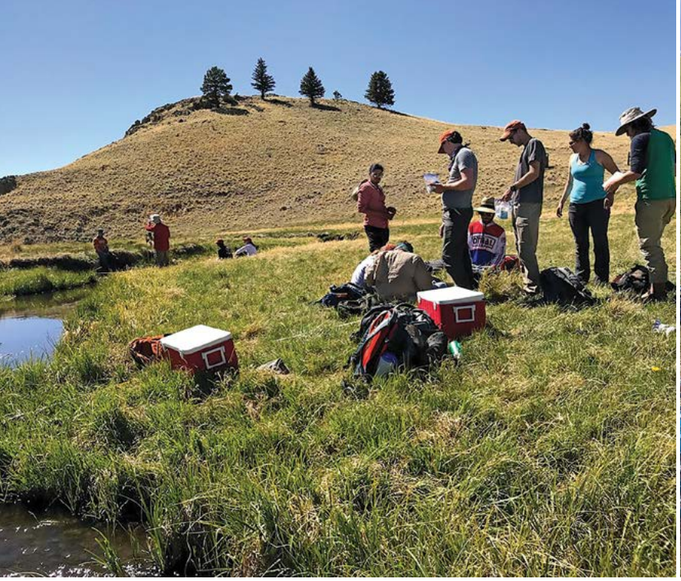
THE UNIVERSITY OF TEXAS AT AUSTIN · JACKSON SCHOOL OF GEOSCIENCES · 2018 NEWSLETTER

2018

Newsletter

A Peek Inside the Jackson School's Collections

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



THANK YOU

Your gifts help students achieve their dreams.

WELCOME

Dear Alumni and Friends

It's been another incredibly busy and exciting year at the Jackson School of Geosciences, capped off by our new strategic plan, "Earth Transitions in Space and Time." The far-reaching document was several years in the making and includes input from throughout the school. It identifies the vision, objectives and priority areas for the school over the next 10 years in education, research, facilities and equity.

I encourage you to read the summary of the plan on page 106 and the full plan at www.jsg.utexas.edu. The stories in this year's *Newsletter* show the plan in action. The feature on page 68 about Leslie P. and Dianne White's wonderful donation of a Central Texas ranch and the school's plans to turn it into our first Texas Observatory is a great example. It embodies the type of interdisciplinary research and teaching we are pushing at the Jackson School to help understand and solve the major issues facing Texas and the world. The feature on page 58 about the research we conducted in the wake of Hurricane Harvey is another illustration of the type of research and education we are conducting to tackle issues that affect everyone.

The expertise and talent we have at the Jackson School is second to none. This was recently recognized nationally when the *U.S. News & World Report's* 2019 edition of "Best Graduate Schools" named us the No. 1 Geology program in the country. You can read about the rankings on page 4. This is a tremendous accomplishment that took the combined efforts of the entire Jackson School community. We should all be very proud.

One reason we are constantly looking to hire the best is that we have to replace those who move on. This year, a number of talented researchers and faculty have decided to retire, topped by founding Dean Bill Fisher, who has spent nearly 60 years at the University of Texas. Bill has had an astounding career and a major impact on the geosciences at UT and far beyond. It is an honor to count him as a colleague and friend, and I encourage you to read the story about his life and career on page 88.

We also said our final goodbye to a number of friends and colleagues this year. As you'll see in the memorials section, the list includes people who helped make the Jackson School the special place it is — Professors Emeriti Bob Folk, Milo Backus and Leonard Brown, as well as Ann Molineux, curator and collections manager at the Jackson School Museum of Earth History Non-vertebrate Paleontology Collections. They will be dearly missed.

On a lighter note, as the cover of the *Newsletter* highlights, we are featuring specimens from across the Jackson School's collections in this issue. Sometimes we forget that our amazing collections are not just scientifically valuable, but beautiful and inspiring. I hope you enjoy the photo spreads that begin on page 74.

Throughout the *Newsletter*, you will see nods to the fact that we have surpassed more than a century of teaching students in our signature field camps. I know many of you have fond memories of these camps, just as I do. We should all take pride in the fact that even as other schools are cutting back their field offerings, we continue to find more and more ways to get our students the hands-on field experiences that we all know are vital to training geoscientists. We couldn't do so without your support.

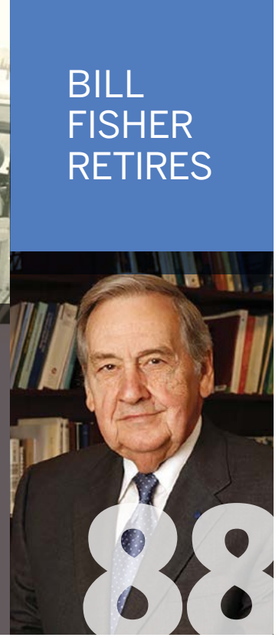
Thank you, and enjoy the *Newsletter*!

Sharon Mosher, Dean

COVER: THE BASEMENT OF THE JACKSON SCHOOL MUSEUM OF EARTH HISTORY VERTEBRATE PALEONTOLOGY COLLECTIONS.

ABOVE: STRUCTURES IN THE GRENVILLE AGE ALBANY-FRASER BELT IN WESTERN AUSTRALIA'S BREMER BAY.

FEATURES



IN THIS ISSUE

THE NEWSLETTER, A TRADITION SINCE 1950, IS PUBLISHED ANNUALLY FOR FRIENDS AND ALUMNI OF THE JACKSON SCHOOL OF GEOSCIENCES AT THE UNIVERSITY OF TEXAS AT AUSTIN.

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JACKSON SCHOOL STUDENTS SEND A HOOK 'EM FROM THE TATRA MOUNTAINS OF SLOVAKIA.

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

Jackson School Ranks No. 1

Research and Education Excellence

The University of Texas at Austin Jackson School of Geosciences has been ranked the No. 1 Geology program in the country by the *U.S. News & World Report's* 2019 edition of "Best Graduate Schools."

The prestigious rankings rate graduate programs throughout the country every four years. The Jackson School was also No. 7 in Earth Sciences (No. 3 among public universities) and No. 7 in Geophysics and Seismology (No. 2 among public universities) in the rankings released March 20, 2018.

"This is a testament to the exceptionally hard work and dedication of our faculty, researchers and students," said Jackson School Dean Sharon Mosher. "I'm tremendously proud of the achievements of everyone throughout the school and the leadership members of the Jackson School have exhibited on a national and international level. This external recognition of our work is an honor for all."

The school improved in all three categories since the 2015 rankings were released, when the Jackson School was ranked No. 5 in Geology, tied for No. 8 in Earth Sciences and unranked in Geophysics and Seismology.

Overall, UT had five programs ranked No. 1 and 49 schools and specialties ranked among the nation's top 10 in disciplines such as business, communications, education, engineering, information, fine arts, natural sciences, pharmacy, public affairs, social work and liberal arts.

Only two other public universities have as many top 10 graduate programs, and UT Austin has more top-ranked graduate programs than any other university in Texas.

"In every college, school and department at The University of Texas at Austin, there is innovative research, teaching and multidisciplinary collaboration taking place by our faculty and students," said UT President Gregory L. Fenves. "These national rankings reflect our focus on quality and our impact as a public flagship university."

U.S. News & World Report's graduate rankings, separate from the magazine's yearly ranking of undergraduate programs, are among the most widely regarded ratings in higher education. They are based on surveys of academic leaders.

RANKINGS: GABRIEL VILLASENOR. BUTTERFLY: CAMILLE PARMESAN.

Remote Fracture Mapping

Energy Geosciences

Over the past two years, the Bureau of Economic Geology's Advanced Energy Consortium has been conducting downhole tests of its electromagnetic proppants at the bureau's Devine Test Site in South Texas. The tests are run to help identify the location of proppants and fluids in hydraulic and natural fractures near the wellbore and in the interwell space with greater accuracy and can help scientists better understand fracture geometries, which influence oil and gas production and, ultimately, recovery within a field.

In 2017, researchers fracked a 300-foot-deep well using electromagnetic proppant in an effort to characterize the resulting fracture pattern. The results were validated with nearby offset wells that transected the fracture pattern. Fractures and proppant from the fracked well were clearly visible in the cores.

In 2018, as a secondary check, the bureau's Near Surface Observatory—with Principal Investigator Jeffrey Paine and Research Scientist Associate Lucie Costard—brought logging equipment to the site to log the new offset wells. They ran conductivity, gamma-ray and mini-resolution logs in the wells to sense the proppant in fractures and to correlate those readings with what is observed in the actual cores. Analysis of the results is ongoing, but the initial results of the experiment have been very positive.

"If we validate the experimental model with this test, we may one day soon be able to use this technology at scale," said Mohsen Ahmadian, a consortium program manager and lead researcher on the experiment.

EDITH'S CHECKERSPOT BUTTERFLY, THE SPECIES EXAMINED DURING THE STUDY.

Rapid Evolution Fails to Save Butterflies

Climate, Carbon & Geobiology

New research from the University of Plymouth and The University of Texas at Austin has found that adaption has its limits. The study examined a population of butterflies that adapted to a weed that was introduced with cattle ranching, but quickly died out when ranching ceased and the environment around the weed changed.

The research shows that while wild species can adapt quickly to human-induced changes, the adaption can cause species to be caught in deadly "eco-evolutionary traps" when resources are quickly taken away.

The findings were the cover story of the May 10, 2018, edition of *Nature*.

The researchers followed a large, isolated population of *Euphydryas* butterflies on a Nevada ranch that had historically fed on a native plant. The researchers documented how the population evolved complete dependence on a European weed introduced to Nevada with cattle ranching more than 100 years ago, and quickly died off when cattle ranching ended in 2005—a change that led to temperature changes around the weed that prevented butterfly caterpillars from developing.

European conservation biologists have long believed this type of process is underlying widespread butterfly population extinctions across Europe. However, in Europe, the evolution of dependence on human management occurred before anyone documented it. The researchers said that this study is the first that provides hard evidence of the process in real time.

Co-author Camille Parmesan, a professor at the University of Plymouth and the Jackson School of Geosciences, said the findings point to the need to mesh land management practices with conservation.

Satellites Reveal Room for Improvement for Water Storage Models

Surface & Hydrologic Processes

Research led by The University of Texas at Austin has found that computer models' estimates of water storage in river basins around the world can differ markedly from more direct measurements of values gathered by satellites.

The findings, published in the *Proceedings of the National Academy of Sciences* on Jan. 22, 2018, raise questions about global models that have been used in recent years to help assess water resources and potentially influence management decisions.

"People are depending more and more on global models to determine projections of the impacts of human water use and climate on water resources," said lead author Bridget Scanlon, a senior research scientist at the university's Bureau of Economic Geology. "We are now able to evaluate water storage changes from models with GRACE data, which suggests that the models may underestimate large water storage changes, both large declining and rising storage trends."

The study used measurements from GRACE satellites from 2002 to 2014 to determine water storage changes in 186 river basins around the world and compared the results with simulations made by seven commonly used models.

For example, in the Amazon River, GRACE data indicated that water storage increased by 41 to 43 cubic kilometers during the study period—the largest increase in water storage of any basin in the world. But most of the models projected huge declines in water storage, with one simulating a loss of 70 cubic kilometers. The model that most closely matched the GRACE data calculated an increase of only 11 cubic kilometers.

In the Ganges River basin, GRACE showed a loss of 12 to 17 cubic kilometers of water per year over the 12-year period—the biggest decrease in water storage measured by the study. The models range between a loss of 7 cubic kilometers and an increase of 7 cubic kilometers.

Overall, the model results calculated a decline in global water storage during the study period, while GRACE data indicated it was on the rise. However, the study notes that while the climate increased water storage globally, humans caused significant declines in certain regions. The study area covered about 63 percent of global land area and excluded Greenland and Antarctica because most of the water in those areas is trapped in glaciers or ice sheets.

MOUTHS OF THE AMAZON RIVER IN BRAZIL.

WATER MODELS: NASA. SUBGLACIAL LAKES: ANJA RUTISHAUSER.

LEFT: THE VAST LANDSCAPE OF THE DEVON ICE CAP.

RIGHT: A UTIG RESEARCH SCIENTIST OPERATES RADAR DURING A FLIGHT OVER THE ICE CAP.

Newly Discovered Salty Subglacial Lakes Could Help Search for Life in Solar System

Surface & Hydrologic Processes

Two newly discovered, subglacial lakes in the Canadian High Arctic could be a potential habitat for microbial life and may assist scientists in the search for life beyond Earth, particularly on Jupiter's icy moon Europa.

The findings, published April 11, 2018, in *Science Advances*, were made possible by airborne radar data acquired by the University of Texas Institute for Geophysics (UTIG) and NASA.

"Geophysically characterizing these lakes and their sub-ice surroundings, followed by very careful sampling of their contents, should give us a real head start on understanding Europa's potential for hosting life," said co-author Donald Blankenship, a UTIG senior research scientist.

There are more than 400 known subglacial lakes in the world, concentrated primarily in Antarctica with a few in Greenland, but these are the first found in the Canadian Arctic. Unlike all the others—which are thought to contain freshwater—these two appear to consist of extremely salty water. Their hypersalinity could make the lakes similar to those thought to be trapped inside the icy shell of Europa. In 2011, researchers from UTIG found evidence for such lakes on the Jovian moon.

An analysis of radar data shows that the lakes discovered in Canada are beneath 550 to 750 meters of ice under the Devon Ice Cap, one of the largest ice caps in the Canadian Arctic. They are thought to be the first isolated hypersaline subglacial lakes in the world, having no contact with an outside environment for thousands of years.

"If there is microbial life in these lakes, it has likely been under the ice for at least 120,000 years, so it likely evolved in isolation," said lead author Anja Rutishauser, a Ph.D. candidate at the University of Alberta who will join The University of Texas at Austin as a postdoctoral fellow when she finishes her degree.

By evaluating the airborne survey data and, eventually, samples from the lakes, scientists can better prepare for NASA's forthcoming Europa Clipper mission, which is expected to deploy similar remote sensing techniques to characterize Europa's ice shell. For the Clipper mission, Blankenship is leading the development of the ice-penetrating radar sounder, an instrument similar to the one used to discover the Canadian lakes.

UTIG's data acquisition and processing were supported by NASA's Instrument Concepts for Europa Exploration Program, the G. Unger Vetlesen Foundation and the National Science Foundation.

AN ARTIST'S INTERPRETATION OF THE RAINBOW DINO, CAIHONG JUJI.

Meet the Rainbow Dino

Climate, Carbon & Geobiology

Ancient dinosaurs were adorned in some amazing ways, from the horns of the triceratops to the plates and spikes of the stegosaurus. A newly described, bird-like dinosaur fossil from China contains evidence that could add a new accessory to the list: a shaggy ruff of rainbow feathers.

A team of researchers, including scientists from The University of Texas at Austin, are the first to conduct an in-depth study of the dinosaur. They dubbed it *Caihong juji*—a name that means "rainbow with the big crest" in Mandarin.

Julia Clarke, a professor in the Jackson School of Geosciences Department of Geological Sciences who helped describe the new species, said that it's possible that the dino used its flashy neck feathers and a bony crest on its snout to attract mates.

"Iridescent coloration is well known to be linked to sexual selection and signaling, and we report its earliest evidence in dinosaurs," said Clarke.

A description of the exquisitely preserved, chicken-sized dinosaur was published on Jan. 15, 2018, in the journal *Nature Communications*. Dongyu Hu, a professor in the College of Paleontology at the Shenyang Normal University led the study.

The dinosaur has features that are both ancient and modern. The bony crest is usually seen in dinosaurs from earlier eras, while the neck feathers show evidence of pigment-containing cells called melanosomes. The scientists found that the preserved melanosomes most closely resembled those in the iridescent, rainbow feathers of hummingbirds.

Caihong is also the earliest known dinosaur with asymmetrical feathers, the feather type found on the wingtips of modern birds that helps control flight. But unlike birds today, Caihong's asymmetrical feathers were on its tail, not its wings—a finding that suggests that early birds may have had a different steering or flight style.

A farmer from China's Hebei Province found the fossil in 2014. Its nearly complete skeleton is preserved in a slab of rock and surrounded by impressions made by feathers which include imprints made by the microscopic melanosomes. Chad Eliason, a postdoctoral associate at the Field Museum of Natural History, helped analyze the microstructural fossil evidence for color while he was a postdoctoral researcher at the Jackson School.

Did Plate Tectonics Freeze the Planet?

Solid Earth & Tectonic Processes

A research duo from The University of Texas at Austin and UT Dallas have put forward a hypothesis that links the dawn of plate tectonics with "snowball Earth"—a period of climate change that sent the planet into a deep freeze that lasted millions of years.

They expect their hypothesis to generate controversy. Geologists usually place the start of plate tectonics at about 3 billion years ago, while the new hypothesis puts the process in a much younger era known as the Neoproterozoic, which occurred about 542 million to 1 billion years ago.

"If you look at the preserved record, diagnostic evidence for modern plate tectonics involving deep subduction is mainly Neoproterozoic and younger," said co-author Nathaniel Miller, a research scientist in the Department of Geological Sciences at the Jackson School of Geosciences. "But most people think we had this much earlier in Earth history."

Miller and Robert Stern, a professor in the UT Dallas Department of Geosciences, examined a suite of published scientific data on the geological activity during the Neoproterozoic—the era of snowball Earth—and found a link between plate tectonics and a cooling world.

The research was published in the April 2018 edition of the journal *Terra Nova*.

Plate tectonics is one of the most fundamental processes that shape the planet, and most geoscientists believe it has been active for most of the planet's 4.5 billion-year history. However, according to Miller and Stern, there are a variety of traces in the geologic record that could be consistent with plate tectonics not getting started until the Neoproterozoic. The authors also note the geologic interval preceding the Neoproterozoic shows a lack of geological activity—a feature that has earned it the nickname "the boring billion," and which could indicate that the Earth was covered by a single lithospheric lid rather than the many moving plates of today.

The overlap in timing between the appearance of these signatures of plate tectonic activity and Earth's snowball phase led the researchers to think that they could be related. The paper lists 22 proposed ways plate tectonic activity could have brought about global cooling that caused the Earth to be covered from pole to pole with ice. They include volcanoes cooling the planet by releasing sulfur into the atmosphere; the shifting of the plates changing the planet's rotational axis; and increased rock weathering pulling CO_2—a greenhouse gas—out of the atmosphere and back into the Earth.

The authors note that their paper presents a possible scenario in Earth's history, and hope that this research will lead other geoscientists to consider the evidence and test the hypothesis.

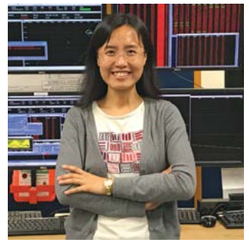
EARTH MAY HAVE RESEMBLED SATURN'S MOON ENCELADUS DURING ITS "SNOWBALL" PHASE.

DINO: VELIZAR SIMEONOVSKI. FROZEN WORLD: NASA.

THE CASCADIA SUBDUCTION ZONE. WHITE OVAL INDICATES AREA WHERE SEDIMENT IS COMPACT.

Seafloor Sediments Enhance Earthquake Risk

Solid Earth & Tectonic Processes



SHUOSHUO HAN

The Cascadia Subduction Zone in the Pacific Northwest is an incubator for powerful earthquakes—and according to the geological record, the region is due for a "big one." Sediment on the seafloor may be a key factor in determining where along the zone the next big quake will strike.

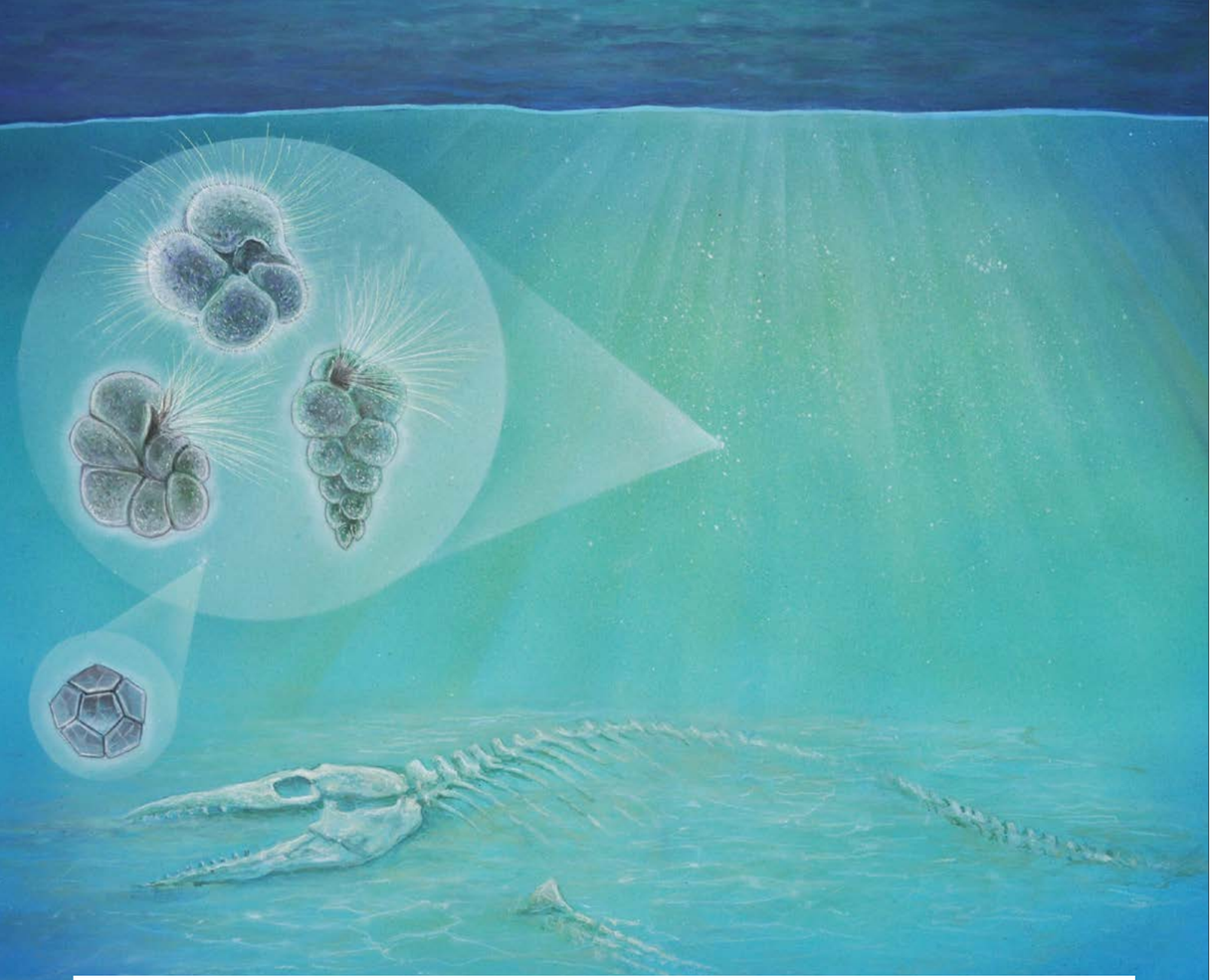
The research, published in *Nature Geoscience* on Nov. 20, 2017, found that compact sediments along the zone near Washington and northern Oregon could make the tectonic plates more susceptible to sticking to each other. Subduction zones are the places where one tectonic plate dives beneath another, creating a trench. When the plates move after enduring centuries of tension, the released energy creates earthquakes and tsunamis.

"We observed very compact sediments offshore of Washington and northern Oregon that could support earthquake rupture over a long distance and close to the trench, which increases both earthquake and tsunami hazards," said lead author Shuoshuo Han, a University of Texas Institute for Geophysics (UTIG) research associate who conducted the work as a UTIG postdoctoral fellow.

The Cascadia Subduction Zone runs roughly from Vancouver, Canada to northern California. Han and her collaborators conducted a seismic survey off the coast of Washington and Oregon that allowed them to see up to four miles of sediment layers overlying the subduction zone.

According to the geologic record, the Cascadia Subduction Zone generates a large earthquake about every 200-530 years. And with the last large quake occurring in 1700, scientists are expecting another earthquake within the next couple of centuries.

Han's research could help scientists understand factors that influence how earth-shaking events occur in Cascadia and subduction zones around the world. The researchers note that a large earthquake anywhere along the subduction zone would have serious impacts for Cascadia, not just areas closest to the event.



ASTEROID: JOHN MAISANO/JACKSON SCHOOL. LOWERY: CHRIS LOWERY. DINO TONGUE: SPENCER WRIGHT.

Life Finds a Way at Impact Site of Dino-Killing Asteroid

AN ARTIST'S IMPRESSION OF THE CHICXULUB CRATER YEARS AFTER IMPACT. THE THREE HAIR-COVERED FORMS (LEFT) REPRESENT SPECIES OF PLANKTON FOUND INSIDE THE CRATER. THE GEOMETRIC FORM (BOTTOM LEFT) IS A SPECIES OF ALGAE.

Climate, Carbon & Geobiology

About 66 million years ago, an asteroid smashed into Earth and triggered a mass extinction that ended the reign of the dinosaurs and snuffed out 75 percent of life.

While the impact killed off species across Earth, researchers from The University of Texas at Austin have found that the crater itself served as a habitat for sea life mere years after impact and was a thriving ecosystem within 30,000 years—a much quicker recovery than other sites around the globe.

Scientists were surprised by the findings, which undermine a theory that recovery at sites closest to the crater is the slowest due to environmental contaminants—such as toxic metals—released by the impact. Instead, the evidence suggests that recovery around the world was influenced primarily by local factors.

"We found life in the crater within a few years of impact, which is really fast, surprisingly fast," said Chris Lowery a research associate at the University of Texas Institute for Geophysics (UTIG) who led the work as a UTIG postdoctoral researcher. "It shows that there's not a lot of predictability of recovery in general."

The research was published May 30, 2018, in the journal *Nature*. UTIG research scientists Gail Christeson and Sean Gulick and postdoctoral researcher Cornelia Rasmussen are co-authors on the paper, along with a team of international scientists.

The evidence for life comes primarily from the remains of unicellular organisms such as algae and plankton—as well as the burrows of larger organisms discovered in rock extracted from the crater during recent scientific drilling mission.

CHRIS LOWERY

The scientists found the first evidence for the appearance of life two to three years after impact. The evidence included burrows made by small shrimp or worms. By 30,000 years after impact, a thriving ecosystem was present in the crater, with blooming phytoplankton (microscopic plants) supporting a diverse community of organisms in the surface waters and on the seafloor. In contrast, other areas around the world, including the North Atlantic and other areas of the Gulf of Mexico, took up to 300,000 years to recover in a similar manner.

The core containing the fossil evidence was extracted from the crater during a 2016 expedition co-led by the Jackson School of Geosciences. In this study, scientists zeroed in on a unique core section that provides a record of the seafloor environment days to years after the impact.

The relatively rapid rebound of life in the crater suggests that the impact didn't hamper recovery. The scientists point to local factors, from water circulation to interactions between organisms and the availability of ecological niches, as having the most influence on a particular ecosystem's recovery rate.

The research was funded by the International Ocean Discovery Program, the International Continental Drilling Program, the National Science Foundation and NASA.

DINOSAURS IN RECONSTRUCTIONS ARE OFTEN SHOWN WITH TONGUES WILDLY WAVING — A FEATURE THAT IS INCORRECT ACCORDING TO RESEARCH CO-AUTHORED BY THE JACKSON SCHOOL'S JULIA CLARKE.

T. Rex Couldn't Stick Out Its Tongue

Climate, Carbon & Geobiology

Dinosaurs are often depicted as fierce creatures, baring their teeth, with tongues wildly waving like giant, deranged lizards. But new research reveals a major problem with this classic image: Dinosaurs couldn't stick out their tongues like lizards. Instead, their tongues were probably rooted to the bottoms of their mouths in a manner akin to alligators.

Researchers from The University of Texas at Austin and the Chinese Academy of Sciences made the discovery by comparing the hyoid bones—the bones that support and ground the tongue—of modern birds and crocodiles with those of their extinct dinosaur relatives.

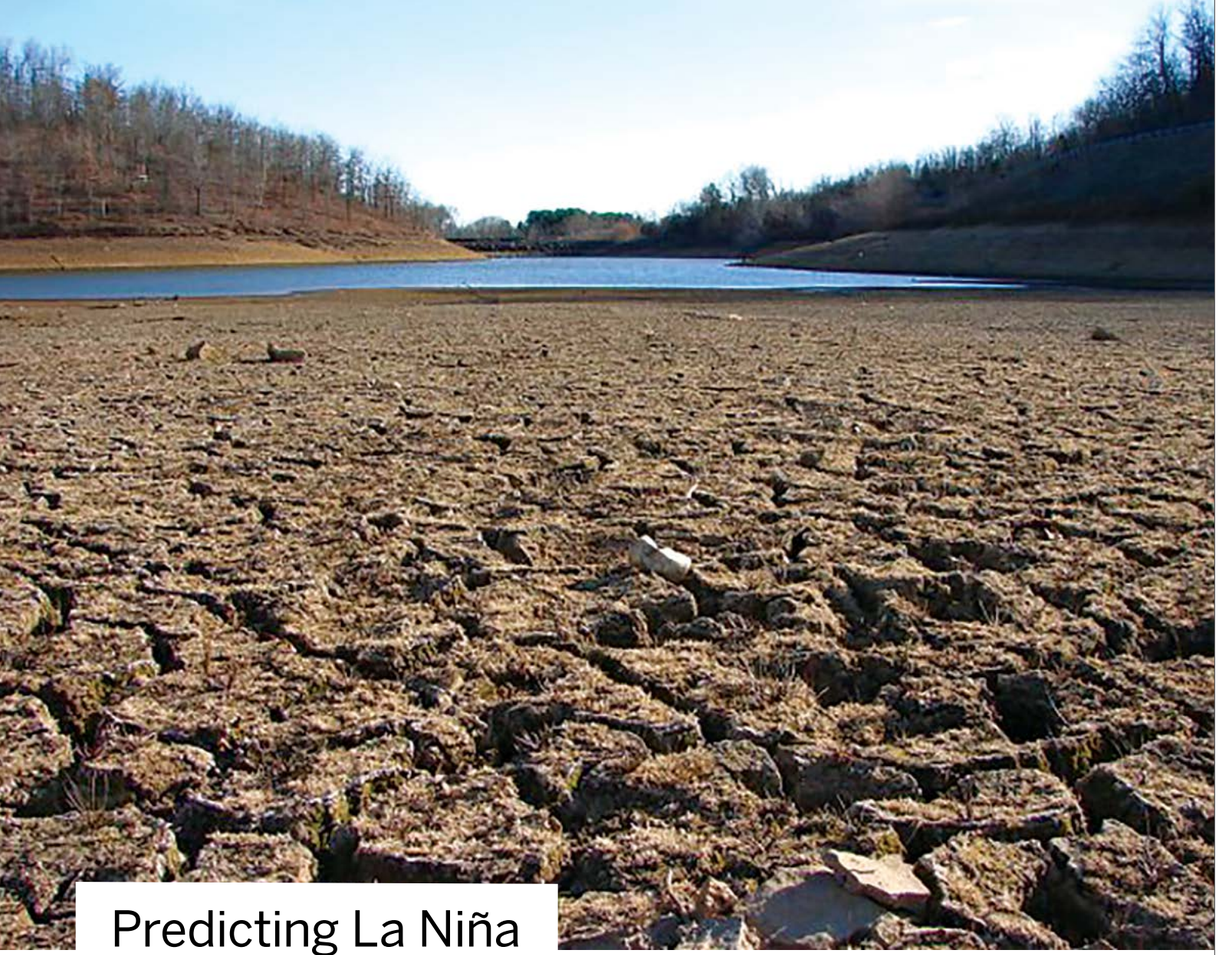
The research was published June 20, 2018, in the journal *PLOS ONE*.

"Tongues are often overlooked. But they offer key insights into the lifestyles of extinct animals," said lead author Zhiheng Li, an associate professor at the Key Laboratory of Vertebrate Evolution and Human Origins of the Chinese Academy of Sciences. He conducted the work while earning his doctorate at the Jackson School of Geosciences.

Co-author and Jackson School Professor Julia Clarke said that the findings mean that dramatic reconstructions that show dinosaurs with tongues stretching out from between their jaws are wrong.

"They've been reconstructed the wrong way for a long time," Clarke said.

In contrast to the short hyoid bones of crocodiles, the researchers found that pterosaurs, bird-like dinosaurs, and living birds have a great diversity in hyoid bone shapes. They think the range of shapes could be related to flight ability. The researchers propose that taking to the skies could have led to new ways of feeding that could be tied to diversity and mobility in tongues.



LA NINA: NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION. ROCK MOISTURE: DANIELLA REMPE.

Predicting La Niña

Climate, Carbon & Geobiology

THE LA NIÑA WEATHER PATTERN CAN CAUSE DROUGHTS IN THE SOUTHERN UNITED STATES, INCLUDING PARTS OF EASTERN TEXAS.

According to the National Oceanic and Atmospheric Administration (NOAA), as of December 2017, the global climate is now in the midst of a "double-dip" La Niña—a La Niña weather pattern that occurs for two consecutive winters.

NOAA determined that La Niña was back for another winter by tracking ocean surface temperatures in the tropical Pacific. But the actual event was predicted in advance by climate research led by The University of Texas at Austin.

The research is part of two studies published in *Geophysical Research Letters* in November 2017 and led by scientists at the University of Texas Institute for Geophysics (UTIG). The authors also predicted that the 2017 La Niña would cause more intense weather than the event that occurred in 2016. The spreading drought conditions across the southern U.S. in late 2017 and early 2018 supported that prediction.

UTIG Research Associates Pedro DiNezio and Yuko Okumura were authors on both studies and collaborated with scientists from the National Center for Atmospheric Research (NCAR). The studies have significantly improved scientists' ability to predict the strength and duration of droughts caused by La Niña events—a recurrent cooling pattern in the tropical Pacific Ocean linked to drought and warm winters in the United States.

The study led by DiNezio used a climate model developed at NCAR to predict that a La Niña that started in 2016 would stretch into its second year. The model put the probability of such an event occurring at 60 to 80 percent.

DiNezio and Okumura had previously found that a La Niña is more likely to last two years when it is preceded by a strong El Niño—its warm counterpart. Therefore, when a record-breaking El Niño event occurred just two years ago, they anticipated that it could lead to a two-year La Niña. DiNezio used the model developed at NCAR to test this idea.

The study led by Okumura showed that La Niña's impact on atmospheric circulation and southern U.S. drought becomes stronger in the second year. This is despite a weakening of La Niña's cooling over the tropical Pacific relative to the first year.

Hidden "Rock Moisture" Could Help Forests Survive

Surface & Hydrologic Processes

Research conducted by The University of Texas at Austin and the University of California, Berkeley has found that a little-studied, underground layer of rock can hold significant amounts of water that may serve as a vital reservoir for trees, especially in times of drought.

This transitional zone beneath soils and above groundwater is often overlooked when it comes to studying hydrological processes, but researchers found that the water contained within the fractures and pores of the rock could play an important role in the water cycle at the local and global level.

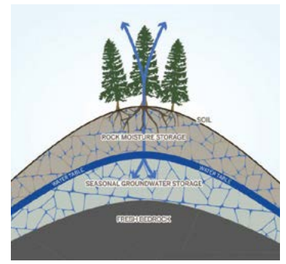
"There are significant hydrologic dynamics in weathered bedrock environments, but they are not traditionally investigated because they are hard to access," said lead author Daniella Rempe, an assistant professor in the Department of Geological Sciences.

The results were published in the journal *PNAS* on Feb. 26, 2018.

At the field site in Northern California's Mendocino County, scientists found that up to 27 percent of annual rainfall was stored as "rock moisture," with water clinging to cracks and pores within the bedrock. The impact of rock moisture will vary depending on the region and topography, but researchers said it likely explains how the trees in the study area showed little affect from the severe 2010-2015 drought that killed more than 100 million trees throughout California.

The researchers monitored the rock moisture from 2013-2016 at nine wells drilled into the weathered bedrock along a steep forested hillslope. They found that the weathered rock layer built up a supply of 4 to 21 inches of rock moisture during the winter wet season, depending on the well. The maximum amount of rock moisture in each well stayed about the same throughout the study period, which included a significant drought year. It's a major finding that indicates that it doesn't matter if it rains a little or a lot during the winter dry season—the total rainfall amount does not influence the rock moisture levels.

The potential for rock moisture to travel back to the atmosphere via evaporation from tree leaves or to trickle down into groundwater indicates that it could have a broad impact on the environment and climate.



CLOCKWISE: RESEARCHERS ON A HILL SLOPE AT THE RESEARCH SITE; TREE ROOTS TAPPING INTO WATER STORED AS ROCK MOISTURE; DANIELLA REMPE WITH A BORE-HOLE DRILL.

New Practices for Zircon Sampling

Surface & Hydrologic Processes

THE RIO SAN JUAN TRANSPORTS SEDIMENT FROM THE HIGH ANDES (BACKGROUND) ACROSS THE PRECORDILLERA MOUNTAIN RANGE (FOREGROUND).

A new study led by The University of Texas at Austin Jackson School of Geosciences suggests that scientists may be able to better leverage zircon data to understand landscape evolution.

The improvements involve considering a suite of factors that can skew zircon geochronologic data and interpretation of the origin of sediments.

The study, published on Dec. 1, 2017, in *Earth and Planetary Science Letters*, focused on a method called detrital zircon U-Pb (uranium-lead) geochronology.

Zircon is an ideal mineral to trace landscape evolution because it is found in most crustal rocks, is very durable (harder than diamond), and contains three isotopic clocks (chronometers) that geoscientist can utilize. The researchers found that estimates of landscape erosion and sediment dispersal could be improved by taking several factors into account:

- Bedrock materials erode at different rates. This means sediment in rivers will be disproportionately enriched in zircon grains derived from weaker, erodible bedrock sources.
- Zircon fertility is a term that indicates how many zircons are in a bedrock source region. Materials that produce less zircons can be underrepresented in a study unless this issue is accounted for.
- Some zircons come from material that has been recycled over time. That means the zircons could contain complex signatures from multiple erosion events from different rocks.

Tomas Capaldi, a Ph.D. student in the Jackson School's Department of Geological Sciences, led the study by collecting zircon grain samples from modern river watersheds in the Andes Mountains where the sediment sources and drainage networks are well known.

"We're exploring how we can use sediment from modern rivers to calibrate ourselves for the ancient sedimentary record," Capaldi said.

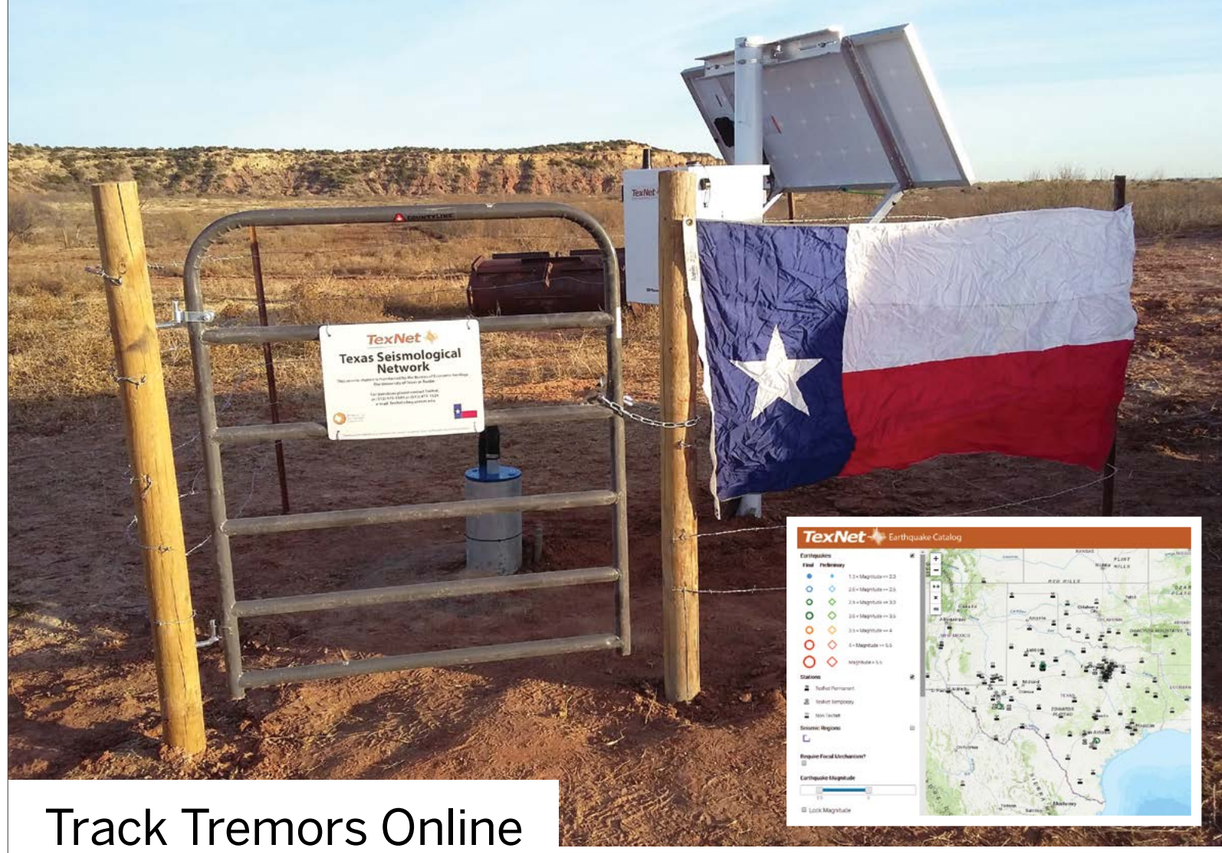
The study found that erosion patterns were reflected more accurately when sampling larger river systems, which receive sand from the entire region and record the overall erosion of the Andes.

The findings are important because thousands of studies each year depend on detrital zircon U-Pb geochronology, said Jackson School Professor Brian Horton, Capaldi's advisor and a co-author on the paper.

The good news is that this can be largely accounted for by researchers in the field and lab, said co-author and Jackson School Professor Danny Stockli.

"You might have to take some of these complications that Tomas points out, maybe even leverage them, to obtain a better understanding of long-term landscape evolution," he said.

ZIRCON: TOMAS CAPALDI. TRACK TREMORS: BUREAU OF ECONOMIC GEOLOGY.



Track Tremors Online

Solid Earth & Tectonic Processes

TEXNET STATIONS LIKE THIS ONE NEAR POST IN WEST TEXAS ARE PROVIDING A COMPREHENSIVE LOOK AT SEISMIC ACTIVITY ACROSS THE STATE.

The University of Texas at Austin Bureau of Economic Geology has finished installing the state's earthquake monitoring network, TexNet, and thanks to a new interactive website, the public can follow and sort seismic activity in Texas in real time.

TexNet, the most advanced state-run seismic monitoring system in the country, was authorized by Texas Gov. Greg Abbott and the Legislature in June 2015 with $4.47 million in state funding. Like many areas in the south-central United States, Texas has experienced an increase in the number of earthquakes during the past decade, especially in the Dallas-Fort Worth area, the Permian Basin region and south-central Texas.

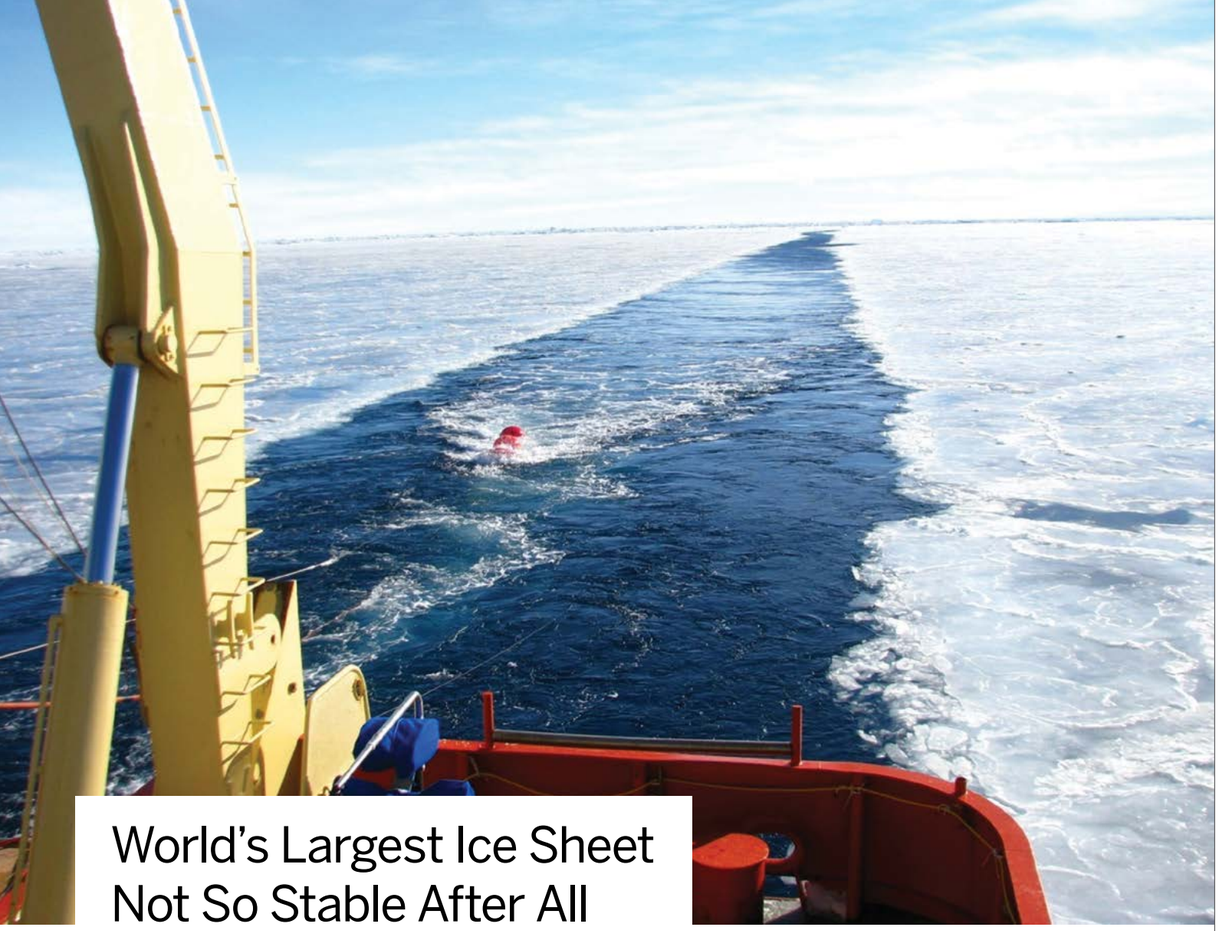
The seismic monitoring system is being operated in parallel with the Center for Integrated Seismicity Research (CISR), a multidisciplinary research team led by bureau Research Scientist Peter Hennings and Professor Ellen Rathje in the Cockrell School of Engineering's Department of Civil, Environmental and Architectural Engineering. CISR is conducting fundamental research to better understand natural and induced earthquakes in Texas.

"Gov. Abbott and the Legislature have put Texas in the forefront of data collection and research into the causes of seismicity in the state," said bureau Director Scott W. Tinker, who led the formation of TexNet in 2015. "Small earthquake events have become more common in Texas recently, and we are now positioned to learn more about them and, hopefully, to understand how to mitigate their impacts in the future."

TexNet includes 22 permanent monitoring stations, which brings the state's total number of permanent seismic stations to 40. The system also includes 40 portable seismic stations that are being used to increase the density of stations in areas with increased seismicity. These portable stations allow for detailed examination of the location, depth, size and frequency of earthquakes, so scientists and engineers can better assess their cause.

For more information on TexNet and CISR and to view the interactive web page, go to www.beg.utexas.edu/texnet.

VIEW TEXNET INTERACTIVE SEISMIC DATA AT WWW.BEG.UTEXAS.EDU/TEXNET



World's Largest Ice Sheet Not So Stable After All

Marine Geosciences

MARINE SEISMIC TECHNOLOGY DEPLOYED FROM THE BACK OF AN ICE BREAKER NEAR ANTARCTICA'S SABRINA COAST.

PHOTO: SEAN GULICK.

The East Antarctic Ice Sheet locks away a lot of water—about 53 meters (174 feet) worth of potential sea level rise. The stability of the ice sheet in modern times has kept it from gaining or losing mass, even as ice sheets in Western Antarctica and Greenland shrink.

However, new research led by The University of Texas at Austin and the University of South Florida has found that the ice sheet may not be as stable as it seems. The first-ever oceanographic survey of East Antarctica's Sabrina Coast revealed that the ice sheet has a long history of expanding and shrinking, a finding that indicates the ice sheet may contribute substantially to global sea level rise as Earth's climate warms.

The results were published in the Dec. 14, 2017, edition of *Nature* and the study was featured on the cover.

Co-lead author Sean Gulick, a research professor at the University of Texas Institute for Geophysics and the UT Department of Geological Sciences, said the survey found that glaciers from the Aurora Basin have been stable only for the past few million years.

"We have evidence for a very dynamic ice sheet that grew and shrank significantly between glacial and interglacial periods," he said. "There were also often long intervals of open water along the Sabrina Coast, with limited glacial influence."

Using marine seismic technology deployed from an icebreaker and core samples, researchers were able to reconstruct how glaciers on the Sabrina Coast have advanced and retreated during the past 50 million years. The Sabrina Coast, and nearby Aurora Basin, are particularly important because regional glaciers are presently thinning and retreating as nearby ocean waters warm.

"This process may just be the beginning," said co-lead author Amelia Shevenell, an associate professor at the University of South Florida. "Once you have that combination of ocean heat and atmospheric heat—which are related—that's when the ice sheet could really experience dramatic ice-mass loss."

The National Science Foundation manages the United States Antarctic Program and provided the funding and logistical support that made field research possible.

For more information, see the story on page 100.

Research Links Rainfall and Ocean Circulation in Past and Present

Climate, Carbon and Geobiology

Researchers have found that changes in ocean currents in the Atlantic Ocean influence rainfall in the Western Hemisphere, and that it's a system that has been linked for thousands of years.

Their findings, published on Jan. 26, 2018, in *Nature Communications*, provide a detailed look into Earth's past climate and the factors that influenced it. The research could help scientists understand how these factors may influence future climate.

"The mechanisms that seem to be driving this correlation [in the past] are the same that are at play in modern data as well," said lead author Kaustubh Thirumalai, postdoctoral researcher at Brown University who conducted the research while earning his doctorate at the Jackson School of Geosciences.

The Atlantic Ocean surface circulation is an important part of the Earth's global climate, moving warm water from the tropics towards the poles. The research tracked the changes in ocean circulation in new detail by studying three sediment cores extracted from the seafloor of the Gulf of Mexico in 2010. The samples give insight into factors that influenced the strength of the ocean current over 4,400 years in about 30-year increments.

The cores showed that, compared to today, the Atlantic Ocean surface circulation was much weaker during the Little Ice Age, a cool period that lasted from 1450-1850. Since these ocean currents are known to influence global climate, the researchers checked to see how they correlated with rainfall in the Western Hemisphere and how such a correlation could change over time.

Researchers compared the core data with proxies for precipitation data, such as data from tree rings and cave formations, as well as data directly collected by humans during the last century on the temperature and salinity of the Gulf and rainfall in the Western Hemisphere. They also analyzed data from a climate model developed by the Max-Planck Institute for Meteorology in Germany.

Lunar Resurfacing

Planetary Sciences

The Earth's moon had a rough start in life. Formed from a chunk of the Earth that was lopped off during a planetary collision, it spent its early years covered by a roiling global ocean of molten magma before cooling and forming the serene surface we know today.

A research team led by the Jackson School of Geosciences took to the lab to recreate the magmatic melt that once formed the lunar surface and uncovered new insights on how the modern moonscape came to be. Their study shows that the moon's crust initially formed from rock floating to the surface of the magma ocean and cooling. However, the team also found that one of the great mysteries of the lunar body's formation—how it could develop a crust composed largely of just one mineral—cannot be explained by the initial crust formation and must have been the result of some secondary event.

