petra to all that are interested."

1990s

Kenneth B. "Keg" Alexander (M.A. '90) writes, "I am still living in New Zealand where I have started my own geothermal exploration and geology consulting firm called Middle Earth Geoscience (www.middleearthgeo.co.nz). Geothermal energy development is slowly growing globally in the most prospective geologic settings — volcanic arcs and spreading rifts. Most of my projects are geothermal prospects located in Indonesia, Latin America or East Africa. Happy to field any inquiries about geothermal or New Zealand!"

Colby Drechsel (B.S. '94) writes, "1 year of living in Denver after 19 years in Wyoming... there's a lot of people here! Working as a Marketer for a small producer in the Williston Basin. Married four years; two boys, 2.5 yrs old and 6 mos old — the absolute best experience of my entire life hands down, Owen and Everett, rough and tough! All that matters is good, and we're living well. If you're in Denver, come say hello." Colby can be reached at cdrechsel@trianglepetroleum.com.

Laura Faulkenberry (M.S. '99) writes, "Enjoying life in Houston with my husband and daughter. Recently started working the Eastern GOM with Nexen Petroleum USA, and I am loving this stage of my professional life despite the vagaries of the oil industry."

Lis Konnecke (M.S. '97) resides in Kiel, Germany and can be reached at liskonn@yahoo.com.

Mark Timothy McCoy (B.S. '91) shares, "Less work, more play. The little lady and I had a 50 foot, Center Cockpit, Hunter sailboat built in Florida and delivered to Kemah, TX two years ago this September. Our furthest trips have only been to Port Aransas since taking possession, however, a trip to Port Isabel/South Padre is in the offing, as well as to Florida and the Caribbean." He can be reached at rockss6@aol.com.

Dianne Pavlicek-Mesa (M.A. '90) writes, "I continue to work as the staff Geoscientist in the Edwards Aquifer Protection Program at the Texas Commission on Environmental Quality in San Antonio, Texas. On December 23, 2014, I married Jesse Mesa and became Dianne Pavlicek-Mesa. We enjoyed the carbonate sand beaches of Cancun on our honeymoon and trips to the interior of the Yucatan Peninsula such as to Chichen Itza."

Christopher Stephen Swezey (M.A. '91, Ph.D. '97) writes, "I continue to work for the U.S. Geological Survey (USGS) in Reston, Virginia on a project focused on understanding the geologic framework of the U.S. Atlantic Coastal Plain. I am also active with the Geological Society of Washington, and with the Butler Cave Conservation Society (Bath County, Virginia)." You can view his USGS Professional Page at https://profile.usgs.gov/cswezey or contact him at cswezey@usgs.gov.

Christina Massell Symons (M.S. '97) resides in Chevy Chase, MD, and can be contacted at chris.symons@mac.com.

Justin Zumbro (M.A. '99) shares, "I am working as an engineering geologist and hydrogeologist at GeoPentech, located in Santa Ana, California and riding my mountain bike as much as I can."

2000s

Sasha Peter Carter (Ph.D. '08) is now teaching four classes at local community colleges while keeping a strong (funded) foothold in Antarctic research Scripps Institution of Oceanography. In his spare time he explores the environs of San Diego, CA with his lovely girlfriend Anita Kuhn.

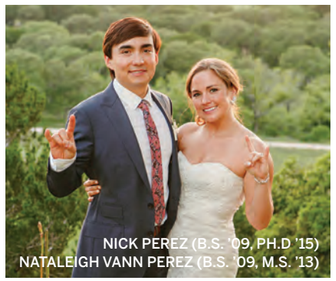

RYAN COPPERSMITH (M.S. '08)

Ryan Thomas Coppersmith (M.A. '08) resides in Pleasant Hill, CA and can be reached at ryan@coppersmithconsulting.com.

Stephanie Cox (B.S. '08) currently resides in Houston and can be reached at scox3@slb.com.

Andrew Johnson (M.A. '08, Energy And Earth Resources) resides in Denver, CO and can be reached at andrew.johnson@utexas.edu.

Eric Lyonford (B.S. '02, M.S. '06) Eric Lyons married Jessica Danford in 2013, and they combined their names. They are expecting a boy just in time for the 2015 football season.


NICK PEREZ (B.S. '09, PH.D '15)
NATALEIGH VANN PEREZ (B.S. '09, M.S. '13)

Nicholas Perez (B.S. '09, Ph.D. '15) graduated with his Ph.D. from UT Austin in May 2015. In April 2015, he married Nataleigh Vann (B.S. 2009; M.S. 2013). He has accepted a tenure track assistant professor position in Basin Tectonics at Texas A&M University starting Fall 2015. Nick also won the JSG Best Student Paper during his final semester at UT Austin. Upon starting at Texas A&M, Nick will begin advising undergraduate and graduate students in basin analysis and tectonics research integrating sedimentology, structural geology, geochronology, thermochronology and geomorphology. Nick is particularly excited about new research areas focused on the Andes, the Cascades in the Pacific Northwest, the Rio Grande Rift, the Atlas mountains of Morocco and West Texas. He can be reached at nicholas.d.perez@gmail.com.

Eric Swanson (B.S. '04) will begin an MBA program at CSU Fresno in Fall 2015 and can be reached at e.swanson@utexas.edu.

Christi Gail Nutter Townsend (B.A. '00) writes, "I earned my Ph.D. in Environmental Geography from Texas State University in San Marcos, Texas. (December 2012). Currently, I am working as a lecturer at Texas State." She can be reached at christinutter@yahoo.com.

Jean-Paul van Gestel (Ph.D. '00) resides in Houston, TX and can be reached at jpgestel@yahoo.com.

2010s

Spencer Whitman (B.S. '10) writes, "Starting the second year of my master's in the Graduate Program for Hydrologic Sciences at the University of Nevada, Reno. Loving life out west!"

Umul Awan (M.S. '14, Energy And Earth Resources) joined the World Bank Pakistan Team as a consultant in their Power Sector Reform, Development Policy Credit Program. The team is working jointly with ADB and JICA to extend a development policy credit to the government of Pakistan to support its power sector reforms, which are to be implemented as a condition under the IMF program that Pakistan is under.

Alan Barraza (M.S. '15, Energy And Earth Resources) is now a Soil Scientist - Water Quality Assessment at the Texas Commission on Environmental Quality in Austin, TX. He can be reached at alan.barraza@tceq.texas.gov.

Thad Bay (B.S. '11) currently resides in Houston, TX and can be reached at thaddeus.bay@gmail.com.

Rita Bitar Nehme (M.S. '15) writes, "After graduating from the Jackson School, I moved to the beautiful city of Melbourne, Australia in May 2015. In Melbourne, I co-founded Steer North an organization that advances health and education through cycling based events. Our signature event is a 4000 km cycling journey from Melbourne to Cairns. The first Steer North team is formed of 42 riders, including myself, who will embark on the longest annual charity bike ride in Australia! The aim is to create a mobile community delivering an innovative health promotion program across Australia while inspiring, connecting and empowering communities we pass through. The ride will also serve as a vehicle to raise funds for cancer research, education and patient care. Along with establishing Steer North, I will be starting a Ph.D. at the University of Melbourne in sustainable development focusing on the application of renewable energy in international development. This is the new adventure I have been living since graduation!"

Brent Blackwell (B.S. '11) resides in Cypress, TX and can be reached at brentblackwell3@gmail.com.

Randy Caber (M.S. '10) shares, "I have graduated with an MBA from the University of Notre Dame and am now working in management consulting with Accenture Consulting in Upstream Oil and Gas as a Manager optimizing operations and creating strategy solutions for clients. I have returned to Houston for the mean time and am having a great time reconnecting with JSG friends." He can be contacted at randycaber@gmail.com.

Marcus Alan Chroback (B.S. '10) writes, "Transferred from EOG Resources Ft. Worth division to EOG Resources San Antonio division at the beginning of 2015. Currently serving as the San Antonio Chapter Director on the Jackson School FANs (Friends and Alumni Network) Board." He can be reached at marcus_chroback@eogresources.com.

Jessica Cori Errico (M.S. '12) resides in Houston and can be reached at jessica.errico@gmail.com.


KATI[illegible] (M.S. '15) AND JOS[illegible]H SMITHERMAN

Katie Fry (M.S. '15) began working full-time as a Geologist in Oxy's World Wide Exploration division at the Houston location.

Joel Funderburg (B.S. '14) says, "After finishing my (second) Bachelor's at UT, I started working at Schlumberger in August of 2014. It's been a year now, and I am thoroughly enjoying it."

Patrick Gustie (M.S. '14) now resides in Spring, TX and can be reached at pigustie@gmail.com.

Aaron Hantsche (B.A. '13) writes, "I defended my Master's Thesis at the University of Colorado at Boulder on August 18th. For the past two years, I have been working on a project titled: Provenance of Grenville-age sediments at the Great Unconformity: A U-Pb and Hf detrital zircon study". With the help of my advisor, Dr. Lang Farmer, I looked at the isotopic composition of a suite of anorthosite intrusions in northwest Mexico and used the information, combined with previous characterization of Grenville-age intrusions, to compare U-Pb ages and Hf isotopic composition to zircon found in basal sandstones deposited at the Great Unconformity in the midcontinent region of North America. We discovered that the Hf isotopic character of these zircon becomes more variable with increased transport distance away from the Grenville Province in eastern North America, and interpreted the western reaches of the continent to have had relatively low topography and negligible sediment contribution during the Cambrian." He can be reached at aaron.hantshce@gmail.com.

Sam Hiebert (B.A. '10, M.S. '13) resides in Houston, TX and can be reached at samuelhiebert@utexas.edu.

Austin Byron Moore (B.S. '15) is pursuing a Masters of Science in Finance at the McCombs School of Business at UT after graduating with highest honors from the Jackson School. Austin can be reached at ausmoore@utexas.edu.

Kaitlin Moran (B.S. '13) completed her M.S. in Earth Science at Rice University in May of 2015.

Frank Morgan (B.S. '11) writes, "I'm currently in my second year working as a geologist for Devon Energy in Oklahoma City. I work in Devon's Rockies Business Unit focusing on the Powder River Basin. Enjoying every bit of it!" He can be contacted at frankmoo053@gmail.com.

Kimberly Dawn Myers (Ph.D. '15) writes, "After graduating in May 2015 I began an NSF funded Postdoctoral Fellowship, working in both the Department of Geology and Geophysics at Texas A&M University, and the Lamont-Doherty Earth Observatory at Columbia University. My work focuses on the Barberton Greenstone Belt in South Africa, and I am looking at the distribution of arsenic in 3.2 billion-year-old sedimentary rocks. In late July I traveled to South Africa to conduct my first field season."

Evan Pearson (B.S. '10) shares, "I will reach my 5 year mark with Pinnacle Potash International, Ltd. in January of 2016. Being able to work in Austin and have operations based in Utah has made post-UT life very enjoyable, but I'll never forget my time on the 40 Acres. Hook 'em!"

Aaron Salin (B.S. '14) shares, "I began work in September as a Geologist at Repsol in the Woodlands after completing a year-long company Masters program in Madrid, Spain. A big thank you to the Career Center, as I found this at the job fair during the fall of my senior year. An even bigger one to the faculty and staff of the Jackson School who prepared me so well for this next challenge." He can be reached at a.salin@utexas.edu.

John Singleton (Ph.D. '11) has accepted a faculty position in the Department of Geosciences at Colorado State University in Fort Collins (starting June 2015).

Nathan van Oort (B.S. '13) says, "The Jackson school provided me with the skills, tools, and knowledge that I needed to enter into the professional world. My focus currently is on characterizing Texas' brackish groundwater resources for the major and minor aquifers across the state for potential desalination plants." Nathan also shares the following quote: "Stay here (school)! Stay as long as you can!" -Billy Madison

Angela Wu Li (B.A. '15) shares, "I'm currently working for Apple Maps and enjoying the recent-grad life in Austin!"

