THE UNIVERSITY OF TEXAS AT AUSTIN · JACKSON SCHOOL OF GEOSCIENCES · 2022 NEWSLETTER

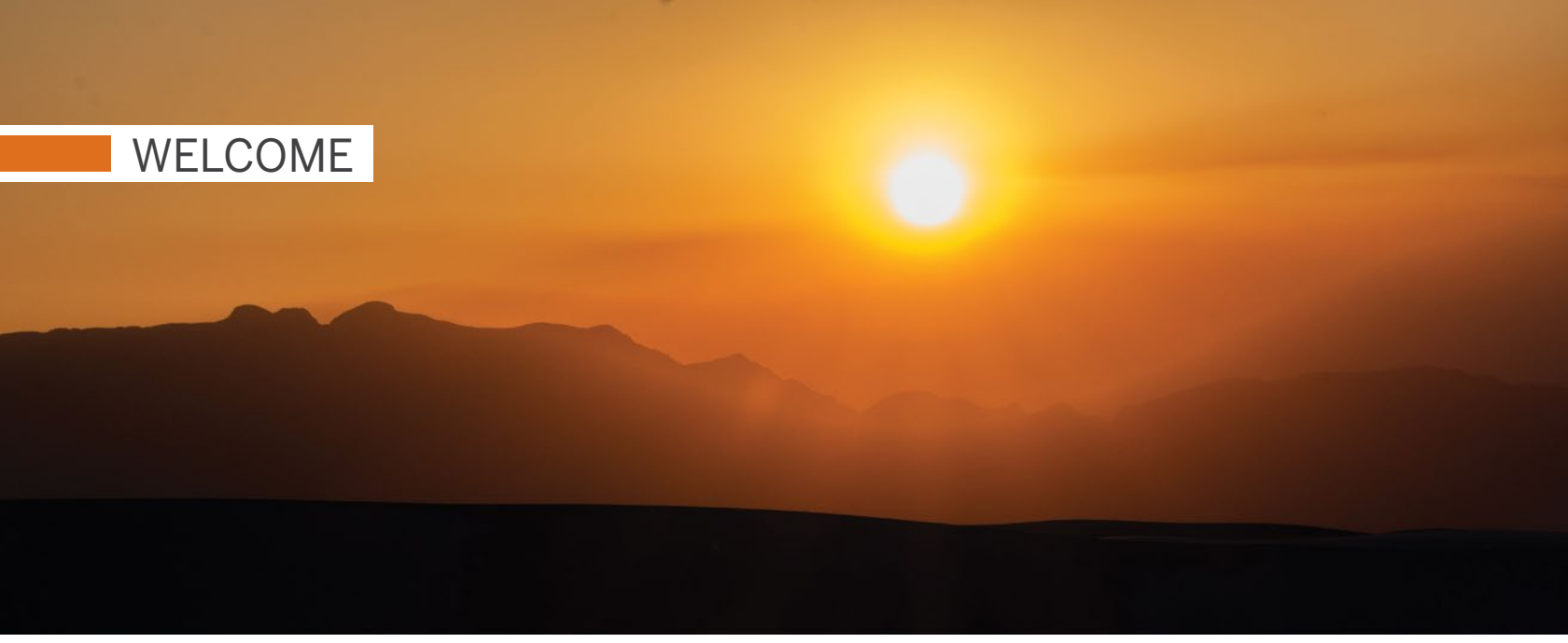
2022 Newsletter

Looking at the World in New Ways

The University of Texas at Austin
Jackson School of Geosciences

THANK YOU!

From the next generation of geoscientists to the ones who paved the way



WELCOME

Dear Alumni and Friends,

The *Newsletter* cover probably caught your attention—a photo of the famously red rocks of the Garden of the Gods National Natural Landmark in Colorado, taken with a digital camera modified to capture infrared light. The cover is a wonderful metaphor for the ever-expanding toolkit that geoscientists use to observe Earth materials and processes, from the planet's core to its atmosphere, and to other worlds in our solar system and beyond.

Technological innovation supports new discoveries that, in turn, drive innovation in the virtuous cycle of scientific research. That research provides the knowledge we use to identify and develop the energy, mineral and water resources that enable a healthy economy and environment and which we can use to mitigate and build resilience to natural disasters and climate change impacts.

At the Jackson School of Geosciences, we strive to innovate and utilize new technologies to better comprehend the forces that shape our world and their spatial and temporal variability. New technologies, new methodologies and new process-based models are greatly enhancing our ability to understand and predict the behavior of Earth systems even as they are undergoing rapid change.

This year's *Newsletter* is full of tremendous examples of technology enabling new ways of seeing, teaching and understanding Earth. Take a look at the efforts of Chris Zahm, Charlie Kerans and others to digitize inaccessible outcrops (page 44), or doctoral student Travis Stone's efforts to create virtual field sites from his work in Morocco (page 72).

Our researchers and students are using computational tools and skills to gain insight on things previously hypothesized but never proved. For instance, geoscientists at the University of Texas Institute for Geophysics used 20 years of seismic data and one of the most powerful supercomputers in the world at UT's Texas Advanced Computing Center to define the shape of a mountain-size pluton buried miles under the coast of Japan and how it affects seismicity and other tectonic processes (page 22).

Follow the efforts of Bridget Scanlon to use years of satellite data to track water storage in Africa's major aquifers and provide insights on sustainably managing the vital resource (page 14). And read how Ginny Catania is leading an upcoming mission to send a robotic submarine to get a first-time view and samples of the underwater face of Greenland's glaciers and basal sediments (page 16).

I could go on and on!

At the Jackson School, we are dedicated to educating the geosciences leaders of the future, to prepare them to lead geosciences efforts that we can't even conceive of at the moment. To accomplish that, we are doing critical scientific research and teaching that is unmatched in depth and breadth by any other geosciences institution.

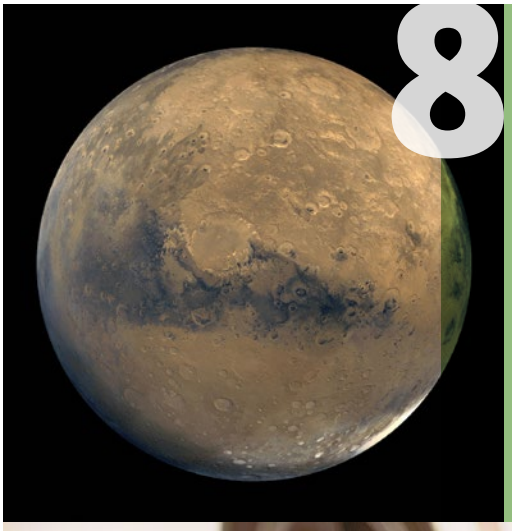
I am extremely proud of the work of our students, faculty, researchers and staff, and as you look through these pages, I know you will be too.

The world needs geoscientists!

Enjoy the *Newsletter*,

Claudia Mora, Dean

FEATURES



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A study by Professor Brian Horton and Jackson School alumni explores how geologic variations in the Andes mountains might be connected to three major geologic phenomena.

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Professor Julia Clarke is a champion for diversity, equity and inclusion in geosciences, with a long record of community involvement. Learn more about her new role as associate dean and her plans for diversity, engagement and outreach at the Jackson School.

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The climate system science major will help students develop a technical, scientific understanding of the Earth's climate and the forces that control it.

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The University of Texas at Austin Jackson School of Geosciences is one of the top research institutions in the world, with a depth and breadth of research that sets it apart. This is made possible by the Jackson School's three world-class units: the Bureau of Economic Geology, the Department of Geological Sciences and the University of Texas Institute for Geophysics. Following are some research highlights from the past year.

- *Climate & Environment*
- *Energy Geosciences*
- *Marine Geosciences*
- *Planetary Sciences & Geobiology*
- *Solid Earth & Tectonic Processes*
- *Surface & Hydrologic Processes*
- *Education*

Jackson School Again Ranks No. 1 in Geology

Education

The Jackson School of Geosciences once again has been rated the No. 1 geology program in the country by *U.S. News & World Report* in its 2022 rankings of best graduate programs.

The Jackson School was also ranked the No. 4 geophysics and seismology program (second among public universities), No. 4 in paleontology (second among public universities), and No. 6 in overall Earth sciences (tied for second among public universities) in the prestigious rankings.

"I'm so proud of the faculty, research scientists, students and staff at this school who made this possible," said Jackson School Dean Claudia Mora. "The geosciences are fundamental to solving the big issues facing our world, from climate change and the energy transition to water issues and natural disasters. That's what drives the education and research at the Jackson School. These rankings are another indication that we are on the right track."

The school has improved across the board since the last rankings came out four years ago. It now stands alone in the No. 1 spot in geology that was tied in the last rankings. In overall Earth sciences, it improved from No. 7 to No. 6; in geophysics and seismology is improved from No. 7 to No. 4; and in paleontology it went from unranked to No. 4.

UT also boasts five specialty programs ranked No. 1 including geology. The other No. 1 programs are accounting, petroleum engineering, Latin American history and sociology of population.

ABOVE: (L TO R) JACKSON SCHOOL STUDENTS LETICIA HSIEH, MARLOWE VAUGHAN BUELER AND MEAGAN BITTNER GIVE A HOOK 'EM AT THE WHAT STARTS HERE CAMPAIGN LAUNCH.

PHOTO: JACKSON SCHOOL.

Tracking Pressure in the Permian

Energy Geosciences

A model created at the Bureau of Economic Geology is providing the most comprehensive look yet at subsurface pressure buildup associated with wastewater injection in the Delaware Mountain Group, the most commonly used geologic layer for disposing of water brought up by oil and gas production in the Permian Basin.

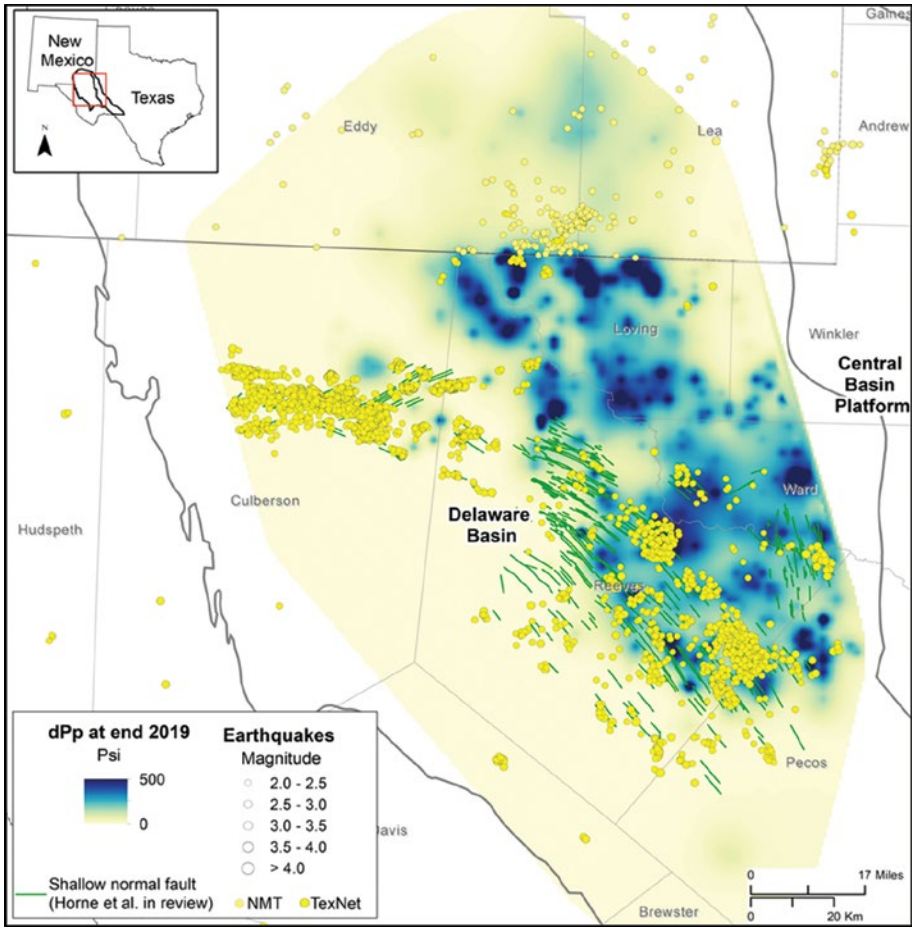
To date, more than 11 billion barrels of wastewater has been injected into the formation. With all that water comes changes in subsurface pressure, which in some cases has been linked to increased seismicity.

The model could help develop strategies to mitigate induced earthquakes and other issues related to injection, said Peter Hennings, the principal investigator at the bureau's Center for Integrated Seismicity Research.

A study that used the model to investigate wastewater flow and associated pressure changes in the Delaware Mountain Group during the past 36 years was published in the *Journal of Hydrology: Regional Studies* in February 2022.

"We are modeling the impact from the very beginning of record-keeping throughout the area of interest," said lead author Jun Ge, a bureau research scientist associate. "We include all of the details of water disposal activities in the area."

According to the model, the increase in pore pressure in the formation can be significant, ranging from 100 to 400 pounds per square inch, with some areas potentially reaching up to 500 psi and higher near wastewater injection wells.



ABOVE: A PORE PRESSURE MAP OF THE DELAWARE MOUNTAIN GROUP CREATED BY THE MODEL. DARKER BLUE INDICATES HIGHER PRESSURE. YELLOW DOTS ARE TEXNET SEISMIC MONITORING STATIONS.

The model confirmed earlier research linking some earthquakes in the southern region of the Delaware Basin to wastewater injection. However, the connection between these quakes and wastewater injection is more complicated in the northern region of the basin, where seismic activity is increasing.

As wastewater injection into the formation is only expected to increase during the years ahead and then continue for decades, Hennings said that the model can help untangle the effects of injection on seismicity, the integrity of thousands of old oil wells in the region and to the land surface itself.

"This work is so timely because it provides a basis for how we view the potential impact of injection and how these injection reservoirs can be managed as resources for disposal," he said.

The study's additional co-authors are the bureau's Katie Smye, J.P. Nicot, Seyyed Hosseini, Caroline Breton and Rebecca Gao, who is also a doctoral student in the Department of Geological Sciences.

MAP: JUN GE ET AL.

Overall, The University of Texas at Austin was ranked one of the top public universities in the country. The publication ranked 53 of the university's graduate programs and specialties among the top 10 in the nation. UT is one of only four public universities with 50 or more specialties ranked so highly.

"With strength in so many disciplines, UT is without doubt one of the best places in the world to pursue graduate studies," said UT President Jay Hartzell.

U.S. News & World Report updates its academic rankings every four years on a staggered basis.

CO_2 Has Little Influence on Tropical Forest Growth

Climate & Environment

The amount of carbon dioxide (CO_2) in the Earth's atmosphere has only a small influence on changes in tropical ecosystems despite evidence of enhanced plant growth under elevated CO_2 scenarios in greenhouse experiments, according to a new international study.

That means it's unlikely that tropical forests will expand in response to rising greenhouse gas levels, an outcome that some had hoped might lead to increased CO_2 storage in tropical ecosystems as carbon-rich woody plants replace grasslands, which are less adept at storing CO_2.

The study was published in May 2020 in *Science*. The research team was made up of scientists from the Netherlands, United Kingdom and United States, including scientists at the Jackson School of Geosciences.

The researchers analyzed 500,000 years of tropical vegetation change in West Africa and found that CO_2 had less of an influence on tropical forest growth than water, wildfires and animal grazing did.

The research examined data extracted from the sediments of Ghana's Lake Bosumtwi, a meteorite impact crater lake that formed more than 1 million years ago. The lake sediment record at the center of the study was extracted more than a decade ago during a National Science Foundation-funded mission led by study co-authors Timothy Shanahan, a professor in the Jackson School's Department of Geological Sciences, and Jonathan Overpeck, a professor at the University of Michigan.

By examining pollen and biological and geochemical records preserved in sediment cores, the researchers were able to reconstruct ecosystem changes in the region and compare them with published records of atmospheric CO_2 from ice cores and new climate model simulations of past temperature and precipitation changes.

The results showed that water availability and wildfires were the most important factors when it came to increasing the coverage of woody plants and set the threshold for transitioning savanna into tropical forest. The effect of CO_2 was small. Even when different methods incorporating uncertainties into the reconstructions were analyzed, the results were the same, said Shanahan.

"Whatever model you use, basically the dominant control on vegetation turns out to be precipitation and disturbance," he said. "What our study shows is that CO_2 plays, at least in the geologic record, a very small role."

ABOVE: TROPICAL VEGETATION NEAR LAKE BOSUMTWI IN GHANA, WHERE SEDIMENTS WERE COLLECTED.

PHOTO: WILLIAM GOSLING.

Researchers Link Coastal Glacier Retreat to Human-Caused Climate Change

Climate & Environment

More of the world's coastal glaciers are melting faster than ever, but exactly what's triggering the large-scale retreat has been difficult to prove because of natural fluctuations in the glaciers' surroundings. Researchers at the University of Texas Institute for Geophysics and the Georgia Institute of Technology think they've cracked a methodology that determines why coastal glaciers retreat, and in turn, how much can be attributed to human-caused climate change.

So far, scientists have only tested the approach in computer models using simplified glaciers. They found that even modest global warming caused most glaciers to melt. The next step is to simulate the coastal glaciers of a real ice sheet such as Greenland's, which holds enough ice to raise sea level by about 20 feet.

Published in July 2022 in the journal *The Cryosphere*, the methodology is unique because it treats rapid glacier retreat as an individual probabilistic event, like a wildfire or tropical storm. The probability of a large retreat happening varies depending on the glacier's stability threshold (usually a steep rise in the bedrock that slows its flow), climate and

Delaware Basin Quakes Linked to Production

Energy Geosciences

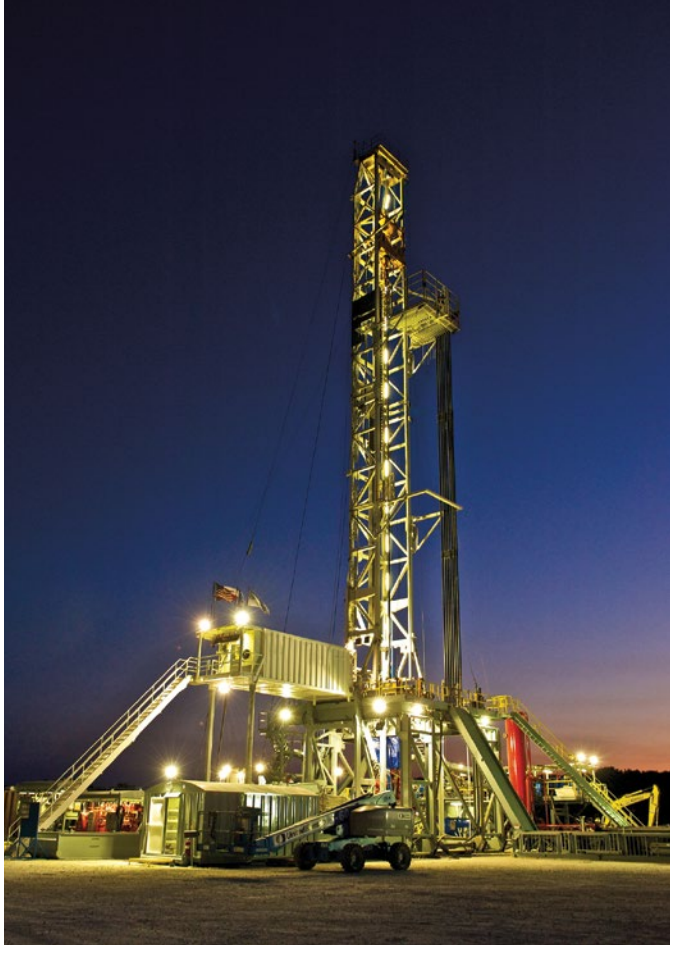
Since 2009, earthquakes have been rapidly rising in the Delaware Basin—a prolific oil-producing region in West Texas and New Mexico. According to a study led by researchers at the Bureau of Economic Geology, most of them can be linked to oil and gas production.

The researchers looked back on data that tracked seismicity and oil and gas production in the region from 2017 to 2020 and found that 68% of earthquakes above magnitude 1.5 were highly associated with hydraulic fracturing or the disposal of produced formation water into either shallow or deep geologic formations.

All of these production activities are known to increase subsurface pore pressure, which is a mechanism for triggering earthquakes, said the study's co-author, Alexandros Savvaidis, a researcher at the bureau and the principal investigator for TexNet, the state's seismic monitoring network that's overseen by the bureau. By using a combination of statistical analysis and physics-based modeling, the study was able to disentangle which activities have a connection to past earthquakes.

"The modeling techniques could help oil and gas producers and regulators identify potential risks and adjust production and disposal activity to decrease them," Savvaidis said.

The study was published in *Seismological Research Letters*. The researchers analyzed about 5,000 earthquakes. Forty-three percent of earthquakes above magnitude 1.5 were linked with injection into shallow sedimentary formations above the hydraulic fracturing depth; 12% were linked with injection into deep sedimentary formations above the basement rock and below the hydraulic fracturing depth. The 2020 magnitude 5.0 earthquake that occurred in Mentone, Texas, happened in a region where seismicity was strongly associated with deep produced water injection. Hydraulic fracturing was linked to only 13% of earthquakes. However, this was higher than previously expected.



ABOVE: DRILLING RIG EXPLORING FOR OIL AND GAS.

ocean fluctuations, and human-caused warming. Even small variations can cause large changes in a glacier's behavior, making them hard to predict.

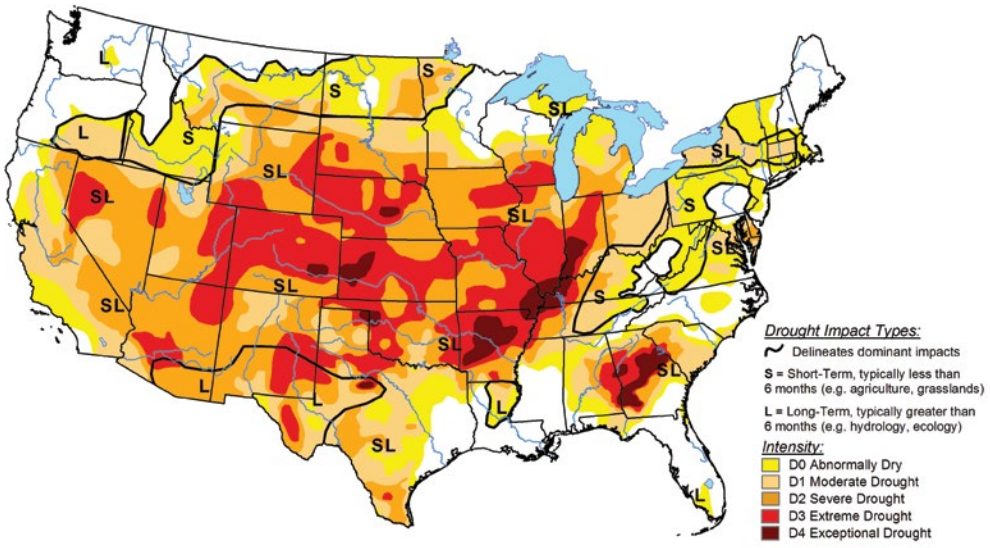
The new methodology accounts for those variations while testing the effect of background trends such as global warming. Co-author and Jackson School of Geosciences Professor Ginny Catania said that means they can now attribute mass coastal glacier retreat to climate change and not just natural variability.

"And that's the first time anyone's done that," she said.

The team ran thousands of simulations of the past 150 years with and without global warming. The simulations showed that even modest warming dramatically increased the probability of ice sheet-wide glacier retreat.

RIGHT: GREENLAND GLACIER EQIP SERMIA HAS RETREATED IN THE LAST TWO DECADES.

GLACIER: JOHN ERICH CHRISTIAN. DELAWARE: BUREAU OF ECONOMIC GEOLOGY.



Flash Droughts Getting Faster

Climate & Environment

Just like flash floods, flash droughts come on fast—drying out soil in a matter of days to weeks. These events can wipe out crops and cause huge economic losses. And according to scientists, the speed at which they dry out the landscape has increased.

Researchers at the Jackson School of Geosciences, The Hong Kong Polytechnic University and Texas Tech University found that although the number of flash droughts has remained stable during the past two decades, more of them are coming on faster. Globally, the flash droughts that come on the fastest—sending areas into drought conditions within just five days—have increased by about 3%-19%. And in places that are especially prone to flash droughts—such as South Asia, Southeast Asia and central North America—that increase is about 22%-59%.

Rising global temperatures are probably behind the faster onset, said co-author and Jackson School Professor Zong-Liang Yang, who added that the study's results underscore the importance of understanding flash droughts and preparing for their effects.

"Every year, we are seeing record-breaking warming episodes, and that is a good precursor to these flash droughts," he said. "The hope and purpose [of this research] is to minimize the detrimental effects."

The research was published in *Nature Communications*.

As the name suggests, flash droughts are short lived, usually lasting only a few weeks or months. But when they occur during critical growing periods, they can cause disasters. For example, during the summer of 2012, a flash drought in the central United States caused the corn crop to wither, leading to an estimated $35.7 billion in losses.

In this study, the scientists analyzed global hydroclimate data sets that use satellite soil moisture measurements to capture a global picture of flash drought and how it has changed during the past 21 years.

ABOVE: A MAP SHOWING THE PEAK OF A FLASH DROUGHT THAT STRUCK THE MIDWEST IN MID-JULY 2012.
LEFT: DRY CORN STALKS IN IOWA DURING THE FLASH DROUGHT OF SUMMER 2012.

Martian Mirage

Planetary Sciences & Geobiology

Liquid water previously detected under Mars' ice-covered south pole is probably just a dusty mirage, according to a new study of the red planet led by researchers at the University of Texas Institute for Geophysics (UTIG).

Scientists in 2018 had thought they were looking at liquid water when they saw bright radar reflections under the polar cap. However, the study published in the journal *Geophysical Research Letters* found that the reflections matched those of volcanic plains found all over the red planet's surface.

The researchers think their conclusion—volcanic rock buried under ice—is a more plausible explanation for the 2018 discovery, which was already in question after scientists calculated the unlikely conditions needed to keep water in a liquid state at Mars' cold, arid south pole.

"For water to be sustained this close to the surface, you need both a very salty environment and a strong, locally generated heat source, but that doesn't

DROUGHTS: RICHARD HEIM/ NCEI/NOAA (TOP); USDA (BOTTOM). MARS SURFACE: ESA/DLR/FU BERLIN.

match what we know of this region," said the study's lead author, Cyril Grima, a planetary scientist at UTIG.

The south polar mirage dissolved when Grima added an imaginary global ice sheet across a radar map of Mars. The imaginary ice showed how Mars' terrains would appear when looked at through a mile of ice, allowing scientists to compare features across the entire planet with those under the polar cap.

Grima noticed bright reflections, just like those seen in the south pole but scattered across all latitudes. In as many as could be confirmed, they matched the location of volcanic plains.

On Earth, iron-rich lava flows can leave behind rocks that reflect radar in a similar way. Other possibilities include mineral deposits in dried riverbeds.

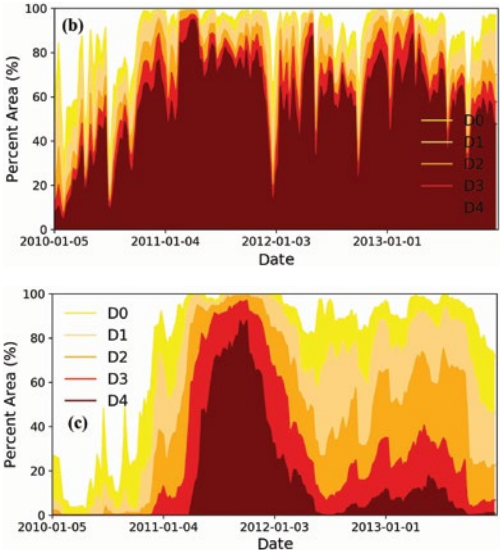
Grima's map is based on three years of data from MARSIS, a radar instrument launched in 2005 aboard the European Space Agency's Mars Express that has accumulated tremendous amounts of information about Mars.

BELOW: ICE AT MARS' SOUTH POLE. **INSET:** A RADAR MAP OF MARS AS SEEN THROUGH A MILE OF ICE. VOLCANIC PLAINS ARE IN RED, REFLECTING RADAR IN A MANNER SIMILAR TO LIQUID WATER.

MARS INSET: CYRIL GRIMA. TEXAS DROUGHTS: USDA. CHARTS: WEIJING CHEN ET AL.

Brutal Texas Drought Even Worse

Climate & Environment



In 2011, Texas experienced one of its worst droughts ever. The dry, parched conditions caused over $7 billion in crop and livestock losses, sparked wildfires, pushed power grids to the limit, and reduced reservoirs to dangerously low levels.

And according to a recent study led by the Jackson School of Geosciences, the drought was worse than previously thought.

The study, published in the *Journal of Hydrology,* incorporated additional soil moisture-related data from gravity and microwave sensors on satellites into a land surface model used by scientists to determine the severity of droughts. According to the updated model simulation, severe drought was more widespread and longer lasting than judged by the U.S. Drought Monitor, which is the current standard for designating drought across the United States.

"The development of technology has allowed us to gain more real-time observation, and this observation can more accurately reflect the ground conditions," said Weijing Chen, the study's lead author and a postdoctoral researcher at the Jackson School.

Even though the 2011 drought is now a decade gone, the results are important because they show that incorporating new sources of data related to soil moisture into an existing land surface model can more accurately predict the severity and impact of droughts. Soil moisture is one of the most important factors when it comes to a drought's impact on agricultural production.

The researchers said that developing methods for better understanding droughts is important to Texas as policymakers try to determine how the state's water resources will be affected by climate change and population growth.

"Using measurements from space is a clever way to be able to more realistically detect and monitor droughts," said co-author Zong-Liang Yang, a professor in the Department of Geological Sciences.

AT TOP: A FIELD DRIED OUT FROM THE 2011 DROUGHT. **ABOVE:** DROUGHT AREA AND SEVERITY IN TEXAS FROM 2010 TO 2013 AS DETERMINED BY THE U.S. DROUGHT MONITOR (BOTTOM) AND AN UPDATED MODEL (TOP).

Exploring Shale Plays Online

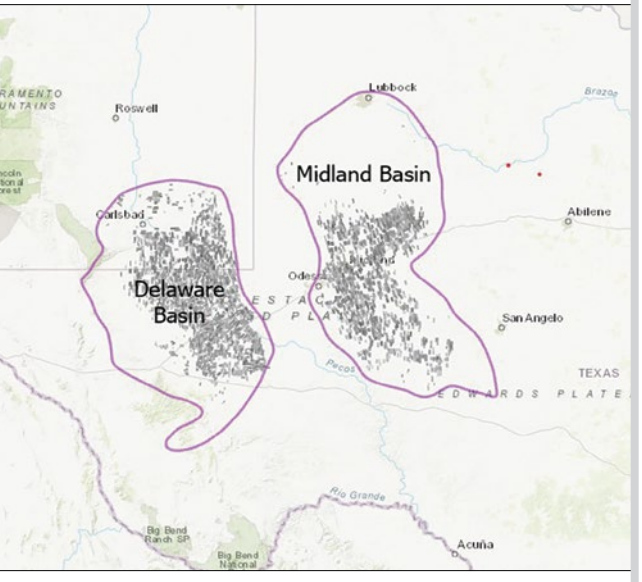
Energy Geosciences

An interactive online portal created by the Bureau of Economic Geology is providing a comprehensive look into studies and maps of U.S. shale gas and tight oil plays.

The portal was launched by the bureau's Tight Oil Resource Assessment (TORA) consortium and offers play-wide and granular mapping of the country's nine major shale gas and tight oil plays, highlighting the areas of highest productivity, in-place resources, and technically recoverable resources. The mapping is based on a robust workflow that characterizes the subsurface and incorporates economic analysis, including profitability-driven future activities.

A limited version of the portal is available to the public, with TORA member organizations having access to the full content of the basin and play content.

Access the portal at ***maps.beg.utexas.edu/toraportal***



ABOVE: A VIEW OF THE INTERACTIVE ONLINE PORTAL.

Mammoth Bones Rewrite Human History

Planetary Sciences & Geobiology

In 2016, Jackson School Professor Timothy Rowe began investigating mammoth bones that were discovered on his New Mexico property.

Six years later, he and research collaborators published a study making the case that the bones are the remains of a prehistoric butchering site—and offer some of the most conclusive evidence for humans settling in North American thousands of years before conventionally thought.

"What we've got is amazing," said Rowe. "It's not a charismatic site with a beautiful skeleton laid out on its side. It's all busted up. But that's what the story is."

Their findings were published in *Frontiers in Ecology and Evolution* in July 2022.