The results were published on Nov. 21, 2017, in *Geophysical Research Letters*. The research was led by Nick Dygert, an assistant professor at the University of Tennessee, Knoxville, who conducted the research while a postdoctoral researcher in the Jackson School's Department of Geological Sciences

Large portions of the moon's crust are made up almost entirely of a single mineral. In these sections, 98 percent of the crust is plagioclase. According to the prevailing theory, which this study calls into question, the crustal purity is due to plagioclase floating to the surface of the magma ocean over hundreds of millions of years and solidifying. This theory hinges on the magma ocean having a specific viscosity that would allow plagioclase to separate from other dense minerals and rise to the top.

Dygert decided to test the plausibility of the theory by measuring the viscosity of lunar magma directly. The feat involved shooting a concentrated beam of high-energy X-rays into a sample of mineral powders and flash melting them into magma. The researchers then measured the time it took for a melt-resistant sphere to sink through the magma.

The experiment found that the magma melt had a very low viscosity that would have supported plagioclase flotation, but would have also led to mixing of plagioclase with the magma, a process that would trap other minerals in-between the plagioclase crystals and create an impure lunar surface. Dygert said the results support a "crustal overturn" on the lunar surface where the old mixed crust was replaced with deposits of pure plagioclase.

TERRY QUINN

UTIG Director Accepts NSF Leadership Role

Leadership

In July 2018, Terrence M. Quinn left his role as director of the University of Texas Institute for Geophysics (UTIG) to join the National Science Foundation (NSF) as director of the Division of Ocean Sciences.

"I am honored to have had a small role in UTIG's great history, and its future is bright," Quinn said. "I depart with a deep admiration and respect for the UTIG scientists, technical staff, administrative staff and students. I will miss my friends and colleagues in Austin, but onward to Alexandria. I look forward to serving the ocean sciences community."

Quinn will remain a faculty member at the Jackson School of Geosciences. UTIG Associate Director Mrinal Sen will serve as interim director while the Jackson School undertakes an international search for a new permanent UTIG director.

Quinn has been UTIG director since 2009. He joined the Jackson School as a distinguished visiting professor in 2005 and then as a professor in 2006. Prior to joining the Jackson School, he was a professor at the University of South Florida College of Marine Science.

Dean Sharon Mosher said she was proud of Quinn and what he accomplished at UTIG.

"I see this as very positive for the Jackson School and UT Austin—this prestigious position reflects well on our reputation," Mosher said. "When Terry returns to the Jackson School at the end of his term, he will bring with him a better understanding of national priorities and NSF funding."

As a scientist, Quinn's area of expertise is paleoceanography and paleoclimatology, focused on the tropical to subtropical oceans. He has written or co-authored over 75 peer-reviewed papers, many of them with his graduate students. He also served as a lead author of a chapter in the 5th Assessment Report of the Intergovernmental Panel on Climate Change and has served in numerous advisory and service roles within the ocean sciences community.

Under Quinn's leadership, UTIG's budget increased by about $10 million, and its climate and planetary geophysics groups expanded significantly. Among other highlights during Quinn's tenure, he helped establish new royalty streams to diversify UTIG's funding, including partnering with a geophysical service company to market seismic data from the Gulf of Mexico, which has yielded about $4 million in royalties to UTIG so far.

"Over the nine years he has been director, the institute has undergone significant positive changes and made numerous scientific advances," Mosher said. "The institute has increased its diversity in terms of science, youth and gender. His leadership for UTIG and JSG will be missed."

Carbon Capture in Japan

Marine Geosciences

The Bureau of Economic Geology's Gulf Coast Carbon Center (GCCC) is renowned internationally as one of the foremost academic research institutions investigating carbon capture and storage. In 2017, the GCCC's Tip Meckel helped maintain that reputation by leading a crew of 20 on a six-day data-collection cruise off Japan's north island of Hokkaido.

Meckel's team arrived in Japan with unique acoustic instrumentation for three-dimensional mapping of the geology below the seafloor with ultra-high resolution. (For more information, see the story on page 84.) The key to the equipment is a set of four, 25-meter-long streamers containing eight-channel acoustic sensors that are towed behind a research vessel. When an acoustic signal from a compressed air source is deployed, changes in the speed of the sound returning to the dense array of sensors are converted to a very fine scale 3-D model of the geology beneath the seafloor.

The survey was conducted offshore of the industrial port of Tomakomai, the site of an extensive CO_2 capture, transport, and injection demonstration project. At the time of the survey, approximately 65,000 tons of CO_2 had been injected into a geologic formation 1,100 meters below the seafloor.

The ultimate goal of the project is to store 100,000 tons of CO_2 per year. The surveys conducted in 2017 were the first to attempt high-resolution subsurface imaging at an active offshore CO_2 demonstration project. Obtaining such information can help reduce the risk of leakage and could provide an estimate of the volume of CO_2 stored in the reservoir. Meckel noted that the technology is suitable for deployment at other offshore sequestration sites, including sites in the Gulf of Mexico.

QUINN: THE UNIVERSITY OF TEXAS INSTITUTE FOR GEOPHYSICS.

Mammal Forerunner—and 38 Babies—Shed Light on Brain Evolution

Climate, Carbon & Geobiology

A newly described fossil of an extinct mammal relative—and her 38 babies—is among the best evidence that a key development in the evolution of mammals was trading brood power for brain power.

The find is the only known fossils of babies from any mammal precursor, said researchers from The University of Texas at Austin who discovered and studied the fossilized family. The presence of so many babies—more than twice the average litter size of any living mammal—revealed that it reproduced in a manner akin to reptiles.

The study, published in the journal *Nature* on Aug. 29, 2018, describes specimens that researchers say may help reveal how mammals evolved a different approach to reproduction than their ancestors.

"They had a lot of features similar to modern mammals, features that are relevant in understanding mammalian evolution," said Eva Hoffman, who led research on the fossil as a graduate student at the Jackson School of Geosciences. Hoffman co-authored the study with her graduate advisor, Jackson School Professor Timothy Rowe.

The mammal relative belonged to an extinct species of beagle-size plant-eaters called *Kayentatherium wellesi* that lived about 185 million years ago.

When Rowe collected the fossil more than 18 years ago from a rock formation in Arizona, he thought that he had found a single specimen. Sebastian Egberts, a former graduate student and fossil preparator at the Jackson School, spotted the first sign of the babies in 2009 when he noticed a speck of tooth enamel as he was unpacking the fossil. A CT scan of the fossil revealed a handful of bones inside the rock. However, it took advances in CT-imaging technology during the next seven years to reveal the rest of the babies.

Visualizations produced by Hoffman revealed that the skulls of the babies were like scaled-down replicas of the adult. This finding is in contrast to mammals, which have babies that are born with shortened faces and bulbous heads to account for big brains. The discovery that *Kayentatherium* had a tiny brain and many babies, despite otherwise having much in common with mammals, suggests that a critical step in the evolution of mammals was trading big litters for big brains and that this step happened later in mammalian evolution.

ABOVE: A FIGURE REPRESENTING THE 38 KAYENTATHERIUM BABIES FOUND WITH AN ADULT SPECIMEN. THEY ARE THE ONLY KNOWN FOSSILS OF BABIES FROM AN EXTINCT MAMMAL RELATIVE THAT LIVED DURING THE EARLY JURASSIC.

MAMMAL FORERUNNER: EVA HOFFMAN.

Methane in Barnett Area Groundwater Naturally Occurring

Energy Geosciences

After four years of studies, scientists have found no link between methane present in water wells outside of Fort Worth and nearby gas production activities in the Barnett Shale. Along the way, researchers believe they have developed important methods that could be applied in similar situations to determine where methane originates in an environment.

The latest study, published in August 2018 in *Water Resources Research,* is the fifth and final in a series conducted by researchers at The University of Texas at Austin and the University of Michigan that looks at groundwater wells in the Barnett Shale area. The vast majority of the wells have little or no methane in the water, but a cluster of 11 wells near the Parker County and Hood County line had methane levels above 10 milligrams per liter of water, a level that can require venting of well water systems to ensure the flammable gas does not accumulate to hazardous levels.

"Protecting groundwater quality is a fundamental requirement for sustainable energy development, and it is important to develop tools that can be used to monitor ongoing gas exploration and production activities," said lead author Toti Larson, a research associate at the Bureau of Economic Geology, a research unit of the Jackson School of Geosciences.

Researchers used the chemistry of dissolved gases in groundwater—including methane, noble gases and nitrogen—to identify their likely sources. The researchers' findings and conclusions have remained consistent through the studies: The methane appears to have migrated naturally to the wells from the shallower Strawn formations and not from the Barnett Shale, where natural gas production and hydraulic fracturing are occurring.

NEWSMAKERS

In 2018, news outlets turned to Jackson School of Geosciences experts to explain everything from local geology to some of the biggest moment's in Earth's history. For a full list of Jackson School in the news go to: jsg.utexas.edu/news/in-the-news

ON MAY 4, 2018, A LANDSLIDE ON A CLIFF THAT OVERLOOKS CENTRAL AUSTIN'S SHOAL CREEK DAMAGED THE TRAIL THAT RUNS ALONG THE WATER, BRINGING DEBRIS CRASHING DOWN. KXAN INTERVIEWED THE JACKSON SCHOOL'S JOEL JOHNSON FOR AN OVERVIEW OF THE AREA'S UNDERLYING GEOLOGY AND WHY IT'S PRONE TO LANDSLIDES.

THE BBC TURNED TO PROFESSOR JULIA CLARKE FOR HER EXPERTISE IN DINOSAUR CALLS AND COLORS. SHE APPEARED IN A DOCUMENTARY WHERE SHE HELPED RECREATE T-REX CALLS IN A BERLIN RECORDING STUDIO AND EXAMINED FOSSILS FOR SIGNS OF COLOR.

OPPOSITE PAGE: MATTHEW BROWN, DIRECTOR OF OPERATIONS AT THE JACKSON SCHOOL'S VERTEBRATE PALEONTOLOGY COLLECTIONS, APPEARED ON FOX 7 AUSTIN IN JUNE 2018 TO TALK ABOUT DINOSAURS IN FILMS, INCLUDING THE LATEST JURRASIC PARK MOVIE.

JOHNSON: KXAN. CLARKE: BBC TWO.

BROWN: FOX 7 AUSTIN. HOW THE DINOS DIED: NOVA.

IN THE NEWS

Now Available in the Oil Patch: Wind and Solar College Degrees

"What we should be training students for is to be energy practitioners."

Richard Chuchla
Director of the Energy and Earth Resources Graduate Program
The Wall Street Journal, May 2, 2018

West Texas Sinkhole Studies Show More Reasons for Concern

"Places like Wink have a favorable subsurface groundwater regime, and you have penetration through the salt wells that allow water to get into the salt and dissolve it. But not every place is like that... Conditions have to be uniquely suited for formation of [a sinkhole]."

Jeff Paine
Senior research scientist at the Bureau of Economic Geology
Midland Reporter-Telegram, April 7, 2018

Venus May Have Hosted Life, Researchers Say

"Our work shows that a planet such as Venus, without plate tectonics, could have had surface temperatures over several billion years allowing for liquid water, which could allow for life."

Matthew Weller
Postdoctoral researcher at the University of Texas Institute for Geophysics
COSMOS, April 3, 2018

Study Finds 'Rock Moisture' Spared California Forest From Drought

"What hasn't been appreciated is that this (rock) reservoir can make or break a forest."

Daniella Rempe
Assistant professor in the Department of Geological Sciences
San Francisco Chronicle, Feb. 26, 2018

ABOVE: THE JACKSON SCHOOL'S SEAN GULICK AND CHRIS LOWERY APPEARED IN THE NOVA DOCUMENTARY "THE DAY THE DINOSAURS DIED." THE FILM TELLS THE STORY OF THE ASTEROID THAT WIPED OUT THE DINOSAURS AND GIVES AN INSIDER LOOK AT THE INTERNATIONAL SCIENCE MISSION (CO-LED BY GULICK) TO RECOVER ROCK CORES FROM THE IMPACT SITE. THE BBC ALSO DID A FULL-LENGTH DOCUMENTARY ON THE MISSION.

Jackson School News: jsg.utexas.edu/news UTJSG @TXGEOSCIENCES JSG UT AUSTIN @TXGEOSCIENCES

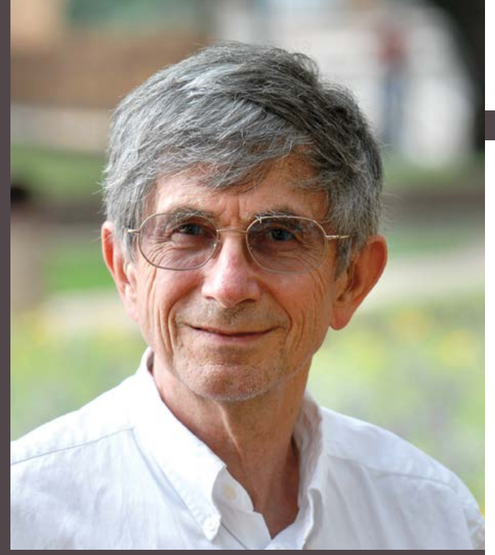
SCIENTIST PROFILE

Robert Dickinson

Climate Giant

By Monica Kortsha

In the early 1980s, while serving as the deputy director of the National Center for Atmospheric Research (NCAR) Climate and Global Dynamics Division, Robert Dickinson found that the computer models the agency was using to study and predict the Earth's climate had some serious issues.



ROBERT DICKINSON

The model was treating the landmass of the planet like a big sponge, acting only as a storage spot for water. It was an unrealistic treatment for a complex surface covered in soils and vegetation, and it led to some improbable predictions. So Dickinson set out to fix it.

His work led to a complete revamping of how the climate modeling community integrates land-surface processes into models, with Dickinson being the first scientist to account for the influence of vegetation on the climate system in climate models. Bringing the biosphere into climate modeling wasn't the only time research spearheaded by Dickinson would lead to big improvements in global climate models. In the early 1970s, when he was just starting as a scientist at NCAR, he discovered that planetary waves—a type of atmospheric disturbance that can impact wind and temperature—could transfer energy to larger atmospheric systems that circulate around the planet.

"I found climate a fascinating issue and continued to learn about it, including the use of large computational models," Dickinson said.

Dickinson's contributions to climate science have led to drastic improvements to climate models, with the global impact of his research receiving international recognition. By the time he joined the Jackson School as a professor in 2008, he could count himself as one of the very few members of both the National Academies of Sciences and Engineering, as well as a foreign member of the Chinese Academy of Sciences and an honorary member of the European Geosciences Union.

Jackson School Professor Zong-Liang Yang, who first met Dickinson in 1991 as a graduate student, said Dickinson's accomplishments hinge on how he refines his scientific expertise to match the topic at hand.

"He realized land was important so he made great contributions," Yang said. "He trained himself to become a plant scientist, a soil physicist and a remote sensing satellite expert, because to study land you need all of those."

> "He trained himself to become a plant scientist, a soil physicist, and a remote sensing satellite expert ..."
>
> *– Zong-Liang Yang*

Dickinson's work has earned him the top awards in climate science, including the Rossby Award, the highest honor bestowed by the American Meteorological Society, and the American Geophysical Union's Roger Revelle Medal, which recognizes sustained and superior contributions to climate science. His contributions to the fourth assessment report of the United Nations Intergovernmental Panel on Climate Change (IPCC)—the most detailed study of climate change ever undertaken—earned him and the rest of the report co-authors the 2007 Nobel Peace Prize, which was shared with former U.S. Vice President Al Gore.

Now, after more than 50 years working to improve scientists' understanding of the climate system and the computer models that seek to emulate it, Dickinson has retired from full-time climate science. This summer he left Austin for Los Angeles, where he will keep an office in the Atmospheric & Oceanic Sciences (AOS) Department at the University of California, Los Angeles.

Before Dickinson went west, Yang organized a two-day research symposium in May to honor Dickinson's career achievements and discuss the trajectory of climate change research going forward. More than 80 scientists, many of them former students and numerous well-known experts, attended the symposium, with an especially strong showing of scientists from China, where Yang said that Dickinson's climate change research has become especially relevant as the country is

continued on page 30

DICKINSON: JACKSON SCHOOL. HARDAGE: JACKSON SCHOOL.

SCIENTIST PROFILE

Bob Hardage

Leadership in 3-D Seismic Research

By Jackson School staff and Bob Hardage

When Bob Hardage arrived at the Bureau of Economic Geology 27 years ago, he was tasked by then-director Bill Fisher with getting the bureau recognized as *the* place for characterizing reservoirs with cutting-edge 3-D seismic technology. It was a big ask: Hardage was the only person on the staff with experience in all areas of the technology and applying it to deep reservoir targets.

BOB HARDAGE

Adding to the challenge, the bureau was completely unequipped. There were no work stations, no seismic processing or interpretation software and no budget to purchase these essential tools.

"I had to start my assignment of building the bureau into a world-class center of exploration geophysics with zero resources and zero budget," Hardage said.

Thanks to Hardage's hard work, what started as a scrappy seismic research operation is now a hub for leading-edge geophysics research. The bureau has more than 150 software licenses for seismic research, 12 research geophysicists, approximately 20 graduate students doing seismic-related research, and more than 400 computers where scientists can conduct the analysis required for reservoir characterization.

Now retired as of January 2018, Hardage played an instrumental part in building the bureau's seismic capabilities and exposing industry—particularly small, independent operators—to 3-D seismic techniques. His career is inextricably linked with the growth and success of the bureau as a powerhouse for seismic processing research and expertise.

"Bob Hardage is a giant in exploration geophysics, both technically with his work in VSP [vertical seismic profile], and multicomponent seismic, and in terms of service, culminating in his role as president of the SEG [Society of Exploration Geophysics]," said bureau Director Scott Tinker. "He will be greatly missed at the bureau and by me, personally."

> "Bob Hardage is a giant in exploration geophysics ... He will be greatly missed at the bureau."
>
> *– Scott Tinker*

Hardage spent 25 years in industry before joining the bureau in 1991. Most of his industry experience was at Phillips 66, where he worked after earning his bachelor's, master's and doctoral degrees in physics from Oklahoma State University. He worked his way to becoming exploration manager of Asia and Latin America, making him responsible for half of Phillips' international exploration. But after an ongoing series of company upheavals, he decided to try a quieter life in a university setting.

He immediately got to work collecting the hardware required for building a seismic research hub at the bureau. IBM donated a workstation and former SEG president, and Hardage's friend, Robert Graebner donated the first 3-D seismic-interpretation software license. These gifts allowed the bureau to start on the first of several in-house, 3-D seismic characterizations of gas reservoirs for a U.S. Department of Energy program called Secondary Gas Recovery.

By the early 1990s, Hardage persuaded Landmark, the then-dominant developer of 3-D seismic interpretation software, to donate several more software licenses to the bureau. Hardage remembers some good-natured teasing about his persistence from Landmark's then-president John Gibson. Hardage recalls approaching Gibson and other Landmark executives at an SEG meeting to thank them for providing licenses.

"John saw me coming, stood up, pulled his wallet from his pocket, laid it on the table, and said, 'Hardage, what do you want now?'"

Gibson later served years on the bureau's advisory committee and has been a valuable bureau supporter and advisor.

Hardage also acquired a full seismic test field for the bureau. The 100-acre Devine Test Site on the southern border of Medina County was gifted by BP to the bureau for public research, and is known worldwide as a research site for many U.S. and international companies, particularly for borehole-related technology.

continued on page 30

SCIENTIST PROFILE

Gary Kocurek

Dune Drifter

By Monica Kortsha

In the wandering dunes and swirling sand of deserts, Department of Geological Sciences Professor Emeritus Gary Kocurek sees the wind at work. To Kocurek, those shifting sands—often an analogy for ephemeral moments—are more like a film reel, a recording of how the wind etches patterns and pushes sand across a landscape over years, decades and longer.

GARY KOCUREK

"The process is highly satisfying," said Kocurek, who holds the J. Nalle Gregory Chair Emeritus in Sedimentary Geology. "You know you're getting it mostly wrong, but you can still get a handle on what's happened."

Although the full story may be out of reach, the best way to improve understanding of the geologic record is to keep an eye on the field. For the past 37 years at the Jackson School of Geosciences, Kocurek has done just that, conducting research at dune sites across the planet while teaching the next generation of geoscientist students how to read landscapes for themselves.

Over the years, Kocurek has supervised 16 doctoral students, 22 master's students and the honors theses of four bachelor's students. He also served as one of the many instructors for GEO660, the school's capstone field course, teaching undergraduates how to unpack the interlayered aeolian and marine deposits of Ghost Ranch, New Mexico.

Now retired, earning the emeritus title in 2017, Kocurek doesn't plan on leaving the field anytime soon. He spent this summer studying dune origins in Namibia's Namib Desert. Later in the year, he's heading out to a dune field in Monahan, Texas, to flatten a 300-square-meter area and watch how the dunes grow back.

Aeolian processes, how wind pushes sand around, are among the quickest ways to shape a landscape. The speed lets researchers observe how dunes changes over real time—from days to decades. This basic research has applications in a number of areas, from studying desert ecosystems to finding energy, with Kocurek collaborating with major oil companies as well as the National Park Service over his career. However, his primary focus has always been on the fundamental questions.

It was an interest that was piqued by a childhood spent outdoors in Southeast Texas. Kocurek distinctly remembers "discovering" stratigraphy at about nine years old, noticing how distinct layers of earth were exposed along the sides of a creek embankment.

Those early experiences led him to a career in geosciences research. After earning his doctorate from the University of Wisconsin in 1980, Kocurek came back to Texas and joined the UT Department of Geological Sciences, his expertise in aeolian processes augmenting an already strong sedimentary research team.

> "If there's a sand dune within reach in North America, he's been there."
>
> *– Earle McBride*

"It was the top soft rock school," Kocurek said. "There were Folk, McBride, Land and Scott. It was a really good place to be with good people to work with."

According to Jackson School Professor Emeritus Earle McBride, Kocurek developed a reputation in the department for his Spartan approach to fieldwork. He never brought a sleeping pad, and preferred staying out directly under the stars. He was also known for his work on dunes in Africa, including Egypt, Mali and Tunisia. Kocurek said the regions he travelled to were relatively stable places to conduct fieldwork, though in 1990 he was caught in Mauritania just as a coup was beginning. The main doors of the airport had been secured, so Kocurek crawled through an airport window to make the last flight home.

Back on the UT Austin campus, Kocurek played a key role in bringing a geosciences education to new communities by working with then-professor and current Dean Sharon Mosher to create "Earth, Wind and Fire," a course for non-majors. Founded in the 1990s and still going strong today, the course is responsible for teaching thousands of students about how geosciences shapes the world and impacts society.

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KOCUREK: GARY KOCUREK. DUTTON: SHIRLEY DUTTON.

SCIENTIST PROFILE

Shirley Dutton

Sedimentary Detective

By Sarah Bloodworth

A thin slice of sedimentary rock can hold a lot of history and a lot of mystery. Shirley Dutton acts as the detective, whose magnifying glass is a microscope and whose clues are petrography. Dutton's career focused on classifying sandstones using her specialty, diagenesis, to unlock the secrets to oil and gas reservoirs.

SHIRLEY DUTTON

While working at the Bureau of Economic Geology under then director Bill Fisher, she received her doctorate at The University of Texas at Austin in 1986. Dutton's career as a senior research scientist at the bureau was rich with research. Overall, she published over 100 authored and co-authored papers and abstracts. Dutton is retiring after working 41 years at the bureau.

Her research has been recognized by the Gulf Coast Association of Geological Societies. The Jackson School has recognized her research accomplishments with the 2007 Joseph C. Walter Jr. Excellence Award and the 2010 Research Excellence Award. Dutton has also been asked twice to participate in the American Association of Petroleum Geologists (AAPG) Distinguished Lecture Tours. Dutton was only the fifth woman to ever participate in the AAPG series when she presented on her first tour from 1986-87.

Dutton said she became interested in sedimentary processes during her junior year of college when she first studied and learned how to make a thin section. She added that her interest in rocks has deeper roots. Her mother took her to visit the Adirondack Mountains near her hometown of Schenectady, New York.

"The Adirondack Mountains are just a lovely area," Dutton said. "There wasn't so much sandstone, but a lot of Precambrian rocks. I would say that I became a geologist due to the influence of my mother. Her interest in the outdoors and rocks was the foundation for me being interested in geology."

One of her key research topics was tight gas sandstones, which are classified by their tight or low porosity due to cementation through diagenesis, or how sediment is turned to stone. This characteristic is important in determining reservoir quality.

"Tight gas sandstones and I were just kind of made for each other," Dutton said.

A recent emphasis of Dutton's has been on reservoir quality of deeply buried sandstones in the Gulf of Mexico.

Kitty Milliken, a sedimentary geologist who also worked as a senior research scientist at the bureau, said Dutton's expertise came in handy.

"I will miss having her in her office ... and her expertise right next door to me. If I ever had a question or found something odd in a sandstone, I could always run to Shirley," Milliken said with a laugh.

Milliken and Dutton both attended small undergraduate universities and attended the intensive geology field camp of Indiana University together in Cardwell, Montana.

Milliken said it was the geology field camp that made them close.

"It was an amazing field camp but there weren't a lot of women there at the time ... it was the early days," Milliken said. "So naturally all the women in the camp bonded. She's just a really wonderful, pleasant woman."

Milliken said she refers to Dutton as her "academic sister" since in grad school they had the same Ph.D. supervisor—Lynton Land.

It is ultimately the people she worked with that Dutton said made her career.

"There are some really good people who work here with great expertise, like Kitty," Dutton said. "It's encouraged [at the bureau] of course, that we collaborate and benefit from each other. The collaborative atmosphere was very important to me."

At the end of Dutton's career, she returns to the beginning of it. She will kick off retirement by visiting the Adirondack Mountains and possibly starting new volunteer opportunities. Milliken said Dutton's contributions will continue to impact sandstone geology.

"Among the people who study sandstones, she is without a doubt one of the world's greatest," Milliken said. "She's looked at more sand grains, more than anybody. She is a storehouse of an amount of knowledge that is just tremendous. To see her retire is, in a way, a big loss to the field ... but on the other hand, what she accomplished is a resource for generations to come."

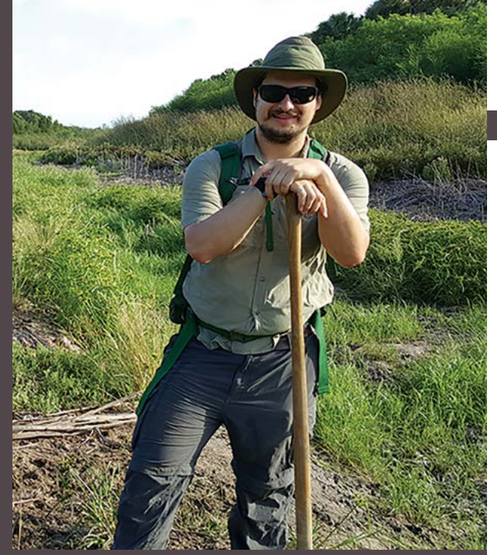
SCIENTIST PROFILE

Timothy Goudge

Cross-Planetary Possibilities

By Sarah Bloodworth

The surface of rusty, red Mars is etched with a network of meandering formations that fork out like little Martian fingers. Timothy Goudge looks to these formations—the remains of ancient river systems that dried up long ago—for glimpses into the planet's past. His work is influencing others to look with him.



TIMOTHY GOUDGE

Goudge's research on Jezero Crater—a crater, turned lake and river system, turned sedimentary rock formation—has helped make the spot one of the top contenders for NASA's Mars Rover 2020 mission, which plans to look for signs of ancient life preserved in rock.

An expert in analyzing the sedimentary evolution of planetary landscapes, Goudge started at the Jackson School in 2015 as a distinguished postdoctoral fellow. In January 2019, he'll be joining the faculty as an assistant professor.

Goudge has an intellectual curiosity that draws him to remote places on Earth and beyond. For his Mars work, the research relies on images captured by the Mars Reconnaissance Orbiter. Goudge analyzes snapshots taken by the satellite for ancient waterways and topography changes that might be linked to sediment deposition. Goudge likens the red planet to a large-scale laboratory, where sedimentary processes can be examined, dissected and compared to those on Earth.

"Mars is a really interesting natural laboratory," Goudge said. "It offers us a world where we know there have been the same types of forces, but some of the variables are different ... like gravity."

Goudge's research so far has resulted in an impressive amount of publications and presentations for an early career scientist. He has published 23 papers in peer-reviewed scientific journals—including the prestigious *Science*—with 11 as first author, and has given 13 invited talks at universities, space-related government agencies and professional meetings. He also is a co-investigator for the NASA Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) instrument on the Mars Reconnaissance Orbiter.

> "The major career goal for myself as much as doing interesting science, is also training young scientists."
>
> *– Timothy Goudge*

"He is unquestionably a rising star with tremendous potential," said Jackson School Dean Sharon Mosher.

His research involves deconstructing the properties of outcrops on Mars by comparing them to outcrops on Earth and forces that shaped them. In turn, his research is helping geologists better understand the sedimentary processes at work on our planet's landscapes and how these processes compare 33 million miles away.

"That cross-talk between studying different planetary bodies is the theme I want to build in my research group," he said.

An example of his cross-planetary research in action is field work conducted with Jackson School geology professor Gary Kocurek, who retired in 2017 (see page 24). The team found that microbial mats in the Todlito formation of New Mexico are controlled by dune topography—a finding that potential Mars missions should keep in mind when searching the dunes of the red planet for signs of microbial life.

"He is a pleasure to work with," Kocurek said of Goudge. "He has the instincts of a field geologist; he is intuitive, and he sees the whole complex package."

Goudge grew up in Canada and earned a Bachelor of Science in geological engineering from Queen's University. Through the help of a professor, he discovered the world(s) of planetary sedimentology, though he enjoyed spending time outdoors in the field long before that.

"Just being at an outcrop and investigating rocks up close is really fun, especially in a group of geoscientists," Goudge said. "Almost by design you're going to places that have some type of natural beauty."

After earning his master's and doctorate in geological science at Brown University, Goudge was accepted to the Jackson School's

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GOUDGE: TIMOTHY GOUDGE. GANEY-CURRY: GBDS PROGRAM.

SCIENTIST PROFILE

Patricia Ganey-Curry

Preserving a Legacy

By Sarah Bloodworth

The basin of the Gulf of Mexico is one of the most sought-after research zones in the world; not only for its petroleum potential but for its intriguing, geologic diversity. The Gulf Basin Depositional Synthesis Project (GBDS), operated by the University of Texas Institute for Geophysics (UTIG), is a leader in synthesizing the rich, depositional history of the basin.

PATRICIA GANEY-CURRY (CENTER) WITH RICHARD BUFFLER (LEFT) AND WILLIAM GALLOWAY (RIGHT).

UTIG project manager Patricia Ganey-Curry has been the steward of data from this important program for decades, working with a team of researchers and geology students to ensure that the history contained in the basin and collected by the institute is never forgotten.

Ganey-Curry, who retired from UTIG after over four decades with the institute, is no stranger to captaining a ship, literally. She had a captain's license while studying at Texas A&M. And before joining UTIG in 1978, she worked as a seaman for Palisades Geophysical, acquiring seismic data in the Gulf of Mexico while working aboard the University of Texas Marine Science Institute Research Vessel Ida Green.

It was on this seismic cruise where UTIG researcher Richard (Dick) Buffler, one of the co-founders of the GBDS project, met Ganey-Curry. This fateful meeting is what led to her long, successful career at UTIG.

"We observed right away how talented she was as a crew member, and we immediately hired her on at the institute," Buffler said. "It has been a wonderful experience to know and work with Patty for over 41 years. Her work with UTIG has been exemplary and has contributed significantly to the institute being recognized as a premier research facility."

When Ganey-Curry first began working at UTIG, all data was collected on 9-track tape. After the research group moved to Austin, one of her tasks involved working with a team to transport a library of 14,000-15,000 tapes from Galveston to Austin, and then eventually transfer that data from a massive collection of large tapes into a more archival medium. Ganey-Curry was well-prepared for the job, having been involved in a number of acquisition and data processing projects related to these data. Recently, in preparation for retirement, Ganey-Curry has been working to ensure all records have been digitally scanned and made accessible.

"Going through those reports was sort of like going through memory lane," she said.

"A lot of universities don't have data from even 10 years ago but I made sure we did."

As data manager, Ganey-Curry would spend 40 years not only helping secure new data, but ensuring that old data could be easily accessed. Now the data from the original mountain of tapes resides on a single terabyte drive.

The GBDS project, which began in 1995 and accessed much of these data, has brought millions in revenue from industry partners. Ganey-Curry attributes much of that success to her colleague Bill Galloway, who founded GBDS with Buffler.

"Bill Galloway was really inspiring for me and my career," she said. "I call him the 'God of the Gulf' because one of the main reasons our project got funded was because of his great knowledge of the Gulf of Mexico."

Ganey-Curry also said the students she worked with helped make her career not only successful, but special.

"I keep in touch with a lot of the students," she said. "I made sure we maintained a good database as the alumni are the key to our success.

In 2010, Ganey-Curry initiated a seismic data reprocessing program and negotiated royalty revenue. This has become one of the highest single earning royalties for the university. Ganey-Curry attributes much of that success to her maintaining the viability of the vintage data.

Looking back at her amazing career, Ganey-Curry said she is particularly thankful for the work-life flexibility that UTIG allowed her. The daughter she raised during her career is now a doctor, and Ganey-Curry has recently welcomed her second grandchild into the world, so she's not worried about being bored in retirement.

"Spending time with my family is very important to me," she said. "I'm going to enjoy being a grandmother."

SCIENTIST PROFILE

Eddie Collins

A Career Focused on Texas Geology

By Monica Kortsha

In 1979, a year after joining the staff of the Bureau of Economic Geology, Edward "Eddie" Collins took a boat trip down the Trinity River with then-colleague Dave Hobday. Their mission: find out if East Texas salt domes could be a safe place to store radioactive waste, or if there were signs of recent geological activity that would nix the domes as a potential storage spot.

EDDIE COLLINS

They found small-scale faults in terrace sand and gravel overlying faulted bedrock along the riverbank, a sign that the area had been more geologically active than previously thought. But that wasn't all they found. As the team's boat moved along the river they encountered an abundance of snakes. "More snakes than I have seen in Africa and Australia combined," wrote Hobday in a collection of memoirs by bureau staff about Collins.

That canoe trip kicked off Collins' long career of conducting field research across Texas—and all that comes with it. During his 40 years at the bureau, Collins has done geologic work in 182 of the state's 254 counties and made a name for himself as a great geologic mapper. Retiring in July 2018, Collins said that studying and documenting the details of Texas geology—from the beaches of the Gulf to the Panhandle plains—became his mission and the common thread binding his eclectic career together.

"My BEG career seems to be linked to a lot of Texas' geology, a variety of long and short projects, a continual learning about geology, and a lot of geologists to learn from," he said.

Collins first joined the bureau as part of the East Texas radioactive storage mission, which included that field campaign down the Trinity River. He came well-grounded in field methods. As part of his master's thesis work at Stephen F. Austin University, he spent three months in the Llano Uplift conducting detailed mapping, interpreting aerial photography, and verifying the features on the ground, plus follow-up lab work and analyses.

Although Collins' work was field-focused, he first got hooked on geology in the classroom, crediting his first general geology course and the engaging Trinity University professor who taught it, Ed Roy, with inspiring him to pursue a career as a geologist.

Collins authored or co-authored dozens of geologic maps at the bureau. From the late 1970s to the 1980s, the mapping focused on geologic features around the state that could potentially serve as long-term storage sites for radioactive wastes. In 1992, he became the coordinator of the Texas branch of STATEMAP, a national program dedicated to creating new geologic maps across the country. Collins' work led to the creation of numerous maps targeting areas of environmental importance, especially urban corridors and aquifers. He also counts mapping parts of Big Bend National Park from 2003 to 2009 among his career highlights.

Collins' maps are a huge contribution toward understanding the geology of the Lone Star State, said Charles "Chock" Woodruff, a geologist at the bureau who frequently collaborated with Collins and co-authored six field guides with him.

"From my perspective, if you want geologic mapping of Texas, Eddie Collins is somebody you'd want to check out," Woodruff said. "He's done really significant work. He's Mr. Texas Geology."

Woodruff spent time with Collins in the field conducting mapping work, as well as leading field trips around Central Texas. He said that like all good geologic mappers, Collins has developed a keen power of observation of surface geology and an intuition about the features that are below it. But what sets Collins apart from most others is his eagerness to put his shovel to work to check and see.

"He engages the outcrop with what I would call aggressive physicality," Woodruff said.

One such instance happened along the Pedernales River at Hammett's Crossing, the home of the Hammett Shale. As Woodruff recounts in the memoir collection, the namesake-shale appeared to be missing from the site. All they saw was sandstone and limestone—that is, until Collins started digging.

"He exhumed the Hammett Shale," wrote Woodruff.

Spending large parts of his career in the field, Collins knows that even the best plans come with detours or unexpected events—from those hordes of snakes, to hungry coyotes eying a campfire cookout, to flat tires in the desert.

When it comes to retirement, he said that he's taking his time to get the lay of the land.

"I've learned from my BEG career that while plans are required and good to have, one mostly has to be flexible and not fixed on items in a plan," Collins said. "I'll probably treat retirement as a new project and figure out what to do as I move forward."

COLLINS: JACKSON SCHOOL. FOSS: MICHELLE FOSS.

SCIENTIST PROFILE

Michelle Foss

A Global Energy Market Educator

By Sarah Bloodworth

The global energy market is dominated by chance events — from the impacts of a natural disaster, to unexpected shifts in politics or stock prices. Michelle Michot Foss not only researches the slippery oil and gas markets, but advises organizations and individuals around the world about how to better understand their idiosyncrasies.

MICHELLE FOSS

For many years, through the Bureau of Economic Geology Center for Energy Economics (CEE) and Texas Executive Education, a continuing education program for professionals offered by The University of Texas at Austin McCombs School of Business, Foss has taken her expertise of energy economics to industry professionals in North America, parts of Asia, West Africa, Angola, Uganda and Mexico.

And although she retired on Aug. 31, 2018, from her position as chief energy economist and program manager at the CEE, Foss is continuing to engage with energy economics by staying on advisory boards and continuing involvement with ExxonMobil-UT, a course she co-developed to help ExxonMobil employees, such as engineers, researchers and scientists, understand the full range of upstream commercial issues.

Britt Freund, the co-developer of the course and the assistant dean of the McCombs School of Business, said that Foss' expertise and drive to present the facts made her a valuable part of the university and the energy industry as a whole.

"There are few people that I know of in the industry who have both the breadth and depth of knowledge that Michelle possesses," he said. "So many experts are either too tentative in their debates or are purely politically driven. Michelle is neither, and that makes her a force to be reckoned with in the industry. It is the university's (and industry's) loss that Michelle is retiring, although it is well-earned."

In 2013, ExxonMobil recognized Foss' abilities and influence with the ExxonMobil Teaching Excellence award.

Like the energy market, Foss saw some fluctuations in her interests before discovering energy economics. She grew up in South Louisiana, immersed in a rich Acadian culture, believing she was going to pursue English literature. Then, while working at a girl's camp in Wisconsin, she decided to focus on science.

"That was one of those funny twists in life," she said. "It just hit me one day that biology was what I wanted to study." She added geology to the mix, including a year in graduate studies at Texas A&M University.

At the Colorado School of Mines, Foss diversified her knowledge base by adding a mineral economics master's and coordinating the Energy & Minerals Field Institute.

After a year at energy investment banking firm Simmons & Company International, she left to pursue her doctorate. Foss founded an energy research program at the University of Houston that attracted interest from the bureau. In 2005, Foss and her research team were invited to join the bureau, and the CEE was formed. She said traveling and making an impact on the industry were her favorite parts of the job. Over the years, Foss and her team implemented many U.S. government energy development assistance grants in several countries in Central Asia, Africa, South Asia and Mexico. She admits that another unwieldy factor in energy economics—human behavior—sometimes created its own challenges.

"The hardest lesson I ever learned from our international development experience was that not everybody is willing to do the things that could be done to make life better," Foss said.

Mark Shuster, assistant director at the bureau, said that Foss built a reputation for being an audacious and knowledgeable expert.

"Michelle has a knack for cutting to the chase and identifying the critical issues or challenges," he said. "She is also fearless and will call a spade, a spade based on her analyses. For me, it is Michelle's practical perspective and deep understanding of energy finance, operations, regulators and policy-makers that sets her apart."

Foss said that while she is formally retired from the bureau, The University of Texas at Austin and the state of Texas, she is glad that she can look back on her accomplishments in the field of energy education.

"The program that I developed was not just a research program, it was very active outreach," she said. "You can make a difference in someone's life, and that's something that you carry with you all of the time."

FROM PAGE 22 | Robert Dickinson

taking concrete measures to curb its large greenhouse gas emissions.

Dickinson credits his interest in global climate science—and climate change in particular—to the late Steven Schneider, a pivotal figure in raising climate change awareness among the scientific community. They met when Schneider joined Dickinson's research team at NCAR as a post-doctoral researcher.

In 1974, the two authored an influential paper simply titled "Climate Modeling" that detailed the need for developing accurate climate models, what those models should include, and the importance of figuring out how humans could sway the climate system.

The first sentence of the abstract reads: "Understanding and predicting climate change have recently acquired a sense of urgency with the advent of serious climate-related food shortages and with the realization that human activities may have an influence on climate."

Decades later, Dickinson served as lead author of the IPCC fourth assessment report section describing the role of land processes on climate change. The report echoes many of the key points that he and Schneider described 33 years earlier—except now the evidence for human-induced climate change was overwhelming.

While at the Jackson School, Dickinson advised or mentored, in some capacity, every student who studied climate, according to Yang. His students have gone on to become leaders in the field of climate research in their own right, taking positions as researchers at top research institutions, such as NASA's Jet Propulsion Laboratory, and faculty at top research universities.

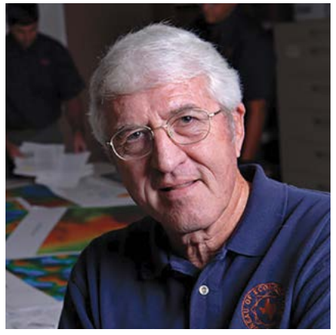
Dickinson was so well known in his field, students would come from around the world to study with him, Yang said. But ever the careful mentor, Dickinson, even in the later years of his career, was known to spend time carefully reviewing students' source code to confirm that the directions underlying a model made sense.

Dickinson said that spending the years collaborating with students and colleagues should be counted among the top highlights of his career in climate science.

"For me, another direction of highlights is all the wonderful people I collaborated with or otherwise interacted with, ranging from students to postdocs to early career scientists to those more senior than I was at the time," he said.

Dickinson's retirement plans continue training the next generation of climate scientists to conduct research that has implications for every person on the planet.

"I have an office in the AOS department at UCLA," Dickinson said, "and I will continue to mentor or otherwise help young people."



FROM PAGE 23 | Bob Hardage

The bureau released the first 3-D survey that it designed, acquired, processed and interpreted (called the Stratton survey) as a public data set in 1994 to assist the transfer of 3-D seismic technology to the global geoscience community. The release of the data coincided with efforts by several entrepreneurs to develop 3-D seismic-interpretation technology. Hardage assisted with connecting business owners to the Stratton data processed by the bureau. This exchange helped the bureau build a reputation as a resource for small geophysics software companies and a key player in applying 3-D seismic technology in reservoir characterization.

Along with building the bureau's own technology and partnerships, Hardage helped spread the word about 3-D seismic to the public via workshops and lecture tours. He remembers how a particular workshop in Graham, Texas, caused a stir among operators who had been exploring for gas reservoirs using only 2-D seismic. They were amazed how the 3-D seismic showed evidence of Ellenburger karst collapse features, which caused compartmentalization of gas reservoirs in the shallower Boonsville interval.

The workshop inspired Hardage to develop a larger-scale, short-course series for independent operators. The series was presented in Texas, New Mexico, Louisiana, Oklahoma and Kansas, and later adapted for an international tour, presented with Landmark, that covered four continents.

The short-course workshops were the first exposure that some operators had to 3-D seismic technology, and as a result of the six-month tour, Hardage received a special commendation from SEG in 1998 for transferring 3-D seismic technology to small independents.

Hardage's efforts in collecting technology, building connections and spreading the word about 3-D seismic innovations has paid off for the bureau, which now has a seismic research capability that Hardage calls remarkable. In 2012, the Jackson School as a whole recognized his accomplishments by awarding Hardage the school's Outstanding Service Award.

Reflecting on the decades-long task, Hardage said that he is proud to have guided the process.

"I have good memories of helping the bureau undergo the transition from near-zero capability in geophysics to its present state of being at the cutting-edge of 3-D seismic reflection technology," he said.

FROM PAGE 24 | Gary Kocurek

Kocurek also brought an expanded perspective to his own research, leading pioneering surveys that captured dune fields from on high. In 2007, he worked with the National Park Service to establish an aerial survey of White Sands National Park in New Mexico, a 275-square-mile dune field that owes its blinding white dunes to sand made of gypsum grains. The surveys used LIDAR, a technique that captures elevation data using lasers, and have provided details about dune topography at the centimeter scale.

Kocurek's research at White Sands helped provide some of the first evidence of dune-to-dune interactions in the field. In the early 1990s, computational models had predicted that dunes could combine or break one another apart. Working with doctoral students Ryan Ewing and Sarah Christian, Kocurek published research that documented the behavior happening in the dune fields of White Sands.

"We had such a big data bank that you could actually get on a real dune and follow it for decades and say that 'yes, it really does collide with another dune and break apart and recombine, and have parts eject out,'" Kocurek said. "We always assumed that dunes migrated and that was the end of the story, but we now know that dune interactions are probably the dominant mechanism in how dune fields achieve such nice patterns."

Kocurek's expertise in studying dunes from a distance caught the attention of NASA's Mars Science Lab team. In 2012, Kocurek joined the team to help analyze formations spotted by the Curiosity Rover and provide guidance on the rover's path to its final destination, Mount Sharp. Mackenzie Day, who earned her doctorate under Kocurek in 2017 and was also part of the NASA team, used data collected from Curiosity and wind tunnel tests to show that the mount was more of a mound, sculpted in part by wind eroding away sediment inside of a crater basin.

McBride said that Kocurek's ability to study dune fields from a variety of vantage points has made for a career of impactful research.

"If there's a sand dune within reach in North America, he's been there," McBride said. "[Aeolian processes] are a unique niche of expertise, and I'm impressed with his innovative ways of studying modern dunes."

As sure as the dunes and deserts continue to shift, Kocurek will keep watching.

FROM PAGE 26 | Timothy Goudge

distinguished postdoctoral program. Collaborating with the Jackson School's top-ranking sedimentology faculty, Goudge sought to learn from them more about the sedimentary processes happening on Earth.

"[I wanted] to focus more on the terrestrial aspects of things to try to broaden my horizons," Goudge said. "There's a strong group here. It's been a really enlightening several years, and it's been really fun to bring a different perspective."

Associate Professor Wonsuck Kim, who worked with Goudge on research projects on both Earth and Mars, said that in addition to collaborating well with faculty, he was impressed with how Goudge interacts with students.

"Goudge is an expert on remote sensing, his specialty is greatly appreciated because it adds a new, nice collaboration between the experimentalists," Kim said. "He worked very hard and was very kind to my graduate students. He naturally became a good colleague and sacrificed his time to help others which is key to his success."

Goudge said he is looking forward to communicating with students in his research group, which he plans to be as diverse as possible.

"The major career goal for myself, as much as doing interesting science, is also training young scientists," Goudge said. "The need to increase diversity in all sorts of aspects across STEM fields is an issue that I personally think about a lot. It's an important aspect of science that is often overlooked—the human aspect of it."

Goudge has been an advocate for not only better representation of the field, but better communication of research. In graduate school he ran a program where geology graduate students would provide hands-on science training for elementary-aged kids. In addition, he is a member of the Geoscience Empowerment Network (GEN), which promotes issues surrounding diversity across the Jackson School.

Goudge said he will continue to jump at any opportunity to participate in public outreach. After all, people love Mars.

"Most of what we do is funded at some level by the taxpayers, so you owe the general taxpayer your science ... plus it's just fun," he said.

GEOSCIENCES ACROSS TEXAS

From exploring energy frontiers to monitoring earthquakes, the **Jackson School of Geosciences** benefits Texans statewide.

1. TEXNET/CISR STATEWIDE SEISMIC MONITORING SYSTEM AND RESEARCH (see page 15)

2. TXSON
A network of ground-based monitors throughout Texas that measures soil moisture to better understand and predict intense droughts and floods.

3. SHALE RESOURCE AND RESERVE STUDIES
The most comprehensive public study of six major shale plays in the nation — with half in Texas.

4. MG&G FIELD COURSE ON THE TEXAS COAST
A one-of-a-kind class that is training the next generation of geophysicists for the energy industry (see page 53).

5. GEOFORCE TEXAS
A program that teaches high school students from underserved areas in Texas about the geosciences and helps prepare them for college and careers. GeoFORCE recently received the Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring, the highest such honor from the United States government.

6. THE STATE OF TEXAS ADVANCED OIL AND GAS RECOVERY PROGRAM
A state-funded program that assists oil and gas operators using the latest technology, geoscience and engineering understanding to increase production in existing fields and regional exploration projects.

7. HURRICANES AND COASTAL EROSION
From using state-of-the art LIDAR techniques to map the Texas coast to the Rapid Response program, which places scientists at the scene of natural disasters soon after they occur, UT is helping the state understand and prepare for the effects of natural hazards (see page 58).

8. FORT WORTH METHANE IN WATER STUDY (see page 19)

9. WATER SCARCITY RESEARCH
Leading research on the impact that energy production and agriculture have on water use and on how to manage the state's limited water resources.

10. STUDYING METHANE HYDRATE AS A FUTURE ENERGY SOURCE

11. GULF BASIN DEPOSITIONAL SYNTHESIS PROGRAM
GBDS builds an ever-evolving picture of Gulf of Mexico geology using data from academic and industry partners. The data recently gave companies a first look into previously off-limits waters around Mexico, an area of critical interest and importance to the Texas oil and gas industry.

12. HR3D GULF SURVEYS
High-resolution 3-D marine imaging technology is giving researchers a better look at Gulf of Mexico subsurface for the potential to store large volumes of carbon dioxide emissions and create a new industry in Texas (see page 84).

13. CORE REPOSITORIES
More than 1.5 million boxes of rock core and cuttings are available for study at each of the Bureau of Economic Geology's three core repositories in Austin, Houston and Midland (see page 80).

14. CARBON MONITORING AT PETRA NOVA SEQUESTRATION SITE

Walter Geology Library 2017–18 Annual Report

Our academic year started out with a bang, as a faulty plumbing repair on the floor above the stacks resulted in an evening flood with about 1,000 books getting wet and 2,000 books being moved. This was barely a week after Harvey tore into the Marine Sciences Library in Port Aransas, and emergency staff had just returned from stabilizing that facility. Thanks to the quick work of building staff and (exhausted) library emergency folks, no materials were completely lost, though a great deal of repair work was required.

Library storage facility No. 3 has opened, and we anticipate moving lesser used periodicals this year to make room for new materials and more space. The USGS geologic map series has been stored, since the majority are now available online, and with the assistance of James Galloway and staff-sharing from the Chemistry Library, the entire map collection was shifted and relabeled. James is also helping us reorganize our oversized and atlas shelving areas. Meanwhile, our gifts flow has been reduced, and we are slowly catching up with all pending materials on-site. Gifts are a slow, expensive undertaking, but many of our most unusual materials come from gifts, ensuring they are not lost to research. With the passing of Dr. Peter Flawn, several collection managers reviewed his office collection and files. Materials went to the Walter Library, the Briscoe Center for American History and the Bureau of Economic Geology.

This year's major purchases included Australian natural history materials, more quads of the China 1:250K Geologic Atlas, and a number of new maps. Most commercial and university press monographs are now being acquired as e-books, so while collections access is growing online, growth of physical volumes has been reduced. Some really like the convenience, some find reading e-books tedious and miss the serendipity of browsing the stacks. Many of our decisions are driven by economics, but we are working to find the right mix of technologies to keep researchers and readers happy.