Ze Yang (M.S. '13) resides in Houston and can be reached at yang.ze@utexas.edu.

Julie Zurbuchen (B.S. '14) resides in Santa Barbara, CA, and can be reached at jmzurbuchen@gmail.com.

Friends of JSG

Joel E. Saylor, former JSG postdoc (2008-2012) with Brian Horton, is now a tenure-track Assistant Professor in the Department of Earth and Atmospheric Sciences at the University of Houston (http://easd.geosc.uh.edu/saylor). In two years at UH, Joel has built a group of 8 graduate and undergraduate researchers working on basin analysis projects incorporating sedimentology, stable isotopes and detrital thermochronology. Field study areas range from the Cordilleran foreland basin and Ancestral Rocky Mountains of western North America, to the Andes of Peru and Colombia, to the high plateau of the Himalayan-Tibetan orogenic system. Joel is particularly excited about the growing capabilities in UH laboratories for U-Pb geochronology, (U-Th)/He thermochronology, stable isotope geochemistry, and paleomagnetic studies.

William "Bill" Woods writes, "This has been a very active year for Francisco and me. We took his mother to El Salvador over Christmas and spent several weeks enjoying her birthday with family. Then we went to Lake Tahoe with our good friends, and enjoyed Spring Break. We enjoyed very much seeing faculty and staff colleagues at Bill Carlson's retirement party! Finally, we took 15 days to see Hawaii, Maui, and Oahu, which was a great summer vacation. I continue to work part-time at UT, just to give me something to do. I'd love to hear from my Geo Sci colleagues, so feel free to email me at billw@utexas.edu."

DAVE LEHMAN AT THE HOLLAND FAMILY STUDENT CENTER GRAND OPENING CEREMONY IN 2012.

Alumnus Matches Gifts to Scholarship Fund in Honor of Professor John Maxwell

Dave Lehman (Ph.D. '74) believes that scholarships are key to helping students pursue an education necessary for meaningful careers. As a reflection of this belief, Dave is offering to match any gift to this fund at $1.50 for every $1.00 (up to $100,000) contributed to the **John C. and Marian B. Maxwell Endowed Undergraduate Scholarship in Geological Sciences** this year.

"Dr. Maxwell was not only a great teacher and scholar, but for me personally he was instrumental in opening up academic and professional opportunities."

Dave hopes that others will share his conviction and honor Dr. Maxwell's legacy by paying it forward. The match is in place through Dec. 31, 2015.

To contribute to the John C. and Marian B. Maxwell Endowed Undergraduate Scholarship in Geological Sciences, or to honor another professor, visit www.jsg.utexas.edu/alumni/support or call 512-471-6048.

Jackson School at a Glance 2014-15

CLOCKWISE FROM TOP LEFT: THE JSG CLASS OF 2015 IS EXCITED TO JOIN THE FRIENDS AND ALUMNI NETWORK; JAY SANTILLAN (PH.D. '14) AND ISAAC SMITH (PH.D.'13) CATCH UP WITH AARON JONES (M.S. '11) AND HIS WIFE HOLLY AT AGU IN DECEMBER 2014; CODY COLLEP (B.S. '13) AND JOHN LONG (M.A. '78) DISCUSS SCIENCE AT THE 5TH ANNUAL STUDENT RESEARCH SYMPOSIUM IN FEBRUARY 2015; KEVIN LABBE (B.A. '04) CUT LOOSE AT THE ANNUAL JSG TAILGATE PARTY WITH HIS WIFE ROBIN AND STEPDAUGHTER MELIA; JOHN CLINCH (B.S. '81), ERIK HANSEN, AND DAVID MARTINEAU (M.S. '97) AT THE ANNUAL SCHOLAR'S LUNCHEON IN NOVEMBER 2014; ED (B.S. '79, M.A. '87) AND KAREN DUNCAN MARCHED TO THE BEAT OF BIG BERTHA AT THE CAMPAIGN CELEBRATION IN NOVEMBER 2014.

MEMORIALS

David Alt (Ph.D. '61), Professor Emeritus at the University of Montana, geologist, teacher, writer, storyteller (you choose the order) passed away on April 26, 2015, in Missoula. Throughout his over five decades in the profession of teaching, David inspired countless numbers of future geologists and scientists, college students, environmentalists, rock enthusiasts, hobbyists and birdwatchers alike, with his unique ability to convey and translate complex geological and natural science into exciting and understandable concepts, often with an artistic and colorful flare. Born in gritty, depression-era St. Louis, Missouri, in 1933, David set his young sights outward to the world, a byproduct of his insatiable love of books and stories — passions that would endure throughout his entire life. He went on to graduate from Washington University in St. Louis in 1955, followed by a Master of Science from the University of Minnesota in 1958. Seeking warmer climes, David headed south to Austin on the quest toward his Ph.D. at UT Austin. From there, he conducted field research in Mexico and began to hone his profession. He held teaching and lecturing positions in Leeds, England, and the University of Florida. No longer able to resist the surging call of the Rockies, David arrived in Missoula from the tepid flatlands of Florida in 1965, a still young, yet experienced college professor destined for the University of Montana. He never looked back, and his university and published writing career took off. In collaboration with fellow UM professor Don Hyndman, the "Roadside Geology" book series was born, bringing the excitement of rocks and the stories that rocks have to tell to the general public. David and Don went on to write seven, very popular "Roadside" guides, known for their simple and understandable explanations to the lay-geologists and naturalists who traverse our nation's road-cuts each and every day. The series is still prominent throughout North America's bookstores. After 36 years at the University of Montana, David retired in 2001. He remained active with his writing and other pursuits, such as painting and birdwatching, and was working on his latest book when he passed away on April 26. David Alt is survived by the love of his life, Sandy, their daughter Sarah, David's son Konrad and daughter Lisa; his sister Karen Grant and stepdaughters, Debbie and Diane; along with 12 grandchildren.

Helen L. Anderson (Spouse of the late Irvin J. Anderson, M.A. '46), 90, of Baton Rouge died April 8, 2015, at her home in St. James Place. Helen was born May 27, 1925 in Rogers, Arkansas to William Lloyd Patterson and Phoebe Jeanette Patterson. Helen attended The University of Texas in Austin and received a Bachelor of Fine Arts degree.

Thomas S. Blackwell (M.A. '52) Thomas Sanford Blackwell, 89, passed away July 3, 2015, in Houston. Thomas was born Jan. 6, 1926, in Fort Worth. Thomas proudly served in the United States Navy during World War II. Upon his return from the war, Thomas earned an undergraduate degree from Texas Christian University. He also completed his graduate degree in Geology at The University of Texas at Austin. Thomas was employed as a Geologist for the Gulf Oil Company for many years before he retired. Thomas called Houston home for more than 40 years. He was a member of Ascension Episcopal Church, were he contributed his time unceasingly, as long as he was able. Thomas was married to Isabel Orrego Blackwell, who precedes him in death. He is survived by his two children, Eliana Bloodworth and Tomás Blackwell, son-in-law, Reverend Lee Bloodworth, two grandchildren, Adriana and Alyse Bloodworth, sister, Vivian Cloyd, sister-in-law, Ann Blackwell, and nieces and nephews.

Asa L. Blankenship, Jr. (B.A. '50, M.A. '52) was born in Amarillo, July 27, 1926, to Asa L. Blankenship Sr. and Beatrice Shore Blankenship. Asa grew up in Amarillo and was baptized at the West Amarillo Church of Christ. Asa attended Amarillo High School and graduated from Peacock Military Academy (high school) in San Antonio in 1944. He served in the U.S. Army for two years and received his B.A. from The University of Texas in 1950 and his M.A. in 1952. Asa was married to Bonnie Hinson in 1947 and they had a remarkable relationship. They enjoyed some wonderful trips together. Their daughter Sue was born in 1957. The family lived in Austin, Abilene, Amarillo, Galveston, and finally in Houston from 1968. Asa worked as a staff geologist from 1952 to 1961, then in banking as a trust investment officer from 1965 until his retirement in 1997. A priority for Asa and Bonnie was serving God together. Asa did lay preaching in a number of congregations and served as an elder of the Rice Avenue Church of Christ in Bellaire and later of the Little York Church of Christ in Houston. Asa passed on to be with Christ on Sept. 24, 2014. He is survived by his daughter, Sue Green and husband Bob of Hilo, Hawaii; granddaughter, Melissa Green and two great-granddaughters. Asa is also survived by a sister-in-law Wanda Ming of Pauls Valley, Oklahoma.

Joseph Louis Brown II "Brownie" (B.S. '54), 87, passed away peacefully on Sept. 14, 2014. Only child to Joseph Louis and Marie Weinheimer Brown of Houston, Joe grew up in Houston, graduating from Lanier Middle School and Lamar High School. After high school, Joe spent a semester at Texas A&M and later entered the Naval Officer Training Program at Southwestern University. He then attended The University of Texas in Austin earning a business degree and was a member of Phi Delta Theta fraternity. Following his graduation, he worked for Creole Petroleum in Venezuela where he became fluent in Spanish. Later, he returned to the University of Texas to earn his geology degree and spent the next three years as a barite specialist. Inspired to work for himself, he decided to make a career shift by opening a record store called the "Disc Count House" off Bissonnet near Kirby and later founded Home Entertainment, Inc. in 1957. Shortly thereafter, he married his true love, Marie Collonge of Dickinson, TX on Oct. 13, 1962. He successfully grew Home Entertainment to include 10 locations in Houston and Dallas, eventually adding Auto Entertainment. He sold the company in February 1999. He also founded Industrial Audio Video, Inc., an affiliate of Home Entertainment in 1971, still in business today. He was a long time member of St. Luke's United Methodist Church, a member of the Executive Breakfast Club, and a member of River Oaks Country Club where he enjoyed golf. Joe was a dignified man and known for his great integrity in all matters. He was fair and generous on all counts, extremely hard-working and never knew a stranger. He always showed great concern for his employees. He is survived by his devoted wife Marie Brown, daughters Erin Brown and Julie McMahon, son in law Kevin McMahon, of Houston, as well as five grandchildren. He is preceded in death by his son, Joseph Louis Brown, III (Louis).

Siras D. Browning (B.S. '53), 85, passed away on June 27, 2015 peacefully at his home of 26 years in Sherman. Siras was born July 9, 1929 in Ellison Springs of Eastland County. He graduated from South San Antonio High School in 1946 and immediately joined the United States Navy. After four years in the Navy, he left to attend The University of Texas at Austin. Upon graduation, he re-entered the Navy as an officer for a total of 28½ years where he became a full captain on four ships and was commander on many other ships as well as served as military intelligence at the Pentagon. Siras then worked at the Texoma Council of Government (TCOG) after his retirement from the Navy. He contributed to many programs at TCOG and started the JTPA program among other accomplishments before he retired after 17 years. Siras continued to serve on many boards after retirement including the Crisis Center, North Texas Workforce in Denton, and cofounded the U.S. Navy Veterans of North Texas and Southern Oklahoma. He is survived by two daughters: Helen Denise Remington and husband Larry of Lewisville, Texas and Mary Leanne Browning-Alquist of Sherman; and five grandchildren.