Jackson School co-authors include Professor Richard Ketcham and research scientists Romy Hanna and Matthew Colbert.

The mammoth site offers a wealth of evidence rarely found in one place. It includes fossils with blunt force fractures, bone flake knives with worn edges, and signs of controlled fire. And thanks to carbon dating analysis on collagen extracted from the mammoth bones, the site also comes with a settled age of 36,250–38,900 years old, making it among the oldest known anthropological sites in North America.

The Clovis culture—which dates to 16,000 years ago—left behind obvious stone-wrought tools. But at older sites that lack tools, evidence for human settlement gets more subjective.

In their study, Rowe and his co-authors compile an array of evidence to support their butchering hypothesis.

AT TOP: THE EXCAVATION SITE, INCLUDING A PORTION OF THE MAMMOTH SKULL.
ABOVE: BUTCHERING MARKS ON MAMMOTH RIBS.

SHALE: BUREAU OF ECONOMIC GEOLOGY. MAMMOTH: TIMOTHY ROWE.

Predicting Earthquake Damage

Solid Earth & Tectonic Processes

New research from the Jackson School of Geosciences could change the way scientists think about potential damage from earthquakes.

The study examined data from one of the densest seismic arrays ever deployed and found that earthquakes emit their strongest seismic shockwaves in four opposing directions. The effect, which leaves a pattern resembling a four-leaf clover, has been known for decades but never measured in such vivid detail.

Daniel Trugman, an assistant professor in the Department of Geological Sciences, said that the study looked at only one type of seismic shaking caused by very small earthquakes in northern Oklahoma.

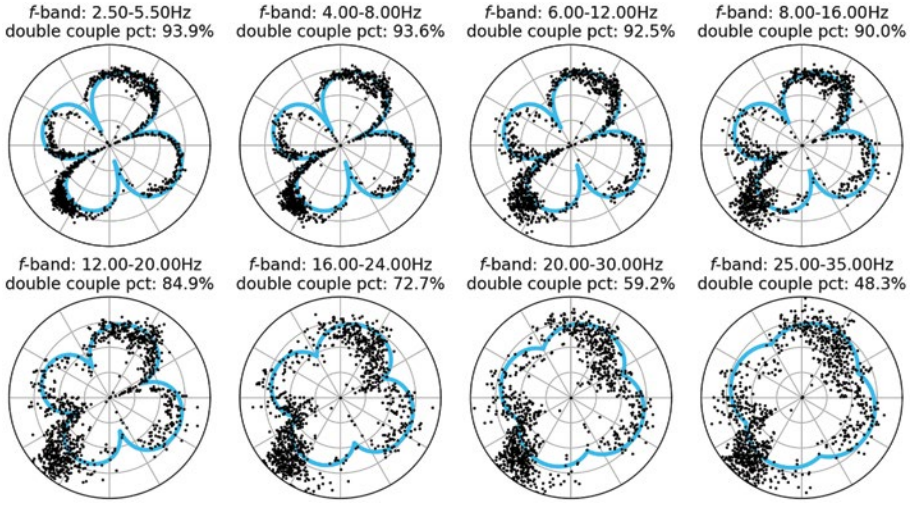
"What's important in these results is that close to the source, we're seeing a variation in ground motion, and that's not accounted for in any sort of hazard model," Trugman said. He added that efforts were already underway to see how the phenomena plays out in California's big fault systems.

The analysis was published in *Geophysical Research Letters* and is based on measurements of two dozen small earthquakes recorded by the LArge-n Seismic Survey in Oklahoma (LASSO), an array of 1,829 seismic sensors deployed for 28 days in 2016 to monitor a remote corner of the state measuring 15 by 20 miles.

When earthquakes strike, they release a thunderclap of seismic energy at many frequencies, but the actual ground shaking people feel ranges from about 1 hertz to 20 hertz. The study found that low-frequency energy—about 1 to 10 hertz—shot from the fault in four directions but barely registered outside of the four-leaf clover pattern. This is important because buildings are more vulnerable to low-frequency waves. The four-leaf clover pattern was not found for higher frequency waves, which travelled at equal strength in all directions, like ripples in a pond.

Co-author Victor Tsai, a geophysicist at Brown University, said that the reason the ground shook unevenly at different frequencies might have something to do with the complex geometry of earthquake faults and the broken-up material packed between them. This material redirects the energy randomly, but at lower frequencies seismic waves simply bypass the rough geologic mess near the fault, travelling in a nice four-leaf clover pattern just as physics predicts.

This means that on the surface, people might feel the same shaking regardless of where they stood, but buildings—which are sensitive to low-frequency waves—would feel the earthquake much more intensely within the lines of the four-leaf clover pattern.



AT TOP: A RUPTURED FAULT IN SEARLES VALLEY, CALIFORNIA, AFTER THE 2019 RIDGECREST EARTHQUAKES.
ABOVE: A TREMOR'S LOW FREQUENCY SEISMIC WAVES TRAVEL IN A FOUR-LEAF CLOVER PATTERN. HOWEVER, THE PATTERN BREAKS DOWN AND SEISMIC WAVES TRAVEL IN ALL DIRECTIONS ABOVE 15 HZ.

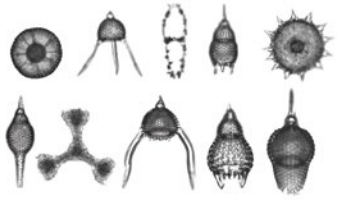
PHOTO: BEN BROOKS/USGS. DIAGRAM: DANIEL TRUGMAN, VICTOR TSAI/AGU.

Bone samples scanned at the Jackson School's University of Texas Computed Tomography Facility were found to have butchering marks. This includes bone flakes with microscopic fracture networks akin to those in freshly knapped cow bones, and well-placed puncture wounds that would have helped drain grease from ribs and vertebral bones.

And chemical analysis of the weathered rock surrounding the bones showed that fire particles came from a sustained and controlled burn, not a lightning strike or wildfire. The material also contained pulverized bone and the burned remains of small animals.

How the Gulf Dodged Mass Extinction

Marine Geosciences



An ancient bout of global warming 56 million years ago that acidified oceans and wiped out marine life had a milder effect in the Gulf of Mexico, where life was sheltered by the basin's unique geology, according to research by the University of Texas Institute for Geophysics (UTIG).

Although the Gulf of Mexico of the present is very different from that of the past, the study offers valuable lessons about modern climate change, said the study's lead author, UTIG geochemist Bob Cunningham.

"This event known as the Paleocene-Eocene Thermal Maximum, or PETM, is very important to understand because it's pointing towards a very powerful, albeit brief, injection of carbon into the atmosphere that's akin to what's happening now," he said.

The findings were published in the journal *Marine and Petroleum Geology* in April 2022.

Cunningham and his collaborators investigated the ancient period of global warming and its impact on marine life and chemistry by studying a group of mud, sand and limestone deposits found across the Gulf. They concluded that a steady supply of river sediments and circulating ocean waters had helped microorganisms survive even while Earth's warming climate became more hostile to life.

The findings also confirm that the Gulf of Mexico remained connected to the Atlantic Ocean, and the salinity of its waters never reached extremes—a question that until now had remained open. This conclusion was reached in part by geologic samples containing radiolarians, a type of microorganism that only thrives in nutrient-rich water that's no saltier than seawater today.

The research also accurately dates closely related geologic layers in the Wilcox Group (a set of rock layers that house an important petroleum system). This information can aid in efforts to find undiscovered oil and gas reserves in formations that are the same age.

The research relied on geologic samples from 36 industry wells dotted across the Gulf of Mexico, plus a handful of scientific drilling expeditions. For John Snedden, a study co-author and senior research scientist at UTIG, the study is a perfect example of industry data being used to address important scientific questions.

"We've used this very robust database to examine one of the highest thermal events in the geologic record, and I think it's given us a very nuanced view of a very important time in Earth's history," he said.

AT TOP: SEDIMENTS FLOWING FROM THE MISSISSIPPI RIVER TO THE GULF OF MEXICO MAY HAVE HELPED SIMPLE SEA LIFE IN THE GULF SURVIVE A MASS EXTINCTION 56 MILLION YEARS AGO.
ABOVE: A GALLERY OF RADIOLARIANS, A TYPE OF MICROPLANKTON.

GRADUATE STUDENT SHUAI YAN (FOURTH FROM RIGHT) WITH THE ICECAP-2 RESEARCH TEAM IN EAST ANTARCTICA.

Ice Sheet Holds Hidden Lake

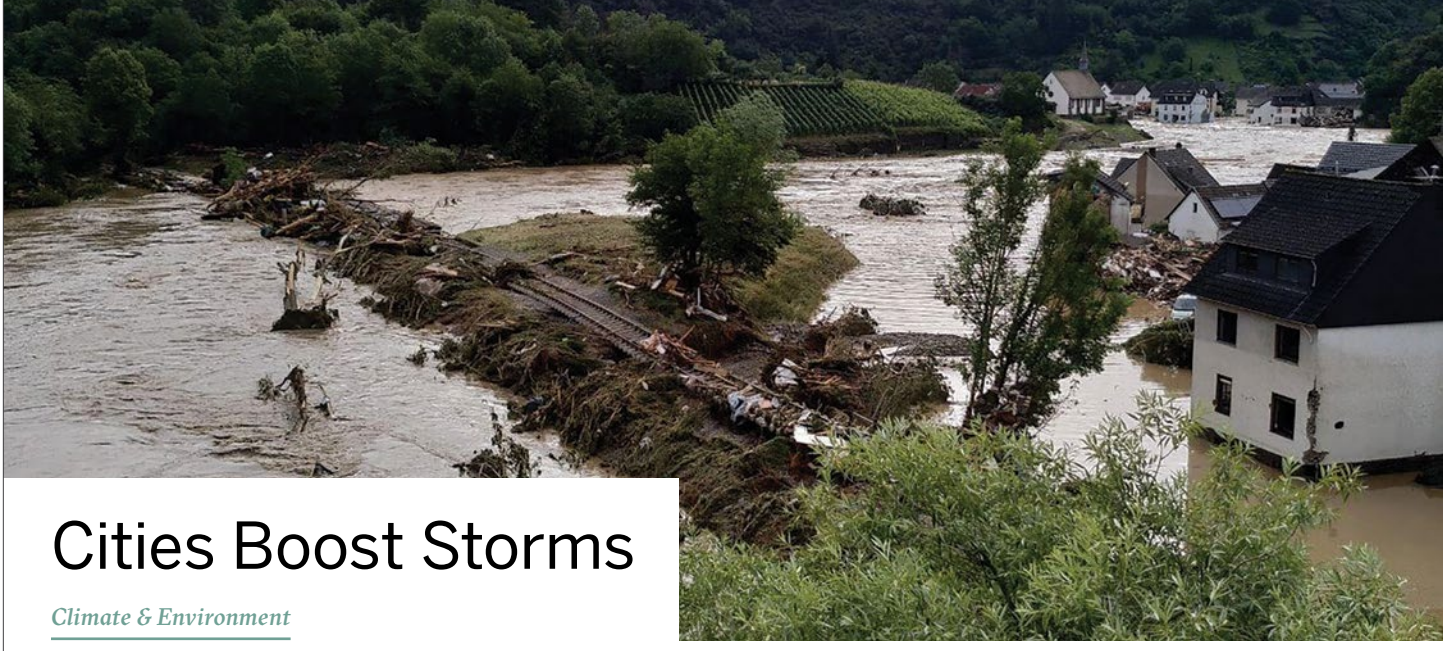
Surface & Hydrologic Processes

Researchers from the University of Texas Institute for Geophysics (UTIG) have discovered a city-size lake buried beneath the East Antarctic Ice Sheet. They named their discovery Lake Snow Eagle after their research plane that carried the ice-penetrating radar which enabled the lake's discovery.

Showing up as a bright radar reflection during an aerial survey, the lake may contain a record of the ice sheet since its earliest beginnings.

"This lake is likely to have a record of the entire history of the East Antarctic Ice Sheet, its initiation over 34 million years ago, as well as its growth and evolution across glacial cycles since then," said Don Blankenship, a UTIG

EXTINCTION: U.S. GEOLOGICAL SURVEY. ICE SHEET: SHUAI YAN.



Cities Boost Storms

Climate & Environment

When it comes to extreme weather, climate change usually gets all the attention. But according to a study from the Jackson School of Geosciences and two universities in China, the unique effects of cities—which can intensify storms and influence where rain falls—need to be accounted for as well.

"In addition to cutting emissions, we need to recognize that understanding the effects of urbanization is part of the solution," said Dev Niyogi, a professor in the Department of Geological Sciences.

Niyogi is a co-author on a study published in *Geophysical Research Letters* that used computer models to investigate how cities and climate change influenced the rainstorm that struck the Rotterdam-Brussels-Cologne metropolitan region on July 14, 2021.

The model found that the interplay of large-scale climate and local-scale urbanization intensified the storm, causing more rainfall than either climate or urbanization on its own.

The severe weather system was part of a storm complex that dropped heavy rain across Western Europe during the summer of 2021, causing destructive and deadly flooding that killed at least 242 people, making it one of the deadliest floods in European history.

Researchers found that interplay between a warmer climate and city environment focused the rainstorm on suburban areas and boosted rainfall by 50% when compared with the influence of the city alone. That means that of the nearly 6 inches of rainfall that fell on the metropolitan region on July 14, about 3 inches of it can be attributed to these interactions.

To conduct the study, the scientists created a storm computer model that included the effects of the environment, city and climate. The model of the storm proved to be representative of the actual event. The storm centered over the same regions in eastern Belgium and western Germany and unfolded over the same timeline, with the simulation running July 13-17 and the most rain falling on July 14.

Although the influence of the climate and the city together had the greatest impact, lead author Long Yang, an associate professor at Nanjing University, said that when viewed individually, the influence of the city equals or outweighs that of climate change.

ABOVE: FLOODING IN THE TOWN OF ALTENBURG, GERMANY, DURING THE JULY 2021 STORM.

STORMS: MARTIN SEIFERT. MAP: UTIG.

senior research scientist and co-author of a study on the lake.

The study was published in *Geology* in May 2022.

The first hint that the lake and its host canyon existed emerged when scientists spotted a smooth depression on satellite images of the ice sheet. The researchers followed up with three years of aerial surveys over the site with ice penetrating radar and other sensors.

"I literally jumped when I first saw that bright radar reflection," said lead author Shuai Yan, a graduate student at the Jackson School of Geosciences who was flight planner for the field research that investigated the lake.

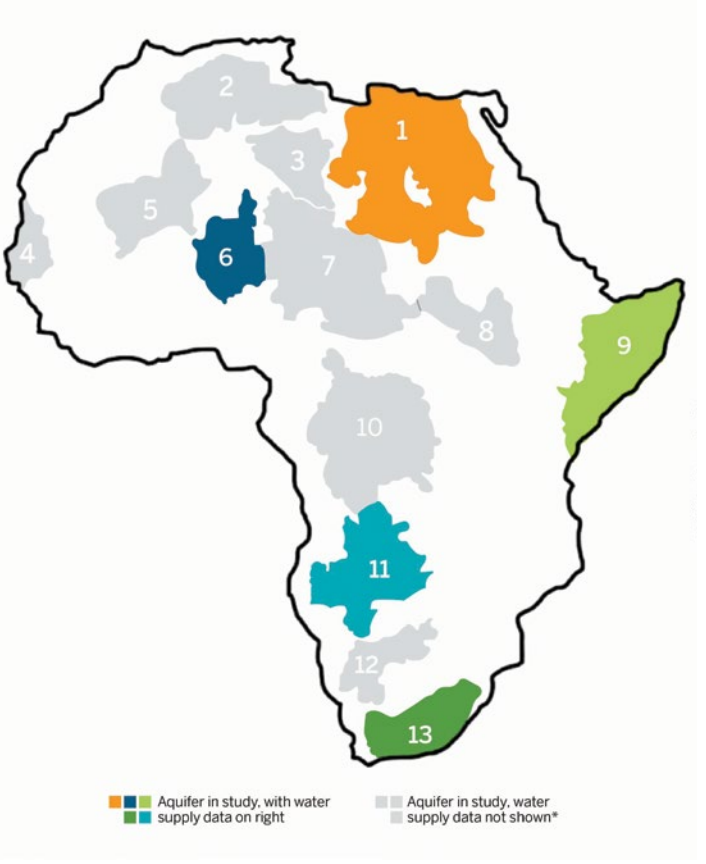
The lake is about 30 miles long, 9 miles wide and 650 feet deep. The sediments at the bottom of the lake are 1,000 feet deep and might include river sediments older than the ice sheet itself.

Moving forward, the researchers said getting a sample of the lake's sediments by drilling into it would fill big gaps in scientists' understanding of Antarctica's glaciation and provide vital information about the ice sheet's possible demise from climate change.

LOCATED IN A CANYON IN EAST ANTARCTICA, LAKE SNOW EAGLE IS BURIED BY MILES OF ICE.

Groundwater Could be Sustainable Resource in Africa

Climate & Environment



Tapping into groundwater can help communities in Africa diversify their water supply and strengthen their drought defenses, according to a study led by the Jackson School of Geosciences.

The research, which was published in *Environmental Research Letters* in January 2022 tracked long-term water storage gains and losses across Africa's 13 major aquifers and found opportunities for sustainably withdrawing groundwater across much of the continent.

The data showed that even though certain sub-Saharan aquifers sometimes faced water level declines, the levels consistently and quickly recovered during rainy periods, which helps guard against overuse, said lead author Bridget Scanlon, a senior research scientist at the Jackson School's Bureau of Economic Geology.

"Groundwater levels go up and down," said Scanlon. "People need to know the dynamics of this resource and optimize for its use."

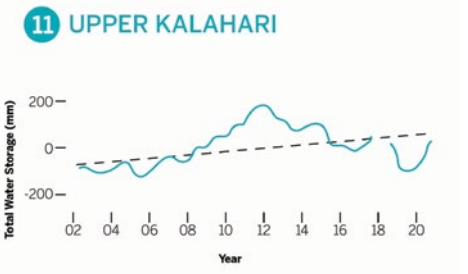
The researchers used data from NASA's GRACE satellites to track total water storage in the aquifers from 2002 to 2020. The result is an 18-year timeline that provides a longer-term perspective on water trends and what drives them.

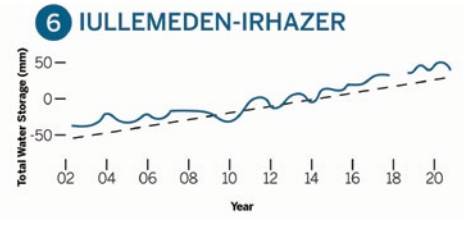
In sub-Saharan Africa, the study found that most aquifers increased their water supply during the period. However, the data show that water levels frequently underwent big swings, too. The study found that these swings closely tracked with climate patterns that are known to influence rainfall in the region.

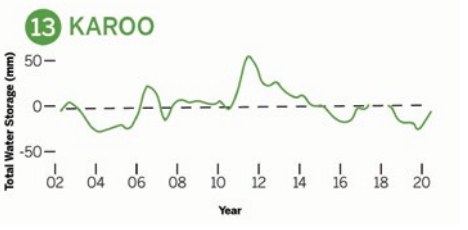
This means that although years with little rainfall can cause sharp declines in water storage, the rain eventually returns and readily refills the aquifers when it does. This helps protect the groundwater from long-term depletion.

Western Africa also saw an overall increase in water levels in most aquifers. But there, the increase was relatively steady and probably due to land use changes. The researchers cite other studies that have linked rising groundwater levels in the area to the clearing of deep-rooted shrubland for crops with shallower roots.

And even in northern Africa, where groundwater showed a steady decline in water storage due to all three of its aquifers being tapped for irrigation, the study notes that the sheer volume of water held in these aquifers provides an extra buffer. However, sharp declines may occur locally, affecting groundwater supplies in local wells and oases.

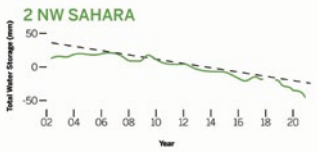


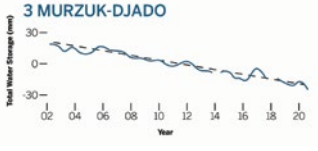


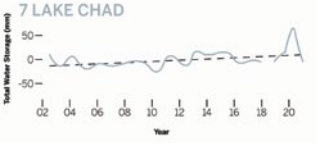


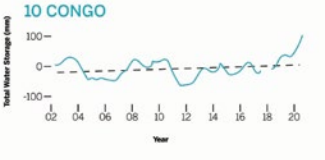
ABOVE: MAPS SHOWING THE LOCATIONS OF AFRICA'S 13 MAJOR AQUIFERS AND THE TOTAL WATER STORAGE PER YEAR IN EACH FROM 2002 TO 2020.

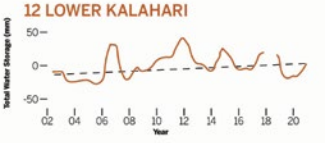
INFOGRAPHIC: JACKSON SCHOOL.



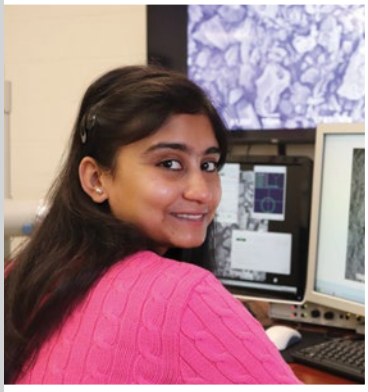








PHOTOS: JACKSON SCHOOL.



Fossilized by Climate Change

Climate & Environment

Climate change can affect life on Earth. According to new research, it can also affect the dead.

A study of exceptionally preserved fossils led by a graduate student from the Jackson School of Geosciences has found that rising global temperatures and a rapidly changing climate 183 million years ago may have created fossilization conditions in the world's oceans that helped preserve the soft and delicate bodies of deceased marine animals.

The fossils include squid-like vampyropods with ink sacs, ornate crustacean claws and fish with intact gills and eye tissue. The fossils came from the Posidonia Shale in southern Germany, Strawberry Bank in southern England, and Ya Ha Tinda in Alberta, Canada.

Despite being from different locations and marine environments, the fossils were all preserved in a similar manner. Geochemical analysis revealed that the conditions needed to preserve such captivating fossils could be connected to Earth's climate.

INSET: GRADUATE STUDENT SINJINI SINHA. **ABOVE:** SINHA HOLDS A FOSSILIZED INK SAC FROM A VAMPYROPOD, A SQUID-LIKE ANIMAL.

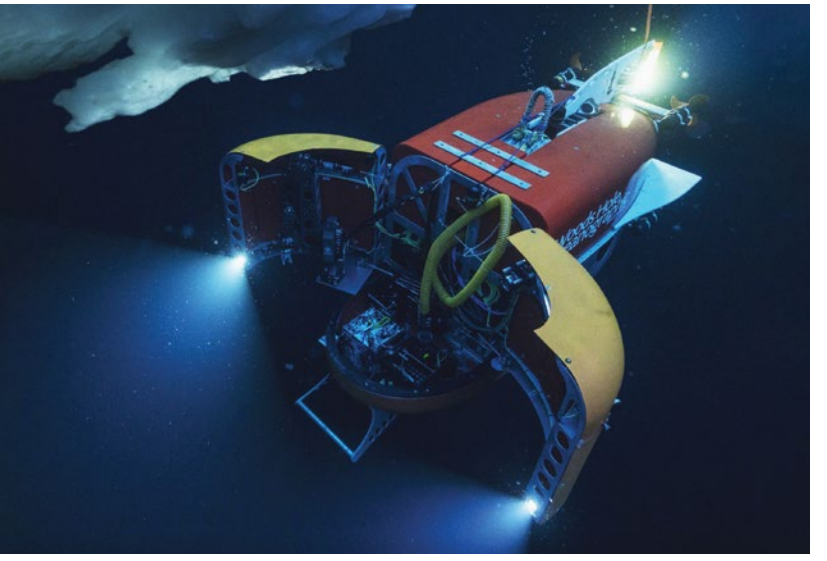
"When I started the research, I had no idea if they would preserve the same way or a different way," said lead author Sinjini Sinha. "I was curious what led to the exceptional preservation."

The research was published in December 2021 in *Scientific Reports*.

The authors examined different parts of fossil specimens under a scanning electron microscope equipped with a tool to detect chemical elements present in the minerals. And in all of them, one element dominated: phosphorous.

"We expected there to be some similarities, but finding that they were so similar was a bit surprising," said co-author Rowan Martindale, an associate professor at the Jackson School.

Phosphorous usually is not available in high concentrations within marine sediments and does not get buried in large amounts except in unusual circumstances. According to the researchers, a period of extreme and rapid climate change caused by an influx of greenhouse gasses into the atmosphere by volcanic eruptions during the Early Jurassic could be just that circumstance, with the rising temperatures causing increased rainfall that carried large amounts of phosphorous-rich sediment from rocks on land into the world's oceans.



Undersea Glacier Robot

Climate & Environment

It's the front line of climate change and could hold the key to predicting global sea level rise, but what goes on at the underwater face of Greenland's glaciers is a mystery to science.

That could change in 2023 with a bold new mission led by researchers at the Jackson School of Geosciences that will explore three of Greenland's glaciers with a submersible robot. The voyage will be the first time Greenland's glaciers—which make up the world's second-largest ice sheet—will be seen up close underwater.

Engineered to survive ice-covered seas by project partner the Woods Hole Oceanographic Institution, the remotely operated vehicle Nereid Under Ice (NUI) will brave icebergs and riptides to approach within feet of the glaciers and return with data and samples from their underwater environment.

The scientists' primary focus is not glacial ice, but the natural sand walls—or moraines—that buttress the glaciers and are thought to naturally, but precariously, stabilize the ice sheet. What they learn will reveal what's shoring up glaciers across the entire Greenland ice sheet, which could lead to more accurate model projections for future sea level rise.

"The big uncertainty in Greenland's contribution to sea level rise is how fast the ice sheet is going to lose mass," said Ginny Catania, a professor in the Department of Geological Sciences and a research associate at the University of Texas Institute for Geophysics. "We know how much sea level is stored in the ice sheet, we know climate is warming and changing the ice sheet, but what we don't know is the rate at which these glaciers will contribute to sea level rise."

The project is funded by the W.M. Keck Foundation, one of the nation's largest philanthropic organizations, which supports outstanding science, engineering and medical research. The mission will investigate three glaciers in western Greenland that lie in the path of warming Atlantic waters but have responded to climate change in different ways. Since 2000, Kangilliup Sermia has experienced only minor retreat, Umiammakku Sermiat retreated rapidly before stabilizing in 2009, and Kangerlussuup Sermia has remained largely unaffected by warming.

The information could also be crucial for future geoengineering projects. Some scientists have suggested building artificial moraines as a way of buying time while the world transitions to low-carbon energy sources.

NUI will make its way underwater to each glacier's face, mapping the seafloor topography as it goes. Once at its target site, operators aboard a nearby support ship will remotely guide the robot's manipulator arm to retrieve sediment cores from the glacier's moraines. The vehicle will also gather samples from the massive sediment plumes jetting from under the glaciers.

CLOCKWISE FROM LEFT: GINNY CATANIA EXPLORING ALASKAN GLACIERS IN 2021; THE GLACIER KANGERLUSSUUP SERMIA, THE FOCUS OF THE UPCOMING MISSION; THE SUBMERSIBLE ROBOT NUI DURING A 2019 MISSION TO THE ARCTIC.

PHOTOS: DENIS FELIKSON; LUIS LAMAR/AVTAR ALLIANCE FOUNDATION; MARCY DAVIS/IUTIG.

Tectonic Mystery Solved

Solid Earth & Tectonic Processes

The longstanding enigma of how tectonic plates can break Earth's rock-hard shell may have been solved by a recent graduate student at the Jackson School of Geosciences who caught the Earth in the act of starting a new tectonic conveyor belt off the coast of New Zealand.

The study of the emerging subduction zone was published in the journal *Nature Geoscience*. It describes how a small break in the tectonic plate was squeezed and pulled over millions of years until it unzipped and set in motion a runaway geologic process, said Brandon Shuck, who did the work for his doctoral thesis at the Jackson School and is now a postdoctoral research scientist at Columbia University's Lamont-Doherty Earth Observatory.

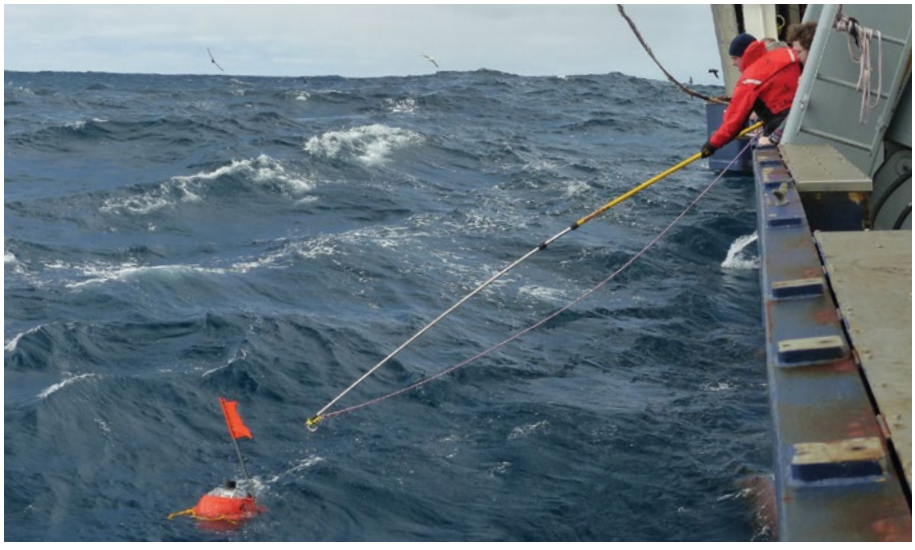
"We now know how subduction nucleated and how fast it's growing," he said. "That's important to know because subduction is the main driver of plate tectonics. It builds mountains, forms new oceans and drives chemical cycling from the deep earth all the way to the atmosphere."

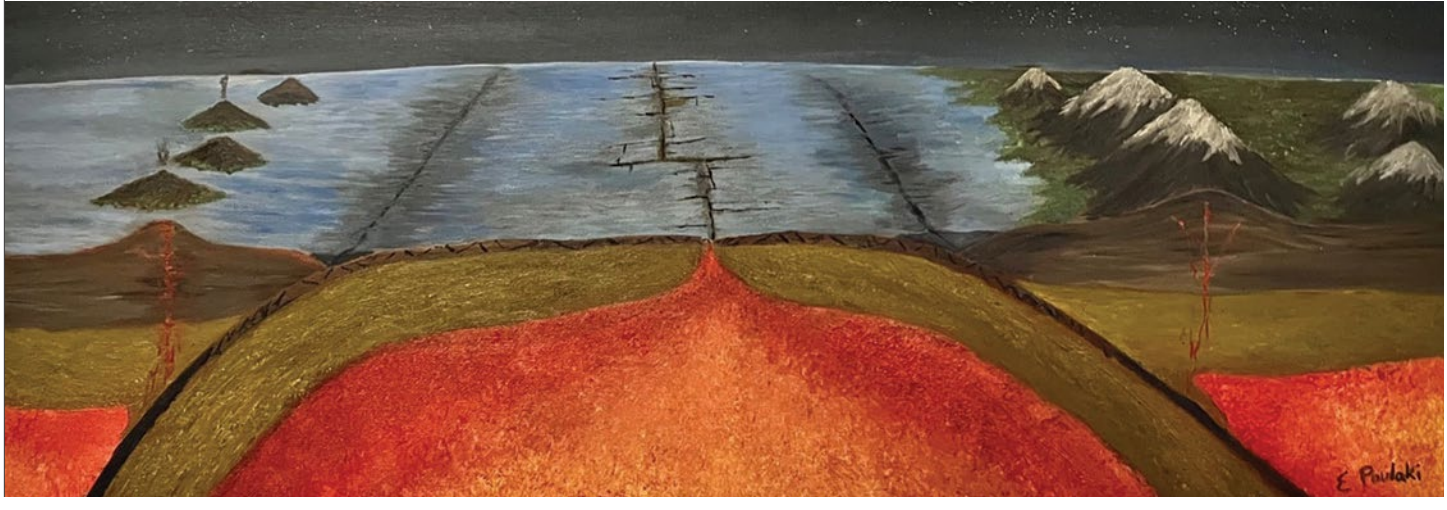
Today, Earth is unique among its rocky planetary neighbors in having plate tectonics. Information from Shuck's findings will help scientists understand how the process started on Earth and how it could work on other worlds, said study co-author Harm Van Avendonk, a senior research scientist at the University of Texas Institute for Geophysics (UTIG), where he supervised Shuck's research.