Budgets are under heavy pressure, a national concern for research libraries. Federal libraries we used to depend on as a fallback, like the USGS Library network, are under even more crushing limitations if not outright decline. Increasingly academic libraries are forced to choose among people, technology and collections.

UT library's efforts to develop a library Geographic Information System (GIS) portal are under way, and we hope to make our first milestones this coming year. Michael Shensky has joined the Libraries as our GIS coordinator, working out of Perry-Castañeda Library. In other e-services news, we have added more than 75 legacy theses to our online repository and many are getting heavy use. We are on track to have everything prior to 1934 completed this summer, and this past year we have received permission to do many of Dr. Jack Sharp's students' theses, thanks to an appeal from him. This year we have also added undergraduate honors theses to the repository, which we hope will be a growing trend. This year we are also beginning a pilot project with the Vertebrate Paleontology Collections to digitize a small number of their Work Projects Administration surveys. You can visit the open ScholarWorks repository at repositories.lib.utexas.edu.

Our social media presence is strong, with almost 850 people following our Facebook (you should too!). Nicola Tisato and the Graduate Student Executive Committee (GSEC) have been sponsoring a morning coffee break on Mondays called ROKAFE, which provides a social crossroads and helps GSEC raise funding. It's a good crowd if you like to talk about geology! We also sponsored the new grad student pizza lunch during orientation.

There is a lot of buzz about open access. For many, this movement opens new information resources and new readership, but there have been unintended consequences. In some cases, this has resulted in lower quality, shady reviewing and acceptance policies, reduced stability and reliability, and increases in retractions. As the flow of information increases from more diverse sources, discovery and archival access become serious concerns. It will take time to stabilize, and in the meantime, we will have to be vigilant.

In staff news, Stacy Ogilvie is working on several website projects, most especially the sprawling geoscience thesis index, which we hope to have in a single searchable file soon. She continues to work with the map catalogers to bring us up to date on map processing. Six student workers graduated this year after many semesters of service with us: Katy Lucas, Brianna Cooley, McKenna Magnuson, Soyoung Lee, Heather Maldonado and Elizabeth Menezes. We wish them well in their future endeavors. This year's winners of the Guion Service Award were recognized for their extra efforts in the flood recovery: Janeice Connors, Bill Gannon, Matt McGuire, Joey Marez and Chris Stella.

I presented on library and information topics to GEO 298T, a graduate course on teaching methods. I have also taken over as subject librarian for Petroleum Engineering and Geography, with the loss or retirement of other staff. I attended the Geological Society of America meeting in Seattle and continue to serve as chair of the American Geosciences Institute GeoRef advisory committee. Deep resources like GeoRef are essential to research, but can be a hard sell against the convenience of search engines, which are neither complete, well-indexed, nor fully reliable.

Dennis Trombatore
Librarian

Jackson School Hosts High School Researchers during AAAS Conference

Roughly 160 of the country's best high school scientists converged on The University of Texas at Austin on Feb. 15-16, 2018, for a first-hand look at one of the nation's top research universities.

The students were members of the American Junior Academy of Science (AJAS), the nation's only honor research society for high school scientists. The university hosted the group as part of the AJAS annual conference, which is held in conjunction with the American Association for the Advancement of Science's (AAAS) annual meeting. In addition to the Jackson School, the students visited the Cockrell School of Engineering, College of Natural Sciences and Dell Medical School.

The Jackson School hosted about 60 of the students, treating them to a full day of lab tours and scientific discussion on the main campus and the J.J. Pickle Research Campus. These included tours of the CT Lab, Methane Hydrate Pressure Core Center, Rock Deformation Lab, Vertebrate Paleontology Collections and the Austin Core Research Center.

"The tour was short but effective," said Assistant Professor Nicola Tisato, who led tours through his rock deformation lab. "Students from my group and I explained the process of taking a rock sample, turning it into a precise cylinder, and testing it at pressures and temperatures that mimic the conditions in the Earth's crust."

Jackson School professors and researchers were impressed with the students and offered them a variety of experiences. Research Scientist Associate Peter Polito, who led tours through the pressure core center, said the students reminded him a bit of his younger self.

TOP: JACKSON SCHOOL ASSISTANT PROFESSOR NICOLA TISATO INTRODUCING STUDENTS TO ROCK DEFORMATION TECHNOLOGY. **BOTTOM:** AN AJAS STUDENT EXAMINES CORE SAMPLES AT THE BUREAU OF ECONOMIC GEOLOGY.

AAAS: AMERICAN JUNIOR ACADEMY OF SCIENCE/JACKSON SCHOOL. CAVE: JACKSON SCHOOL.

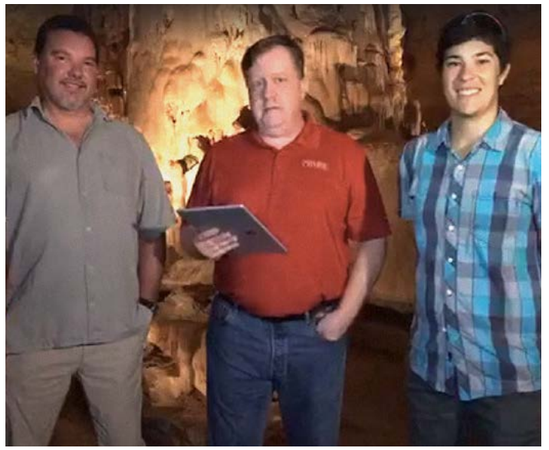
"They were very bright, asked challenging questions," he said. "I was just a bit younger when a meteorologist from the National Weather Service gave me a tour of the NWS office for a school project—I can point to that event as a big reason I ended up in the geosciences today. I only hope 20 minutes in the pressure core center might have the same effect on one or two of them."

After the day of tours, students were given the opportunity to have a sit-down breakfast with 10 UT scientists, including two from the Jackson School.

"The students are extremely impressive, and we were honored to host them and show them around our campuses," said Maurie McInnis, executive vice president and provost at UT. "UT Austin is one of the world's leading research universities, and our faculty love sharing their work with students and hearing about their interests and what they want to explore."

The tours were part of the Jackson School's overall efforts during the AAAS Conference. UT, with the Jackson School's support, helped sponsor the conference, which brought thousands of scientists to Austin. Among the conference-related events the Jackson School participated in were a mixer with UT researchers and national science reporters, family science day, and representing the school at a UT booth.

TOP: JESSIE MAISANO, THE CT LAB MANAGER AND RESEARCH SCIENTIST ASSOCIATE, SHOWS STUDENTS A RECONSTRUCTION OF A KOMODO DRAGON HEAD SCANNED AT THE CT LAB. **BOTTOM:** PETER POLITO, A RESEARCH SCIENTIST ASSOCIATE, WITH STUDENTS AND METHANE HYDRATE CORES.



LEFT TO RIGHT: MARCUS GARY, BRIAN VAUTER AND CORINNE WONG INSIDE NATURAL BRIDGE CAVERNS.

Jackson School Scientists Go Deep for Cave and Karst Day

Jackson School of Geosciences scientists explained the importance of cave research and cave environments in a chat that was broadcast live from deep inside Natural Bridge Caverns, a cave system located near San Antonio and the largest commercial cave in Texas.

Adjunct Assistant Professor Marcus Gary and Research Associate Corinne Wong took part in the chat, which was held on June 6, 2018, in honor of National Caves and Karst Day and broadcast on Facebook Live. Brian Vauter, the staff geologist for the caverns, moderated the discussion which took place 165 feet underground in front of a formation known as the Castle of the White Giants.

Wong explained how she uses cave deposits to reconstruct past climates. Gary, who is also a hydrogeologist at the Edwards Aquifer Authority, emphasized the importance of the Edwards and Trinity aquifers, which both flow through the cavern area, in supplying drinking water to communities in Central Texas.

"It's really important for us to be able to document the conditions of the aquifer, how they recharge, what types of conditions are dependent for recharge to occur ... to maintain a sustainable resource for the whole region," Gary said.

About 11,500 viewers tuned in to the broadcast.

Graduate Students Host An Evening on Texas Water

About 200 people filled Austin's Scottish Rite Theater on April 27, 2018, to attend "An Evening on Texas Water," a unique event exploring the past, present and future of water in Texas sponsored by the Jackson School of Geosciences and organized by graduate students.

The free, public event mixed art, science and policy. It featured a screening of the multi-award winning film "Yakona" with music performed by a live quartet. The film is a visual exploration of the San Marcos River, which is located about 30 miles south of Austin. It follows the river over space and time, tracing its path from source to sea and its history from prehistoric times to the present.

The screening was followed by a panel discussion with water experts, policy makers and advocates who focus on water research and policy in Texas. The discussion helped bridge the often disconnected worlds of academic research, public policy, law, environmental regulation and environmental advocacy. The panel included:

- Robert Mace, chief water policy officer at the Texas State University Meadows Center for Water
- Vanessa Puig-Williams, executive director and general Counsel for the Trinity Edwards Springs Protection Association
- Michael Young, associate director of the Bureau of Economic Geology's Environment Division.

"I think the most exciting thing about the event is that these folks all came from different backgrounds and almost everyone was being introduced to something new," said graduate student Michael O'Conner, who helped organize the event with graduate student Caroline Hackett. "We had members of the film, music, and environmental science communities all in one place, and each group left with something more than what they came in with."

TOP: (LEFT TO RIGHT) VANESSA PUIG-WILLIAMS, ROBERT MACE, MICHAEL YOUNG, MICHAEL O'CONNER AND CAROLINE HACKETT.

BOTTOM: THE EVENT FLYER.

PHOTOS: JACKSON SCHOOL.

BUREAU DIRECTOR SCOTT TINKER (RIGHT) RECORDS EARTHDATE WITH WRITER/DIRECTOR HARRY LYNCH.

On Earth Day, UT's EarthDate Celebrated One Year of Exploring the Planet's Mysteries

Did you know that 99.9 percent of species that have ever lived on Earth have perished, or that maps of the moon, Mars and even Venus are 50 times as detailed as maps of much of our ocean floor? Did you hear that miners have recently discovered 2-billion-year-old water that provides a snapshot of Earth from the time when only single-celled life existed?

These are the types of fascinating tidbits that EarthDate brings its listeners in digestible two-minute chunks. The radio show, produced by the Bureau of Economic Geology, turned one year old this Earth Day on April 22, 2018. Since premiering on Earth Day last year, it has grown tremendously and now can be heard on more than 300 public radio stations in all 50 states, Canada, the Philippines and New Zealand.

The remarkable growth of EarthDate underscores people's thirst to understand and connect with the world around them, said bureau Director Scott Tinker, who conceived of EarthDate and is the voice of the show.

"The Earth is a wondrous and complicated place full of amazing stories, and we help unravel those stories," said Tinker, the state geologist of Texas. "Through EarthDate, we break those stories down into ways that people can understand and, hopefully, enjoy. It's really a nice convergence of science and education."

The bureau is a research unit of the Jackson School of Geosciences and is the State Geological Survey of Texas. Each episode of EarthDate undergoes a rigorous process. Bureau project manager Juli Hennings leads the research efforts for the show, which involves employing experts from around the globe to fact-check episodes. The show covers a wide variety of topics ranging from the 2004 tsunami that swept over Indonesia, Thailand and 12 other countries, to the secrets of bird songs and glaciers.

Each episode is posted with the script and a fact sheet for teachers and the general public, and all the episodes are available to download for free. To date, 101 episodes have been produced, and many more are in the works. Listeners can even suggest ideas for future episodes. Schlumberger sponsors EarthDate.

For more information, or to listen to or download EarthDate episodes, go to www.earthdate.org

OPENING CEREMONY OF GEO 2018.

Bureau Director Presents Keynote in Bahrain

Bureau of Economic Geology Director Scott Tinker gave the keynote address at the opening of GEO 2018—the 13th Middle East Geosciences Conference and Exhibition held in March 2018 in Bahrain. GEO, the largest and best-attended technical conference of its kind in the Middle East, hosts government leaders and industry professionals interested in the future development of the region's hydrocarbon resources. Tinker's address was titled "Energy, Poverty, and Climate: Seeking the Radical Middle."

"The growth and development in the Middle East is remarkable," Tinker said. "It is underpinned by energy. I appreciated the opportunity to discuss climate, poverty and energy with leaders from the region, probably for the first time in such a public setting. These issues must be addressed as the region moves forward."

Later in the week, Tinker appeared at King Abdullah University of Science and Technology, near Jeddah, Saudi Arabia, as the Dean's Distinguished Visitor. He presented on "The Future of Fossil Fuels" to a packed house. Tinker gave 40 such keynote and invited lectures globally to audiences of all kinds in 2018.

Tinker Filming Switch Sequels

Bureau of Economic Geology Director Scott Tinker will be spending much of 2019 filming two sequels to *Switch*, the award winning 2012 documentary that explores the world's energy sources, and the issues and choices associated with each. In addition to the two new movies—"Switch On" and "Making the Switch"—Tinker will also be developing a video-based course on energy for high school and college level students. During that time, Associate Director Mark Shuster will be acting as director. For more information on the switch projects, see www.switchenergyproject.com.

Geoscience Empowerment Network Builds Support and Diversity at JSG

In spring 2018, faculty and graduate students founded the Geoscience Empowerment Network (GEN), an organization dedicated to fostering a more inclusive and equitable environment for people of different backgrounds at the Jackson School of Geosciences through mentorship and outreach.

"My reasons for founding GEN is in response to a need for a more supportive community for our students, faculty and staff who are from diverse backgrounds," said Associate Professor Ginny Catania, a founding member of GEN. "My goal is to prepare our students to be the future leaders in geosciences, and in providing this support we can attract a more diverse set of students to the JSG."

The organization offers the Jackson School research community opportunities for personal and career development and mentorship, and frequently hosts female and minority speakers to talk about their own experiences navigating a career in the geosciences.

In addition to supporting the current Jackson School community, GEN is working with the Office of Outreach and Diversity to develop plans for a number of outward facing initiatives to help recruit and retain minorities. They include outreach at minority-serving institutions, minority-centered scholarships and providing funds for minority students to visit the Jackson School during Prospective Student Weekend.

The organization is interested in building a network of mentors and supporters from both industry and academia. To get involved, visit www.genatjsg.org/support-us.

IMAGE FROM THE GEN WEBSITE.

Jackson School Brings Earth in 2100 to Masri Institute

In April 2018, The Masri Institute for Energy and Natural Resources at the American University of Beirut invited Associate Dean for Research David Mohrig to present on the Jackson School of Geosciences' research vision for studying natural resources and the environment, and their effect on society.

Mohrig delivered two talks as part of his visit. One described the new Jackson School research initiative, Earth in 2100: Water, Energy, Land Use and Climate, and the other focused on his own research on how extreme weather events affect rivers and coastlines.

Earth in 2100 is a research initiative described in the Jackson School's new strategic plan. The initiative focuses on how issues related to energy, climate, water, land and other areas concerning the environment and natural resources, will impact society within the next century and how humans can prepare to face them. The initiative was also the launching point for Planet Texas 2050, a UT-wide research program that treats Texas as a laboratory for environmental issues facing the world.

"The environment is definitely a challenge that the geosciences have a lot to contribute to," Mohrig said. "And we probably have a couple dozen faculty [at the Jackson School] who specifically work on integrated environmental science."

Alan Shihadeh, dean of the Maroun Semaan Faculty of Engineering and Architecture at the American University of Beirut, said that the initiative is an inspiration for research at his own program and is interested in hearing how UT and the Jackson School approach these pressing global issues.

"These problems require intellectual agility, radical collaboration and tolerance for ambiguity," Shihadeh said. "I look forward to hearing about how Texas is cultivating this mental landscape."

GEN: GINNY CATANIA. MASRI: AMERICAN UNIVERSITY OF BEIRUT. FOSSILS: JACKSON SCHOOL.

UNDERGRADUATE STUDENT BLAKE CHAPMAN INTRODUCES A MOSASAUR FOSSIL TO EVENT ATTENDEES.

Talking Texas Fossils

Matthew Brown, the director of operations for the Vertebrate Paleontology Collections at the Jackson School's Museum of Earth History, launched a science outreach series called "Talking Texas Fossils" in spring 2018. The series invites members of the community to learn from Jackson School experts about ancient life and fossils, especially those held at the school's vertebrate paleontology collections.

So far, there have been three public presentations. The topics covered include: the history of fossil collecting in Texas, the mosasaur research of Jackson School doctoral student Josh Lively, and how the dinosaurs depicted in the latest Jurassic Park movie compare to the real things.

The talks usually take place at the museum. For the Jurassic Park talk, the series teamed up with the Alamo Drafthouse movie theater to host a question and answer session after a showing of "Jurassic World: Fallen Kingdom."

Graduate Program Coordinator Philip Guerrero, who attended the event, said it was a great way to spread the word about the important collections held at the museum.

"I think that's important for its continued success," he said.

To stay up to date on future talks, follow the University of Texas Vertebrate Paleontology collections on Facebook at facebook.com/TexasVertPaleo.

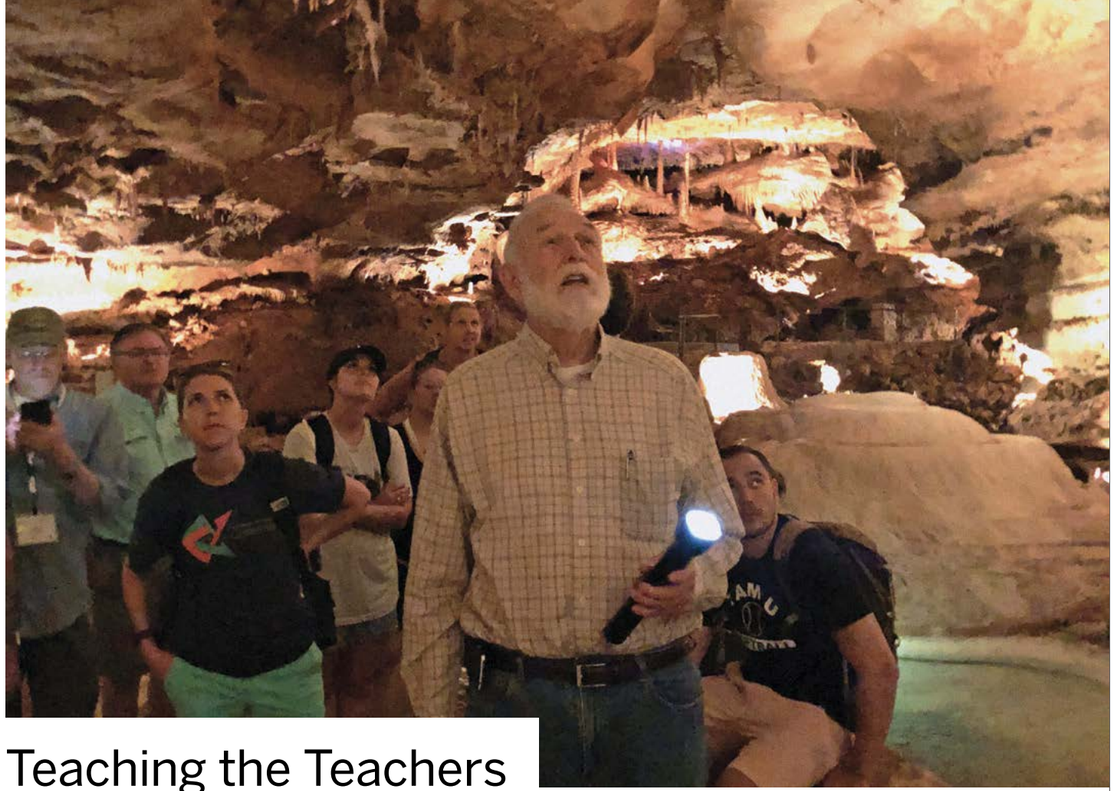
Future of Geoscience Education Initiatives

One of the goals in the 2018 Jackson School of Geosciences Strategic Plan is to provide national leadership in geoscience education. To that end, the Jackson School is involved in two national efforts sponsored by the National Science Foundation.

The Future of Undergraduate Geoscience Education, a national initiative that Dean Sharon Mosher has been spearheading since 2014, is nearing completion. A document entitled "Vision and Change in Undergraduate Geoscience Education: A Call to Action" is being produced that will encapsulate all results and outcomes of this initiative and will be published in partnership with the American Geosciences Institute. This initiative developed a community vision for undergraduate geoscience education through input from geoscience employers and academics from across the country. It identified concepts, skills and competencies needed by undergraduate geoscience students to prepare them for the future workforce and best practices for achieving these outcomes. Programs across the country have begun implementing this community vision and are developing best practices for curricular and program change. The vision and change document will serve as a catalysis for change and provide a roadmap of proven pathways to success.

Building on the success of the undergraduate initiative, the National Science Foundation has funded Dean Mosher for an initiative to investigate the skills and competencies that should be an essential part of graduate geoscience education to prepare students for a wide variety of career options, and the best means for developing these in programs nationally. Most master's and doctoral students do not become academics when they graduate, and many that do are employed at institutions where research is only a small part of their responsibilities, if at all. However, the focus of geoscience graduate programs is on research, mentoring and instruction of students and on developing intellectual depth and strength within a subdiscipline. By becoming experts in a specific subfield and having highly developed research skills, graduate students are placed on a path toward an academic career at a research institution where this kind of specialization is sought and rewarded. The goal of this new initiative is to change this dynamic so that graduate students are prepared for academic, government, industry, consulting or other employment.

The first workshop with geoscience employers was in October 2018, with over 50 employer representatives from across all branches of the geosciences, including Earth, atmosphere and ocean sciences. The next step is to engage department heads, chairs, graduate program directors and advisors from across the country to raise awareness of the critical skills and competencies for geoscience doctoral and master's graduates and to find ways to implement the development of these skills and competencies into their graduate programs.



Teaching the Teachers

Jackson School of Geosciences scientists helped prepare 50 high school teachers from throughout Texas to teach geosciences to their students during a field trip to Inner Space Cavern in July 2018.

The trip was part of The University Texas at Austin OnRamps Program, which focuses on preparing high school students for success in college. In this case, a trio of Jackson School scientists gave the teachers an up-close glimpse of the geosciences. Among the subjects they covered were karst geology and karst aquifers.

"You're going to get a real window into how the aquifer works," Professor Jay Banner told the group. "We're going to be able to see the path the water takes as it flows into the aquifer."

The high school educators learned about cave formations and how they contain detailed records of past climate change, and what the bones found in caves reveal about the environment of past ages.

Some of the teachers, like Sarah McKeon from Crosby High School in Crosby, Texas, had no background in geosciences. McKeon admitted she found the task of teaching the subject a bit daunting but said she felt much better about it after spending the morning with Jackson School scientists.

"This is very helpful," she said. "They explain things in a way that I can understand even though I don't have a geology background."

Others, like science teacher Rohn Butterfield of Amarillo's Caprock High School, had significant experience teaching the subject and a good background in the geosciences. He graduated from the University of Texas El Paso with a degree in geology, but even he said the trip taught him a lot.

"I haven't done a lot of cave stuff, so this has been really enlightening," he said. "I know how karst geology works, but the intricacies of this, to have it explained by people of this caliber, is really good."

In addition to Banner, the teachers got to learn from two Jackson School scientists with more than 100 years combined experience studying the famous cave: Professor Emeritus Ernie Lundelius and geologist Jim Sansom, who graduated from the University of Texas in 1963.

Lundelius has been searching for and studying bones in the cave almost since it was first discovered in 1963. But Sansom's experience with the cavern actually predates Lundelius'—and just about anyone else's for that matter. He was part of the highway crew that discovered the cave when they were building Interstate 35. After the drill pipe and bit had fallen through thin air and then became stuck, Sansom volunteered to climb down the drill hole to try and figure out the problem.

After a 25-foot descent, he found himself in the middle of one of Inner Space's awe-inspiring caverns, which would later became one of the region's best known natural attractions.

"I told them they should be careful, they might hit a cave," he remembers warning the drilling crew. "I never thought it would be anything like this though."

ABOVE: GEOLOGIST AND UT ALUMNUS JIM SANSOM TRAINING HIGH SCHOOL TEACHERS IN INNER SPACE CAVERNS, WHICH HE HELPED DISCOVER IN 1963.

PHOTO: JACKSON SCHOOL.

Alva Ellisor and Lynton Land Join Elite Group of Geoscientists

The Jackson School inducted a pioneering petroleum geologist and a distinguished academic scientist into its Hall of Distinction this year when it welcomed Alva Ellisor and Lynton Land to the group.

Ellisor was a pioneer in the petroleum industry who made a major technical breakthrough in 1921 when she discovered and proved that *foraminiferal* micropaleontology could be reliably used to correlate geological units in the Texas Gulf Coast. Her work and collaboration with two other female paleontologists, Esther Applin and Hedwig Kniker, led to the discovery of valuable new oil fields, created oil industry jobs for micropaleontologists, and gave rise to micropaleontology courses in 31 geology departments. By 1931, 75 percent of all oil wells drilled and completed in the country were using micropaleontology. This new technology had a profound impact. Prior to that, there was no reliable way to correlate strata other than fragments of macrofossils found in cuttings — the dogma of the day was that one-celled animals could not provide the diversity and rapid change through time to be effective.

Ellisor is a University of Texas alumna. She graduated with high honors in 1915 and taught at UT afterward for two years. She started working for Humble Oil in 1920 when Walter Pratt hired her for its paleontological laboratory to examine megascopic fossils, and her discovery revolutionized the industry. In 1927, she became Humble's first research stratigrapher and paleontologist and worked there until her retirement in 1947. She became a fellow of the Geological Society of America in 1929, and in 1962 received the Distinguished Alumni Award from the Geology Department of The University of Texas at Austin. She is a founding member of the Houston Geological Society. After a life devoted to stratigraphic research, and marked by numerous publications on most phases of Cretaceous and Tertiary stratigraphy and paleontology of the American Gulf Coast, she passed away in 1964 at the age of 72.

Land is a distinguished scientist who spent his entire academic career at the University of Texas Department of Geological Sciences, bringing worldwide recognition to our program in sedimentary geology and geochemistry. Lynton made major contributions to the study of diagenesis of sedimentary rocks, especially burial diagenesis in the Gulf of Mexico sedimentary basin. This research has important implications for petroleum reservoirs, and his work was funded and closely followed by major oil companies. He was also the principal investigator of numerous NSF grants throughout his career.

Lynton's work has been cited 5,374 times and, as of 1996, Lynton had supervised 19 master's and 21 doctoral students, including two future presidents of the Society for Sedimentary Geology (SEPM) (Kitty Milliken and Dave Budd). He was an excellent teacher and won the Knebel Teaching Award in 1979. He worked closely with his colleagues (and Hall of Distinction members) Earle McBride and the late Robert Folk and, making the department *the* place to study sedimentary petrology and geochemistry.

In 1996, Land received the SEPM Pettijohn Medal in recognition of his continued contributions to carbonate sedimentology and geochemistry, diagenesis of siliciclastics, and origin of dolomite and saline formation waters; his inspiring teaching skills, and his international stature and leadership in sedimentary geology. Land is now a professor emeritus in the Department of Geological Sciences. In retirement, Land uses his scientific expertise to help society. As he states on his Jackson School web page, "Since retiring to Northumberland County in tidewater Virginia, I have tried to use my scientific knowledge to educate citizens and local and state government officials about critical [environmental] issues for the future."

PHOTOS: JACKSON SCHOOL.

The Jackson School's Hall of Distinction was founded in 1980 and currently has 38 members, including this year's new inductees. To see a full listing of honorees, visit www.jsg.utexas.edu and type "Hall of Distinction" in the search field.

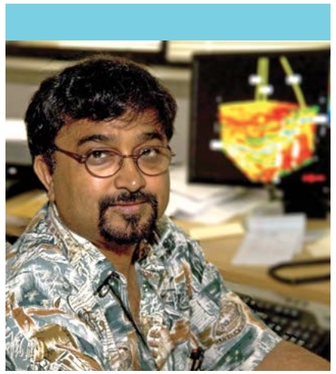
Horton Inaugural Recipient of SEPM Dickinson Medal

The Society for Sedimentary Geology (SEPM) selected Jackson School of Geosciences Professor Brian Horton as the first recipient of the William R. Dickinson Medal. The award recognizes a midcareer research geoscientist who is significantly influencing the sedimentary geology community with innovative work.

"Contributions to major shifts in scientific thinking, via original and innovating data generation, tools and analyses, which help solve broad geological questions are hallmarks of a Dickinson Medal awardee," according to the SEPM description of the award.

Horton is a professor in the Department of Geological Sciences, a research professor at the University of Texas Institute for Geophysics and is the Alexander Deussen Professor of Energy Resources. His research focuses on sedimentary basin development and mountain building. Recent work includes investigating the connection between geological processes, such as tectonic uplift, magmatism, erosion and sedimentation, and the biology and climate of the Amazon.

The award is named in honor of William R. Dickinson, a geoscientist known for broadening the applications for sedimentological analysis, including developing the Gazzi-Dickinson method for statistically measuring components in a sedimentary rock. Award recipients receive a medal featuring Dickinson's likeness.



Sen Receive SEG's Virgil Kauffman Gold Medal

Mrinal Sen, interim director of the University of Texas Institute for Geophysics, professor and Jackson Chair in Applied Seismology, was awarded the Virgil Kauffman Gold Medal from the Society of Exploration Geophysicists (SEG) at their annual meeting in October.

The award is presented to a person who has made an outstanding contribution to the advancement of the science of geophysical exploration in the past five years.

"It is a pleasant surprise and quite an honor," said Sen, who was nominated by his peers for his work in seismic wave propagation.

Over the past five years, Sen and his students focused on developing methods for building starting models for use in full wave form inversion and uncertainty quantification, and the modeling of seismic wave propagation in fractured media. These models have applications in oil and gas exploration and production.

"There were some limitations in the existing methods," said Sen. "In earlier methods it was difficult to put discrete fractured networks in, so there was a serious computational bottleneck."

The new models developed by Sen's group use more specific information instead of average properties, resulting in a more detailed picture of the reservoirs.

Mohrig Wins Pettijohn Medal; Named Associate Dean of Research

David Mohrig has been selected by the Society for Sedimentary Geology (SEPM) to receive the Francis J. Pettijohn Medal for Sedimentology. He is the second faculty member at the Jackson School of Geosciences to receive the medal, which recognizes excellence in sedimentology. Mohrig was also named associate dean for research at the Jackson School.

The Francis J. Pettijohn Medal recognizes individuals who have a significant record of outstanding contributions in sedimentary geology, including all aspects of sedimentology and stratigraphy. The award will be presented at the 2019 President's Reception and Awards Ceremony, during the SEPM Annual Meeting held in San Antonio on Tuesday, May 21, 2019.

Mohrig has been a part of the faculty of the Jackson School since 2006 and is the John E. "Brick" Elliott Centennial Professor in Geological Sciences. As the associate dean for research, he is responsible for fostering an active research culture and promoting the formulation and implementation of major collaborative research initiatives and multi- and interdisciplinary research. Mohrig also oversees the implementation of the research portion of the Jackson School's Strategic Plan.

"Dave is an outstanding scientist and educator, and a key addition to the Jackson School's leadership team," said Jackson School Dean Sharon Mosher. "I am pleased he has taken on this critical role in our school."

Mohrig's own research focuses on how sediment is transported and deposited to build landscapes on land and in marine environments.

Haddad Honored with Ferguson Medal

Postdoctoral Fellow Mahdi Haddad has been awarded the Cedric K. Ferguson Medal from the Society of Petroleum Engineers (SPE).

The medal recognizes professional achievement in petroleum engineering. Haddad won for his paper published in the SPE Journal in December 2017 titled "Integration of Dynamic Microseismic Data With a True 3-D Modeling of Hydraulic-Fracture Propagation in the Vaca Muerta Shale."

SPE considers papers that are published in SPE journals by SPE members in good standing and younger than 36 on the date of peer approval. The award was created in honor of Cedric Keith Ferguson, who died in 1953 at the age of 31.

Tinker Wins AGI Campbell Medal

The American Geosciences Institute has honored Bureau of Economic Geology Director Scott Tinker with the Ian Campbell Medal.

According to AGI, the award is given in recognition of singular performance in and contribution to the geoscience profession. Candidates are measured against the distinguished career of Ian Campbell, whose service to the profession touched virtually every facet of the geosciences. Campbell was a most uncommon man of remarkable accomplishment and widespread influence. In his career as a geoscientist, educator, administrator and public servant, he was noted for his candor and integrity.

Tinker has been bureau director since 2000.

PHOTOS: JACKSON SCHOOL.

SEG Recognizes Bureau's Excellence

The Society of Exploration Geophysicists honored the Bureau of Economic Geology with its Distinguished Achievement Award. The award is given to a company, institution or other organization for a specific technical contribution or contributions that have, in the unanimous opinion of the honors and awards committee and the board of directors, substantially advanced the science of exploration geophysics.

Among the bureau's many achievements in geophysics that helped them garner the award were: former bureau Director John Udden's 1920 paper that showed the first raypath diagram explaining how seismic reflection imaging should be used in exploration; Bill Fisher and Frank Brown developing the basic principles of seismic stratigraphy concurrently with Exxon researchers and publishing on the concepts; and the bureau releasing the first 3-D seismic data to the public (Stratton) in 1993. The SEG also noted that in the late 1990s and early 2000s, three SEG presidents were involved in research at the bureau: Bob Hardage, Milo Backus and Robert Graebner.

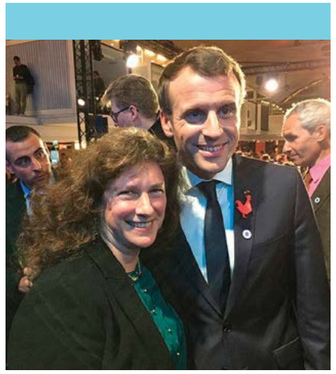
Clarke Named HHMI Professor for Innovation in Undergraduate Education

Jackson School of Geosciences Professor Julia Clarke was chosen by the Howard Hughes Medical Institute to join a select group of world-class scientist educators known as HHMI Professors. The honor includes a five-year, $1 million award to support ongoing efforts to improve undergraduate education.

Clarke researches the evolution of birds, drawing on both fossil data and anatomical information from birds living today to study the development of feathers, flight styles and vocalization. She is one of three UT Austin professors selected in December 2017 to be a HHMI professor. UT Austin is the only institution to have three awardees among the 14 winners, selected from more than 200 applicants across the country.

"These scientists are highly engaged and at the top of their respective fields," HHMI President Robert Tjian said. "By integrating the same creativity and tenacity that they employ in their own research, HHMI professors foster a melting pot of innovation and science that invigorates undergraduate science education."

Clarke will apply her grant toward a program called "Curiosity to Question," which focuses on design-centered thinking through project-based research. Through a course, and a new international summer program, UT Austin undergraduate students will develop and execute their own interdisciplinary projects. In addition, a Texas-focused Geoscience Ambassadors program will establish a mentorship framework for minority and first-generation students where they present their research and undergraduate experiences at high schools in their home communities.



Parmesan Gets "Make Our Planet Great Again" Grant

Camille Parmesan, an adjunct professor at the University of Texas at Austin Jackson School of Geosciences and professor at Plymouth University in the UK, is one of 18 scientists selected to receive a "Make Our Planet Great Again" grant from the government of France. The grant is an initiative of President of France

Emmanuel Macron, and provides awardees with three to five years of funding to conduct climate and Earth science research in France.

Macron launched the initiative on June 1, 2017, shortly after U.S. President Donald Trump announced that the United States would withdraw from the Paris Agreement, a United Nations agreement to respond to climate change and keep temperature rise below 2 degrees Celsius. The grant recipients were selected from 1,822 applications and announced on Dec. 11, 2017.

Parmesan studies how plants and animals respond to climate change. In the 1990s, she found that butterfly populations in the U.S. and Europe were dying out in southern regions while expanding their habitat northwards. Her research was among the first to show climate change directly impacting animal populations.

Parmesan plans to use her grant to study how animals from tropical areas are moving into Europe and how they may be spreading tropical diseases into new areas. She will be conducting her research at an ecological station in Moulis, France, in the Pyrenees Mountains.

Awards

Common Abbreviations:

AAPG	American Association of Petroleum Geologists
AGS	Austin Geological Society
AGU	American Geophysical Union
BEG	Bureau of Economic Geology
DGS	Dept. of Geological Sciences
EERI	Earthquake Engineering Research Institute
GCAGS	Gulf Coast Association Geological Society
GSA	Geological Society of America
GSEC	Graduate Student Executive Committee
IAS	International Association of Sedimentologists
JSG	Jackson School of Geosciences
SEG	Society of Exploration Geophysicists
SEPM	Society for Sedimentary Geology
UTIG	Institute for Geophysics

Faculty and Researchers

WILLIAM AMBROSE
J. C. "Cam" Sproule Memorial Award, AAPG

NATHAN BANGS
Director's Circle of Excellence, UTIG

JAIME BARNES
Knebel Teaching Award, Undergraduate Course, DGS

THORSTEN BECKER
Director's Circle of Excellence, UTIG

BUREAU OF ECONOMIC GEOLOGY
Distinguished Achievement Award, SEG

TODD CALDWELL
Excellence in Review Editor's Citation, Vadose Zone Journal

GINNY CATANIA
Director's Circle of Excellence, UTIG

GAIL CHRISTESON
Outstanding Research Award, JSG

JULIA CLARKE
HHMI Professor for Innovation in Undergraduate Education, Howard Hughes Medical Institute

DGS FEMALE FACULTY
Outstanding Service Award, JSG

PEDRO DINEZIO
Director's Circle of Excellence, UTIG

SHIRLEY DUTTON
Thomas A. Philpott Award 2nd Place, GCAGS

SERGEY FOMEL
First Author Award, BEG
Best Paper in Interpretation, SEG

CYRIL GRIMA
Outstanding Young Researcher Award, UTIG

MAHDI HADDAD
Cedric Ferguson Medal, SPE

MARK HELPER
Knebel Teaching Award, Graduate Course, DGS

BRIAN HORTON
William R. Dickinson Medal, SEPM
Director's Circle of Excellence, UTIG
Outstanding Educator Award, JSG

MICHAEL HUDEC
Tinker Family Publication Award, BEG
Hamilton Book Awards Finalists, UT

MARTIN JACKSON (POSTHUMOUS)
Tinker Family Publication Award, BEG

JOEL JOHNSON
Knebel Teaching Award, Introductory Course, DGS

CHARLES KERANS
Honorary Membership, SEPM

RICH KETCHAM
Fellow, Mineralogical Society of America

LUC LAVIER
Director's Circle of Excellence, UTIG

TIP MECKEL
John C. Frye Award, GSA

DAVID MOHRIG
Pettijohn Medal, SEPM

YUKO OKUMURA
Director's Circle of Excellence, UTIG

CAMILLE PARMESAN
Make Our Planet Great Again Grant, France

ERIC POTTER
Alumnus of the Year, BEG

ELLEN RATHJE
William B. Joyner Lecture Award, EERI

KATHERINE ROMANAK
Outstanding Reviewer, International Journal of Greenhouse Gas Control

BRIDGET SCANLON
Hydrologic Sciences Award, AGU
President's Award, International Associations of Hydrogeologists

MRINAL SEN
Virgil Kauffman Gold Medal, SEG

JOHN SNEDDEN
Director's Circle of Excellence, UTIG

RONALD STEEL
J. C. "Cam" Sproule Memorial Award, AAPG

SCOTT TINKER
Ian Campbell Medal, AGI

HARM VAN AVENDONK
Director's Circle of Excellence, UTIG
Research Excellence Award, UTIG

XINMING WU
Best Paper Award, Geophysics

MICHAEL YOUNG
Joseph C. Walter Jr. Excellence Award, JSG

JINYU ZHANG
J. C. "Cam" Sproule Memorial Award, AAPG

Promotions

WILLIAM AMBROSE
Senior Research Scientist, BEG

TODD CALDWELL
Research Scientist, BEG

TIMOTHY DOOLEY
Senior Research Scientist, BEG

JOHN LASSITER
Professor, DGS

TIP MECKEL
Senior Research Scientist, BEG

YUKO OKUMURA
Research Scientist, UTIG

DUNCAN YOUNG
Research Scientist, UTIG

Students

YASER ALZAYER
Best Talk Fall Seminar, DGS

AUSTIN ARNOLD
Endowed Scholarship, AGS

SEAN BADER
Best Student Poster Paper, 2017 Annual Meeting, SEG

GRACE BEAUDOIN
2nd Place Graduate Petrography, DGS

PATRICK BOYD
Technical Sessions Best Speaker, Fall M.S., DGS

CLARA BRENNAN
Graduate Student Research Award, GSA

TYLER CADENA
2nd Place Undergrad Petrography, DGS

AMANDA CALLE
Technical Sessions Best Speaker, Fall Ph.D., DGS
Best Talk Spring Seminar, DGS

TOMAS CAPALDI
Muehlberger Graduate Fellowship, JSG
Postgraduate Research Grant, IAS

PETER CARLSON
Best Talk Fall Seminar, DGS

CANSU DEMIR
Fulbright Scholarship, Turkish Fulbright Committee

THOMAS ETZEL
Global Research Fellowship, UT Austin International Office

PEDRO ALEJANDRO GARZA
DeFord Technical Sessions Best Speaker Spring M.S., DGS

SCOTT ECKLEY
2017 Travel Grant to Sudbury Impact Structure Field Course, NASA/LPI

YI FANG
Elected Future Leader, American Rock Mechanics Association

MASON FRIED
Technical Sessions Best Speaker, Spring Ph.D., DGS
Best Talk Fall Seminar, DGS

PETER GOLD
Technical Sessions Best Speaker, Spring Ph.D., DGS
Best Talk Fall Seminar, DGS

SOPHIE GOLIBER
Outstanding Graduate Student, UTIG

KIARA GOMEZ
NDSEG Fellowship Finalist, Dept. of Defense

SARAH GREER
Computational Science Graduate Fellowship, DOE

JESSE GU
Undergraduate Prize, Mineralogical Society of America

JENNIFER HARDING
Fellowship, UTIG

JAIME HIRTZ
Endowed Scholarship, AGS

PEDRO GARZA JUAREZ
Technical Sessions Best Speaker, Spring M.S., DGS

MICHELLE GEVEDON
Outstanding Teaching Assistant, Fall, DGS

DOMINIK KARDELL
Outstanding Graduate Student, UTIG

ALISSA KOTOWSKI
1st Place Graduate Petrography, DGS

ADAM MARSH
Best Talk Fall Seminar, DGS

EDWARD MARSHALL
Outstanding Teaching Assistant, Fall, DGS

DMITRII MERZLIKIN
Award of Merit for Best Student Paper, 2017 Annual Meeting, SEG

EMILY MIXON
Graduate Research Fellowship, NSF

SEBASTIAN MUNOZ
Groundwater Fields Methods Awards Undergraduate, DGS

GRACE MUSSER
Stephen J. Gould Award,
The Paleontological Society
Ornithology Collection Grant,
American Museum of Natural History

ANDREA NOLTING
Technical Sessions Best Speaker, Fall Ph.D., DGS
Best Talk Spring Seminar, DGS
Calvert Memorial Scholarship, Houston Geological Society

MARGO ODLUM
Equinor (Statoil) Research Fellowship
STEM Chateaubriand Fellowship, Embassy of France
Best Student Oral Presentation, 2018 International Thermochronology Conference

ANDREW PARISI
Outstanding Teaching Assistant, Spring, DGS

ESBEN PEDERSEN
Equinor (Statoil) Research Fellowship

AUDREY PFEIL
Repsol Student Innovation Award

ENRICA QUARTINI
Best Talk Spring Seminar, DGS

EVAN RAMOS
Outstanding Teaching Assistant, Spring, DGS

MARK REID
Repsol Student Innovation Award

SAM ROBBINS
Estwing Hammer Award, DGS

ARISA RUANGSIRIKULCHAI
1st Place Undergraduate Petrography, DGS

AARON RUSSELL
Endowed Scholarship, AGS

COLIN SCHROEDER
Outstanding Student Chapter Award
SPWLA Foundation Grant

LILY SERACH
Student Service Award, GSEC

BRANDON SHUCK
Outstanding Graduate Student, UTIG

SAAD SIDDIQUE
Repsol Student Innovation Award

LAURA SIGELMANN
Brumley Next Generation Fellowship
William H. Crook Fellowship

LOGAN SCHMIDT
2018 Outstanding Mention Recipient, GSA

BENJAMIN SMITH
Student Grant Award, SEPM

CAROLYN TEWKSBURY-CHRISTLE
Outstanding Teaching Assistant, Fall, DGS

KELLY THOMSON
Equinor (Statoil) Research Fellowship
Student Research Grant, SEPM
ExxonMobil/GSA Student Geoscience Grant

CHIARA TORNABENE
Best Graduate Paper, JSG

ALISON TUNE
Groundwater Field Methods Award Graduate, JSG
Graduate Research Fellowship, NSF

MERT UGURHAN
Student Research Grant, SEGCF

ANNA WEISS
Outstanding Teaching Assistant, Spring, DGS

JINYU ZHANG
J.C. "Cam" Sproule Memorial Award, AAPG

Staff

JANEICE CONNORS
Guion Library Staff Honors, DGS

KEVAUGHN EVANS
Guion Library Staff Honors, DGS

LISA GAHAGAN
Career Award, UTIG
Staff Excellence Award, JSG

ROSALIND GAMBLE
Outstanding Staff Award, UTIG

PATTY GANEY-CURRY
Career Award, UTIG

BILL GANNON
Guion Library Staff Honors, DGS

JOEY MAREZ
Guion Library Staff Honors, DGS

MATT MCGUIRE
Guion Library Staff Honors, DGS

SEAN MCKEEVER
Staff Excellence Award, DGS

PENELOPE PARR
Outstanding Staff Award, UTIG

JUDY SANSOM
Picard Excellence Award, UTIG

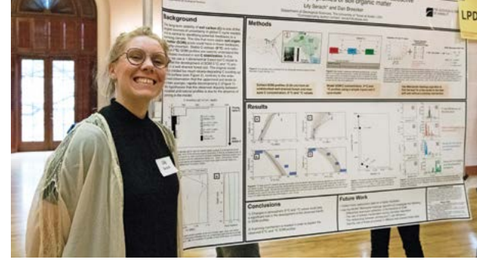
STEFFEN SAUSTRUP
Outstanding Staff Award, UTIG

SARA DIANE SEIBERATH
Outstanding Staff Award, UT President's Office

CHRIS STELLA
Guion Library Staff Honors, DGS

RAMÓN TREVIÑO
John C. Frye Award, GSA

PHOTOS: JACKSON SCHOOL.



STUDENT RESEARCH SYMPOSIUM AWARDS

In February 2018, the Jackson School's Graduate Student Executive Committee organized its 7th Annual Research Symposium. Winners and honorable mentions are as follows:

LATE-CAREER PH.D. STUDENT

1st Place: Alissa Kotowski: Length Scales and Types of Heterogeneities Along the Deep Subduction Interface: Insights from an Exhumed Subduction Complex on Syros Island, Greece

2nd Place: Sarah George: Testing Models of Orogenic Development in Ecuador: Multiproxy Provenance Analysis of the Hinterland Cuenca Basin

Honorable Mention: Rachel Bernard: Plagioclase-dominated Seismic Anisotropy in the Eastern Mojave Lower Crust

LATE-CAREER MASTER'S STUDENT

1st Place: Evelin Gutiérrez: Provenance and Geochronological Insights into Late Cretaceous-Paleogene Foreland Basin Development in the Sub-Andean Zone and Oriente Basin of Ecuador

2nd Place: Sean Bader: Missing Well Log Data Interpolation and Semiautomatic Seismic Well Ties Using Data Matching Techniques

Honorable Mention: Scott Eckley: Honorable Mention: 3-D Textural and Geochemical Analyses on Carbonado Diamond: Insights from Pores and the Minerals Within Them

EARLY-CAREER GRADUATE STUDENT

1st Place: Brandon Shuck: Constraints on Mantle Dynamics During Jurassic Rifting in the ENAM Area from Seismic and Petrological Modeling of the Oldest Oceanic Crust

2nd Place: Carolyn Tewksbury-Christle: Rheological Properties and Heterogeneities Along the Down-Dip Extent of a Subduction Megathrust: Insights from the Condrey Mountain Schist, Northern California

Honorable Mention: Kelly Olsen: Development of a Shallow Decollement Along the South-Central Chile Margin from 2-D Seismic Reflection Data

UNDERGRADUATE STUDENT

1st Place: Sebastian Munoz: Heat Transport in the Streambed of a Large Regulated River

2nd Place: Elizabeth Davis: Pyroclastic Flows from Mount St. Helens: The Effects of Topography on Flow Behavior and Deposition on the Leeward Slope

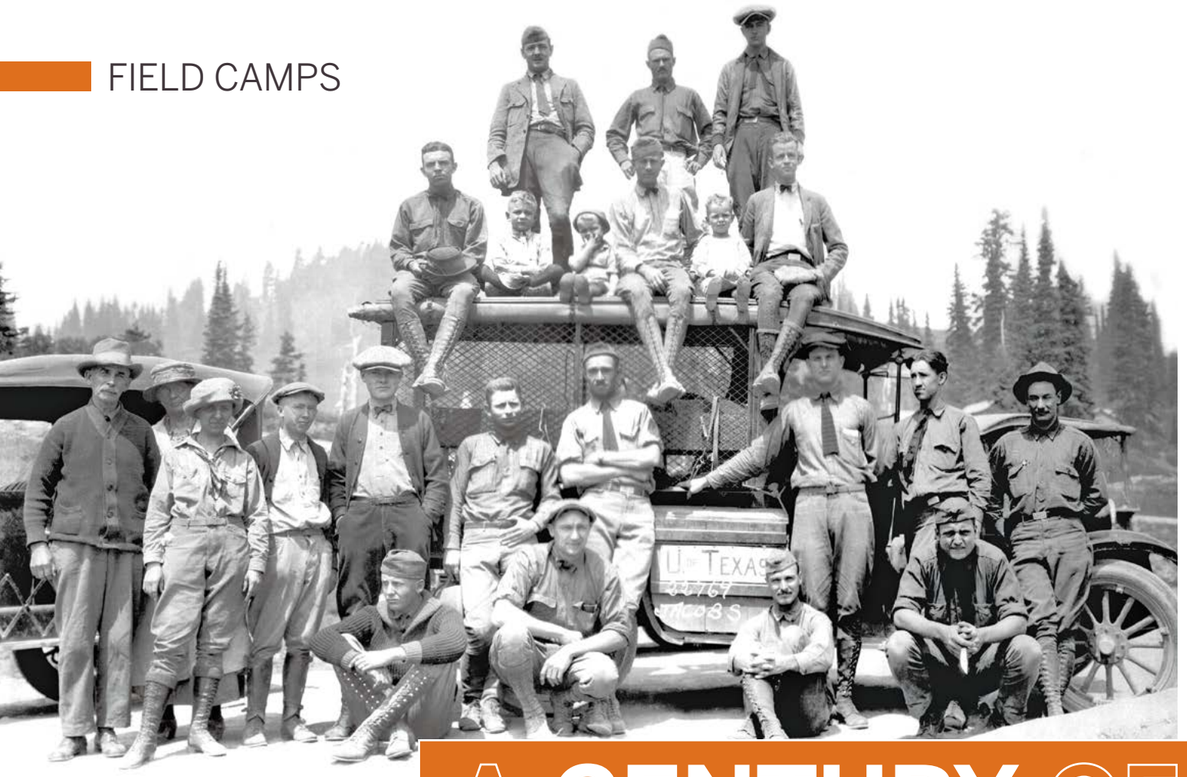
Honorable Mention: Jordan Oefinger: Evidence of Possible Ocean Acidification at the Paleocene-Early Eocene Boundary Recorded in the Adriatic Carbonate Platform

BEST REPRESENTED RESEARCH GROUP

1st Place: Whitney Behr Research Group

2nd Place: Brian Horton Research Group

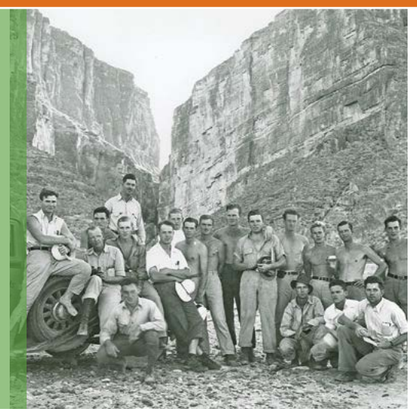
CLOCKWISE: UNDERGRADUATE SEBASTIAN MUNOZ EXPLAINS HIS WORK TO GRADUATE STUDENT SAM ROBBINS; LATE-CAREER PH.D. STUDENT LILY SERACH PROUDLY PRESENTS HER RESEARCH; PROFESSOR MARK CLOOS REVIEWS LATE-CAREER PH.D. STUDENT DOUGLAS BARBER'S RESEARCH.