Ina R. Brundrett (Spouse of the late Jesse Lee Brundrett, B.S. '53, M.A. '55) entered the Garden of Heaven on June 3, 2015, leaving behind a bountiful legacy of giving to education and gardening initiatives across Texas. Ms. Brundrett was an educator, gardener and philanthropist who served with numerous clubs and organizations devoted to landscape beautification. She was born Aug. 27, 1923, in Victoria County, to Ira Franklin Riggs and Pearl M. Riggs. Ms. Brundrett graduated from A.C. Jones High School in Beeville, received her bachelor's degree from Texas College of Arts and Industries, Kingsville (now Texas A&M University Kingsville) and completed 12 hours of graduate work at The University of Texas at Austin. She married Jesse Lee Brundrett on July 5, 1944, before he left for combat service in World War II. In memory of her late husband, she established the Jesse L. Brundrett Memorial Endowed Presidential Scholarship and the Jesse Brundrett Family Rock Garden for the Jackson School of Geosciences at The University of Texas at Austin. In addition, she established endowed scholarships in education in honor of her parents and another endowed scholarship in architecture to honor her daughter, Lynne Brundrett Maddox. Her contributions also helped to establish the Ina Brundrett Conservation Education Building at the Stephen F. Austin State University Pineywoods Native Plant Center; the Ina Brundrett Azalea Garden, the Botanical Gardens Preservation Endowment and the Ina Brundrett Presidential Honors Scholarship at Tyler Junior College; and the Ina Brundrett Environmental Health Science Endowment at UT Health Northeast. She gave generously to educational and botanical endeavors with the assistance of matching gifts from the Exxon Foundation.

Wallace E. Brunson (B.S. '42, M.A. '54), born Sept. 25, 1919 in the old Baptist (later Memorial) Hospital (demolished) in downtown Houston; passed away on Oct. 7, 2014. He was preceded in death by his daughter, Barbara B. Copeland; parents, Howard E. Brunson and Ouida L. Brunson; and a brother, Donald L. Brunson. He attended schools in Baytown, Texas, and went to the New Mexico Military Academy, and graduated

from The University of Texas in Austin with degrees of B.S. (1942) and M.A. (1954) in Geology. At UT he was president of Delta Chi Fraternity and was a member of Sigma Gamma Delta, honorary geological fraternity. He was a Life Member of the Texas Ex-Students Association. Wallace retired from Amoco in 1980, after 26 years and has remained semi-active as an independent geologist. He served in the U.S. Air Force in WWII and in Korea in 1951-52 where he was a Captain, and was Officer-in-Charge of the massive aerial photo lab in the 5th Air Force's 67th Tactical Reconnaissance Wing. Wallace had memberships in the American Association of Petroleum Geologists (AAPG), Society of Independent Professional Earth Scientist (SIPES), Houston Geological Society and Petroleum Club of Houston. He was past president of the Lubbock, Texas Geologist Society, Editor for the Fort Worth Geological Society and Past President of the Southwest Section of the AAPG. Wallace is survived by his wife of 72 years, Elizabeth (Betty) C. Brunson; son and daughter-in-law, Dr. Wallace E. and Carol Brunson, Jr.; grandson, Trey Brunson; brother and sister-in-law, Howard E. and Lindy Brunson of Austin; son-in-law, Dr. James Copeland of Austin; and numerous cousins, nieces and nephews.

Jeff Burnett, Jr. (B.S. '49) passed away peacefully with his children at his side on January 9, 2015, after a short illness. He was born in Houston on the 26th of September 1922 where he lived with his wife Catherine. He is survived by their three children, Jeff III and his wife Buena of Houston, Robert and his wife Ja Chidapha of Houston, Catherine Gaeke and her husband Dwaine of Wimberley; his eight grandchildren and 11 great-grandchildren with two more on the way. Jeff graduated from The University of Texas with a degree in geology after which he worked at the Texas Company (Chevron-Texaco today) and then joined his Father's Insurance Agency, T. J. Burnett & Son where he worked until retirement in 1996. Jeff and his wife, Cathy, were founding members of Saint Francis Episcopal Church where they were very close to the congregation.

Jean F. Burney (Spouse of William Morrow Burney, Jr., B.S. '48) was welcomed into Heaven on Monday, Dec. 1, 2014, while surrounded by her family. Jean, known lovingly by her family and friends as "Gege," was a beloved wife, mother, grandmother and great-grandmother. Everyone who met and knew her were instantly taken in by the twinkle in her eyes and her gorgeous loving smile.

Marilyn D. Callender (Spouse of Dean Lynn Callender, B.S. '56) died unexpectedly in her home Jan. 11, 2015, in Houston, at the young age of 77. She is survived by her loving husband of 56 years, Dean Callender; children, Larry Callender and his wife Allison, Don Callender, and Sharon Callender Snowden and her husband Richard, all of Houston; seven grandchildren; sister, Wanda Jean Dull Koenig and her husband, Lloyd, of Bayou Vista, and brother, John Dull of Fredericksburg.

Walter Wilson Carter, Jr. (B.A. '49), age 87, of San Antonio passed away on Dec. 2, 2014. He was born on April 11, 1927, in Mount Airy, North Carolina. During World War II he received an appointment to the United States Naval Academy. Upon war's end, he transferred to The University of Texas where he received a degree in geology. Wilson was a member of the Texas National Guard for 18 years, and he was a Major of Artillery. He was a member of The University of Texas Geological Society, an avid outdoorsman and a patriot. Wilson is survived by his wife and friend Rosalie M. J. Carter; daughter Eliza Katherine Duncan and her husband Johnny, son Will Carter and his wife Dana, son John Carter and his wife Ana Francisca, stepsons Paul E. Jornayvaz and his wife Mary, and Robert P. Jornayvaz, III and his wife Louisa.

John J. Chambers Crowell (B.S. '39) passed away May 13, 2015, an hour after his 98th birthday in Montecito, California. He was a world-renowned geologist and professor emeritus at University of California Santa Barbara. During World War II, with two other officers he forecast surf conditions for the Allied Invasion of Normandy. John Crowell was born on May 12, 1917, in State College, Pennsylvania, to James White and Helen Hunt Chambers Crowell. A succession of moves took the family to Claremont, California, where John's father took a position as professor of Romance languages at Claremont College. After graduating from The University of Texas with a degree in geology in 1939, Crowell undertook graduate work at UCLA. While studying the geology of a part of the San Joaquin Valley, he was offered employment as a geologist with Shell Oil Company and would have followed that career path had not World War II military service serendipitously intervened. The U.S. Army put him into intensive training as an oceanographic meteorologist with several of the world's leading meteorologists and oceanographers. He was commissioned as a second lieutenant in May 1943. Crowell became a member of General Dwight D. Eisenhower's Operation Overload weather forecasting team that made the critical forecasts of sea, swell and surf for the June 6, 1944, Normandy Invasion which earned Crowell the Bronze Star. Later in the war he was based in Ceylon preparing for the invasion of Burma and led a U.S. Army convoy across the Ledo-Burma Road from India into China. He was working on the planned invasion of Japan when the war ended. In 1946 he met and married Betty Marie Bruner of Claremont. They remained married for 61 years until she died in 2007. Their daughter Marty was born in 1951. In 1946, Crowell obtained his M.A. in oceanographic meteorology from Scripps Institution of Oceanographyand then his Ph.D. in geology from UCLA in 1947, where he was a distinguished university professor for 20 years. Crowell came to UCSB from UCLA in 1967. With Professor Preston Cloud, he founded the UCSB Environmental Studies Program. He taught courses in structural geology, field studies in tectonics, and graduate seminars in structure and tectonics at UCSB and short courses all over the world for the American Association of Petroleum Geologists' Continuing Education Program, and for many oil companies and geological societies. Crowell's research contributions were primarily concerned with sedimentation, tectonics, paleoclimatology, and the regional geology of California. In the early and mid-1950s he published several papers dealing with the origin of submarine canyons and turbidity currents. In California and in the Alps he studied the characteristics of flysch-type sedimentation. During the 1950s and 1960s, Crowell worked out the displacement history of some of the major strike-slip faults in California, including the San Gabriel and southern stretch of the San Andreas. Crowell's work of the tectonic and sedimentation history along the San Andreas transform belt formed the basis for his seminal publication about the nature of these processes along similar tectonic belts, such as those in the Caribbean region, Southeast Asia, Australia, the North Sea region and the Alps. His interest in downslope sliding processes, in California as well as in Europe, led him to study the origin of pebbly mudstone and to discriminate between these downslope deposits and those laid down by continental glaciers. In the late 1960s this interest led Crowell to investigate the record of ancient glaciations in Europe, North American, and on all the Gondwanan continents in the Southern Hemisphere and to work out the history and causes of continental glaciation through geologic time. Among Crowell's many honors were membership in the U.S. National Academy of Sciences, fellowship in the American Academy of Arts and Sciences, a Fulbright Award to Austria, a Guggenheim Scholarship to Switzerland, the Penrose Medal, the Career Contribution Award from the Geological Society of America and an honorary doctorate from the University Louvain, Belgium. In 2013 he received the Lifetime Achievement Award, SEPM (Society for Sedimentary Geology.)

Samuel Y. Dorfman, Jr. (B.A. '57), passed away on Sept. 6, surrounded by family and loved ones. Born Sept. 10, 1935, in Longview, Texas, Dorfman was a true product of the American Dream. He was the son of Elizabeth Florsheim Dorfman of Shreveport, Louisiana and Samuel Y. Dorfman, Sr., a Ukrainian Jewish immigrant who escaped religious oppression to come to the United States via Galveston as a teen, speaking no English, and who forged success in the East Texas oil field and co-founded the Delta Drilling Company — which in its heyday was the world's largest privately-owned oil and gas drilling contractor. Sam, Jr. graduated from Longview High School and The University of Texas, obtaining a B.S. in geology in 1957. It was at the university that Sam met Judith Abrams, the mother of his two children. Following graduation, Sam served in the U.S. Navy on board a destroyer escort based out of New Orleans and Guantanamo Bay, Cuba. Upon returning to civilian life, he initially worked as a geologist in the oil and gas industry. He later served on the Board of Delta Drilling and ran, along with his brother Louis Dorfman, Dorfman Production Company — an independent oil and gas operator. Sam enrolled at The University of Texas Southwestern Medical School, securing his M.D. in 1967. He interned at the Los Angeles Veterans Administration Hospital and returned to Dallas to practice internal medicine at the Brookhaven Medical Center (now known as the R.H. Dedman Memorial Medical Center), where he rose to become chief of medicine. Combining a restless spirit, a love of hamburgers and the fairer sex, and a burgeoning collection of vintage gas station paraphernalia (accumulated over years of rummaging through East Texas towns), Sam opened the Filling Station Restaurant and Bar on Greenville Avenue in 1975, quickly becoming a Dallas landmark and ultimately growing to five locations in Dallas, Addison, Austin and Houston. Sam was an avid sportsman and a hobbyist with many and varied interests, among them playing golf and tennis, skiing, bicycling, ballooning, sailing, scuba diving and underwater photography. He was also an enthusiast of world travel, who regularly cruised to exotic locales and entered numerous floating contract bridge tournaments with his devoted partner, Barbara Stanfield. Outside of spending time with family and close friends, his greatest enjoyment in recent years came from jointly running Dorfman Production Company with his brother and coming home to Barbara and their menagerie of four-legged children. He is survived by his beloved Barbara Stanfield, daughter Stacey and her husband Don Kivowitz, son Grant and his wife Angie Dorfman, and grandchildren and great-grandson. He is also survived by his brother, Louis Dorfman.

John Leslie Douglas (B.A. '57) died in San Antonio Nov. 1, 2014. He was born Feb. 14, 1934, in San Antonio to Leslie Alan Douglas and Avis Sutton Douglas. He is survived by his wife, Frances Spires Douglas (Frannie); brother, David Douglas; sons, Gene Douglas and wife, Ruth; John Spires Douglas and wife, Elizabeth; four grandchildren and many other family members and friends. A life-long resident of San Antonio, John graduated from Alamo Heights High School in 1952 and furthered his education at Princeton University and received a B.S. in geology from The University of Texas. Later in life, John received a M.A. in Counseling from St. Mary's University. John was involved in several business ventures in San Antonio including Spires-Douglas Buick Company, Viva (Mini Mansions) bookstore, the Twig bookstore, and real estate interests. He was a member of St. Mark's Episcopal Church. He was a member of various social and civic clubs

including the Kiwanis Club, the Conopus Club, the San Antonio Country Club, the Town Club, the Order of the Alamo, the German Club and Club Giraud.