The research began in 2018 aboard a UTIG-led scientific research cruise off the coast of New Zealand, where Shuck and his crewmates gathered detailed seismic images of the fault. Onshore, Shuck matched the images with rock samples from other ocean drilling expeditions, providing a geologic timeline to reconstruct the unzipping plate. According to his reconstruction, a small break appeared in the Australian plate around 16 million years ago that slowly grew as it collided with other tectonic plates. When the break had unzipped far enough, the heavier portion of the plate broke through the Earth's rocky shell (known as the lithosphere), setting it on an unstoppable downward conveyor into the Earth that has continued for the past 8 million years.

Today, the new subducting margin is about 300 miles long. For now, the only sign on the surface is a handful of volcanoes near New Zealand's South Island. Most emerged during the last 100,000 years, but they are likely to grow into a volcanic chain as the split spreads south over the coming millennia, Shuck said.

BELOW: A RESEARCHER RECOVERING A SEISMIC IMAGING SENSOR DURING A SEISMIC CRUISE NEAR NEW ZEALAND IN 2018.
AT BOTTOM: ARTWORK ILLUSTRATING THE INFLUENCE OF PLATE TECTONICS ON THE SURFACE OF THE PLANET.





OCEAN: UTIG. ILLUSTRATION: EIRINI POULAKI.

Leaping Pterosaur

Planetary Sciences & Geobiology

With a wingspan nearing 40 feet, the giant pterosaur Quetzalcoatlus is the largest known animal to take to the sky. But how such a massive animal—known from only a few fossilized bones from West Texas—got airborne has been mostly a matter of speculation.

Some think it rocked forward on its wingtips like a vampire bat. Or that it built up speed by running and flapping like an albatross. Or that it didn't fly at all.

But according to new research, the mammoth creature probably leaped, jumping at least 8 feet into the air before lifting off by sweeping its wings.

Seen in movies and comic strips and suspended from museum ceilings, the giant "Texas Pterosaur" has been a media staple since it was discovered in 1971 in Big Bend National Park by Douglas Lawson, then a 22-year-old geology graduate student at The University of Texas at Austin.

However, science has not kept up with the pterosaur's popular image. Aside from Lawson's early descriptions of the fossils, almost no scientific research has been published based on direct study of the bones.

A new research collection—a monograph made up of an introduction and five studies—helps remedy that, said the co-editor of the collection, Matthew Brown, director of Vertebrate Paleontology Collections at the Jackson School of Geosciences.

"This is the first time that we have had any kind of comprehensive study," Brown said. "Even though Quetzalcoatlus has been known for 50 years, it has been poorly known."

The Jackson School's collections hold all known Quetzalcoatlus fossils. The research involved close study of all confirmed and suspected Quetzalcoatlus bones, along with other pterosaur fossils recovered from Big Bend. This led to the identification of two new pterosaur species—including a new, smaller species of Quetzalcoatlus with an 18-to 20-foot wingspan.

Brian Andres, who began studying Quetzalcoatlus as an undergraduate at the Jackson School and is now a postdoctoral researcher at the University of Sheffield, performed the analysis and named the new species *Quetzalcoatlus lawsoni* in honor of Lawson.

The two Quetzalcoatlus species both called Big Bend home about 70 million years ago, when the region was an evergreen forest instead of the desert of today. But each led a distinct lifestyle, according to Thomas Lehman, who started his research as a doctoral student at the Jackson School and is now a professor at Texas Tech University.

By examining the geological context in which the fossils were found, Lehman determined that the larger Quetzalcoatlus might have lived like today's herons, hunting alone in rivers and streams. The smaller species, in contrast, appeared to flock together in lakes—either year-round or seasonally to mate—with at least 30 individuals found at a single fossil site.

AT TOP: AN ARTIST'S INTERPRETATION OF THE 'TEXAS PTEROSAUR' QUETZALCOATLUS WADING IN THE WATER. **ABOVE:** DOUGLAS LAWSON (LEFT) AND WANN LANGSTON WITH QUETZALCOATLUS FOSSILS AT THE TEXAS MEMORIAL MUSEUM IN THE 1970S.

ILLUSTRATION: JAMES KUETHER. SCIENTISTS: JACKSON SCHOOL.

Overlooked Channels Influence Flow and Flooding Along Gulf Coast

Surface & Hydrologic Processes

An unnoticed network of channels is cutting across the coastal plain landscape along the Gulf Coast and influencing how water flows, according to research from the Jackson School of Geosciences and The Water Institute of the Gulf that could help predict flooding from major storms in the future.

The coastal plains are relatively flat, which has kept most research on flood risk and water flow focused on large rivers in the region. But the new research revealed that although the surface elevation is steady, the landscape is covered in deep, narrow channels that play an important role in moving water.

"We see through things like Hurricane Harvey that what is happening to the broader landscape when there is a lot of water present is really important," said the study's lead author, John Swartz, who started the research as a doctoral student at the Jackson School and is now a research scientist at The Water Institute of the Gulf.

The research was published in *Nature Geoscience* in February 2022.

Scientists said that understanding the specifics of how the channels move water—especially during floods—in different areas will require more research, and ultimately the findings will need to be incorporated in national and regional flood models.

Channels on their own are not an uncommon sight along the coastal plain. However, researchers were able to show the full extent of the branching networks they form by creating a high-resolution elevation map spanning the Gulf Coast from Texas to Mississippi.

The data for the map came from state and federal agencies—including the Texas General Land Office Natural Resources Information Service, the U.S. Geological Survey and the Federal Emergency Management Agency—which collected the information over the years for local and regional use.

As it became public, Swartz and his collaborators pieced it together to get the most comprehensive and detailed look yet at coastal plain topography.

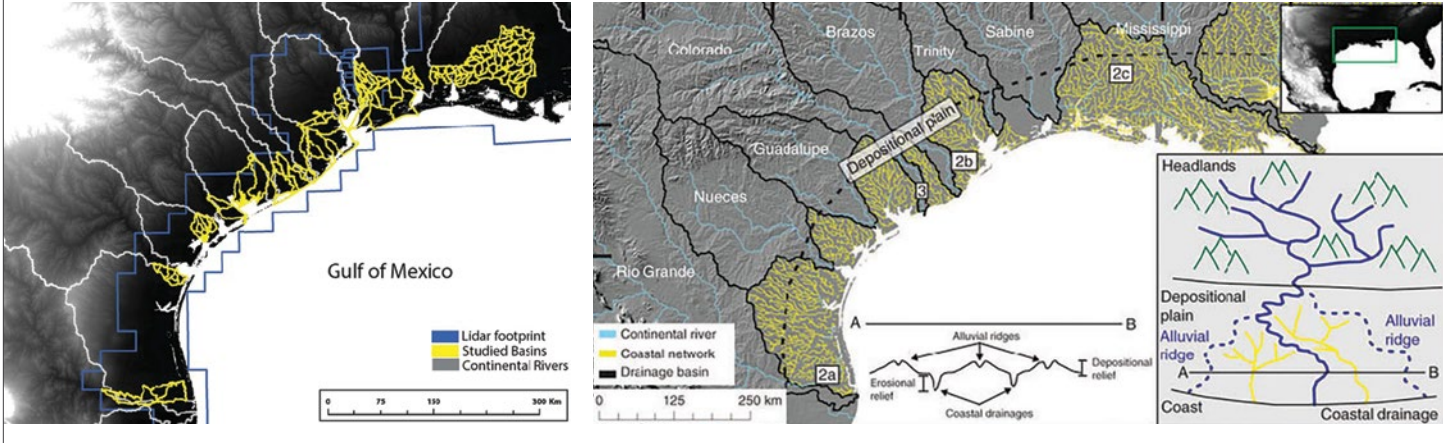
The map captured every 3 meters of the coastal plain and measured elevation changes within a few centimeters. At this scale, a complex array of channel networks emerged. The channel networks cover more than 12,000 square miles, or about one-third of the study region, and separate into more than 40 distinct drainage basins. The depth of these basins can be as large as 22-32 feet, which is comparable to the depths of the larger rivers in the area.

"How the topography is distributed has significant consequences for how extreme precipitation is routed across the landscape," said co-author David Mohrig, a professor in the Jackson School's Department of Geological Sciences.

The study has already led to important geological insights about how these channel networks form and evolve.

For example, in most geological settings drainage basins form when a landscape is hollowed out over millions of years of erosion. But in the case of the coastal plain networks, the basins are built up at their edges by accumulated sediment, which was deposited on the landscape by the region's rivers when they followed different paths hundreds to thousands of years ago. As the rivers' paths change in the future, the sediments they leave behind will probably define the edges to new drainage basins.

Mohrig said that this study exemplifies a growing research stream at the Jackson School called "environmental sedimentology," which focuses on how the dispersal and buildup of sediments over time affects human communities and larger ecosystems.



INFOGRAPHICS: SWARTZ ET AL.

LEFT: THE TEXAS AND LOUISIANA COASTLINE SHOWING CHANNEL BASINS, RIVERS, AND THE OUTLINE OF THE STUDY AREA.
RIGHT: BASINS, RIVERS AND CHANNEL NETWORKS ON THE GULF COAST. INSET SHOWS HOW GEOLOGICAL FEATURES LEAD TO CHANNEL FORMATION.

Climate Change Coming After Your Marinara

Climate & Environment

Climate change is on track to interfere with tomato production—and could be especially bad news for fans of ketchup, pasta sauce and other processed tomato products.

According to a study published in *Nature Food*, rising temperatures are projected to lower yields around the world for "processing tomatoes"—the cultivar used in ketchup and other tomato products. By 2050, the global supply of processing tomatoes is expected to decrease 6% compared with the study's baseline of 1990-2009, with Italy's crop being among the hardest hit.

Researchers at the Jackson School of Geosciences, Purdue University, the University of Salerno, the University of Florida and NASA's Goddard Institute for Space Studies collaborated on the study.

Study co-author Dev Niyogi, a professor in the Jackson School's Department of Geological Sciences, said that while the climate's impact on the food supply is widely researched, most of the focus has been on staples such as wheat and rice. This study is among the first to take a global look at climate change's impact on tomatoes.

The researchers used five climate models to inform three scenarios projecting how rising temperatures will influence tomato yield, focusing on

Channel Belts Hold Clues to Past

Surface & Hydrologic Processes

Long after a river has dried up, its channel belt lives on.

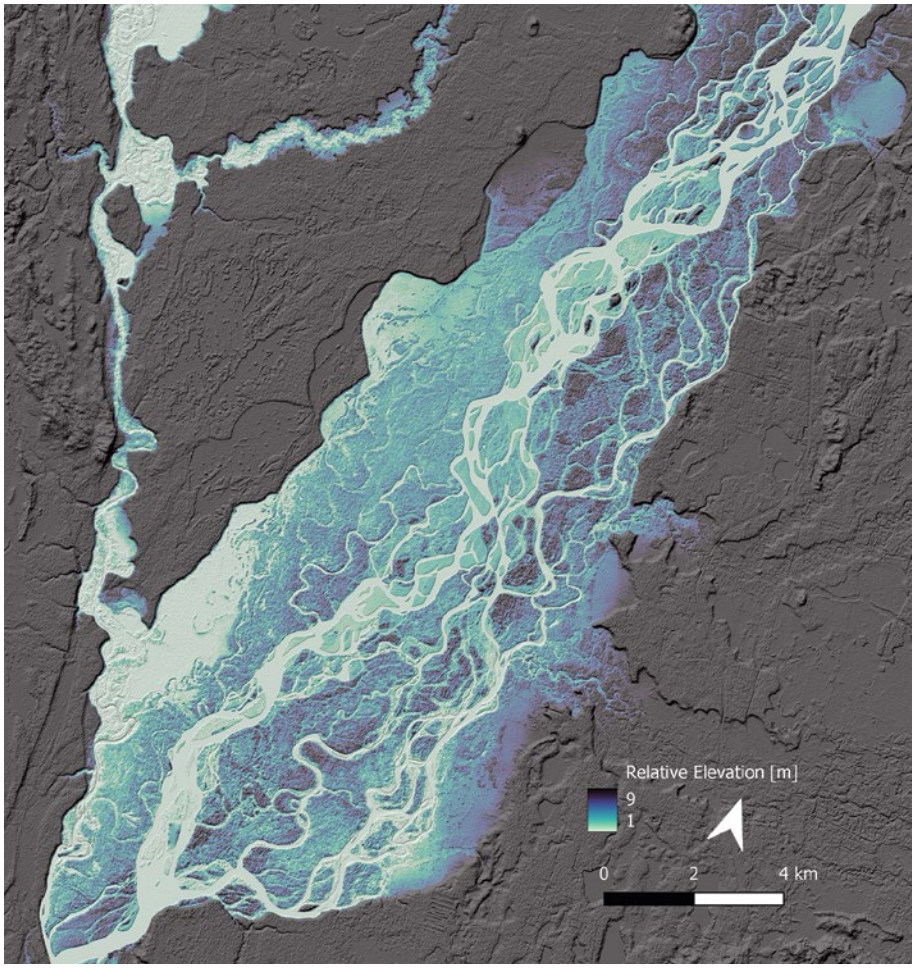
Made up of swaths of sediment surrounding the river, channel belts, once hardened into rock, preserve the paths of rivers that once were. However, reconstructing details about an ancient river from channel belt deposits is a notoriously difficult task.

New research from scientists in the Jackson School of Geosciences Department of Geological Sciences is making progress on that front. Lead author Tian Dong, a postdoctoral researcher, said that by analyzing modern rivers, they have been able to come up with a rule that connects channel belts to river patterns, finding that, in general, the more channels a river has, the narrower its channel belt.

Because the physics shaping rivers is the same over time and place, the rule should hold for ancient rivers and rivers on other planets, too, said co-author and Assistant Professor Timothy Goudge.

"We can look at a river deposit from 100 million years ago on Earth or from 3.5 billion years ago on Mars, and we can say something about what the actual river looked like," he said.

The researchers discovered the rule by analyzing 30 modern rivers and their channel belts, drawing on high-resolution images and elevation data captured by satellites. The results were published on June 13 in the journal *Geology*.



ABOVE: A RELATIVE ELEVATION MAP OF ALASKA'S SUSITNA RIVER, ONE OF THE 30 RIVERS THAT WERE MAPPED AS PART OF THE STUDY.

MAP: TIAN DONG.

the world's top three tomato-growing countries: the United States (California in particular), Italy and China. Together, these countries produce about 65% of the world's processing tomatoes.

Although the outcomes varied, the projected scenarios all pointed to a future where tomato production will dramatically change during the coming decades. Most scenarios show the three countries experiencing steady yield declines over the next 30-40 years.

RIGHT: PLUM TOMATOES.

MARINARA: DEI FRATELLI TOMATOES. MARS: NASA/GSFC/ JPL ASU.

Floods Shaped Mars' Surface

Planetary Sciences & Geobiology

On Earth, river erosion is usually a slow-going process. But on Mars, massive floods from overflowing crater lakes had an outsized role in shaping the Martian surface, carving deep chasms and moving vast amounts of sediment, according to a new study led by researchers at the Jackson School of Geosciences.

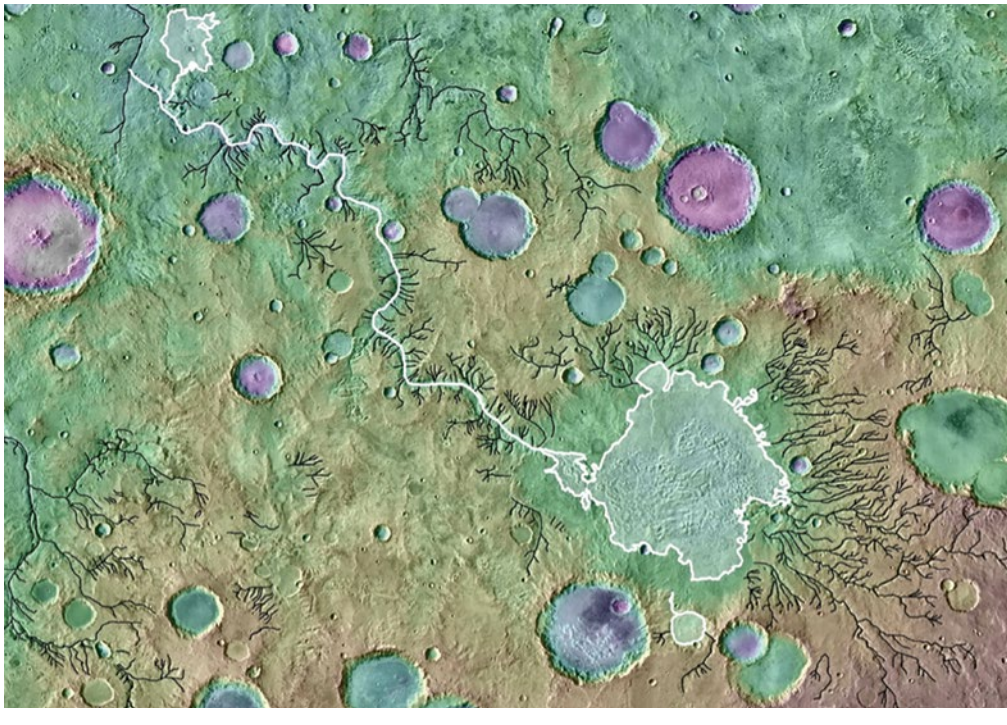
The study, published in *Nature* and funded by NASA, found that the floods, which probably lasted mere weeks, eroded more than enough sediment to completely fill Lake Superior and Lake Ontario.

"If we think about how sediment was being moved across the landscape on ancient Mars, lake breach floods were a really important process globally," said lead author Tim Goudge, an assistant professor in the Department of Geological Sciences. "And this is a bit of a surprising result because they've been thought of as one-off anomalies for so long."

Remote sensing images taken by satellites orbiting Mars have allowed scientists to study the remains of breached Martian crater lakes. However, the crater lakes and their river valleys have mostly been studied on an individual basis, Goudge said. This is the first study to investigate how the 262 breached lakes across the red planet shaped the Martian surface as a whole.

The research entailed reviewing a preexisting catalog of river valleys on Mars and classifying the valleys into two categories: valleys that got their start at a crater's edge, which indicates they formed during a lake breach flood, and valleys that formed elsewhere on the landscape, which suggests a more gradual formation over time.

From there, the scientists compared the depth, length and volume of the different valley types and found that river valleys formed by crater lake breaches punch far above their weight, eroding away nearly a quarter of the red planet's river valley volume despite making up only 3% of total valley length.



ABOVE: CRATERS AND RIVER VALLEYS ON THE SURFACE OF MARS. A BREACHED CRATER LAKE AND OUTLET VALLEY ARE OUTLINED IN WHITE.

How an Alien Ocean Gets Oxygen

Planetary Sciences & Geobiology

On Jupiter's moon Europa, an ice-covered ocean might harbor alien life. And if it's anything like life as we know it, it will probably need oxygen.

Scientists at the Jackson School of Geosciences have built the world's first physics-based computer simulation showing how oxygen could seep into the ocean from the surface, carried on plumes of salt water from beneath the moon's "chaos terrain"—landscapes made up of cracks, ridges and ice blocks that cover a quarter of the icy world.

The simulation results show that not only is the transport possible, but that the amount of oxygen brought into Europa's ocean could be on a par with the quantity of oxygen in Earth's oceans today.

"It provides a solution to what is considered one of the outstanding problems of the habitability of the Europa subsurface ocean," said lead researcher Marc Hesse, a professor in the Department of Geological Sciences.

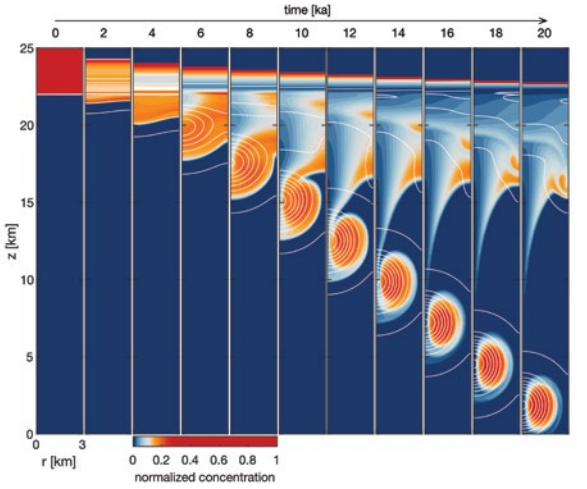
The study was published in February 2022 in the journal *Geophysical Research Letters.*

Scientists think that chaos terrains form where Europa's ice shell partially melts into brine. At the surface, this brine can then mix with oxygen, which is generated by sunlight and charged particles from Jupiter striking the icy surface.

The model created by the researchers shows the brine draining in a distinct manner as it passes through the ice, with the salty water forming a "porosity wave" that makes pores in the ice to momentarily widen—allowing the brine to pass through—before sealing back up. Hesse compares the process to the classic cartoon gag of a bulge of water making its way down a garden hose.

This mode of transport appears to be an effective way to bring oxygen through the ice, with 86% of the oxygen taken up at the surface riding the wave all the way to the ocean.

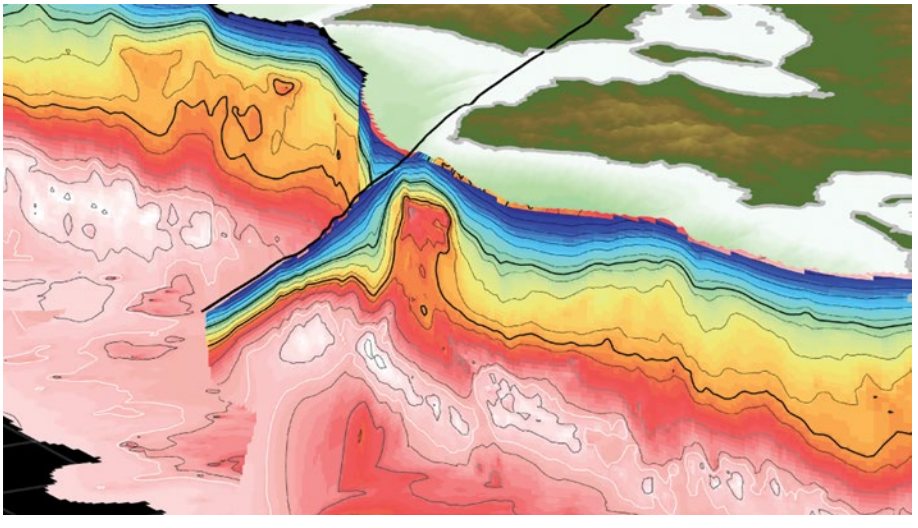
According to co-author Steven Vance, a research scientist at NASA's Jet Propulsion Laboratory and the supervisor of its Planetary Interiors and Geophysics Group, the highest oxygen estimates would make the oxygen levels in Europa's ocean similar to those in Earth's oceans—which raises hope about life on the alien world.



ABOVE: THE PHYSICS-BASED MODEL SHOWING A "POROSITY WAVE" (SPHERICAL SHAPE) OF BRINE CARRYING OXYGEN THROUGH EUROPA'S ICY SHELL TO THE LIQUID WATER OCEAN. THE CHART SHOWS TIME (IN THOUSANDS OF YEARS) AND ICE SHELL DEPTH (IN KILOMETERS). RED INDICATES HIGHER LEVELS OF OXYGEN. BLUE REPRESENTS LOWER LEVELS OF OXYGEN.

Massive Pluton Directing Quakes

Solid Earth & Tectonic Processes



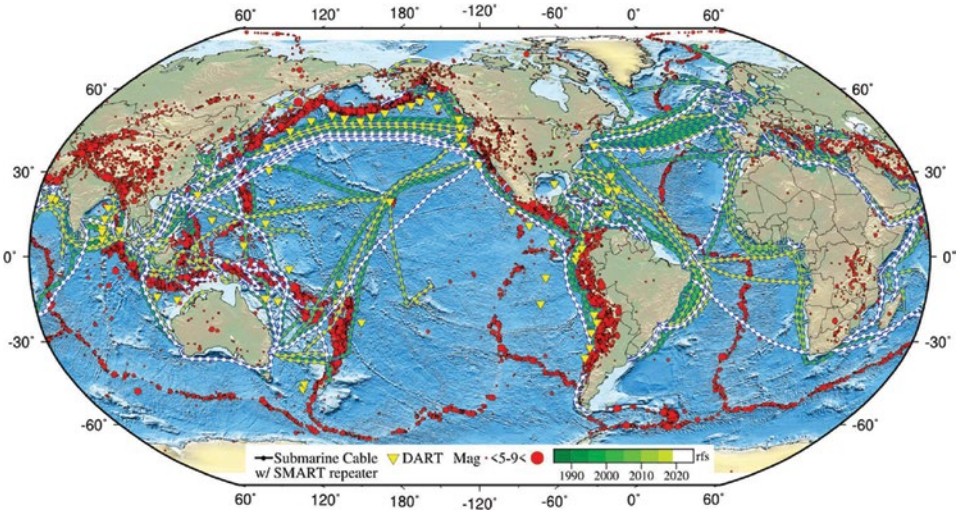
Thanks to 20 years of seismic data processed through one of the world's most powerful supercomputers, scientists have created the first complete, 3D visualization of a mountain-size rock called the Kumano Pluton buried miles beneath the coast of southern Japan. They can now see the rock could be acting like a lightning rod for the region's megaquakes, diverting tectonic energy into points along its sides where several of the region's largest earthquakes have happened.

Scientists have known about the pluton for years but were aware of only small portions of it. Thanks to new research by an international team of scientists led by the University of Texas Institute for Geophysics (UTIG), researchers now have a view of the entire subterranean

OCEANS: HESSE ET AL. QUAKES: ADRIEN ARNULF.

Underwater Cables Get Retrofit for Geosciences Research

Solid Earth & Tectonic Processes



A million kilometers of fiber-optic cable lie on the ocean floor, carrying telecommunication signals across vast stretches of ocean to keep the whole world connected. A new international collaboration, including scientists from the Jackson School of Geosciences, aims to turn them into a global early warning system for tsunamis and earthquakes, as well as a sensor array for monitoring unexplained temperature changes.

Researchers from the University of Texas Institute for Geophysics are developing sensors that can "piggyback" on the infrastructure of the existing telecommunications network. The sensors will allow for low-cost global deep ocean observation to detect temperature, pressure and seismic acceleration—the rate of change in the Earth's natural vibrations. Data provided could inform scientists of oncoming underwater earthquakes, volcanic eruptions and tsunamis, as well as keep track of any long-term changes in the state of the ocean.

"Our focus here is on bottom pressure, temperature and acoustic data, and their value for ocean climate monitoring," said Jackson School Professor Patrick Heimbach, who is part of the team that will be conducting a series of numerical simulations that will determine data quality available from the modified cables—called Science Monitoring and Reliable Telecommunications (SMART) cables.

Heimbach is also a researcher at The University of Texas at Austin's Oden Institute for Computational Engineering and Sciences.

The effort will support the United Nations' SMART Cables Joint Task Force working to bring the SMART cables concept to fruition by uniting experts from around the world and across disciplines.

ABOVE: DEEP OCEAN TELECOMMUNICATIONS CABLES COULD CREATE A GEOLOGICAL MONITORING NETWORK BY HOSTING SENSORS FOR MEASURING TEMPERATURE, PRESSURE AND SEISMIC ACTIVITY. CURRENT CABLES (GREEN); IN PROGRESS/PLANNED (WHITE); AND HISTORIC (RED).

OPPOSITE: THE KUMANO PLUTON IN SOUTHERN JAPAN APPEARS AS A RED BULGE, INDICATING DENSE ROCK.

RIGHT: THE KUMANO PLUTON IS IN SOUTHERN JAPAN NEAR THE NANKAI SUBDUCTION ZONE.

formation and its effect on the region's tectonics.

The findings will provide critical information for a major new Japanese government-funded project to find out whether another major earthquake is building in the Nankai subduction zone, where the pluton is located, said Shuichi Kodaira, director of the Japan Agency for Marine-Earth Science and Technology and a co-author of the study published in the journal *Nature Geoscience*.

"We cannot predict exactly when, where, or how large future earthquakes will be, but by combining our model with monitoring data, we can begin estimating near-future processes," said Kodaira, who was among the scientists who first spotted signs of the Kumano Pluton in 2006. "That will provide very important data for the Japanese public to prepare for the next big earthquake."

The full extent of the Kumano Pluton was revealed using the LoneStar5 supercomputer at UT's Texas Advanced Computing Center to piece together 20 years of seismic data into a single high-definition 3D model. The study was led by Adrien Arnulf, a research assistant professor at UTIG.

The model shows the region around the Nankai subduction zone, with the Earth's crust bending under the pluton's weight. The researchers think the pluton's interference with the wider subduction zone is influencing the tectonic forces that cause earthquakes.

HotRock to Take Geothermal Anywhere

Energy Geosciences

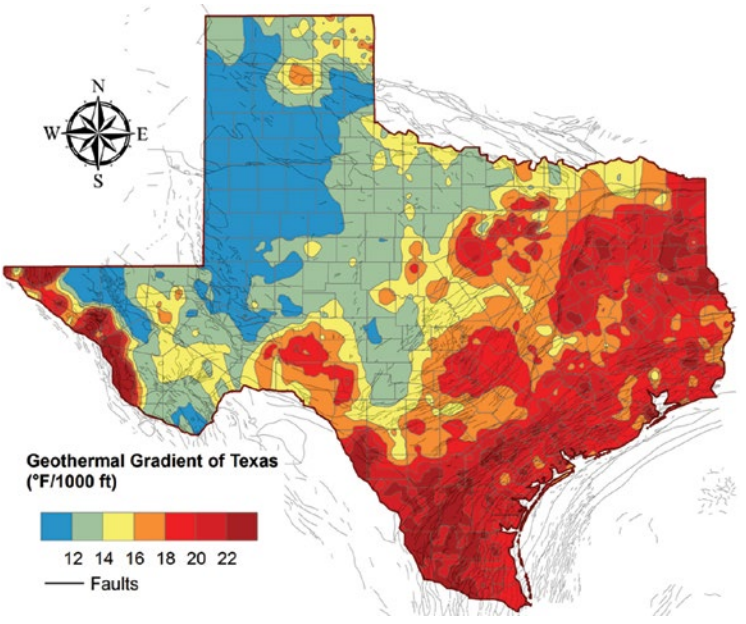
The Bureau of Economic Geology is launching a new industrial affiliates program to spur the potential development of geothermal energy in a wide variety of settings.

Called HotRock, the new multidisciplinary research program officially kicks off Dec. 1, 2022, with the goal of developing "geothermal anywhere." HotRock will specialize in geothermal resource assessment, production, seismicity, exploration and development methodologies, and economic development.

"The new paradigm of 'geothermal anywhere' is a very different animal from the established geothermal industry, which is limited to tectonically active areas of the world," said principal investigator Ken Wisian, who is also the associate director of the bureau's environmental division.

HotRock will explore the new geothermal anywhere paradigm, which uses advanced technology to produce geothermal energy from subtle heat reservoirs, including many oil- and gas-producing sedimentary basins. Member companies will gain access to research results ahead of publication, the opportunity to recommend lines of research, and the opportunity to collaborate in research when appropriate.

The bureau conducted foundational research into geothermal power in the Gulf region during the 1970s and '80s and is currently conducting projects to deploy geothermal in Texas. Director Scott Tinker said he has seen interest in geothermal with the need for carbon-free baseload power. The bureau, he said, is well positioned to lead this mission.



ABOVE: A GEOTHERMAL MAP OF TEXAS SHOWS THAT MANY OIL AND GAS BASINS ALSO HAVE GEOTHERMAL POTENTIAL.

"There are several challenges when considering low-emissions power, including scalability, affordability and reliability," Tinker said. "Europe, California and Texas are teaching us what happens when policy tries to circumvent physics and economics. All of these challenges must be satisfied to have an impact. Natural gas and/or hydrogen with carbon capture replacing coal, nuclear, hydro and geothermal lead the pack."

Bureau research associate Shuvajit Bhattacharya is co-principal investigator. HotRock is expected to support four to five research scientists and two graduate students. Membership is $75,000 a year. For more information, contact Ken Wisian at ken.wisian@beg.utexas.edu.