A CENTURY OF FIELD CAMP

"I early learned that the success of a camp was largely determined in the dining room."

Professor Fred Bullard reflecting on the 1930 field camp.



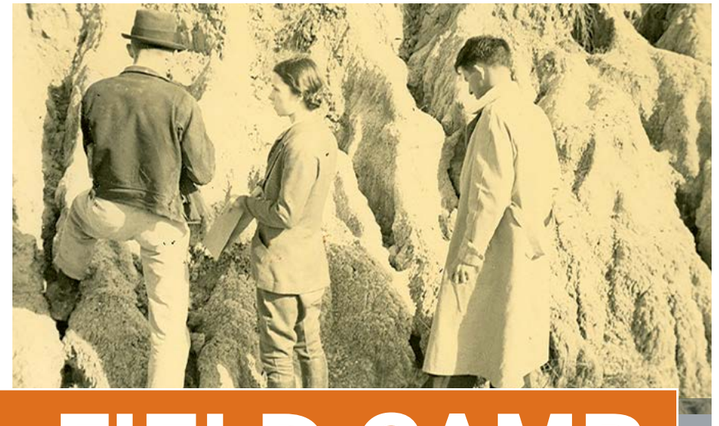
CLOCKWISE: AN EARLY 20TH CENTURY FIELD SHOT; GEOLOGY STUDENTS AT BIG BEND'S SANTA ELENA CANYON; A SCENE FROM THE 1973 FIELD CAMP; GEOLOGY STUDENT JEANNE ALLEN FERRIN IN THE FIELD CIRCA 1949.

OPPOSITE PAGE, TOP TO BOTTOM: A FIELD TRIP PROBABLY FROM THE LATE 1960S; A 1936 FIELD TRIP; "RAISING THE FLAG" IN MARATHON, TEXAS, DURING THE 1968 GEO 660 FIELD CAMP.

PHOTOS: JACKSON SCHOOL.

"Field camp is my favorite course, so it was wonderful to be able to teach in the field all year long."

Assistant Professor (now Dean) Sharon Mosher in 1982.



THE JACKSON SCHOOL RECOGNIZES OVER A CENTURY OF FIELD CAMP

Help us mark this historic achievement by sharing your own stories.

The UT Geology Department embarked on its first field camp more than 100 years ago. A lot has changed since Professor Hal Bybee organized that first camp in 1917—fashion, transportation, locales and demographics to name a few. But the core mission of this right-of-passage has stayed the same: learn how to think like a geoscientist by witnessing and interpreting geology in the field.

What started as trips to geological formations around Texas has since grown into three distinct field offerings. GEO 660 takes students on a six-week trip to classic geological formations across the United States. Marine Geology & Geophysics (MG&G) brings geophysics students aboard research vessels in the Gulf of Mexico to acquire and interpret seismic data and sediment samples. And the Hydrogeology Field Course teaches students the fundamentals of hydrogeology and water sampling research at Austin's Hornsby Bend, the streams of the Valles Caldera of New Mexico, and as of 2018, a hydrology field site near Dripping Springs donated by Leslie P. and Dianne White (see page 68).

To mark more than a century of shaping young geoscientists through field camp, we're asking the Jackson School community to share their own memories of field camp. If you took part in a Jackson School field camp, no matter the year, we would love to hear from you.

Please visit www.jsg.utexas.edu/field to upload stories and photos. You can also email Georgia Sanders at gsanders@jsg.utexas.edu or send us a letter at 2305 Speedway, Stop C1160, Austin, TX 78712.

We are elated to have passed the century milestone, and to have expanded our field course offerings as other geosciences programs around the country have cut back. Geosciences is at its core a field science. With your continued support, we will keep introducing generations of geoscientists to come to the fundamental skills and experiences that can only be gained through education in the field.

GEO 660

Students spent six weeks in the field conducting geology at classic sites across West Texas, New Mexico, Colorado, Wyoming, Montana, Idaho and Utah.

ABOVE: UNDERGRADUATE EMILY MIXON IN WHITE SANDS, NEW MEXICO. **RIGHT:** GROUP SHOT IN THE BEARTOOTH MOUNTAINS OUTSIDE OF CODY, WYOMING.

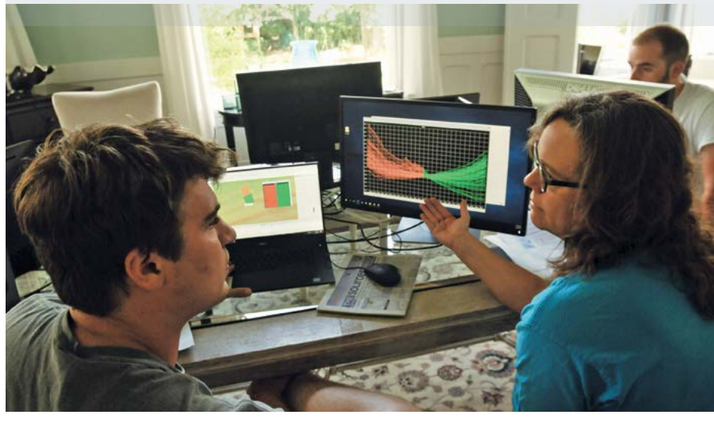
CLOCKWISE FROM TOP: A RAINY DAY IN THE BIG BELT MOUNTAINS OF MONTANA; (LEFT TO RIGHT) BROOKE KOPECKY AND ABBY VARONA IN THE SAWTOOTH MOUNTAINS OF MONTANA; A GROUP DISCUSSION OF AEOLIAN DUNE PROCESSES IN WHITE SANDS, NEW MEXICO.

GEO 660: EMILY MIXON. MG&G: JACKSON SCHOOL.

MG&G

The class traveled to Galveston to take part in the collection and processing of marine geological and geophysical data from the Gulf of Mexico.

CLOCKWISE: EXAMINING A RECENTLY COLLECTED CORE SAMPLE; (LEFT TO RIGHT) STUDENTS JOHN FRANEY, KATHLEEN WILSON AND DARBY LEE ABOARD THE R/V BROOKS MCCALL; (LEFT TO RIGHT) STUDENTS MAKSAT ZHAZBAEV AND TOM MESSER WITH SEISMIC STREAMERS. UTIG RESEARCH SCIENTIST ASSOCIATE MARCY DAVIS AND STUDENT HARRY HULL REVIEW MULTIBEAM DATA; STUDENT YANG ZHANG ON THE R/V SCOTT PETTY.



hydro

In addition to their usual field site stops at Hornsby Bend in Austin, Texas, and the Valles Caldera in New Mexico, the hydrology field course for the first time visited the property of Jackson School alumnus Leslie P. White, who donated the land to the school earlier this year.

LEFT: STUDENTS ABSORBING A FIELD CHEMISTRY LESSON ON THE BANKS OF THE JEMEZ RIVER, NEW MEXICO; **ABOVE:** RIO MURSINA AND ZACH MUNGIA PREPARING A BOTTLE KIT WHILE CHANCE BOLDUC TAKES NOTES NEXT TO TAYLOR MORRIS (WITH BRAID).

CLOCKWISE: RILEY WINEBARGER USES AN ACOUSTIC DOPPLER VELOCIMETER TO MEASURE THE FLOW OF THE JEMEZ RIVER WHILE KIMMY MCCORMACK LOOKS ON: ANNA TURETSKAIA AND LOGAN SCHMIDT ANALYZING THE GRAIN SIZES OF A SOIL CORE IN THE VALLES CALDERA: LISA THOMPSON, COLT KERNAN, RILEY WINEBARGER AND CHANCE BOLDUC LOOK AT CORE SAMPLES FROM THE EDWARDS AQUIFER ON THE WHITE FAMILY OUTDOOR LEARNING CENTER

PHOTOS: JACKSON SCHOOL.

Investigating Mountain Building in Slovakia

Understanding the origin of curved mountain belts has been a fundamental problem in geology and is critical for deciphering the mechanics of plate boundaries. The National Science Foundation awarded an International Research Experiences for Students (IRES) grant to Drs. Elizabeth Catlos, Brent Elliott and Richard Kyle to provide four weeks of geological field-based research and training experiences to students at The University of Texas at Austin who studied a portion of a "type location" for a curved mountain belt: the Carpathian Mountains. The mountains are the second longest mountain range in Europe, forming about a 1,500-kilometer-long arc across Central and Eastern Europe.

This past summer, three UT Austin undergraduates, Theresa Perez, Gabriel Villasenor and Thomas Quintero, and their graduate student mentor, Thomas Etzel, traveled with Catlos, Elliott and Kyle to Slovakia to investigate the geological processes exposed in Slovakia that are associated with the Western Carpathian Mountains. Because of its extensive exposures of ocean suture zones and crustal fragments, Slovakia is an ideal location to study how continents grow.

The High Tatra Mountains are located in the northern part of Slovakia and are the highest and best-exposed range in the entire Western Carpathians. Rocks in this range and its western extension, the Western Tatra Mountains, provide clues into the nature and timing of ancient mountain-building events that affected large portions of Europe and North Africa. The mountains consist mainly of granites that vary widely in composition and age, resulting in their origin being debated. Understanding their history would provide insight into ocean-closure events that occurred during the ancient Variscan orogeny.

As part of the IRES program, students are tasked with seeking to understand the origin and tectonic history of metamorphic and igneous assemblages within the Western and High Tatras. The region is highly accessible, being only about 60 kilometers long by 20 kilometers wide, with many hiking trails and tourist ski lift and trams providing excellent access to outcrops. The range is considered a miniature-sized, accessible Himalayas, where one-day hikes can provide access to many geological features and rock types.

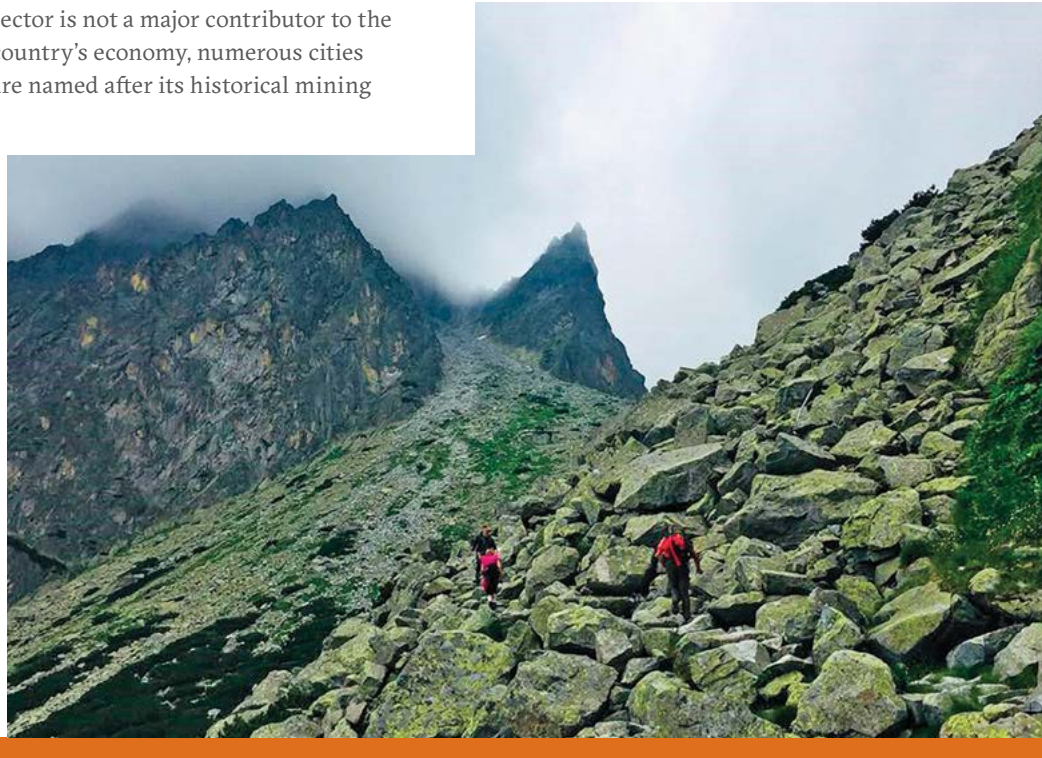
Students also studied Slovakia's mineral deposits, which are a product of its geological history. Most of its economic resources are due to processes related to the closure of ancient oceans. Although today Slovakia's mining sector is not a major contributor to the country's economy, numerous cities are named after its historical mining activities. Students in the IRES program visited numerous sites associated with mining activities, from historical sites to active underground mines.

"Field work is the right of passage for any budding geologist," said Jackson School of Geosciences IRES student Thomas Quintero. "The International Research Experience for Students kindled a passion in me to explore new fields of geology while continuing to provide the support I need to complete a research project of my choice. I have never felt more confident in my decision to study geology than after the program, and I cannot wait to see what the future holds."

The project was developed with the assistance of Slovak researchers and geologists from Comenius University and the Slovak Academy of Sciences in Bratislava. UT Austin's International Office and Center for Russian, East European and Eurasian Studies provided additional funding to support student travel.

Elizabeth Catlos
Associate Professor, Department of Geological Sciences

The High Tatra Mountains are located in the northern part of Slovakia and are the highest and best exposed range in the entire Western Carpathians.



STUDENTS HIKING IN THE CHALLENGING TERRAIN OF THE HIGH TATRA MOUNTAINS. PHOTO: ELIZABETH CATLOS.

Training Arctic Geologists

During the short Arctic summer of 2018, four graduate students traveled to Svalbard and Far Eastern Siberia with Professor Daniel Stockli, principal investigator of a Norwegian-Russian-North American collaboration funded by the Norwegian Science Foundation to promote international circum-Arctic collaboration, research and education in Arctic and High Arctic regions, and training of the next generation of Arctic geologists.

A major focus of the collaboration is to connect researchers and expose students to tectonics under the midnight sun. In early August, graduate students Margo Odlum and Cullen Kortyna traveled to Svalbard, a remote Arctic archipelago off Norway and Greenland at 78N for a week-long short course and field trip co-taught by Stockli. The course included classes on the tectonic, volcanic and stratigraphic evolution of the High Arctic since the Paleozoi as well as field safety and survival training for working at the top of the world amongst polar bears and in frigid conditions. An unexpected highlight: meeting the king and queen of Norway at the University of Svalbard.

During the second half of August and early September, Stockli and a colleague from the Yakutsk Geological Institute took two UT graduate students, Megan Flansburg and Sam Robbins, and three Russian students and a U.S. post doc from Norway on a three-week field trip through the Verkhoyansk fold-and-thrust belt. After crossing the mighty Lena and Aldan Rivers, the expedition followed the Kolyma "highway," constructed by GULAG forced labor, for 1,000 km from the foreland, through the fold and thrust belt, to the magmatic arc. The field work in eastern Siberia exposed the students to extremely difficult working conditions in the Taiga with its swampy bogs, dense forests, permafrost, mosquitos and Siberian brown bears, and to truly amazing geology in one of the most-remote regions of the world, the coldest city on the planet, and semi-abandoned Soviet mining towns. The trip's unrivaled highlight was a four-day float trip down the Indigirka River to investigate the transition from the fold-and-thrust belt to the magmatic arc.

The NOR-R-AM initiative plans will offer future field opportunities to UT graduate students in Svalbard, Russia, and Alaska over the next couple of years and also have students and researchers from the partner countries visit laboratories at UT.

Daniel Stockli
Professor, Department of Geological Sciences

Chasing Icebergs

We went to gather observations on iceberg melt and movement in Greenland's fjords by tracking the horizontal and vertical motion of large, deep-keeled icebergs at high temporal resolution. Researchers used multiple platforms: ship-based hydrography and underwater imagery, aerial scanning, remotely sensed iceberg movement (GPS sensors), and satellite derived iceberg distributions. I helped with multibeam imaging and the GPS sensors. The team consisted of 12 scientists from Oregon (University of Oregon), California (University of California San Diego Scripps Institute), Massachusetts (Woods Hole Oceanographic Institute), and The University of Texas at Austin.

Dan Duncan
Research Scientist Associate, University of Texas Institute for Geophysics

TOP: SURVIVAL SUIT TRAINING IN LONGYEARBYEN, SVALBARD. JSG SCIENTISTS INCLUDE: MARGO ODLUM (FRONT LEFT), CULLEN KORTYNA (FRONT RIGHT), DANNY STOCKLI (CENTER).

BOTTOM: SCIENTISTS TAKE MULTIBEAM DATA ALONGSIDE AN ICEBERG.

ARCTIC: STOCKLI. ICEBERGS: ALEX HAGER. ROMANIA AND STUDENT TAKEAWAY: BRIAN HORTON.

Field Stratigraphy in Romania

A geology field trip to Romania in May 2018 provided opportunities for 14 Jackson School of Geosciences graduate students to explore a range of sedimentary, structural, tectonic and geodynamic issues related to the evolution of the diverse sedimentary basins of Romania. Department of Geological Sciences Research Associate Cornel Olariu, originally from Romania, was joined by professors Brian Horton and Ron Steel as well as Romanian geoscientist Dan Jipa from the Romanian National Institute of Marine Geology and Geoecology. As part of a semester long course, GEO 383U Dynamic Field Stratigraphy, students read and presented key elements of numerous research articles and designed a 78-page field guide that provided critical information for over 30 stops on the 11-day field trip. They also wrote field reports highlighting important takeaways from the trip. Key topics included: marine versus non-marine depositional systems, complex shifts in sediment routing and accumulation, and polyphase basin histories associated with various Mesozoic-Cenozoic collisions and the development of the Carpathian Mountains. Students and faculty generated a framework for understanding the linked development of a fold-thrust belt, foreland basin, hinterland (backarc) basin, lithospheric delamination, intermittent connections to Paratethys and the Black Sea, the paleodrainage history (including the Danube River), and oil and gas resources in the various basins. Special stops included the Berca mud volcanoes, the Slanic salt mine, the medieval walled city of Sighisoara, and the Horezu historical ceramic center and monastery. The trip was partially funded by Chevron.

Brian Horton
Professor, Department of Geological Sciences
Research Professor, Institute for Geophysics

TOP: JSG STUDENTS AND FACULTY STUDYING THE LOWER MIOCENE (BURDIGALIAN) SALT DIAPIR STRUCTURE AND DEFORMED SHALES AT LOPĂTARI, ALONG SLANIC DE BUZAU VALLEY, ROMANIA.

BOTTOM: STUDENTS ALONGSIDE A MUD VOLCANO.

Student Takeaway

As a fourth year doctoral student, I've had the privilege of attending several field trips with Drs. Olariu, Horton and Steel. Each trip emphasizes different skill sets, depositional systems and tectonic styles, ensuring that new geologic frameworks are developed. Romania has a complicated tectonic history, and the sedimentary strata provide insight into the larger scale processes. During this trip, we observed and interpreted each stop without significant a priori knowledge about depositional environments. This method forced us to think critically about diagnostic features of different depositional systems. As somebody who works on regional tectonics, the ability to quickly discern between depositional environments is a critical skill set.

The students in the course had a range of backgrounds, which promoted significant knowledge exchange. For example, the sedimentologists within the group explained how to distinguish between slope and basin floor turbidites and why the difference is so critical from a petroleum systems perspective. Similarly, the tectonicists emphasized the importance of understanding basin connectivity and subsidence patterns through time and offered various methods to infer paleogeography.

Sarah George
Ph.D. Student, Jackson School of Geosciences

RAPID RESPONSE

JACKSON SCHOOL RESEARCHERS STUDY AFTERMATH OF HURRICANE HARVEY ON TEXAS GULF COAST

BY MONICA KORTSHA

When Hurricane Harvey hit the Texas coast about one year ago, the Bureau of Economic Geology's Jeff Paine was ready.

Paine, the coordinator of the bureau's Near Surface Observatory, had been watching the storm since it was just a tropical wave in the Caribbean. When it rapidly gained strength while approaching the Texas coast—turning from a Category 1 to a Category 4 hurricane in less than 24 hours—he knew that there would be damage to the state's beaches and barrier islands, home to coastal communities, robust businesses, busy ports and rare bird rookeries.

While first responders and regular Texas residents alike sought to help people directly affected by Harvey—from the flooding in Houston to the wind-damaged homes of Port Aransas and Rockport—Paine began discussions about surveying the damage from the air with the General Land Office (GLO), the state agency that manages the state's coastal lands. By the following Thursday, researchers from the bureau's observatory were airborne.

"Within a week of landfall we were out acquiring imagery and topographic data," Paine said.

Geosciences were probably not on most people's minds in the wake of Harvey. But the days and weeks after a hurricane are a vital time for collecting field data about its impact. This data not only records the extent of the damage but can also hold clues about how the coast is expected to recover and what communities can do to prepare for future storms. Paine's survey was just the start of this collection process for scientists at the Jackson School of Geosciences, with three research teams—one from each of the school's research units—heading out shortly after the storm to conduct field work. Thanks to the Jackson School's Rapid Response Program, they were all able to gather the resources and equipment they needed to get to the coast fast.

Time was of the essence. With every passing day, evidence of the hurricane was starting to disappear, smoothed away by waves and wind or removed by communities on the mend. Disappearing with them would be valuable information about the potential lingering effects of the storm on beaches, wetlands and the state's narrow string of barrier islands—a delicate system that forms the first line of defense against powerful storms such as Harvey.

ABOVE: CHANNELS CARVED ON SAN JOSE ISLAND, A BARRIER ISLAND OFFSHORE OF PORT ARANSAS, BY STORM SURGE OVERTOPPING THE ISLAND AS IT FLOWED BACK TO THE SEA. THE IMAGE WAS CAPTURED DURING THE HURRICANE HARVEY RAPID RESPONSE MISSION LED BY THE BUREAU OF ECONOMIC GEOLOGY'S JEFF PAINE. **CREDIT:** JEFF PAINE.

CANOE: HIMA HASSENRUCK-GUDIPATI. PAINE: JACKSON SCHOOL.

After the Storm, Into the Field

The Rapid Response Program was created with speed in mind. The program funds fieldwork in the aftermath of natural disasters—research that is vitally important for understanding nature's most powerful forces and their effects on the environment and society, but understudied because of the logistics of funding research on the fly, especially in disaster areas.

The program sent Jackson School scientists to the Philippines to measure aquifer contamination after Typhoon Haiyan struck in 2013, to New York in 2012 to study signs of coastal erosion in the wake of "Super Storm" Sandy, and to the Texas coast in 2008 to study seafloor changes after Hurricane Ike.

After Harvey, the Jackson School quickly mounted a multipronged research mission that leveraged the expertise and resources of its research units.

Paine's mission was the first to take to the coast. Supported with funds from the GLO and the Rapid Response Program, he and a team of scientists from the Near Surface Observatory captured changes from the air using high-resolution photography and LIDAR, an imaging technique that uses an array of laser beams to measure landscape elevation. From early September through October, they surveyed the entirety of the Texas Gulf shoreline—flying from South Padre Island near the mouth of the Rio Grande to Sabine Pass along the Louisiana border—pausing only for an exhaust pipe replacement and on days when Gov. Greg Abbott or Lt. Gov. Dan Patrick called dibs on the state-issued plane.

The survey was able to start only days after the storm in part because of lessons learned from Hurricane Ike, said Daniel Gao, a geographic information specialist at the GLO. After Ike, the office relied on LIDAR data collected by the U.S. Geological Survey. Gao said the LIDAR data proved so important after Ike that the GLO wanted to ensure it had a system set up to quickly and accurately gather data after the next storm.

"It was after [Ike] that we were in talks with the BEG where we asked them, 'If something like this were to happen again, could we quickly get elevation data from LIDAR?'" Gao said.

Harvey was the first chance for the team to put the plan into action.

Paine's initial GLO flights focused on quickly getting images of the Port Aransas area where Harvey made landfall back to the state so workers could assess the damage and plan cleanup and recovery efforts. These flights zeroed in on beaches and dunes, shipping channels in bays, and coastal bird rookeries, with data from each new flight being added to a digital map operated by the GLO to help guide on-the-ground assessment.

"Collecting data early doesn't help if you can't get it out to anybody for them to use," Paine said. "So we had next-day delivery."

Although the GLO-funded surveys eventually spanned most of the Texas coast, they didn't cover San Jose Island and Matagorda Island, the two barrier islands just a few miles offshore that took a direct hit from Harvey. All of San Jose Island and a portion of Matagorda Island fall outside of the state's emergency response purview, explained Kevin Frenzel, a Jackson School alumnus who now manages the GLO's Coastal Erosion Planning and Response Act program.

"The fact that they're not publicly accessible means that the GLO doesn't have authority for a response," Frenzel said. "San Jo (San Jose) is also a private island, so we can't expend public money on a private island."

Nevertheless, the islands are an essential part of the state's coastal well-being, shielding the coast from the brunt of hurricane impacts and creating coastal channels that guide shipping barges to Texas ports.

"The islands protect everything [along the coast], refineries, communities, fisheries," said doctoral candidate John Swartz, who participated in the Rapid Response missions. "Understanding how they're built up and destroyed is really important."

With Rapid Response support, the Jackson School teams turned toward discovering what happened to the barrier island system when Harvey arrived, with Paine's team collecting data on the islands from the air and missions led by the other units documenting damage from land and at sea.

John Goff, a UTIG senior research scientist, took to the coast in September to lead a four-day seafloor mapping survey of Lydia Ann Channel and Aransas Pass, and collect data on how the storm affected coastal sediments—the raw material that builds up barrier islands. Goff's team included Research Science Associates Marcy Davis and Dan Duncan, as well as Swartz.

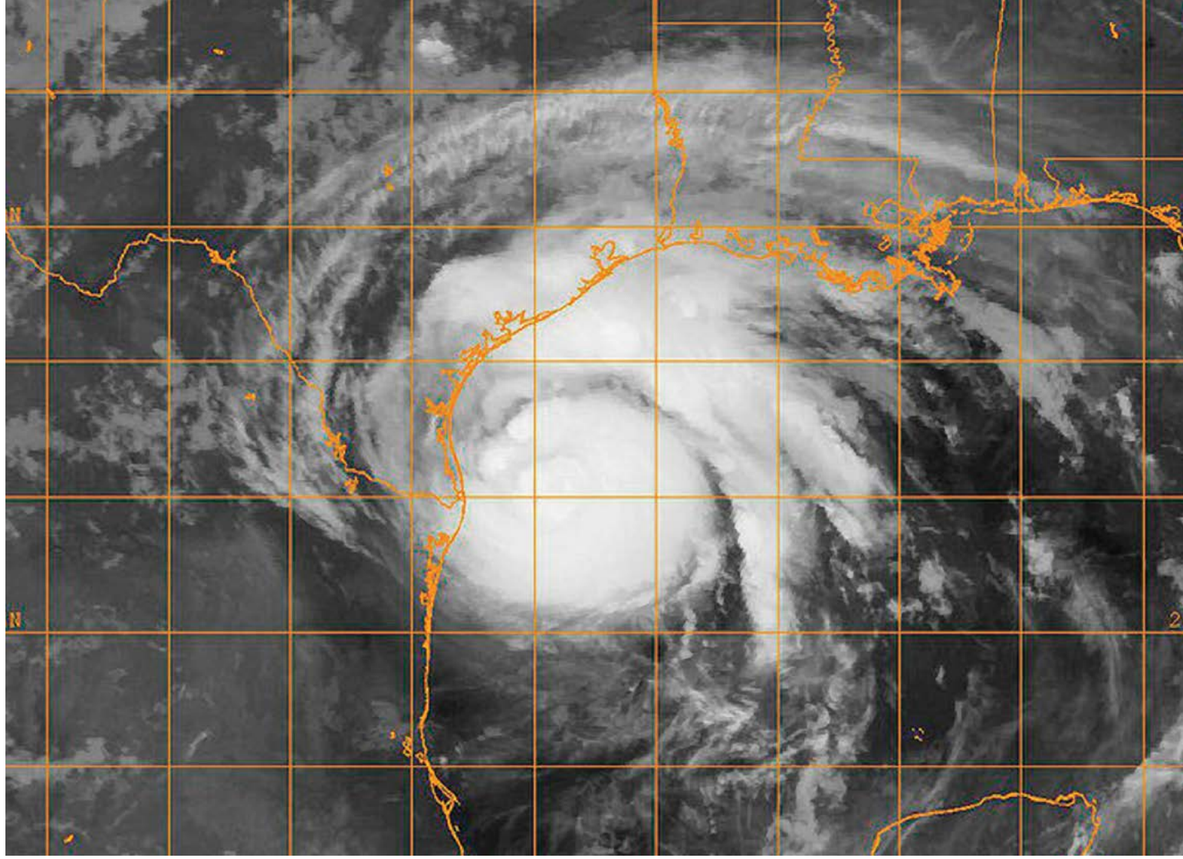
And in October, Associate Dean for Research David Mohrig, a professor in the Department of Geological Sciences, led a survey of Sargent Beach and the Matagorda Peninsula, a barrier-island peninsula to the east of Matagorda

"COLLECTING DATA EARLY DOESN'T HELP IF YOU CAN'T GET IT OUT TO ANYBODY FOR THEM TO USE."

– JEFF PAINE,
BUREAU OF ECONOMIC GEOLOGY

OPPOSITE PAGE: PRINCETON UNIVERSITY DOCTORAL STUDENT KATJA LUXEM (PICTURED) CANOES ON A FLOOD PLAIN DURING A RAPID RESPONSE MISSION LED BY JACKSON SCHOOL DOCTORAL STUDENT HIMA HASSENRUCK-GUDIPATI.

ABOVE: JEFF PAINE, THE COORDINATOR OF THE BUREAU OF ECONOMIC GEOLOGY'S NEAR SURFACE OBSERVATORY.



Island proper. During the three-day mission the team studied sand and sediments on land, digging trenches to document the history of sediment deposition and tracking how fans of sediment deposited by the storm surge sprawled across the island. Mohrig's team included Ph.D. candidates Benjamin Cardenas, Kathleen Wilson and Swartz; postdoctoral researcher Eric Prokocki; and Jackson School undergraduates Arisa Ruangsirikulchai, Matthew Nix and Mitchell Pham.

The barrier islands and coastal communities faced Harvey's 130 mph winds and storm surge. But what set Harvey apart from other hurricanes—and what made it so destructive—was the days-long deluge it dumped on Houston and the surrounding areas. The rain led to flooding across the area, killing dozens by drowning and causing the majority of Harvey's estimated $125 billion in property damage, according to the National Hurricane Center.

The rising waters also had a geological effect, sweeping up sediments and moving them to new places with the flow of the current. To document this part of the storm, Ph.D. candidate Hima Hassenruck-Gudipati ventured into the field in a canoe to conduct a Rapid Response mission of her own.

"It's not storm surge, it's not coastal erosion, but it's important nonetheless because when Harvey made landfall, it brought all this moisture," she said.

The mission site was a floodplain in Liberty, Texas, about 40 miles east of Houston. Hassenruck-Gudipati had been monitoring the area for her doctoral research on sediment transport, placing game cameras in trees to track the rising waters during the area's frequent flood events. Harvey dropped 55 inches of rain in the Liberty area, inundating the plain and causing the nearby Trinity River to overflow its banks. When Hassenruck-Gudipati arrived about a week after Harvey's landfall, the water was still moving swiftly across a plain dotted with debris.

"The water on the floodplain was moving faster than what we were expecting, so it took some courage to be like 'OK, let's just go for it,' " Hassenruck-Gudipati said.

She and two field assistants, Timothy Goudge, then a postdoctoral researcher and now an associate professor, and Katja Luxem, a Ph.D. candidate in the Department of Geosciences at Princeton University, spent two days on the scene, piloting the canoe through the floodwaters and collecting data on current speed, a key variable for estimating the size of sediment moving through the water and how far it could be deposited on the plain once the water subsided.

Harvey by the Numbers

From the floodplain to the coast, the Rapid Response missions documented Harvey's geological impact on Texas, with the data collected by each unit working together to tell a larger story on the aftermath of the storm.

Along the barrier island system, that story centered around erosion. Harvey's storm surge stripped away massive amounts of sediment from island beaches and carried it into the ocean.

According to the bureau's LIDAR data, Harvey eroded the 21-mile-long shoreline of San Jose Island, removing sand up to 125 feet inland and eliminating 13 feet of dune elevation in the process. On Matagorda Island, the erosion reached 75 feet inland along the 38-mile-long shoreline and eliminated three feet of dune elevation. The storm brought a similar fate to the shoreline of the Matagorda Peninsula, flattening the beach to a near uniform level.

On San Jose Island, erosion from the storm also cut a series of inlets that sliced up parts of the Gulf side beach. However, rather than being formed by water lashing onto the shoreline, the inlets appeared in satellite imagery to be carved by water actually flowing over the top of the islands from behind. The water was initially pushed through existing channels and passes by the hurricane, built up in the bays and estuaries behind the barrier island, and then topped the island as it returned to sea, with the counterclockwise rotation of Harvey's winds providing a push.

"The water was pushed right out of Port Aransas," said Goff.

A computational model of Harvey's storm surge created by Clint Dawson, a collaborator of Goff's at the university's Institute for Computational Engineering and Sciences, helped confirm that theory, as did on-site analysis of beach sediments conducted after the initial Rapid Response missions. But perhaps the clearest evidence for outflow creating the inlets came from three large shipping barges stranded on the Gulf side of the island

GOFF: JACKSON SCHOOL. HARVEY: U.S. NAVY.

OPPOSITE PAGE: UTIG SENIOR RESEARCH SCIENTIST JOHN GOFF CALIBRATES A CTD, A DEVICE THAT CALCULATES THE SPEED OF SOUND IN WATER. GRADUATE STUDENT JOHN SWARTZ LOOKS ON.

ABOVE: AN INFRARED SATELLITE IMAGE OF HURRICANE HARVEY APPROACHING THE TEXAS COAST.

after the storm. A satellite image taken months earlier shows those same barges secured to mooring posts in Lydia Ann Channel, the shipping channel that runs along the mainland side of the island.

It's normal for barrier islands to lose large amounts of sediment during hurricanes, Paine said. The factor that will influence the long-term integrity of the barrier islands is whether that swept-away sediment can make its way back to shore.

According to the offshore seismic data collected by UTIG researchers, the fate of sediments that were swept into the sea is uncertain. Signs of seafloor erosion in Lydia Ann Channel and Aransas Pass indicate that the hurricane's storm surge exited the waterways at high speed, sweeping away large amounts of sediment from the islands and into the Gulf. And at Aransas Pass, two jetties that extend the natural reach of the channel may have exacerbated the loss of sediment by acting like the nozzle of a hose—concentrating the fast-flowing water and shooting it out to sea.

"Without the jetties, the sand could have just been deposited [outside the channel]," Goff said. "The jetties channeled the sediment offshore."

Offshore sediment can still make its way back to the barrier island system. However, if it happened to venture beyond a point known as the "depth of closure," the sediment exits the coastal system completely and is unlikely to return. The exact values for determining the depth of closure are still up for debate. However, Goff hopes to learn more about where the sediments went—and whether they might come back—by collecting core samples offshore of the barrier islands.

Whereas the coastline lost sediments, the floodplain near Liberty was a different story, with the floodwaters taking material from the Trinity River and depositing it across the plain. Hassenruck-Gudipati's research revealed that the floodwaters maintained high enough speeds for long enough to spread sediment thousands of feet away from the river banks.

"We thought that any sedimentation would happen locally near the banks, not a half kilometer from the bank," said Mohrig, who is Hassenruck-Gudipati's Ph.D. adviser.

The data showed otherwise, with the water moving quickly enough to leave deposits in the middle of the floodplain once the water dried up. Over time, this process may influence the lay of the land and affect what areas around Liberty are susceptible to future floods. In addition, Hassenruck-Gudipati notes that sediment distribution is a good indicator for how other substances, from nutrients to synthetic chemicals, can be transported throughout an environment during a flooding event, information that could prove useful to studying how hazardous materials might have spread through the Houston area.

The data collected by the Rapid Response missions are a baseline that researchers and policymakers can use to gauge Harvey's effects and are already proving useful to long-term recovery efforts coordinated by the GLO, said Frenzel. The LIDAR survey data documenting erosion on the coast is helping the agency apply for federal grants for beach renourishment projects, which bring new sand supplies to eroded coastlines. The renewed beaches help bolster the coastline's resiliency to future storms, Frenzel said, as well as recharge the local economies that took a blow from the storm.

"Our cost benefit for beach nourishment range that for every $1 spent, we get a return of $6 to $8," Frenzel said. "That's a heck of a return on investment."

The Rapid Response results are also helping Jackson School scientists conduct basic research on the geoscience of storms. In particular, findings from the mission led by the department's David Mohrig are revealing how far-afield events can prime beaches for erosion when hurricanes such as Harvey strike.

Coastlines Unzipped

There's a theory in sedimentology that when a hurricane disturbs sand and sediment along a coast, that initial disturbance makes the coastline more vulnerable to more erosion. Unsettled sand grains are simply easier to move.

"Once you've had a big erosion event and liberated a lot of sand that makes the coastal deposit, it's much more susceptible to future reworking by subsequent storms that happen in fairly short order," Mohrig said. "You sort of unzip it."

The theory makes sense conceptually, but according to Mohrig, there's little field data to show just how much more easily erosion happens after an initial hurricane strike. An unusual sediment fan observed by Mohrig's team on Sargent Beach is helping to show how this "unzipping" process works and what forces can influence it.

"THE MOMENT THE STORM PASSES, RECOVERY BEGINS."

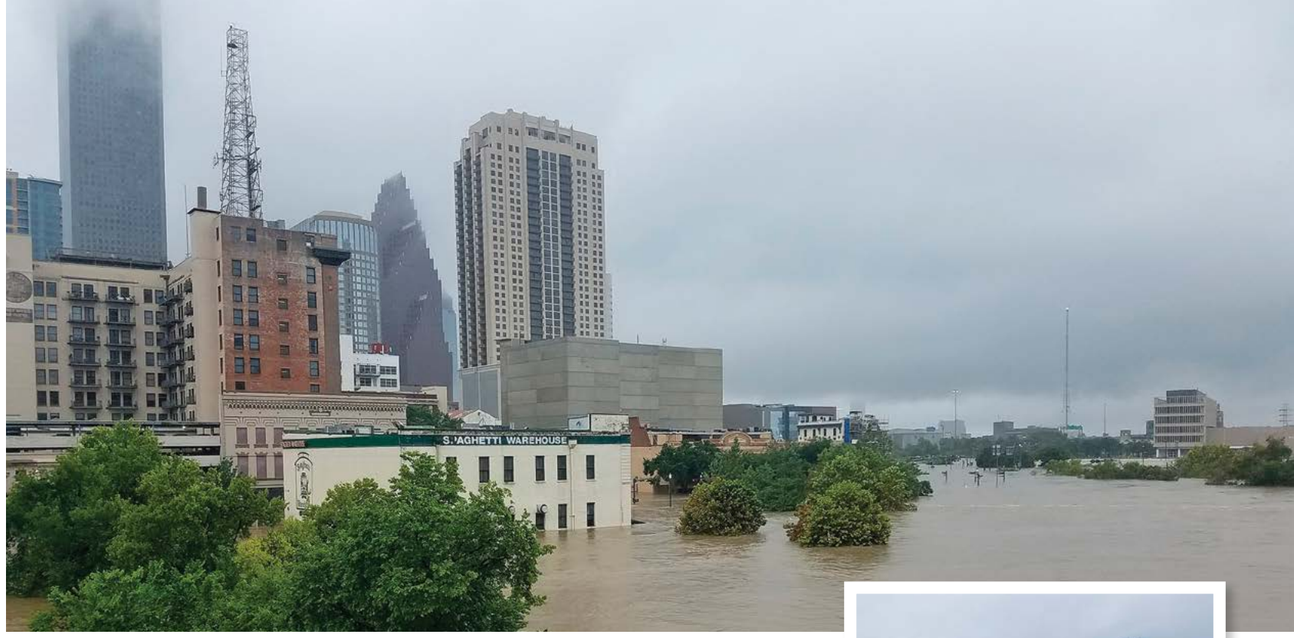
– JEFF PAINE,
BUREAU OF ECONOMIC GEOLOGY

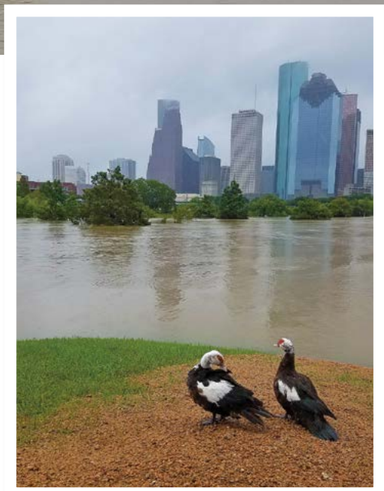
FAR TOP: GRADUATE STUDENT KATHLEEN WILSON (LEFT) AND UNDERGRADUATE ARISA RUANGSIRIKULCHAI (RIGHT) INVESTIGATE A CHANNEL CARVED INTO SAN JOSE ISLAND BY OUTFLOWING STORM SURGE. A STRANDED BARGE IS IN THE DISTANCE. **ABOVE:** GRADUATE STUDENTS KATHLEEN WILSON (LEFT) AND JOHN SWARTZ DIG A TRENCH TO STUDY DEPOSITION RATES AND SEDIMENTATION ON SAN JOSE ISLAND. **RIGHT:** RAPID RESPONSE MISSION SITES.

CARVED CHANNELS: KATHLEEN WILSON. TRENCH DIGGING: KATHLEEN WILSON. MAP: JACKSON SCHOOL.

“THE REPORTS AND DATA WE GET FROM [THE BEG] ARE JUST SPOT ON. IT’S A BIG ASSET THAT WE HAVE THE UNIVERSITY HERE.”

– KEVIN FRENZEL, *GENERAL LAND OFFICE*





ABOVE: GRADUATE STUDENT KATHLEEN WILSON (LEFT) AND UNDERGRADUATE ARISA RUANGSIRIKULCHAI NEXT TO A BARGE THAT WAS WASHED ASHORE ON SAN JOSE ISLAND DURING HURRICANE HARVEY. **OPPOSITE PAGE, TOP:** THE MASSIVE AMOUNTS OF RAIN DUMPED BY HURRICANE HARVEY CAUSED SEVERE FLOODING IN THE HOUSTON AREA. **OPPOSITE PAGE, BOTTOM**: UTIG RESEARCH SCIENTIST ASSOCIATE MARCY DAVIS DISEMBARKS FROM THE RESEARCH VESSEL SCOTT PETTY AFTER A DAY OF SEAFLOOR SURVEYING NEAR PORT ARANSAS.

Sediment fans are deposited during storm surge events, with the sediments recording how far inland the storm surge reached. The team expected to find an uninterrupted swath of sediments left by Harvey. Instead, they found that the fan contained breaks and areas where the deposits doubled in thickness. When the team dug a trench into the sand to get a better read of the depositional history of the beach—with each sedimentation event recorded as a distinct layer—the break appeared there in the form of a dark layer made of material much smaller and finer than the surrounding layers.

“That break left us scratching our heads and wondering what caused it,” said Kathleen Wilson, a Ph.D. candidate who took part in the mission.

The researchers initially attributed the breaks to Harvey’s surge receding and advancing at different points during the storm. However, aerial photos of the fan collected by Paine’s mission combined with data on wave energy off the coast during the weeks after Harvey suggested a different story: Hurricane Nate and Hurricane Irma—two storms that didn’t make landfall on the Texas Gulf Coast—were nevertheless still able to disturb sediment on its beaches. The storms even generated about as much wave energy as Harvey, though over a much shorter period.

Wilson notes that under different circumstances, the waves generated by Nate and Irma wouldn’t have disturbed the beach at all. But the erosion caused by Harvey, which flattened the beach and disturbed sediments, allowed the waves from the far-away storms to wash over the shoreline and leave deposits of their own.

“The coast was already damaged and still in the recovery phases,” Wilson said. “So distant storms can definitely cause an outsized effect to the coast than what otherwise would happen.”

Mohrig said that the Rapid Response findings illustrate how effects from one storm can influence the damage done by others. The sedimentary record uncovered in the trench has inspired his research team to look for signs of more storm interactions for past events, including Hurricane Ike and Hurricane Ida, and how erosion and deposition linked to hurricane events influence the coastal landscape over time.

“This is the most interesting thing to report scientifically, this idea that you can remobilize these things by far-afield events,” Mohrig said. “When we think about our coast being hit by big, eroding storms, we have to think more broadly than we often do. Other storms in the Gulf can do a lot of damage—particularly if there’s been a previous storm.”

Building on Knowledge

It will take years to understand the long-term effects of Hurricane Harvey on the Texas Gulf Coast. The data retrieved by the Rapid Response missions will be an important starting point for evaluating how the coast is recovering, and what actions the state can take to prevent damage from future storms.

“Very rarely have data like this been collected so early,” Paine said. “We have good data for what the conditions were like right after the storm. And that’s really critical because the moment the storm passes, recovery begins.”

But the Rapid Response data is just part of what makes the analysis possible. The researchers were able to put their findings in context thanks to consistent monitoring of the coast by the Jackson School and state and federal research organizations.

Paine compared his group’s LIDAR data with surveys conducted by the Army Corps of Engineers in 2016; Hassenruck-Gudipati had been monitoring the site in Liberty for months prior to Harvey; and Goff’s baseline data for the seafloor surveys came from channel surveys collected in 2009 and 2012 by Jackson School students during their Marine Geology and Geophysics summer field courses.

Together, the data are helping Jackson School scientists evaluate the aftermath of the storm. It will take ongoing research to determine the storm’s long-term effects and what should be done to mitigate them.

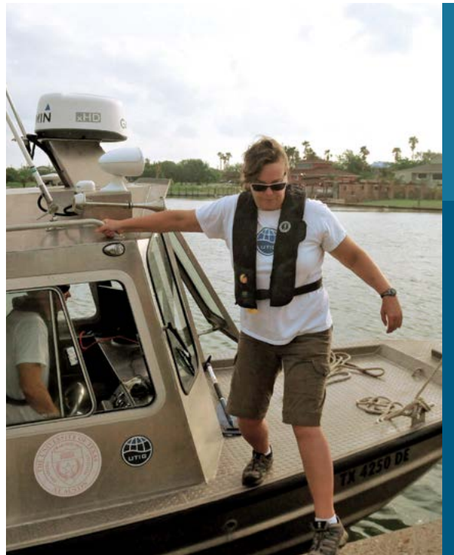
“It’s hard to know at this point how much permanent damage was done,” Paine said. “Material will be coming back to the beach and dune system within weeks, months and years after the storm.”

Having data collected in the wake of the storm—when dunes were flattened, channels were scoured, and a flood plain was still filled with water—will make this future data even more meaningful. Frenzel, the geologist from the GLO, said the Rapid Response data from the bureau will be key in informing how Texas will rebuild.

“The reports and data we get from them are just spot on,” Frenzel said. “It’s a big asset that we have the university here.”

Rebuilding is just part of the process. According to Mohrig, the Rapid Response missions kicked off research on the state’s coastlines that will last for hurricane seasons to come.

“We’ll be monitoring how recovery happens,” he said.



BEACHED BARGE: KATHLEEN WILSON. FLOODING AND DUCKS: TOM FITZPATRICK / FUGRO. RV PETTY: JACKSON SCHOOL.

HELP SUPPORT OUR NEXT RAPID RESPONSE MISSION: SCIENTIST-ESTABLISHED ENDOWMENT WILL MATCH DONATIONS DOLLAR FOR DOLLAR

Natural disasters affect all of us. Rapid Response missions gather data that can help us recover. James A. Austin, Jr., a senior research scientist at the University of Texas Institute for Geophysics, knows the value of Rapid Response missions and established an endowment to support them. Austin will be matching gifts made to the Rapid Response program dollar for dollar up to $100,000. In the wake of natural disasters, Rapid Response missions gather priceless geologic data that can help in understanding long-term impacts of events, and help inform recovery and preparedness efforts. Your support makes future missions possible.

*To make a gift online, go to www.jsg.utexas.edu. Click the **“make a gift”** link at the top of the page and note that it is for **Rapid Response**. You can also contact Belle German, Executive Director for Development and Alumni Relations at bgerman@jsg.utexas.edu or 512-471-1993.*

LEFT TO RIGHT: LESLIE P. WHITE EXPLAINING THE GEOLOGY OF THE PROPERTY TO (LEFT TO RIGHT) JACKSON SCHOOL ASSOCIATE DEAN FOR RESEARCH DAVID MOHRIG, UT EXECUTIVE DIRECTOR FOR DEVELOPMENT AMANDA BROWN IRVING AND UT FOUNDATION IMMEDIATE PAST PRESIDENT REX BAKER.

THE TEXAS OBSERVATORY

Jackson School Turning Hill Country Ranch into Field Site of the Future

By Anton Caputo

PHOTO: JACKSON SCHOOL.

Covering 266 acres of rocky pasture, oak savannah and cedar-covered hillsides, the White Family Outdoor Learning Center is classic Hill Country. South Onion Creek bisects the ranch, providing a nice water source for the cattle that until recently grazed this property outside of Dripping Springs. There's even a 1920s-era windmill near what's left of the old homestead. It's a beautiful piece of history.

But when David Mohrig, the Jackson School of Geosciences' associate dean for research, scans the property, it's not the past staring back at him. It's the future. The donation of the land to the Jackson School is a game changer for immersive education. It's a place where generations of Jackson School students will be able to learn how to conduct field science of all sorts, with their observations and measurements providing new data about the karst geology that underlies and influences the Hill Country landscape and its residents.

"The White family property will allow the school to make long-term environmental observations that will be truly cross-disciplinary," Mohrig said. "Our challenge now is to develop a protocol for how to use the land and leave a minimal footprint, so it can really be used for generations to come."

The property has been described as a living classroom. Its acreage, now owned and controlled by the Jackson School, is within an hour's drive of campus, which means scientists and students have easy access for research and fieldwork. This is a big deal for a school that emphasizes fieldwork and hands-on science as a foundational part of its world-class geoscience education.

The property also fits in perfectly with the Jackson School's new research focuses. The school just completed its strategic plan, a document years in the making, that will act as a road map for moving the school forward during the next decade (see page 106). The sweeping plan outlines an expansive set of research priorities. Among them is establishing a Texas Observatory that, the plan states, "focuses on the science and human impacts of water, weather, surface processes, energy resources, tectonics, and geochemistry on the state of Texas."

The Texas Observatory will be a network of strategically placed research sites across the state that can be accessed over the long term, and places where scientists can study and gather data on the intricate and interconnected processes that affect the land, water and atmosphere. With the donation of the White Family Outdoor Learning Center, the school is on the way to building that network.

"The White family property is a gem of the observatories in that it will be the first one," Mohrig said. "Everyone realizes the benefit of these long-term observatories now, but no single institution has been as bold as our strategic plan is to try to get something like this going. We have to lay baselines of integrated data to understand what will happen in the next 50 years. Who better to collect the data than the Jackson School?"

The Texas Observatory is part of an effort to conduct long-term interdisciplinary research on the Earth and all of its processes. This effort enhances the school's evolving mission of tackling the big, hard issues facing Texas and the world. These issues include how to manage scarce water resources in the face of a booming population or, conversely, how to determine when heavy rains will turn into dangerous floods.