Clarence Orson "Clay" Durham, Jr. (B.S. '42) passed away Sunday, April 12, in Houston at the age of 94. Clay was born in Victoria on Oct. 20, 1920, the son of Clarence Durham, Sr. and Maud Leffland Durham. He received a B.S. in geology with honors from The University of Texas in 1942. He earned a professional certificate in meteorology from University of Chicago in 1943 and served as a meteorologist in the Army Air Corps during World War II. After the war, he continued his education at Columbia University where he was awarded his Ph.D. in geology. Clay joined the faculty at Louisiana State University in 1951 as a professor of geology. He also served as Director of Research for the Louisiana Geological Survey during his tenure at LSU. In 1965 he was named chairman of the LSU Department of Geology, a position that he held until he retired in 1975 to pursue work as a consulting geologist. Clay moved to Houston in 1978 and began a successful career in oil and gas exploration in partnership with ex-student and longtime friend Brian Parsons. He had a passion for geology, and some of his daughters' favorite memories were the impromptu geological lectures during road trips of any natural phenomena that he found interesting. Clay was well-known and well-loved by many. His former LSU students held him in great esteem. Many say their lives were forever changed by their association with this remarkable man. Clay is survived by his former wife, Louise Durham, daughters Evelyn Durham and Amy Durham Wang, future son-in-law Matthew Harding, son-in-law Warren Wang, and three grandchildren.

Frederick Ahrens Ealand (B.S. '48), born April 13, 1923, in Waco, entered into rest on April 6, 2015, in Houston. Fred was a graduate of The University of Texas at Austin where he was a member of the Texas Cowboys. He worked his entire 40 year career as a petroleum geologist with Humble Oil/Exxon. Fred was an avid tennis player, active member of AAPG and the HGS and loved to fish. He is preceded in death by his parents, Fred T. Ealand and Elsie Ahrens Ealand. Left to cherish his memory: his loving wife of 65 years, Dorothy Stewart Ealand; daughters, Becky Jackson and husband Tommy, Carol Simpson and husband Richard; sons, Frederick Ahrens Ealand II and wife Peggy, Greg Ealand; grandchildren and great-grandchildren.

Lawrence Jerald Finklea (B.S. '54), 85, of Sonora, passed at home on May 18, 2015. Lawrence was preceded in death this past August by his devoted wife of 62 years, Jodie Moore Finklea. Born Sept. 13, 1929, at West Columbia, Texas, Lawrence was the son of Ralph and La Nell McShan Finklea. His father was a highly-respected oil drilling supervisor for Humble Oil Company, and throughout his youth the family frequently moved in South Texas. His final high school years were spent at Texas Military Institute in San Antonio, where he established lifelong friendships before graduating in 1947. Lawrence enrolled at The University of Texas at Austin, where he met his future wife, Jodie Moore, from Sonora, and received his B.S. in geology. After earning an army commission through the ROTC at UT, Lawrence served two years during the Korean conflict. He graduated from deck officers school at Fort Eustace, Virginia and was stationed in Thule, Greenland. Lawrence and Jodie married on Aug. 14, 1952, at the historic Burton Parish Episcopal Church in Colonial Williamsburg, Virginia. Lawrence was honorably discharged as a 1st Lt. in the spring of 1954. In the summer of 1954, Jodie and Lawrence accepted a ranch pasturing opportunity from W .L. Miers. Their decision led to a long and productive life of ranching in Sutton and Edwards counties. Those left to honor and cherish his memory include his two sons, Bill and Larry; his daughter, Marsha Cardwell; his two grandchildren, his half sister-in-law, Angie Wright, and many friends.

Richard Lynn Goode (B.S. '82), 55, had a heart attack and died in Wylie, Texas, on June 27, 2015. He was born in San Angelo, on March 30, 1960, to Louise and W.L. "Boots" Goode. Rick was raised in Midland. He graduated from Midland High School, where he played football three years. In 1977, as a center and in 1978 as a defensive tackle, he was selected to the All-District football teams. He also played varsity baseball three years. In 1982, Rick graduated from The University of Texas at Austin with a B.S. in geology, where he was active in the Kappa Sigma Fraternity. He returned to Midland to work for Hexad Oil Company and later joined his father as an independent geologist. In 1990, Rick completed a second B.S. degree, graduating from The University of Texas Permian Basin, in computer programming. He married Brenda Osborn on Sept. 22, 1990, in Midland and adopted her two girls, Vanessa Van Alstyne of Dallas and Katie Goode of Austin. The family moved to Dallas, where Rick did computer programming for various companies, ending his career at MedAssets Inc. Rick was preceded in death by his brother, William Goode, and all his grandparents, Mr. and Mrs. Homer Goode and Mr. and Mrs. Louis Gayer of San Angelo. Survivors include his wife, Brenda of Wylie, his daughters, and his parents.

Arch H. Heim (B.S. '50) of Boonville, Mo., and recently Denver, Colo., died peacefully on Aug. 12, 2015. He was 90 years old. Mr. Heim was born May 9, 1925, to Melbourne and Dorothy Heim. A graduate of Little Rock High School and The University of Texas at Austin, he served in the Navy in World War II and was a research and development engineer with Schlumberger-Doll Research Company for his entire professional career, including several years as a young man stationed on Lake Maracaibo in Venezuela, an experience he remembered throughout his life. Located to Connecticut with the Schlumberger Company in the 1950s, Mr. Heim lived and raised a family in Ridgefield, where he remained for more than 30 years before retiring to rural mid-state Missouri, near his grandparents' farm where he had spent many happy childhood summers. He lived his many remaining years in Missouri, renewing family ties, and making and enjoying new friends. Arch was deeply interested in the natural world and the sciences, and had a special love for animals as well as people. His numerous hobbies included photography and collecting antique cameras. He is survived by two daughters, Amanda V. Sawyer of Denver, Colo., and Abigail M. Heim of Rowley, Mass.; a sister, Melba Wilkat, of Florida, and her family; a sister-in-law, Marcia Maresca, of North Haven, Conn., and her family; and cousins Cynthia Boles of Texas and Susan Heim-Davis of Missouri and their families.

Alison T. Henning (B.S. '94, M.A. '97) passed away peacefully from complications related to breast cancer on Aug. 12, 2015, in Houston, her home for over 17 years. She was 42. Born July 28, 1973 in Plymouth, Mass., she graduated from Plymouth South High School and The University of Texas at Austin. She went on to receive a Ph.D. in Geophysics from Rice University and enjoyed an exciting career as a geophysicist in the oil industry and academia. She was able to travel the world and meet many wonderful people, and education became one of her many passions, along with Longhorn sports and baseball. She was an active member of the Houston Geological Society, serving most recently as the Secretary of the Calvert Scholarship Committee for graduate student scholarships. She married her high school sweetheart Tod Henning in Austin, in 1996 and they were blessed with two beautiful sons and over 18 years of wedded happiness. She was preceded in death by her father, Robert Louis Teagan, her paternal grandparents John and Gladys Teagan, and her maternal grandparents Edward and Florence Coffey. She is survived by her husband of 18 years, Tod, and sons Mark Edward Henning and John (Jack) Joseph Henning of Houston; mother Linda Teagan, of North Conway, N.H.; brother Edward Teagan, sister-in-law Melissa Teagan, nieces Whitney and Abigail and nephew Liam of Madison, N.J., and her many Texas friends.

Herbert "Bert" A. Hemphill, Jr. (B.S. '50), 87, of Burton died Jan. 17, 2015, after a lengthy battle with congestive heart failure. He was called to his wife Phoebe on the 36th anniversary of her passing. Bert was born in Columbia, South Carolina, on Oct.12, 1927, to Herbert Augustus Hemphill, Sr. and Helen Sellards Hemphill. He moved to Midland as a young boy. On graduation from high school he served in the United States Navy. He earned a degree in geology from The University of Texas and became a geologist like his father, his grandfather Elias H. Sellards and his wife's father Frank E. Lewis. He worked for many years in the oil fields of West Texas then moved his family to Austin where he worked as a realtor and appraiser before moving to his family's farm in Burton. Bert is survived by his children Leigh Hemphill Thompson, her husband Gary and their daughter Holly; Teg Hemphill Israeloff, her husband Sim and their daughters Kat, Amy Shine and her husband Nick; and by his son Mike Hemphill. He is also survived by his sister Nancy Hemphill Gaido, her husband Sandy and their daughters Missy Gaido Allen, her husband Rich and children Gus and Astrid; Ashley Gaido; and Lindsay Gaido Bramwell, her husband Jake and their son Zane. Bert was preceded in death by his wife Phoebe Lewis Hemphill, and by his sister Susan Hemphill Bosworth and her husband Bill.

Harold T. Henslee (B.S. '50) was born April 4, 1925, in Best, TX, and died April 20, 2015. Harold was the eldest son of Clinton and Alleen Taylor Henslee. Mr. Henslee is survived by a brother, Charles, of Houston, his beloved former wife, Marilyn, Richmond, Texas, a son, Mark Henslee, Lawton, Oklahoma, a daughter, Janice Mixson (Mack), Addison, Texas, and six grandchildren and four great-grandchildren. He was preceded in death by granddaughter Emily Henslee. Harold played basketball, ran track, and went to state in high jump while attending Amarillo High School, graduating in 1942. Harold enlisted in the United States Navy in 1943, graduating from Corpus Christi Naval Air Station in 1945 as a Naval Aviator. Harold served in the Naval Reserves until 1955, having attained the rank of Lieutenant J.G. He attended The University of Texas at Austin, Texas, earning a B.S. in geology. Harold and Marilyn married in August 1948. He was employed by Phillips Petroleum in Amarillo in 1950 until 1970, when he became an independent petroleum geologist. Mr. Henslee served in leadership positions with the American Association of Petroleum Geologists, the Panhandle and West Texas geological societies, and on the Alibates Flint Quarry National Monument Committee. In post-retirement, Harold drove a limousine for the Big Texan Steak Ranch for nine years.

Nolan Hirsch (B.S. '44) a longtime resident of Midland, died July 24, 2015, at his home. Nolan Hirsch was born at Fort Clark, Brackettville, Texas, Horse Calvary Post, on Oct. 16, 1921, to Myrtle Blanche Nolan, daughter of a prominent ranching family and Lt. Col. Victor Hugo Hirsch. His father transferred to an army post in San Antonio. Nolan attended early schooling through high school in San Antonio, and graduated from Brackenridge High School. He attended on scholarship St. Mary's University and later transferred to The University of Texas at Austin. He graduated with a B.S. degree in Geology and was selected to the Honorary Fraternity, Sigma Gamma Epsilon. Hirsch served in the U.S. Army in World

War II, 96th Infantry Division in the South Pacific including battles of Layte and Luzon in the Philippines. His service included the invasion and battle of Okinawa and he was selected after Okinawa to serve as part of the cadre in reorganizing the Philippines Scouts. Through his military service he earned the Combat Infantry Badge, was awarded the Bronze Star and Purple Heart in the battle of Okinawa, and received three Bronze Battle Stars and one Arrow for an invasion in Okinawa. After discharge from the U.S. Army in 1946, Hirsch came to Midland, worked for Stanolind Oil and Gas, Deep Rock Oil, Texas Pacific Coal and Oil in Midland and Fort Worth. Hirsch also served with independent oil company Keith Graham OMNI Exploration. Hirsch had been an independent geologist from 1968 to the present time. He formed and served as President of M.V.C. Inc. in oil and gas exploration and production. He is given credit for finding several oil and gas fields and field extensions in the Permian Basin and Eastern Shelf of West Texas. He met Lila Sue Caruthers in Midland, in 1947, a graduate of Texas Tech University. Hoping to overcome "volatile times," they declared a truce, and were married on "Armistice Day," November 11, 1950 (now called Veterans Day). He and Sue were together for 51 years and raised three children, Melissa Hirsch, J.D., a local attorney for many years, now retired in San Miguel de Allende, Mexico, and New York City; Victor Nolan Hirsch, Ph.D., of League City; and Cathy Hirsch Hamilton, Ph.D., of North Carolina. Hirsch is also survived by six grandchildren and three great grandchildren.