Hydrogen Research Advances

Energy Geosciences

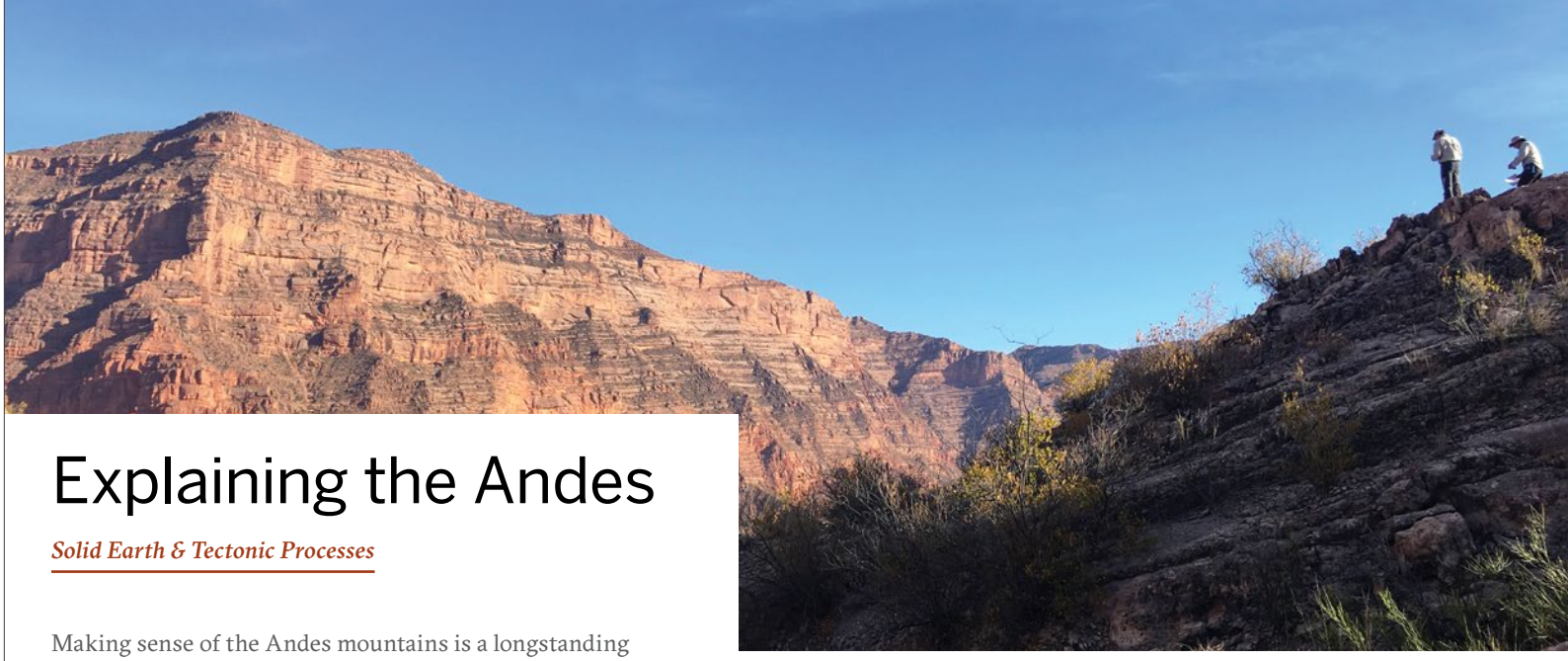
The hydrogen economy is growing. And so is research on the important fuel source at the Bureau of Economic Geology.

The bureau's $GeoH_2$ consortium was officially launched in February 2022 with its first sponsor meeting. Since then, the consortium has engaged with sponsors in an interactive technical meeting in April and a virtual workshop in July that was attended by 176 people representing 101 companies, demonstrating the growing interest in hydrogen energy in the larger market.

"The successful startup of the $GeoH_2$ consortium reflects a very high level of interest in low carbon intensity hydrogen as part of a future low carbon economy," said Mark Shuster, the leader of the $GeoH_2$ consortium and the deputy director of the bureau's energy division. "$GeoH_2$ research addresses geological storage, value chain pathways and new subsurface concepts, which are paramount to developing hydrogen systems and infrastructure."

The $GeoH_2$ group includes 13 researchers from the bureau and three from The University of Texas at Austin's Cockrell School of Engineering. At the $GeoH_2$ meeting, participants heard directly from the scientists on research advances in hydrogen production, storage and transport.

Bureau research scientist Ian Duncan provided an overview of the technology required for in situ hydrogen



Explaining the Andes

Solid Earth & Tectonic Processes

Making sense of the Andes mountains is a longstanding problem in geology.

Based on the mountains' shared geologic history, one would expect the Andes to be simple, with a consistent and uniform topography and geologic record throughout the span of its 8,000-kilometer range.

But the reality is that the Andes are far from simple. The mountain belt narrows and widens as it curves along the west coast of South America. Although geoscientists agree that the nearby subduction zone is a major driving factor, there's debate about whether it's the subducting plate or overriding plate that's in the driver's seat.

According to a study published in September 2022 in *Geology*, three major geologic phenomena—flat slab subduction, ridge subduction and tectonic inheritance —are connected to the geologic variations along the length of the Andes. It suggests that factors related to both plates might be at play.

"There's been a difference of opinion on what the drivers are, what's controlling the extent of mountain building and the width of the zone of deformation," said lead author Brian Horton, a professor in the Jackson School of Geosciences. "What our work demonstrates is that there are multiple answers."

Horton co-authored the study with Jackson School alumni Tomas Capaldi and Nicholas Perez. Capaldi is now an assistant professor at the University of Nevada, Las Vegas. Perez is an associate professor at Texas A&M University.

Using GIS software, the researchers quantified the distances among the three geologic phenomena and key topographic elements of the Andean mountain belt. They found that flat slab subduction and ridge subduction were associated with widening. Inherited tectonic features —including notable structures and contrasting sedimentary thicknesses on the overriding South American plate — were associated with both widening and narrowing.

Although the study simply identified spatial connections, the researchers said this is the first step to more in-depth investigations.

ABOVE: A VIEW OF THE ANDES FROM BOLIVIA.

ANDES: BRIAN HORTON.

production— a presentation he also gave to the U.S. Department of Energy in 2021 during its kickoff symposium for its Hydrogen Shot initiative.

Several bureau researchers presented work on geological and geophysical research needed for storing hydrogen in depleted fields and saline aquifers. In addition, Lorena Moscardelli and Oliver Duffy of the bureau's State of Texas Advanced Resource Recovery (STARR) program presented research on the potential of large-scale hydrogen storage in salt caverns.

Mojdeh Delshad, Larry Lake and Yuzheng Lan of the Hildebrand Department of Petroleum and Geosystems Engineering at the UT Cockrell School of Engineering spoke about reservoir engineering research examining hydrogen storage in depleted fields and saline aquifers, and hydrogen flow and mixing.

In addition to sharing research on the physical science of hydrogen, the meeting also highlighted hydrogen market research. The bureau's Ning Ling, the chief economist at its Center for Energy Economics, presented research on techno-economics and value chain analysis.

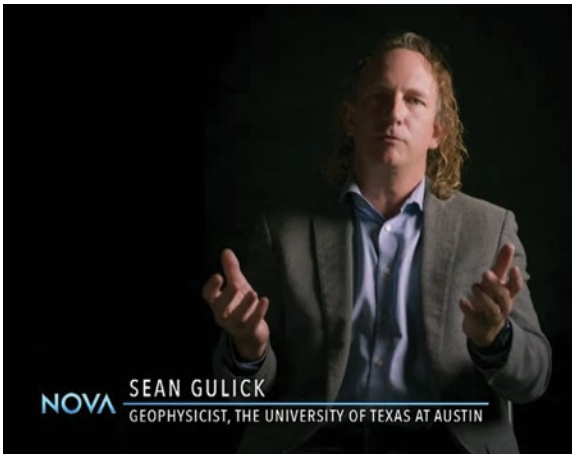
The $GeoH_2$ workshop provided a research overview to prospective members of the consortium, while also giving scientists an opportunity to answer questions and hear feedback from participants.

"The world has been transitioning from carbon-based fuels to hydrogen-based fuels for over a century," said bureau Director Scott Tinker. "Storing hydrogen in large volumes and safely is critical to this transition. That's exactly what GeoH2 will investigate."

The $GeoH_2$ consortium is one of 13 research consortia at the bureau. For more information on each, visit ***www.beg.utexas.edu/research/consortia/overview***.

Jackson School of Geosciences researchers made science news headlines and served as expert sources for news stories across the state and the world. Check out a few of the highlights.

CLOCKWISE FROM TOP: 1) PROFESSOR DEV NIYOGI ON A TEXAS TRIBUNE PANEL ON THE 2021 WINTER STORM THAT STRUCK TEXAS AND ITS CONNECTION TO CLIMATE CHANGE. 2) ENGINEERING SCIENTIST MARCY DAVIS TALKS ABOUT RESEARCH ON AUSTIN LAKES ON KXAN. 3) PROFESSOR GINNY CATANIA SHARES GLACIER RESEARCH ON KXAN. 4) PROFESSOR SEAN GULICK APPEARS IN A NOVA DOCUMENTARY ON THE EXTINCTION OF THE DINOSAURS.



PHOTOS CLOCKWISE: TEXAS TRIBUNE, KXAN, KXAN, KXAN, NOVA.

Weather forecasts impacted by global helium shortage, Russian invasion

"Helium is produced from uranium and thorium decay in the rocks. But it's collected just like natural gas is collected in the rocks."

Toti Larson, Research Associate
Bureau of Economic Geology
KXAN, April 7, 2022

Can extinct volcano in Mississippi help state become key player in carbon storage industry?

"The Gulf Coast states are particularly well-endowed. When you look at maps of the pore space availability, these states shine out as winners."

Susan Hovorka, Senior Research Scientist
Gulf Coast Carbon Center, Bureau of Economic Geology
Sun Herald, June 17, 2022

55-sided, 555-carat 'Enigma' black diamond (potentially from space) goes on sale

"I believe the chances of carbonado specimens we've studied and seen data for being from outer space are low."

Richard Ketcham, Professor
Department of Geological Sciences
Live Science, January 20, 2022

Climate Change Is Harming the Planet Faster Than We Can Adapt, U.N. Warns

"One of the most striking conclusions in our report is that we're seeing adverse impacts that are much more widespread and much more negative than expected."

Camille Parmesan, Adjunct Professor
Department of Geological Sciences
The New York Times,
February 28, 2022

UT researcher heads out on drill ship to study Earth's past

"It's very busy. There are no breaks, but it's a lot of fun. We are the first people to look at these sediments and rocks, and they tell us how the Earth has changed in the past."

Chris Lowery, Research Associate
University of Texas Institute for Geophysics
FOX 7, April 27, 2022

A deep dive into earthquake forecasting

"There are things we've never been able to see before... We see the creaks and groans very close to these events."

Laura Wallace, Research Scientist
University of Texas Institute for Geophysics
Cosmos Magazine, January 21, 2022

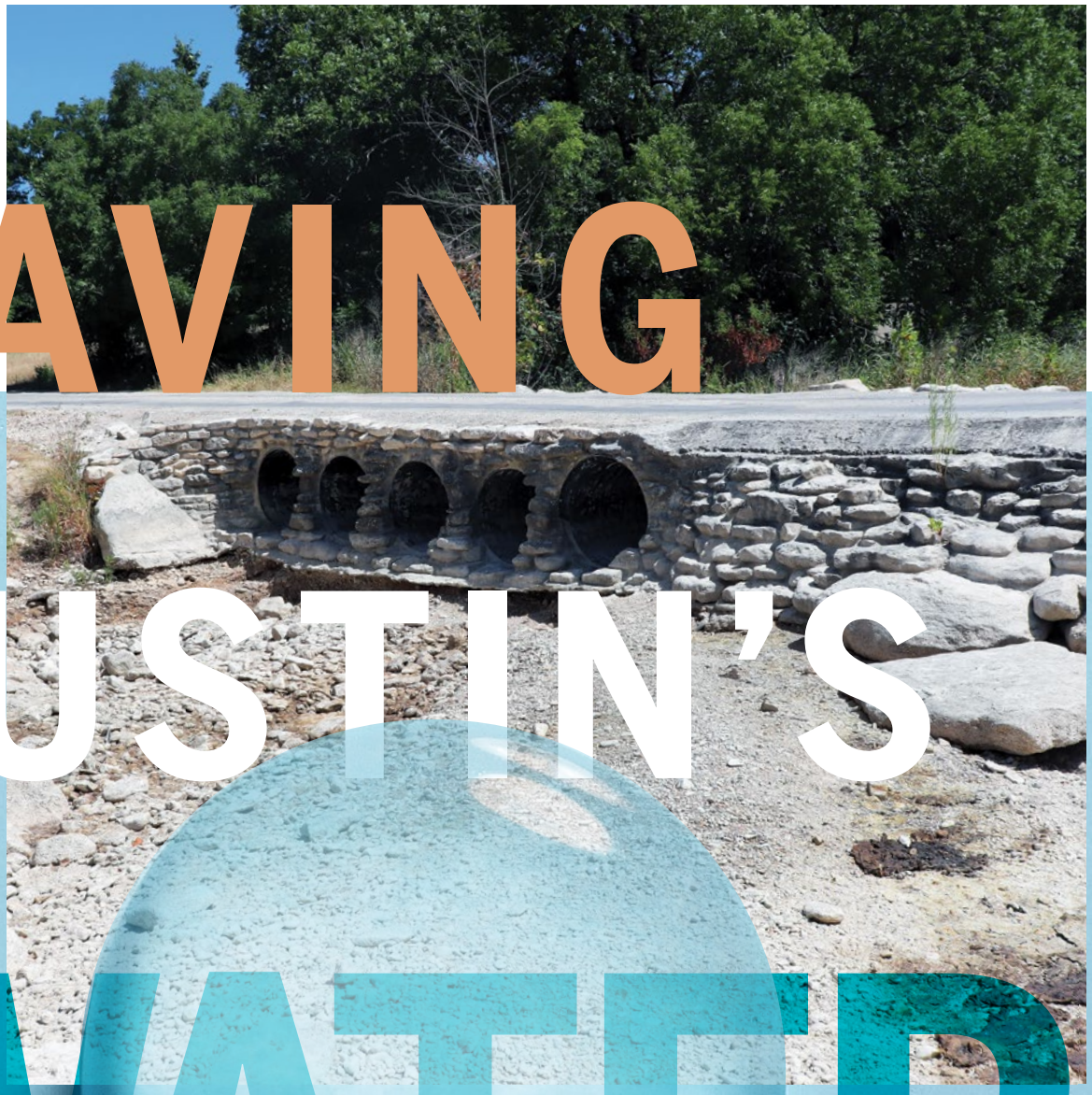
Jackson School News: jsg.utexas.edu/news

UTJSG @TXGEOSCIENCES JSG UT AUSTIN @TXGEOSCIENCES

ABOVE: (FROM LEFT TO RIGHT) GEETA PERSAD, LIANG YANG, SABIHA TABASSUM, PAOLA PASSALACQUA AND DEV NIYOGI.

OPPOSITE: A DRY BIG SANDY CREEK IN TRAVIS COUNTY OUTSIDE OF AUSTIN.

PHOTOS: JACKSON SCHOOL.



SAVING AUSTIN'S WATER

UT Geoscientists are helping the City of Austin protect its water supply in the face of a changing climate

BY ANTON CAPUTO

BOAT RAMP: JACKSON SCHOOL.

On a good day, Big Sandy Creek winds 12 miles through the rural Texas Hill Country, carrying water to the Big Sandy arm of Lake Travis and helping the Jones Brothers Park boat ramp remain a popular launching point. Today, the creek is bone dry, as it has been for weeks, leaving the boat ramp nothing more than a concrete walkway to a grassy field.

There's nothing terribly unusual about a dry creek bed in the Hill Country during a Texas summer. Creeks that dry up one season can swell quickly the next, as torrential thunderstorms turn sun-cracked ground into flood zones. But the fate of waterways like Big Sandy have impact far beyond local boaters, with creeks throughout the region filling the Highland Lakes and bringing life-sustaining water to the city of Austin and its booming population and growing economy.

With climate change expected to make dry spells more pronounced—and storms more violent and severe—it makes it vitally important to understand the future of these local watersheds, big and small.

Although global climate models are mostly clear on the overall trend of longer droughts punctuated by major storms, they paint a hazy picture at best on the local level. Austin water planners, who have watched local reservoirs drain to a third of their capacity in recent droughts, want to sharpen that picture and get a more detailed forecast of how climate change may affect the water the city depends on.

To tackle this critical issue, the city has turned to climate scientists at The University of Texas at Austin, led by the Jackson School of Geosciences. The project entails analyzing all the massive global climate models available, finding the ones that most accurately reflect local climate, and then downscaling and tweaking them to even more accurately mirror local conditions.

"We're really excited about this partnership," said Marisa Flores Gonzalez, supervisor of the Austin Water resources team. "I think it's just really valuable in general for folks from academia to team up with folks who are applying the science that academia produces. It can help academic research become more targeted and have a real impact on decisions that are made in the real world."

Targeting academic research to tackle pressing, real-world issues is exactly what the Jackson School has been focusing on in recent years. This project is one of many that the school is leading or participating in that deal directly with issues around Austin and Central Texas, thanks to a new interlocal agreement between the city and UT Austin. Others include a project to pinpoint areas around the city where hot temperatures are affecting people the most—and proposing solutions to cool down these places—and a project to help forecast wildfire conditions in Central Texas.

"In all regards, this is geoscience at its best," said Jackson School Professor Dev Niyogi. "We are taking global data sets coming from global models—highly complex satellite data sets, highly complicated computational models—and we are deciphering that knowledge into a bite-size information, which is the framework of making knowledge useful and usable."

OPPOSITE PAGE: THE JONES BROTHERS PARK BOAT RAMP IN JONESTOWN.

RIGHT: LAKE TRAVIS IS ONE OF TWO WATER SUPPLY RESERVOIRS IN THE HIGHLAND LAKES CHAIN IN CENTRAL TEXAS.

LAKE TRAVIS: ROSCHETZKYISTOCKPHOTO. GRAPHIC: ADAPTED FROM LOWER COLORADO RIVER AUTHORITY.

Securing the Future

The Austin water climate project is part of the city's 100-year water plan, which is a road map to providing reliable water to a population expected to grow from about 1 million people to more than 4 million people in a century. The city's water plan addresses the issue from all angles—conservation, water reuse and new water supply projects. But Austin's main source of water will remain the Highland Lakes, the chain of lakes in Central Texas created by dams built along the Colorado River in the 1930s, '40s and '50s.

City officials first recognized the need for the 100-year water plan during the prolonged drought that affected Austin and Central Texas from 2008 to 2016. During those eight years, hot weather, long dry spells and parched ground that soaked up the little rain that did fall resulted in local creeks and rivers that remained dry for months. Residents were put under severe watering restrictions, and water that had historically been sent downstream to farmers was curtailed or cut off. Still, Lake Travis and Lake Buchanan, the massive water reservoirs in the Highland Lakes chain, dropped to a third full, and cities and communities throughout Central Texas had to make plans to move water intakes and even scramble to find backup supplies. Local water planners have said the drought even eclipsed the epic drought of the 1950s and now stands as the worst ever recorded in the Austin area.

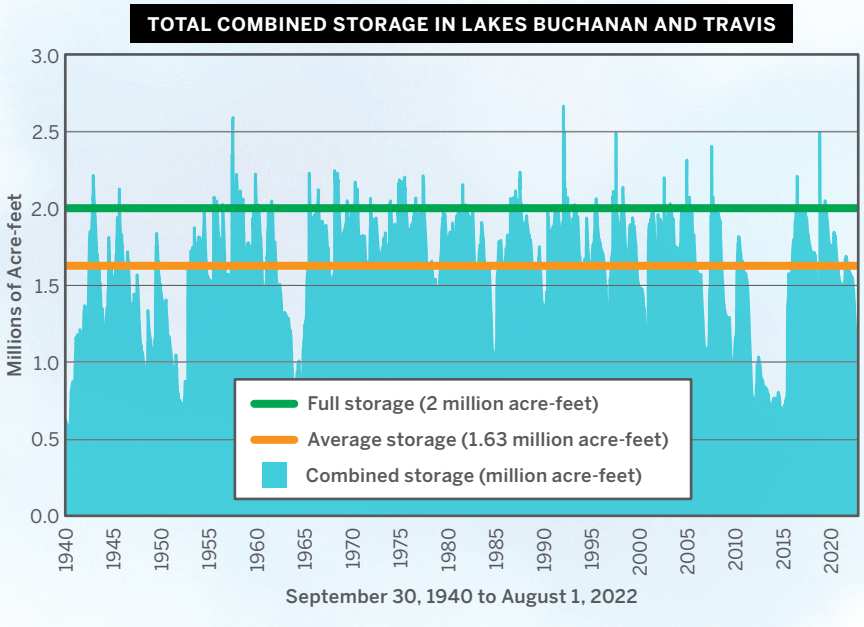
The city adopted the 100-year plan in late 2018 and plans to update it regularly to keep up with the latest science, technological advances and demographic shifts. This time around, it wants to include the updated climate models used in the International Panel for Climate Change's most recent report.

Incorporating the data into the water plan would put Austin on the cutting edge of communities preparing for the realities of climate change, said climate scientist Geeta Persad, an assistant professor at the Jackson School. But the specialized expertise needed to do so involves both a proficiency with climate science as well as the access and the ability to work with supercomputers, a combination that is beyond what most communities can muster.

"That data is all publicly available, but it's often not in the form that's needed for local decision making," she said. "There's also a ton of data, so separating the wheat from the chaff and understanding how to use it appropriately can be a serious challenge."

Jackson School Professor Liang Yang and others on the team had been assisting with the process as part of a volunteer climate technical advisory group, but Flores Gonzales said it soon became obvious that they were the best choice to do the job.

"That group initially was advising us on developing a scope of work to update this climate and hydrology analysis," she said. "It became clear that Liang and his team had the necessary skills and expertise to perform that work."



Sharpening the Picture

Led by Yang, the UT team includes Niyogi and Persad, with all three being faculty members in the Jackson School's Department of Geological Sciences. Cockrell School of Engineering Professor Paola Passalacqua and several Jackson School students round out the team.

The team has evaluated the 35 global models available from the major modeling centers around the world to determine which best represent the climatology and hydrology of the Colorado River basin. These global models, Yang explained, are incredibly complex. They integrate the climate forces of the Earth's oceans, atmosphere, land and ice sheets and take into account the impact of greenhouse gas concentrations, aerosol pollution, changes in land cover, urbanizations and natural variations such as solar output and volcanic eruptions.

The challenge is that the models are so large that the resolution literally becomes fuzzy when trying to zero in on local areas. That's because, Persad said, a given global model might include only 10 data points for the entire state of Texas.

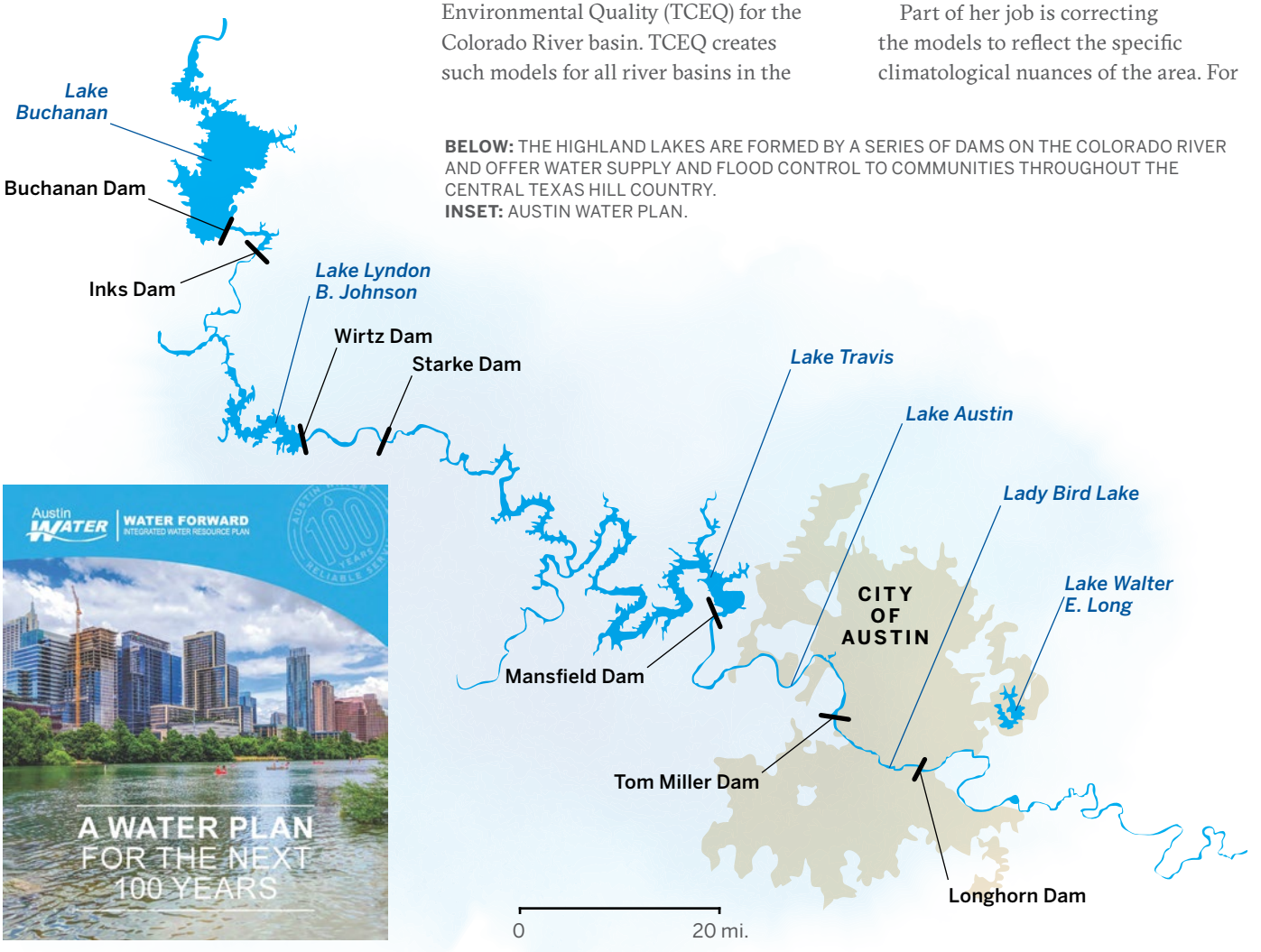
To overcome this problem, researchers improve the resolution by downscaling the models. To do so, UT climate scientists are using statistical relationships between what the models have shown on a broad global level and local climate data. In this instance there is a plethora of local data collected by the Texas Water Development Board and other agencies that covers precipitation, lake evaporation, stream flow and soil moisture. In some cases, the local data reaches back into the mid-19th century.

After downscaling the global models to better reflect local conditions, the results will be plugged into the Water Availability Model (WAM) provided by the Texas Commission on Environmental Quality (TCEQ) for the Colorado River basin. TCEQ creates such models for all river basins in the state to determine how much water will be available in a given season or year. The Colorado River basin WAM encompasses all of the approximately 31,000 square miles of contributing drainage area and the 2,000 different legal water rights contained in the basin.

"We need to evaluate those models and find the best performing models in terms of producing precipitation, temperature, seasonalities and extreme events, drought and the floods as well as the stream flow, soil moisture and things like that," Yang said. "These are the inputs needed by the water availability model."

Currently, the team is working with about six of the global models that it has determined to best reflect local conditions. Most of the actual data crunching is being done by Jackson School doctoral student Sabiha Tabassum working with the Stampede2 supercomputer at UT's Texas Advanced Computing Center.

Part of her job is correcting the models to reflect the specific climatological nuances of the area. For



BELOW: THE HIGHLAND LAKES ARE FORMED BY A SERIES OF DAMS ON THE COLORADO RIVER AND OFFER WATER SUPPLY AND FLOOD CONTROL TO COMMUNITIES THROUGHOUT THE CENTRAL TEXAS HILL COUNTRY.
INSET: AUSTIN WATER PLAN.

WATER PLAN: CITY OF AUSTIN. LAKE MAP: JACKSON SCHOOL.

ABOVE: MANY PARTS OF LAKE TRAVIS RAN DRY DURING THE SEVERE DROUGHT THAT HIT CENTRAL TEXAS FROM 2008 TO 2016.

instance, Texas has a very noticeable moisture gradient running east to west throughout the state. As you travel east, conditions become wetter; as you travel west, it becomes drier. The local region also has two notable peaks in rainfall —May and October. Making sure that the models correctly reflect these two variables is vital for accuracy.

This project is putting Tabassum front and center in the relationship between the Jackson School and the city, which includes meeting regularly to discuss progress and presenting results. The setup involves much more communication with interested stakeholders than typical academic work.

"For federal grants, you only write an annual report," Yang said. "For this, we meet every few weeks with the city and with the advisory group once a month."

For Tabassum, who is interested in a career in the private sector focusing on climate risk, the experience of regularly communicating with stakeholders who are not experts in the field has been invaluable.

"We have learned through the process because we have to present to people who are maybe not familiar with the climate data," she said. "The goal is to make it easier to understand so they can continue to give feedback on the project. I never thought I would be given this opportunity, to be honest. I feel very lucky."

This update of the plan is scheduled to be complete in 2024. It won't provide a single answer about the future of the city's water supply, but a range of possibilities depending on different climate scenarios, demographic possibilities and policy decisions. Although the future will remain uncertain, the results of the local climate modeling will provide city leaders with valuable information to plan and prepare, said Persad.

"The thing I always come back to with these climate projections is yes, they have uncertainty ranges about them, but think about how much worse it would be if all of this was happening and we had no idea that it was coming and we had no idea what was causing it," she said.

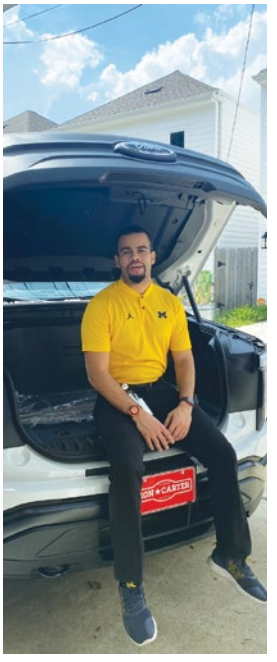
The 2024 update will be the end of this project, but not the end of the relationship between Yang's UT climate team and the City of Austin. Both sides said they expect to continue to work together, painting a clearer picture of the future of Austin in a changing climate.

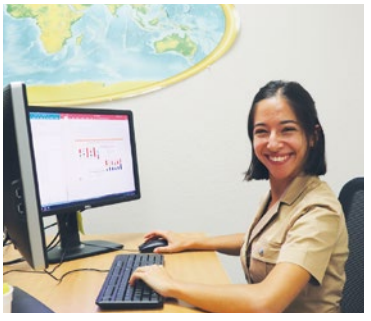
Austin isn't the only city working on local climate modeling, but it is still rare and generally only being done in large cities with significant resources or with the support of state governments that are historically active in climate modeling like California and New York. UT climate scientists hope that the framework they are establishing, particularly the way academic scientists and local officials are working together, can be an example for other communities wrestling with similar issues.

"It is a framework that is considered as a model for what the cities want to do now and in the near future," Niyogi said. "We are just perhaps a couple of steps ahead. And with that privilege comes the responsibility that we do this right and share the framework that others can emulate."

DRY LAKE TRAVIS: CHASE A. FOUNTAIN, TEXAS PARKS AND WILDLIFE DEPARTMENT

PICK YOUR PATH





THE ENERGY AND EARTH RESOURCES GRADUATE PROGRAM TAKES AN ALL-ENCOMPASSING APPROACH TO ENERGY CAREERS, SETTING UP STUDENTS TO THRIVE IN A RAPIDLY DIVERSIFYING ENERGY LANDSCAPE

BY MONICA KORTSHA

Not long ago, a career in energy was practically synonymous with a career in fossil fuels.

But according to Richard Chuchla, who spent more than 35 years at ExxonMobil before joining the Jackson School of Geosciences, that's no longer the case. Energy is oil and gas. But it's also renewables. It's hydrogen and nuclear. It's batteries and power grids that can store and transmit electricity from multiples sources, among other growing industries.

"When I was in graduate school, if you were interested in energy there was one place you were going, with just a few exceptions, and that was the oil and gas industry," Chuchla said. "And that is so different today."

Chuchla is director of the Jackson School's Energy and Earth Resources (EER) graduate program. The master's level program prepares students for careers in energy, water and other industries involved with earth resource production. And while hydrocarbons continue to be a popular career path, the energy transition to lower-carbon fuels along with efforts to mitigate climate change are opening new career opportunities.

EER students and alumni show the breadth of what a career in energy and related fields can look like. They're working with electric vehicles (EVs) and utility-scale batteries. They're researching how ancient cultures managed soil to see if applying similar techniques could boost environmental carbon storage today. They're helping energy startups get the business skills and connections they need to succeed. And even those entering traditional oil and gas jobs are encountering an industry that's working toward more sustainable business practices.

TOP THREE, CLOCKWISE FROM LEFT: EER STUDENT STEVEN WEDEL; EER ALUMNUS TOMÁS FUENTES-AFFLICK; EER STUDENT HAZAL KIRIMLI. **MIDDLE:** EER DIRECTOR RICHARD CHUCHLA. **BOTTOM (L TO R):** EER ALUMNUS MARCO GUIROLA WITH CHUCHLA; EER STUDENT TARA GREIG.