The Jackson School codified this approach in the new strategic plan. And the university as a whole has followed suit, kicking off its first Bridging Barriers grand research challenge with Planet Texas 2050, a project that seeks to understand environmental and energy challenges facing the state in the near future, in which the Jackson School is playing a major role (see page 72).

Long-term access to key research sites is essential for conducting the type of science that provides the knowledge and understanding of ecological and hydrological processes that are at the root of big issues facing the state. The Whites said they are excited that their donation of property will be helping make that long-term research possible, all while educating students in the process.

Leslie P. White, a Waco native, came to The University of Texas at Austin in 1951 to study geology, which he figured was a reasonable choice for a young man looking for a career. Along the way, he fell in love with the science and the university itself, which he talks about like an extended family. Giving back to future generations so they can make the same type of connections that he did, both scientifically and personally,

ABOVE: LESLIE P. AND DIANNE WHITE

RIGHT: ZACH MUNGIA LEADS FELLOW HYDROLOGY STUDENTS DOWN SOUTH ONION CREEK.

is exactly what he had in mind when he decided to donate the property.

"Geologists need to be outside," White said. "They need to see geology where it lives. It thrills me to think about all the young people that will be out here."

The Jackson School is still determining exactly how it will incorporate the property into its curriculum, but plans are to use it for all levels from freshmen on. Students have already taken advantage of the donation. The hydrology field camp spent a day on the property in May 2018 before traveling to New Mexico. During that single day, they were able to stream gauge, look at soil processes, soil moisture and soil water tension, and practice some ecohydrological monitoring techniques, specifically using a pressure chamber to look at water saturation in leaves.

Doctoral candidate Stephen Ferencz helped conduct the camp. He said he was blown away by the property and the opportunities it offers for education and research.

"It's fantastic," he said. "We were sizing up the property, and the idea of doing a weeklong field camp here is definitely feasible. There is so much you can look at. The idea of driving an hour instead of 14 hours to New Mexico, it's an opportunity to have a field experience that is so rich but also very local."

Assistant Professor Daniella Rempe led the camp with Ashley Matheny, another assistant professor in the Department of Geological Sciences. Rempe has made groundbreaking discoveries on the role rock moisture can play in helping trees survive extended droughts in certain geological settings (see page 13). The work was made possible by collecting long-term data in an observatory in Northern California while she was earning her doctorate at the University of California, Berkeley. Rempe said having access to a similar site here in Central Texas opens a new world of teaching and research opportunities.

She pointed out, for instance, that students will work on the Onion Creek watershed, which is already being monitored by the U.S. Geological Survey and has been modeled extensively by others at the university. She said this offers students the chance to have their work applied to projects such as the National Oceanic and Atmospheric Administration's national water model, a hydrologic model that is being developed to simulate and forecast streamflow over the entire continental United States.

"We're able to extend what we learn here to much bigger projects that they may encounter in their research or professional lives," Rempe said.

She also stressed that the observatory was going to be used for more than just collecting measurements. She envisions it as a spot for working on scientific issues and processes that can span from the pore space in rock and soils to the entire landscape, with time spans covering mere milliseconds to millions of years.

"As scientists, we're uniquely suited to understand the processes that motivate our observations, not just make and share the observations," Rempe said. "We're thinking about these sites as places where we monitor over the long term and do hypothesis-driven science that fundamentally changes how we predict the land, atmosphere, climate, hydrology and chemistry to change."

Department Chair Charlie Kerans said the opportunities for students will go well beyond hydrology. The advantages of ready access to a field site can't be overstated for most geosciences disciplines, Kerans stressed.

The Jackson School prides itself on offering field opportunities at every level of education. This is often accomplished by traveling hundreds or thousands of miles and by spending untold hours building relationships with landowners and negotiating access. With the White family property, those issues don't exist.

"To me, there is a big upside in that we have a place where we can set up shop and do different types of geology and not worry about losing land access," he said. "I know that being able to go out and work through the exposures and the creek beds and build the stratigraphy will be a fun and useful project."

There are other observatories of this kind across the country, but this is the first one that is in a carbonate domain, which, according to Mohrig, makes it uniquely important for studying and understanding karst ecology and geology. The overall strategy for the Texas Observatory network is to expand across the state to encompass its diverse geological and ecological settings. The plan calls for four sites, with two in Central Texas, one in East Texas near the coast and one in West Texas. Discussions are in the works for the other three.

Now that the White family donation is complete, the first job is determining which instruments to install to start collecting data, Mohrig said. On the initial wish list are an eddy flux tower to monitor local meteorology and instruments to monitor streamflow, soil moisture, deep and shallow groundwater, and some of the local ecology. Much will come down to funding opportunities, as do long-term plans for a learning facility of some sort. But the Jackson School is going to focus on getting students to the property as soon and often as possible to learn science in a real-world environment where things aren't as nice and tidy as they are in a lab or classroom.

In learning how to be a scientist, Mohrig said, messy can be good.

"I think we have a tendency to train scientists to think that if they work hard enough, they can see change very clearly and isolate it from other things," he said. "But the fact is that going out into the field, you realize that all these things are connected. It's not a laboratory setting where everything is set up to isolate a particular signal."

Understanding that interconnectivity is vital, particularly when trying to track issues such as environmental change. This type of science often involves studying large systems where variability in the data can be massive. The classic example, Mohrig said, is climate change, where the overall trend shows warming over the whole globe, yet there are some areas experiencing more severe winters. The next generation of geoscientists will need to understand how to collect and analyze that type of data, and be comfortable working with and explaining that data to a wide variety of audiences.

"We talk more and more about environmental change, but we can't do it without recognizing that the change is nested in variability that in many cases is as large as the change itself," he said. "When you're thinking about the Earth's surface and that system, that variability is as much the signal of what's happening as the mean."

No matter which directions future research goes, White is confident that his family's property will play an important role in the future of Jackson School students and their professors. White said his life was significantly influenced by his professors, particularly Stephen Clabaugh, with whom he developed a lifelong friendship. He stressed this impact to Rempe, urging her not to undervalue the impact she will have on her students.

Rempe said she knows exactly what he is referring to. She graduated with her bachelor's degree from The University of Texas in 2008 and fondly remembers learning from Jackson School hydrology Professor Bayani Cardenas and now retired Professor Jack Sharp. She said that her experience conducting research in the field with these two professors was one of the main reasons she jumped at the chance to return to the university as a faculty member.

"The science is important, but the relationships that you develop through that science are as important," White said. "That tells the story of why we're making this donation."

PORTRAIT: WYATT MCSPADDEN; CREEK: JACKSON SCHOOL.

PLANET TEXAS 2050

A UT Grand Challenge

UT Schools Work Together to Help Make Texas More Resilient

—

BY ANTON CAPUTO

SUSTAINABLE ENERGY SOURCES LIKE WIND TURBINES **(PICTURED ABOVE)**, AND ISSUES RELATED TO GROWING URBANIZATION **(LOWER PICTURE)** ARE AT THE HEART OF PLANET TEXAS 2050.

At least 1 out of every 4 new Americans between now and 2050 will be a Texan, according to current projections.

Let that sink in.

Put another way, Texas' population is on track to reach 50 million or more by midcentury, nearly doubling the amount of people in the state today.

Do you see any potential problems or issues with that kind of growth? If so, you're not alone.

From providing a sustainable supply of clean water and energy, to feeding and housing a booming population, the challenge posed by the expected growth is enormous. Throw in a changing climate in which intense droughts such as the one we experienced in 2011 are projected to become more common, as are devastating floods and massive storms such as Hurricane Harvey, and the challenge grows.

It is what The University of Texas at Austin has termed a grand challenge, one so large that it's too big for any single sector or academic discipline to take on. That's why the university chose the issue for its first Bridging Barriers Grand Challenge. The university-wide initiative introduced by President Gregory L. Fenves in his 2016 State of the University address brings together experts from across the university to address pressing problems facing Texas, the nation, and beyond.

"The toughest questions facing humanity and the world cross the boundaries of existing knowledge, and we must take an interdisciplinary approach to address them," Fenves said. "Breakthroughs happen when we break down silos of knowledge. And we are doing that now."

Planet Texas 2050 is the first grand challenge initiative to be announced. It's tying together faculty members and scientists from 14 colleges and schools throughout the university so they can begin looking at how Texas can support the enormous growth of the next three decades in a way that allows its communities, economy and environment to thrive.

The project was chosen from hundreds of potential concept papers that researchers from throughout the university submitted to the Office of the Vice President for Research. Planet Texas 2050 is largely based on a concept submitted by eight UT researchers, including two in leadership positions at Jackson School research units and programs: Michael Young, a Bureau of Economic Geology senior research scientist and associate director for environment; and Jay Banner, Jackson School professor and director of the Environmental Science Institute (ESI).

"The two driving factors, climate change and population change, those aren't unique to Texas. What's unique to Texas is that we really hit those factors on all cylinders," Banner said. "Coming up with a way to plan for a more resilient Texas, that's what this is all about."

The Jackson School is playing a key role in this project, but the geosciences are far from alone. In addition to Young and Banner, the organizing team includes experts on indoor environments and air quality from the schools of architecture and engineering, a community health expert from Dell Medical School and a researcher from the Texas Advanced Computing Center (TACC), which will be using its supercomputer to crunch the massive amounts of data gathered during the process. TACC is represented on the organizing committee by Suzanne Pierce, a research scientist at TACC who is also an assistant research professor at the Jackson School-affiliated ESI.

Beyond the sciences, there are also representatives on the organizing committee from the humanities and social sciences who will be helping determine how to communicate information to policymakers and the public at large, as well as bringing other points of view to problems that will almost certainly require new approaches. The group includes a classics expert who specializes in ancient civilizations that have dealt with environmental change and water shortages in the past, and an English professor who focuses on how we understand and respond to environmental crisis. Both are from the College of Liberal Arts. In addition to this core group, 100+ researchers from 14 colleges and schools are helping with the effort in some way.

PHOTOS: BRIDGING BARRIERS.

Their work will focus on understanding the interconnectedness of four critical resource systems:

- **Water** – Scientists will conduct a number of research projects, from measuring current water availability today to understanding the processes by which urbanization affects watersheds, with the goal of using that data to build an integrated modeling platform that produces accurate long-term water resource projections.
- **Energy** – Researchers will focus on gaining a comprehensive understanding of the state's energy sources and production capabilities, and they will build simulations that replicate the energy needs of entire cities throughout seasons and weather events. Their work will help engineers and architects design urban centers.
- **Ecosystem Services** – Healthy ecosystems are critical because they provide crop pollination and shade, water filtration and natural carbon sequestration. Planet Texas 2050 researchers will map Texas' most vulnerable areas and study the effects that population growth and weather extremes have on the ecosystems that Texans rely on.
- **Urbanization** – Researchers will examine energy and water use within single buildings and across metropolitan areas. Other projects will focus on the connections among transportation corridors, air quality and health outcomes. The goal is to find common ways that all of Texas' 25 major metropolitan areas can better manage water distribution, improve transportation planning, mitigate traffic-related air pollution, and improve the prevalence and affordability of energy-efficient construction. This issue is vital because all of the state's projected growth is coming into the urban areas, particularly in the corridor stretching from Dallas-Fort Worth to the Rio Grande Valley and the Houston area. Conversely, the population of rural Texas is projected to remain flat.

The ability to use a large state for a laboratory of this kind of effort is unique, said Young. Texas is the only state in the contiguous United States where nearly all of its water and electricity are generated within its borders. Most of the state's rivers begin and end within Texas, as do the recharge zones of most aquifers. The same can be said of the state's energy, which is virtually all generated and used within its borders. Texas is also the only state in the continental U.S. with its own self-contained power grid.

This means these factors can be studied in Texas without outside influence, a key feature in helping model and predict how Texas communities and environments will be affected by change. Young's ultimate goal is to help create a model platform that integrates these resources and that can help decision makers plan for the future by looking at different growth, resource and climate scenarios. For example:

"If we got the 2011 drought in 2050, and we're down to 28 percent in the Highland Lake's system—what are we going to do," Young said. "Are we going to desalinate water and pipe in water? Because building that pipeline takes time, so we need to think about long-term planning."

Just as important, what researchers at the university discover will have applications that extend far beyond Texas. The team plans to share its findings, tools and processes with researchers across the U.S. and the world who are facing similar challenges.

With Planet Texas 2050 just starting up, it's too early to know what form most of the research will take. One of the issues that Banner said he is most excited about is the prospect of tracking and predicting the health impact a changing climate and rapid growth can have on Texas communities, which is an issue he wouldn't have had much exposure to without the interdisciplinary nature of the project.

Some of the early research is revealing interesting connections between human-made and natural environments. For instance, Banner is working on a project with students looking at the water supply of Austin's Waller Creek, which seems immune to the droughts that dry up most area creeks. By tracking the strontium isotope signature of the water, Banner's team discovered that the urban creek does so well during droughts because, when it's not raining, as much as 90 percent of the water may come from leaky water pipes in central Austin. And while this isn't particularly good for water conservation, it may mean that some components of the environment and ecosystem supported by the creek are largely immune to the otherwise harmful effects of droughts.

Among the many challenges still to be overcome are how to communicate the research and results to the public and how to get the tools in the hands of decision makers in a way that will help them determine the best paths forward for their communities and the state as a whole. These include companies and industry in Texas, many of whom Young and Banner are currently visiting to assess their interest in the project. Given the scope of the challenges at hand, Young said that generating support during the early stage of the project is key.

"We've not really seen anybody try to do anything of this scale in a state this size," Young said. "This is really big for the university."

For more information, go to: www.bridgingbarriers.utexas.edu.

Inside the Collections

Specimens that span Earth's history combine wonder with scientific worth

IMPRESSIVE SPECIMENS ABOUND IN THE COLLECTIONS OF THE JACKSON SCHOOL OF GEOSCIENCES. There's the Texas Pterosaur, *Quetzalcoatlus*, the largest flying animal ever discovered; the rock cuttings that first hinted at the amazing energy productivity of the Eagle Ford Shale; and a trove of jewels personally faceted by internationally recognized lapidarists Glenn and Martha Vargas.

These select notables are just a miniscule sampling of the millions of items kept inside the collections, which include:

- The Jackson School Museum of Earth History's Vertebrate Paleontology Collections, which hold approximately 2 million specimens and is one of the largest collection of vertebrate fossils in the United States.
- The museum's Non-Vertebrate Paleontology Collections, the sixth largest non-vertebrate fossil collection in the United States. The collections hold an estimated 4 million specimens, which include rocks and minerals along with fossils. Roughly 95 percent of Texas' 254 counties are represented among its diverse fossil holdings.
- The Bureau of Economic Geology's three core and cuttings repositories — spread across Austin, Houston and Midland — which have combined holdings of nearly 2 million boxes of geologic material, and make the repositories among the largest public collections in the world.
- And the Jackson School's gem and mineral collections, which hold hundreds of thousands of minerals and gems — from expertly faceted jewels, to historic samples collected during the early mapping of Texas, to meteorites.

Through careful curation and cataloging, the immense array of material is a world-class resource for education and research. The collections' designation as a public resource means that students, scientists and the general public alike are able to benefit from the rare and diverse materials stored within them.

A small sampling from across the collections is featured on the following pages. Chosen for their intrigue and beauty — as well as their scientific worth — we hope these treasures spark your curiosity while showcasing the importance of maintaining collections that catalogue the history of our planet.

THE AUSTIN CORE RESEARCH CENTER IS STACKED FLOOR TO CEILING WITH MORE THAN 700,000 BOXES OF CORE AND CUTTINGS FROM WELLS DRILLED IN TEXAS, THE U.S. AND THE WORLD.

PHOTO: SARAH WILSON.

Jackson School Museum of Earth History: Vertebrate Paleontology

1.

1. SCIMITAR-TOOTH CAT
HOMETHERIUM SERUM
FRIESENHAHN CAVE, BEXAR COUNTY, TEXAS

THIS BIG CAT LIVED IN TEXAS TWO MILLION TO 20,000 YEARS AGO AND HAS BEEN FOUND IN SEVERAL CAVES IN THE HILL COUNTRY. THE SABER TEETH ARE 3 INCHES LONG AND HAVE SERRATED EDGES ON BOTH SIDES.

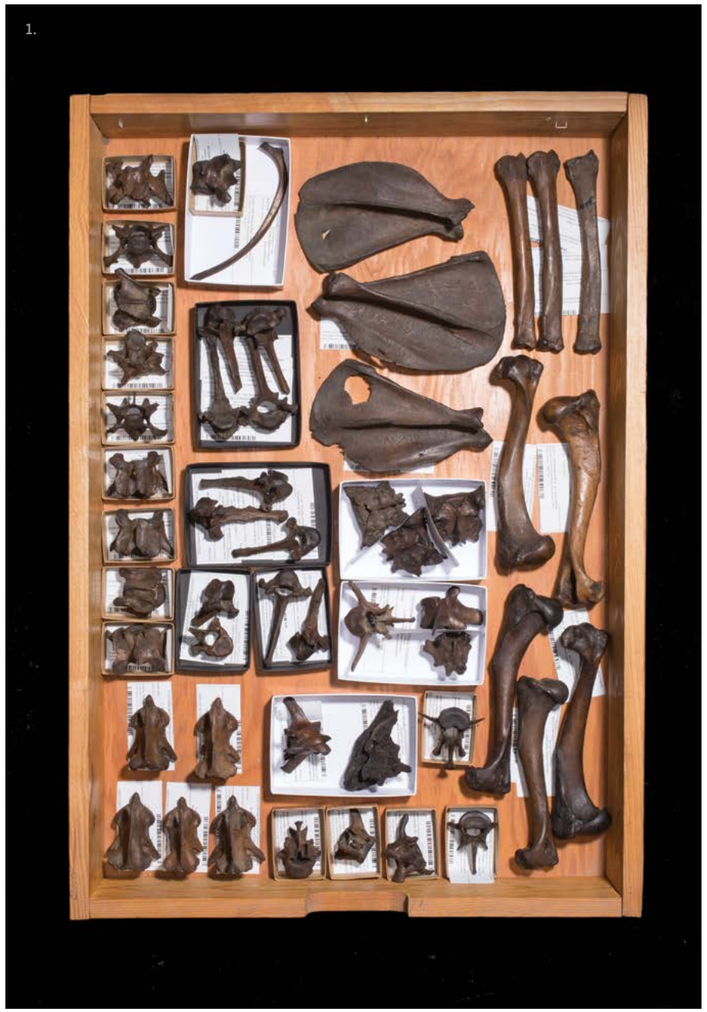
2. TEXAS PTEROSAUR
QUETZALCOATLUS NORTHROPI
BIG BEND NATIONAL PARK, TEXAS

WITH AN ESTIMATED WINGSPAN OF 36-39 FEET, THE TEXAS PTEROSAUR IS THE LARGEST KNOWN FLYING ANIMAL TO HAVE EVER LIVED. THE SPECIES LIVED DURING THE LATE CRETACEOUS AND WAS DISCOVERED IN 1971 BY DOUGLAS LAWSON, A UT GEOLOGY GRADUATE STUDENT. PHOTOGRAPHER SARAH WILSON FOR SCALE.

2.

PHOTOS: SARAH WILSON.

1.



2.

3.

1. DIRE WOLF
CANIS DIRUS
RANCHO LA BREA, LOS ANGELES, CALIFORNIA

THE WORLD FAMOUS LA BREA TAR PITS PRESERVE MILLIONS OF FOSSILS THAT LIVED BETWEEN 11,000 AND 50,000 YEARS AGO. STAINED DEEP BROWN BY THE NATURAL ASPHALT THAT TRAPPED THE ANIMALS, THESE SPECIMENS ARE SIMILAR TO THE FLORA AND FAUNA THAT LIVED IN CENTRAL TEXAS DURING THE PLEISTOCENE.

2. ALLIGATOR SNAPPING TURTLE
MACROCHELYS TEMMINCKII
HIDALGO FALLS, WASHINGTON COUNTY, TEXAS

ONE OF THE LARGEST ALLIGATOR SNAPPING TURTLES KNOWN AT THE TIME IT WAS COLLECTED, THIS SKULL WAS EXCAVATED DURING DREDGE OPERATIONS IN THE BRAZOS RIVER AND DESCRIBED IN A 1911 PUBLICATION BY O.P. HAY.

3. UNSORTED SKELETAL REMAINS
HALL'S CAVE, KERR COUNTY, TEXAS

THESE BATCH-CURATED BONES REPRESENTING NUMEROUS SPECIES FOUND IN CAVE SEDIMENTS ARE STORED IN BULK UNTIL NEEDED FOR RESEARCH. THEY WILL BE SORTED, IDENTIFIED AND CURATED, AND CAN BE USED IN BIODIVERSITY, CLIMATE, DNA AND RADIOCARBON DATING STUDIES.

Jackson School Museum of Earth History: Non-Vertebrate Paleontology

DEVONIAN SEA URCHIN
ARCHAEOCIDARIS BROWNWOODENSIS
WINCHELL FORMATION, TEXAS

A SEA URCHIN'S MOUTH IS NORMALLY HIDDEN INSIDE ITS SHELL. IN THIS FOSSILIZED SPECIMEN, THE SHELL FELL APART AND EXPOSED THE STAR-SHAPED TOP OF THE MOUTH, AN APPARATUS CALLED ARISTOTLE'S LANTERN.

OPPOSITE:

1. CRINOID CALYX AND ARMS
EOPINNACRINUS PINNULATUS
BROMIDE FORMATION, OKLAHOMA

THIS SPECIES OF CRINOID, OR SEA LILY, LIVED DURING THE ORDOVICIAN PERIOD WHEN MUCH OF WHAT IS NOW THE SOUTHERN UNITED STATES WAS UNDER WATER. THIS EXAMPLE IS A HOLOTYPE, THE SPECIMEN ON WHICH THE SPECIES DESCRIPTION IS BASED.

2. CRETACEOUS OYSTER
ILYMATOGYRA ARIETINA
DEL RIO FORMATION, TEXAS

THE DISTINCTIVE SPIRAL SHAPE OF THIS OYSTER'S SHELL HAS EARNED IT THE NICKNAME "RAM'S HORN OYSTER." THE SPECIES IS A COMMON FIND IN FOSSIL LOCALES AROUND AUSTIN.

3. CROSS SECTION OF FRUIT PIT
DRACONTOMELON MACDONALDII
BÚCARO FORMATION
LOS SANTOS STATE, PANAMA

THIS FOSSILIZED FRUIT PIT WAS FOUND IN CENTRAL AMERICA, BUT ITS ONLY KNOWN LIVING RELATIVES GROW IN SOUTHEAST ASIA. SCIENTISTS ARE STILL WORKING ON WHAT SIDE OF THE WORLD THE FRUIT GENUS ORIGINATED.

4. BRACHIOPOD WITH MARKINGS
DICTYOCLOSTUS WELLERI
CALLAHAN COUNTY, TEXAS

BRACHIOPODS ARE CONSIDERED TO BE LIVING FOSSILS, AND ALTHOUGH UNCOMMON TODAY, WERE SOME OF THE MOST COMMON SHELLFISH DURING THE PALEOZOIC ERA. THE LIGHT-COLORED CHIPS IN THE FOSSIL WERE MADE BY BARNACLES THAT BORED THROUGH THE SHELL. THE CONCENTRIC BLACK RINGS ARE FROM A PALEONTOLOGIST'S GREASE PENCIL.

5. PALEOGENE OYSTER
CUBITOSTREA SELLAEFORMIS
COOK MOUNTAIN FORMATION, TEXAS

THE TISSUE-PAPER APPEARANCE OF THIS OYSTER'S SHELL RELATES BACK TO THE SPECIMEN'S LIFE HISTORY. AS THE ANIMAL GREW SO DID ITS SHELL, WITH THE OLD LAYERS STACKING ATOP THE NEW. THE GROOVES IN THE SHELL REPRESENT TIMES WHEN THE OYSTER DID NOT HAVE ADEQUATE RESOURCES TO ENLARGE ITS HOME.

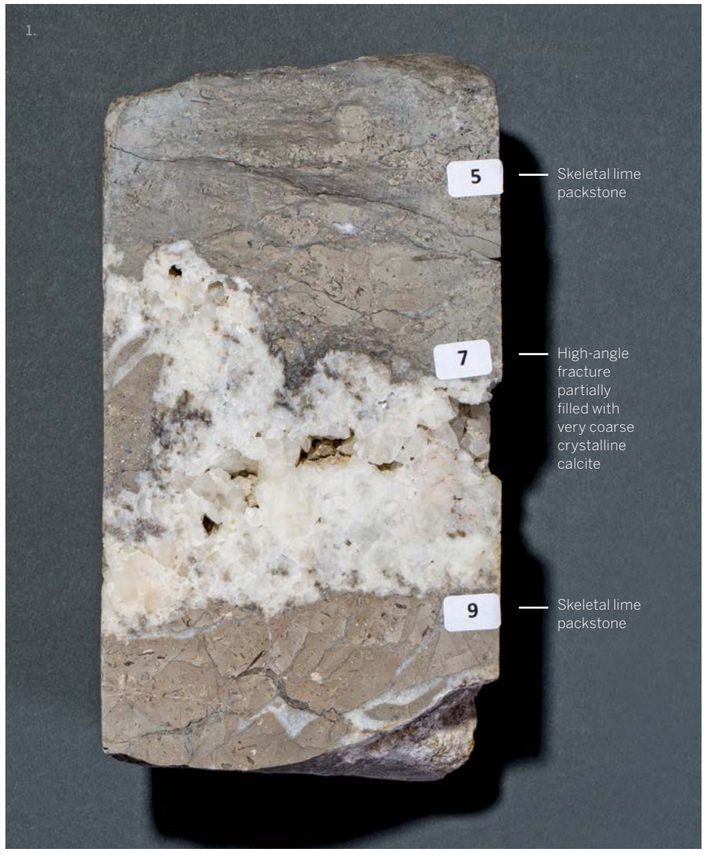
6. PALEOGENE BIVALVE
VENERICARDIA ALTICOSTATA
BURLESON COUNTY, TEXAS

THIS SPECIMEN WAS COLLECTED MORE THAN A CENTURY AGO BY THE BUREAU OF ECONOMIC GEOLOGY DURING A GEOLOGIC SURVEY OF TEXAS IN 1899. THE RED MARK DESIGNATES THE SPECIMEN AS A HOLOTYPE, THE SPECIMEN ON WHICH THE SPECIES DESCRIPTION IS BASED.

PHOTOS: NON-VERTEBRATE PALEONTOLOGY COLLECTIONS.

Austin Core Research Center

1.



3.

2.

1. TENNECO NO. 1 NEY WELL CORE SLAB SLIGO FORMATION, SOUTH TEXAS

THE SLIGO FORMATION IS KNOWN FOR ZONES OF POROUS LIMESTONE, WHICH COMPRISE A LARGE PORTION OF OIL AND GAS PRODUCTION IN NORTH LOUISIANA, ARKANSAS AND EAST TEXAS. THIS PIECE OF CORE SHOWS A FRACTURE WITH CEMENT FILL AND LARGE PORES. FRACTURES SUCH AS THESE CAN BE A MAJOR CONDUIT FOR HYDROCARBON PRODUCTION.

2. CORE OF PURE SALT MIDLAND BASIN, WEST TEXAS

THIS NEARLY TRANSPARENT, PERMIAN SALT CORE WAS SAMPLED FROM A WELL IN WEST TEXAS IN THE 1980S. THE WORK WAS PART OF A DEPARTMENT OF ENERGY-FUNDED PROJECT THAT TASKED THE BUREAU OF ECONOMIC GEOLOGY WITH EVALUATING BEDDED SALT LAYERS TO SEE IF THEY COULD SERVE AS STORAGE FOR HIGH-LEVEL RADIOACTIVE WASTE. YUCCA MOUNTAIN IN NEVADA WAS ULTIMATELY CHOSEN OVER TEXAS.

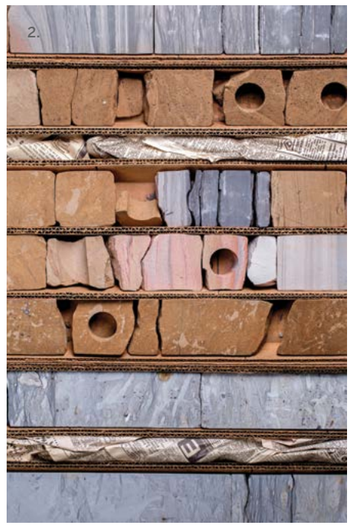
3. SANDSTONE CORE FROM GAS RESEARCH INSTITUTE'S STAGED FIELD EXPERIMENT NO.2 TRAVIS PEAK FORMATION NACOGDOCHES, TEXAS

OPEN NATURAL FRACTURES ABOUND IN THIS PIECE OF SANDSTONE CORE COLLECTED FROM 9,842 FEET IN THE CRETACEOUS TRAVIS PEAK FORMATION, AN IMPORTANT LOW-PERMEABILITY GAS RESERVOIR IN EAST TEXAS. FRACTURES LIKE THESE SERVE AS IMPORTANT CONDUITS AND CONTROLS FOR GAS EXTRACTED FROM LOW-PERMEABILITY RESERVOIRS.

PHOTOS: SARAH WILSON.

1.

2.



3.

1. CUTTINGS FROM PHILLIPS PETROLEUM COMPANY NO.1 LASALLE COUNTY, TEXAS

THE BEGINNING OF THE EAGLE FORD SHALE BOOM CAN BE TRACED BACK TO THESE INCONSPICUOUS CUTTINGS. FIRST BROUGHT TO SURFACE BY PHILLIPS PETROLEUM IN 1952, THE CUTTINGS LAID IN STORAGE FOR DECADES UNTIL CORPUS CHRISTI GEOLOGIST GREGG ROBERTSON TRACKED THEM DOWN IN 2008 TO GROUND-TRUTH DRILLING PLANS BY PETROHAWK ENERGY CORP. THE EAGLE FORD IS NOW ONE OF THE MOST PRODUCTIVE SHALE PLAYS IN THE WORD, HOLDING AN ESTIMATED 8.5 BILLION BARRELS OF OIL.

2. ARCO NO. 17 GRIFFIN CORE RUSK COUNTY, TEXAS

THE LIGHTLY COLORED UPPER CRETACEOUS AUSTIN CHALK (BOTTOM TWO ROWS), OVERLIES SANDSTONE AND SILTSTONE BEDS OF THE WOODBINE GROUP THAT WERE DEPOSITED IN A DELTAIC SETTING. THE WOODBINE GROUP HAS PRODUCED MORE THAN 5.4 BILLION BARRELS OF OIL IN EAST TEXAS SINCE THE FIELD'S DISCOVERY IN 1930.

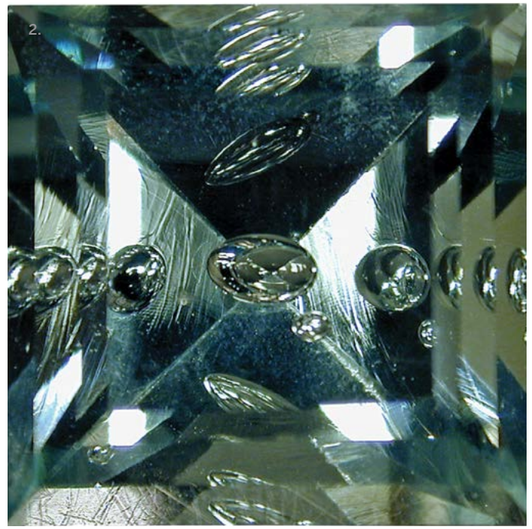
3. TENNECO NO. 1 NEY WELL PEARSALL FORMATION, TEXAS

THE SEDIMENTS THAT COMPRISE THIS 18 FEET OF CORE FROM THE LOWER CRETACEOUS BEXAR MEMBER OF THE PEARSALL FORMATION WERE DEPOSITED IN SHALLOW AND QUIET WATER WHERE BURROWING ORGANISMS AND OYSTERS COULD EASILY THRIVE. THE YELLOW SECTION REPRESENTS LATER GEOCHEMICAL ALTERATION, INDICATING A TIME WHEN OXYGENATED WATER WAS FLOWING THROUGH THE ROCK. EQUIVALENT ORGANIC-RICH STRATA DOWNDIP MAKE THE BEXAR MEMBER AN ACTIVE EXPLORATION TARGET FOR UNCONVENTIONAL OIL AND GAS.

The Vargas Collections, The E.M. Barron Collections

PHOTOS: DEPARTMENT OF GEOLOGICAL SCIENCES.


1.


2.

OPPOSITE:

AGATES
LAGUNA RANCH
CHIHUAHUA, MEXICO

THESE THREE SPECIMENS ARE PART OF THE MORE THAN 500 AGATES HELD BY THE BARRON COLLECTION, WHICH WAS DONATED TO THE UNIVERSITY BY COLONEL ELBERT MACBY BARRON. THE AGATES ARE THE JEWEL OF THE COLLECTION. THEY ARE AMONG THE BEST SPECIMENS OF THEIR KIND AND SHOWCASE THE SPECTACULAR ARRAY OF COLORS THAT MAKE AGATES FROM NORTHERN MEXICO AMONG THE MOST PRIZED IN THE WORLD.

—

1. QUARTZ, VARIETY AMETRINE
OVAL BRILLIANT CUT
BRAZIL

2. GREEN GLASS WITH BUBBLE
ROUND MIXED CUT
UNKNOWN

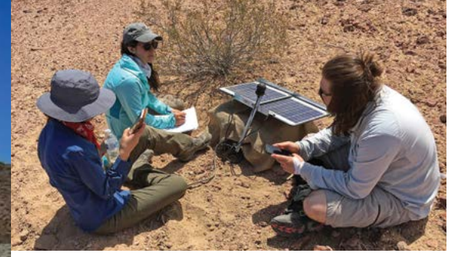
3. QUARTZ, VARIETY CITRINE
PENTAGONAL STEP CUT
UNKNOWN

THE THREE GEMSTONES ARE AMONG THE MORE THAN 1,000 FACETED GEMSTONES DISPLAYED IN HAND-MADE WIRE MOUNTS THAT MAKE UP THE VARGAS GEM AND MINERAL COLLECTION. GLENN AND MARTHA VARGAS ASSEMBLED THE COLLECTION OVER 60 YEARS, HAND-SELECTING AND FACETING THE STONES THEMSELVES. FOR 24 YEARS, THEY TAUGHT THEIR CRAFT TO THE THOUSANDS OF STUDENTS WHO TOOK THEIR GEMS AND GEM MINERALS COURSE IN THE DEPARTMENT OF GEOLOGICAL SCIENCES.


3.

TECHNOLOGY IN THE FIELD

BY MONICA KORTSHA



One of the most important skills a field geologist can develop is the ability to interpret rocks in their native environment.

Developing a keen eye is a good start. But at the end of the day, there's only so much the human eyeball can do.

We can't see below the surface. Or detect the tiny shifts in topography caused by tectonic movement underfoot. And although it may be possible to map the details etched into sheer-sided cliffs from up close, it takes more time and carabiners than most would care to spend.

To do all that, modern geoscientists depend on diverse technology——cameras, sensors, sounders and more——that shows parts of the world that would otherwise remain hidden.

Scientists at the Jackson School of Geosciences are using geosciences technology to take their powers of observation to new places. Some of the devices are cutting-edge and just making their way into the market, with the Jackson School's early adopter role helping refine applications and further development. Others, borne of elbow grease and Walmart runs, show the power of creativity in problem solving.

LEFT PAGE: UNDERGRADUATE ASHLYN ZARE FINISHING UP AN INSTALL OF A FIELD SEISMOMETER

RIGHT PAGE, CLOCKWISE: UNDERGRADUATES (LEFT TO RIGHT) ASHLYN ZARE, JACKIE RAMBO AND DANIEL ORTEGA-ARROYO INSTALLING A FIELD SEISMOMETER IN THE MOJAVE DESERT; A DRONE TAKING FLIGHT DURING FIELDWORK IN THE BAHAMAS; GRADUATE STUDENT ERIC PETERSEN CONDUCTS A RADAR SURVEY OF ALASKA'S SOURDOUGH ROCK GLACIER USING A HOME-BUILT "POD RACER;" RESEARCHERS DEPLOY THE P-CABLE SEISMIC SYSTEM IN THE GULF OF MEXICO TO LOOK FOR CO_2 STORAGE SITES.

PHOTOS CLOCKWISE: ROB PORRITT. CHRIS ZAHM. TYLER MENG/ÉRIC PETERSEN.

PHOTOS CONTINUED: THE BUREAU OF ECONOMIC GEOLOGY. DANIEL ORTEGA-ARROYO.

PORTABLE SEISMOMETERS: PINT-SIZED PLATE TRACKING

Geoscientists use seismometers to measure ground movement, with researchers often putting them to work along tectonic plate interfaces to track the daily movements of the plates.

Rob Porritt, a postdoctoral researcher at the Institute for Geophysics, said he remembers spending long hours in the field installing seismometers——a process that involved mixing sand, cement and water, and moving heavy batteries and sensors. But he said that a new generation of pint-sized seismometers, only about the size of a soda can, is simplifying the installation process, and changing the type of work that's possible and who can participate.

"This box weighs 50 pounds, and that's everything you need for the station," Porritt said about the seismometer and its associated machinery held inside a plastic container.

"These, they are light enough that we can just put them on our packs and hike the 1 to 3 kilometers to our sites."

Another improvement is the installation time. The boxes only take about an hour to get in the ground.

In April 2018, Porritt led a team of undergraduates to eastern California's Mojave Desert to deploy 19 seismometers above a fault system about 150 miles east of the San Andreas fault, an active tectonic boundary and earthquake incubator. The project, overseen in part by the Jackson School's Thorsten Becker and Whitney Behr (now at the university of ETH Zurich) and funded by the Southern California Earthquake Center, seeks to learn more about how nearby tectonic activity is deforming the fault, and how it might relate to tension between the plates that could be released as earthquakes.

The seismometer's portable size allowed the team to hike to the area——cars are forbidden because of the area's designation as a habitat for endangered desert tortoises——with UTIG Research Scientist Associates Marcy Davis and Dan Duncan developing a seismic station design and installation protocol with the undergraduate researcher in mind.

"One of the design elements of this project was to make everything simple enough that an undergrad, without any help, could put it all together," Porritt said.

The mission was a success: Undergraduates Ashlyn Zare, Jackie Rambo and Daniel Ortega-Arroyo successfully installed monitors, which, if all is in working order, are currently recording the seismic lurches and wobbles happening miles beneath the desert.

DRONES: FLY-BY GEOLOGY

Sometimes, revolutionary technology solutions are available right off the shelf. Chris Zahm, a bureau research engineering scientist associate, said that drones—those small, whirring, and camera-equipped quadcopters—have revolutionized fieldwork by making hard-to-reach places easier to access.

"I remember being an early geologist and thinking—several times—man, if I could just fly and see what this looks like from the air," Zahm said. "And now, suddenly, that's possible."

Earlier attempts by geologists to get a bird's-eye view included releasing camera-mounted weather balloons into the wild and dangling poles equipped with cameras on a timer delay over cliffs. (Zahm said he attempted that technique in graduate school with little success). Drones, easily toted in a backpack and operated via remote control, offer a much more maneuverable option.

Zahm and Department of Geological Sciences Chair Charlie Kerans have been using drones to investigate the carbonate geology of Texas and New Mexico and various islands in the Caribbean for years, usually accompanied by a cadre of graduate students during summer field trips. This year, the group visited the island of Eleuthera and used a drone to photograph two gigantic boulders—dubbed "the cow" and "the bull," each reaching more than 20 feet tall. It's a mystery how the duo got to their current spot, with many in the scientific community thinking an ancient storm might have hoisted them into position.

A drone flight around the boulders helped reveal their topography in new detail, bringing centimeter-scale features into view. They also provided the raw material to conduct photogrammetry, a technique that pieces together photos from various vantage points to construct a 3-D model. Zahm often uses photogrammetry to create topological maps of survey areas. In this case, the team applied the technique to calculate the weight and volume of "the cow," with the boulder weighing between 518 and 620 tons, with a volume of 219 cubic meters.

THE POD RACER: RADAR ON ICE

It doesn't always take the latest and greatest technology to get big improvements in data collection. Graduate students Eric Petersen and Tyler Meng, who both study rock-covered glaciers and how their ice records climate fluctuations, were able to do it by simply putting their ground penetrating radar system on a sled.

Petersen came up with the idea while walking radar equipment across parts of Alaska's Sourdough Rock Glacier during a 2015 summer field work trip with his adviser Research Professor Jack Holt (now at The University of Arizona) and other students. Carrying the radar system across the cragged surface made for slow-moving surveying. Petersen thought that gliding the system over a winter snowpack could speed up the process.

"To [Texans], dragging a sled behind skis is a novel idea, but everyone does it up there," Petersen said. "If you're going somewhere, look at how people get around … it can be a good source of inspiration."

In 2018, Petersen got his chance to try the design, with a Jackson School seed grant covering the travel and the supply costs of building the "Pod Racer"—the name Meng and Petersen gave to the two radar-toting sleds lashed together with PVC pipes and a handful of nuts and bolts.

"This was the most fun aspect of doing this project," Meng said. "We came up with a rough idea of what we wanted to build and do, but we basically arrived in Alaska and bought all of the pieces and built it in a couple days."

Meng estimates that the Pod Racer cost less than $200 to build. But that relatively inexpensive addition to the radar setup led to a significant boost in the data quality. The images of the glacier's interior came back so clear that they didn't need to go through the usual post-processing that the walking surveys required. And with Meng and Petersen taking turns pulling the Pod Racer on cross-country skis, they were able to cover more ground than ever before. A normal day of surveying on foot usually covered about 200 meters. On skis it was about 630.

The technique does come with a few caveats. Not all winters produce enough suitable snowfall on the glacier to use the sled. And the ones that do come with an avalanche risk that limits surveying to lower elevations. But the Pod Racer more than proved its worth, Petersen said, providing useful data and the confidence boost that comes with trying something new and succeeding.

DRONE: DJI. PODRACER: TYLER MENG/ERIC PETERSEN.

PHOTO: JACKSON SCHOOL.

THE P-CABLE: CARBON STORAGE SCOUT

The P-Cable system acquired by the Bureau of Economic Geology in 2012 shows the strata of the sea floor in unprecedented detail—offering a resolution up to four times better than conventional seismic systems.

The system is best at revealing structures about a mile under the seabed—a zone that's critical when scouting for potential carbon sequestration spots, said Tip Meckel, a researcher with the bureau's Gulf Coast Carbon Center. Faults and fractures in this stratigraphy could serve as passageways and escape valves for carbon dioxide injected deep below.

"You can see migrating methane in the subsurface, and that helps you understand whether you have preferential flow paths for CO_2 to the surface," Meckel explained. "And we've definitely been identifying sites that we think are suitable for long-term safe CO_2 storage."

The reason for the improved resolution lies in the P-Cable's streamers—plastic tubes embedded with sound receivers that are pulled behind a survey vessel. They're short—only 25 feet long, in comparison with the kilometers-long streamers used by conventional systems. The compact design keeps them from getting tangled, allowing for more streamers in a single area and resulting in a more refined image.

Meckel described surveying with the P-Cable streamers "like combing the sand with a finer rake."

To Meckel's knowledge, The University of Texas at Austin is the only university in North America conducting research using P-Cable technology, with the bureau acquiring the $2.5 million system with help from a Department of Energy grant. Meckel has put the technology to the test during several surveys offshore of Texas, as well as a six-day survey in 2017 at the Tomakomai carbon-storage site, an active carbon dioxide injection site offshore of the Japanese island of Hokkaido.

Meckel said that these surveys are helping determine best-practices for P-Cable deployment, and that an international conference series focused on offshore CO_2 storage started by the Gulf Coast Carbon Center in 2016 is helping spread the word.

At the moment, the surveys are primarily for basic research purposes. However, with Texas and other states already passing regulations governing carbon storage, it's just a matter of time until this data could turn into an important resource for companies looking for places to safely store the greenhouse gas. In addition, Meckel said that there's a whole world of subsurface geology that the P-Cable could help illuminate.

"This type of tool could be used for studying Quaternary [period] relative sea level change. You could use it to study geologic hazards," Meckel said. "Anywhere where better resolution is needed is an interesting target for this technology, and it could be used to study a diversity of geologic interests that are in a relatively unexplored part of the stratigraphy below the sea floor."

LEFT: SEISMIC STREAMERS ARE EMBEDDED WITH RECEIVERS THAT PICK UP SOUNDWAVES REFLECTED BY SEAFLOOR GEOLOGY. THIS DATA CAN BE USED TO MAKE A PICTURE OF THE UNDERLYING SEAFLOOR GEOLOGY

OPPOSITE PAGE:
TOP: THE PHANTOM 4 PRO V2.0 IS THE DRONE MODEL USED BY ZAHM TO SURVEY GEOLOGY FROM THE AIR.
BOTTOM: THE HOME-BUILT "POD RACER" CARRYING THE RADAR SYSTEM.

HELPFUL TECH

Technology is not a panacea to problems in Earth science. That eyeball still needs to be honed and tested to know when something is worth examining or ignoring. But with the new vantage points offered by the technology—from the high-tech and high-dollar devices, to humble DIY projects—geoscientists are able to see more of the planet than ever before. Petersen, one-half of the team that developed the Pod Racer, said that opportunities abound for creative application and invention. He urges everyone to scout out their surroundings and strive to see more.

"I encourage everyone to MacGyver," Petersen said, referring to the improvisational problem-solving style of the 1980's TV show character Angus "Mac" MacGyver. "Put on your skis, but be safe!"

LEFT: BILL FISHER (CENTER) STANDING BESIDE ECONOMIST WALT WHITMAN ROSTOW AT GOV. BILL CLEMENTS' ANNOUNCEMENT OF THE TEXAS ENERGY PLAN IN 1979.

ABOVE: THE BUREAU OF ECONOMIC GEOLOGY ON UT'S "LITTLE CAMPUS."

OPPOSITE: FISHER'S OFFICIAL PHOTOGRAPH AS ASSISTANT SECRETARY FOR ENERGY & MINERALS, U. S. DEPARTMENT OF THE INTERIOR, 1976.

ENERGY, DISCIPLINE AND VISION

For nearly six decades, Bill Fisher has been a driving force in geology in Texas and beyond, helping turn the Bureau of Economic Geology into a world-class research institution, launching the Jackson School of Geosciences, educating generations of geoscience leaders and shaping policy across the nation.

BY ANTON CAPUTO

PHOTOS: BILL FISHER/JACKSON SCHOOL.

PHOTOS: JACKSON SCHOOL.

Among the books, memorabilia and pictures that line the walls and shelves of Bill Fisher's office, a typed letter hangs near the desk. At the bottom are signatures and a note scribbled firmly in the right corner. It reads:

To Bill, from Jack,
I could not have put together this whole deal without your help.
Thanks,
Jack

That simple message from Jackson School of Geosciences founder Jack Jackson succinctly sums up the fundamental role Fisher had in the formation of the Jackson School—without him, there probably wouldn't be a school.

This fall, Fisher is retiring after nearly six decades with The University of Texas at Austin. During that time, he led the Bureau of Economic Geology for 24 years, growing it from a small, well-respected shop into a national and international powerhouse. He made foundational scientific breakthroughs in sedimentary geology that helped him earn a place in the National Academy of Engineering and win just about every major award a geoscientist can receive. He made stops to serve in Washington, advising presidents and Congress on national energy and science policy. He supervised or co-supervised 155 graduate students and taught hundreds more in Texas and beyond. And, of course, there was the relationship Fisher fostered with Jackson and stoked over the years, along with a small group of others, that would lead to the formation of the Jackson School and ultimately help change the face of geosciences in Texas.

"Bill was the thread of continuity through it all," remembered Larry Faulkner, who served as university president when the Jackson gift that enabled the formation of the school was finalized. "Bill and Jack had a personal relationship that went back a long way, and long-established relationships were important to Jack."

By the time the ink dried in 2002 on the letter officially bequeathing the Jackson Estate to the University of Texas, Fisher had known Jackson for 27 years. Their first meeting dated back to when Jackson joined the Geology Foundation in 1975, but the relationship really strengthened in the decade before his 2003 death as Jackson hinted at his desire to do something meaningful for his beloved university. It was a relationship Fisher prioritized while juggling roles as bureau director, department chair, Geology Foundation director, president of national societies and many more duties.

Why? Well of course, he liked Jackson. But ultimately it boiled down to a singular skill that anyone who has spent significant time with Fisher is quick to point out: Fisher sees the big picture and recognizes opportunities. It's a skill he would exhibit time and time again during his long, storied career. In the case of Jack Jackson, he saw the opportunity to help a friend leave a positive, permanent impact on the geosciences while building what would become one of the world's best geosciences programs in the process.

"If you're willing to spend some energy, and if you're willing sometimes to take a little bit of a chance, it can make all the difference in the world," Fisher said.

MAKING THE GRADE

Faulkner sums up the impact of Fisher's career succinctly.

"Bill is as influential a figure in geology in Texas as anybody ever has been," he said.

But for someone who would have so much influence on Texas geology, Fisher started out life with virtually no connection to the state or the discipline.

Born in tough southern Illinois coal country during the Great Depression, Fisher grew up on the farms where his father worked, attending first a one-room and then a two-room school house. He worked his first full-time summer job at age 8, receiving 50 cents a day to punch wire in a hay bailing operation. At 11, he graduated to driving the tractor that pulled the bailer. By the time he graduated from high school, Fisher, like most kids of his generation, was well acquainted with hard work.

Fisher was a bright and diligent student, and his parents encouraged him to pursue college even though they had not, reasoning that earning a living with your mind is preferable to earning one with your back. After years of working on the farm, he wasn't hard to persuade. Fisher earned a scholarship to the University of Illinois at Urbana-Champaign, but he found it less expensive to attend Southern Illinois University without a scholarship than the University of Illinois with one. He started as an agriculture major but soon switched to biochemistry. Not long after making the switch, one of his professors told him he wasn't cut out for chemistry and suggested he switch to geology, which the professor himself was doing. Fisher was disappointed with his professor's take on his chemistry skills, but obviously the change suited him.

"I liked it and stayed with it," he said. "If you find something that you like to do and is fun to do, it's the best way to make a living."

After receiving his undergraduate degree and marrying Marilee Booth, whom he met at church when he was a boy, Fisher was looking forward to beginning his graduate studies at the University of Kansas. But the U.S. government had other ideas. In

1954, Fisher was drafted and sent to South Korea for nearly two years. He managed to wrangle a position in a petroleum laboratory by exaggerating his background in chemistry. The lab was preferable to his initial position at the front, but Fisher still found himself counting the days until he could return to his wife and pursue his career. Still, Fisher said he came away with a valuable life lesson.

> "IF YOU FIND SOMETHING THAT YOU LIKE TO DO AND IS FUN TO DO, IT'S THE BEST WAY TO MAKE A LIVING."
>
> **– BILL FISHER**

"You learn how to tolerate a system that you are in that you can't do a damn thing about," he said. "Over life's course, you occasionally get into situations where you don't have much control. You learn to work through the situation the best you can."

After returning home, Fisher attended the University of Kansas as he planned. He was drawn there by the presence of Professor Raymond C. Moore, one of the most famous geologists of his time and a larger-than-life character in the field. Moore had a reputation for terrorizing students, particularly if he felt they were not pulling their weight. He was known on more than one occasion to dump a thesis into the trash in front of a panicked grad student, leaving the student to sift through the garbage to retrieve it after Moore had left for the day. Here again, Fisher learned another lesson that would serve him well.

"You learn to be prepared," said Fisher, whose doctoral thesis explored the geology of the western Grand Canyon at Moore's directive. "If you weren't, he would just run you right out. He would say, 'Don't waste my time.'"

When Fisher graduated with his doctorate in 1960, jobs in the industry were hard to find, but he managed to get three job offers: Texaco, in Farmington, New Mexico; Narragansett Marine Laboratory at the University of Rhode Island; and the Texas Bureau of Economic Geology in Austin.

Fisher visited Rhode Island but was put off by the high cost of living and the specter of harsh winters. Moore urged him to consider the research position at the bureau. The advice set his course—and that of the bureau, as well.

ABOVE: BILL AND MARILEE FISHER.