Susanne C. Hooper (Spouse of the late Charles Jackson Hooper, B.S. '50), died peacefully in Austin on Nov. 2, 2014, following a beautiful life that began in Okemah, Oklahoma on Oct. 7, 1927. She was the second daughter born to Eugene Newlon Catlett and Mary Board Catlett.

Kenneth Roland Johnson (B.S. '50) passed away on Dec. 31, 2014, in Houston, at the age of 90. He was the son of the late Chester and Doris Johnson. Ken was predeceased by his younger brother Hugh Edward Johnson. He is survived by his beloved wife Kathy Fraser Johnson, daughter Cindy Northington, sons Steve and Jeff Johnson and their spouses Guy Northington, Mary Price Johnson and Amye Tatum Johnson. Ken had 11 grandchildren: Will Northington; Wes Northington and wife Kellie; Ginny Northington Quinn and husband Daniel; Fletcher Johnson and wife Tracy; Price Johnson and wife Sarah; Gardener, Wilson, and Hill Johnson; Tatum, Rawls and Forrest Johnson; and his sister-in-law Barbara Johnson. Ken had three wonderful wives, two of whom preceded him in death: Bernita Fletcher Johnson and Katherine Lamar Johnson. His stepchildren were: Shepherd Smith; Margaret Lamar and husband David Gaar; Bill Fraser and wife Molly; Patricia Reeder and husband Jeff. He had a number of step-grandchildren, two great granddaughters and one great grandson. He also leaves behind long-time faithful friend of the family, Justina Villalobos. Ken was born in San Augustine on the 15th of September 1924 and grew up in Houston where he attended Lanier Junior High and Lamar Senior High schools. He began his college career at Texas A&M before going into the service. Ken spent 44 months in the Merchant Marines and U.S. Navy during World War II. He served 13 months in the Southwest Pacific participating in the New Guinea and Philippine Islands campaigns before being assigned to the Eighth Naval District Headquarters in New Orleans. Following his service he returned to The University of Texas where he was a member of the Kappa Alpha Order Fraternity and received his B.S. degree in geology in January 1950. Ken spent 35 years as an exploration geologist with one major oil company and several large independent oil companies and as a consulting geologist. He had a number of significant discoveries to his credit. During his time with different companies he lived in Shreveport and Lafayette, Louisiana, and in Beeville, Brenham, Lakeway and Houston. He was active in Lafayette Geological Society, Houston Geological and Corpus Christi Geological Society.

Allan Ronald Keown (B.S. '58), 79, passed away Sept. 25, 2014 in El Paso. He was born in Boston, Massachusetts and lived in El Paso since he was eight years old. He considered himself a true Texan. He graduated from Ysleta High School and The University of Texas at Austin where he earned a Bachelor of Science in geology. Upon graduation he earned a direct commission as a second lieutenant and served four years as a U.S. Army Medical Officer and Troop Commander at Fort Sam Houston. He was honorably discharged as a first lieutenant. After his discharge he, along with his partner Foster Drummond, operated Pearl Sales Company, a Mexican import firm, and Showhouse El Paso, a manufacturer's representative firm. They also operated Little Mexico, a curio shop, in the airport. For 41 years he served the legal community as a forensic document examiner (handwriting expert) and expert witness throughout the United States. He had a distinctive voice that led to a number of years of doing both radio and TV commercials as well as acting in two movies, "The Border" and "Fandango." He was a member of St. Luke United Methodist Church. He was a big fan of the Texas Longhorns and the Dallas Cowboys. He was preceded in death by his parents, Charles and Mildred Keown, and his brother, William. He is survived by his wife and best friend, Wanda; daughters, Kymberly Arnold and Kelly Pierce; grandchildren, Jeremy and Jason Smith; stepdaughters, Kathryn Wood and Diana Lucas; step-grandchildren, Steven and Jason Borrego, Jefferson, Anna and Michelle Lucas, two step-great-grandchildren Mikayla and Addison Borrego and one niece June Andrews. He is also survived by his dog, Archie

Lambert "Bert" Millholland Macy (B.S. '74), age 66, of Lawson, Missouri, born Feb. 11, 1948 in Newburg, New York, died Nov. 28, 2014. He was survived by his wife Stacy A. Macy (formerly, Stacy M. Andreas), his children Elizabeth Rogers of Stamford, Connecticut., Lambert Allan Macy of Denver, Colorado, Barbara Metallo of San Diego, California, and stepson Christopher Andreas Wilkinson of Lawson; grandchildren Catherine, Keira and Anna Rogers, and Cecelia and Gregory Metallo, brother to E. Herbert Macy, James Macy, and Virginia Renschen.

William L. Mantinband (B.A. '59), passed away on Dec. 30, 2014. Beloved husband of the late Edith Shapiro Mantinband; dear father and father-in-law of Shmuel (Sharon) Mantinband of Jerusalem, Israel, Yehoshua (Hadassah) Mantinband of Efrat, Israel, Monti (Cheryl) Mantinband, Rabbi Joel (Ophira) Mantinband of Yitzhar, Israel and Golda (David) Cohen; dear brother and brother-in-law of Carol (the late Abram) Ginsburg, Frank (Toni) Aaron and the late Daniel Aaron; dear grandfather of 21; dear great-grandfather of seven; our dear brother-in-law, uncle, cousin and friend.

Jerry Jordan McCauley (B.A. '49), 89, of Houston, passed away the 3rd of December 2014. He was born to George Wesley McCauley and Birdie Jane Delamar the 14th of January 1925 in Oklahoma City. Jerry was the youngest of six children. Throughout his life he lived many places including Wellington, Amarillo, Lubbock, Durango, and Lafayette, spending the remaining 51 years of his life in Houston. Jerry graduated from Lubbock High School in 1943. Wanting to support the war efforts with his brothers and sister overseas, he tried to enlist in the U.S. Army Air Corps at the young age of 17. At 18 he earned his pilot's wings and was commissioned as a lieutenant, serving from 1943 to 1945. Following his service he attended The University of Texas at Austin, and graduated with a degree in geology. There Jerry lettered in football in 1945 and 1946 playing alongside his friends and teammates, Tom Landry, Hub Bechtol and Bobby Lane. He often spoke fondly of his days on the football field and religiously watched the Longhorns play every season. After graduation from UT, he continued his football career with the Colts. Jerry spent the rest of his life working in the oil industry. Beginning as a geologist, he loved mapping areas around the U.S., had several business ventures with his brothers Dan and Worth, and eventually opened several of his own ventures, including J.J. McCauley, Inc., in 1981. Jerry was very active in the city of Houston. He served on the Board of Directors for the Briar Club, Houston Log Library and the Society of Independent Professional Earth Scientists. He enjoyed his daily exercise: swimming at the Briar Club, playing a weekly game of golf and keeping up with his neighbors in Oak Estates. Jerry married his wife of 50 years, Jaqueline "Jackie" Gilbert, the 1st of October 1955 in Beaumont, Texas. Jerry and Jackie moved to Houston in 1963. Preceding Jerry in death are his wife, Jaqueline Gilbert McCauley; daughter, Anne McCauley Hedgcoxe; his beloved parents; and his brothers: Worth, Jack, Harris and Dan. Jerry is survived by his daughters, Lynn McCauley Block and husband, David Block, of Alpine, Wyoming; Sue McCauley Vaden and husband, Dr. Pete Vaden, of Uvalde, Texas; his son-in-law, Reif Hedgcoxe of Houston; and his eight grandchildren. In addition, he is survived by his sister, Georgene McCauley Watson, of Montevallo, Alabama, and brother-in-law, Edwin F. Gilbert of Houston.

Terrance R. Leary (B.S. '54), 84, of Saint Petersburg, passed away July 19, 2015. He was born in San Antonio, Jan. 28, 1931. Terry graduated from The University of Texas at Austin and received his bachelor's in Journalism and Marine Biology. He was a veteran of the United States Air Force. Terry was a Marine Biologist for the state of Texas and Gulf of Mexico Fisheries Management Council. He was an avid reader and enjoyed caring for his orchids and mango tree. Terrance is survived by his daughter, Kathleen Crotts, her husband Robert; former wife, Sandy Williams; grand-dogs, Brady, Maggie, and Daisy; many cousins, nieces and nephews.

Loring G. Lemmon (B.A. '60) passed away quietly in the home of his son, Zack Lemmon, in Sandy, Ore., on the morning of Jan. 26, 2015. Loring was born in Christiansburg, Montgomery County, Va. A longtime resident of Radford, Va., he developed friendships in childhood that he carried throughout his life. Loring grew up loving nature and animals of all kinds, particularly dogs. He was a kind man that showed great care towards all things that he was a steward over. He was the epitome of a Southern gentleman, bred with good manners and charm. Loring served in the U.S. Air Force and was a veteran of the Korean War. He received his bachelor's degree from University of Texas at Austin and spent much of his career working for the Boy Scouts of America. Loring was a faithful member of the LDS Church and served in many and varied callings during his life. He and his family joined the church in 1969 and were later sealed as a family in the Washington D.C. LDS Temple. Loring was a dedicated husband of more than 50 years. He was a kind and loving father who loved his children and his family meant everything to him. He was known as a man of integrity and principle. Loring is survived by his two children, Zack Lemmon and Elizabeth L. Chandler; six grandchildren, three great-grandchildren, and his brother, Carson. He was preceded in death by his wife, Elizabeth Reed Stoms; his mother, Mary Frances Gladstone Lemmon and his father, Carson Loring Lemmon.

James C. Loomis (B.S. '51) died at his home in Bulverde, Texas, on Aug. 15, 2015 at age 87. During the past year Jim frequently expressed his satisfaction with his long, full life. Jim was raised on the Florida coast, free to explore land, beach and sea. After graduating from The University of Texas at Austin in 1951 with a geology degree, Jim entered the Navy for four years of service in Japan during the Korean War. After his military service, Jim worked as an oil exploration geologist in Columbia traveling for weeks at a time by foot and mule into the backcountry. In 1985 he retired from a 24 year career with IBM to maintain the Loomis Finca, and to pursue his lifelong interests in travel and nature. Jim loved birds: he raised toucans in Bogota, exotic finches in Alamo Heights, and screech owls in Bulverde. For over 40 years Jim shared hunting leases with friends and IBM colleagues; joined infamous "wet" boating/camping trips to Lake Amistad and, for over a decade, enjoyed an annual road trip to West Texas with the BBEF (Big Bend Expeditionary Force). In recent years, although they no longer hunted or vacationed together, the friends dined at El Jarro twice a month with "campfire" stories getting better with time. His wife, Claire Holliday, knew that she would have an adventurous life when she married Jim in 1989. As a geologist, map maker, and explorer, Jim loved traveling in familiar and foreign landscapes. Travel destinations included the Far East, South America and Europe. Numerous trips to Mexico were followed by many trips to Spain which allowed them to better understand the culture and history of Mexico, a country they loved. As volunteers for the Texas Nature Conservancy, they had unique opportunities to enjoy camping and working to preserve some very special places in Texas. Jim also had a fine artistic eye, with a special interest in metalwork, and blacksmithing in particular. At one time, he had a complete blacksmith shop at home and he loved to fire up his forge and create an original tool from hot iron. Jim created impressive outdoor sculptures from salvage yard relics. He was never bored, and had his "to do" list in his pocket every day. Jim is survived by his wife, Claire, and his three children from previous marriages: Nancy Wilson and her partner Gary First, Will Loomis and his wife Jeannie, Mark Loomis and his wife Kathleen; and grandchildren Hannah Wilson and Mark's son Stephen Loomis. Jim was preceded in death by Nancy's daughter, Erin Wilson, and by Mark's daughter Sarah Loomis. Jim was also preceded in death by his two prior wives: Merry Blue Molteni and Suzanne Turner Loomis.