PHOTOS: JACKSON SCHOOL.

Take recent EER graduate Marco Guirola, who is now an intern at ExxonMobil. For his thesis research, he investigated carbon capture and storage—a method for keeping carbon dioxide emissions out of the atmosphere by injecting them into the subsurface—and the potential migration rates and costs associated with storage in reservoirs under the Gulf of Mexico. Although his internship is in conventional hydrocarbon reservoir development, on his first day on the job he was asked to share his thesis work to colleagues with the company's Low Carbon Solutions division.

"There are now CCS experts here," Guirola said. "I think that if someone's going to make [CCS] happen at scale, it's going to be at the majors first. So, that's what I'm aiming for."

All of the Above

Although oil and gas are projected to remain the most consumed energy source in the country for the near to midterm, renewables are the fastest-growing energy sector and are on track to stay that way, according to the U.S. Department of Energy. What's more, this growth is expected to receive a big boost thanks to the federal Inflation Reduction Act that passed in August and includes hundreds of billions of dollars in tax credits and other incentives for companies involved with renewable energy, energy efficiency and carbon removal, including carbon capture and storage.

Some universities have responded to the growth of renewables by spinning off new graduate programs based on sustainability, or even specific energy sources, such as solar or wind. But the EER program, which got its start in 1981, has a different approach. Instead of focusing on select energy sectors, it encompasses all by providing a broad-base energy education.

"As regards education, we are energy agnostic because we believe that the long-term solutions will require all of the above," said Chuchla.

All EER students share a foundation in the four key areas that any energy business must consider: the geology of earth resources, computational data analytics, energy and resource finance, and decision analysis.

At the same time, each student must stake out their own path, undertaking original research and writing a thesis and developing a concentration in a particular area. They do this by working with the program's 38 affiliated faculty and research scientists from across The University of Texas at Austin, including those in the Jackson School, Cockrell School of Engineering, LBJ School of Public Affairs, College of Liberal Arts and UT School of Law.

This multidisciplinary approach attracts students with wide-ranging interests, backgrounds and career goals. Some students already have energy industry experience and are looking to branch into new directions. Others see the program as a way to launch their energy careers.

EER student Hazal Kirimli falls into the first category. She has a bachelor's in chemical engineering from Koç University in Turkey and was a data analyst at Shell for about a year, where she worked on optimizing transportation of oil from refineries to gas stations. She enrolled in EER to pivot into more environmentally focused work and is now collaborating with Michael Young, a senior research scientist at the Jackson School's Bureau of Economic Geology. Young is leading a project assessing the environmental costs of three types of West Texas electricity sources—wind, solar and natural gas—over the course of their "life cycles," an analysis that considers the impacts of mining, water consumption and manufacturing components and the disposal of old equipment, along with direct power generation. Kirimli said that the project is an opportunity to apply her previous experience to new ends.

"My chemical engineering background plays a role in a new way," she said. "My research is all about flowcharts and understanding mass balances, inputs, outputs and analyzing them for a bigger picture."

For her thesis research, Kirimli is applying similar techniques to evaluate different sources of nickel, an essential battery ingredient. And as an intern at Benchmark Mineral Intelligence, a

GUIROLA: MARCO GUIROLA. KIRIMLI: JACKSON SCHOOL. WEDEL: JACKSON SCHOOL.

ENERGY AND EARTH RESOURCES GRADUATE PROGRAM

- JACKSON SCHOOL OF GEOSCIENCES *ADMINISTRATIVE HOME*
- MCCOMBS SCHOOL OF BUSINESS *DUAL MBA*
- LBJ SCHOOL OF PUBLIC AFFAIRS *DUAL MPAFF, MGPS*
- COCKRELL SCHOOL OF ENGINEERING
- SCHOOL OF LAW

company that provides intelligence and forecasts on the battery market, she is learning more about how these analyses are applied in a business setting.

"The future is really in the EVs, batteries, and the supply chains for those batteries," she said. "I want to stay in this area."

Steven Wedel, another EER student, has walked a very different path. Before enrolling in EER he was working as a diver at the Georgia Aquarium, a job that spoke to his interest in ocean life and ecosystems. After earning a bachelor's in earth and environmental science from the University of Michigan, Wedel initially planned on going to graduate school to study coral reefs and how they could be protected from climate change. But a lack of graduate funding led him to explore other career options. He thought back to a class that emphasized the connection between climate change and the energy system, and the need for lower carbon options to mitigate that change. He also watched the stock market.

"I followed a lot of sustainable companies ... and I kind of realized I could go to grad school for something along those lines," he said. "I was fascinated by [the EER program] because I would be able to get the business experience while getting sustainability to play into it, too."

Now an EER student, he is building skills and experience in business development in the sustainable energy space. As part of his thesis work on Environmental, Social and Corporate Governance (ESG) evaluation—a metric that seeks to capture the broader impacts of a company's business practices—Wedel is working as a senior student associate with UT's Austin Technology Incubator. The program helps start-up companies build business skills and connections in its specific sector. Wedel's job involves working closely with businesses with technological innovations that achieve an aspect of sustainability. He said that he thinks of himself as the "optimistic scientist" in the start-up space, believing in the ability of businesses to help mitigate climate change, but only if sustainable practices are considered from the very start.

"A lot of people just look at things from a business perspective, ROI —return on investment —how much money companies are making them, and then try to incorporate sustainability measures," Wedel said. "It can be a big reality hit, realizing that that's not always something that can be easily done."

Good Business

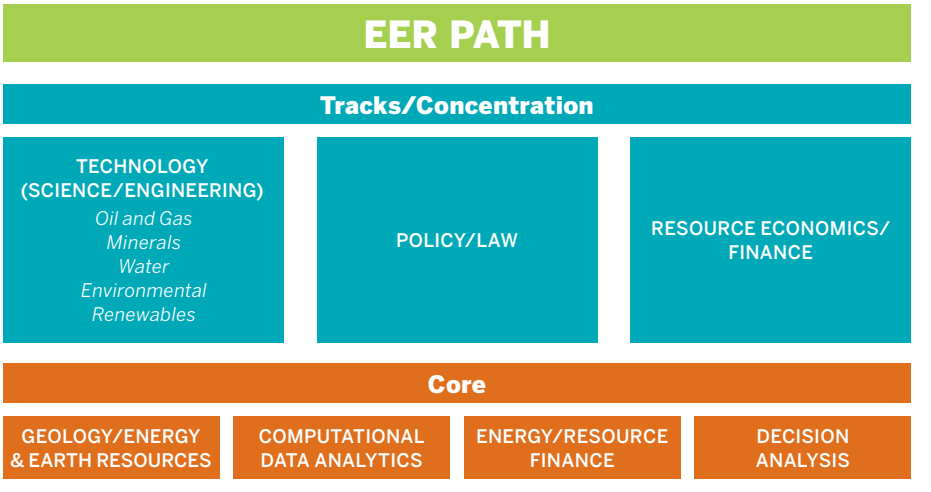
While the EER program provides a space for each student to pick a specialized track, the multidisciplinary foundation helps students see how the different parts intersect in the energy space. It also gives them a foundation that can help them collaborate with colleagues from different areas.

"The premise is you can't solve any energy or earth resources program with just technology, with just finance, or with just policy," Chuchla said. "Think of each of these as equations that you have to solve simultaneously to come up with what I call a truly sustainable energy and earth resources solution."

During his time at ExxonMobil, Chuchla went from being a field geologist in the mining and minerals sector to a project executive in oil and gas, seeing firsthand the success of leaders who kept that balance in mind while seeking input from colleagues across disciplines. EER alumna Jenny Brown (née Sauer) said this approach is an essential part of her work, too, even though she is in a very different part of the energy industry—grid-scale energy storage.

OPPOSITE PAGE, ABOVE: MARCO GUIROLA ON THE JOB AT EXXONMOBIL.
LEFT: HAZAL KIRIMLI IN HER OFFICE AT THE BUREAU OF ECONOMIC GEOLOGY;
RIGHT: STEVEN WEDEL IN THE JACKSON SCHOOL COURTYARD.

ABOVE: THE EER PROGRAM IS BASED IN THE JACKSON SCHOOL BUT DRAWS ON EXPERTISE FROM ACROSS UT. SOME STUDENTS CHOOSE TO DOUBLE MAJOR.
BELOW: ALL EER STUDENTS SHARE A COMMON CORE AND THEN SELECT THEIR OWN CONCENTRATION ROOTED IN TECHNOLOGY, POLICY AND LAW, OR RESOURCE ECONOMICS AND FINANCE.



ARTWORK: JACKSON SCHOOL.

2050 PROJECTION: HOURLY U.S. ELECTRICITY GENERATION AND LOAD BY FUEL TYPE

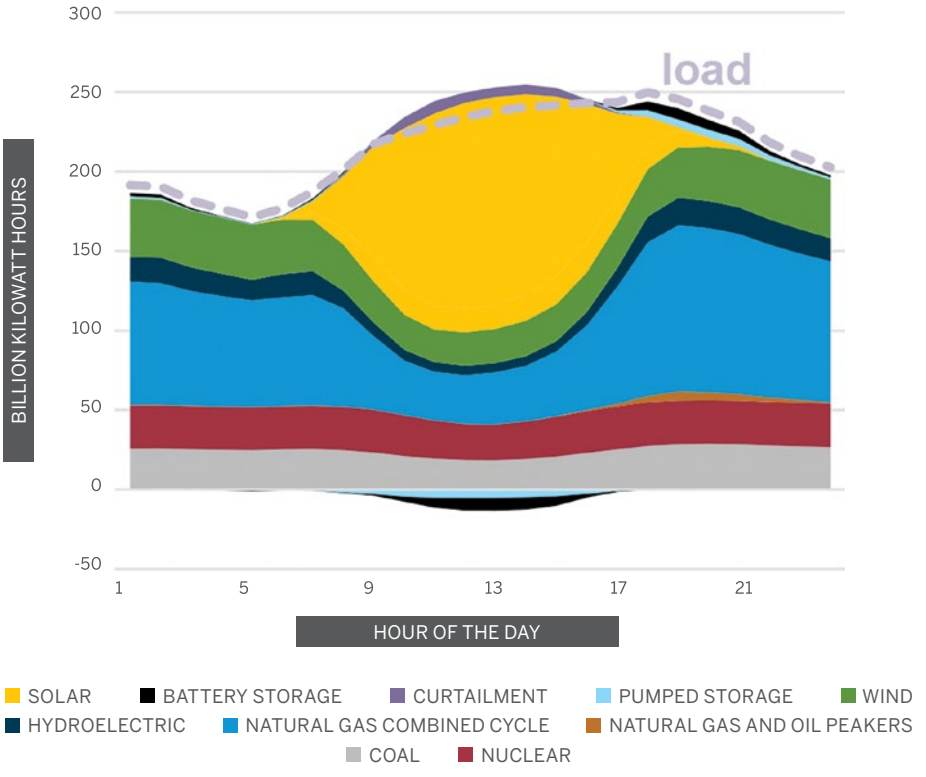


CHART: ENERGY INFORMATION ADMINISTRATION. ENERGY STORAGE: JUPITER POWER. OIL JACK AND WIND TURBINES: DAVID INGRAM.

Brown is manager of market analytics at Jupiter Power, a company that develops, constructs and operates batteries that can be linked to the electric grid to store and release surplus power. Large-scale batteries play an important role in expanding the adoption of wind and solar, Brown said, because they help counter intermittency issues. During sunny and windy hours, the batteries charge on excess power. When it's cloudy and still and grid demand is high, they can release their store of electrons back to the grid and preempt the need for generators to come online.

With multiple Jupiter sites already plugged into the Texas power supply, the company is developing construction plans across the country, including across the northeast, Midwest and California. Part of Brown's job is determining the commercial prospects of energy storage at different locations. To do that requires analyzing input from energy experts from across the company, including colleagues in finance and data science, engineering and development. She said that from day one in the EER program, students are set on a path to problem solve in this collaborative fashion.

"EER equips students with a synthesis and judgment skill base where they become deeply exposed to a variety of disciplines," she said. "The students will always have that ability to engage with an expert on the other side of the table, which I think allows more enriched analysis, communication and decision making in a business environment."

Carbon Careers

With hydrocarbons expected to fulfill the majority of energy demand over the next several decades, capturing and sequestering emissions is a necessity to keep them from contributing to climate change. This need is spurring a sister industry in carbon management. Researchers at the Jackson School's Gulf Coast Carbon Center frequently supervise EER students interested in subsurface storage of CO_2, such as Guirola, the alumnus who is now at ExxonMobil.

But carbon management can take place at the surface, too. Soils are a major carbon sink for the CO_2 taken in by plants, but erosion can release the greenhouse gas back into the atmosphere. EER student Tara Greig is investigating ways to keep soil in place by looking to the past.

Greig, who is earning a dual master's from the EER program and the LBJ School of Public Affairs, is interested in analyzing how the ancient Maya civilization of Central America used soil terracing, creating horizontal plots on hillsides, to mitigate soil erosion after a long period of great soil loss.

Greig's background is in mathematics and statistics, earning her bachelor's in both from Southern Methodist University. And she is currently interning at the semiconductor company Tokyo Electron in their informational systems department. But after learning about the importance of soils in an introductory geology class, she became interested in both the science and sociological impacts of climate change on soil.

"Erosion is generally a smaller issue when we think of climate change," she said. "We think about oceans rising or how it's so hot we can't leave the house. Within the public media, soil isn't something that's discussed as much but is something I find interesting."

The interest led her to UT Professor Timothy Beach, a soil researcher and geoarchaeologist in the College of Liberal Arts who is investigating the soil retention techniques of the ancient Maya.

Although she is early in the research, it's Greig's goal to quantify how much terracing was used in a particular area and how much carbon it stored. She said that depending on the results, similar techniques could be put to use in other erosion-prone regions.

OPPOSITE PAGE, ABOVE: A DEPARTMENT OF ENERGY CHART PROJECTING ENERGY SOURCES IN THE UNITED STATES IN 2050 AND HOW MUCH POWER THEY PROVIDE THROUGHOUT A DAY.
MIDDLE: A JUPITER POWER ENERGY STORAGE FACILITY IN TEXAS.
BELOW: HYDROCARBONS AND RENEWABLES PRODUCING ENERGY SIDE BY SIDE IN TEXAS.

ABOVE, LEFT: TARA GREIG IN THE JACKSON SCHOOL COURTYARD.
ABOVE, RIGHT: TOMÁS FUENTES-AFFLICK WITH A FORD F-150 LIGHTNING , PART OF NRG ENERGY'S ELECTRIC VEHICLE FLEET.

Staying Grounded

Chuchla said that the diverse research projects and career trajectories of EER students and alumni often take him by surprise. He said that this just goes to show how much change and innovation are happening in the energy and climate sector—and how EER students are well prepared to participate and lead.

"When I find out what students go on to do after they graduate, I'm blown away, and I would have never predicted it in many cases," he said. "But it ends up being a reaffirmation of what this degree is all about, while underscoring how uncertain the specific path is to our energy future and why we need to offer an education that creates robustness to changing opportunities."

While the EER education approach helps students build a foundation that can serve them across energy sectors, Chuchla said that it also provides another important benefit. In an energy environment that can be highly polarized and politicized, it helps them build an understanding of the facts and the competing priorities.

"Part of what I hope our students do is play a role of honest brokers in the energy discussion because they have an understanding of the breadth of energy issues and the problems and contrasts," he said.

EER alumnus Tomás Fuentes-Afflick said that this type of measured analysis is what businesses are looking for as they address their own energy issues. He was hired by NRG Energy in Houston to lead the effort on transitioning the utility giant's vehicle fleet to all electric by 2030, and then work with NRG's partner companies to help them do the same.

The job description aligns well with his EER thesis research, where he analyzed the CO_2 emissions changes that would come from converting the city of Austin's fleet of conventional diesel buses to EV models. The research involved accounting for the emissions associated with different electricity sources, from Austin Energy's own energy mix to electricity produced with renewables, fossil fuels and nuclear energy. In all cases, he found that the electric buses produced lower overall CO_2 emissions than diesel.

Fuentes-Afflick said that the finding underscores the importance and opportunity that the energy transition to lower-carbon fuels presents and that he is excited for the opportunity to apply the science with a major player like NRG in an energy hub like Houston.

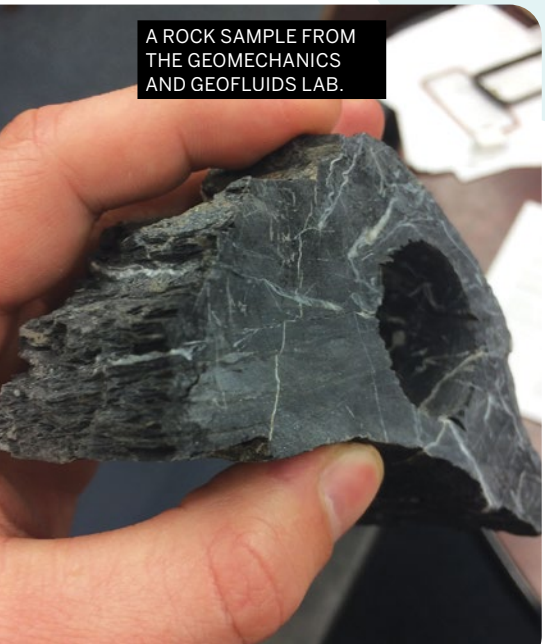
"I was looking for a position where I could feel like I was making an impact on the environment," Fuentes-Afflick said. "I feel this role definitely has it."

THINGS YOU SHOULD KNOW ABOUT JACKSON SCHOOL LABS

THE JACKSON SCHOOL OF GEOSCIENCES IS HOME TO DOZENS OF LABORATORIES.

LEARN MORE ABOUT THEM AND SOME OF THE RESEARCH HAPPENING INSIDE.

BY MONICA KORTSHA



A ROCK SAMPLE FROM THE GEOMECHANICS AND GEOFLUIDS LAB.

PLASTIC WASTE FOR STUDY IN THE SEDIMENTARY LAB.

LAB MANAGER STACI LOEWY IN THE UT RADIOGENIC ISOTOPE FACILITY.

The Sedimentary Lab

The Sedimentary Lab is sieving and separating Texas bay sediments in search of microplastics—particles of plastic that leech into the environment from clothes, car tires and personal care products. The goal of the research, led by doctoral student Will Bailey, is to catalog microplastic types and look for connections between microplastic concentration and sediment grain size, which can help illuminate how plastics travel and accumulate along the Texas Coast. The research uses plastic-free equipment from "field to filter," including custom glassware constructed by the UT chemistry department's glass blower. This helps avoid plastic cross-contamination from equipment to samples.

Across the school, labs are staffed and managed by expert scientists who collaborate with faculty, researchers and students to carry out experiments and collect data. Their areas of expertise include

- geochemistry
- mass spectrometry
- thermochronology
- geochronology
- mineral physics
- morphodynamics
- high-resolution X-ray computed tomography

The Morphodynamics Lab

The Morphodynamics Lab recently built a salt basin in a water tank. The experiment entailed releasing a stream of sediment over a layer of putty that served as a salt stand-in—and then watching the basin build-up from inside and out. Doctoral student Chris Liu led the project, collaborating with Professor David Mohrig, experimentalist, geodynamicist and lab manager James Buttles, and research engineering scientist associate Thomas Hess. The experiment produced a wide range of salt-influenced submarine landscapes, such as minibasins. By using ultrasonic sonars, distancing lasers and acoustic Doppler profilers, Liu got an unprecedented look at the 4D evolution of the coupled salt-sediment system and current-topography interactions while unraveling the internal dynamics governing pattern formation in salt basins that can be used for geomorphic forecasts and solving inverse problems—as well as with deciphering the evolutionary history of salt-hosting continental margins.

Most of the Jackson School's labs are on The University of Texas at Austin's two campuses, the main UT campus in the heart of the city and the J.J. Pickle Research Campus in North Austin. Researchers can take advantage of facilities at both locations.

UT Radiogenic Isotope Facility

The UT Radiogenic Isotope Facility helped determine the age of a prehistoric human settlement by using U-Th dating on ostrich eggshell fragments. UT Austin anthropologist John Kappelman recovered the fragments at a dig site in Ethiopia and brought them to the lab. But small pores that covered the egg were clogged with sediment that interfered with the usual age analysis. Lab manager Staci Loewy devised a way to visualize and map the pore clusters, drill out the in-fill, and date the egg. She found that the ancient snack—and the settlement it came from—was about 74,000 years old.

In addition to campus labs, the Jackson School is home to two "living laboratories," outdoor facilities where scientists can run experiments in natural settings. The White Family Outdoor Learning Center is a 266-acre slice of the Texas Hill Country that Jackson School researchers use for observational field classes and environmental experiments. Formerly owned by BP, the Devine Geophysical Test Site is dedicated primarily to subsurface research, with the site containing three test wells, four boreholes and other amenities for carrying out geotechnical and seismic research.

The Geochemistry Lab

The Geochemistry Lab is looking for signs of critical elements—especially lithium—in produced water brought up by oil and gas operations. Critical elements are the chemical ingredients needed to produce modern electronics, from batteries to solar panels. By analyzing hundreds of water samples from across Texas and neighboring states, research scientist associate Roxana Darvari and senior research scientist JP Nicot are leading the search, while also making discoveries about geological formations. For example, recent findings from the Permian Basin of West Texas came up empty for lithium so far. But the wide range of salinity and dissolved ions allowed the researchers to fingerprint individual saline aquifers.

Some labs share research news and updates on ongoing experiments on social media. Follow these labs on Twitter.

- Geomaterials Characterization and Imaging Facility **@EbeamUT**
- High-Resolution X-Ray Computed Tomography Facility **@UTCT**
- Quantitative Clastics Laboratory **@ClasticsLab**
- Mudrock Systems Research Laboratory **@MSRL2009**
- Vertebrate Paleontology Laboratory **@TexasVertPaleo**

The GeoMechanics & GeoFluids Lab

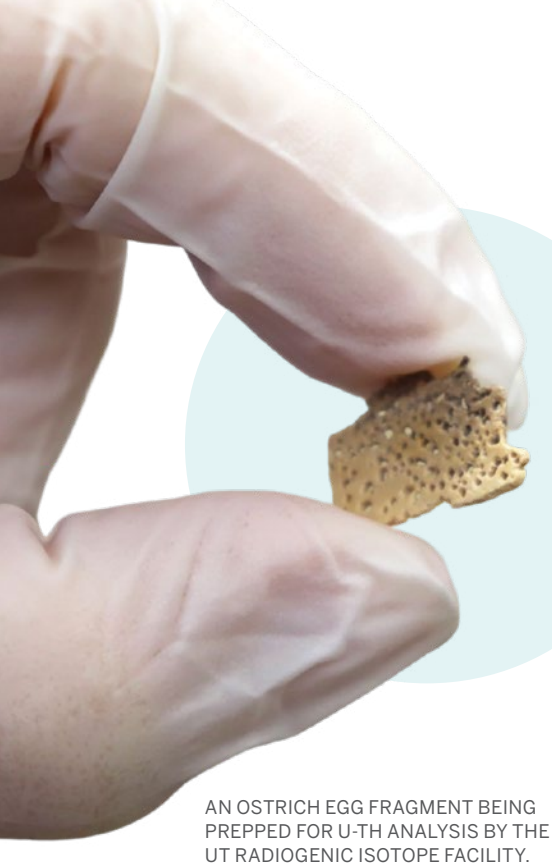
The GeoMechanics & GeoFluids Lab found that grain patterns in rocks from Alaska's Kodiak Island were formed by millions of years of tectonic squeezing underneath the Eastern Aleutian subduction zone. UTIG graduate researcher Peter Miller used lab machinery to analyze the pattern, using seismic sensors to look inside the samples under high pressure. The results show that the sample was probably sandwiched between tectonic plates in the subduction zone before making its way to the surface.

Many labs are available for hire to conduct scientific analyses for research groups, businesses and individuals. Lab managers can provide full details on available services and costs.

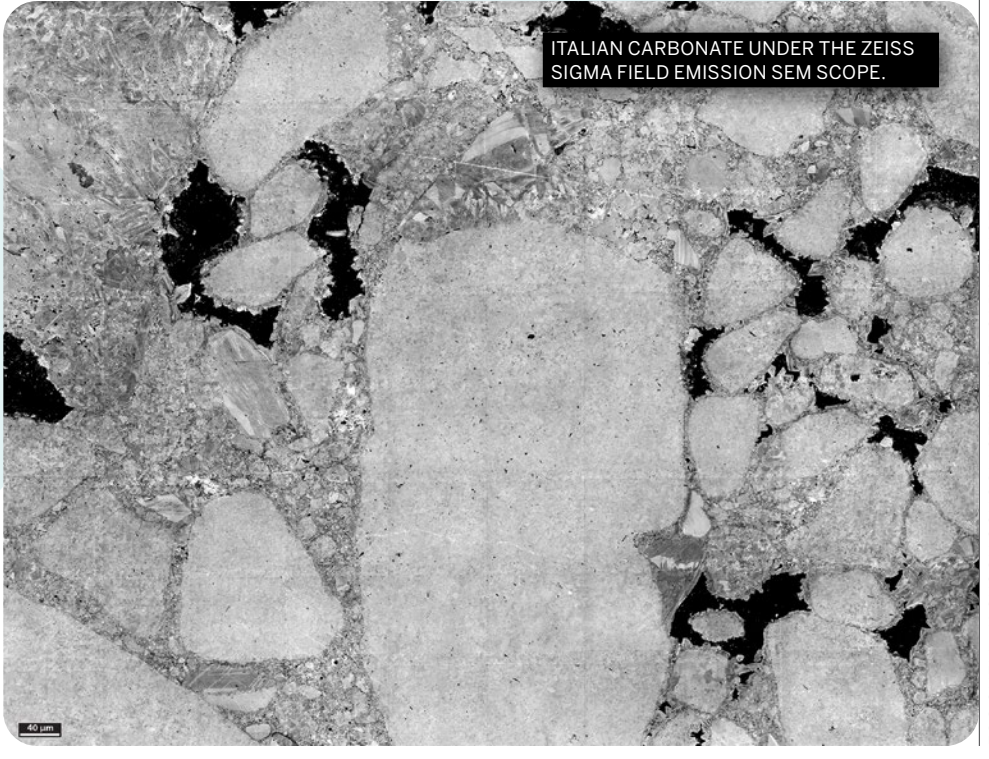
Zeiss Sigma Field Emission SEM Lab

This specialized scanning electron microscope lab has seen many microfractures—more than an estimated 80,000 and counting, according to lab principal investigator and research scientist Esti Ukar. It's all part of a structural diagenesis campaign led by the Fracture Research and Application Consortium group. The group is seeking answers to fundamental questions about fractures: how they start, grow and evolve—and how this influences rock mechanics and fluid flow. With its state-of-the-art cathodoluminescence imaging capabilities, this lab is the workhorse behind the research, with researchers building up and analyzing an impressive catalog of fractured formations, including hard-to-image carbonate-rich rocks.

TGI-Research Friday! In 2019, the Jackson School started the Research Friday initiative to encourage undergraduate involvement in laboratory and field work. Since then, Fridays have been kept clear of upper-division courses so students can dedicate a whole day — or long weekend — to research.



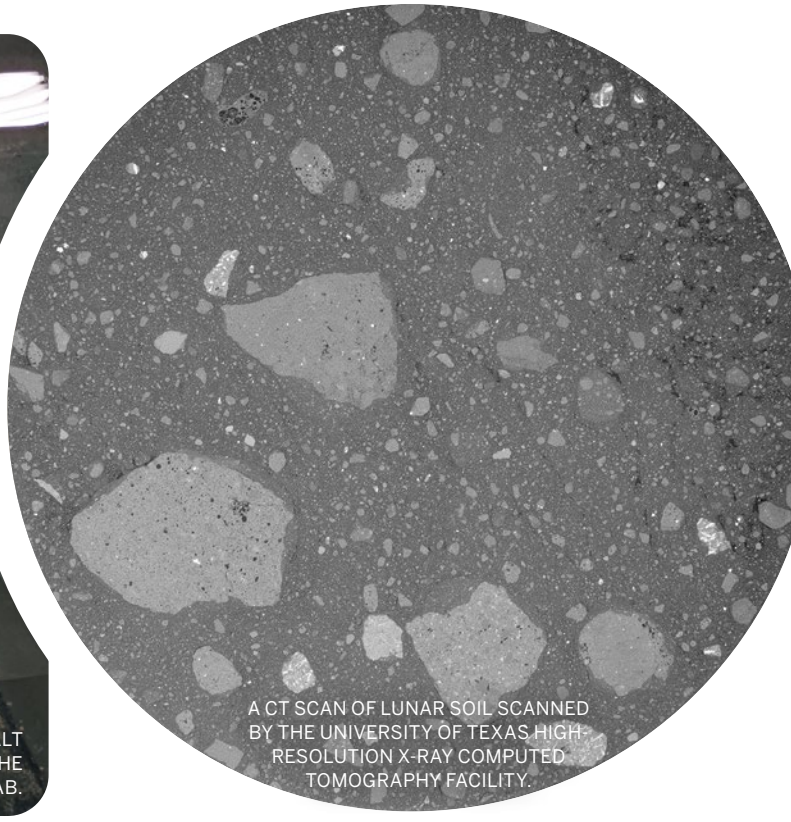
AN OSTRICH EGG FRAGMENT BEING PREPPED FOR U-TH ANALYSIS BY THE UT RADIOGENIC ISOTOPE FACILITY.



ITALIAN CARBONATE UNDER THE ZEISS SIGMA FIELD EMISSION SEM SCOPE.

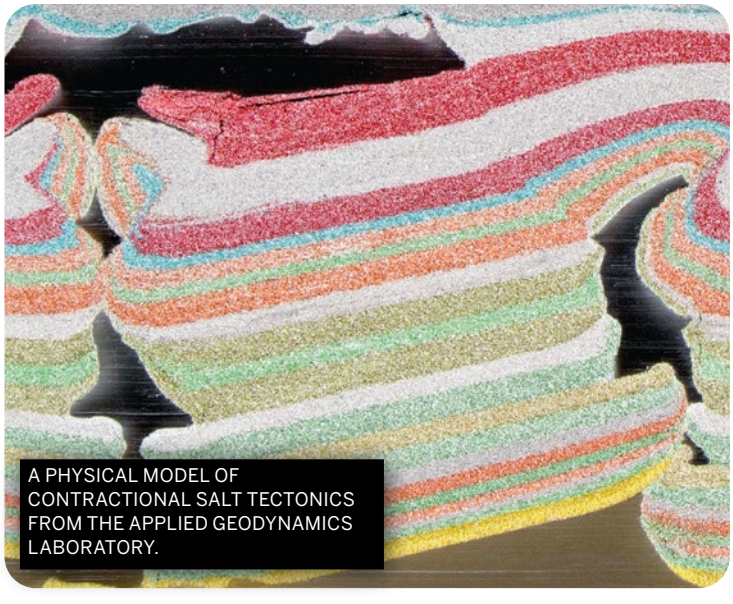
EGG SHELL: JACKSON SCHOOL. SEM IMAGE: SARA ELLIOT.

A MINIATURE AND SIMPLIFIED SALT BASIN IN A WATER TANK IN THE MORPHODYNAMICS LAB.



A CT SCAN OF LUNAR SOIL SCANNED BY THE UNIVERSITY OF TEXAS HIGH-RESOLUTION X-RAY COMPUTED TOMOGRAPHY FACILITY.

DOCTORAL STUDENT CHRIS LIU CHECKING ON THE SEDIMENT DISCHARGE TANK IN THE MORPHODYNAMICS LAB.