RIGHT: FISHER (CENTER, IN BURNT ORANGE HAT) LEADING THE ANNUAL SEQUENCE STRATIGRAPHY TRIP TO THE GUADALUPE MOUNTAINS IN APRIL 2018.

PHOTOS: BILL FISHER/JACKSON SCHOOL.

CAPITAL TO CAPITAL

When Fisher joined in 1960, the bureau was a well-regarded but small organization. It was in an area known as the Little Campus near Scholz Garten, the famous beer garden that a young Fisher and his colleagues would frequent. Fisher was hired as a coastal plain stratigrapher despite the fact that the job had little to do with the work he conducted to earn his doctorate.

It was in his early years at the bureau that Fisher formed what would be a lifelong friendship with then bureau director Peter Flawn, who would become a mentor throughout Fisher's career. Flawn, who would later become president of UT Austin, named Fisher associate director of the bureau in 1968 and then acting director in 1970 when Flawn became the university's acting vice president of academic affairs. Six months later, the university pulled the acting from Flawn's title, and Flawn pulled the acting from Fisher's.

There have been only eight directors in the organization's history. Fisher was the longest serving, taking the position in 1970 and stepping down in 1994. As director for 24 years, Fisher was at the helm for nearly a quarter of its existence.

Current bureau Director Scott Tinker, who has served in the role for 19 years, said it's difficult to overstate the importance of Fisher's tenure at the bureau in terms of widening its scope and profile.

"The bureau had its first real big growth spurt under Bill's leadership, and its hiring expanded beyond the Texas border quite a bit," he said. "I think Bill believes that you are only limited by your own ambition, and so nothing is really off the table."

The raw numbers back this up. In 1970, Fisher inherited an organization with a budget of $384,000. That grew to more than $20 million by the early 1990s. That tremendous growth was achieved by expanding the mission and the vision of the bureau. When Fisher came, the bureau relied on, as it always had, the relatively modest line-item funding the Texas Legislature granted it for serving as the state's geological survey. By the time he left the role of director, more than 90 percent of its funding came from grants and contracts. That remains the case to this day.

The funding has enabled the bureau to take part in a diverse array of research. When Fisher first became director of the bureau, he continued work on the environmental atlas of the Texas coast that he started as a researcher. Fisher also oversaw the bureau as it stepped up its efforts on basin analysis and depositional system work on the coastal zone and the Permian Basin. In 1972, Fisher persuaded the Texas Water Development Board to fund a study of the environmental geology of South Texas in concert with its plans to develop new reservoirs. Then in 1973, the OPEC embargo created oil shortages and sent gasoline prices through the roof, creating interest in alternative energy sources. This provided the bureau with the opportunity to expand research into geothermal, lignite and uranium resources.

"Those were times when energy resources were getting scarce and environmental concerns were big," he remembers. "It was a question of: Can you catch that wind? The answer was, yes you can, but you've got to know how to do it."

In 1975, Fisher was offered a position at the Department of the Interior in Washington as deputy assistant secretary for energy. Fisher was no stranger to offering his expertise on a national level, having served on the boards of national organizations and policy advisory councils. He knew such a position could expand his knowledge and career. However, he was hesitant because of the financial and personal difficulties posed by moving his young family to Washington. He might have decided against the move, but his spouse Marilee insisted he take the job. Fisher took a temporary leave from the bureau, naming Associate Director Chip Groat acting director in his absence. Later that year, he was appointed assistant secretary of energy and minerals by President Gerald Ford.

Fisher describes his time in Washington as a fast-paced and sometimes grueling environment. But he said it honed his ability to learn quickly, prioritize and figure out whom to trust while delegating duties. It also expanded his view of what the bureau could do when he came back to the helm of the organization in 1977. For example, when he returned, Fisher helped the bureau become involved in scientific studies for the national efforts to store both high-level and low-level nuclear waste in West Texas among many other new avenues of research including the quickly evolving world of oil and gas recovery.

Even after his return to Austin, Fisher would be a frequent visitor to Washington, serving on advisory committees and presenting testimony to Congress. All told, he has presented testimony on more than 100 occasions to the U.S. Congress and Texas Legislature. He also served on the White House Science Council under President Ronald Reagan.

PHOTOS: BILL FISHER/JACKSON SCHOOL.

LEADERSHIP IN ACTION

Fisher recognized that generating world-class research at the bureau meant creating the right environment. As director, he played a large part in setting up a workplace where science could thrive.

Among Fisher's innovations at the bureau was starting the industrial associates programs, which were the first at the bureau and among the first in the country when the Offshore State Lands Lab (1985), the Reservoir Characterization Research Lab (1986), and the Applied Geodynamics Lab (1988) were launched. These programs bring industry together into a consortium to help fund bureau-led research. Each industrial partner provides a relatively small amount of funding, but the combination is enough to support substantial research that benefits all the partners.

There was a time when industry simply didn't fund academic research, explained Tinker. Each company depended on its own labs, but this became an issue in the 1980s as the industry took a downturn and research funding began to dry up. Fisher saw an opportunity for the bureau to step into the void, and the industrial associates programs were born.

The approach has since been emulated across the country, including, as Tinker points out, by successive directors of the bureau. There were four industrial associates programs at the bureau when Tinker took over in 2000. There are currently 11.

"That's the kind of vision Bill has," Tinker said. "It's a matter of looking beyond today and looking over the long term. He's been a great mentor in that way."

Jackson School Dean Sharon Mosher, who started at UT Austin as an assistant professor in 1978 before being named department chair in 2007 and dean in 2009, said Fisher has been a constant source of support.

"I've learned a great deal from Bill about leadership over the years, and I have regularly sought his advice on any number of issues," she said. "Bill has been a tremendous resource and has always been willing to help. I feel fortunate that I've had the opportunity to work with him and hope that he remains available after his much-deserved retirement."

Fisher was also adept at juggling tasks, even big ones. In 1984, he was named chair of the Department of Geological Sciences, taking on the role at the same time he was bureau director and chair of the Geology Foundation. Professor Mark Cloos, the Getty Oil Company Centennial Chair in Geological Sciences, worked closely with Fisher during much of his time at the department, acting as associate chair under Fisher from 1986 to 1989 and then serving as department chair himself from 1996 to 2000, when Fisher was chair of the Geology Foundation and a professor.

Cloos remembers Fisher taking over at a difficult time when enrollment was falling quickly because of a downturn in the oil and gas industry. Fisher's business and leadership skills proved to be crucial as he brought a steadying hand to the department, Cloos said. He even helped create new courses aimed at nonmajors to help keep enrollment up.

"He helped bring a sense of order and direction," Cloos said. "That was fundamentally important."

Doug Ratcliff worked with Fisher for most of his career, starting as a clerk in the bureau's core repository before Fisher recognized his talent with numbers and brought him over to help with the bureau's budgeting.

"He's the best numbers guy alive," Fisher said, pointing out that Ratcliff had to keep track of more than 200 contracts at a time for the bureau at some points.

Fisher also took him over to the dean's office when the Jackson School was formed to help with the enormous task of documenting the Jackson gift —valued at $272 million when it was finalized—and figuring how to use the money to tie the bureau, the Department of Geological Sciences and the Institute for Geophysics into the Jackson School.

Fisher was a tough and driven boss, Ratcliff remembers, but he got the best out of people.

"He was an incredible mentor, and he backed it up," Ratcliff said. "He demanded a lot from his scientists. He demanded they do what was required by the contract, and in addition, use their ingenuity and a lot of hard work to generate publishable, meaningful scientific results."

Understanding that publishing world-class science—not just conducting it —was the lifeblood of an organization like the bureau, Fisher set up a complete editing and graphics department to make it as easy as possible to create quality copy and figures for publication, a setup that Ratcliff said was unique at the time. Ratcliff also said that Fisher set up a rigorous internal peer review system and made everyone understand that they weren't publishing solely for themselves, but were publishing for the bureau. It was part of a concerted effort to raise awareness of the organization and its science.

During his tenure as director, the bureau published 483 reports, maps and atlases, and 1,433 research articles. In addition, bureau staff members, taking an example from their energetic and outgoing leader, gave 2,828 invited lectures, served on 170 committees and served in 10 national offices of professional societies.

Groat, who is now a professor at Louisiana State University and acting director of that state's geological survey, said that there is an important lesson to learn from all the activity.

"We need to be trusted in what we do well, but part of that is rooted in getting out there and communicating, and Bill symbolizes it well," Groat said. "That's something we all need to think about."

Fisher's good eye for talent and tremendous ability to see how smaller parts fit into a bigger plan often led to scientists being assigned tasks that didn't fit in directly with their specialty, remembers Department Chair Charlie Kerans, who joined the bureau in 1985 as a research associate.

"He would say here is where you're going, and here's the big picture and how you fit into it," he said. "That's not the traditional approach, but that was his style."

This certainly posed challenges to researchers, particularly if they weren't versatile or open to change. But it also helped many grow and forge successful careers in areas they might not have considered. The best example, according to Kerans, is the late Martin Jackson, who came from South Africa to the bureau with an interest in working on brittle deformation. The work didn't fit in with the opportunities available to the bureau at the time, so Fisher assigned him to salt dome research to help with potential geothermal projects.

"That was the start of the best-known salt tectonics person in the world," Kerans said.

It was this type of foresight that helped Fisher years later to forge a strong relationship with Jack Jackson. The former oil and gas man, as Fisher pointed out, was a tough businessman and over the years reminded Fisher often that he could change his mind about the gift at any time.

"It was really just about getting on with him and developing trust," Fisher said. "That's true anytime, anywhere, but particularly of individuals you are working with. You have to develop trust."

As department chair for several years, Cloos remembers Fisher had great support from Marilee, who acted quietly as the "first lady" of the Geology Foundation. From the late 1980s to the late 1990s, she hosted the Geology Foundation Advisory Council for dinners, first at the Fisher home and later at their Hill Country ranch in Liberty Hill. She prepared a wonderful meal for a group that could approach 80 people. How the Fishers made room for everyone in the Austin house was memorable for all who attended. Cloos said Marilee probably hosted a dozen of these homey gatherings that created a truly special kind of interaction between the faculty and the department's supporters who made up the advisory council.

Jackson attended many of these dinners. Through it all, the potential game-changing gift was not common knowledge.

"Very few people knew about it," Cloos said. "Bill nurtured it along for more than a decade. And then it finally happened, and everything changed."

SCIENTIST AND EDUCATOR

When reviewing Fisher's many accomplishments as a leader and administrator, it could be easy to assume that running organizations took up all of his time. But he managed to do some teaching and conduct groundbreaking research.

Fisher's research has focused on the areas of stratigraphy, sedimentology, and oil and gas assessment. He's credited with two foundational discoveries. In 1967, he and colleague Joe McGowen introduced the concept of depositional systems, a fundamental part of modern stratigraphy and sedimentology. The second was the concept of systems tracts, introduced by Fisher and colleague Frank Brown, which linked contemporaneous depositional systems from source to sink. Among his other research highlights is a 1987 assessment he led for the Department of Energy that turned around the then-prevalent view of natural gas scarcity.

Fisher was also a pioneer in the field of seismic stratigraphy, which was developed in the late 1960s and early 1970s simultaneously by Exxon researchers and Fisher, who was working with colleagues at the Petrobras Brazilian oil corporation, and later with Brown, to independently develop the approach in the offshore sedimentary basins of Brazil.

LEFT: LARRY FAULKNER, JACK JACKSON (CENTER) AND BILL FISHER.

OPPOSITE, ABOVE: OFFICIAL OIL PAINTING OF FISHER AS JACKSON SCHOOL FOUNDING DEAN.
RIGHT: FISHER TEACHING UNDERGRADUATES IN GEO 416P, SEDIMENTARY ROCKS, IN 2010.

PHOTOS: BILL FISHER/JACKSON SCHOOL.

The first reference in scientific literature to the term seismic stratigraphy (actually *"estratifia sismica"* in Portuguese) was in a paper published by Fisher and Brazilian colleagues Ercilio Gama and Hideberto Ojeda in the *Bulletin of the Brazilian Geological Society.*

In recent years, Fisher has taken on a full teaching load that includes graduate courses and teaching sedimentology to engineering students. Stephen Ruppel, a senior research scientist at the bureau, taught advanced reservoir geology with Fisher for the past decade and described him as an engaging, highly knowledgeable and entertaining instructor. Ruppel said he always had a little advice for students when it came to Fisher's lessons: "Listen to what he says; he's the one who developed these ideas so he knows what he's talking about."

Fisher is also always willing to pick up courses, a trait Kerans found a little maddening at times, particularly when he thought younger faculty members might be dodging the classes.

"I said more than once, you don't need to volunteer for this stuff. You've done more than your fair share," Kerans said. "But, of course, he'd wind up doing it, and he'd do a great job."

During his decades of teaching, Fisher supervised or co-supervised more than 150 graduate students. Many were international and went back to their home countries to take on leadership positions in the industry or government. These include places such as Colombia, Venezuela, Mexico, Turkey, China and of course, Brazil, where Fisher played a foundational role in building the country's oil and gas industry.

For three years Cloos co-taught with Fisher a course on natural resources and the environment. He described Fisher's teaching style as distinctive and invigorating, one that would weave current events, historical anecdotes, and political and policy knowledge into practical lessons.

"He was one of these guys who always had a story to go with whatever the subject is," Cloos said. "He was always able to put in parts of the story that aren't found in a book."

Fisher took on his first student in 1966, serving as a master's adviser while working as a researcher at the bureau. That student, Bill Galloway, went on to have a tremendous career in industry, at the bureau, and in the department, winning the Society of Sedimentary Geology's Twenhofel Medal nine years after Fisher won the award. Galloway has since had a long professional and personal relationship with Fisher. He remembers Fisher from those early years as an educator who would always take time for his students and loved to talk about science.

Galloway was so taken with Fisher's love for the science that he laughingly recounts predicting at the time that Fisher would never become director of the bureau or take a similar position that took him away from his research. Among Galloway's many memories was Fisher's initial reaction after reviewing his first draft of his master's thesis.

"He said, 'The first thing you want to do is take the first third and throw it away,'" Galloway said.

The first third of the thesis was a "grand review of the geology of the Gulf of Mexico Basin," which Fisher was quick to point out could be found in plenty of books. It was during that time that Fisher gave Galloway a piece of advice that he still hears echoing in his head when writing papers.

"If you've got something to say, you need to say it in the title, the abstract and the illustrations," Galloway remembers Fisher telling him.

That was Fisher.

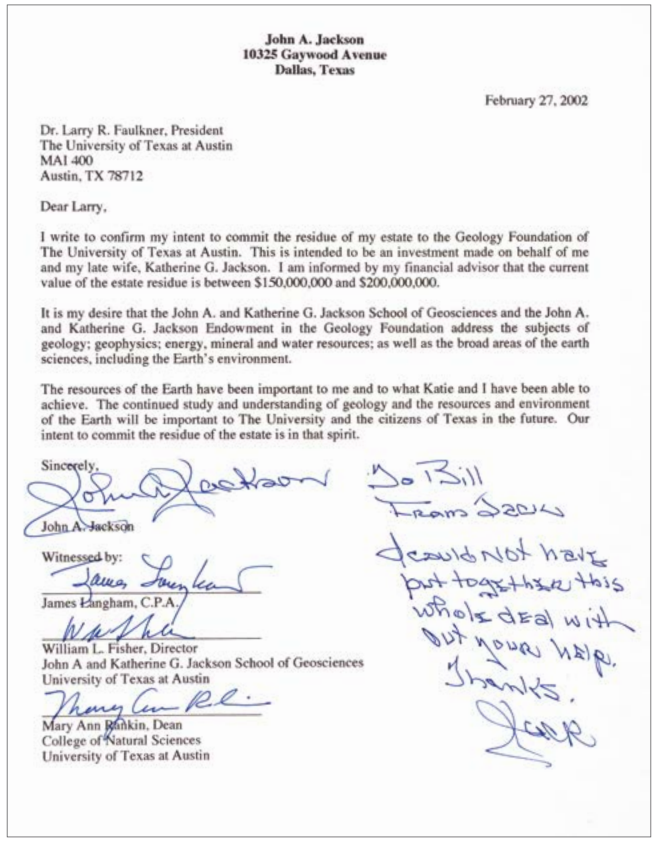
"He always plowed straight ahead, and he got stuff done," Galloway said.

Forty years later, it was that same attribute that would lead to Fisher becoming the Jackson School's founding dean, taking the helm of the school he helped create. President Faulkner was looking for someone to launch the new school and put it on a solid course for the future. The job was difficult, to say the least. It involved tying together three academic and research units with distinctly different identities, cultures and budgets. And it needed to be done in a way that followed the guiding principles of the Jackson gift, which stated the money was not to be used "for daily bread"—meaning the funds weren't for covering regular operational costs or programs, but to tie the university's geosciences assets together and build them into something truly exceptional. Given the energy, abilities and strong will needed to handle such a unique job, Faulkner said he didn't seriously consider anyone but Fisher.

"We were looking for leadership that would push it to advance," Faulkner said. "Bill had the credentials and the eminence and the drive to do it."

Now that he's retired, Fisher hopes to keep his office at the Jackson School. He said he's going to take it easy, which none of his colleagues really believe, and will finish a paper he's been working on and having fun with during the past year.

"I think I've got one more in me," he said. "And maybe it will turn a few heads."



John A. Jackson
10325 Gaywood Avenue
Dallas, Texas

February 27, 2002

Dr. Larry R. Faulkner, President
The University of Texas at Austin
MAI 400
Austin, TX 78712

Dear Larry,

I write to confirm my intent to commit the residue of my estate to the Geology Foundation of The University of Texas at Austin. This is intended to be an investment made on behalf of me and my late wife, Katherine G. Jackson. I am informed by my financial advisor that the current value of the estate residue is between $150,000,000 and $200,000,000.

It is my desire that the John A. and Katherine G. Jackson School of Geosciences and the John A. and Katherine G. Jackson Endowment in the Geology Foundation address the subjects of geology; geophysics; energy, mineral and water resources; as well as the broad areas of the earth sciences, including the Earth's environment.

The resources of the Earth have been 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.

Sincerely,

John A. Jackson

Witnessed by:

James Langham, C.P.A.

William L. Fisher, Director
John A and Katherine G. Jackson School of Geosciences
University of Texas at Austin

Mary Ann Rankin, Dean
College of Natural Sciences
University of Texas at Austin

To Bill
From Jack
I could not have put together this whole deal with out your help.
Thanks.
Jack

PHOTOS: JACKSON SCHOOL.

FISHER AT A GLANCE

FAMILY

Wife: Marilee Fisher, *married December 18, 1954*

Children:

- Leah Fisher Nyfeler, *Editor, Greenleaf Book Group and Writer/ Editor, Freelancer;*
- Dr. Karl B. Fisher, *Astrophysicist, Executive Director, Applied Research Labs, The University of Texas at Austin;*
- Peter B. Fisher, *Geologist, Director, Houston Division, Texas Railroad Commission.*

EDUCATION

- B.S. Geology, Southern Illinois University, 1954
- M.A. Geology, University of Kansas, 1958
- Ph.D. Geology, University of Kansas, 1961

TEACHING

Supervised or co-supervised 155 graduate students, including 30 Ph.D.s, plus some 50 executive training students, many of whom went on to accomplished careers in industry, government and the academy.

SCIENCE

- Published 350 titles, including 15 books;
- More than 4,150 Google citations and an h-index of 26 (as of April 2018);
- Presented 750 invited lectures around the world, and has presented testimony to the U. S. Congress, the Texas Legislature and federal and state commissions more than 100 times.

FUNDRAISING

Raised a total of $821 million, including $283 million at the Bureau of Economic Geology (1970-1994) and $538 million for the Geology Foundation, virtually all dedicated to geological research and teaching.

NATIONAL ORGANIZATIONS

- Served as elected president of five national geological societies and associations, with service on more than 150 professional committees, many of which he chaired;
- Served as trustee and secretary for the AGI Foundation and served as elected chairman of the board of trustees of the AAPG Foundation.

NATIONAL ACADEMIES AND NATIONAL RESEARCH COUNCIL

- Chaired or served as member of 15 committees, boards, workshops, and commissions, including chair of both the Board on Earth Science and Resources and the Board of Mineral and Energy Resources;
- Elected member of the National Academy of Engineering (1994) and appointed a life-time National Associate for work supporting the National Academies and the National Research Council.

MEDALS

- Powers Medal, *American Association of Petroleum Geologists;*
- Parker Medal, *American Institute of Professional Geologists;*
- Boyd Medal, *Gulf Coast Association of Geological Societies;*
- Twenhofel Medal, *Society for Sedimentary Geology;*
- Milling Medal, *American Geological Institute, 2007;*
- Campbell Medal, *American Geological Institute;*
- Hedberg Medal, *Institute for the Study of Earth and Man.*

OPPOSITE: THE OFFICIAL LETTER FROM JACK JACKSON BEQUEATHING HIS ESTATE TO THE UNIVERSITY. **ABOVE:** THE WALL IN BILL FISHER'S OFFICE.

Science at Sea

GRADUATE STUDENTS PULL DATA FROM THE DEPTHS ABOARD SEISMIC CRUISES

BY JESSICA HALL

Kelly Olsen spotted dolphins for as far as the eye could see off the coast of Chile in 2017 while aboard the R/V Marcus G. Langseth. But while the Jackson School of Geosciences graduate student was excited to see the animals, she was also disappointed. The proximity of the protected marine species meant the end of data collection until the dolphins left the area. She would have to wait to gather data for her thesis—how the incoming sediment off Chile influences the development of powerful earthquakes—another time.

This story is familiar to Jackson School graduate students conducting research with the University of Texas Institute for Geophysics (UTIG), a research unit of the school. Over the last few years, students have had many opportunities to take part on research cruises, from Chile to Alaska to New Zealand.

This research is essential for improving scientists' understanding of earthquakes and tsunamis. For instance, why do earthquakes in some places—like Chile—happen quickly with great force, but in other places—like New Zealand—occur very slowly over an extended period of time in what's known as "slow slip events?" These research cruises are imperative to understanding how our world works and helping those that live in areas impacted by earthquakes.

The Jackson School provides opportunities for students to gather this data themselves, helping create the foundation of their scientific careers whether in academia or industry. Participating in field research allows them to learn about data collection, meet people from around the world and develop leadership skills.

"It's important to see the entire process, for collecting and then processing the data," Olsen said. "It gives me insight into how data sets are collected and the uncertainties."

Unlike industry cruises, research vessels like the Langseth allow plenty of opportunities for students to have a first-hand experience in the data collection and processing, working side-by-side with lead researchers and the ship's technical and operational crew during the often six-week long experience.

Most recently, students took part in three cruises conducted off the coast of New Zealand from October 2017 to January 2018, taking advantage of the Langseth's schedule in its waning years of operation. (The research vessel is slated to end operations in 2020.) The missions were dubbed Seismogenesis at Hikurangi Integrated Research Experiment (SHIRE), Hikurangi 3-D, and South Island Subduction Initiation Experiment (SISIE).

Research Professor Sean Gulick, the co-principle investigator of the SISIE mission, explained that bringing students aboard helps build them into better geoscientists.

"I think it's critical for students to have the field experience," Gulick said. "It is part of what makes us geoscientists; it's an observational science."

PHOTOS: BRANDON SHUCK.

COLLECTING DATA

For the students, being aboard these cruises gives them insight into how to use the various equipment, including ocean bottom seismometers, airstream guns and multibeam sonar.

"It's eye-opening to see how much work goes into collecting the data and why it's so expensive," said graduate student Andrew Gase. "A lot of people have put a lot of work into these data sets and don't get recognition for the work they've done."

Students are studying everything from the development of megathrust earthquakes, to failure of lithosphere and tectonic history, to the changes in physical properties and structures of oceanic crust. By using various means of data collection, they are able to have more information to interpret and better understand how earthquakes are happening and how the structure of our planet comes into play.

Dominik Kardell, a graduate research assistant, had spent very little time in the field prior to the SISIE cruise this January in New Zealand. He described the cruise as an unparalleled learning experience.

"One of the things I knew very little about was how some of the scientific instruments worked and how to use them to efficiently collect geophysical data," Kardell said. "My eyes were opened toward many research components that successful scientists need to be able to manage."

On the cruise, the team came across two named storms and had to seek shelter behind an island, delaying work by days. The five primary investigators were constantly in communication with each other and the crew. And while they were ultimately successfully in gathering the data they required, hard decisions were being made every day, Gulick said.

Involving students in those decision-making discussions was a priority, he said. Learning how to collect data means also knowing when to stop data collection for safety—for those aboard the ship and the instruments.

"Decision making skills are a critical part of being a scientist," Gulick said. "Doing that under pressure is part of the job, it's exciting to see it being done in front of you and maybe advising."

ABOVE: A VIEW FROM THE DECK OF THE R/V MARCUS G. LANGSETH ON THE SISIE CRUISE OFFSHORE OF NEW ZEALAND.

RIGHT: UTIG RESEARCH PROFESSOR SEAN GULICK (LEFT), KENNY GRAHAM OF THE VICTORIA UNIVERSITY OF WELLINGTON (CENTER) AND LUKE CARRINGTON OF THE UNIVERSITY OF OTAGO (RIGHT) INSPECT AN OCEAN BOTTOM SEISMOMETER.

TOP: SCIENTISTS AND STUDENTS ABOARD THE SHIRE CRUISE OFFSHORE OF NEW ZEALAND. **MIDDLE:** (L TO R) JESS HILLMAN (GNS SCIENCE) AND ANDREW GASE (JACKSON SCHOOL) WITH A "BIRD," A DEVICE THAT HELPS STABILIZE SEISMIC STREAMERS. **BOTTOM:** (L TO R) DOMINIK KARDELL, SEAN GULICK AND STEFFEN SAUSTRUP, ALL PART OF THE JACKSON SCHOOL, CARRY AN OCEAN BOTTOM SEISMOMETER.

LIFE ON BOARD

As Andrew Gase explained, being onboard a research cruise is a lot like Groundhog Day. Each person on the ship is assigned a shift, and that is when they work every day for the duration of the cruise. And in wide-open ocean, the scenery doesn't change much.

A TYPICAL DAY INCLUDES:

- Breakfast
- Shift work (either in the lab or as a watcher on deck)
- Down time (typically spent napping, reading, exercising or processing data)
- Lunch
- Shift Work
- Down Time
- Dinner
- Sleep

A key thing to remember is that the research is happening around the clock, so breakfast could be at lunchtime or dinnertime depending on the time you are assigned.

Graduate student Brandon Shuck said he made sure to do one thing on each of the two cruises he was on last year.

"I tried to watch as many sunrises and sunsets as I could," he said. "On SHIRE, I saw the sunset every night. And on SISIE, it was sunrise every morning."

This helps break up the monotony of day-to-day life on the cruise, Shuck said. Senior Research Scientist Nathan Bangs shared a few other tips to help with the monotony.

"Patience, keep your eyes open, and talk to people," he said.

LOOKING TO THE FUTURE

Research cruises are building up what scientists know about how earthquakes happen. The knowledge doesn't stop there, though. It's essential data for real-world applications that seek to protect people from devastating events, like early warning systems for earthquakes and tsunamis.

"Our career depends on collecting high-quality images of the earth, and it depends on the next generation to know how to collect it," said Gulick. "We want to instill in [students] the excitement and attention to detail that has to occur at sea so what you come home with will satisfy the science questions and move the science forward."

And that's just what they are doing. Each student expressed an interest in continuing to go into the field and conduct research, whether their own or to help fellow scientists. Olsen recently went to Alaska to gather data aboard a different research vessel for the added experience. And other students described it as invaluable for their own career plans, which include both academia and industry. But to Gase, the fact that the data could have a life beyond his own projects is what makes collecting it so worthwhile. What he finds could play a part in advancing research and helping others.

"It's cool to go in field and work on big projects," he said. "It's going to be used by people for decades."

GROUP PHOTO AND BIRD PHOTO: STEFFEN SAUSTRUP. RESEARCH TRIO: BRANDON SHUCK.

Taking on 21st Century Challenges

The University of Texas Jackson School of Geosciences is at the forefront of helping solve many of society's great challenges, including those related to energy, climate, water and geohazards.

Creating 21st Century Leaders

We investigate how the planet's interior, surface, hydrosphere, cryosphere and biosphere are linked and how processes in one affect those in another.

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

UNLOCKING SECRETS BENEATH ANTARCTIC ICE

BY BARBRA A. RODRIGUEZ

Spanning an area nearly the size of New Mexico, Antarctica's Thwaites Glacier has the potential to increase global sea levels by a meter if it unloads its ice. What's more, the unstable giant acts like a plug for much of West Antarctica. That means if Thwaites collapses in upcoming decades—as scientists predict it might—it could release enough ice from neighboring glaciers to increase sea levels by 3 meters.

Understanding what's happening at Thwaites Glacier and other glaciers across the continent of Antarctica is vital and extremely challenging science. Researchers from across the globe have spent decades trying to gather data and perfect the science to determine how these glaciers work and the affect they could have on the planet as the climate changes.

Nowhere have researchers done more to overcome the scientific challenges presented by Antarctica than at the University of Texas Institute for Geophysics (UTIG). Scientists at UTIG have spent nearly 30 years looking into and under the ice, and their history of leading the way isn't likely to stop anytime soon.

In 2016, UTIG joined an effort by the Korea Polar Research Institute to monitor Thwaites. Then in the spring of 2018, the national research foundations of the U.S. and U.K. announced $50 million in funding for an international collaboration that will also work on the Thwaites Glacier system. Both of the major research initiatives will have distinct UTIG components. The glacier models that the U.S.- and U.K.-led international collaboration will use rely on 2004 aerogeophysical data collected by the UTIG team.

Carrying out the difficult 2004 journey fell to a group led by UTIG Senior Research Scientist Don Blankenship, who teamed up with the British Antarctic Survey and glaciologist David Vaughan. Both were concerned that little was known about the West Antarctic region despite its potential for collapse.

"Up until the 2000s, there had been exactly one tractor traverse across Thwaites," said Blankenship. "The big fear that everyone had of a runaway ice sheet collapse looked like it applied to Thwaites, and we didn't even know the shape of this ice sheet. Can you imagine, having a single line of data across an area the size of Texas, and trying to understand geology and hydrology from that?"

Even back then, Blankenship was no newcomer to the study of glaciers. He and other glaciologists had determined in the late 1980s how important the geology underlying a glacier was to its behavior. UTIG glaciologists have since pioneered detailed analyses of ice sheets' subglacial geology and the forces that act upon them while revealing added sea level threats from Antarctica.

PHOTO: THWAITES GLACIER IN ANTARCTICA. IMAGE FROM NASA.

PENGUINS ARE A COMMON SIGHT OUT ON THE ANTARCTIC ICE.

The Underpinnings of Glacial Movement

Glaciers can resemble rivers of flowing ice. Whether in the Alps or Antarctica, glaciers often rest on a bed of meltwater that hastens their movement the same way a water slide speeds swimmers into a pool.

Scientists used to think this was the most important relationship guiding a glacier's movement. However, for many polar glaciers the scenario isn't so simple. Blankenship helped make this clear in studies of West Antarctica in the late 1980s while at the University of Wisconsin-Madison. During those studies, he developed an array of new seismic techniques to examine glaciers feeding into West Antarctica's Ross Ice Shelf, southeast of Thwaites and Pine Island Glacier. Unexpectedly, researchers found that there was more than water at work controlling the glacial flow.

While withstanding subzero temperatures, the Wisconsin team dug holes to drop dynamite deep within the fast-moving ice streams. Seismic reflections from the explosions revealed that about a mile beneath the glaciers that fed into the ice shelf, there was mud, not water.

The 20 feet of soupy material was glacial till, sedimentary leftovers of rocks pulverized by ancient glaciers. This mud, infused with subglacial water, would allow those ice streams to move unexpectedly dynamically, moving more slowly at first as the mud held the ice back, but changing over time.

The findings reported in 1986 *Nature* articles have defined much of UTIG's glaciology studies ever since.

"We made the case that geology controls the evolution of marine ice sheets," Blankenship said. "As the climate changes, having a structural understanding of what lies beneath these glaciers is key to predicting future glacial decay and sea level impacts."

By the time he joined UTIG in 1991, Blankenship had moved on from the ground-based seismology approach. By then, he had pioneered a multipronged aerial approach to survey glaciers and subglacial geology over thousands of miles during Antarctic field visits. UTIG's polar aerogeophysical survey methodology has since evolved to include improved instruments, acquisition and flight systems, and it has been adapted for many different aircraft.

"UTIG has provided important boundary information from our airplanes and helicopters that researchers need to answer questions about past glacial behavior and to improve predictions of future change," said Jamin Greenbaum, a UTIG postdoctoral fellow who has participated in every Antarctic summer season with Blankenship since UTIG began studying East Antarctica in 2008.

Widening the Antarctic Lens

By the 2000s, the UTIG team had broadened its focus beyond West Antarctica. Why only study glaciers in the west, the thinking went, when their ice payload could be dwarfed by largely unstudied glacial systems elsewhere that might have similar instabilities? To learn more, they ventured to the vast southern reaches of East Antarctica, developing the ICECAP (International Collaborative Exploration of the Cryosphere through Aerogeophysical Profiling) program, which relies on the research stations of multiple international collaborators to conduct broad airborne surveillance.

Nicknamed the "Sleeping Giant" at the time for its assumed stability, East Antarctica covers about two-thirds of the continent. However, satellite monitoring by UT Austin's Center for Space Research in the 2000s revealed that areas in East Antarctica such as Totten Glacier were losing ice and mass (based on GRACE satellite imaging).

Moreover, field research led by Blankenship, Professor Martin Siegert of Imperial College of London, and Tas van Ommen of the Australian Antarctic Division had shown that parts of East Antarctica included unstable reservoirs of ice held within rock basins below sea level. This was of concern because the lower a basin's rim is, the more likely the ocean can erode and destabilize the ice sheet.

PENGUINS: JAMIN GREENBAUM. MAP: JACKSON SCHOOL.

From outlining the structure of the subglacial basin that fed Thwaites, Blankenship knew these basins resemble a soup bowl in profile where water couldn't pour in until it tops the rim. East Antarctic basins had been assumed to be too high up along the coast for this to occur, but the UTIG team had shown otherwise.

"Everyone thought that little of East Antarctica was below sea level," Blankenship said, "but Martin and I knew that everything that was going on at Thwaites and Pine Island in West Antarctica could go on there as well."

Unraveling Glacial Collapse

To help clarify the potential of East Antarctica to contribute to future sea level rise, Blankenship and Research Scientist Duncan Young developed a map of the major basin-feeding glaciers such as Totten's Aurora Subglacial Basin.

"We chose to focus on the Aurora Subglacial Basin because it may represent the weak 'underbelly' of the East Antarctic Ice Sheet," Blankenship said of the ice sheet.

Using ice-penetrating radar, magnetometers and other instruments attached to an airplane, they developed the first high-resolution map of the basin's structure. In a 2011 *Nature* paper, they revealed that about one-fifth of the California-size basin extended more than 1 kilometer below sea level, making it susceptible to being destabilized by the Southern Ocean. The ice contained in that basin could raise sea level by at least 3.5 meters, more than the total amount believed to be vulnerable to being lost in West Antarctica.

UTIG researchers also found that the ice sheet filling the basin had a history of instability when they discovered signs that the ice had advanced and retreated across the basin enough times in the past to erode a large system of fjords into the subglacial topography. The carvings in the Earth's crust had a different orientation than the way the East Antarctic Ice Sheet is flowing today and came from faster moving ice sheets during warmer millennia, when coastlines were farther inland.

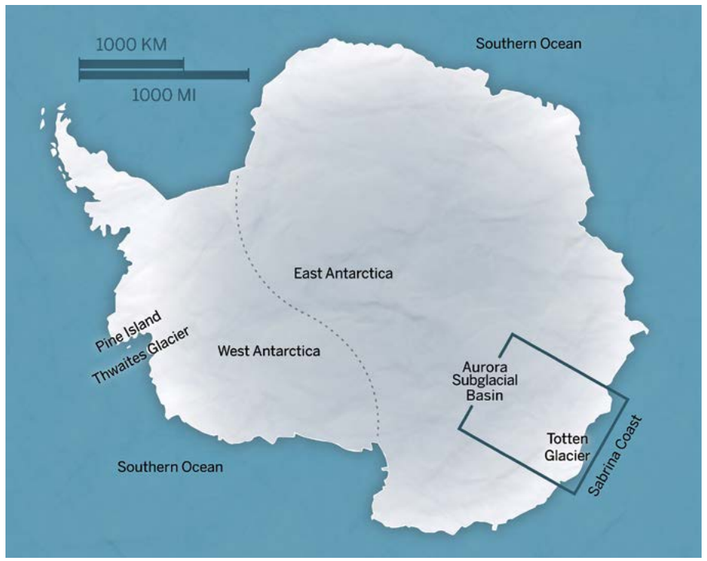
"Duncan made the convincing argument that just looking at the shape of the basin's bedrock provided compelling evidence that this ancient ice sheet advanced and retreated multiple times, that it was a dynamic ice sheet," Greenbaum said.

This demonstration that glacial carnage had occurred in East Antarctica before, back when atmospheric CO_2 levels resembled those of today (see research highlight page 16), added weight to the notion that the basin could substantially retreat again. Furthermore, the satellite data sets showed that Totten Glacier—the basin's main ice outlet—had become the most rapidly thinning glacier in East Antarctica. Independent studies confirmed that surface melting could not explain the thinning, indicating other processes at work.

The prevailing wisdom was that deep warm water couldn't reach the base of Totten Glacier to thaw it. But Greenbaum and Blankenship thought it was worth investigating whether there were troughs in the sea floor deep enough to allow warm water observed on the continental shelf to reach Totten Glacier's grounding line, the area where the ice transitions from resting on the sea floor to floating.

If so, warm water hundreds of meters below the Southern Ocean's surface could be the impetus of Totten's melting. This deep water came from other oceans over the centuries and is relatively warm compared with water near the surface. Most of it circulates around East Antarctica without reaching the coast. However, if deep water were to extend inland, its warmth could enhance ice melt along Totten Glacier's grounding line.

To map the shape of the sea floor beneath Totten, Greenbaum and Blankenship used airborne gravity measurements to infer where the seafloor rock begins. They used this method because although aerial radar signals can penetrate the ice, they bounce off the ice-water interface. In a March 2015 *Nature Geoscience* article, the team reported finding two unexpected seafloor troughs along the



THE GLACIERS IN THE AURORA SUBGLACIAL BASIN MAY BE ESPECIALLY SUSCEPTIBLE TO CLIMATE CHANGE BECAUSE THE BASIN MOSTLY LIES BELOW SEA LEVEL.

glacier's southwestern flank that could allow seawater beneath Totten.

"We showed that the troughs not only existed," Greenbaum said of the multinational work, "but were deep enough that they could let warm water reach Totten's cavity in two places, including one that wasn't thought to be an entry to the ice shelf cavity at all."

However, before this could occur, the warm, deep water would have to breach the ridge that juts up at the edge of Antarctica's continental shelf. Chad Greene, a doctoral candidate advised by Blankenship, collaborated with Australian colleagues to look at one possibility: The winds over the Sabrina Coast, affected by global changes in atmospheric conditions, were stirring up enough deep water to breach the ridge.

Evaluations of wind-stress data confirmed that the waters close to Totten flowed in the reverse direction of the waters farther offshore—a phenomena that allowed the divergent waters to slide past each other along the line of the continental ridge. These conditions allowed upwelling to occur, in which wind displaces the surface water, and deeper and warmer water rises to replace it.

"The warm water that's deep starts rising over the continental shelf," said Greene. "From there it can start attacking Totten, just the way it had been shown to be attacking Thwaites and Pine Island."

Greene had also developed a detailed assessment of Totten Glacier's elevation loss by combining hundreds of aerial laser altimetry profiles UTIG gathered while monitoring the region. As described in a November 2017 *Science Advances* study, ice loss at Totten Glacier peaked during periods when the wind conditions offshore allowed the upwelling of warmer seawaters.

"Jamin and Chad's remarkable research showed how and where the ocean was delivering heat, as well as how Totten Glacier is responding," Blankenship said of the seafloor trough and wind-driven melting discoveries, which helped spur acceptance that East Antarctica was awakening. "Now we're focusing on what that glacial undercutting is doing to the interior of ice sheets."

The answer has come in part from work that Greenbaum, Greene, Young and Blankenship have done with a Canadian researcher and others that appeared in *Science Advances* in June 2018. The work focused on signs of decay in four Antarctic ice shelves and one in Greenland. It showed that wherever an ice shelf was eroded from below by warm ocean water, matching grooves had formed on the surface. Warmer Antarctic air temperatures in recent years have added meltwater into those grooves, causing surface-driven melting.

The researchers showed that in one of the glacier systems, the separation of a very large iceberg from the main ice sheet was associated with this process. They also found that many other glacier systems have all the pieces in place for it to occur as air temperatures continue to rise and cause additional surface meltwater.

"What's going on beneath the ice, unseen, is modulating what's happening on the surface that satellites have captured," Blankenship said. "Those two things are conspiring to disintegrate ice sheets faster, which is not good."

UTIG POSTDOCTORAL FELLOW JAMIN GREENBAUM SENDS A HOOK 'EM FROM THE SOUTH POLE.

FLAG: JAMIN GREENBAUM. UPLIFT: IAN DALZIEL.

Charting New Territory

Never content to relax, the UTIG researchers are planning to study the forces at play along the coast of the Wilkes Subglacial Basin in East Antarctica, as well as revisiting Thwaites in the west. In the coming years, the international Thwaites Glacier collaboration will use research icebreakers to investigate the glacier's coastline and conduct seismic and radar investigations over the ice sheet and floating ice tongue. As part of this effort, UTIG has proposed a five-year international project called the LIONESS (Land-Ice/Ocean Network Exploration with Semi-autonomous Systems) to work with helicopters from the Korea Polar Research Institute to monitor the evolution of the Thwaites Glacier system.

Specifically, they will use the instruments Blankenship's team has developed over 27 years to look at where Thwaites extends from its grounding line near the Amundsen Sea to where the lip of its basin begins farther inland.

"No one understands what's occurring about 100 kilometers upstream of any Antarctic glacier's grounding line," Blankenship said. "In the case of Thwaites, we're within a few decades of the ocean disrupting its subglacial boundary conditions to the point where there's potentially a big collapse because we've got ocean water melting coastal ice about 40 to 50 kilometers from the lip of the Thwaites' basin."

Blankenship and the UTIG team are determined to lead the way and keep up the important work.

"We've always been where everyone else is not to get at these problems," he said. "We now need to understand how soon Thwaites will become a full-blown problem that society cannot ignore."

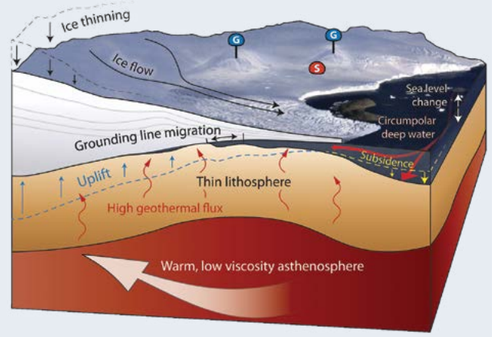
ANTARCTIC BEDROCK UPLIFT COULD DELAY ICE SHEET COLLAPSE

By Monica Kortsha

The weight of the West Antarctic Ice Sheet is a considerable load for the planet to carry. Research published in June 2018 in the journal *Science* has found that as the ice melts the underlying bedrock is showing signs of creating at least temporary relief, with the rock rising up to 4.1 centimeters (1.6 inches) per year.

The international team who conducted the research—which includes the Jackson School's Ian Dalziel—said that the uplift could stave off ice sheet collapse by raising parts of it out of reach from encroaching sea water. However, Dalziel said that in the long run, even rapidly rising bedrock won't be able to outpace the effects of climate change.

"That pinning bedrock isn't going to hold it back forever," said Dalziel, a research professor at the University of Texas Institute for Geophysics (UTIG) and a professor in the Department of Geological Sciences. "Eventually the ice will retreat beyond that and nasty things are going to happen to our sea level globally."



As the climate has been warming, the ice sheet has been losing mass near its seaward edge, notably south of the Pacific Ocean. The mass loss is allowing sea water to get closer and closer to vulnerable parts of the ice sheet grounded below sea level on the Antarctic continent. In the study, an international team of scientists found that the rising bedrock is creating a barrier that could block water from reaching these critical parts of the ice sheet. In addition, the uplifted bedrock slows down the flow of ice and the reduction in local gravitational attraction caused by the ice loss lowers sea level along the Antarctic coast, which could help keep the water at bay.

The team discovered the uplift using data collected by the United States Antarctic component of POLENET (Polar Observing Network), an international network of six continuous GPS monitors and seismometers installed on areas of the ice sheet where bedrock is exposed over an area roughly equivalent to the United States east of the Mississippi River. This part of the POLENET system stems from a monitoring campaign started in the early 2000s and led by Dalziel called WAGN (the West Antarctic GPS Network) where monitors were run for a few weeks instead of year-round. UTIG has been highly involved with both projects, Dalziel said, with a team of UTIG scientists leading the initial installation of four of the six POLENET monitors used in the study.

The uplift was not unexpected. Rock rebounding as an overlying load lightens is a phenomenon that has been documented around the world. But no one expected such rapid uplift.

The rate is so rapid, geologically speaking, that the researchers discovered that satellite data used to measure ice loss in the West Antarctic region needed to be readjusted to account for the uplift. Their work revealed that up to 10 percent more ice has been lost from the West Antarctic ice sheet than previously thought.

"That's a critical correction for being able to use the satellites to measure what's actually happening and hence to contribute to modelling of future ice sheet behavior," Dalziel said.

And as the ice sheet loses more ice over time, the rate of uplift is only expected to speed up. Within 100 years the bedrock could be moving upward at a rate of more than 14 centimeters (5.5 inches) per year.

The rapid rebound indicates that the mantle—the semi-molten layer of the Earth that separates the crust from the core—is in a low-viscosity state beneath the ice sheet. Like a water bed mattress filling a vacated space faster than a foam mattress, the mantle rock is quick to flow into the lower-pressure areas created by a lightening ice load. Dalziel said that this behavior probably relates to the long history of the Pacific margin of Antarctica as part of the volcanically and seismically active "Ring of Fire."

The research findings exemplify the planet's interconnected nature, and show that ice loss in Antarctica results in uplift of its own bedrock even as it contributes to global sea level rise.

STRATEGICPLAN
EARTH TRANSITIONS IN SPACE AND TIME

Executive Summary of the Jackson School of Geosciences' New 10-Year Strategic Plan

JACKSON SCHOOL OF GEOSCIENCES

The Jackson School of Geosciences at The University of Texas at Austin is one of the largest and most prestigious academic geoscience institutions in the world. It was established as a college-level school in 2005, as the result of the bequest of Jack and Katie Jackson, with the overarching goal of becoming the preeminent academic geoscience program, with international prominence in geology and geophysics, energy, mineral and water resources and in the broad areas of Earth science, including Earth's environment.

The school consists of the Department of Geological Sciences (DGS), Institute for Geophysics (UTIG), and Bureau of Economic Geology (BEG), which also serves as the Texas Geological Survey. It is made up of 53 faculty, 90 research scientists, 110 research staff and postdoctoral scientists, 600 graduate and undergraduate students, and 140 support staff, working together to create a distinctive academic institution unlike any other in combined scope, impact and direct societal relevance.

MISSION

The Jackson School of Geosciences seeks to advance the understanding of Earth as a system, its resources and environment, for the lasting benefit of humankind. Combining innovative research with educational experiences, we work to train future generations of geoscience leaders.

VISION

The goals of the Jackson School are to:

- Address fundamental geosciences questions regarding Earth's transitions over space and time. We will lead research in the areas of Earth science that directly relate to societal challenges of the 21st century, including water, energy, natural hazards, natural resources, climate, life, land use and soils.
- Foster a diverse community of scholars that includes collaborative research groups that promote transformative research at the interfaces between traditional disciplines. We will develop new programs and capabilities by not only working between units within the Jackson School, but also collaborating with other schools and colleges at UT Austin, as well as at the state, national and international levels.
- Provide world-class education for students at all levels by involving them in research, offering comprehensive, innovative curricula and field and practical experiences, focusing on student learning outcomes, and preparing them for successful careers so they can create, innovate,and lead the geosciences into the future.

This Strategic Plan for the Jackson School identifies the vision, objectives, priority areas and roadmap for success of the school's enterprises over the next 10 years. The plan will: (1) inform the school's long-term funding priorities and infrastructure investments; (2) guide engagement with federal and state agencies, industry, non-governmental organizations and philanthropists, as well as institutions based in other countries; (3) influence new directions for improving education of Jackson School students; and (4) help faculty and research scientists organize into teams for major research initiatives. The primary components of this Strategic Plan are:

EARTH: NASA; EUROPA: NASA; MOUNTAINS: JACKSON SCHOOL.

1. RESEARCH: Jackson School research encompasses all parts of the Earth's dynamic systems, investigating the linkages between the Earth's interior, surface, hydrosphere, cryosphere, biosphere and atmosphere, and coupling among chemical, physical, biological and geological processes. This research spans from deep time to the present day and from basic to applied. Our 10-year strategic plan for research explores transitions on Earth and other planetary bodies with three broad areas of concentration:

- *Earth in 2100: Water, Energy, Land, and Climate:* Some of the grand challenges facing the world in this century are rooted in the geosciences. We will address these challenges on local to global scales to provide the scientific data and models needed for predicting and managing the effects of human activities on habitat and global climate, on securing affordable energy resources, and providing sustainable access to clean water for human consumption and a diverse natural environment.
- *Geodynamic Systems and Linkages:* Couplings between the mantle, lithosphere, surface, and atmosphere drive geologic change at vastly different temporal and spatial scales. We seek to advance our understanding of these critical processes and their interaction, including mantle convection, tectonics, evolution of surface topography, basin formation, geochemical cycling and impact of climate. All of these are fundamental to the evolution of the Earth and other planetary bodies.
- *Transitions, Boundary Events and Resilience of Life:* Changing conditions at temporal boundaries have produced profound effects on life, including mass extinction and mass survival. We seek to understand the long-term processes and discrete events that influenced life on Earth and to explore the limits and requirements for life on other planetary bodies.

The Jackson School Research Themes provide an established mechanism to facilitate and promote research collaborations across the Jackson School and the university. Essentially all research in the Jackson School falls within one of our six research themes: surface and hydrologic processes; solid earth and tectonic processes; energy geosciences; marine geosciences; climate, carbon and geobiology; and planetary geosciences. We will establish research incubators/think tanks, geographic foci/collaboratories and infrastructural nodes to implement our research initiatives.

2. EDUCATION: Our strategic plan for education focuses on developing the conceptual understanding, skills, and competencies that our students need to be successful into the future. We will achieve these goals through an increased emphasis on experiential learning, quantitative and computational reasoning, independent research and field experiences. Research and education are intimately intertwined. By integrating our research into our undergraduate program and increasing its emphasis at the graduate level, our students will learn how to think critically, identify and address geoscience problems, and work in multi- and interdisciplinary teams. Moreover, they will develop a firm understanding of important geoscience concepts and be able to apply them to real-life research questions and applications. We will continue to have a strong focus on written and verbal scientific communication to multiple audiences, with an increased emphasis on the importance of scholarly publications by our graduate students. We will transform our undergraduate courses, curriculum and teaching to improve student learning outcomes and to prepare our students for graduate school and/or the future workforce. Our graduate courses and curriculum will constantly evolve to reflect the changing areas of scientific inquiry and technological advances and to prepare students for success in all future geoscience careers. Our goal is to develop the future leaders of academia, industry, government and non-governmental organizations.

3. BROADER IMPACTS FOR EQUITY AND INCLUSIVENESS: We will focus on broadening the societal impact of our research and teaching by increasing diversity within the Jackson School and the geosciences and geoscience literacy of citizens and policy makers.

FOR THE FULL PLAN, VISIT WWW.JSG.UTEXAS.EDU.