Donald G. Metzger (B.S. '48) of Phoenix, passed away on May 1, 2015 at 92 years old. Don attended The University of Texas receiving a bachelor of science in geology. He served in the United States Army where he was stationed in Okinawa and Korea. He worked for the United States Geological Survey from 1948 until his retirement in 1972. He married Shirley in 1949 and they were together until her death in 2012. He is survived by his daughters Stephanie, Dennise, Sharon and sister Virginia of Huntsville.

Robert "Al" Moore (B.S. '52), 84, of Yukon, Oklahoma, passed away March 15, 2015 due to complications with leukemia. He was born June 26, 1930 in McAlester, Oklahoma. He was preceded in death by his wife Marita Joyce Moore, mother Irene White Moore, father Bob Moore; sister Betty Nicholl; and nephew Bobby Nicholl. Al graduated with a Bachelor of Science from The University of Texas; and served in the United States Air Force during the Korean Conflict — honorably discharged at the rank of Captain. Al married Marita Joyce Malacord on Aug. 2, 1958. Together the family moved from Tulsa, Oklahoma to Dallas in 1963. They lived in St. Paul, Minnesota for six years and later moved to Yukon, Oklahoma in 1973. In 1962 he joined 3M Company in Dallas and shortly thereafter was promoted and moved his family to St Paul, Minnesota to lead the headquarters marketing department for the electrical wiring and components division. In 1971, Al was offered a new position in 3M to open the Oklahoma City Medical Division as a senior sales representative. He was extremely successful and highly respected in his career field and retired in 1998 to enjoy his passions in tennis and traveling. Al was known as the life of the party, enjoying each and every moment of every day. He was an avid tennis player and loved attending philharmonic concerts. Al was a renaissance man who supported many philanthropic charities to financially and spiritually help those in need. Al loved travel with his family, including ski trips, cruises to Europe and Alaska, and especially touring wineries around the country. Al is survived by his two sons, Richard "Rusty" Martin Alford (Owasso, Oklahoma) and Robert Daryl Moore (Oklahoma City) daughter, Pamela Kaylor Moore (Irving) three grandchildren, Jessica Nicole Wolf and husband, Brad Wolf (Oklahoma City), Chodey Rhae Moore (Irving), and Staci Cox and husband Colt Cox (Norman, Oklahoma); step-granddaughter Jill Waring; and favorite cousin Karen Jo Anderson; as well as five loving great-grandchildren that will forever be impacted by his generosity and love.

Gustave Allan Nelson (B.S. '47), 92, passed away Jan. 21, 2015 in Boulder, Colorado. He was born May 6, 1922 in Summit, New Jersey to Gustaf Albert and Olga Elizabeth Olson Nelson. He graduated from Summit High School in 1940. Serving as a member of the U.S. Army, he was in the Battle of the Bulge on the first day of the initial assault. He served honorably and received a Purple Heart at the Remagen Bridge. Returning from his army service, he attended The University of Texas where he graduated in 1947 receiving his Bachelor of Science in geology. He met and courted Ruth Virginia Kentta, 2nd Lt. army veteran, and they were married June 25, 1954 in the Augustana Lutheran Church in Denver, Colorado. G. Allan became a consulting petroleum geologist in 1957 and worked in this capacity his entire life. He served as president of the Denver Round Table, Presidents Round Table, Petroleum Pioneers, Remagen Bridge Society; executive vice president of Big Brothers; and national president of the 99th Division Association and as a member of the Denver Jaycees. He also was a member of the Rocky Mountain Association of Geologists-Wyoming, the Geologic Association, American Association of Petroleum Geologists and the Denver Well Logging Society, becoming an honorary lifetime member. After sharing 53 years of marriage, his beloved wife, Virginia, passed away in 2007. He is survived by his two children, Elizabeth "Libby" Nelson Crouch (husband, Scott) and Jon Nelson (wife, Jennifer); five grandchildren, Morgan Crouch, Max Crouch, Henry Crouch, Brooklyn Nelson and Byron Nelson. He was preceded in death by his brother, Robert Nelson.

A. M. "Red" Olander (B.S. '48) dearly loved his family, colleagues, and friends as they loved him. He loved and served his Savior Jesus Christ who received him into His care on Tuesday, Jan. 13, 2015. He was preceded in death by his beloved wife of 59 years, Rose, his sister Johanna, and his son-in-law "Mac." Born to Arthur and Ellen Olander on June 5, 1925, in Taylor, Red had one sister, Johanna Olander Wimberley. Graduating from Hutto High School, Red attended and graduated from The University of Texas with a degree in geology. Red was a proud Longhorn! He also served in the U.S. Air Force. On Aug. 6, 1949, Red married Rose Marie Ballerstedt of Austin. Red began his career with Humble Oil and Refining Co. in 1948 after graduating from The University of Texas at Austin. Red's initial assignment was as a "computer" on seismic reflection crew, Party Six, in south Texas. He spent most of his career involved in seismic interpretation and was a strong advocate for the concept of integrating geophysical and geologic data in the development of petroleum prospects. Red retired as chief geophysicist of Exxon Co. USA in 1986 and was elected president of the Society of Exploration Geophysicists (SEG) in 1984. He considered that the high point of his exploration career. Red was fond of saying, "It was amazing to me that a Swedish farm boy from Hutto, Texas was elected SEG President." In retirement, Red would often reminisce about his long association with Party Six, his work in the Gulf Coast Division, and his SEG presidency and always spoke fondly of the people he worked with. Faithfully serving the Lord, Red served the Presbyterian Church USA on the local, state, and national level throughout his life. In churches in Florida, Louisiana and Texas, he was an elder and served in a variety of leadership capacities including but not limited to finance, stewardship, personnel, education and pastor search committees. Following his retirement, Red returned to his roots on the farm and in collaboration with 4-H and his former business colleague, he raised and showed Blonde DAquitane cattle. Proud of his Swedish heritage, he was a member of the Swedish Society VASA in Austin. Red was a truly amazing husband, father, grandfather, and great-grandfather and his family was his greatest joy and blessing. Rose and Red's four children are Rosellyn Olander McIver, Gary Olander, Maribeth Olander Story and David Olander. Rosellyn and her late husband, the Rev. Dr. Malcolm C. Mcver III have three daughters, Sara, Catherine, and Mary Elisabeth and one granddaughter, Zoey Rose. Gary and Grace Olander have one daughter, Carrie, and son-in-law, Brett Neal. Maribeth and her husband Dave Story have one daughter, Rebecca, one son David, daughter-in-law, Rose Ann, and one grandson, William. David and Debbie Olander have one daughter, Lauren, and one son, Hayden.

Janet Pritchett (Spouse of the late Joseph L. Pritchett, B.S. '46) leaves to cherish her memory, three sons, Joseph L. Pritchett III and his wife, Carol, Christopher F. Pritchett and his wife, Sheila, and Gregory E. Pritchett and his best friend, Debbie; five grandchildren, William C. Pritchett and his wife, Anita, Benjamin G. Pritchett and his wife, Amanda, Meghan P. Duplechin and her husband, Alex, Paul M. Pritchett and his wife, Katie and Joseph L. Pritchett IV and his wife, Katie; and seven great grandchildren.

Clyde M. Rascoe (B.S. '49) was born about 11 p.m. Sat., Nov. 13, 1921, in Franklin, Texas to Jack Uriah and Ollie Mae (Smith) Rasco. His early childhood was spent sharecropping cotton around the area of Fife, Texas. He graduated from Lohn School as Valedictorian in May 1938. He graduated from Texas Agricultural College in Arlington in 1940 with an associate's degree in Petroleum Engineering. He graduated from The University of Texas at Austin in Jan. 1949 with a Bachelor of Science degree in Geology. Clyde volunteered for the Air Corp Cadet Training Program in Lubbock in April of 1943. He flew a C-47 transport plane (Old Douglas DC-3). He was assigned to A-58 Air Base in Coulimer, France. He was credited with nine combat missions before the war was over May 5, 1945. Clyde was proud to be a part of the oil and gas industry. He worked for Magnolia Petroleum Company and Atlantic Refining Company before becoming an independent consulting geologist in 1954. Clyde had offices in Midland and Houston before settling in San Angelo in 1959. He started Merit Oil Company in October 1969 and became an independent oil operator. He also was a partner in Concho Gathering Company, a local natural gas gathering company which began in 1987. He was a member of the San Angelo Geological Society. Clyde was a founding member of Parents Without Partners, and considered the group members his family while raising

his daughter Lori as a single parent. He married the love of his life, Joanie Bringolf Harris, August 31, 1957. Even though their life together was short, he always said those five years were the best years of his life. Clyde was preceded in death by his father and mother, Jack and Ollie, his wife Joanie, his brother John "J.W." Rasco, and his sisters Opal Dalton, Floy Lewallen, Juanita Payne and Louise Morrison. He is survived by his sister Betty Dunn and husband Nelson of Arlington, his sister-in-law Leona Rasco of Arlington, his daughter Lori Potter and husband Dale of San Angelo, his step-daughter Bonn McSorley and husband Art of Pittsburgh, Pa., his stepson Chilton Harris and wife Joetta of Garland, granddaughter Kyrie Villa and husband John of San Angelo, grandson Nolan Potter of San Angelo, step-grandson Sheldon Hough and wife Bridget of Columbus, Ohio, and step-great granddaughter Zoe Hough of Columbus, Ohio.

Cecil Taylor Rhodes, Jr. (B.A. '49) lost his long battle with cancer on Saturday, Nov. 29, 2014, at the age of 87. He was born in Hearne, Texas to Mary Elizabeth Jackson Rhodes and Cecil Taylor Rhodes, Sr. on Jan. 19, 1927. After attending schools in Hearne, Cecil served in the U.S. Army in Japan at the end of World War II, returning to finish his degree in geophysical science at The University of Texas at Austin. Cecil worked in oil exploration for Petty and later Phillips Petroleum Company for 36 years. In Aug. of 1962 he married Margaret June Scott. Their first home was in Brisbane, Queensland, Australia. They also lived in Perth, West Australia, Bogota, Colombia, Bartlesville, Oklahoma, and Houston. Their first child, Scott Alan, was born in 1963, and daughter Kerry Ellen in 1966. His family was the greatest pride and joy of his life. He is survived by his wife June; daughter Kerry; son Scott and his wife Kris and their sons Jonathan and Jeremiah; sister Beth Allen; nephews Dave Scott, Rob Rhodes and Steve Allen; nieces Janet Allen, Nancy Allen, Denise Castilleja, Diane Rhodes and Ann McFarland. Cecil will be greatly missed, but he will live in the many happy memories we have of him.