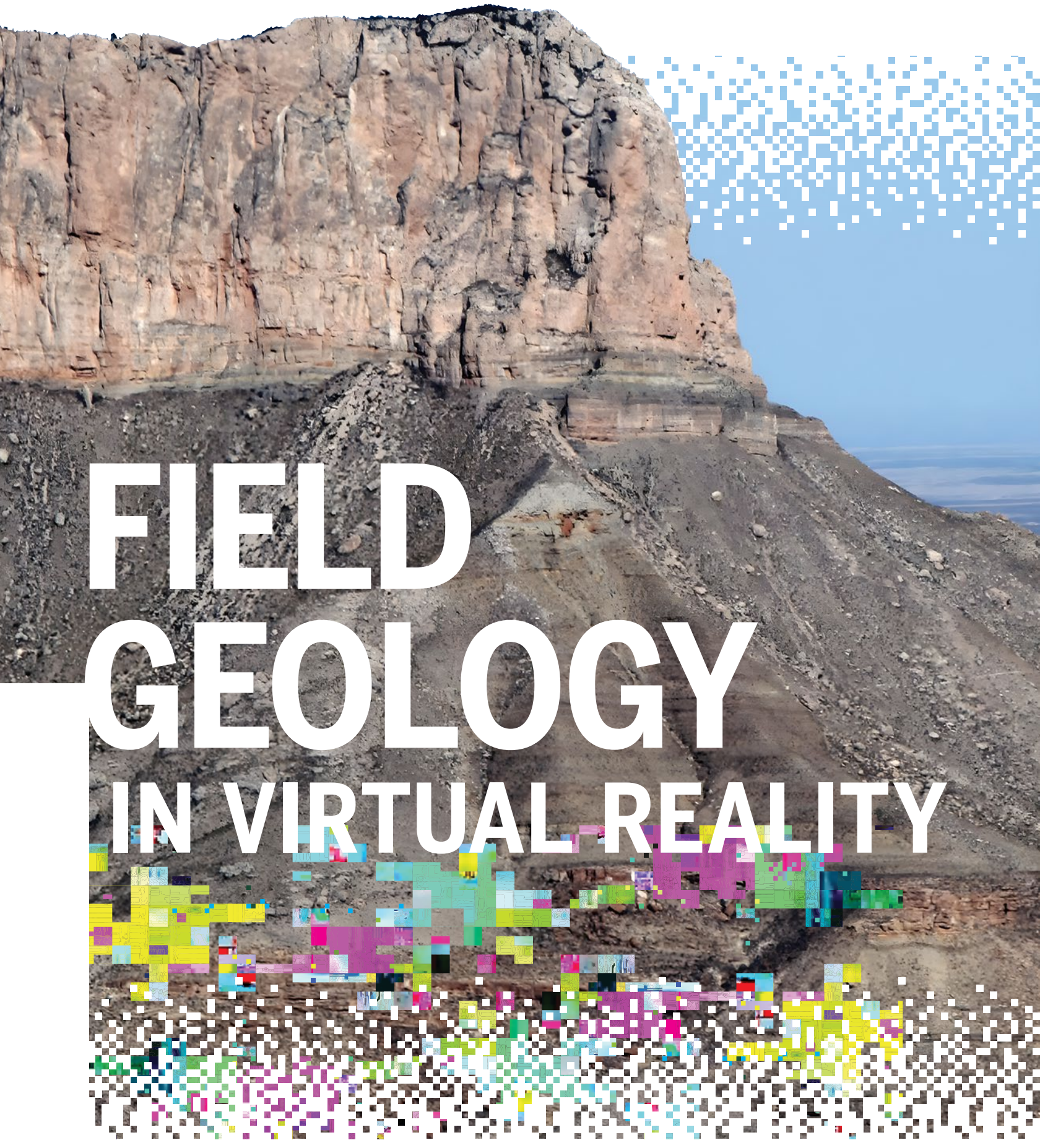


A PHYSICAL MODEL OF CONTRACTIONAL SALT TECTONICS FROM THE APPLIED GEODYNAMICS LABORATORY.

To learn more about lab facilities, staff and services, visit:

www.jsg.utexas.edu/dgs/research/research-facilities

LIU: JACKSON SCHOOL. SALT TECTONICS: TIM DOOLEY. LUNAR SOIL: DAVID EDEY. SALT BASIN: JACKSON SCHOOL.



FIELD GEOLOGY IN VIRTUAL REALITY

SOME OF THE MOST VALUABLE OUTCROPS ARE DIFFICULT TO ACCESS IN THE BEST OF CIRCUMSTANCES. JACKSON SCHOOL RESEARCHERS ARE WORKING HARD TO CHANGE THAT.

BY JULI BERWALD

When asked why he has spent the past 35 years studying outcrops, Jackson School of Geosciences Professor Charles Kerans, who also co-founded the Bureau of Economic Geology's Reservoir Characterization Research Laboratory (RCRL), said "outcrops are a mental image of what things ought to look like."

It's the word "image" that has been a main driver behind a new initiative at RCRL: to image a suite of informative outcrops in three dimensions. The detailed images will be interwoven with critical geological information and comments from experts such as Kerans, creating the virtual experience of taking a field trip to see "what things ought to look like," all while sitting at your desk. Although still in its early stages, this virtual reality project has vast potential for both education and industry.

Outcrops have proved valuable to geologists because the methods of studying the subsurface are limited by the available tools. Cores have very high resolution, but their scale is only 5 to 10 centimeters in diameter, which means piecing together structures from narrow windows of information. Seismic imagery can cover tens of square miles continuously, but the vertical resolution is commonly limited to 10 to 30 meters.

"In order to have a clear understanding of what the subsurface looks like," Kerans said, "it's extremely helpful to go see [outcrops to understand] what the rocks would actually look like in terms of scale and style of layering or other types of important patterns. We might study fracture distributions, or we might study distribution of corals on a reef, and that would be impossible to figure out from subsurface data."

Studying outcrops has proved so important to oil and gas exploration that thousands of people, including members of RCRL's industrial associates and students, have joined Kerans, Chris Zahm, Xavier Janson and other RCRL leaders on field trips to outcrops over the decades. Outcrops are also important for understanding the extent and behavior of aquifers, developing models of climate change and past sea level positions, and, as the world looks to shift to electric vehicles and battery storage, evaluating locations of critical metals such as lithium.

Yet, a major impediment is that opportunities to physically visit outcrops are not available to everyone all the time for a variety of reasons.

"There's one outcrop that's illustrative of the current exploration activity within the Permian Basin," RCRL structural geologist Zahm said, referring to a place known as Apache Canyon in the Sierra Diablo mountains of West Texas. But the location was recently purchased by a private landowner. "So now we can't see it."

MOUNTAIN: CHRIS ZAHM. KERANS: KELLY HATTORI.

LEFT: A HELICOPTER FLY-BY VIEW OF EL CAPITAN IN THE GUADALUPE MOUNTAINS. **RIGHT:** CHARLIE KERANS DESCRIBES THE PERMIAN SAN ANDRES FORMATION OF THE ALGERITA ESCARPMENT, ONE OF THE WORLD'S BEST EXAMPLES OF A CARBONATE RAMP.

Many informative outcrops in Texas are, in fact, on private property, making access limited due to regulations.

Not only property rights, but physical capability can also impede the ability to view and study outcrops. Remote locations, rough terrain and steep inclines limit people's ability to visit and understand important geological structures. Informative outcrops exist all over the world, from the Australian coastline to the Arctic Circle. Time to fly to those places and money to fund the trips are also significant barriers.

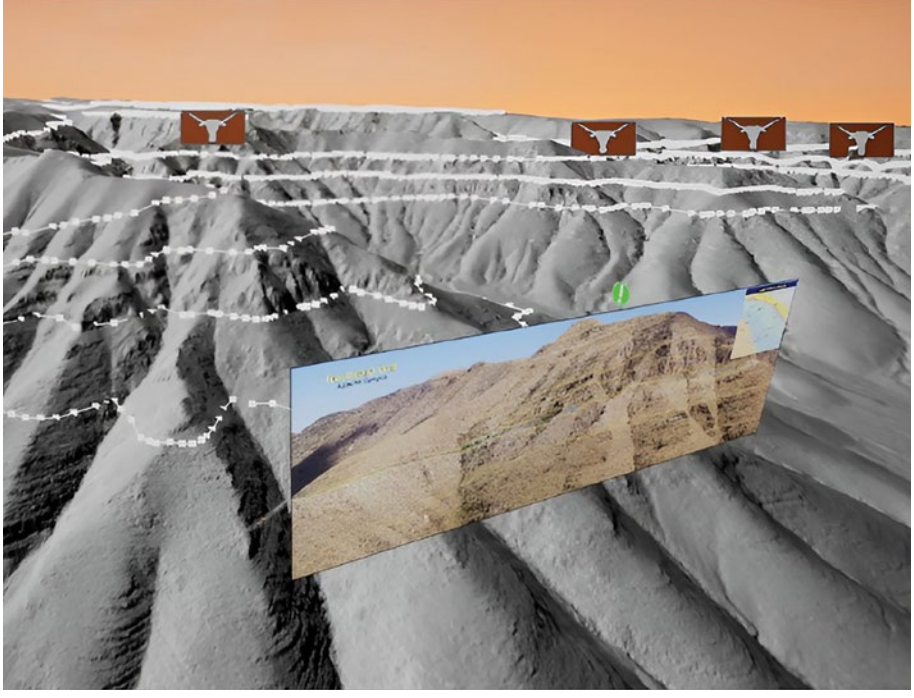
To address these obstacles, Kerans, Zahm, Janson, Robin Dommisse, and then-doctoral student Buddy Price (Ph.D., 2021) envisioned a virtual reality system that would allow anyone to explore outcrops "from a desk chair, right now," Zahm said. Price developed a proof-of-concept model that began the current efforts.

The project started in 2021 with highly detailed Lidar imagery collected by the U.S. Geological Survey at outcrops in Texas and New Mexico. Then, drones were flown back and forth across the outcrops, taking imagery at multiple angles. Using photogrammetry—the same technology used to combine images in View-Master stereoscopes—the images were stitched together into three-dimensional models.

Although the technology is still in a beta version, a user will experience the virtual outcrop from a first-person point of view, initially through a web browser, so no software will need to be downloaded. Eventually, Zahm said, the project will be ported to an immersive experience with VR goggles and headset.

Layered on top of the 3D drone imagery, the researchers can "paint in" geologically relevant structures. And at the same time, they capture video of experts such as Kerans describing

ABOVE: GEO 660 STUDENTS AND INSTRUCTORS PAUSE FOR A SELFIE AFTER A 3.5-MILE HIKE ALONG THE PERMIAN REEF GEOLOGY TRAIL.
MIDDLE: CHRIS ZAHM TOWS CANOES ON THE PECOS RIVER.
BOTTOM: A VIRTUAL RENDERING OF THE WEST WALL OF APACHE CANYON IN THE SIERRA DIABLO RANGE OF WEST TEXAS. THE SITE IS NO LONGER ACCESIBLE IN PERSON DUE TO PRIVATE OWNERSHIP.



ABOVE: A VIRTUAL LANDSCAPE MADE UP OF A LIDAR MODEL OF VICTORIO CANYON IN THE SIERRA DIABLO MOUNTAINS (GRAY) AND A PHOTOGRAPHIC PANORAMA OF THE CANYON WALL. **BELOW:** KERANS (RIGHT) AND GRADUATE STUDENTS ANDREA NOLTING AND KELLY HATTORI DURING A FIELD GEOLOGY COURSE TO SAN SALVADOR ISLAND, BAHAMAS.

SELFIE: KRIS VOORHEES. ZAHM: CHRIS ZAHM. APACHE CANYON MODEL: KIRT KEMPTER/ CHARLIE KERANS. SIERRA DIABLO MODEL: BUDDY PRICE/ CHARLIE KERANS. DIVE: CHRIS ZAHM.

the formations during field trips. These videos are laced into the imagery like waypoints that can be clicked on as various locations in the virtual world.

"We want you to be interactive in the environment," Zahm said. "So there's a floating symbol that says, 'Hey, there's information to talk about [here], and now I can just walk over the surface to that spot.'"

Depending on the purpose, those waypoints could be very specific reservoir characteristics relevant to petroleum engineers, good fossil-hunting spots for a general audience, or points of interest for National Park visitors.

But with outcrops that can soar up to 3,000 feet of local relief or more and stretch for tens of miles, the amount of data required for a seamless virtual reality outcrop quickly becomes massive. To shift perspective—or in virtual reality parlance, level of detail—from the kilometer scale to the meter scale to the centimeter scale with the kind of smoothness that feels like human experience, gigabytes of data and huge amounts of computer time are involved.

To wrestle the concept into code, Janson and Zahm began collaborating with The University of Texas at Austin Department of Computer Science. The project now uses a commercial visualization program called Unreal Engine, which is software developed for the kinds of three-dimensional environments used by wildly popular computer games such as Fortnite and highly visual television shows such as "The Mandalorian."

Although the software is still in development, a virtual field trip of an outcrop called Dog Canyon in the Sacramento Mountains of New Mexico starts with a view of the entire 2,500-foot-tall structure. A user can turn the entire outcrop in three dimensions like spinning a rock in your hands. This outcrop contains dauntingly steep cliffs.

As the user moves the virtual outcrop rightward, Charlie Kerans comes into view. He is discussing the clastic and carbonate layers. As Kerans refers to various cross sections, they appear as floating slide projections. Zahm said that it's not just about providing a virtual world, "it's about adding critical information."

Kerans points out that once a catalog of VR outcrops has been assembled, their usefulness will extend well beyond the virtual field trip model that's currently in development.

"In a VR world, you could stack together two or three different examples that you really want to compare but would be impossible to do in the short term," Kerans said. "You could compare the Canning Basin of Australia, and the Cretaceous of central Mexico, and the Permian in the Guadalupe Mountains [of Texas]. You could start to see what different ancient reefs looked like and the associated deposits in a way that you really can't do otherwise."

Although outcrops in virtual reality are still in early stages of development at RCRL, their potential is clearly immense.

"I think that as we do more of this," Kerans said, "you're only limited by your own imagination."

in search of the

NEXT BIG ONE

SUBDUCTION ZONES ARE THE SOURCE OF THE WORLD'S MOST DANGEROUS EARTHQUAKES AND TSUNAMIS. UTIG'S RESEARCHERS ARE ON A MISSION TO UNDERSTAND THEM

BY CONSTANTINO PANAGOPULOS

On Jan. 26, 1700, a barrage of tsunamis ripped across the Pacific Ocean at the speed of a jet liner. The 100-foot waves slammed into the northwest coast of America and carved a path of destruction 3 miles inland.

Hours later, towering waves destroyed coastal villages in Japan, searing the catastrophic event into the cultural memory of people on both sides of the ocean.

The disaster was the result of a magnitude 9 earthquake at the Cascadia fault in the Pacific Northwest, which struck with such violence that the coastline dropped by at least 3 feet.

Cascadia is one of several subduction zones on the Pacific Ring of Fire. Similar faults encircle all the world's oceans. By the simplest description, they are the colliding fronts of tectonic plates and the conduits through which most of the world's tectonic energy is released. It's no surprise then that they are responsible for the largest earthquakes and tsunamis.

It's also why they're the target of researchers at the University of Texas Institute for Geophysics (UTIG), one of the foremost investigators of subduction zone earthquake hazards worldwide.

"There's a real big push to try and understand the earthquake and tsunami hazard posed by subduction zones," said UTIG Research Scientist Laura Wallace.

Subduction zone earthquakes are a worldwide problem, but scientists have yet to find a reliable way of forecasting when the next big one will hit. Their unpredictable nature and lack of warning set earthquakes apart among natural disasters.

"They are the only large-scale natural hazard for which we are truly at the mercy of the planet," said UTIG Director Demian Saffer.

PHOTO: UTIG.

UTIG'S DEMIAN SAFFER AND LAURA WALLACE ON AN IODP RESEARCH CRUISE, OFF THE COAST OF NEW ZEALAND IN 2018.

PHOTO: UTIG.

UTIG researchers are investigating subduction zones around the globe in search of insights into how they work, using every tool and method available.

In Japan, they took the deepest-ever measurement of the country's Nankai fault and installed a network of subseafloor sensors that monitor its every creak.

In New Zealand, where Wallace has a joint position with the country's national geologic research institute, GNS Science, UTIG researchers are wiring up the Hikurangi fault to assess the risk it poses to the country's east coast.

And in the Pacific Northwest, UTIG researchers have their sights set on Cascadia, where they recently co-led the first-ever complete subsurface imaging of the fault.

Other ongoing field investigations include subduction zones off the shores of Chile, Costa Rica, Mexico and Alaska.

Back in Austin, UTIG lab researchers have constructed a scaled-down fault zone for studying real earthquakes up close. Others are using supercomputers to re-create major earthquake faults in 3D.

And now a UTIG-led initiative is bringing all the pieces together to create the first physics-based earthquake forecasts, a feat that would put scientists' understanding of earthquakes on the same track as weather and climate predictions.

"We're bringing every method at our disposal to the table as part of a concerted effort to better understand subduction zone earthquakes and the hazards they pose," Saffer said.

Wiring Up Faults in the Deep

Subduction zones are found in the deepest parts of the ocean and stretch for miles under the seafloor. To study them up close, UTIG researchers are using sensor-packed observatories drilled over a thousand feet into the seafloor.

Installing subsurface instruments in the deep ocean is no mean feat, but UTIG researchers have been doing it successfully for over a decade.

In Japan, where the Nankai fault has been eerily quiet for decades, Saffer, together with Japanese colleagues, co-led a series of International Ocean Drilling Program (IODP) expeditions, the last one in 2018, to place a new network of observatories on the seafloor where the fault faces Tokyo.

"The observatories let us hear every tiny creak, even those far out at the trench," Saffer said. "It puts our finger right on the fault's pulse."

Among other details, the observatories revealed previously unknown movement that researchers think lets the fault periodically release some tension and could be important in understanding how it causes tsunamis.

With Japan's Nankai wired up, Wallace and other UTIG researchers are now leading efforts to do the same at New Zealand's Hikurangi fault, another Pacific Ring of Fire subduction zone.

Two observatories were installed in 2018 by an IODP expedition led by Wallace, but because of the pandemic, it was several years before the opportunity came up to retrieve the observatories' recordings.

Finally, in March 2021, Wallace boarded the research vessel *Tangaroa* to deliver a truck-size remotely operated vehicle called ROPOS that travelled 2 miles down to the seafloor to dock with the observatory.

After 10 years working on the project, Wallace was understandably nervous. But when data finally streamed across her screen, the ship's dimly lit operations room filled with elation.

There were whoops, high fives, and much relief, recalled Wallace.

"Putting sensors into the deep-sea environment is extremely challenging," she said. "It's like trying to put something into space."

The wait was worth it. The observatory recorded priceless information about the occurrence of slow-motion earthquakes, called slow slip events.

Just like the largest earthquakes, slow slip events release tension between tectonic plates. But because they unfold so slowly—taking days or weeks—slow slip events pose little threat, at least not immediately.

Wallace points to several instances of slow slip events occurring before big earthquakes. In Japan it's thought a large slow slip event may have triggered the massive 2011 Tohoku earthquake. If such a connection exists, slow slip events could help warn of an imminent dangerous earthquake.

The borehole observatories are a way of investigating whether there's a connection by looking for patterns between slow slip and other seismic events as the fault moves through its cycle.

The results so far are encouraging and are already factoring into New Zealand's latest earthquake hazard assessment models.

"We're seeing where and when strain builds in the Earth's crust in far greater detail than I ever would have imagined," Wallace said. "That gets us a step closer to making that link between

slow slip events and earthquakes, and potentially using them to forecast larger earthquakes."

A Geologic Ultrasound

When an undersea earthquake hits in a particular way, it creates a whiplash in the ocean floor that triggers a tsunami. While subduction zone earthquakes are destructive enough on their own, it's the tsunamis that make them exceptionally dangerous.

To find out which faults have the most potential to cause a tsunami, UTIG scientists are using seismic imaging to peer inside subduction zones and see what makes them tick. They're finding that what plates are made of plays a big role in the threat they pose.

In 2017, Andrew Gase, a UTIG graduate student researcher, joined an international team of scientists aboard the *R/V Marcus Langseth* on the longest-ever seismic survey of the Hikurangi fault. For 35 days, the ship sailed along the 300-mile margin, performing an ultrasound of the fault using seismic pulses and a 7-mile-long microphone.

"The seas were calm, the equipment never failed, and we collected over 4,000 kilometers (2,500-plus miles) of excellent 2D seismic data. It was a complete success," Gase said.

In practical terms, however, it was much like mowing the lawn.

"Well, they say the best cruises are also the most boring," he said.

Uneventful though it was, the data they collected kept Gase busy for the next five years.

What he found was a fault divided. In the north, where the fault is known to cycle harmlessly through regular slow slip events, he found a motley mixture of rocks of all sizes and origins, including ancient volcanoes and sea sediments. In the south, however, where measurements show that the fault is stuck, he found a mile-thick homogenous wedge of sand jammed in the fault right where the largest earthquakes are thought to happen.

Now a postdoctoral researcher at UTIG, Gase thinks that the motley rocks in the northern section mean the fault breaks more easily, releasing the locked plates before tectonic forces can build. Remnant volcanoes that are being sucked into the fault further roughen the fault and halt the occurrence of large earthquakes. In the south, however, the sandy wedge has made the fault rigid and smooth, which might create resistance with the tectonic plates until they slip all at once and smash together in a large earthquake.

For now, the question remains unresolved.

"We don't yet know exactly why these materials cause different slip behaviors. That's a challenge for the modelers to figure out," he said.

Gase's analysis of the seismic images does not show how close the fault is to failure, but it does confirm for the first time a hypothesis that UTIG scientists have tested for years in lab experiments: Rock type governs earthquake behavior.

Making Earthquakes

Postdoctoral researchers Srisharan Shreedharan and David "Chas" Bolton are tightening bolts on a squat, car-size metal frame. They're in a warehouse at The University of Texas at Austin's J.J. Pickle Research Campus, dwarfed by vats, pipes and large equipment, but the instrument they're working on is by far the most unusual.

It's called the Earthquake Machine. The device, which Shreedharan and Bolton have designed and constructed themselves, is in fact a replica of a subduction zone.

GASE: JACKSON SCHOOL. TSUNAMI: U.S. NAVY/FLICKR.

OPPOSITE PAGE: POSTDOCS SRISHARAN SHREEDHARAN AND CHAS BOLTON ASSEMBLE THE EARTHQUAKE MACHINE.

TOP: DOCTORAL STUDENT ANDREW GASE DURING A RESEARCH CRUISE TO INVESTIGATE NEW ZEALAND'S HIKURANGI FAULT IN 2017.
BOTTOM: CARS AND HOMES DESTROYED BY THE 2011 TOHOKU EARTHQUAKE AND TSUNAMI IN JAPAN.

When fully operational, the machine will push two synthetic tectonic plates together and record what happens. Although its fault is only a little over 3 feet long, that's still much larger than most lab-scale faults, which are usually only a few inches in length.

"What's unique with this machine is that because it's so large, it's going to allow the actual ruptures to nucleate and propagate in ways that are more analogous to what actually happens along natural fault zones," Bolton said.

This means that unlike typical lab-scale faults that break all at once, their Earthquake Machine is large enough that earthquakes should break along just parts of the fault.

It also means they can configure it to mimic a divided subduction zone like Hikurangi.

"What we can do is re-create something like a patchy fault, with carbonates here, volcanic clays there, and see how the earthquake evolves," Shreedharan said.

The Earthquake Machine will begin simulating life-size earthquakes in late 2022. The researchers said it can be configured to mimic other kinds of faults such as San Andreas or the complex faults found in the Permian Basin.

It'll soon be joined by the Friction Machine, a similarly large device that's designed to simulate faults under the kind of pressure found miles underground and is currently being installed at the Jackson School of Geosciences' GeoMechanics & GeoFluids lab.

Together, the two machines are the latest additions to a suite of instruments UTIG researchers are using to make lab measurements of each stage of an earthquake.

"There are few places with laboratory capabilities that can cover such a wide range of conditions and slip speeds," Saffer said. "Having these instruments under one roof allows us to explore how earthquakes nucleate and evolve in different types of fault rocks, as they might in the real world, and that's a pretty unique combination."

In the Heart of the Subduction Zone

Japan sits at the meeting point of four tectonic plates, so it's no surprise that each year, the island nation records more earthquakes than anywhere else in the world.

But there's another reason so much seismicity gets recorded. On land and at sea, Japan's faults are the most closely monitored and heavily instrumented in the world.

One of those is the Nankai Trough, a 430-mile-long segment of a subduction zone south of Japan that's been the focus of UTIG scientists' research for over two decades.

On Dec. 21, 1946, Nankai ruptured in a massive earthquake and tsunami that left thousands dead in southern Japan. History shows that a major earthquake occurs there every 100 to 150 years, so there should be detectable signs that the next earthquake is building.

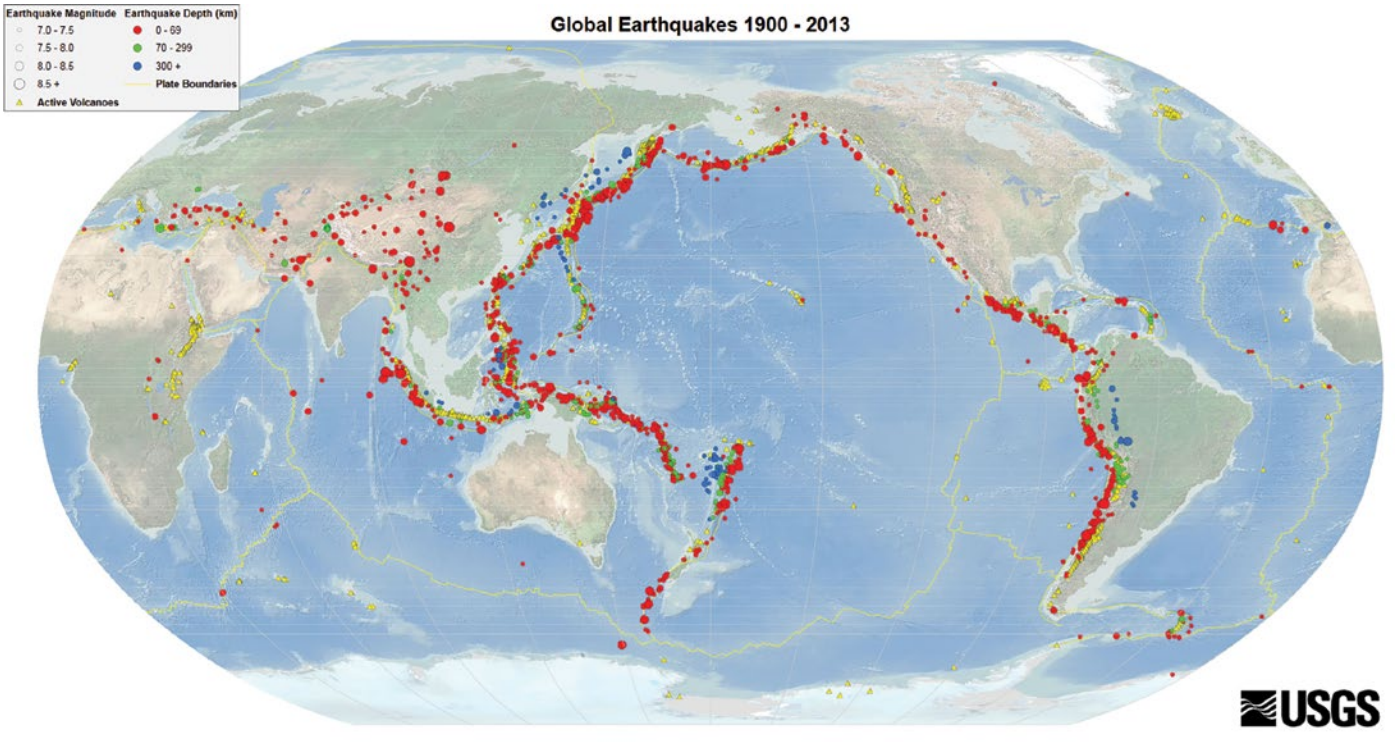
Beginning in 2007, Saffer and colleagues from Japan, Europe and the U.S. co-led several ocean drilling missions to investigate. So far, the program has taken measurements at 25 locations, including one in 2019 that at the time was the deepest ever drilled into a subduction zone.

"This is the heart of the subduction zone, right above where the fault is locked, where the system should be storing up energy between earthquakes," Saffer said.

According to Saffer, models predicted that 76 years into its cycle, tectonic stress in this part of the Nankai fault should be noticeably rising.

The models, it seems, were wrong.

Saffer and his collaborators found that tectonic stresses were essentially zero. Eerily, it was just like Tohoku,



MAP: USGS.

which researchers investigated soon after it shook Japan with a magnitude 9 earthquake in 2011. The Tohoku measurements made sense—the fault had slipped 100 feet during the earthquake. Nankai's did not.

"It's raised more questions than it's answered," he said. "It doesn't violate the physics of the fault as we understand it, but it does revise the way we're thinking about stress in these systems."

Saffer said there were many possibilities for why the expected stress was not found. It could be that the locked zone is more slippery than previously thought and slips easily when strain starts to build.

The stresses may also be lurking deeper in the fault than expected.

Or it could be that the tectonic push will come suddenly in the coming years. Either way, Saffer said the drilling showed the need for further investigation and long-term monitoring of the fault.

A Rock in a Hard Place

In 2015, former UTIG research associate Adrien Arnulf made an intuitive leap that seven years later would lead to the most accurate 3D visualization of Japan's subsurface ever constructed. The premise was simple: What if Japan's vast seismic network—usually geared to listen for tremors—was detecting seismic pings from nearby ocean surveys?

When a ship performs a seismic survey, it pings sound waves into the Earth, each one of which is meticulously catalogued.

Looking back 20 years through the catalogues, Arnulf and his collaborators found thousands of seismic pings in and around the southern coast of Japan. When they laid the pings over the seismic network's archives, they found each one had been detected by hundreds of sensors. Individually, each seismic ping was a pinprick in the dark, but when put together, they fully illuminated the subsurface for the first time.

Arnulf's work lit up a buried mountain-size rock, called a pluton, wedged in the upper plate. It showed how the pluton forces tectonic pressure and buried fluids around it while earthquakes get channeled into its flanks. (Read more about the pluton on page 22.)

Published in early 2022, the information is already being used for a major new government-funded project in Japan to find out whether another major earthquake is building in the Nankai subduction zone.

Arnulf's pioneering project was a triumph of big data analysis and supercomputing. He has since left UTIG, but his former collaborators at UTIG have taken up the baton, continuing his work at other subduction zones, beginning with Hikurangi and eventually turning to Cascadia in the Pacific Northwest.

Cascadia

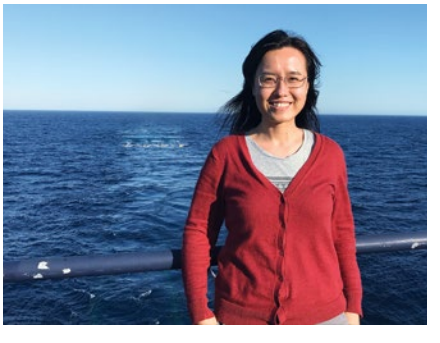
For the people living on Japan's east coast, the tsunami of Jan. 26, 1700, seemed to come out of nowhere. The merchants who detailed the destruction wrote of an "orphan" tsunami that arrived with no accompanying earthquake.

The wave, of course, was no orphan. It was set off by a massive earthquake on the other side of the Pacific Ocean, at Cascadia.

For the Native American and First Nation communities who lived there, the event was catastrophic.

More than 600 miles of the fault slipped, triggering waves that swept away forests and wiped out entire communities.

Since then, Cascadia's subduction zone has remained mysteriously quiet. No significant earthquakes have been recorded in the hundred years or so since seismometers were introduced.



"The question is when the next big one will happen," said Shuoshuo Han, a UTIG research associate who studies Cascadia.

According to Han, paleoseismic evidence in the form of lake deposits and petrified tsunami ripples show that Cascadia produces a near-magnitude-9 earthquake every 300 to 500 years. That means the next one could be on the horizon, but until recently not much was known about the fault.

That all began to change in 2021 when Han co-led a 41-day research cruise aboard the *R/V Marcus Langseth* to image the entire subduction zone—from Vancouver Island to the northern tip of California—for the first time.

Trailing a massive 9-mile-long antenna, the cruise produced spectacular images of the subduction zone, revealing previously unknown details about the geometry and physical properties of the part of the fault responsible for great earthquakes.

It's taken a year to fully process the data, but Han hopes their findings will soon help bring the fault, and its actions, into focus.

ABOVE: UTIG GEOPHYSICIST THORSTEN BECKER.
LEFT: UTIG RESEARCHER SHUOSHUO HAN ABOARD THE R/V MARCUS LANGSETH IN 2021 WHILE ON A SURVEY OF THE CASCADIA FAULT MARGIN.

PHOTOS: JACKSON SCHOOL.

"This data set will provide critical information for future computer modeling work on earthquake rupture along the Cascadia subduction zone," she said. "I think it will greatly advance our understanding of this margin in particular, but also earthquake and tsunami processes at subduction zones in general."

Getting Serious About Seismic Hazard Forecasting

Whether it's observations from state-of-the-art instruments or using big data to pluck clues from archives, UTIG has an impressive record of making break-through discoveries about the world's major subduction zones. The goal, of course, is to know when the next big earthquake or tsunami is most likely to strike.

That's where UTIG's computational modelers come in.

The processes behind earthquakes are, at present, too complex to be useful for predictions. But scientists are hopeful that a new generation of computer models could help them better understand the timing and strength of future earthquakes and even forecast their potential damage.