In Recognition of Donors

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Texas Leadership Society

The Texas Leadership Society is composed of a distinguished group of friends and alumni who have included The University of Texas at Austin in their estate plans. Estate gifts support faculty and research, provide scholarships and graduate fellowships, and keep libraries, laboratories and facilities up to date. We would like to recognize those members who have designated the Jackson School as their beneficiary.

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The Flawn Circle of Excellence recognizes individuals who have given cumulative gifts of $1 million or more. Established in 2014, this society is named after Peter T. Flawn, former president of The University of Texas at Austin, professor emeritus at the Jackson School of Geosciences and lifetime member of the Geology Foundation Advisory Council.

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Katie Society

The Katie Society recognizes individuals who have given cumulative gifts of $500,000 or more. It was established in 2014 in fond remembrance of Katherine G. "Katie" Jackson, beloved wife of the late John A. Jackson. Katie was a great philanthropist and Jack's partner in all things, including the creation and naming of the Jackson School of Geosciences.

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ALUMNI NOTES

1940s

Jule Jacobson Moon (B.A. '40, M.A. '41) retired in 1992 to Fairhope, Ala. She published Sherds a Memoire. She also co-authored three Fairhope writers, two books of short stories, and Fairhope Original Guidebook. She will be 99 years old on June 13, 2019.

1950s

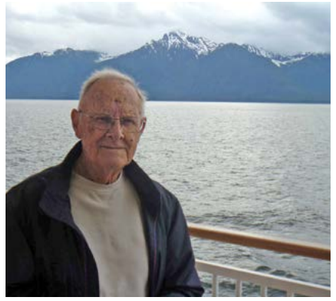
Walter V. Boyle (B.S. '54, M.A. '55) writes, "Our travels for 2018 have been confined to the Lower Continental United States. I stay active attending Houston Geological Society meetings, men's church group sessions, men's book club meetings, and working in the yard. Vada continues to stay active in the Houston Symphony League, The American Association of University Women, and two women's book clubs. Congratulations to Dean Sharon Mosher and the staff of the Jackson School of Geosciences for being Ranked No. 1 in Geology, No. 6 in Geophysics & Seismology, and No. 7 in Earth Sciences overall in 2018 by the U.S. News & Reports Graduate Ranking."

Jimmie Russell (B.S. '52, M.A. '54) shares, "Nostalgia: a longing for, or to go back to, something. Although going back is not possible, fond memories are, and those I have. Some are of UT, other are not. Professor Robert Folk, to gain some local knowledge of Texas geology, joined Professor Sam Ellison and myself to review the area I worked on in Erath County for a M.A. under Dr. Ellison. The trip went well, the investigation was successful, and we enjoyed each other's company. A few months later, Dr. Folk shared a pleasant evening at the annual Sigma Gamma Epsilon banquet. As president, I invited Dr. Folk to be the guest speaker. He graciously accepted and delivered an informative discussion on sandstone porosity. Although I saw him infrequently, we were pleased to meet at the Night of Remembrance, shortly prior to his passing. Professor Folk was the last of the initial group of professors that educated me at the University of Texas. When you share a "pup-tent" for a week or so a few times, during a Korean winter, you remember it. John Oehlertz and I did this near the DMZ/38th Parallel, a couple of years after the armistice. Our other lodgings were spartan, also. We were in the same platoon in the 31st Infantry Regiment, of the 7th Infantry Division, U.S. Army. John Oehlertz grew up working with his father on the family farm in Western Iowa, near Avoca. He continued with the farm, as well as many civic activities and singing in his church's choir until the end. He and his wife Betty visited us but we did not get to Iowa. John was a true husband to Betty and cherished their family. He was a gentleman in all aspects. I was fortunate to have had him as a friend. John Oehlertz was my "buddy." He recently passed away abruptly." Jimmie can be contacted at ritalrussell@gmail.com.

Floyd F. Sabins (B.S. '52) shares, "My major news is to announce completion of the manuscript for the 4th edition of my book "Remote Sensing – Principles, Interpretation and Application" that will be published by Westland Press of Chicago. Jim Ellis is co-author. Since the 3rd edition was published, there have been major advances in both the acquisition and digital processing of remote sensing images that are particularly significant for us earth scientists. For example, there is now a world-wide topographic data base derived from NASA satellite radar images. Hyperspectral images in the visible, near IR, and thermal IR spectral regions are now routinely acquired by global-orbiting satellites. The data can be digitally processed and visually interpreted for a wide range of applications. Sensor systems are now being miniaturized for deployment on drones. Drone operators can now acquire images at a time, locality and spectral range of their own choice. In order to cover all these advances, over 50 percent of the illustrations and text in the 4th Edition are new. The new edition does retain the clear explanations and illustrations of basic interactions between matter and electromagnetic energy that contributed to the technical and commercial success of the three earlier editions."

Dan L. Smith (B.S. '50) writes, "I continue as an explorationist generating and investing in oil and gas prospects. My life time interest in working with professional societies continues with trips lately to AAPG and SIPES. As an active member of the Jackson School Advisory Council, I keep in touch with everything in Austin."

Theodore Stanzel (B.S. '56) shares, "All good news during the past year. Growing older and wiser. Wanda and I spent 12 informative and rewarding days visiting the holy places in Jerusalem and other parts in Israel. We are watching the progress of Wanda's two great-grandbabies, a boy and a girl born in February 2018. We wish our classmates health and happiness."



Bill D. Watson (B.S. '58) writes, "Still enjoying my retirement. Would never have dreamed that it would have lasted longer than my working career! The family continues to grow with the addition of a fourth great-grandchild. Jean and I play golf, sing in our church choir and senior adult choir. Trying to stay busy as long as I can at 88 1/2 years old. Miss going to the Longhorn games and playing in the Alumni Band, but The Longhorn Channel is a must in our household. Go Horns!" Bill can be contacted at bdjewatson1930@gmail.com.

Leslie P. White (B.S. ’56) says, “Dianne and I are so proud of the Jackson School. We are happy to see that *U.S. News and World Report* has discovered something that we have known for a long time.”

Don Winston (M.A. ’57, Ph.D. ’63) says, “This is a hello, particularly to those who were at UT in the middle and late 50s. I am writing this from Quebec at the IAS Congress where I am giving a paper on sheetfloods in the Middle Proterozoic Belt Supergroup in Montana. About 50 years ago, I got sucked into Belt rocks and switched my focus from bugs and carbonates to field stratigraphy and sedimentology in the high country of Montana. It has been challenging and fun. Harry West, who some of you may remember, and I were both at the IGC in Copenhagen in 1960. Harry stayed in a rooming house with lots of neat Danish girls, with whom we partied. One of those is Bente, my wife of 50 years. We have two children and three grandchildren. Both work in D.C. and live in Arlington, Va. Bente started a K-8 school in Missoula and taught math. She still teaches the mathcounts team that generally comes in within the top four schools in the state competition. I still have a couple of stratigraphic and sedimentologic field projects that I plan to work on in late August and September. After that, I plan to hunt ducks and geese at our hunting cabin on the Missouri River below Great Falls. So, life is good.”

1960s

Robert H. Fakundiny (M.A. ’67) writes, “Anne and I are still living in the Capital District of New York. I continue to consult on a part-time basis to State and Federal agencies on the long-term disposal of radioactive waste in western New York. I’m also finishing a large report on a landslide project South of Syracuse, and compiling geologic maps of the Adirondack Mountains. Giant thrust sheets appear to dominate the structural picture of the modern and central parts of the Adirondack Mountains.”

Jereld E. McQueen (B.S. ’61, M.A. ’63) writes, “I am still pursuing investment opportunities and will always being astounded by the great work of JSG.”

Joe Norman Meadows (B.A. ’62) writes, “My bride of 50 years died of Alzheimer’s, so now I’m adjusting to being a widower. Enjoy the *Newsletter* and the amazing things going on. No longer practice Oil and Gas law, but try to keep up with what’s happening in the industry. The young men and women are doing so many exciting things. God bless them.”

Tom S. Patty (M.A. ’68) writes, “Field studies for sand and gravel as well as crushed stone were reduced during 2017 due to me spending extensive care for wife JoAnn. She had reoccurring health issues that required increased care giving. She passed in late December 2017. We had been together for 61 years and married 58 years. She worked putting me through graduate school. So far 2018 has allowed me to mentor the younger employees at Wiss Janney Elstner Associates in our fast growing Austin office and especially working with the new geologist in the Tom S. Patty Petrographic Laboratory. Since opening the Austin branch in 1981 the office and lab have grown to almost 50 engineers, architects and materials scientists. Although I retired five years ago, I remain on staff as an affiliated consultant and show up at the lab a few hours a week.” Tom can be reached at tspgeorock@gmail.com.

Peter D. Rowley (Ph.D. ’68) says, “Still in the consulting business but for fun and free-mapping the Markagunt and Sevier gravity slides of SW Utah, the world’s biggest and third biggest landslides on land. The Geological Society of America sponsored their Thompson Field Forum in September 2017—six days of field conference for about 30 specialists here.”

Rubin Amos Schultz, Jr. (B.S. ’61) shares, “Still enjoying retirement and travels. Spent some time in Branson, Mo. in May. Family is growing. Last August, a great-granddaughter was added and then September saw a great-grandson added. Not a lot else new. Still enjoy visiting UT and active in UT exes.”

Richard B. Waitt (B.S. ’66, M.A. ’70) writes, “Though well past conventional retirement age, I remain a research geologist at USGS’s Cascades Volcano Observatory in Vancouver, Wash. Continue writing various science-journal papers and book chapters—mostly on physical volcanology as at Mount St. Helens, and on the Pleistocene Missoula floods. On the great floods, I co-led a fieldtrip for GSA in fall 2017 and will co-lead a Friends of the Pleistocene one in September 2018. (Rhythmic bedding in the photo proves the giant floods had repeated by the score.) Editing a GSA Special Paper on Quaternary geology. My 2015 book on Mount St. Helens’ 1980 eruption told through survivors and other eyewitnesses (Wash. State Univ. Press) continues in print. Will do another driving tour round the continent this fall (2018) with my wife Cynthia. If any of my former 1960s’ UT geology gang should come to the Pacific Northwest, please give a ring.”

William Feathergail Wilson (B.S. ’60, M.A ’62) shares, “Still working as a petroleum and groundwater geologist in Texas. Still living and working on a small ranch near Tarpley, Texas, on Williams Creek. Primarily working West Texas and the Gulf Coast. Geology still remains my only passion and hobby at the age of 83. Finished my third Texas and Mexico historical novel - awaiting publication.”

William C. Young (B.A. ’61) shares, “I am still marking off parts of my bucket list. Next up, a trip down the Danube. Thankfully, no change in my eyesight and my family is well.” William can be reached at wcy3@outlook.com.

1970s

Sara Sue Avant (B.S. ’78) lives in The Woodlands and can be reached at savant@utexas.edu.

Janie Bell (B.S. ’78) writes, “Finally moved to a place with outcrops and real topography. Living in Nashville and enjoying middle Tennessee. Come see me!”

Gale A. Bishop (Ph.D. ’71) writes, “Still writing some about fossil decapods and sea turtles and living in beautiful NE Iowa. My colleagues at Georgia Southern and St. Catherines Island fired me from my Sea Turtle Program after 26 years! Then their depredation from feral hogs shot upward to a new record, 68.1 percent! So I’m finishing a few papers to get some of the rest of my knowledge out before the end. Now in remission for CLL and feeling fine. Cataracts are being removed this summer, then I’ll start renewing the search for fossilized nests of the giant sea turtle, Archelon! Visited Iceland last winter and will visit Ireland and Scotland in August.”

C. Elmo Brown (B.A. ’76) shares, “The big news this year is that I just retired (more or less) this past March from The Discovery Group in Denver, Colo. where I served as a senior geological advisor. Since then, I have continued to do a bit of work for the company, but mainly Kathy and I have been traveling to different spots in Texas and Colorado to scope out potential retirement locations. In addition, we also did a bit of sightseeing around the world as we traveled to Paris and then on to Kenya for a photo safari. It was our first trip to both, and they were great in their own way; however, I still prefer the wilds of the world compared to the big cities. Now it is on to our next big adventure, wherever it may be.”

Roger Callaway (B.S. ’77) writes, “I actually started at Texas in 1970 in engineering, but there were... distractions. I finally decided to drop out after the fall semester of 1972 and bumbled around for a year, testing the resources of my guardian angel, and eventually coming back to Austin from Salt Lake City and falling into employment with a sheetrock crew. The approximate nine months with the sheetrock crew in Austin and onward to Wichita, Kan., provided more education. I decided I might give college another try, so I came back to school in the spring of 1975 on my own dime. Things had changed. Other than me, there was not a longhaired hippie in sight, and the engineering students had traded their slide rules hanging on their belts for calculators. Even with the best intentions I started to flounder badly. I happened onto a How to Study in College course and choose geology as a major. Who knew going to school was a skill that could be acquired? It was the first time I had actually done well in school. The trip back to school, though successful, featured several more chapters of the saga: “The Perils of Strong Drink.” The attraction of geology, and the influence of several excellent professors, somehow pulled me through. After finishing 660 in the summer of 1977, I returned to Colo. and took up my previous career of construction worker. Somewhere in late 70s, after putting up sheetrock outside in 10 degree weather, I once again thought, “There has got to be a better way.” I had sort of kept track of Dr. John Lufkin and inquired if he knew of any employment opportunities. Darned if he didn’t offer me a job with a crew riding dirt bikes into the desert collecting sediment samples from intermittent stream drainages! A better way for sure. That job eventually took me around most of the western states, supervising drill rigs, mapping, sampling and learning some geology, and having some role with two ore bodies that went into production. 1985 found me recently married and out on the street, as the gold business tanked. A pal told me to come to Midland. Got a job on a well site, met some people, and moved into the oil business. Not long after, I was working out of Carlsbad, N.M., 16 hours on and 16 hours off, as a mudlogger. After about six months, the downturn of 1985 commenced. I found I was about to become a dad, and I had a pal in Austin prospering in the construction business, so I decided to go back to construction. Things looked

good - tower cranes all over town and six months work booked, until it just stopped. Who knew a state capital with a big University could be affected by a downturn in the oil business? You could not buy a job of any kind. Then, out of the blue, an old pal from Houston Oil offered me a job in South Carolina, working on a gold mine! Heck Yeah! The gold mine was in the late discovery stage, and we took it up to and into production. In 1989, I identified a hole in the reserves, and I was invited to seek work elsewhere! Seeking stability in 1990, I got into preconstruction and geotech investigations with the highway department. I had stability, but was starving, and departed for the private side. I was hired to work on a drilling project evaluating high purity limestone or dolomite projects, in Pennsylvania and Ohio. We had managed to establish proven reserves of a high purity dolomite deposit in Tiffin, Ohio, that made the economics and reserves of most goldmines look silly. That one I think is still operating. After that, the lure of a steady paycheck kept me at the DOT until the beginning of 2016, when under the squeeze of privatization, I left. I thought, "I guess I'm retired!" Our three kids are mostly grown, all prospering in various ways, still talk to me, and, my "First Wife" and I are still married, so winning! I found out late that eating wheat turns me into "Snappy Dad," instead of "Happy Dad." Something about serotonin and depression. I knew something had been making it hard to stay employed. Of my old geology school pals, I have tracked down Mary Moran, Dr. Lufkin, and Bruce Kuyper. It's been at least 15 years since I touched base with James Willrodt, who prospered in oil. I stay in touch with some of the distractables of the first go-around when I left school with a master's in hippie. Though geology has mostly been good to me, the economics of metals seems grim. Gold mines often wind up as superfund sites. The run of oil will never occur again. Get on Google maps and look at Oil Center, NM. All those spots are wells. There might be a Permian Basin play in China or one of the 'Stans, but 30, 40 years and it will be gone. Still, I can go hiking near Asheville and see garnets 3/4 of an inch across and go to the bank and admire the Rapikivi texture in veneer on the floor and walls. Geology is endlessly interesting, and I highly recommend it; it is after all, where you live. So, thanks UT Austin. I never had anything to apologize for in regards to my geology education. That piece of paper from UT had a lot to do with me making it through, at times, by the skin of my teeth. It certainly was entertaining."

JB Chimene (B.S. '79) can be reached at jbchimene@gmail.com.

Frank Cornish (M.A. '75) writes, "I've been riding out this financial storm at Suemaur, but now that is over. Suemaur has cut its staff and operations. I have several prospects from SV Energy and one from Suemaur that are being handled now by Hurd. Hurd completed two of my conventional wells this year. Hopefully, we will move the prospects forward as I try to get to a better work balance between full goofing off (retirement) and geostuff. I am currently president of the Corpus Christi Geological Society, as its membership is in rapid decline because of aging and retiring members and lack of jobs for young professionals. I am working on publishing my past poster session at GCAGS, as a paper and also two future posters regarding the Wilcox canyons I have been mapping. I've found some interest among other Gulf Coast geologists on the subject. I am still involved in the Jackson School FAN program. The SIPES convention, this year in Santa Fe, is always a great destination location, and great talks and field trips. I still like to see the rocks. I've also been trying to make the AGS field trips. I am so glad I got to spend some time talking with Bob Folk at the UT Night of Giving. His passing is such a loss to our whole community. I've been enjoying the down time, working on photography, and the local art scene. Find me at FrankGCornishPhotography on Smugmug, Flickr, Facebook, and Instagram. I have my works up in several local venues and working to expand into other communities in the area. It is humbling to work among and with local artists young and old with so much talent. We have moved into ground-level accommodations to avoid the hurricane debacle of multiple step climbing in a towering condo when the power is out. I miss the views and the community there. I lean more now to Florida and Georgia, where my one granddaughter is and the promise of more grandchildren resides. I'm also hopeful to see old and lost faces at our UT reunion at George Stanton's in Austin this November."

Abelardo Garza-Hernandez (B.S. '75) shares, "I continue living and working in Parral, Chihuahua, Mexico, running my own mining consulting business, and I can be reached at abgarza@grupogamo.com."

Borden Jenkins (B.S. '78) writes, "I finally got to walk through the Geology building after 30 years—the new Jackson Geological Sciences Building. The rock & fossil collection was great. Makes me wish I was 20 again. Going through a tough three years and slump in the oil business. This is my fourth Boom to Bust Cycle, I think."

Charles Edward McKemie, Jr. (B.S. '79) can be reached at charlesmckemie@icloud.com.

John W. Preston (B.S. '70) shares, "Retired but still riding with the Hurd herd. Have a bunch of Lobo prospects down in Webb Co. that I would like to see get drilled. First three almost sold so hopefully this will be the year. I think retirement is just another word that lets everyone know you have time to do all sorts of things nobody else wants to do." John can be reached at johnwmp@gmail.com.

Steven L. White (B.S. '78) lives in Tyler, Texas, and can be contacted at swhitegeo@gmail.com.

Bill Olsen (B.S. '78) writes, "I never worked in geology, but during my U.S. Navy career, I created program successes and new technology breakthroughs in environmental protection and maintenance efficiency, from ships to shipyards to space shuttles, saving $Billions$ and milestones. Since '99, I've been a group-process facilitator, trainer and keynote speaker who guides program successes in government, industry and nonprofits around the globe."

James C. Willrodt (B.S. '77) writes, "Still residing in the Energy Corridor of Houston, Texas and just missed flooding by 1 whole inch from the Barker Dam release last August due to Harvey's drenching. We were blessed! I retired from deep-water drilling in 2016 after 35 years with ExxonMobil and four years of consulting in West Africa. Both Karen and I are doing well. Our kids, Erika and Alec have also graduated from UT and are doing well too. Erika is in NYC and Alec is in Austin. I have been settling in from the pace of drilling life to retirement by splitting time between Houston and our place on the Texas coast. The past few falls, we have made trips to the Ozarks with a Porsche group to enjoy the great roads there. This past January we made a nice trip to Hawaii visiting Oahu, Maui and Kauai and a Flying Longhorns Cuba trip a while back. Hello to all the old classmates. jcwillr@sbcglobal.net."

1980s

Bill Anderson (Ph.D. '85) shares, "I retired from ExxonMobil after 34 years and we bought a place up in Breckenridge, Colo., where we spend summers and winters. Look us up sometime." Jim and Deb can be contacted at debraanderson@sbcglobal.net.

Walter B. Ayers (Ph.D. '84) retired from Texas A&M University Department of Petroleum Engineering in January 2017 and is enjoying retirement in Virginia Beach, Va.

Carol Swenumson Baker (B.S. '84) writes, "I'm still enjoying working at ExxonMobil. Rod and I don't get to Austin enough."

Patricia Bobeck (M.A. '85, Ph.D. '17) shares, "I finished a Ph.D. in hydrogeology at UT in May 2017. The dissertation title is "Jean-Baptiste Paramelle: Method, Results, and Contribution to Hydrogeology." Paramelle was pioneering self-taught hydrogeologist/country priest who in 1827 figured out how to find groundwater on a dry karst plateau in southwestern France. Thus began a career that spanned 1832 to 1854 during which he found groundwater at 10,000 places in 40 of 89 France's departments. He did not use a dowsing rod, and he did not have geologic maps. He developed an observational method based on lithology, stratigraphy and geomorphology. After he retired, he wrote a best-selling book called "The Art of Finding Springs" to share his observational method and experiences with the public. Henry Darcy reviewed Paramelle's book in his own 1856 publication, "The Public Fountains of the City of Dijon," and praised Paramelle's work. In fact, Paramelle was more famous than Darcy in the 19th century. Over the summers of 2014 and 2015, research on Paramelle took me to the 40 French departments where Paramelle worked. I was able to find archives that support Paramelle's claims and have documented two water distribution systems built as a result of his discoveries. As part of the dissertation, I translated, "The Art of Finding Springs," and the Geological Society of America is in the process of publishing it. This summer I am again in France, presenting the Paramelle story at professional meetings, improving my French, and conducting research. The Comité Français de l'Histoire de la Géologie invited me to speak at their June 2018 quarterly meeting. I also presented at EuroKarst2018 in Besançon France on July 3. Both presentations provoked lively questions and comments about this forgotten pioneer of hydrogeology. I continue to translate geologic literature from French to English. My most recent project is the 2nd edition of Aurèle Parriaux' "Geology Basics for Engineers" published by CRC Press. These projects have benefited from generous funding and the professional community of the Jackson School. I am immensely grateful to the Jackson School for what it has helped me accomplish."

Bruce Calder (B.S. '81) writes, "Everyone, please check out the Falcon Cam that I got UT to install on the Tower: biodiversity.utexas.edu/resources/falcon-cam."

Richard Frank Carroll (B.S. '80) writes, "I am still gainfully employed by Caza Petroleum and still working the Delaware Basin. Good job and good people. Both of my sons are doing well, and I am very proud of both of them. And I have a new dog named Bob, and I'm pretty proud of him too. I am still doing some traveling for fun and outside of New York and Colorado to visit my sons. I've been to Bhutan, India, Italy and Spain in the past couple of years. Not sure where I'll be going next, but it will be fun."

Joel Mark Coffman (B.S. ’84) writes, “Still here at Region 9 EPA in the Underground Injection Control program trying to make it through some tough years of budget cuts and being told to do even more with even less and do it better and faster. Looking to possibly relocate to the Atlanta area in the coming year or two to be near our Ana Rose, my 18-month-old granddaughter. All is well with us! If you are in Northern California, give us a shout out! Bella, Susan and Joel.”

William D. DeMis (M.A. ’83) shares, “I am finally retired after three tries. Now Mary and I are traveling. We find geology wherever we go. We have a summer home in Colorado too. Life is awesome.” Bill can be contacted at billdemis@aol.com.

Richard Alan (Rick) Kolb (M.A. ’81) writes, “Spent a week in Austin for the spring graduation ceremonies. Daughter Jennifer (born when I was in grad school at UT) received her master’s in social work in August from the Steve Hicks School of Social Work, 37 years to the month after I received my master’s in geology. She plans to stay in Austin and be a social worker. Son Travis also lives in Austin, working for GeoSearch. I am still a consulting environmental geologist in Cary, N.C., and completed my second and final term last year on the North Carolina Board for Licensing of Geologists, but I’m still on the board ’til the governor appoints my replacement. Achieved one of my goals on the board by establishing a continuing-education requirement for geologists licensed in North Carolina. I’m also active in the Carolina Chapter of the Association of Environmental & Engineering Geologists and expect to begin a three-year term as director for the southeastern US chapters for AEG in September.”

Bill Layton (B.S. ’81) writes, “KC and I are doing fine, and between us, we have seven grandkids to keep us in line. I’m working at Abraxas Petroleum in San Antonio, and we are busy drilling wells in North Dakota and West Texas primarily. Hope all you 1981 grads are healthy having phun...and to quote from 660 field camp...“The Phantom Rules!!”

Bruno Maldonado (B.S. ’82) writes, “Hello Longhorns...I am not quite fully retired yet but continue to consult. I am currently working on a part time basis for Gustavson Associates as geophysical manager/business development role. Additionally, I consult through my own company BXM Petroleum Geoscience. Most of my work focus is International, but have done some work in Pennsylvania, Oklahoma and the Texas Gulf Coast. I am still involved with the Jackson School serving on their FANs Board. My free time is dedicated to spending time with the grandkids (shown in attached photo). My youngest son and wife are expecting another girl this month. Hope to see you at some of the Longhorn and Jackson School events in the near future...Hook ’em.”

Jeffrey J. Palmer (M.A. ’82) shares, “I’ll be retiring from ExxonMobil at the end of August, 2018, after almost 36 years.”

Joseph Elton Patterson (M.A. ’83) shares, “After almost three years in Abu Dhabi working as an ExxonMobil secondee geologic modeler with ZADCO/ADNOC, it’s time to head back to the U.S. I’ll be returning, in October, to the North Houston area to continue work for EM (at least for a while). Retirement is starting to sound kind of nice after 35 years. I hope to get reacquainted with UT/Rice alums in the Houston area.”

Robert Mark Reed (B.S. ’85, Ph.D. ’99) shares, “I am still working at the UT Bureau of Economic Geology (coming up on 20 years), where the focus of my work is on the microstructures of sedimentary rocks, particularly shales. I was recently promoted to Research Scientist Associate V. I look forward to seeing my former classmates at the JSG alumni functions at the GSA and AAPG annual conventions.”

Barrett Riess (B.S. ’86) is managing projects worldwide with Core Lab Reservoir Geology in Houston.

Paul Quint Warren (B.S. ’88, M.A. ’95) can be reached at paul_q_warren@utexas.edu.

1990s

Donald Andrew Bowen (B.S. ’91) writes, “Hello! I have made a career change. After graduating in ’91, I worked as a groundwater consultant. In 1998, I left UT after earning my MBA. However, I have found my true calling; working as a professional life coach! I will help people create an enjoyable life that aligns with their personal values. I have done this in my life, and I’d like to help others do the same. Please feel free to reach out to me, even if it is just to catch up! Best wishes to all.” Andrew can be reached at bowen.andrew@gmail.com.

Danielle Leigh Carpenter (M.A. ’96) married Sam Downing on June 8, 2018.

James Farmer (B.S. ’94) lives in Houston and can be reached at jfarmer04@hotmail.com.

Daniel Russell McConnell (B.S. ’95) writes, “Life is good. Beth and I were fortunate to not flood during Hurricane Harvey because of the known, but fortuitous, quirk of being at the top of a minor watershed in fairly flat-lying NW Houston (I think it is because the Hockley-Cypress fault reoriented the Cypress Creek watershed in the recent past). Our daughters are well. The older (B.A. Geography ’17) is working in Taiwan for her international experience year before deciding on graduate school. The younger is thriving and studying up the road at Southwestern in Georgetown. My job at Fugro has me working future-oriented businesses in gas hydrates and marine minerals on both a technical and strategic level. I am interested in characterizing gas hydrates from seismic data and helping governments and research groups with gas hydrate field programs. This past year, in a new development for me, I was appointed to serve a two-year term on the U.S. Department of Energy Methane Hydrate Advisory Committee. For marine minerals and deep sea mining, much of the pre-commercial site characterization work has been done by academic research groups, but eventually it will need to be done for purpose-hire. To that end, I was the lead field scientist on a two month cruise—one of the first private sector ultra-high resolution survey and sampling programs for polymetallic nodules in the Eastern Pacific this year. It was good to be at sea again—it is not something that I often do. So yes, all’s good and well. I can be contacted at dan.mcconnell@utexas.edu.”

James (M.A. ’95) and Sheri White with their daughters Grace (age 12) and Hadley (age 10).

John Wilcox (B.S. ’90) in Canyonlands National Park, Utah. Hook ’em!

2000s

Gilberto A. Calderon (M.A. ’09) with niece Amalia in Mexico City where he is an advisor with the Comision Federal de Electricidad.

Theresa Damiani (Ph.D. ’08) shares, “There are two pieces of news to share: Personally, I’m very happy to tell you that my husband and I welcomed our first child, a girl, to the family in September 2017! She is happy, healthy, and such a joy to us! There may be a little of mom in her since she’s already trying to disassemble everything she gets her hands on. Professionally, after nearly 10 years with the NOAA- National Geodetic Survey as a research geodesist, I’ve been promoted to Chief of NGS’ Spatial Reference System Division. I’m very excited to move into management and supervision of this active group, who conduct both operations and research! The Division helps to define the U.S.’ National Spatial Reference System, manages NGS’ national GNSS network (CORS and Foundation CORS), houses an International GNSS Service (IGS) analysis center for GPS satellite orbit products, and maintains the OPUS suite of tools for precise GNSS positioning.” Theresa can be reached at theresa.damiani@noaa.gov.

Kelly Iacono Daniel (B.S. ’04) was selected for the Austin Under 40 Award in the Energy, Mobility & Transportation Category based on her leadership in the engineering industry, specifically through environmental services provided to the energy industry, and her commitment to serving the Austin community. She manages the environmental group at Kleinfelder and is the vice president of finance for the Pflugerville Education Foundation Board of Directors. She also contributes to the community by volunteering for Ronald McDonald House Charities and driving for Meals on Wheels.

Laurel Michelle Gandler (M.S. '06) recently moved back to Houston with her family and started a new position with W&T Offshore.

Cory Lane Hoffman (Ph.D. '00) writes, "After 11 great years with SM Energy in Midland, I recently decided to pursue another opportunity here in Midland, also within the oil and gas industry. So, after two years of serving in various manager roles (exploration manager, operations geology manager, and asset development manager) focused primarily on the unconventional plays of the Midland Basin, I am excited to return to a technical role. Moreover, I'm excited to join Apache and return to what brought me to the Permian Basin some 19 years ago—working carbonate reservoirs. I look forward to the challenges and opportunities those reservoirs and assets offer, immersing myself in the literature again, and collaborating with those having similar interests. On the home front, Tonya, my wife of 24 years is doing well as are all our 4 children. My oldest daughter, Rebecca, is now a senior at high school with drivers license in hand and way too many potential career paths for my liking. My middle son, Robert, is now a sophomore in high school, seems to have a strong engineering bent, and still enjoys training/competing in gymnastics. My middle daughter, Leah, has started middle school and is the only one of my children who has shown some interest in geology (I'm still hopeful). My youngest daughter, Rachel, is still in elementary school and also is into gymnastics like her big brother. Our family is very involved in First Baptist Church Midland, and I have had the privilege and blessing to teach a Sunday School class each week to a group of adult couples and senior adults for over 15 years. I look forward to hearing your stories. God bless!" Cory can be reached at cory.hoffman@suddenlink.net.

Lauren Greene Martin (B.S. '07) and her husband, Pascal, welcomed their son Ben in March. He joins big brothers Graham and Charlie.

Julie Mitchell (B.S. '08) shares, "I graduated from UT Austin in 2008 with B.S. degrees in geological sciences and aerospace engineering. I recently completed my PhD in geological sciences with a focus in planetary science at Arizona State University. I'm now working in the Astromaterials Curation Office at the Johnson Space Center; we curate NASA's returned planetary samples, including the Apollo lunar samples, Antarctic meteorites, and other samples. As curator of ices and organics, I am responsible for preparing NASA for sample return missions from the lunar poles and comets." Julie can be reached at julie.l.mitchell@nasa.gov.

2010s

Gabriel Aguilar (M.S. '14) and Fatma Kubra Arisoy (M.S. '15) writes, "Hello, I am a reservoir geophysicist, and I have worked in the Deparment of Reservoir Geophysics and Quantitative Seismic Interpretation at Turkish Petroleum Corporation for almost three years. I was a graduate student at Jackson School of Geosciences from 2013-2015. It was a unique experience that gave me so much confidence for my job and changed my whole understanding of what I am capable of. I learned a lot, met so many great people, had so much fun and now I am a proud alumni. I hope that someday my path will cross The University of Texas at Austin again."

Maggie Behnke (B.S. '12) is now a Texas professional geoscientist and is working as the sole geologist at the environmental consulting firm Blanton & Associates in Austin, Texas. Maggie can be reached at maggie.behnke@blantonassociates.com.

Ryan T. Brown (M.A. '18) shares, "I completed a dual master's program with degrees in energy and earth resources from the Jackson School and global policy studies from the LBJ School. I am now located in Geneva and working at the UN Economic Commission for Europe in the Sustainable Energy Division promoting research assistance for the Group of Experts on Renewable Energy." Ryan can be reached at ryanbrown@utexas.edu.

Mackenzie Day (Ph.D. '17) shares, "This past July (2018), I started a faculty position as an assistant professor at UCLA. We are in the process of building a wind tunnel and have already established a productive research group!"

Diana Eldam (B.S. '12) and fellow JSG alumn **Julianne Wooten (B.S. '12)** 40-ft deep under water during a wall dive at UT's favorite modern carbonate system, Turks and Caicos!

Kayla Fenton (M.S. '17) was selected for the 2018 GreenBiz 30 Under 30. Determined to fight the sort of suburban sprawl that defined her Houston childhood, Kayla Fenton started her career in urban planning, digging into community development projects throughout Portland, Oregon, and even developing a flood resilience plan there. She jumped to the private sector a year ago, armed with a master's thesis, analyzing the energy consumption and emissions profile of meal-kit delivery services and on-the-job experience at Nestlé Waters North America and Amazon. The first was thanks to an internship with EDF Climate Corps. The latter connection led Fenton to her current job as part of the team that helped Amazon eliminate more than 305 million shipping boxes in 2017 by researching and designing smaller, more flexible ways to deliver goods safely and efficiently. "A lot of where the rubber hits the road is in operations," she said. "This is where we have the most opportunity to influence outcomes from an energy perspective, from a waste-reduction perspective, lots of elements of sustainability that are usually both economical and a win when it comes to sustainable outcomes." Fenton is an enthusiastic hiker and camper who vividly recalls her first glimpse of the majestic Columbia River Gorge. She is also an EDF Climate Corps mentor eager to guide her peers toward meaningful and rewarding careers in sustainability. "We're missing out on really smart people that want to work in this space."

Stefanie Frelinger (M.S. '15) has been a geologist and 3-D geomodeller with Nexen NPU since October 2015.

Hector K. Garza (B.S. '16) is a geoscientist at Premier Oilfield Group in Houston, TX.

Sam Hiebert (B.A. '10, M.S. '13) shares, "2018 was a great year. I started my second year of the Professional MBA program at Rice, joined a team exploring in Mexico, and got married in July! I am working hard to find and develop new resources using the world-class education I received both in the class room and in the field while a student at the JSG. Thanks again to the Alumni Network for organizing great events in Houston and Austin. It is always fun to catch up with old friends and mentors." Sam can be contacted at samuelhiebert@utexas.edu.

Pedro Alejandro Garza Juarez (M.S. '18) works at Pemex in Mexico and can be reached at alejandro.garza@utexas.edu or pedro.alejandro.garza@pemex.com.

Justin Mauck (M.S. '17) writes, "I am off to the boom town of Midland, Texas, to join the oil and gas industry! I look forward to interacting with all the past and future University of Texas graduates." Justin can be reached at jmauck@slb.com.

Frank Morgan (B.S. '11) shares, "After almost 4 years of working for Devon Energy in Oklahoma City, I started a new job as a geologist for Austin-based ATX Energy Partners (formerly Brigham Resources). We focus on U.S. onshore basins all over, but in particular, the Rockies region including the Powder River Basin." Frank can be reached at frankmo0053@gmail.com.

Juan Jose Munoz (M.S. '17) can be reached at jjmunoz33@gmail.com.

Jordan Oefinger (B.S. '18) shares, "I am pursuing a M.S. in sedimentary geology at the University of Arkansas under the supervision of Dr. Glenn Sharman after completing a summer internship as an exploration geologist with Lewis Energy Group."

Christine O'Neill (M.S. '14) shares, "I'm currently working in the mining industry in Nevada and have the wonderful opportunity to see all kinds of different deposit types."

Evan Pearson (B.S. '10) writes, "I will be completing my law school career at Texas Law beginning this fall. I'm very excited to be back in Austin, and I look forward to hanging another degreee from the University of Texas in my home. Although my career pivoted, I'll never forget the opportunities that the Jackson School provided me." Evan can be reached at ezpearson@gmail.com.

Forrest Roberts (M.S. '13) is a geologist at Terra Guidance and can be reached at forrest.roberts@terraguidance.com.

Jacoup Roiz (B.S. '18) shares, "This fall I will be starting my M.S. in geology at the University of Texas at El Paso." He can be reached at jroiz12@yahoo.com.

Reed Roush (B.S. '12, M.S. '15) is an exploration geologist with EOG Resources in San Antonio and can be reached at reedroush@gmail.com.

Makoto Sadahiro (M.A. '14) can be reached at sadahiro@gmail.com.

Kristopher James Voorhees (B.S. '14, M.S. '16) writes, "Since graduating from the Jackson School just over

two years ago, I've been working for Apache. I've been able to work assets in offshore Suriname, the Gulf Coast, and I'm currently working Permian Basin stratigraphy. During my time in the Jackson School, I developed a love for the outdoors and adventure through extensive fieldwork and class field trips. I've continued to foster that passion through travel. Last winter, I trekked to Everest Base Camp and summited Kala Patthar. Over the summer, I went on an epic surf trip along the coast of Portugal. Feel free to reach me at kris.voorhees@utexas.edu!"

Rachel Veronica Simon Wallace (M.S. '13, Ph.D. '18) shares, "I graduated from the Jackson School of Geosciences in the spring of 2018. I am now beginning my dream job as a human gross anatomy instructor at the Dell Medical School in Austin, Texas."

Friends

Jay McGovern shares, "I wrote a book on Geology."

William I (Bill) Woods shares, "In November we took a month-long trip to Australia and New Zealand. Francisco and I traveled first to Sydney and had a great time doing the Bridge Climb and seeing the sites, including the Opera House, the Zoo, the Blue Mountains and Botanical Garden. It was fun to use the ferries to move around the city and to visit outlying beaches. Then on to Cairns where we snorkeled on the Great Barrier Reef and took the Kuranda rail tour into the mountains. I really liked the laid-back atmosphere in Cairns; it's an easy city to visit. In Auckland, New Zealand we visited the Hobbiton movie set where they filmed "The Hobbit" and "Lord of the Rings." This was truly a highlight for me as we got to walk among the Hobbit houses and see where the various scenes were filmed. Then we flew first to Christchurch and then to Queenstown. Queenstown is one of the most beautiful places on earth, located on a huge lake with surrounding mountains. It's close to Doubtful Sound, so we took a side trip there and got to see penguins and whales. Our last stop on this wonderful adventure was Hobart, Tazmania, where we spent five days with Francisco's childhood friend Victor and his family, who were super hosts. The weather was a bit cold and drizzy after the first day, but we still had a great visit. Later, in March, we visited Caddo Lake State Park in NE Texas. It's Texas' largest freshwater lake and is a maze of slow-moving bayous, wetlands and backwaters. It covers about 26,810 acres of cypress swamp, depending on rainfall. The State Park has cabins to rent and is very comfortable. Friends and coworkers may reach me at billw@utexas.edu."

Professors Emeriti

FAMOUS SANDSTONE PETROLOGISTS; TIM DIGGS (MS 1989; CAREERS WITH SHELL AND SAUDI ARAMCO), FRANCESCO MCBRIDE (EMERITUS FACULTY), SHIRLEY PETERSON DUTTON, KITTY LOU MILLIKEN (STALWARTS OF THE BEG AND DEPARTMENT).

Earle Francis McBride reports, "A year ago I got into print my interpretation of the sedimentary geology of basal Paleozoic rocks between Durango and Silverton, Colo. My first sampling was done in the 1980s; some projects move at a glaciers pace. Some of the rocks were misdated by the USGS in the 1890s. Lynton Land, Kitty Milliken, and a couple of Luigi Folk's ex-students and I, with Dean Mosher's approval, are compiling anecdotes about Luigi. If you have one to contribute, email it to me at efmcbride@jsg.utexas.edu. Our compilation will become available as an internet download before long. Luigi and I started a study of the ferricretes (tertiary sandstones strongly cemented by iron oxides) in central Texas. I was to do the field work and he most of the SEM work. I'm pondering how to proceed. The Jackson School International Rock Collection was established a few years ago. Samples will be archived at the Pickle Campus. A searchable database will be available online. Already on hand are 6,000 of Luigi's samples, 3,000 of mine, plus samples from the collections of Steve Clabaugh, Doug Smith, Dan Barker, Rich Kyle, and others. We would like to have thin-section images of many of the samples attached to the on-line database. My daughter, Suzanne McBride, is transcribing locality information of Luigi's 6,000 samples into a database. She has to interpret Luigi's handwritten notes in pencil. So far she has kept her sanity!"

James Sprinkle writes, "2017-2018 was my fifth year as a professor emeritus. I kept busy presenting a joint abstract (with my co-worker Tom Guensburg) at the 2017 GSA Annual Meeting in Seattle, two joint abstracts (with my former Ph.D. student Lou Zachos, and with Tom) at the SE GSA Regional Meeting in Knoxville in April, another joint abstract and talk with Tom at the Fifth International Palaeontological Congress in Paris, France, in early July, and I was involved in three additional joint talks (one that I will present with six other co-authors, and two others in which I was the co-author) in a paleontological session in my honor at the upcoming 2018 GSA Annual Meeting in Indianapolis. Several manuscripts from these seven talks are almost ready to be submitted, but no journal papers of mine were published this academic year."

MEMORIALS

George Baxter Adams, Jr. (B.S. '51, M.A. '53) passed away peacefully in his sleep on March 21, 2018, just shy of his 90th birthday. Baxter was born in Paducah, Texas, to Baxter, Sr. and Nell Boutwell Adams. He graduated from Waco High and was manager of the state co-championship football team in 1945. He attended Baylor University for two years and graduated from the University of Texas with a master's degree in geology. He was a member of Kappa Sigma Fraternity and the Texas Cowboys. In 1952 he married Carol Nash of Waco. He was employed in Houston by Shell Oil Co., Edwin Allday Independent Oil Co., McCormack Oil & Gas, and was owner of Sunbelt Oil & Gas. In 1981, he retired from the oil business and bought Love Creek Ranch in the Hill Country and pioneered the Texas apple industry. He was also the first to propagate the Native Texas Bigtooth Maple Tree. After 25 years they sold the ranch and moved to Kerrville in 2002. Baxter and Carol donated 1,400 acres of their ranch to the Nature Conservancy to create Love Creek Preserve in Bandera County. Their gift demonstrated their commitment to conservation and helped ensure their legacy will be enjoyed by future generations of Texans. He was preceded in death by his parents; his granddaughter, Audrey Ellen Ducote; and his brother-in-law, James Roberts Nash. He is survived by his wife, Carol Nash Adams; sister, Katherine Adams Stanley, Ph.D.; three daughters, Ellen Adams Ducote and husband, Lester; Ann Adams Landry and husband, Christopher; and Kelley Adams Burgess and husband, Bob; as well as six grandchildren, and four great-grandchildren.

Olusegun Kokumo Agagu (M.A. '75) passed away in September 2013. He was born in Okitipupa, Ondo State, Nigeria, and graduated from the University of Ibadan (UI) at the top of his class with a B.Sc. (Hons) in geology (1971). He worked as a geologist with Gulf Oil Company (now Chevron Plc) before proceeding back to UI to lecture in the Department of Geology. He obtained his master's degree in geology from The University of Texas at Austin in 1974 and worked with a research scientist for the United States Atomic Energy Commission on geothermal energy. He then returned to the UI Geology department where he obtained a Ph.D. in petroleum geology in 1978 and taught for 16 years before voluntarily retiring as a senior lecturer and acting head of department in 1988. He published several articles in reputable national and international journals and authored more than 100 technical reports. He worked as a geological consultant to numerous companies and governments including the governments of Oyo, Ogun, Osun and Ondo States; Shell Petroleum Development Company; Mobil Producing Nigeria; Texaco; Nigeria Agip Oil Company; Lexington Exploration U.S.A and Nitex Exploration U.S.A. He also established many successful private businesses including a water borehole drilling company, a kaolin mining and processing company. The desire to help transform his native land led him to public service where he distinguished himself in the political arena. He served as deputy governor of Ondo State (1992-1993), Minister for aviation (1999-2000), minister for power and steel (2000-2002) as well as governor of Ondo State, Nigeria (2003-2009). He had many landmark public sector successes. He helped Ondo State become an oil producing state, which massively expanded the economic base. He also restructured the aviation industry. He increased power generation and reinforced the transmission and distribution systems by the time he left in 2002. He also laid the foundation for the privatization of the power sector and unbundling of the Power Holding Company of Nigeria (PHCN) into different generation, distribution and transmission entities during his tenure, which was implemented in 2012. He instituted an unprecedented planning approach to governance, which resulted in unprecedented investments in infrastructure (roads, bridges, schools, water supply and health centres). His comprehensive healthcare strategy received an award from the UNDP and was proposed as a template to be adopted across the West African subregion. He conceptulized and executed the Olokola Free Trade Zone and Deep-Sea Port project, a 10,000-hectare complex with anticipated investment value of over $22 billion implemented as a joint venture by Ogun and Ondo States. This was widely regarded as potentially one of the largest and most viable free trade zone facilities on the African continent and attracted investment from the Nigerian National Petroleum Corporation (NNPC), Shell Oil, ChevronTexaco and British Petroleum (BP) towards the establishment of one of the key components, the Olokola Liquefied Natural Gas plant (OKLNG). Ondo State received many awards and achievements under his leadership including: Best Poverty Alleviation Programme in Nigeria by the UNDP in 2005, Best Zonal Performance by Ondo State Universal Basic Education Board (SUBEB) in 2006 and 2007 from the Universal Basic Education Commission, 2nd Cleanest Capital City (Akure) in Nigeria in 2005 by the Federal Ministry of Environment, Designation of Ikaram (Akoko North West LGA) as one of the three Millennium Development Goal projects and Akure as one of 10 Millennium Development Cities in Africa by the UN in 2005, Inclusion of Idanre Hills as a UNESCO World Heritage site. Olusegun Agagu belonged to many national and

international professional bodies including the Geological Society of America, the Geological Society of Africa, and the Association of Petroleum Geologists. He was also a fellow of the Nigerian Mining and Geosciences Society and a fellow of the Nigerian Association of Petroleum Explorationists. He received the award of the Citizen L'Órdre National du Merite, from the government of France in 2000. He received the prestigious Commander of the Order of the Niger (CON) in 2012. In social capacity, he also received several honorary chieftaincy titles for his contributions to the society, some of which are The Ajanuku of Osooro Kingdom, The Gbobaniyi of Iloko-Ijesha, Osun State, The Atunluse of Idoani and The Atunluse of Ondo State. Olusegun Dr. Olusegun Agagu was a loving family man and was married to his school sweetheart and dance partner, Mrs. Olufunke Agagu (also a University of Texas alumnus), for more than 39 years. Their union was blessed with three children. He is also survived by seven grandchildren...and counting.

Jannette H. Balke, spouse of Bennie K. Balke (M.A. '58), passed into the loving arms of our Lord on April 16, 2018, surrounded by her loving husband and family.

Charles Martin Boenig (B.S. '61) of Woodsboro, Texas, passed away with his family by his side on June 27, 2018. He was born on Dec. 17, 1936 and preceded in death by his parents Martin and Lottie Boenig and sister Kaye Melton. His high school sweetheart and wife of 55 years, Fran Boenig, and children Tracie Heil (John), Brad Boenig (Vanessa), Pam Cox, Kari Burke and grandchildren Lauren and Connor Boenig, Kaitlyn and Garrett Cox and Charlie and Ben Burke will miss him very much. Charlie graduated from the University of Texas with a B.S. in geology and earned his M.S. from Texas A&M University. He worked as a geologist for Pennzoil (now Devon Energy) for over 15 years. As successful as he was in his career, he was most proud of his wife, children and grandchildren, and he loved spending time with family. You could often find him around the kitchen table with his brothers Bryce and Dennis, talking about the weather, their cattle business and politics. He was a great man who influenced many by living a life where his actions spoke volumes of his character and kindness.

Christopher Lee Bowland (M.A. '84), age 58, of Tomball, Texas, passed away on July 20, 2018, after suffering a sudden cardiac arrest while running with his dogs on July 3, 2018. Chris was born in Spring Valley, Illinois, on July 21, 1959. He graduated from St. Bede Academy in 1977 and received a B.S. in geology from Northwestern University. He later received an M.S. in geological sciences from The University of Texas at Austin. He was married to Anne Smith Bowland on June 15, 1985, in Austin, Texas, and they lived in Plano, Texas, for 15 years, where they had three sons. While living in Plano, he worked for 13 years at Arco Oil and Gas and two years at Mobil Oil Company. In 2000, Chris began working for ExxonMobil, and the family moved to Tomball, Texas, where they reside to this day. Chris has many passions and hobbies. Landscaping and gardening, running, movies, Star Trek, politics, cars, comic book collecting and astronomical photography are a few of the things in which he was interested. He was looking forward to retirement in a couple of years so that he could finally have time to focus on some of his interests. He was an intensely private person who had few friends but loved his family and dogs. He always looked forward to coming home from work so he could run with his dogs. On the weekends, he enjoyed running errands and going to casual lunches with Anne and working in the yard. He was preceded in death by his parents, Charles R. Bowland and Johanna F. Bowland. He is survived by his wife, Jacque Anne Bowland; sons, Jonathan Austin Bowland, Jeffrey Addison Bowland, and Gregory Allen Bowland; Jeff's wife, Mallory Bowland; Gregory's partner, Samantha Patterson; and his grandchildren, Noah, Parker and Aubrey.

Leroy C. (Lee) Buehrer (B.S. '57), 87, died March 9th in Edmonds, Washington, following a lengthy illness. Lee was born in Brenham, Texas, on Dec.31, 1930 to Reinhart and Edna Buehrer. After graduating from high school he enlisted in the U.S. Air Force. While stationed in Spokane, he met Florence Besas, and they were married in 1954. After Lee's discharge he attended the University of Texas where he received his degree in geology, working in oil exploration. Lee and Florence lived in various locations around the world and traveled extensively before moving back to Dallas. They moved to Seattle six years ago to be closer to family. In addition to his love of travel, he also loved the opera and symphony. Lee was preceded in death by his parents, two brothers and one sister as well as his beloved wife Florence who died in 2015. He is survived by his friend and companion Nancy Ketterling and eight nieces and nephews. He will be dearly missed by all.