Ron Robinson (B.S. '58) After a full and wonderful life, Ronald Steigler Robinson departed to his eternal home Feb.11, 2015 joining his parents, youngest sister Jan, and beloved grandson Henry. Ron was surrounded in love by Carolyn, his wife of more than 56 years, and his three children. Ron was born June 11, 1935 in Hot Springs, the first of four children born to Henry and Virginia Steigler Robinson. He attended The University of Texas in Austin where he met the love of his life, Carolyn Howell. Ron was a loving husband to Carolyn, proud father of Jeffrey, Adrienne Ann, and Paige Marie, and doting grandfather to seven grandchildren. Ron's career was real estate and he enjoyed many interests including art, hunting, fishing and raising cattle. He never met a stranger. His genuine interest in those he met was sincere and created special bonds of trust and camaraderie. Above all things, Ron gave honor to the Lord Jesus Christ. He was an active member of First United Methodist Church in El Dorado where he served as Sunday school teacher, lay leader and lay preacher. His faith was strong and unwavering. He understood he was blessed to be a blessing and attributed his successes to God, living in faithful service and witness for Jesus Christ. He is survived by his wife Carolyn, three children, and their spouses; Jeffrey and Katie Robinson, Adrienne Ann and Dick Ilseman, and Paige Marie and DJ Davis. He is also survived by six grandchildren who loved their "Pop Pop" very much; Carolyn Reeves Robinson, Emma Rose and Susannah Ilseman, and Sydney, Robert, and Sophie Davis. He is also survived by his brother Ray, sister Judy, and numerous cousins, nephews, and nieces. Ron will be remembered as a loving husband, father, uncle, grandfather, friend, and inspiration to all who knew him. He set an example through his integrity, loyalty, courage, humor, honesty and faith. Next to his name in his high school yearbook is written, "If it be a gentleman and scholar that you seek, you have found him." Indeed.

Evan Fletcher Schulz (B.S. '78), our beloved Son of God, went to be with the Lord on June 20, 2015 with family and friends by his side. He was born on July 19, 1955 to Elmo and Claire Schulz in Houston He was a loving husband, devoted father, loyal friend and accomplished geologist as owner of Apex Energy. Evan was a proud graduate of The University of Texas at Austin and a lifetime Longhorn fan. Evan was our inspiration in life. He was a gentle giant with a heart of gold. He always had a smile on his face and a kind word for everyone he met. Evan was a family man whose greatest joy in life was watching his sons compete and excel in sports. He never missed an opportunity to be a part of their lives. Evan's generosity and compassion extended not only to family and friends, but also to business acquaintances and complete strangers in need. He was always quick to lend a helping hand. Evan married his best friend and love of his life Judith in 1996. They loved scuba diving in Cozumel, skiing in Telluride, traveling the world, and just hanging out with their family in Austin and in Corpus Christi. They built a life of love and memories that will live on forever; a love that only comes along once in a lifetime. Evan is preceded in death by his parents, and father-in-law Bruce Survant. Evan is survived by his angel and the love of his life, Judy Schulz; his sons, Evan, Skylar, Ian and Drake Schulz; brother, Clinton (Gayle) Schulz; sister, Deane (Alan) Gremmel; nieces, Katrina (Timothy) Boughal, Heidi (Doug) Gesler, Michelle Gremmel and Courtney Gremmel; nephew, Eric Schulz; in-laws, Lynn and Lon Hipp, Jay (Ali) Survant, Corey (Erin) Survant; nieces and nephews, Wyatt, Becca, Ava and Ella Survant.

Robert T. Sellars (B.S. '57) passed away July 22, 2015, at the age of 81 in Highlands Ranch, Colo. Robert was born in Decatur to parents Johnnie Mae and Robert T. Sellars Sr. Robert is survived by his loving wife of 39 years, Sharon of Highlands Ranch, Colo., daughters Kathryn Sellars of Denver, Colo., Kay (Kevin) Hulstrom of Mead, Colo., and Kara (Ross) Ullrich of Centennial, Colo.; Grandchildren, Chandler & Melissa Hulstrom, Aiden & Eion Smyrnios, brother Dr. Richard W. (Judy) Sellars of Santa Fe, N.M., and sister Sally (Jim) Florian of Decatur. Robert received his Ph.D. from Tulane University in 1966 and worked for Kerr McGhee, Louisiana Land, and Exploration Club Oil and Gas. He was a member of the Rocky Mountain Association of Geologists and AAPG. Robert enjoyed the outdoors by golfing, fly fishing or hiking.

Coyle Edward Singletary, Jr. (B.S. '48), 91, of Midland passed away surrounded by his family on Dec. 13, 2014. Coyle was born on June 28, 1923 in Palestine, Texas to Coyle Sr. and Ollie Singletary. He enlisted in the United States Army from July 28, 1944, to June 30, 1946, and was discharged honorably as a private first class. Coyle received his master's in geography from The University of Texas and became a faithful employee of the oil industry. Most of his career was spent as a petroleum geologist with Union Oil Company and Marathon Oil, but his first priority was always his family. On June 5, 1949 in Texarkana Coyle married the love of his life, Dorothy Mckeehan. Together the couple raised three children, Coyle Edward III, John, and Dorothy (Dotti). Coyle and Dorothy were faithful members of Memorial Christian Church of Midland and he also contributed time to the Boy Scouts of America. He was a very loving, generous man with an enormous heart and a soft spot for his dogs. He loved traveling with his family and spending time outdoors, especially if they were camping or exploring in his RoadTrek. He will be greatly missed by his family and friends. He is preceded in death by his parents, Ollie Pate Singletary and Coyle Edward Singletary, Sr., and one brother, John Thomas Singletary. Coyle is survived by his loving wife of 68 years, Dorothy Singletary; son, Edward Singletary and wife, Carol; son, John Singletary and wife, Terra; and his daughter, Dotti Franz and husband, Charley; and his three grandsons, Eric, Ben and Marshall Singletary.

Frederick Arlick Skidmore, Jr. (B.S. '56) was born on Jan. 14, 1933 to Annie and Fred Skidmore in Dallas and peacefully went home to His Savior Jesus Christ on Feb. 7, 2015. Before graduating from Sunset High School in Dallas, Fred was the quarterback for the 1950 State City Conference Champions Sunset Bisons. He played football at The University of Texas, graduating in 1956 with a B.S. in Geology. After working for Atlantic Refining Company in Guatemala, Fred returned to The University of Texas, earning a master's degree in petroleum engineering while coaching the Longhorn's freshman football team. Fred worked for Texaco in West Texas, Texas Pacific Oil Company, and other independent companies before forming his own consulting company, CoSap. The consulting business took him to work in the Austin chalk of South Texas, and in the degasification of coal mines in methane gas production in Oklahoma, Pennsylvania, Alabama and West Virginia, as well as the Czech Republic and Australia. While Fred enjoyed supporting his family through work and sharing stories of his travels, he also enjoyed coaching his son's elementary school's football team and cheering for his children's and grandchildren's activities. Fred was a charter member of Park Cities Presbyterian Church, faithfully serving as a deacon, lead usher and hosting a small group Bible Study with friends. If Fred wasn't at the church or consulting, he could be found on the tennis courts at Royal Oaks Country Club, and in later years the local University Park tennis courts, sharing his love of the game with his wife, friends, daughter and grandchildren. He was married on Valentine's Day to Peggy Weddington Skidmore for 42 years. He has four children: Fred Skidmore, III; Todd Skidmore, wife Robin and children John Todd and Caleb; daughter Eugenia Skidmore Fersing, husband David and children Allie, Brittany and Maggie; step-son Tommy Reynolds, wife Michele and children Austin and Courtney.

John Daniel Slay (B.A. '51) passed away in the morning of December 30. He was born Nov. 5, 1931 in Dallas. His parents were Esther Henderson Slay and Frank Conley Slay. His schooling began at Mrs. Bender's preparatory classes, then Rosemont Elementary School, and Sunset High school. John graduated from The University of Texas at Austin in 1951. While serving in the U.S. Air Force during the Korean War he began as basic assistant flight chief, later he graduated from the Defense Language Institute course on the Russian language. He served on the St. Lawrence Island, Alaska. John married Bettye Ann Palmer in 1957 at Tyler Street UMC. John loved life as seen in his enthusiasm, optimism, generosity, gratitude and the manner in which he cherished his family and friends. He is survived by his wife, Bettye; his children, John Slay, Laura

Gibbons, Mary Bass, Anne Scholz; his daughters husbands, Bill Bass, Joe Scholz, Michael Gibbons; grandchildren, John Patrick Scholz, Hannah Scholz, Joseph Scholz, William Bass, Sarah Gibbons and Caroline Gibbons; brother, Frank Slay; sister Sarah Chalk and husband Jeff D. Chalk III and their children; Jeff Chalk, Rebecca Krueger, Phillip Chalk and Priscilla Oliphant.

Glen E. Taylor (B.S. '56) passed away peacefully on Aug. 10, 2015. He was born July 1, 1931, in Amarillo, to Earl Sloan Taylor and Loma Gladys Wheat. He grew up in Sweetwater. After graduating from Sweetwater High School in 1948, he attended The University of Texas at Austin. While there, he joined the Marine Reserves and was called to active duty during the Korean War as part of the Special Services, specializing in underwater demolition. During this time, he met and married his wife of nearly 64 years, Barbara Wilks. After leaving the Marines, he returned to Austin, where he completed degrees in Geophysics and Law at the university, later teaching Law at the University of Colorado-Boulder. He then moved to Washington, DC, serving in the Justice Department as Head of the Lands and Minerals Division during the Johnson administration. He then went to work for British Petroleum and was instrumental in opening up the Alaskan Pipeline. He later moved from New York to the San Francisco area. While there, he worked for Natomas, staying with the company until moving to Houston in order to work with Tenneco. Moving to Austin in 1989, he became Chief Legal Counsel of Lower Colorado River Authority, helping to reorganize the company. He worked there until retiring in 1997. He and Barbara were able to travel to many places, including Russia, Switzerland, France, Morocco, The Netherlands and more. He is survived by his wife, Barbara, his daughters Jessica Taylor, Jennifer Bridges and Hillary Branda, as well as his sisters Linda Duncan and Patty Walker. Glen also had four grandchildren and many nieces and nephews.

Robert "Bob" Theodore Terriere (Ph.D. '60), born in Seattle on July 17, 1926, passed on Nov. 20, 2014. He is and will be missed by all those who knew and loved him. He is survived by his wife Betty of 56 years, children Betsy and Fred, grandchildren, Jacob and William, and Ryan, and great-grandson Braydon. Robert served in the USAAF during the very end of World War II. He later attended Cal Tech where he obtained his bachelor's degree. He went on to receive his master's from Penn State, and his Ph.D. from The University of Texas. He lived in Lakewood, Colorado for the past 36 years. He spent his career first with the USGS and later in research in the oil industry.

Lloyd "Rex" Travis, Jr. (B.A. '48) was born on Aug.20, 1922, in Ganado, Texas, to Lloyd Rex Travis, Sr. and Eunice Holt Travis. He married Marie Ross Sagesar on Jan. 12, 1951, in Stephenville, Texas. Rex attended The University of Texas for three years, where he played baseball, then joined the Marines and fought in World War II. Once the war was over, he returned to UT Austin and obtained his degree. He worked for Exxon, 33 years as a geophysicist, until he retired and opened his own consulting firm. Rex was a member of the Katy VFW and St. Peter's United Methodist Church. He loved to travel and his greatest passions were watching the Houston Astros play ball and watching the Katy Tigers football team. Rex passed away at home in Katy surrounded by his loved ones on Sunday, Feb. 15, 2015. He is survived by his grandchildren; Teri and her husband, Todd Gay, David Anderson, Amy Flanagan-Parker, and Lynn Anderson; four great grandchildren; brother in law, Bill Ross and his wife, Carolyn Ross; five nieces and one nephew. He is preceded in death by his wife, Marie Travis; daughter, Pamela Anderson; father, Lloyd Travis, Sr.; mother, Eunice Holt; step-mother, Fanny Travis; sister, Dorothy Childress; and granddaughter, Gina Anderson.

John Theodore Twining (B.S. '48, M.A. '54), 93, passed away in Houston on Oct.25, 2014. Born Dec. 6, 1920 in Kipton, Ohio, he lived throughout Texas in Austin, El Paso, and Corpus Christi, and in Covington, Louisiana. He obtained his Bachelor and Master of Science from The University of Texas and was a staff sergeant in the U.S. Army Air Corps serving during World War II. John was a staff paleontologist at Shell Oil until retiring in 1985. During his retirement, he became a certified Texas master gardener. Survivors include his wife of 60 years, Jeanne, sons Tom, Tedd, Tim and his wife Laine, granddaughter Jessica, niece Rose Marie and her husband Pete, nieces Elizabeth and Justine, nephew Norman "Duke" and his wife Lynne, great-nieces Genei, Dawn, Royana and her children Isaac and Janie. John was preceded in death by his parents Isaac and Rose and his sister Blanche.