Among those leading the way is UTIG's Thorsten Becker, who in 2021 launched a National Science Foundation-funded project to figure out the physics needed to make earthquake forecasting a reality.

"We've brought together people with expertise in different parts of the problem to see if we can build a model that captures it all," said Becker, who is also a professor at the Jackson School's Department of Geological Sciences.

Known as the Megathrust Modeling Framework, the goal is to develop models that glue everything together: earthquake nucleation, seismic cycles, tectonic strain, subducting materials, anything from the gaps between mud grains to the march of continents.

The models will merge and compare findings from three natural laboratories: Japan, New Zealand and Cascadia.

The five-year project is already developing computational tools to narrow in on uncertainties that are critical to understanding earthquakes. But Becker believes the surest way to achieve a quantum leap in earthquake science is to expand the community of people who are working on the problem.

In 2022, the project held its first summer school, which brought together graduate students and mentors from across the globe to work on a real-world earthquake hazard problem.

Organized and hosted by UTIG, the intense week-long program introduced students to earthquake physics and probabilistic hazard assessment—then asked them to estimate the likelihood of a major earthquake happening at Hikurangi in New Zealand within the coming years. The problem posed was intentional: It was exactly what the New Zealand government had asked Wallace and her GNS Science colleagues after the 2016 Kaikoura earthquake.

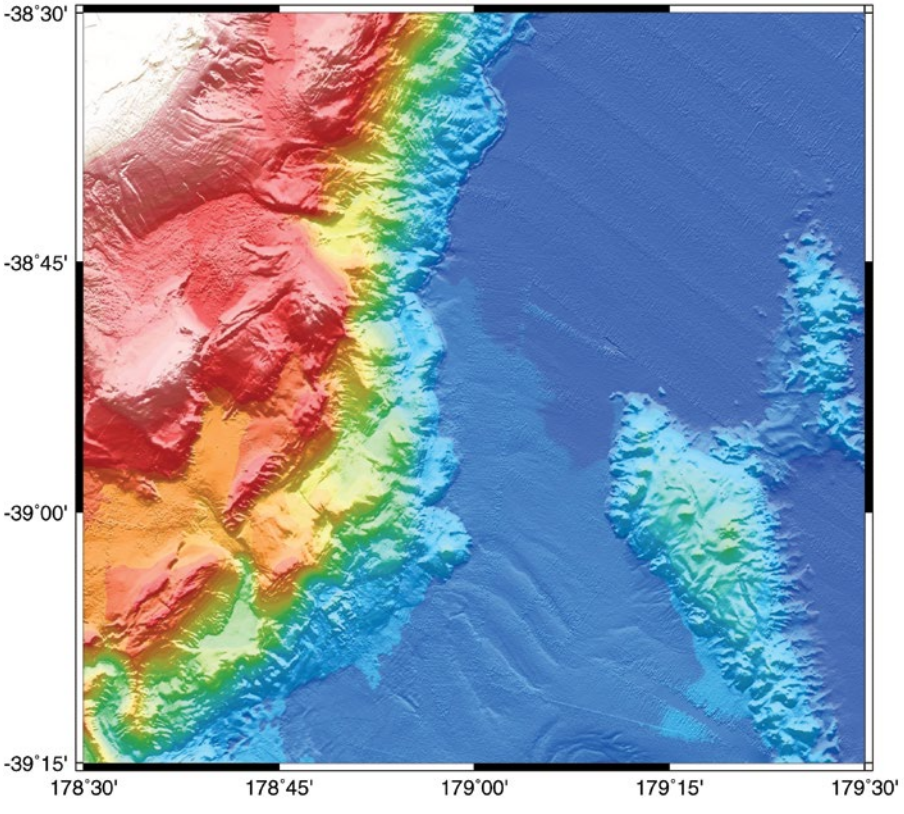
The students' results were impressive, and comparable to the best hazard forecasts for the region. More importantly, said Becker, they identified questions about how to improve models that could be studied for years to come.

"Some really great ideas came out of the students' projects," he said. "My hope now is that they take the computational tools we've taught them and go and make them better."

Becker and his collaborators don't expect to be giving earthquake forecasts any time soon. But with an emerging generation of researchers who are fluent in geophysics and computational geosciences, he's confident the science and tools to do so are within reach.

Saffer agrees that with UTIG researchers continuing to push the frontiers of subduction zone research in everything from deep ocean measurements and large-scale field experiments to computer modeling, they could soon be on the cusp of a great leap forward.

"That's a strength of UTIG," Saffer said. "We have a critical mass of researchers with a diverse set of tools in their toolbelts, approaching the problem from a very interdisciplinary point of view. You would be hard-pressed to find that in many other programs."



BATHYMETRY MAP OF THE HIKURANGI FAULT, OFF THE COAST OF NEW ZEALAND, WHERE UNDERWATER MOUNTAINS (SEAMOUNTS) ARE BEING PULLED INTO THE SUBDUCTION ZONE.

MAP: ANDREW GASE/NIWA.

GEO660

After two years of pandemic disruptions, GEO 660 students returned to the usual six-week field camp. It was a fitting return to form for the final field camp led by Mark Helper, who retired this year after 27 years as field camp director (Read more on page 77). This year's camp traveled to New Mexico, Utah, Wyoming and Montana. Wildfire risks led to the closure of some sites in New Mexico, but instructors successfully rerouted to safer alternatives, and students were able to complete their field projects as planned.

CLOCKWISE FROM TOP:

THE GEO660A CLASS PREPARING TO MEASURE A SECTION IN THE BOOK CLIFFS, NEAR PRICE, UTAH.

LEFT TO RIGHT: BRADEN VINES, MATTHEW RILEY, WARREN WEGENER, COLE CARRABBA, SETH COLEMAN AND JOSHUA MILLER AT DELICATE ARCH, ARCHES NATIONAL PARK, ON A VERY HOT DAY OTHERWISE DEVOTED TO STUDYING THE MOAB FAULT.

DINNER AT CAMP AFTER A DAY OF MAPPING IN THE BIG BELT MOUNTAINS, NEAR HELENA, MONTANA.

GLEN (BAILEY) GLENEWINKEL TAKES A CLOSE LOOK AT SHOREFACE SANDSTONE NEAR ALCOVA RESERVOIR, CENTRAL WYOMING.

PHOTOS: JACKSON SCHOOL.

MG&G

CLOCKWISE FROM ABOVE:

INSTRUCTORS SEAN GULICK (FAR LEFT) AND JINGXUAN WEI (FAR RIGHT) SUPERVISE STUDENTS PROCESSING DATA ON SHORE.

A STUDENT TEAM PREPARES TO UNREEL THE BOAT'S SEISMIC STREAMER.

INSTRUCTOR ZACH SICKMANN DEMONSTRATES HOW TO FREE A JAMMED VIBRACORE.

THE SWAMP CORING TEAM RECOVERS A SAMPLE WHILE BATTLING HEAT AND BUGS.

The class traveled to Port Aransas to study coastal geology aboard the R/V Katy, the UT Marine Science Institute's research vessel. The class also explored Packery Flats near Corpus Christi, looking for damage done to salt marshes by storms and rising seas.

BOTTOM LEFT: THE CLASS LOADS UP ON THE R/V KATY BEFORE SETTING OUT TO MAP THE SEAFLOOR AND GATHER SEDIMENT CORES.

BOTTOM RIGHT: STUDENTS RECOVER A SEAFLOOR IMAGING DEVICE CALLED A SPARKER.

PHOTOS : JACKSON SCHOOL.

hydro

The hydrogeology field camp travelled to three sites around Texas: Hornsby Bend, Port Aransas and the Jackson School's White Family Outdoor Learning Center in Dripping Springs. At the learning center, students watched well drilling in action guided by alumnus Pat Goodson and his company Geoprojects International. They also heard from alumnus Marcus Gary of the Edwards Aquifer Authority.

TOP LEFT: GRADUATE STUDENTS EBONY WILLIAMS (LEFT) AND ADDISON SAVAGE MEASURING WATER QUALITY OF THE LOWER COLORADO RIVER WITH A FIELD SPECTROPHOTOMETER.

TOP RIGHT: STUDENTS GAUGING THE STREAMFLOW OF SOUTH ONION CREEK AT THE WHITE FAMILY OUTDOOR LEARNING CENTER. L-R: CAMERON DEFABRY, SUVAN CABRAAL, COLE CARRABBA AND PHILIP LUPTON.

PHOTOS: JACKSON SCHOOL.

BOTTOM LEFT: MANUALLY INSTALLING PIEZOMETERS ON THE BEACH IN PORT ARANSAS TO MAP GROUNDWATER FLOW TO THE COAST. L-R: ALEC SLIGHT, ADDISON SAVAGE, EMMA PUSTEJOVSKY AND NEELARUN MUKHERJEE.

BOTTOM MIDDLE: STUDENTS GETTING READY TO DEPLOY PRESSURE TRANSDUCERS IN GROUNDWATER WELLS. L-R: AIDAN FOLEY, JOJO SANANDA, AYA SHIKA BANGUN, PHILIP LUPTON AND LOGAN SCHMIDT

BOTTOM RIGHT: DRILLING INTO THE COW CREEK FORMATION COURTESY OF PAT GOODSON AND GEOPROJECTS. THE BOREHOLE, AND SOON TO BE A WELL, IS AT THE WHITE OUTDOOR LEARNING CENTER.

Fossilization Board Game Hits Shelves

After years as a print-and-play version, Associate Professor Rowan Martindale's fossilization board game is now available at the University of Texas Co-op and game shops in Austin.

Called "Taphonomy: Dead and Fossilized," the game teaches the basics of how fossils form by challenging players to protect, preserve and unearth Jurassic fossils. Martindale and former doctoral student Anna Weiss created the game with students in mind, but Martindale said that the game has appeal outside the classroom.

"I think we have managed to make something that is both fun and educational," she said. "I hope to see people using it in their classes as well as for fun on family game night."

The game puts players in the shoes of time-travelling paleontologists, transporting them back to the Jurassic to find and protect organisms as they enter the fossil record. Players respond to different scenarios that may help or hinder the fossilization of specimens they compete to collect. The player with the best collection—which doesn't always mean the most fossils—wins.

Martindale and Weiss debuted a homemade version of the game in 2018 at the Geological Society of America annual meeting. Support from The University of Texas at Austin's Texas Innovation Center and the Jackson School of Geosciences helped turn their vision into a professionally produced game, complete with original artwork for the box and cards by the Jackson School's resident artist, John Maisano.

"John's beautiful depiction of the Jurassic marine ecosystem really brings the game to life," said Martindale. "It's rare that an educational item looks right at home on the shelf of a game store."

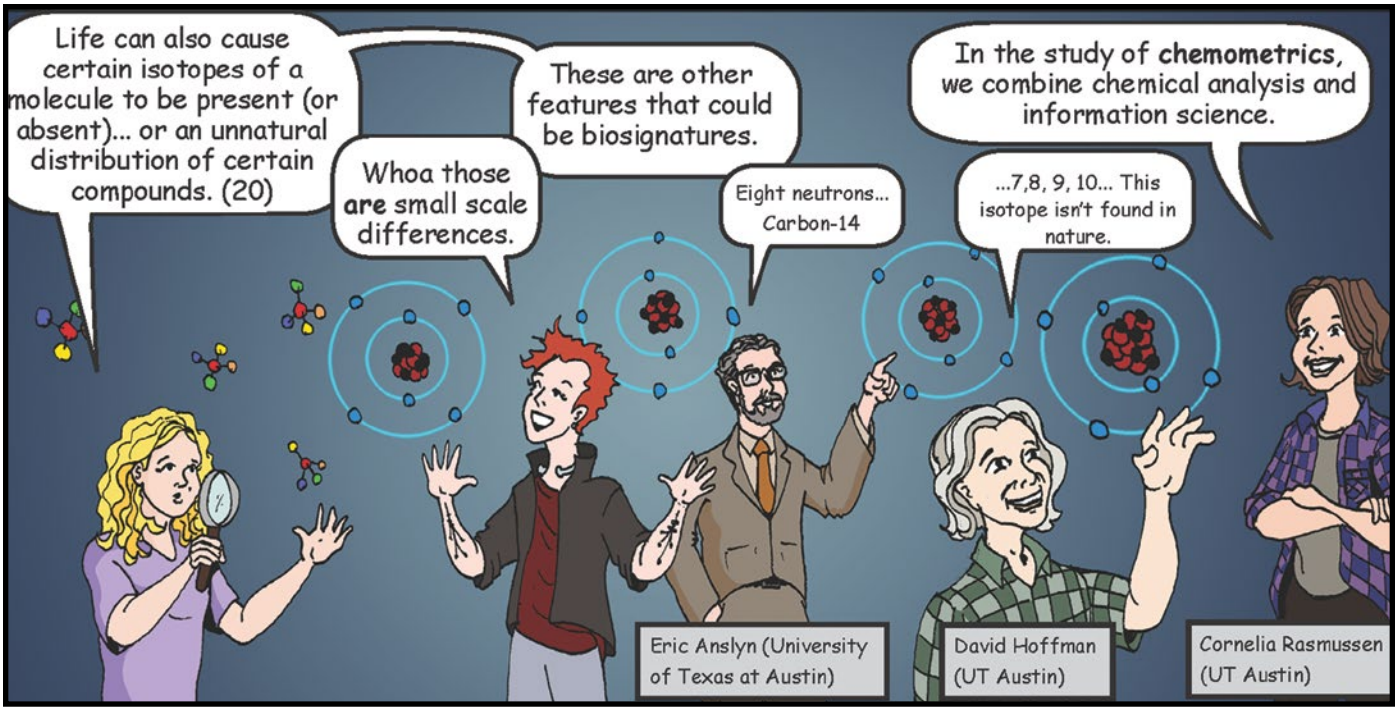
The game can be played with two to four people and is recommended for ages 12 and older.

Funds from game sales support Jackson School student research focused on developing additional paleontology education activities.

The game is available for purchase online at: ***www.universitycoop.com/Jackson-School-of-Geosciences-Taphonomy-Game***

AT TOP: ASSOCIATE PROFESSOR ROWAN MARTINDALE WITH GAME IN HAND AT THE UT AUSTIN CO-OP.
ABOVE: THE BOARD GAME INCLUDES GAME PIECES THAT REPRESENT REAL JURASSIC FOSSILS FOUND BY MARTINDALE AT YA HA TINDA RANCH IN ALBERTA, CANADA.

MARTINDALE: JACKSON SCHOOL. GAME: ROWAN MARTINDALE.



NASA Turns Jackson School Scientist into Comic Book Character

A researcher at the Jackson School of Geosciences made an appearance in a NASA-produced comic book that features real scientists and how their research is aiding in the search for life on other worlds.

Cornelia Rasmussen, a research scientist at the University of Texas Institute for Geophysics, appeared in issue 8 of "Astrobiology: The Story of our Search for Life in the Universe," with Rasmussen sharing how scientists use isotope geochemistry to find biosignatures.

"It shows researchers as real-world role models who are passionate about their work," she said. "And I'll be honest. I loved being a comic book character. That was so much fun!"

Joining Rasmussen on the page are UT professors David Hoffman and Eric Anslyn, both of the College of Natural Sciences. All three are members of the UT Center for Planetary Systems Habitability, a research center managed by the Jackson School that is investigating the science of how and where life evolves.

The comic highlights a bio-fingerprinting technique that Rasmussen and her collaborators developed for determining whether a molecule has biological origins. Their method uses stable isotope geochemistry and chemometrics (the science of finding chemical patterns by numerical analysis) to spot isotope ratios associated with life. The technique could be used to look for biosignatures in samples returned from Mars or other interplanetary missions.

ABOVE: EXCERPTS FROM THE COMIC FEATURING THE JACKSON SCHOOL'S CORNELIA RASMUSSEN ALONG WITH OTHER UT AUSTIN SCIENTISTS.

COMICS: NASA.

Tinker Gives TEDx Talk on Energy Transition

On March 5, 2022, Bureau of Economic Geology Director Scott Tinker took the stage at TEDxUTAustin to talk about the challenge—and necessity—of balancing energy access with environmental protection, and the importance of having science-informed discussions on how best to balance these competing needs.

"Energy and the environment: They have to be addressed together or both will fail," Tinker said. "It's not simple, the dual challenge. But it is solvable."

TEDxUTAustin is a student-led spin-off of the popular TED talk series that promotes "ideas worth sharing." Speakers come from across The University of Texas at Austin community and include students, alumni, professors and researchers.

Tinker was one of nine speakers who presented ideas at the 2022 TEDxUTAustin event. The uniting title for the talks was "Blueprints," or perspectives that can serve as a framework for the future.

Tinker's talk, "The Dual Challenge: Energy and Environment," is available on YouTube: ***https://youtu.be/hnT-PYHaSxAs***

LEFT: SCOTT TINKER TAKES THE STAGE AT TEDXUTAUSTIN.

Fossils Go Live

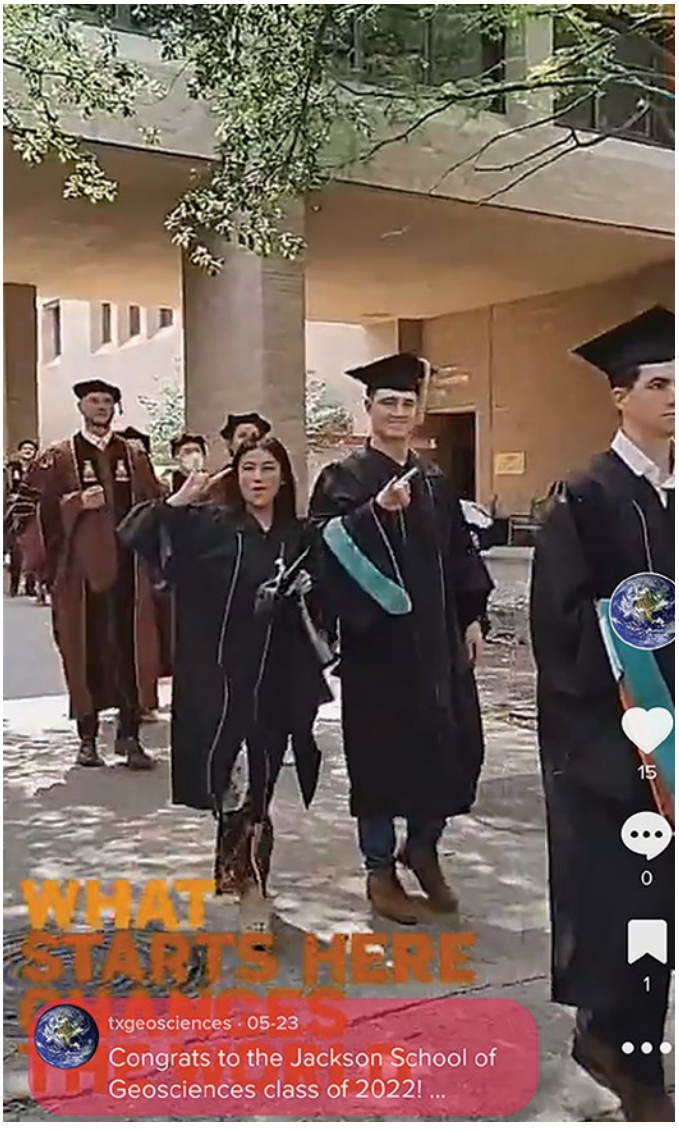
In December 2021, researchers at the Vertebrate Paleontology Laboratory Collections got a head start on the holiday season by unwrapping a "mystery fossil" on Facebook Live.

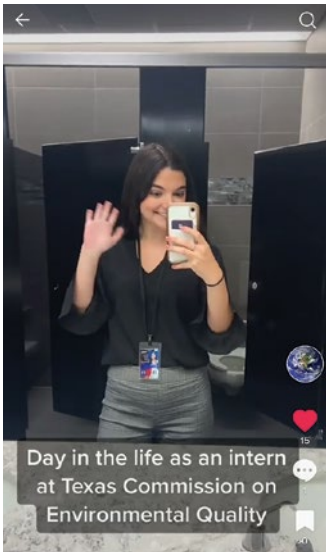
Dozens of people tuned in live to watch fossil preparator Kenneth Bader cut through layers of plaster with an electric saw and utility blades—revealing a probable phytosaur skull surrounded by red dirt. Assisting Bader was volunteer preparator Grace Self.

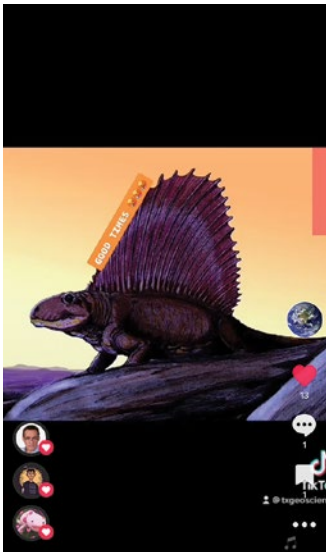
Since its debut, the video has received over 5,000 views on Facebook and close to 300 more on YouTube.

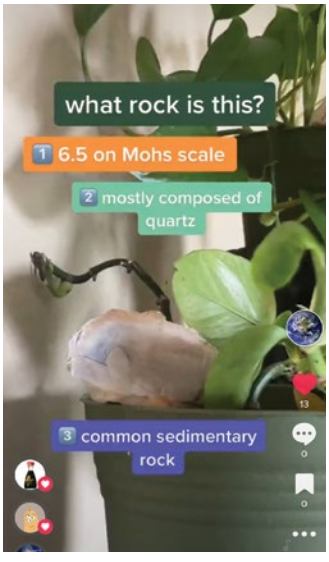
The phytosaur was collected between 1939 and 1941 as part of a Works Progress Administration project that employed hundreds of Texans in need of work as trainee fossil hunters. Thousands of other fossils from that period still remain under wraps in the Jackson School of Geosciences collections.

LEFT: THE MYSTERY FOSSIL STILL UNDER WRAPS AND LOOKING FESTIVE IN A TEASER IMAGE PROMOTING THE EVENT.









Jackson School TikTok Team Shares Student Life

In spring 2022, the Jackson School of Geosciences started a TikTok account to help share the student experience, with most posts produced directly by five students on a dedicated TikTok team.

The students are undergraduates Arushi Biswas, Atticus Cabrales, Eleanor Cote and Eden Lagnado, as well as master's student Aya Bangun.

From dances to how-to videos, TikTok is a platform known for its creative expression, said the Jackson School's assistant director of communications, Monica Kortsha, who manages the school's social media accounts and the TikTok team. She said that students have done a great job tapping into their creativity to make informative, funny and engaging posts.

"Each member of the team has their own style of posting and their own experience to share," Kortsha said. "I think TikTok is a great way to humanize and demystify the geosciences, especially for a younger generation."

The videos have been viewed thousands of times so far. They include "day in the life" montages of summer internships and classes, views from the field; skits about taking tests and registering for classes; and popular TikTok trends with a geosciences spin.

"I really like how creative we get to be," said Biswas. "We have all sorts of videos from educational to silly. We have lots of different ways of reaching an audience interested in geosciences."

Cabrales said he likes sending his Jackson School posts directly to his friends so they can learn more about the geosciences and see what he's studying. For Lagnado, she said that she enjoys having a platform to show the array of topics and experiences that the geosciences encompass.

"I like being part of a science communication community and breaking stereotypes about what geology and geosciences are" she said.

Follow the Jackson School on TikTok at @txgeosciences.

ABOVE: SCREENSHOTS FROM JACKSON SCHOOL TIKTOK POSTS.

PHOTOS: JACKSON SCHOOL.

Hollywood Dinos Bring Paleo to Life

There's a scene in the new "Jurassic World: Dominion" movie in which a pyroraptor leaps on screen with a mouthful of razor-sharp teeth and a coat of fire-red feathers. Although the "Jurassic Park" movies were made for entertainment, there's much about their iconic dinosaur depictions that scientists agree were spot on. That's why the movies are such a great opportunity for paleontologists to present real dinosaur science to the public, said Sarah Davis, a graduate student and researcher at the Jackson School of Geosciences Museum of Earth History's Vertebrate Paleontology Collections.

"The 'Jurassic' movies have been a fantastic opportunity for paleontologists to engage with the public and bring our science to a much wider audience than we can typically reach," she said.

Hollywood has long provided the museum with opportunities for public outreach, usually by partnering with movie theaters to set up fossil exhibits at screenings and answer audience questions about the science behind the movies.

With the new "Jurassic World" movie on the big screen, the museum team partnered with Alamo Drafthouse for just such a special screening, bringing with them their unmatched dino knowledge and a mini-exhibition with real fossils—just right to get the audience ready for an evening of teeth, claws and Laura Dern.

Think what you like about the new movie. Many such as Davis were thrilled to see some of the latest science in the way dinosaurs looked and behaved.

"I was particularly excited to see so many feathers!" said Davis, who joined the museum's panel after the movie to share the science about what it got right and wrong. "And these fluffy coverings don't take away from how terrifying it would be to unexpectedly run into a theropod."

After a long pandemic-induced hiatus, the museum was also back at Blue Hole Regional Park for an under-the-stars screening of the first "Jurassic Park" movie, co-organized with the City of Wimberley and the Austin Paleo Society.

ABOVE: A SMILING DINOSAUR SKULL POSES WITH UT PALEONTOLOGISTS AT THE ALAMO DRAFTHOUSE. FROM LEFT TO RIGHT: KENNETH BADER, SARAH DAVIS, JOHN JACISIN, LISA BOUCHER, MATTHEW BROWN.

PHOTO: MATTHEW BROWN.

Gulick Brings Dino Doomsday to Comic Convention

Science lovers were in for a treat at Awesome Con 2022, where Jackson School of Geosciences Professor Sean Gulick joined the convention's science fair to answer questions about extinction events and the asteroid that wiped out the dinosaurs.

Awesome Con DC is one of the nation's largest annual pop culture conventions, bringing together more than 70,000 fans of science fiction and comic books in what the organizers bill as a celebration of "geek culture."

This year, alongside the usual star-studded sessions with authors and actors, the convention teamed up with the National Science Foundation (NSF) and NASA to offer an Awesome Con Science Fair: a series of talks and events where fans discussed the science behind the fiction with real scientists.

Gulick, who is a research professor at the University of Texas Institute for Geophysics (UTIG) and the Department of Geological Sciences, said the convention was a great new way to get people talking about science, technology, engineering and math subjects.

"What I liked about this audience, aside from the Vulcan ears, fairy wings and hero costumes, is that they're already interested in learning about science," he said. "They were very engaged with some truly great questions."

Gulick led a talk for 200 people in the NSF's "Terra" room (NASA ran a parallel "Cosmos" room) at a session titled "Deep impact—the asteroid that killed the dinosaurs." The session was hosted by NSF program manager Gail Christeson, a former associate director of UTIG.

AT TOP: COVER SLIDE FROM GULICK'S TALK, TITLED "DEEP IMPACT- THE ASTEROID THAT KILLED THE DINOSAURS."
ABOVE: JACKSON SCHOOL PROFESSOR SEAN GULICK WITH HIS SISTER AND NIECE AT AWESOME CON 2022, WASHINGTON, D.C.

PHOTOS: SEAN GULICK.

STEM Outreach Group Visits Jackson School

High school students with Fort Valley State University's Math Science and Engineering Academy (M-SEA) visited the Jackson School of Geosciences this summer to learn about the geosciences firsthand.

The M-SEA outreach program offered by the historically Black university in Georgia was the inspiration for the Jackson School's successful GeoFORCE Texas outreach program, which was launched in 2005. Founding GeoFORCE Director Doug Ratcliff worked closely with M-SEA founder Isaac Crumbly to launch GeoFORCE in M-SEA's image.

"Doug said, 'We don't need to reinvent the wheel,'" Crumbly remembers. "And we had already worked out all the kinks."

Crumbly, who is associate vice president for careers and collaborative programs at Fort Valley State, made the trip with M-SEA students to the Jackson School. Over three days, the students visited labs and researchers on The University of Texas at Austin main campus and the J.J. Pickle Research Campus, and fit in some sight-seeing around Austin, too.

"[The visit] definitely opened my eyes to the different options and how college life might be," said Neal Willis, 18. "If I could go through CDEP (a dual-degree program), I would definitely choose this school."

This year, Fort Valley State undergraduates also participated in the Jackson School's RTX program, a nine-week program that showcases graduate opportunities through geosciences-focused math and science activities, research opportunities in Jackson School labs, and lessons in computer coding.

ABOVE: M-SEA STUDENTS CONDUCT A PERMEABILITY EXPERIMENT.

GeoFORCE Retakes the Field

GeoFORCE Texas was back in the field this summer for the first time since the COVID-19 pandemic turned the program virtual in 2020. Some 441 students in 13 academies visited field sites in Texas, Nevada, Utah, Arizona and the Pacific Northwest.

"There was such tremendous energy and excitement in the field," said Dean Claudia Mora, who attended the trip to the Pacific Northwest. "Watching these young people go through the process of learning and discovery was invigorating!"

GeoFORCE Texas is an outreach program of the Jackson School of Geosciences that introduces high school students from underserved communities to STEM and geosciences careers through summer field experiences, corporate mentoring, and college guidance.

In addition to returning to in-person field trips, the program ran its first symposium where high school seniors showed off their research at The University of Texas at Austin Texas Student Union. The event was followed by an awards ceremony where the keynote was given by Izaak Ruiz, a GeoFORCE and Jackson School alumnus (B.A. 2017, M.S. 2019) who works at Repsol's Geological Low Carbon Americas group.

GeoFORCE also broadened its scope this year to include family members of GeoFORCE students from Southwest Texas. The pilot program funded by Repsol used virtual sessions to educate family members about the geosciences and how to prepare for college. The plan, depending on additional funding, is to expand the GeoFORCE Family program to include the families of all GeoFORCE students and include in-person field trips and information sessions.

To round out the year, GeoFORCE Texas received a 2022 Special Commendation Award from the Society of Exploration Geophysics. The award honors the program for contributions over the past decade in fostering diversity and supporting underrepresented minorities and women in STEM during the transition from high school to college. The Jackson School also awarded $2,500 scholarships to 11 GeoFORCE alumni who are attending the Jackson School this year, including three incoming freshmen.

ABOVE: A GEOFORCE GRADE 11 COHORT GIVES A HOOK 'EM HORNS FROM OREGON'S CAPE PERPETUA.

PHOTO: PBS.

Energy Switch Debuts on PBS

The Jackson School of Geosciences' Scott Tinker is the executive producer and host of a new PBS talk show, "Energy Switch," that brings together two experts on each show to address the biggest questions in energy, climate and the economy.

Tinker, who is the director of the school's Bureau of Economic Geology and the state geologist of Texas, said the goal of the show is to foster and model good-faith discussion and debate.

"The guests don't always agree, and that's by design," he said. "But they model civil dialogue and critical thinking."

The name of the show is a nod to the "switch" in tone he hopes the show brings to an often-cacophonous media and political landscape, as well as a nod to the Switch Energy Alliance, a non-profit started by Tinker dedicated to "inspiring an energy-educated future."

"Energy Switch" debuted on Austin's KLRU in September and features 12 half-hour episodes. The show has been picked up by 21-plus PBS stations nationally, including Los Angeles, Salt Lake City, Cincinnati and Dayton, Ohio. It's also available online and will probably begin streaming on key podcast applications in the spring.

The topics covered in the first season range from exploring the potential of renewables to power the world, to the meaning of sustainability, to the future of nuclear, to the relevance of the oil and gas industry in the United States. The guests include national and international energy experts from academia, non-governmental organizations, industry and government, and include former U.S. Energy Secretary Ernest Moniz, Pulitzer Prize winner Dan Yergin, author Michael Shellenberger, and Environmental Defense Fund Chief Scientist Steven Hamburg, among many others.

"Energy Switch" is part of a growing collection of energy media produced by Tinker and the Switch Energy Alliance. They include two feature length documentaries, "Switch" and "Switch On"; a video series on energy poverty; a short film for iMax and large museum screens, "Energy Makes Our World," which is currently in the Houston Museum of Natural Science, the Perot Museum of Natural Sciences and others; a classroom platform for advanced placement high school environmental science called *Switch Classroom*, which was developed with high school teachers nationwide; and much more.

Tinker said that PBS "Energy Switch" is deepening the energy conversation and bringing it to new audiences interested in a nuanced understanding of energy issues.

"I'm encouraged that we're starting to see more thoughtful, reality-based dialogue on energy, climate and other environmental impacts, and economics," Tinker said. "'Energy Switch' is leading the way on that front."

The show is funded in part by The University of Texas at Austin, Microsoft and the Switch Energy Alliance. Season two has already been recorded and will debut in the spring of 2023. Season three is in pre-production. The program is seeking sponsors.