Ray A. Burke (B.S. '47) passed on Aug. 11, 2018. It was a peaceful event with several family members present, in Mission Viejo, California. He was 96. He is survived by his wife of 72 years, Jimmye Myrtle Burke, their three sons, daughters-in-law, six grandchildren and a brother. Ray was born in Elgin, Texas, to Wade Hampton Burke and Lula Belle Burke on December 5, 1921. He had four brothers and two sisters. After graduating from Elgin High School, he went on to study geology at The University of Texas at Austin. It was during this time that he met the love of his life, Jimmye Myrtle Winkler from Giddings, Texas, at a dance at Lake Bastrop State Park. His studies were interrupted by World War II. He became a naval aviator and flew over 30 missions in the Pacific Theatre. When he was stateside for additional training, he married Jimmye, in Wildwood, New Jersey, and then returned to combat. After the close of the war, he finished his degree. Just last year, he was honored by the L.T. Barrows Founders Circle at the Jackson School of Geosciences. Ray and his brother Thomas created an ongoing scholarship and work program for students in the Jackson School of Geosciences. Ray was an oil finder extraordinaire. The arc of his career with UNOCAL took him from the Gulf Region, to West Texas and on to Los Angeles. From there, he helped open oil and gas regions domestically and globally, creating an intercontinental industry for UNOCAL. He was also a visionary in geothermal energy, making UNOCAL the worldwide leader in that industry. Having compiled an impressive list of achievements, he retired in 1989 as executive vice president in charge of worldwide energy resources, a member of the Board of Directors and a member of the Executive Committee of UNOCAL. They lived in Arcadia, California, while working at UNOCAL and raising their family. Ray was decorated by the U.S. Navy and was awarded the Distinguished Flying Cross and the Air Medal with five clusters. He also earned a Carnegie Hero's Medal for bravery, and the oil industry honored him with the prestigious Mr. Spindletop Award. He was the recipient of Thailand's highest honor, the Royal Decoration "Commander of the Most Noble Order of the Crown of Thailand" and received several other industry awards. Ray was a man of faith and leadership. He will forever be remembered as an adventurer with a great curiosity for knowledge. He possessed the drive to be his best at all that he did. He was modest in speech but a brilliant conversationalist and storyteller who could talk about anything but himself. He was an extremely generous man to both his family and community. His warmth and humanity, wit and wisdom will be missed greatly by all who knew and loved him.

Sarah L. Bybee, spouse of the late Halbert H. Bybee (B.A. '41), died in her sleep on Dec. 24, 2017. She was born October 29, 1917, to Richard Travis "R.T." Lipscomb and Leonora Gale "Nora" Lipscomb. Growing up, Sally had fond memories of going to their Ector, Texas, farm where they raised sheep. She graduated from Bonham High in 1935. She entered The University of Texas in Austin majoring in math and pledged the Delta Delta Delta sorority. She was later elected into Orange Jackets, Mortar Board, and the Phi Beta Kappa honorary society. There she met Hal Bybee, who was also a native Texan, majoring in geology, and a member of the Sigma Nu fraternity. Sally graduated in 1939 and married Hal on December 23, 1940. When Hal graduated in 1941, he got a job with the Carter Oil Company as a field geologist, and they started a tour of the Indiana, Illinois, and Kentucky oil fields. There they survived war rationing and snowy winters. They had a son, Hal, Jr., in 1942, and a daughter, Ann Marie (born 1945 – died 2013). In 1947, Hal got a job with the Continental Oil Company, and they moved to Fort Worth, Texas. This started a tour of the West Texas oil fields with stops in Abilene, Wichita Falls, Midland and Houston. Sally was active with the several geological wives' organizations and started teaching math at Midland High School. When they moved to Houston in the middle 1950s, Sally taught at Spring Branch High School for a few years and finished at Memorial High School. In Hal's later career he managed Gulf of Mexico offshore and North Slope Alaska oil fields. They had one short assignment where they lived in Georgetown, Guiana, and he consulted with the local government under a temporary title of Conoco vice president. They made two trips to China and the Far East where Hal did geological consulting through People to People. He came down with a rare blood disorder and died Nov. 14, 1984. Hal, Jr. married Karen Elisabeth Kummer and had one daughter Alice Marie. Ann married Walter Preston Tyree, III and had two sons, Walter Preston, IV, and John Edward. Sally moved into Austin to Westminster Manor in 2004. She befriended many on the nursing wing staff and will be missed by friends and family alike. We are all grateful for her long life and positive contributions to people and society.

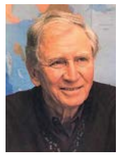
Weyman Wakefield Crawford (B.S. '50), age 94, of Houston, Texas, passed away peacefully at his home on Nov. 9, 2017. Weyman was born October 31, 1923 in Dallas, Texas, to Pearl and Fred Crawford. He graduated from Mirabeau B. Lamar High School in Houston. In 1942, he entered The University of Texas at Austin on a basketball scholarship. He was drafted in 1943 and served in the United States Army Air Corp stationed in Kunming, Yunnan Province, China. In 1947, he returned to Austin to earn his B.S. in geology, graduating in 1950. He began his career at Union Sulphur Company as a Gulf Coast geologist, then left to work for the R.A. Welsh Foundation. He transitioned into working for himself a few years before moving to Texas Gulf Inc. where he served as senior vice president. In 1982, Elf Aquitaine acquired Texas Gulf and he served out the remainder of his career as executive vice president of the Oil & Gas Group, retiring in 1989. He served as a member of the American Association of Petroleum Geologist, Houston Geological Society, Houston Petroleum Club and the Houston Racquet Club. He also served on the Advisory Counsel for the University of Texas Geology Foundation and was an Elder at Grace Presbyterian Church. Mr. Crawford is preceded in death by his first wife, the late Loraine Roscoe Crawford, his infant daughter, Carole Ann Crawford and his sister Martha Virginia Graham; his parents, the late Pearl

Weyman Crawford and Fred Homer Crawford. He is survived by his present wife, Carol Akkerman Crawford and his daughters, Carolyn Crawford of Houston and Anne Elizabeth Crawford of Austin.

Decker Dawson, beloved husband and father, left this world on Feb. 6, 2018, to be reunited with the dearly departed love of his life Louise (Lou) Loper in the presence of his Lord and Savior. Deck was born to Louis Decker Dawson and Suzie Cramer on July 28, 1920. He was born at home in Tulsa and passed in the comfort of his home in Midland surrounded by his loving family and caregivers. Decker was a clarinet player in the marching band at Tulsa Central High School. He continued to play the clarinet in various bands to help fund his early years in the School of Engineering at the University of Tulsa from 1937-1939. Coming to the realization that his love of music (or lack of talent, as he often quipped in jest) was not going to provide an adequate living, he transferred to Oklahoma A&M (State) in 1939 and completed his degree in civil engineering in 1941. Unable to find an engineering job, he took a doodlebugger job as a geophysical helper (juggie) with Magnolia Petroleum Company (ExxonMobil) working in Oklahoma and Texas. After one year in the oil patch, Decker served the country in the U.S. Naval Reserves as a civil engineer. He was stationed on the island of Guam during World War II preparing for the invasion of Japan. He left the Navy having served as an Ensign and Lieutenant (jg) in 1946. After his time in the Navy, Decker took a job with Republic Exploration Company as a seismic party chief in Mississippi, Louisiana, Oklahoma and Texas. In 1950, Republic moved him to Midland as a seismic supervisor. Here, he found the love of his life Lou. Lou and Decker were married in 1950 until her passing in 2011. They have one daughter, Mary. In 1952, Decker and Lou founded Dawson Geophysical Company, and Lou became the first pregnant seismic computer known to the industry. Dawson Geophysical became an industry leader in the adaptation of technology and currently is the largest provider of geophysical services in North America and the longest standing name in the industry. Decker has served his profession as past president and honorary life member of the Permian Basin Geophysical Society. He served as secretary-treasurer and president of the Society of Geophysicists. He was a member of the SEG since 1948, awarded the Enterprise award in 1997 and Honorary Life Member in 2002. He was a past director, chairman of the board and honorary life member of the International Association of Geophysical Contractors. With a true love of Midland, Decker and Lou served the Midland community with love and support beyond his professional contributions. Since 1979 Decker was a member of the Board of Governors for the Midland Memorial Hospital Foundation. He served his church as both a deacon and an elder. Outside of Midland, Decker was a member, past chairman and Honorary Life Member of the Geology Foundation Advisory Council of the Jackson School of Geological Sciences at The University of Texas at Austin. Later in life Decker was the recipient of multiple awards. In 1997 he was inducted into the Permian Basin Petroleum Museum Hall of Fame. In that same year he received the "Top Hand" Award from the Permian Basin Petroleum Association. Five years later Decker received the Hearst Energy Award for Lifetime Achievement and in 2005 the Top Pioneer Award from the Permian Basin Petroleum Pioneers. The AFP Permian Basin Chapter presented Lou and Decker as Outstanding Philanthropist in 2010. Decker was also the recipient of the T. Boone Pickens Boot Strap Award from Oklahoma State as well a member of the OSU Hall of Fame, School of Engineering both OSU & University of Tulsa. Decker leaves behind his beloved daughter Mary as well as many longtime friends, colleagues and co-workers. Decker was known for his honesty, integrity and compassion. He was often referred to as a "Gentleman's Gentleman." He loved people, life and those around him.

Carr P. Dishroon (B.A. '53), 87, native Houstonian, died August 11, 2018, following several years of suffering with Alzheimer's disease. Mr. Dishroon was a distinguished geophysicist who worked in many countries. He graduated from San Jacinto High School, the University of Texas, and went to work immediately for The Humble Oil Company until his retirement. Mr. Dishroon is survived by his wife of 20 years, Janie Currlin Permenter Dishroon. In his last years, he was cared for by his devoted daughter, Karen Dishroon Breitbeil.

Curtis C. Franks (B.S. '50), 92, died on March 5, 2018, in Fair Oaks Ranch, five years after a stroke that robbed him of speech and mobility, but not the basic goodness that made him widely loved. His wife of 71 years, Betty Jean Franks, preceded him in death last year. Curtis was born in 1925 in Lockhart, Texas, to Curtis Franks Sr. and Lillie Franks. In 1944, he joined the Marines, fought in World War II—including Okinawa, the bloodiest battle in the Pacific—returned home in 1946 and married Betty. He got a geology degree from the University of Texas and embarked on a long career in oil and gas. He was proud to have been a founder and president of the San Antonio Petroleum Club where he and Betty spent many happy hours with friends. Curtis was an intelligent, warm-hearted man of great integrity. Like his beloved Betty, he will be much missed. He is survived by sons Gary and Jeff Franks, daughter Kerri Blanton, their spouses and numerous grandchildren and nieces and nephews.



Jack Q. Frizzell (B.S. '50) of Abilene passed away peacefully on April 14, 2018, due to complications from a stroke. He was 94. Jack was born June 24, 1923 to J.O. "Tad" and Frances Atilla (Matzen) Frizzell. Life began on farmland 12 miles north of Weslaco in the Lower Rio Grande Valley of Texas, the land being cleared at the time of dense cactus and mesquite forests, and well-populated with rattlesnakes and wild animals. He and his sister Bettie moved with the family to Weslaco after the good life on the farm came to an end as the family land was sold off in the depths of the Great Depression. Three more siblings were born, sister Ann and brothers J.O. "Joe" and Gayle "Skippy." After joining the U.S. Navy in 1942, Jack earned his rating as an aerographers mate and was then assigned to Naval Intelligence as a cryptanalyst of Japanese encoded messages. He spent the rest of his duty at CINCPAC (Admiral Chester Nimitz's command headquarters) near Pearl Harbor with a 500-man intelligence corps deciphering daily encoded transmissions from the numerous enemy-occupied South Pacific islands. He was honorably discharged in December 1945. Jack returned to the Rio Grande Valley and enrolled under the G.I. Bill at Edinburg Junior College. There he met Patsy Ann Day, and they married on June 21, 1947. Both enrolled at the University of Texas in September 1947. Pat studied business and worked as secretary to Governors Beauford H. Jester and Allan Shivers while Jack studied geology and worked at the Texas Board of Water Engineers. Their first son Allan D. Frizzell was born in 1949. Jack and Pat moved to Plainview after graduation where Jack continued his work with the TBWE while looking for jobs in the oil field, which were few and far between in those years. The beginning of Jack's good fortune in the oil business came in November 1950, when he was employed as a geologist for Delaware Drillers, a San Angelo based company owned by Richard King, Jr., a King Ranch heir who in Jack's words "thought I could do everything." In reality, Jack was learning as he went, perfecting skills that weren't taught in school, which later enabled him to find millions of barrels of oil throughout Texas and the American West. While living in San Angelo they were blessed with two more children, son Lane Patrick and daughter Joni Ann. After the company was sold, they moved to Albuquerque, where Jack entered the booming search for uranium in the Four Corners Area. With the discovery of a promising deposit north of Grants, N.M., Jack was able to sell out and return to Texas where he would re-enter the oil business. They spent 10 years in Abilene, and then moved to Denver where Jack served as president of International Energy Company. They returned to Abilene in 1972 and founded Frizzell Exploration with Allan and later Lane upon their graduation from Texas Tech University. Working together with his beloved wife and two sons, Jack survived the booms and busts of the Texas oil business for 45 years. During the last years of his life he was specially engaged in looking for oil reserves on the River Lake Ranch, a co-investment by Enrich Oil in a large tract of land on the Colorado River in Runnels County. After several attempts and the passing of his beloved wife in October 2017, Jack's dream of finding oil on the ranch finally came true with the discovery of a deposit of oil and gas in the Odom Limestone formation. Never one to retire, even at 94, he was preparing to drill again, perfecting his subsurface mapping and zeroing when he suffered a stroke at his home. Though Jack was an accomplished and respected oilman, perhaps the greatest legacy of his long life is the love he shared with Pat. They enjoyed the bounteous times and endured the lean times—always together. Their greatest joy was their family, and they participated in every event in the lives of their children, grandchildren, and great-grandchildren. On vacations to Disneyworld, Hawaii, and family reunions in California, the growing Frizzell clan traveled together, laughing and playing in one big group, with Jack "Baba" and Pat "Granny" at the head. They loved nothing better than to throw a big party where friends and family could eat, drink, and dance to the music of Lane's band, Slim Chance and the Survivors. When Pat's health declined, Jack cared for her at their home with the help of dedicated caregivers until the very end. Jack is especially known for his charity and generosity, a trait he inherited from his father. Even animals were beneficiaries of his concern—stray dogs and cats as well as the ducks who roamed his property next to the golf-course pond were sure to find sustenance from his hands. Jack was preceded in death by his father J.O. "Tad" Frizzell, his mother Frances Matzen Frizzell, his brothers Joe and Skippy Frizzell, sisters Bettie Buchanan and Ann Carter, wife Patsy Ann, and son Lane Patrick Frizzell. He is survived by his son Allan Douglas and his wife Linda Ruth (Long) Frizzell of Abilene, his daughter-in-law Miriam Holly (Lutz) Frizzell of Abilene, his daughter Joni Ann and son-in-law Bill O. Wood of Abilene, seven grandchildren, and 8 great-grandchildren.

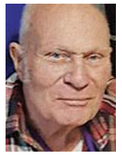
David Bruce Hailes (B.S. '84), 57, of Dawsonville, Georgia, passed away at home on September 9, 2017. He was born on March 18, 1960, in Kansas City, Missouri. David was preceded in death by his father, Jack Hailes and father-in-law, Carl Miller. He is survived by his wife, Cindi Hailes of Dawsonville, Georgia; mother, Gladys Hailes of Cedar Park; sons, Paul Hailes and wife Erica of Pflugerville, and John Hailes of Dawsonville, Georgia; grandson, Ian Hailes; brother, Jack Hailes and wife Susie of Round Rock; as well as, many nieces, nephews and other extended family and friends. David loved his family and friends and made a huge impact on their lives. He always made time for all of his nieces and nephews. David made friends with everyone he met. His best friends traveled miles to be with him at the end. David had a passion for teaching. He graduated from the University of Texas with a B.S. and continued his education at New Mexico Technical Institute with an M.S. in teaching. He taught for over 25 years at Grisham Middle School, McNeil High School and Stony Point High School in Round Rock, Texas. He then taught at Volcano Vista High School in Albuquerque, N.M. and South Forsyth High School in Cumming, Ga. He had a passion for sharing science with his students. David was a

scoutmaster of Troop 145 and cubmaster at Pack 404. He organized many trips and helped scouts grow into productive young men. He was an Eagle Scout, and this showed in all his actions during his life.

Robert Sebran Harvill, Jr. (B.S. '50) was born in Robstown, Texas, on June 30, 1926 to Robert Sebran Harvill, Sr., and Francis Elizabeth (Fannie Nunley) Harvill. He passed away on June 9, 2018 in Amarillo surrounded by his loving family and faithful caregivers. He served his beloved country during WWII as a member of the United States Army Air Corps where he was sent to occupy Germany after the Allied victory. When Bob returned to the United States, he continued his studies at The University of Texas at Austin and earned his degree in geology in 1950, becoming a life-long, orange-blooded Longhorn. Upon graduation, Bob went to work for Humble Oil & Refining Company which eventually became Exxon. Bob began to be commonly known as "Red Dawg" amongst his friends, and later his grandchildren would call him "Grand Dog" or "GDog". While working for Humble in Perryton, Texas, Red Dawg met a beautiful woman from Georgia named Norma Ruth Marshall. They were married on Feb. 12, 1954, in Perryton. The couple moved several times with Humble before eventually settling in Conroe, Texas, with their three children where they became long-time residents of River Plantation. Red Dawg served as a geophysicist for Exxon in Houston until his retirement in 1986. Bob was preceded in death by his wife, Norma, and his son, Patrick Marshall Harvill. He is survived by his daughters Sharlane Harvill Billman, and Lynn Harvill Rich. He is also survived by his sons-in-law Greg Billman, and Jon Rich, and his daughter-in-law, Jelia Jones Harvill. "Gdog" also leaves behind seven grandchildren and three great-grandchildren. Red Dawg loved his family, his friends, golf, dogs and, of course, the Longhorns. He will be greatly missed. Hook 'em!

Charles W. Henslee (B.S. '51) was known to friends as "Red" and to family as "Pop." CW Henslee gave this world 90 years of love and laughter from January 7, 1928, to August 13, 2018. A native of Pyote, he lived in San Antonio, Amarillo and Houston. After graduating from Amarillo High School, he served his country and received an honorable discharge from the United States Army. Red attended both Texas A&M and The University of Texas at Austin where he earned his bachelor's degree in petroleum geology. He began his career at Shamrock Oil & Gas in 1951 and retired as Gulf Coast regional geologist from Maxus in 1989. Red was a member of the Hearthstone Country Club, Houston Geological Society, the Gulf Coast Geological Society and an avid Longhorn fan who proudly displayed the burnt orange. He was a prolific songwriter, musician and singer who enjoyed both karaoke and singing his own songs a cappella. His last performance was on his 90th birthday! He enjoyed softball, golf, bowling, bridge, camping, fishing, storytelling, traveling adventures and never stopped telling jokes. Preceded in death by his parents, Alleen Matthews, Clint Henslee & stepfather Max Matthews, wife of 54 years Ruth, brother Harold, & son Kerry Henslee. Survived by three children: Gale Henslee (Careyn Henslee) (Samantha Scott), Karen Mitchell, Lora Putney (Brian); daughter-in-law Terry Henslee; sister-in-law Joy Smith; eight grandchildren, eight great grandchildren, and numerous nieces, nephews, close friends and "adopted daughter" Diane (Jim). Red was a benevolent and selfless man with astute intellect and wisdom who lit up every room he entered.

Stephen W. Hodgkins (M.A. '92) passed away on Sept. 26, 2017, in Edinburg, Texas. Stephen was born in Rockville Centre, New York, on March 9, 1956, to Claire and Wendell Hodgkins. He grew up in Kensington, Maryland, graduated from St. John's College High School in 1974, and received a bachelor's degree from the University of Maryland. At an early age, Stephen's desire was to work in the oil and gas industry. In 1986, Stephen enrolled in the University of Texas and received his M.S. in geology. He worked as a Landman in Texas for almost 30 years. He is survived by his parents, two sisters, Yvonne and Lisa (Richard); a brother, Gerald (Marissa); three nephews and two nieces; many other relatives and friends.



Robert B. Lomerson (B.A. '53) was born on Sept. 11, 1929, and passed away on Oct.18, 2017. Robert was a resident of Fort Worth, Texas, at the time of passing. A 1953 graduate of The University of Texas at Austin with a B.S. degree in geology, Mr. Lomerson was an advanced development engineer with a diverse technical background. He made significant contributions to both private industry and the U.S. government during his 50-year career.

Don Haden Martin (B.S. '58) passed away on Jan.27, 2018, after a difficult and courageous battle with thyroid cancer. He was born in Houston on Oct.29, 1935, to Lucydean Haden McDow and Harry Lee Martin. After the completion of high school at the Shreiner Institute in Kerrville, Texas, Don first attended Rice University and then completed his degree in geology at The University of Texas at Austin. While attending UT, Don was an ATO and also met the love of his life Barbara Ann Pearson. They were married in 1956 and began an exciting journey. Don's professional career included stints as a geologist, 1st lieutenant in the Army, land man, home builder, commercial developer, private investigator, FBI special agent and lastly as a member of the Command Staff of the Fort Bend County Sheriff's Department (FBCSO). During his tenure with FBCSO, Don was instrumental in the original formation, construction and operation of the Fort Bend County Law Enforcement Academy, now known and named after his good friend, the Gus George Law Enforcement Academy. Don was very proud that his efforts with the academy resulted in a commendation from the governor of Texas. Don was a lifetime NRA Master Handgun Marksman and was also a firearms instructor during his tenures with the FBI and FBCSO. Don was preceded in death by his parents and his son, Donald Haden Martin, Jr. He is survived by his beloved wife Barbara and his son Bobby Martin and daughter-in-law Lynne Martin. He is also survived by three grandchildren and three great-grandchildren.

Margaret Ellen (Tyer) Meadows, spouse of Joe Norman Meadows (B.A. '62), passed away Feb. 27, 2016, at her home surrounded by her loving family after a long struggle with Alzheimer's.

Kenneth "Ken" Eugene Nemeth (M.A. '76), 66, passed away June 14, 2018 in Houston. He was born June 15, 1951 in Hamtramck, Michigan to Eugene and Patricia Anne (Ryder) Nemeth. He attended St. Rita's in Detroit from first through ninth grade and Clintondale High School for tenth through twelfth grade. High school activities and achievements included: basketball, track, captain of the football and wrestling teams, National Honor Society, Quill and Scroll Society, Latin Club, Varsity Club, Key Club, Student Council and Salutatorian. He was inducted into the Clintondale Hall of Fame in 1999 in recognition of outstanding athletic achievement. At Albion College in Albion, Michigan, he majored in geology and completed a B.A. degree in 1973. He graduated with honors after surviving Division II NCAA football, where he co-captained the team his senior year. While completing an M.A. degree in 1976 at the University of Texas, Ken was a teaching assistant in the Department of Geological Sciences and a research assistant at the Bureau of Economic Geology. He turned in his thesis on a Monday, showed up for work at Shell Oil in New Orleans on Tuesday, and attended his first Mardi Gras the following week. From 1976 to 1980, he worked for Shell and then worked for Louisiana Land & Exploration in New Orleans. Ken met Sandra Olson in 1976 at the Parc Fontaine Apartments where they both lived. Sandra was a teacher at Archbishop Blenk High School. They married June 11, 1977 at St. Louis Cathedral in New Orleans. By fall 1981, Ken went to work for BlueSky Oil & Gas Company in Houston and later worked for Adobe Resources. In 1991, he moved to Dallas to work for Browning Oil Company. Schlumberger hired him in Dallas and moved him back to Houston in 1999. Ken was active with the Houston Geological Society, the Dallas Geological Society, the Gulf Coast Association Geological Society, and the American Association of Petroleum Geologists (AAPG) and the Imperial Barrel Award. He held numerous leadership positions and won many awards and honors from these groups. He was also a former board member and instructor at Ellison Miles GeoTechnology Institute, Brookhaven College in Dallas. Ken loved playing tennis. He attended multiple tennis tournaments across the gulf coast and participated in the World Oilman's Tennis Tournament (WOTT) for over 35 years held at the Houston Raquet Club. Surviving him are his wife, Sandra; daughter, Samantha; brother-in-law, Foster Olson; sister, Debbie and her husband, Dan Doyle; nephews, Josh and Kyle Doyle; brother, John and wife, Denise Nemeth; niece Stephanie and her husband, Michael Lee; and niece, Jennifer and her husband, Curtis Ferguson.

JoAnn Sweeney Patty, spouse of Tom Patty (M.A. '68), passed away on Dec. 31, 2017. JoAnn was born on Dec.24, 1940 to Mamie Jo Franklin Sweeney and Virgil William Sweeney in Vernon, Texas. She is survived by her beloved husband of 58 years.

Robert Randolph Ray (B.S. '74) was an eternal optimist and giver, in life and in his work as a geologist & geophysicist. He never knew a stranger. His smile will be remembered forever. God called Randy home on Dec. 6, 2017, just shy of his birthday on December 8. He and his wife Kathy walked this life together for 45 years (married 43 1/2 yrs). They have two amazing sons, Brandon & Austin Ray. Back in 1951, his proud parents were Bob & Jeannine Hallmark Ray. Two awesome sisters followed—Jean Ann DeFord (husband Mike, children Kalena & Evan) and Lisa Morris (husband Mark, children Tyler & Rachel). Sisters-in-law loved him, too—Mary Ann Moghannam (husband Samir) and Shirley Dion—and many cousins, nieces, nephews, and a special aunt & uncle, Audrey & Marion Porter, will miss him dearly. Having grown up in Dallas, Randy was a Texan at heart even while straying to Calgary for high school. He returned to his roots to attend college at UT Austin for a B.S. in geology, and there he met Kathy. They married in Austin and moved to Tulsa, where he was trained as a geophysicist with Cities Service Oil Co. From there they were Denver bound. In 1980 Randy established himself as a consultant, integrating geology & geophysics, and R3 Exploration was created. Work was his life, and volunteering for the local & national geological societies, meeting new people, and sharing his knowledge enthusiastically was his passion. He furthered his education with an M.S. in geology at the Colorado School of Mines. Randy was happiest climbing the outcrops with fellow geologists and hiking Canyonlands with his buddies. God blessed me, Kathy Dion Ray, with the Best Man on earth, and Austin & Brandon with a wonderful, caring Father. We love you my Sweetheart and will miss you greatly till we are united again in God's beckoning.

Leland Thomas Stowe (B.S. '49), born at home in Dallas on March 24, 1926, passed away on June 27, 2018 in Hurst, Texas. Leland graduated from Crozier Tech and served in the Army Air Corp before attending The University of Texas at Austin. He spent his career at Alexander & Alexander Insurance Company before retiring as a senior vice president. He will always be remembered as a strong Christian man. He is preceded in death by his wife, Alleen Stowe and his daughter, Debbie Stowe. Leland is survived by two sons, Gary Stowe and his wife, Linda; Dan Stowe and his wife, Mary; brother-in-law, John Loucks and his wife, Kay; numerous grandchildren and great-grandchildren.

Billy D. Thomas (B.S. '49) passed away April 27, 2018, from complications of pneumonia. He graduated with a geology degree from The University of Texas at Austin and worked for the State of Texas. During WWII, he served his country as a B-24 pilot in the Pacific Theatre. Billy and Catherine were long-time members of Hyde Park Baptist Church. He loved flying, NASCAR and other car races, but especially his family. Billy is survived by his wife Catherine, daughter Martha, and son Walter (Vickie).

Eric Elon Thompson, Jr. (B.S. 1950) was born to Blenda and Eric Thompson on May 6, 1924, in Worcester, MA. Eric's formative years were spent with the Greendale Avenue kids during the Depression. He was active in baseball, basketball, Boys Scouts, and he was a big fan of the library. Spending summer days at the summer home at Stiles Reservoir was his favorite pastime. It was at the age of 9 that he met his future wife, Barbara May Carr.

Eric graduated from North High and enlisted in the Army Air Corp on December 7, 1942. He served as a flight engineer, top turret gunner, and an engine mechanic. Through the G.I. Bill, Eric obtained an Associates of Arts Degree in Science from the College of Mines and Metallurgy. He went on to graduate with a B.S. in Geology from the University of Texas in 1950. Eric and Barbara married August 25, 1951, the same year Eric entered Yale University graduate school.

Stanolind Oil Company lured Eric and eight-months-pregnant Barbara to Bismarck, ND, to begin his long career in the oil business. Eric was a proven oil finder participating in the discovery of Sandish Field, recommending acreage on Cedar Creek Anticline, and completing numerous regional studies that lead to other discoveries.

In 1962 Eric was ready to step out on his own and begin a career as a highly sought after consultant. Eric joined Wheless Drilling Company on a retainer in 1970 and was instrumental in the discovery of the Salt Lake Field, Trail Creek Field, and others. Being his own boss gave Eric time to purse another passion—golf.

Family was important to Eric. He and Barbara were married for 66 years. He was devoted to Barbara and took great pride raising two successful children, Jan and Brad. He also found great joy in his four grandchildren and three great-grandchildren.

Eric lived a life full of passion for his work, devotion to his wife, and love for his family. It was a life well lived. Eric is survived by his wife, Barbara; his daughter Jan Thompson of Kennewick, WA; his son Braden (Allison) of Edmond, OK; four grandchildren; and three great-grandchildren.

Steven R. Trudeau (B.S. '70) passed peacefully from this port on February 13. He was a beloved husband to Ruth Kelly Trudeau; caring father to Wayne Trudeau and his wife, Evelyn; loving grandpa to Nicole and Michelle; playful brother to Sharon Trudeau, Noel Trudeau and Tim Trudeau and his wife Tina; and kind uncle to Belinda Trudeau, Danielle Trudeau and Deanna Trudeau. Steve graduated from the University of Texas with a B.S. in geology and spent his career in minerals and petroleum. He was proud Life Member of the UT Ex-Students Association. Steve was active in numerous professional organizations: Dallas Geological Society, Society of Independent Professional Earth Scientists and American Association of Petroleum Geologists. He had a general aviation pilot's license, was a member of the Grapevine Sailing Club, and was an avid racer of his Catalina 22 (named Archaeopteryx, a bird-like dinosaur whose name means "first wing"). Steve loved the earth and the sky; now his spirit sails and his soul is free to fly.

Norman G. Van Broekhoven (M.S. '02) passed away July 30, 2018, at his home in Austin at age 66. Originally from Fayson Lakes, New Jersey, Norm moved to Austin in the late 80s. He matriculated to the Jackson School for graduate work in 1994. Research for his thesis "Recharge in a Semi-Arid Basin Aquifer: Ryan Flat and Lobo Flat, Trans-Pecos, Texas" took him to West Texas where he fell in love with the independent ranchers and open spaces. Texas became his home. While in the program he was a teaching assistant for the summer Field Methods course under the guidance of his thesis advisor, Dr. John (Jack) Sharp, who has shared many colorful stories about their years together. His large 6'6" frame was in sharp contrast to his nimble fingers that could reassemble an antique firearm without a diagram. The several months he spent meticulously restoring water-damaged firearms at the Texas Memorial Museum was a testament to his passion and knowledge in that area. His was recognized as a brilliant individual with many skills as well as a great conversationalist. He was a gentle soul, yet he could stand up for the truth no matter how unpopular. Norm is survived by his sister, Nancy Van Broekhoven of Barrington, Ill. and Breckenridge, Colo.

Staff

Eleanor P. Picard, age 78, went to be with our Heavenly Father on Dec. 15, 2017. Eleanor worked as assistant to the director of geophysics at The University of Texas at Austin for over 33 years. Art Maxwell brought Eleanor down to be his chief accounts representative from Woods Hole Oceanographic Institution, where he had been for many years before serving as director of the University of Texas Institute for Geophysics (UTIG) from 1982-1994. Even though Eleanor was not a scientist, she was very well connected and soon established herself as a wonderful colleague and leader in her own right who contributed greatly to the positive, science-centered life at UTIG. The institute named the Eleanor Picard Excellence Award after her because of her exemplary performance at UTIG during her tenure. Eleanor was preceded in death by her parents Walter and Helen (Hogan) Lahti; and her brother Lloyd Lahti. She is survived by the love of her life, her husband, Robert of 58 years; her beloved children, Robert, Russell and Mary (Gianino), Michelle and Patrick Morrelli; her precious grandchildren, Michael, Joshua, Phillip, Kristina and Autum; and her twin sister Eloise Morrison; and lots of others who loved her dearly.

Faculty & Researchers

Milo M. Backus, Shell Chair Emeritus in the Department of Geological Sciences, passed away May 25, 2018, in Dallas, Texas, after a remarkable career in geophysics that included two decades in industry and more than two decades at The University of Texas at Austin. Milo was born in Chicago, Illinois, in 1932 and attended the Massachusetts Institute of Technology (MIT), majoring in geophysics and graduating in 1952. He entered graduate school there, completed his Ph.D. in 1956, and joined Geophysical Services Incorporated (GSI) in Dallas. He came to UT Austin in 1975 as the first Pratt Professor of Geophysics, which had been endowed by legendary exploration geophysicist Wallace Pratt with the goal of attracting a person of Milo's stature. Upon retirement in 1998, he moved to Dallas to be near family, while continuing his affiliation with the university as a senior research scientist at its Bureau of Economic Geology until age 80.

Although Milo's doctoral dissertation was in the field of geochemistry, he was surrounded at MIT by colleagues in the Geophysical Analysis Group, a petroleum industry-sponsored project (1952-57) developing time-series analysis tools for geophysical digital data processing, building upon MIT Professor Norbert Wiener's World War II classified research. There was also a direct MIT-GSI pipeline promoted by GSI President Cecil Green to recruit graduate students for summer and permanent positions. Milo worked at GSI, including field work on seismic crews, during his summers, and then joined GSI full time in 1956. Only three years later, he published the landmark paper "Water Reverberations-Their Nature and Elimination" using time-series analysis methods to solve a major problem in seismic reflection prospecting. Digital recording and computer processing were at the heart of this paper, which became the focus of GSI's successful efforts to convert seismic recording in the global exploration geophysics industry from analog to entirely digital recording and processing within a period of about three years. Milo, who was the leader in this remarkable achievement, was soon promoted to GSI vice president and research director. Later in the 1960s and into the early 1970s, Milo led GSI to the forefront of new technologies in exploration seismology, especially in three-dimensiona data acquisition and processing. Technologies developed at GSI under his direction are now the industry standard in the search for petroleum. With its strength in digital data processing, GSI also became a leader in the nascent field of seismic nuclear weapons discrimination, and many of Milo's publications from the 1960s are concerned with associated fundamental problems in array signal processing and detection of seismic signals in noise. Milo was not just a data processing technical genius, but was also deeply engaged in the interpretation of seismic data, traditionally the purview of geologists. His 1975 paper "Flat Spot Exploration" demonstrated that seismic waves reflected from the level surface formed by the water-oil or gas-oil contact in reservoirs provided a direct indicator of hydrocarbons.

Upon joining UT Austin in 1975, Milo taught classes in exploration geophysics and related fields and supervised many master's and doctoral students. Within a few years, he launched an industry-sponsored consortium, Project SEER (Solid Earth Exploration Research), which provided support for students and the industry contact that launched careers for many. The focus of research efforts under SEER were, broadly, to recognize and exploit information from both compressional and shear properties of Earth materials. Up to this point, most exploration seismic methods simply ignored shear properties and shear waves, so an "acoustic" (that is, fluid) Earth was the customary starting model for designing field acquisition and processing methods and for interpreting

data. Milo was again at the forefront of a revolution that changed the exploration geophysics industry. Many research projects from SEER (with students) and later work at the UT Bureau of Economic Geology were concerned with developing methods such as Amplitude Versus Offset (AVO) and others that extract shear properties and associated lithology information from seismic data. He also helped develop field and processing techniques to generate, observe and interpret shear wave reflections. He served as the Society of Exploration Geophysicists (SEG) Distinguished Lecturer in 1985, presenting "The Fourth Dimension—Offset-Dependent Reflectivity," in recognition of his leadership in developing this technology.

During his career, Milo was active in the SEG, serving on many committees and as vice president (1976-77) and president (1979-80). He became an honorary SEG member in 1988, receiving its highest award, the Maurice Ewing Medal, in 1991. His "Flat Spot Exploration" paper was recognized by the European Association of Geophysical Exploration with its Conrad Schlumberger Award in 1975. The 1959 "Water Reverberations" paper was the best article in the SEG journal Geophysics that year. The SEG also granted GSI two Distinguished Achievement Awards recognizing that, under Milo's direction, GSI had led the industry to adopt digital seismic systems and processing methods (awarded 1986) and had developed three-dimensional seismic methods (awarded 1989). After Milo's retirement from the UT Austin faculty, the SEG devoted an article to him in its magazine, The Leading Edge (September 2000), which featured testimonials from former students, many in academic and industry leadership positions. In 2004, the Milo M. Backus Endowed Fund for Exploration Geophysics was created by the Board of Regents of the UT System, with funding provided by Decker Dawson, also a former SEG president and a long time colleague and benefactor of the university. Milo was named to the Jackson School of Geosciences Hall of Distinction by the UT Geology Foundation in 2011.

L. F. (Frank) Brown, Jr., Professor Emeritus of Geological Sciences and a prominent, internationally known geologist, died Dec. 25, 2016. He was 88. Brown was well known to geoscientists worldwide for his seminal contributions in siliciclastic depositional systems—not only formulating the initial concepts, but also applying them to seismic stratigraphy, sequence stratigraphy, and coastal studies management. During his five-decade career, Frank had global influence as a researcher, consultant and mentor. Frank made these contributions while working at the Bureau of Economic Geology in Austin (1957–1960, 1966–1989, 1998–2011), with a faculty appointment at The University of Texas at Austin (1971–1989). He also taught at Baylor University (1960–1969) and worked as a full-time international consultant from 1989 to 1996.

Professor Brown was a native of Oklahoma. He was born and raised in the small town of Drumright, where his father worked in the Gulf Oil production department. After high school, Frank financed his college education by working summers as a roustabout and sometimes as a roughneck. He finished a four-year premedical program at Baylor University in 1950 with a major in chemistry and biology. But rather than attending medical school, he decided to pursue a B.S. degree in geology, which he completed in 1951. He entered the University of Wisconsin at Madison in 1951, earning an M.S. degree in 1953 and a Ph.D. degree in geological and geophysical sciences in 1955.

In 1955 Frank accepted a job with Standard of Texas (Texas Chevron subsidiary) in Amarillo, Texas, but he left there in early 1957 to accept a position of research scientist at the Bureau of Economic Geology in Austin, where he began stratigraphic studies of Pennsylvanian strata on the Eastern Shelf of the Midland Basin. In 1960, Brown became an assistant professor in geology at Baylor University. Frank continued fieldwork in North-Central Texas for the BEG during the summers of 1961 through 1963. In 1966, Frank returned to UT full time as a research scientist, where he continued studying the Eastern Pennsylvanian Shelf of the Midland Basin. Frank also began a long-term research initiative on ancient deltas and other siliciclastic systems with William Fisher. Their work, centering on Cenozoic and Paleozoic deltas, led to the concept of "depositional systems" first published in 1967. In 1969, Brown and Fisher, along with Al Scott and Joe McGowen, published a monograph titled "Delta systems in the exploration for oil and gas," which became the key publication of its time. Brown and Fisher were later (1977) to introduce the concept of "systems tracts," which, along with depositional systems, forms the core of modern sedimentology and stratigraphy.

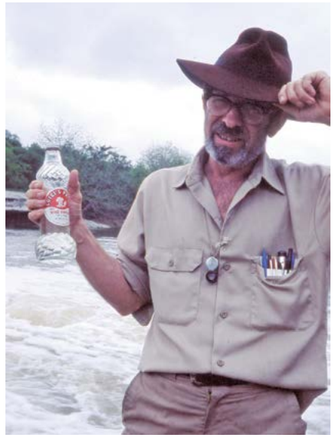
In 1969, Frank undertook direction of the bureau's Gulf Coastal Environmental Geology project. Frank also showed breadth in his field by working on modern depositional systems and environmental geology. During the 1970s, this work resulted in a seven-volume environmental series covering the entire Texas coastal zone, comprising multicolor geologic maps of the Texas coastal Pleistocene and Holocene, as well as many derivative environmental maps emphasizing the impact of coastal processes and planning. Frank also managed the bureau's long-term nuclear waste isolation study of the Palo Duro Basin (1977–1985) for the U.S. Department of Energy and was later involved in siting of the Superconducting Super Collider for the state of Texas.

Brown served as associate director of the bureau from 1971 to 1984 and then as senior research scientist from 1984 to 1989. During most of his tenure at the bureau, Frank served as a rigorous technical editor of all geological publications. A good writer himself, Frank exacted a high standard for clarity of thought and expression in the manuscripts he reviewed. His ubiquitous red ink filled the margins of papers he edited. In 1972, Brown and Fisher began a joint research and training venture with the Brazilian national oil company, Petrobras. For 10 years, Bill and Frank brought Petrobras geologists and geophysicists to Austin for several months of intensive analysis of an offshore Brazilian basin. It was during their Brazilian studies that they developed seismic stratigraphic interpretations of the passive and rifted Brazilian basins, which led to their memorable contribution to the American Association of Petroleum Geologists (AAPG) Memoir 26 (1977) on seismic stratigraphy. Brown articulated his ideas from a direct principle basis and logically extended the concepts of depositional systems into their 2-D seismic stratigraphic signature. From 1987 to 1989, Brown worked closely with three groups of geoscientists from Soekor, then the state oil company of South Africa, doing regional studies in three offshore basins of South Africa. This work was published in the 1995 AAPG Studies in Geology No. 41 and remains a premier publication illustrating how to do regional sequence stratigraphy and basin analysis by integrating different data sets. From 1989 to 1996, Brown retired from the University of Texas to undertake full-time geological consulting and was named professor emeritus. In 1998, he was invited to return to the bureau as a senior research fellow, where he worked until his retirement in 2011.

As a professor in geological sciences Brown co-taught Depositional Systems, supervised seven doctoral and nine master's graduate students, and served on numerous thesis and dissertation committees. He served as an AAPG Distinguished Lecturer, stacking up a record 65 presentations to academic departments and professional societies across the United States. As an international lecturer, Brown taught short courses in more than 40 countries over a four-decade period. Several societies acknowledged Frank's lifetime contributions. He received AAPG's highest award in 2010—the Sidney Powers Medal—for his work in basin analysis. In 2007, he received the Gulf Coast Section SEPM Doris M. Curtis Medal, a career award recognizing his lifetime contributions in sedimentary geology. He was awarded the first honorary life membership of the Permian Basin Section SEPM in 1960. In 1990, he received the Monroe Cheney Award for contributions to the petroleum geology of the Southwest by the AAPG Southwest Section. In 2008 he received the AAPG Pioneer Award.

Frank and his wife, Linda, enjoyed living in Georgetown, Texas. She preceded him in death in 2015. Frank Brown was a brilliant and dedicated scientist with a keen appreciation for detail and thoroughness in his work and writings. His legacy will be the rigorous scholarship he practiced and inspired to advance key concepts in the geological sciences. He is missed by his many colleagues in geology throughout the world.

Ann M. Molineux (Ph.D. '97) passed away February 2018. She worked tirelessly to build, promote and preserve the amazing collections we have here at The University of Texas at Austin, and was a mentor and friend to so many of us here and around the globe. She will be deeply missed by those within the scientific community, and the many organizations in which she was actively involved. She was born in Lindfield, Sussex, England and earned her M.A. in geography from Cambridge University in 1965. Her professional career began as a cartographer at the Oxford University Press, followed by Syracuse University, Harvard University Laboratory for Computer Graphics, Boston University, and the NERC Experimental Cartography Unit in London, England. Her focus at the time was on developing computerized methods for cartography. After a hiatus while raising her family, she obtained a Texas Certificate of Education in earth sciences in 1989, followed by a Ph.D. in geology in 1997, both from The University of Texas at Austin. After completing her Ph.D., it seemed that no occupation could be quite as challenging or exciting as hunting for calcified demosponges (sclerosponges) in the Caribbean. She was mistaken. Fascinated by the wealth of fossil material in the collections, she was infected by a strong desire to develop some way to make the collections more accessible to everyone. This involved making them accessible both for research, exhibit and education. She became collections manager at the Non-Vertebrate Paleontology Laboratory (NPL), eventually becoming director of museum operations and curator of the NPL at the Jackson School Museum of Earth History. Paleontology remained an insatiable passion for Molineux, with her own paleontological research interests involving relationships between organisms and what can be learned from their patterns of growth, especially within reef environments. She was particularly interested in sponges and rudist bivalves and conducted specimen-based research grounded in fieldwork and collections. Her career came full circle as she turned her attention to the development and application of computer technologies to enhance the relevance of NPL collections for stratigraphic and paleobiological research. Ann was a true visionary about the possibiltiies of digital technologies for expanding access to the UT collections, and for organizing and storing curatorial information to facilitate local access and improve collections management. Those efforts earned her enhanced national and international recognition, and elevated the NPL collections to a new plane of relevance in the museum community. To acknowledge Molineux's devotion to sharing the collections and her exemplary technical skills, The University of Texas at Austin recently named a room in the NPL the "Ann Molineux Paleontology Laboratory."



Robert Louis (Luigi) Folk. On June 4, 2018, the Department of Geological Sciences of The University of Texas at Austin and the sedimentary geology community of the world lost one of its heroes, Dr. Robert (Bob) Louis (Luigi) Folk. Bob joined UT Austin in 1952 and retired as professor emeritus in 1987 after 35 years of service, although he continued his research and provided counsel to students for another 20 years. He supervised more than 50 graduate students, many of whom had stellar careers in academe and industry. He established an international reputation based on his classifications and interpretations of the origins of sandstones and limestones, but also on his ebullient personality that allowed him to build friendships and collaborations with colleagues all over the world.

Folk authored more than 100 research papers in international scientific journals and professional volumes. Six of his publications have more than 1,000 citations and his soft-bound quasi-textbook on the Petrology of Sedimentary Rocks, first printed in 1957, has 10,000 citations. The value of his written and oral contributions earned him the W.H. Twenhofel Gold Medal from the Society of Sedimentary Geology (1979), the H.C. Sorby Medal from the International Association of Sedimentologists (1990), and the Penrose Gold Medal from the Geological Society of America (2000). In addition, he was awarded the Neil Miner Outstanding Teacher Award from the National Association of Geology Teachers (1989).

Folk was born in 1925 in Cleveland, Ohio, a son of George Billmyer Folk and Marjorie Kinkead. He became interested in rocks and minerals around age 5 because of all the pretty pebbles that had been carried down from the Canadian shield by glaciers. He became attracted to sedimentary rock classifications, because there existed exotic names for igneous rocks, like andesite or gabbro, but sediments were just sandstone, limestone or shale; he thought there must be a better way. Later, he found the better way and his classification of sedimentary rocks is still one of the gold standards and established him as one of the founders of "Soft Rock Geology."

Bob received his B.A., M.S., and Ph.D. from Penn State, where he was strongly influenced by P. D. Krynine, one of the stalwarts of sedimentary geology. After getting a Ph.D. in 1952, he spent a postdoc at Columbia University. Bob worked briefly for Gulf Research and Development Company in Houston, Texas, Mississippi, and Alabama examining marine sediments and river sands of the eastern Gulf Coast. At that time, textural analysis was thought to be the "key to finding oil fields." But Bob decided that his future lay in teaching, and in February 1952, while driving through Austin, Texas, Bob walked in off the street to the Geology Department and asked if they had any jobs. Luckily, their sedimentologist was about to retire, so the department chair virtually hired him on the spot for $4,200 a year. In those days, before the pressure of grant-driven science, the department allowed him to work on anything he pleased—dune sands in Australia, pebble shapes in Tahiti, modern carbonate sediments of Yucatan, the petrology of avian urine, the petrography of roofing tiles, enhanced stereo vision using two hands, black phytokarst from Hell, a unit of scuffle abrasion on stone steps, vitrified rat feces of aragonite, and a challenge to the concept that the pyramids of Egypt are made of epoxy-cemented crushed stone. He did this research without having to squander science-time writing proposals. Wherever he traveled Bob sought out the local culture and cuisine, using bits of languages he quickly acquired and applied with abandon. He was passably fluent in Czech and Italian, but never hesitated to make exclamations in Chinese. He liked to grade graduate student papers in Egyptian hieroglyphics, leaving it up to the students to translate his marking system.

He had many hobbies, including a very complicated dice baseball game that he started in 1944 and maintained right up until last year. He enjoyed history, particularly about the Civil War (both great-grandfathers were in the war), non-realistic painting (several people have his acrylics), and collecting rocks, stamps and coins, as well as engaging in amateur astronomy.

He served as a geological consultant on archaeological studies in Israel and southern Italy.

Bob liked to dance with his wife and students at the Broken Spoke, and loved country music as well as Grand Opera, Symphony, and popular, melodious music. Marge and he were members of the Wedding Ring class at First Methodist Church from 1954 on. They enjoyed almost every weekend at their log cabin overlooking Lake Travis. Bob was also an accomplished pasta chef (sauces only).

The last item in his recipe for carbonara is "add a smattering of fireplace ashes."

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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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Research Unit Experience:
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Additional details on UT Austin or JSG experience:

Class Notes for the 2019 Newsletter

Attach a separate sheet or use the online form at **www.jsg.utexas.edu/alumni** for longer entries.

Check if you would like more information on:
❍ Alumni events in your area or at upcoming geoscience meetings
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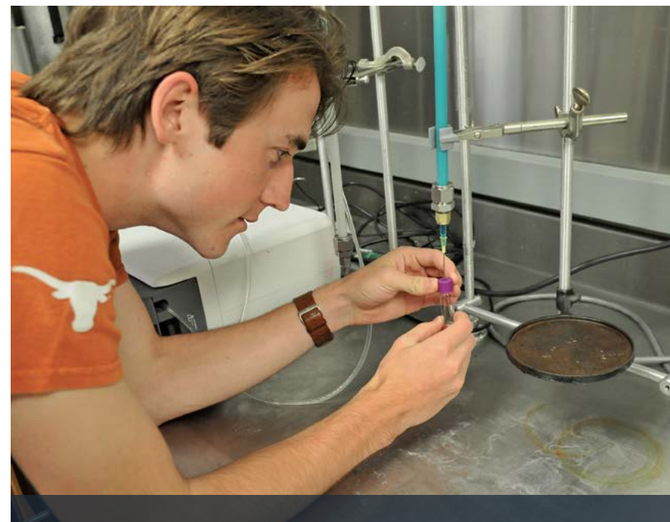

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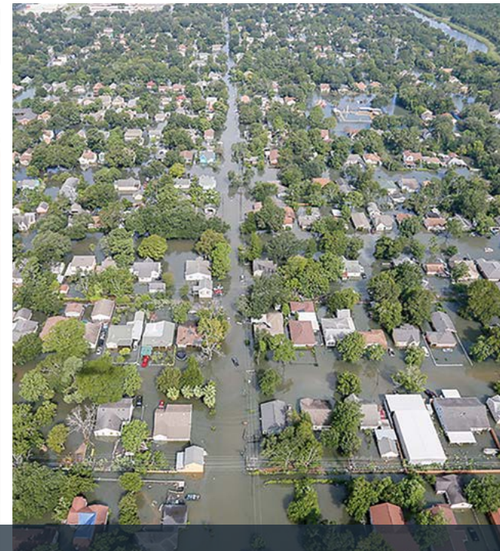

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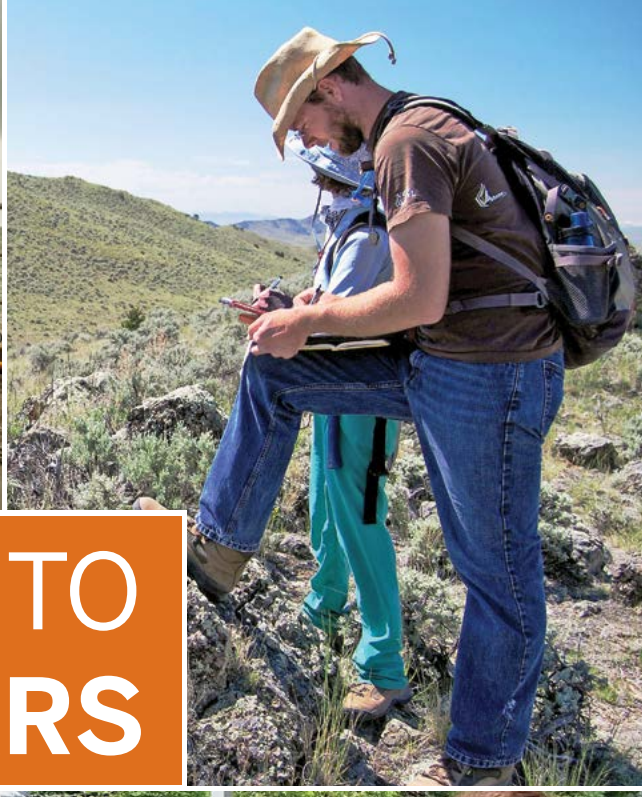

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