Robert Chan Tysor, Sr. (B.A. '52) passed away on Jan.10, 2015. He is survived by his wife of 60 years, Johanna Tysor; their five children and their spouses, Susan Lloyd (Robert), Janet Klem (Patrick), Robert Chan Tysor Jr. (Mary), Alice Maynard (Jeff) and Roger Tysor; 15 grandchildren; his brother James Tysor (Fran); and his niece and nephews. Chan was born Jan.3, 1931 in Dallas and was raised in the Oak Cliff area. He graduated from Crozier Tech High School at the age of 16 and attended The University of Texas at Austin. Chan graduated from UT with a B.S. in Geology, and then enlisted in the U.S. Navy during the Korean War. In 1954 Chan married the love of his life, Johanna Barnes. He was widely recognized as one of the most knowledgeable and most successful petroleum geologists in the Texas gulf coast region. He began his career at Amoco, then moved to Davis Oil in the 1970s. He later worked with a number of independents and continued his passion until very recently through his own company, Tysor Oil and Gas and Associates. Chan was the kind of father everyone would like to have. He was the person you could always go to for good advice and understanding. He was a loving and generous husband. Chan will be missed for his sense of humor and his positive outlook on life. He was a lifelong Longhorn fan and was proud that all five of his children graduated from UT.

Julie Anne Ullrich (B.S. '76), 60, of Houston, passed away peacefully in her sleep on Dec. 30, 2014. She was born on Jan. 18, 1954 in Oklahoma City to Gaston and Betty Jane Broyles. She married Martin S. Ullrich on Oct. 1, 1977. Julie was a long time resident of West University Place. She graduated from Sharpstown High School in 1972 and The University of Texas in 1976 with a B.S. in Geology. She was a longtime volunteer with the Girl Scouts of America San Jacinto Council, serving as troop leader for her daughters. Julie is preceded in death by her husband, Martin, and parents, Gaston and Betty Jane. She is survived by her three daughters, Betty Ganske of San Antonio, Anne Ullrich and Marie Ullrich of Houston; her granddaughter, Evelyn and grandson, August, both of San Antonio; and her brother Gaston Broyles, Jr. of Austin.

Ben Taylor Whitefield (B.S. '60) died on Thursday March 19th in Corpus Christi. He is survived his wife of 50 years, his son and daughter. Ben was born in Houston on April 6, 1937. He worked in the oil and gas business after graduating from The University of Texas at Austin in 1960.

Robert Joseph Whitson (B.S. '85) passed away on May 23, 2015. He was 52 years old. He was born to Patricia Wales and James A. Whitson Jr. on June 14, 1962, and grew up in Houston. He attended Memorial High School and The University of Texas where he actively participated in the KA fraternity and was a Silver Spur. He graduated with a geology degree and worked with his father and partners for several years before joining Unit Petroleum where he worked for 16 years. He was a vital part of his father's last few months managing the family business. He married Pamela Haskins in 1993 and they had two children, Wesley and Zachary, during their 19 year marriage. Robert was an active outdoorsman enjoying hunting and fishing and cherished time spent with his father, uncle, sons and friends. He also loved cooking and valued family trips out on his boat and family time in Hunt and Grand Cayman. His two boys were the greatest joy of his life. He will always be remembered for his wonderful sense of humor. He is predeceased by his father, Jim Whitson, and his sister, Patricia. He is survived by his children, Wesley and Zachary, his former wife, Pam Whitson, his mother, Patricia Wales, his sister, Patrice Jegi and her husband Doug and children Sophia and Miles, and stepmom, Paula Whitson.

John William Wood (Ph.D. '65) of Dripping Springs was born in Hazlehurst, Mississippi, on April 2, 1929, and died in Austin on Feb. 13, 2015. His parents were Katherine Slane Wood and Claude Sandifer Wood. He graduated from Hazlehurst High School in 1947, and received a degree in geology from Mississippi State College in 1954. He completed a degree in geology from Texas Technological College in 1956, and a Ph.D., also in geology, from The University of Texas at Austin in 1965. John served his country during the Korean Conflict with the 40th Infantry Division in Japan and Korea from 1951 to 1953. He married Nancy Amelia Smith on June 6, 1953, at the Pleasant Valley Methodist Church in Allen, Mississippi. John was an instructor in the Department of Geology at Texas Tech from 1955 to 1959. After completion of his degree from The University of Texas, he worked as a geologist with Texaco, Inc., spending most of his career as a carbonate research geologist in Texaco's central research department for petroleum exploration and production technology in Houston. His retirement years were spent at Dripping Springs, in the beautiful Texas Hill Country. He is survived by his wife, Nancy Amelia Smith Wood; their daughters, Nancy (Nan) Wood Hanus and her husband, Matthew C Lewis; Amy Rebecca Wood and her husband, Todd W Shaw; grandchildren Joseph Jeremiah Hanus and his wife Jessica, Violet May Hanus, and Ian Wood Shaw; and great-grandchildren, Elijah Forrest Hanus and Valentine Rose Morgia.

The staff and members of the Jackson School of Geosciences community would like to convey our respects to the families of the following alumni and friends:

George G. Tubb (BA '46)
Scott J. Harden (BA '81)

Faculty

Daniel Stephen Barker (F.M. Bullard Professor of Geology Emeritus at The University of Texas at Austin's Jackson School of Geosciences) died May 21, 2015, in Austin. He was born in Waltham, Massachusetts, on Feb.27, 1934, the only child of Kenneth Watson Barker and Sadie Brown Barker. Raised in rural Maine, he was probably the last UT faculty member to be educated in a one-room schoolhouse. After graduating in 1952 as valedictorian from Cony High School in Augusta, Maine, he attended Yale University on full scholarships, graduating magna cum laude in 1956. He then earned his M.S. in Geology in 1958 at the California Institute of Technology, and in 1961, his Ph.D. from Princeton University.

He came to Austin in 1963 and stuck. In 1964 he and Barbara Catherine Mackin wed and produced Molly in 1965 and Amy in 1967. These they considered their finest achievements. He and Barbara remained the best of friends long after their marriage ended in 1984, until her death in 2002. In 1994 Dan and Rosemary Brant married, in a joyous union that lasted until her death in 2006. He is survived by his daughters and sons-in-law Molly and Billy Gray of Austin, and Amy and Mark Rielly of Needham, Massachusetts; a grandson, Mackin Murphy Rielly; a granddaughter, Sadie Fallon Daphne Rielly; and a step-granddaughter, Paloma Gray. Four first cousins, Jane E. Barker, Ph.D. of Bar Harbor, Maine, Judith B. Carducci of Hudson, Ohio, Donald C. Freeman, Jr. of Brewster, Massachusetts, and Hank Freeman of Provo, Utah, also survive him, as does his cat, Big Joe.

Dan enjoyed 36 years of teaching and research at the University. He supervised seven doctoral students and 11 master's students. He demanded that each come up with his or her own original research topic and write a proposal that competed with him for his endowed research funds. His colleagues benefited from his enthusiastic help and cheerful humor. He inherited great empathy for animals from his grandfather, Maine farmer Zebediah Barker, of whom it was said, "His animals were always glad to see him." Colleagues and students felt the same way about Dan.

In the undergraduate classroom, his approach was traditional, but engaging. For graduate students, he produced a teaching collection that forced them to think independently and on their feet. And he had nearly one of everything, acquired on vacation and on field trips with experts that spanned the globe. His stories from those expeditions provided a colorful backdrop for the science. His lecture notes and reference lists were up to date. At 10 a.m. on Tuesdays he could be found at the new acquisitions table in the Walter Geology Library.

In 1994, Dan was awarded the Jubilee Medal of the Geological Society of South Africa, and the Knebel Distinguished teaching Award in the Department of Geological Sciences in 1976, 1980, and 1987. In 1991 and 1999, the College of Natural Sciences conferred on him the Teaching Excellence Award. He was most gratified when students called him Obi-Wan. He was a senior fellow of the Mineralogical Society of America and the Geological Society of America, and received several research grants from the National Science Foundation. Dan was a Fulbright Senior Research Fellow in Denmark in 1974. He published a textbook, several guidebooks, five encyclopedia articles and more than 50 peer-reviewed papers and book chapters. Dan believed in careful study of rocks as key to understanding how the earth works, and he collected samples all over the world, from Greenland to the Cape Verdes, Scotland to Italy, New Zealand to Namibia, Easter Island to Patagonia and Japan to Turkey. During these travels, he met many strangers, some of whom were not very nice. His enthusiasm for collecting inspired his colleagues to do the same. In 2013, he made a substantial contribution to start the Jackson School of Geosciences International Rock Collection Endowment, a resource for teaching and research that will be useful to geologists all over the world.

Dan retired in 1999, but continued his research. He made a variety of contributions to the University of Texas Digital Repository, a resource that can be searched and accessed online. Included are PowerPoint slide shows on igneous rocks and folders of published and unpublished data. All geologists, specialists and non-specialists alike, will find some material to enjoy among Dan's catalog of work.

Travel, photography, pipe smoking, classical music, reading, New York Times Sunday crossword puzzles, food and family were among his loves. He enjoyed puns, even good ones, and tried to hide Down-East humor that "was so dry it made your nose bleed," according to one friend. He thought he had a good life.

Memorial gifts in Dan's memory can be directed to the endowment he created, The Jackson School International Rock Collection. Contact the Development and Alumni office for further assistance.

The University of Texas at Austin

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2015 JACKSON SCHOOL OF GEOSCIENCES CONTRIBUTION FORM

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Contributions are tax-deductible and may be mailed to the Development Office, Jackson School of Geosciences, 2305 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*.

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2015 JACKSON SCHOOL OF GEOSCIENCES ALUMNI NEWS UPDATE SUBMISSION FORM

All personal and work 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, former researchers, faculty and staff affiliated with JSG and its research units are encouraged to submit. If you are not receiving the *Newsletter* in the mail, this form will ensure you receive future copies.

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Class Notes for the 2016 Newsletter

Attach a separate sheet or use the online form at **www.jsg.utexas.edu/alumni** for longer entries.

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❍ Alumni events in your area or at upcoming geoscience meetings
❍ Mentoring and recruiting students
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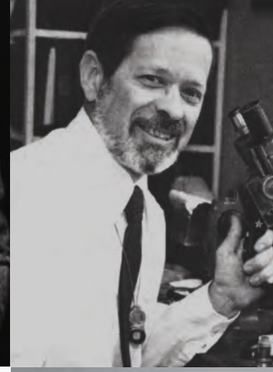



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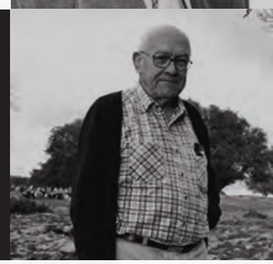
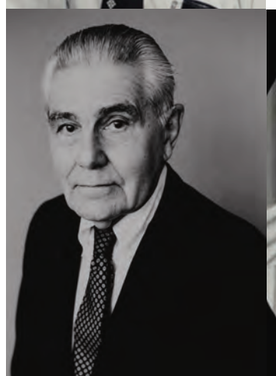
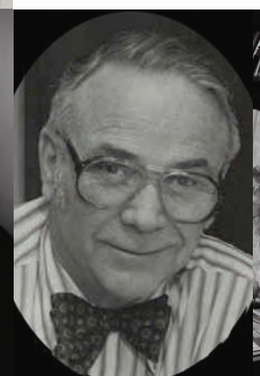

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