Watch the first season: www.pbs.org/show/energy-switch/

ABOVE: SCOTT TINKER (MIDDLE) SPEAKS WITH GUESTS DAVID VICTOR (LEFT) AND MATT GALLAGHER ABOUT THE U.S. OIL INDUSTRY ON "ENERGY SWITCH."

Shanahan Leading EVS Degree Overhaul

TIMOTHY SHANAHAN

The Environmental Science degree program (EVS) is undergoing a revamp with Professor Timothy Shanahan serving as the program's first director.

Shanahan, a climate scientist in the Department of Geological Sciences at the Jackson School of Geosciences, is focusing on two key priorities: growing the student body, and modernizing the curriculum so that it equips students with the skills they need to succeed in sustainability and environmental careers.

"There's a need for this," Shanahan said. "The idea behind the program is that students have a broad but targeted set of skills."

EVS is the only inter-college degree offered at The University of Texas at Austin. The Jackson School, the College of Natural Sciences, and the College of Liberal Arts share a common core curriculum while each school has its own degree track. The college a student graduates from depends on the degree track.

The program was previously managed collectively by a group of faculty representatives from each college. As director, Shanahan will now lead the group while working to advance program priorities.

Environmental science careers aren't limited to a single sector, Shanahan said. From oil and gas companies looking to reduce emissions, to insurance companies estimating the on-the-ground impacts of climate change, to environmental consulting, the need for environmental experts is growing across industries.

Geosciences students are also increasingly interested in these areas, said Shanahan, who has seen the shift himself over his eight years of teaching GEO 303, Introduction to Geology.

The EVS degree is a way for students to channel that conviction into a career. As sustainability programs grow across UT and other universities, EVS stands out by offering a curriculum rooted in science and oriented toward career development, Shanahan said.

To help update and inform the curriculum, Shanahan has been meeting with companies in the environmental science and sustainability space. He said that some of the most in-demand skills—such as spatial thinking and quantitative reasoning—are skills that form the foundation of a geosciences education.

The EVS program accepted 62 new students in the fall semester, including transfer students, bringing the total size of the program to 201 students.

JULIA A. CLARKE

Meet Associate Dean for DEI Julia Clarke

Professor Julia A. Clarke is the first associate dean for diversity, equity and inclusion (DEI) at the Jackson School of Geosciences. Named to the position in October 2021, Clarke is the John A. Wilson Professor in Vertebrate Paleontology in the Department of Geological Sciences. In her role as associate dean, she is leading efforts to promote and support diversity and inclusivity in classrooms and workplaces across the Jackson School's three units as well as developing and refining equitable academic processes. With a long history of actions and recognition for outreach and extended learning, Clarke was recognized in 2017 as a leading scientific scholar-educator by the Howard Hughes Medical Institute (HHMI). Named an

New Climate Science Degree

The Jackson School of Geosciences is launching a new degree option in climate system science for undergraduate students in fall 2024, although students can begin taking the classes immediately.

"It's a science option that will allow students to have a technical understanding of climate and how it works," said Professor Kerry Cook. "This includes the atmosphere and the ocean primarily, but also hydrology and other related areas. [The new degree] is broad scientifically, but the focus is on the physical climate system, rather than policy, social issues, or ecology."


KERRY COOK

The new curriculum was spearheaded by Cook and Assistant Professor Geeta Persad, both in the Department of Geological Sciences. Cook said the new degree was prompted by students' growing desire for a technical education in climate change and the growing needs of employers from a wide variety of sectors to have employees who understand climate science. These include companies in the energy and manufacturing sectors, insurance, reinsurance, government, consulting and many others, she said. The major also provides a path for graduate work in climate science and related fields.

The new degree will require four core classes including upper-division courses in atmospheric sciences and ocean sciences, a course covering contemporary climate variability and climate change, and a course in either paleoclimatology or hydrological science. Students will also be required to take two upper division computational classes—a necessity given the massive data sets used in climate observations and modeling—and five additional upper division courses in the Department of Geological Sciences. Classes in multivariate calculus, physics, and chemistry are also required.

"One of the major goals for me as the department chair when I took over last year was to modernize our curriculum to focus on skills and to reflect the breadth and societal relevance of the geosciences, and to attract students with a more diverse spectrum of interests," said Department Chair Danny Stockli. "Creating a climate system science degree is a critical addition, and I am extremely appreciative of Dr. Cook's and Dr. Persad's efforts in making this a reality."


GEETA PERSAD

HHMI Professor, she has led a million-dollar program aimed at transforming undergraduate geosciences education by centering educational frameworks that encourage designing, experimenting, and exploring. Her work at the Jackson School includes the creation of the Geoscience Ambassadors program, a student-led outreach program in which students connect with communities by sharing their own pathway to the geosciences. She was also a founding faculty adviser for the Jackson School's Geoscience Leadership Organization for Women (GLOW).

JACKSON SCHOOL COMMUNITY CLIMATE SURVEY

As part of the efforts to make the Jackson School a more diverse and inclusive environment, the school conducted an anonymous workplace climate survey this fall. For more information on the survey, its goals and methodologies, see the following Science Y'all blog post by doctoral student and student leadership DEI liaison Emily Bamber at ***www.jsg.utexas.edu/science-yall***

— STAY UP TO DATE —

For more about Jackson School DEI programs, initiatives and contacts, see www.jsg.utexas.edu/diversity-inclusion

Searching for Our Ocean's Climate Past

Isaac Newton invented calculus and discovered gravity while hanging out at his mom's house in 1666. These days it's a bit harder to have a major impact on science while working alone. This fact was reinforced for me this summer during a seismic survey cruise in the Gulf of Mexico on which I was chief scientist, in which dozens of people from multiple countries all worked together to achieve the objectives of the expedition.

The goal was to determine the age and thickness of sediment drifts along the Campeche Bank in the southeastern Gulf of Mexico, along the edge of the Yucatan Platform. This is where warm, salty surface water enters the Gulf from the Caribbean and forms the Loop Current. The Loop Current flows north into the Gulf before swinging east and then back south, forming a big loop (hence the name) and flowing south along the edge of Florida and then out through the Florida Straits, where it forms the Florida Current and then the famous Gulf Stream, which is so important to North American and European climate and North Atlantic Deep Water Formation (and thus global climate).

The Loop Current itself is important for the climate of the Gulf: sometimes the loop pinches off and forms a warm core eddy, which drifts across the western Gulf of Mexico disrupting fisheries, stressing offshore infrastructure, and providing a massive source of heat for tropical cyclones (the rapid intensification of both Katrina and Harvey right before landfall was due to those storms passing over a warm core eddy). In short, the Loop Current is *important*. But surprisingly, we have a very poor understanding of its history before the era of direct observations.

A 2009 cruise of the German research ship *Meteor* discovered sediment drifts on the edge of the Campeche Bank at a depth attributable to the Yucatan Current, the deeper countercurrent to the Loop Current. Sediment drifts mean there is a physical sedimentary archive of current flow here, and if we can figure out how for how long those drifts have been being deposited then we can figure out how long the modern current regime has been operating.

So, in 2018 Jamie Austin and I wrote a proposal to the National Science Foundation to go out and study them, which was rejected. So, in 2019 we wrote another proposal taking into consideration the reviewers' comments, and this time it was accepted. Then we got on a ship and collected the data. Ha ha, just kidding! Writing the proposal and getting it funded is the easy part...

Chris Lowery,
Research Associate

An excerpt from ***"Nobody Does Science Alone: How I Learned to Stop Worrying and Love Logistics"****, Chris Lowery's account of leading a research cruise and the unsung heroes who made it happen. Published online at www. jsg.utexas.edu/news/blogs/texas-geosciences*

CLOCKWISE FROM TOP: THE SHIPBOARD SCIENCE PARTY, INCLUDING UTIG SCIENTISTS JAMIE AUSTIN (THIRD FROM LEFT) JINGXUAN WEI (FOURTH FROM LEFT), PATTY STANDRING (SEVENTH FROM LEFT) AND CHRIS LOWERY (SEATED, CENTER); SCIENTISTS AND TECHNICIANS DEPLOY THE HYDROPHONE STREAMER; UTIG POSTDOC JINGXUAN WEI AND PHD CANDIDATE PATTY STANDRING ON DECK;AIRGUNS TOWED BEHIND THE B/O JUSTO SIERRA IN THE GULF OF MEXICO.

PHOTOS: CHRIS LOWERY.

Ecological Response to the Early Jurassic Climate Crises

During the Early Jurassic, there were severe perturbations in environmental conditions (such as ocean warming or acidification) resulting in mass extinctions. But these environmental conditions may also have enhanced exceptional fossil preservation (e.g., soft tissues of organisms). For my Ph.D. dissertation, I am assessing the impacts of changing environmental conditions on Early Jurassic exceptional fossilization, extinction, and recovery. In summer 2022, I was awarded the DAAD (German Academic and Exchange Service) short-term research grant to conduct research at the University of Hamburg, Germany. Specifically, the research project in Germany involves studying the Early Jurassic macrofauna, including preparation of the fossils, their taxonomic identification, and finally the paleoecological analyses. I am working under the expert supervision of Dr. William Foster, my Ph.D. committee member and former JSG postdoctoral fellow.

In addition to conducting research at Hamburg, I visited the Museum für Naturkunde in Berlin to work with Dr. Martin Aberhan. Dr. Aberhan is a macrofaunal expert and visiting the museum allowed me to learn macrofaunal identification directly from him. I learnt about the various field sampling techniques, and could access his Jurassic fossil bivalve collections. At the Berlin Museum, I got the opportunity to learn fossil preparation from the museum's head preparator, Mr. Brinkmann.

The Early Jurassic is also known for Lagerstätten deposits, which preserve soft tissues and articulated skeletons of fossils. My first dissertation chapter includes what environmental conditions drove soft tissue preservation and I studied fossils from the Posidonia Shale Lagerstätte in Germany. This visit to Hamburg provided me the opportunity to meet with Posidonia Shale experts Dr. Guenter Schweigert and Dr. Erin Maxwell at the Naturkunde Museum Stuttgart. The museum houses the exceptionally preserved Posidonia Shale fossils, and I got an opportunity to visit both the collections and the exhibits.

My research will produce new paleontological data about long-term patterns of biotic change in tropical marine communities in an understudied but crucial period and region. Further, the results will enable us to study how these communities recovered from events driven by factors similar to modern anthropogenic changes.

Preliminary research results will be presented at the Jurassic conference 2022 in Budapest, Hungary. While the discussions and exchange of ideas could have been done over Zoom calls, learning unique fossil preparation and fossil photography techniques was better learnt in the same physical space as compared to an online environment. The research conducted at Hamburg will contribute as the second and third chapter of my Ph.D. thesis, which is environmental conditions impacting extinction and recovery during the Early Jurassic of Morocco.

In September, I headed out to the Central High Atlas Mountains in Morocco for fieldwork and additional sample collection. Post-fieldwork will involve processing the samples and learning statistical techniques from Dr. Foster.

Any additional financial assistance was provided by the NSF career awarded to my supervisor Dr. Rowan Martindale and the Jackson School off-campus research grant.

Sinjini Sinha,
Doctoral candidate

AT TOP: SINJINI SINHA HOLDS A JURASSIC FOSSIL.
ABOVE: SINHA PREPARES A FOSSIL.

PHOTOS: SINJINI SINHA.

GEO 383: Dynamic Stratigraphy Field Seminar

Despite the travel hurdles, we renewed the exciting tradition of geoscience field seminars (Argentina 2014, Ecuador 2017, Romania 2018) with a field trip in Fall 2021. We focused on the North American Cordilleran foreland basin along a west to east transect from Salt Lake City, Utah, to Laramie, Wyoming, and a return route through the Book Cliffs of Utah. A group of 10 graduate students led by Research Scientist Cornel Olariu, Professor Emeritus Ron Steel, and Professor Brian Horton discussed sedimentologic and stratigraphic responses at the transition from Sevier to Laramide style tectonic deformation. Our observations near Rock Springs, Wyoming, provided a window into the criteria used for recognizing patterns of Laramide deformation. In contrast to typical unconformities, we identified stratigraphic trends involving sub-basin thickening versus crustal thinning, nicely expressed around the Rock Springs and Rawlins uplift areas. The biostratigraphic chronology for the regional geological transect provides resolution of 300-500 thousand years.

Some spectacular classic localities included Cretaceous-Paleogene growth structures within the Echo Canyon Conglomerate, tidal shoreline deposits of the Blair Formation, and fluvial deposits of Ericsson Formation around the Rock Springs uplift. Marine to nonmarine regressive-transgressive cycles of the Cretaceous Western Interior Seaway strengthened student understanding of the temporal and spatial scales of sedimentary processes and possible allogenic controls. Lacustrine deposits within the Paleogene Uinta Basin provided a sharp stratigraphic contrast with the marine basin fill of the Western Interior Seaway.

Students attending the field seminar emphasized the importance of fieldtrips to their educational journey with Jackson School of Geosciences. Rawan Alasad: "I especially enjoyed listening to student presentations in the field and having engaging and lively discussions afterwards. It was a great field trip, and I highly recommend it to students with broad interest in sedimentary geology, basin analysis and tectonics."

Cornel Olariu,
Research Scientist

CLOCKWISE FROM LEFT: RON STEEL EXPLAINS THE SEDIMENTOLOGY OF THE FOX HILLS DELTA FRONT HYPERPYCNAL FLOW DEPOSITS ; CORNEL OLARIU (HEAD ON LEFT) DISCUSSING FLUVIAL-LACUSTRINE GREEN RIVER DEPOSITS OF THE UINTA BASIN DURING THE FIELD SEMINAR; BRIAN HORTON (PINK HAT) DISCUSSING THE SEDIMENTOLOGY OF PALEOGENE CONGLOMERATES IN THE NORTH HORN FORMATION OF RED NARROWS, CENTRAL UTAH.

PHOTOS: CORNEL OLARIU.

Listening to Glaciers in Disenchantment Bay

In August 2022, I was part of a team of UT scientists that traveled to Disenchantment Bay in Alaska to study Turner and Hubbard Glaciers. Turner Glacier is of particular interest right now to glaciologists as it is one of the few glaciers worldwide that is advancing. We were based in the fishing village of Yukutat (population 600) from which our team had to travel over an hour by boat each day up to the termini of the ice giants.

Our main scientific aims were twofold: 1) collect data on Turner Glacier as it advanced, and 2) collect acoustic data from both glaciers to learn more about the soundscape of tidewater glaciers as they stretch, calve, and release sealed air pockets into the bay. Other complementary data, including from conductivity temperature depth (CTD) sensors and a tilt sensor, were also collected. This unique approach was the result of a collaboration between UTIG (myself and Marcy Davis, led by Dr. Ginny Catania) and the Applied Research Laboratories (Dr. Matt Zeh and Dr. Colby Cushing, led by Dr. Preston Wilson). Joining me on the trip were Marcy, Colby, and Dr. Wilson, with Dr. Catania and Dr. Zeh providing additional support from the lower 48 states.

After successfully retrieving sensors that had been buoyed underwater for the past 14 months, our team took the opportunity to collect additional data as we watched (and listened to) the glaciers calving, including an up-close discharge event. If you've never been near the terminus (face) of a tidewater glacier, there are a couple of things you need to know:

1. Tidewater glaciers are loud: each time ice broke off and tumbled into the water, whether it was a large pillar of ice or a smaller icefall, the thundering sound would pierce through the pristine silence and echo around the nearby fjord walls. The sea ice, too, from earlier calving events, would cackle at us as we slowly aimed our boat between the largest islets of sea ice. These loud sounds are what motivated the acoustic study of the glacial soundscape.
2. Another interesting fact about tidewater glaciers is they often make the nearby waters extremely murky. The waters we drove through were dirty and silt-laden, as the remnants of bedrock pestled into a fine silt by the glaciers' ice were discharged into the bay by meltwater.
3. Lastly, glacier termini can be dangerous. Like an iceberg, large portions of the terminus of some glaciers are underwater, so unexpected sheets of sea ice can break off and emerge near the front without warning.

The trip overall was a success, with each member contributing to the data retrieval and recording and everyone acting safely in this harsh environment. I look forward to continuing to work with the team as we listen through over a year of data from below the surface of Disenchantment Bay.

Kevin Shionalyn,
Doctoral student and
UTIG Graduate Research Assistant

PHOTOS: KEVIN SHIONALYN.

CLOCKWISE FROM LEFT: THE FIELD TEAM. FRONT FROM LEFT COLBY CUSHING AND PRESTON WILSON. BACK FROM LEFT: MARCY DAVIS AND KEVIN SHIONALYN; HUBBARD GLACIER; A ROCKFALL CALVING EVENT ON HUBBARD GLACIER REMINDING KAYAKERS FROM A NEARBY CRUISE SHIP NOT TO GET TOO CLOSE.

Creating Virtual Field Sites of Moroccan Reefs

In the fall of 2021, Dr. Rowan Martindale, Tanner Fonville of the Martindale Lab, and I did fieldwork in the Central High Atlas Mountains of Morocco. We're studying how a series of mass extinctions that occurred during the Early Jurassic affected reef ecosystems by collecting hand samples from field sites across the mountain range. It was our first time back in the field since the pandemic had begun and delayed this trip by more than a year, so we needed to make up for lost time.

We spent a month in the field and collected more than 500 hand samples to build a dataset for my dissertation. I used many of these samples to make thin sections for point counting, so I could quantify each reef's community and structure. In addition to studying the reefs though, I also wanted to create new ways to teach people about them. This led me to partner with Ryan Petterson, of Stanford University, to create virtual field sites for each of our actual sites in Morocco. This would be helpful in a few ways. First, due to some travel restrictions still in place, not all of the members of our lab were able to travel with us, so the virtual sites would allow those lab members to better visualize the locations. Second, I'm working towards making guided virtual field trips to accompany future publications, so virtual field sites were a necessary starting place.

While we were collecting our samples, Dr. Martindale and I would pause whenever we moved to a new area and use the Google Street View app on our smartphones to create a 360° photosphere by stitching together 32 individual pictures. We were sure to include key features of each site, and include frequent enough photospheres to make line-of-sight connections between each one possible.

The GPS coordinates in each photosphere's metadata allows us to connect them on a map in a program called Pano2VR, where other helpful info can be augmented into the virtual sites like strat columns, geologic maps, and on-site lectures. The virtual sites themselves are a lot of fun to explore, and the potential for this augmented imagery to inform our own lab members and other researchers is something we'll be investigating over the next few years as I continue to expand and improve them.

Travis Stone,
Doctoral candidate

AT TOP: THE DADES VALLEY OF MOROCCO. THE EXPANDED SECTION PROVIDES VISIBLE EXAMPLES OF EXTINCTION INDUCED CHANGES. **ABOVE LEFT:** MEMBERS OF THE MARTINDALE LAB. LEFT TO RIGHT: TRAVIS STONE, ROWAN MARTINDALE, TANNER FONVILLE. **ABOVE RIGHT:** A VIEW FROM THE VIRTUAL FIELD SITE SHOWING A MAP AND ANNOTATIONS.

PHOTOS: TRAVIS STONE.

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Gail Christeson

Former UTIG Associate Director

By Constantino Panagopulos

GAIL CHRISTESON

Like many scientists, Gail Christeson often turned to the National Science Foundation for research funding. It's how she ended up leading one of the longest continuous seismic imaging profiles of the Earth's oceanic crust, and it's what took her to the southern Gulf of Mexico to drill an underwater crater that marked the fate of the dinosaurs.

"I understand a lot of what's going on with the PIs [principal investigators] when they're proposing a project," she said. "I've been on that side of it, so it makes me better able, I think, to assess them."

That insight guides her decisions as director at NSF's marine geology and geophysics program, a role she took late in 2021 after 28 years as a researcher and later as an associate director at the University of Texas Institute for Geophysics (UTIG). Her role involves directing the agency's money toward impactful studies of the geology of ocean basins.

Before she joined NSF, Christeson's career focused on the Earth's oceanic crust. Unlike continents, oceanic crust is transitory and geologically much younger. New crust emerges from mid-ocean ridges and heads landward, where subduction shunts it back into the Earth—its movement is the engine belt of plate tectonics.

Christeson's interest in it began when she was an honors freshman learning about plate tectonics for the first time at an intro to geophysics course.

From volcanoes to earthquakes, "it just explained everything," she said. Geophysics was followed by a course in oceanography, which led to a joint graduate school program with the Massachusetts Institute of Technology and Woods Hole Oceanographic Institution, funded by an NSF graduate fellowship. That began with back-to-back scientific cruises in the mid-Atlantic Ocean.

"I found I really liked that environment. I liked acquiring data for the first time, and I liked the team aspect of collaborating with other people," she said.

Her doctoral research focused on the characteristics of brittle rock layers in younger crust, near where it comes out of the Earth, and relied largely on seismic imaging acquired using the novel method of detonating small explosives on the seafloor and recording the Earth's echo with ocean bottom seismometers. That research landed her a job at UTIG in 1994, where she was soon back at sea but at the other end of the tectonic conveyor, studying Costa Rica's subduction zone.

Her first turn at the helm of a research expedition came in 2003 as chief scientist aboard the *R/V Maurice Ewing* on a mission to Hess Deep in the Pacific Ocean, where a massive seafloor rift splits the Earth like a road cut. The research matched subsurface images of oceanic crust with the exposed rock layers, giving scientists a Rosetta stone to interpret the geology of the oceans.

Since Hess Deep, Christeson has been chief or co-chief scientist on six major investigations of oceanic crust, including a large project in the southeast Caribbean involving two ships and land-based science teams, and a similar coordinated study of fault zones in the Gulf of Alaska with UTIG colleague Sean Gulick. Christeson and Gulick also collaborated on surveys of the underwater Chicxulub crater near the Yucatán Peninsula, in preparation for a major 2016 expedition (led by Gulick) to drill into the crater's peak ring.

Collaboration is the connecting thread between Christeson's research projects and is, she said, what appealed to her about being a researcher.

"Gail is very uncomplicated," said Dominik Kardell, a former student of hers. Working with Christeson, according to Kardell, was an education in efficiency and pragmatism, a style she applied to everything from research to teaching—including a Python for Geosciences course she launched in 2019, for which she won a departmental Knebel Teaching Award in 2020.

"She taught what people really needed to use," Kardell said. "Once the rumor spread, [her Python course] became very popular. Everyone wanted to take it."

The idea to teach the programming language Python to geoscientists began in 2018 when Christeson noticed its potential for making data analysis more accessible. She taught herself Python, put a syllabus together and proposed a new class for geoscience students.

"She was amazing, just such an incredibly effective instructor," said Sharon Mosher, the Jackson School's dean

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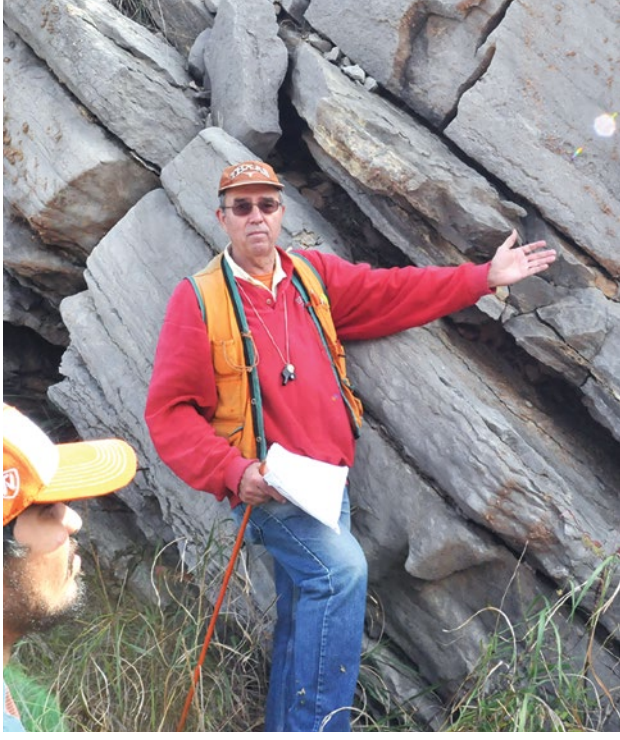
Mark Cloos

Professor Emeritus

By Anton Caputo



MARK CLOOS

It has been just over 40 years since Mark Cloos stepped on the campus at The University of Texas at Austin as a young assistant professor. Raised in the northern suburbs of Chicago, he chose UT over other offers because he saw the potential, particularly in the remarkable crop of young assistant professors that he would soon be joining.

"Bill Carlson was here. Sharon Mosher was here. The petrology and sedimentology groups were in strong support of the structural geology and tectonics program. We had the microprobe, X-ray diffraction, thin section lab—all the tools that I wanted," Cloos said. "There was a lot of energy. The place had a hum, and the senior faculty, John Maxwell and Bill Muehlberger, were not just supportive, they said, 'Take us to the future.'"

During the next four decades, Cloos would do as much as anyone to ensure the program kept on humming. He taught structural geology to generations of UT students—more than 2,300 in all, with some of those students being the children of students he taught in the 1980s. He was associate chair of the Department of Geological Sciences from 1986 to 1989 and chair from 1996 to 2000. He made significant scientific breakthroughs and carved out a near-legendary status with his hand specimen labs and field trips that helped students develop a holistic understanding of the forces that shape the planet. More than 700 students attended his whirlwind Oklahoma field trip to the Arbuckle and Ouachita mountains.

As an educator, he has a rare way of pushing students to think and work through a problem, said Jackson School of Geosciences Professor Richard Ketcham. He said Cloos could be intimidating because of his depth of knowledge, but he gave tremendous time, energy and encouragement to his students. Ketcham should know; he was a student of Cloos' before becoming a colleague.

"If you're resting on fuzzy logic, gray literature or catch phrases instead of real thinking, he would call you on it," Ketcham said. "It was challenging, but you always knew he was on your side. He took some really raw material and made some very, very good scientists."

Now, after years of working with students in the classroom and field, Cloos, the Getty Oil Company Centennial Chair in Geological Sciences, has retired from the faculty and joined the ranks of professor emeriti.

During his career he lived the highs and the lows of UT geosciences—literally. He was an assistant professor in 1983 when undergraduate enrollment peaked at 825 students—with only 24 faculty members to teach them—as a generation rushed to get into the booming oil and gas industry. Both his stints as department chair and associate chair were when the price of oil plummeted and the department had to focus on nonmajor classes to justify teaching assistant budgets and to attract students. A silver lining from the 1980s low was the creation of the wildly popular class on the geology of national parks, which Cloos co-created and taught with Professor Gary Kocurek. The course has since morphed into a class called Earth, Wind and Fire.

Cloos was also one of the early contacts with Geology Foundation member Jack Jackson, helping secure the original oral agreement to fund an addition to the geology building. That was the beginning of the philanthropic relationship that eventually became the endowment that launched the Jackson School of Geosciences.

Cloos received his undergraduate degree from the University of Illinois Urbana-Champaign. As a doctoral student at the University of California, Los Angeles, he worked with legendary Professor Gary Ernst as he developed the model of how backflow up subduction shear zones can explain the origin of shale-matrix mélange in accretionary prisms.

As he was completing his degree, Cloos began to collaborate with another UCLA faculty member, Ronald Shreve. They expanded the flow mélange concept to a general model for subduction shear zones, which they termed "subduction channels."

"I think we were well ahead of our time in terms of that mode of thinking, but now many others are on board as the term subduction channel is widely used," Cloos said.

In 1988, Cloos traveled to Papa New Guinea as part of a National Science Foundation-sponsored field trip to investigate the results of arc-continent collisional tectonism

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Craig Fulthorpe

Retired Senior Research Scientist

By Alan Gomez

CRAIG FULTHORPE

Craig Fulthorpe was born and raised in Newcastle in northern England, nearly 300 miles from bustling London and, in his mind, a world away from everything. His father was a factory worker and his mother worked office jobs all her life, but Fulthorpe knew that way of life wasn't for him. He wanted to see the world.

"I always thought the important stuff was happening somewhere else," he said. "I didn't want to miss out."

That's why, after graduating from the University of Leeds with a bachelor's degree in civil engineering and working at an engineering firm in Newcastle for a couple of years, he left the United Kingdom and started his new life in the United States.

At first it was Chicago, where he earned a master's degree in geotechnical engineering at Northwestern University. And then, while working on his doctoral degree in geological sciences, he got a call that would set him on a lifetime of adventuring.

A member of an upcoming trip aboard a research ship had dropped out and they were looking for a replacement. Fulthorpe leapt at the opportunity, joining Ocean Drilling Program Leg 101, a six-week research cruise through the Bahamas. It would be the first of 17 voyages, several lasting as long as two months and taking him to the waters off New Jersey, California, New Zealand and Australia.

"When I look back, it's pretty remarkable that any of this actually happened," said Fulthorpe, who retired in August 2021 after 31 years at the University of Texas Institute for Geophysics.

Fulthorpe focused his research on continental margins, the region where continental crust extends beneath the ocean to abut oceanic crust. Those regions are tantalizing for geologists because they provide relatively easy access to a sedimentary record that's built up over millions of years, what Fulthorpe describes as "an archive of geological history."

That gave Fulthorpe a view of the ups and downs of sea level and led to some unexpected finds. While working on the eastern margin of the South Island of New Zealand, he observed massive, buried, U-shaped troughs in the margin that he realized were created not by variations in sea level, but by strong currents flowing through the Pacific Ocean.

That discovery altered the way geologists viewed the margin, but Fulthorpe downplayed the revelation, saying his body of research was more about continuing to fill in the sedimentary record to help the scientific community better comprehend what's happening now and what may occur in the future.

"You have to understand the whole history to realize which bits are relevant today," he said.

In his later years, Fulthorpe joined the Jackson School's Gulf of Mexico Basin Depositional Synthesis (GBDS) project, a comprehensive, industry-supported attempt to map the entire basin to better understand its history and depositional systems. Fulthorpe reveled in one last opportunity to explore a new corner of the world.

Jamie Austin, a senior research scientist at UTIG, was the co-chief scientist aboard Fulthorpe's first cruise in the Bahamas and later recruited him to The University of Texas at Austin. Austin described his colleague as a hard-working scientist and a great shipmate.

"Craig is incredibly diligent, reliable, a good teacher and a great person," Austin said. "It has been an honor to work with him."

Fulthorpe made the decision to retire in 2021 shortly after his younger brother James died from ALS, also known as Lou Gehrig's disease. The younger Fulthorpe had also left their hometown of Newcastle and became a successful engineer. But he never got the chance to sit back and enjoy his accomplishments.

"He never got to retire," Fulthorpe said. "It just made me take stock."

Fulthorpe said retirement has been busy as he and his wife, Marjorie Mulanax, sort through a lifetime of work files and mementos. Mulanax also retired last year after 27 years as the executive director of Hospice Austin, so they're still figuring out their next chapter.

They know they'll spend more time visiting their two daughters, both University of Texas at Austin alumnae who now live in San Francisco and Boston. And Fulthorpe said he wants to see more of Europe.

But one thing is clear: His seafaring days are behind him. Fulthorpe sheepishly admits that he always struggled with sea sickness, taking a prescription-level anti-nausea medication

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Mark Helper

Distinguished Senior Lecturer Emeritus

By Monica Kortsha

MARK HELPER

For decades, Mark Helper has spent his summers leading students on the Jackson School of Geosciences' capstone field camp. But he has new plans for next year: returning to blueschist research and fly fishing.

After taking part in field camp for 37 years —and serving 27 of those years as its director—Helper retired from the Jackson School in August, about a month after finishing his final camp.

"It was particularly gratifying this final summer to join the class near the end and find everyone in such high spirits and working hard," he said. "It was a stellar group of students, teaching assistants and instructors, as good as any I've worked with, a truly high note to end on."

Helper is the architect of the camp's ambitious itinerary, which whisks students across six states in six weeks to take in a diverse array of geological landscapes, from the gypsum expanse of New Mexico's White Sands National Park to the Grand Tetons of Wyoming. Over the years he has guided hundreds of students, some who have gone on to lead field camps of their own.

Jamie Levine, who assisted Helper as a graduate field assistant and now leads a field camp as an associate professor at Appalachian State University, recalls how Helper would get students to engage with complicated geology by asking encouraging questions rather than giving a straightforward lecture.

"Mark is such a phenomenal instructor," said Levine. "He did a great job of modeling what to do."

Helper has spent his entire professional career at The University of Texas at Austin, earning a doctoral degree from the school in 1985 and staying on as a postdoctoral researcher and then instructor. After graduating, he and his wife Sharon Mosher, who was then an assistant professor at the school, briefly considered pivoting to careers in oil and gas, with the two even getting industry offers in Dallas.

"But in the end, we realized that we weren't that interested in working in oil and gas or being somewhere else," Helper said.

Mosher went on to become the dean (and retired last year.) Helper continued conducting research—spending his first years on the same blueschists that occupied his graduate research and then collaborating with scientists across the school on a variety of projects. At the same time, he prioritized teaching, going on to earn the title of Distinguished Senior Lecturer in 2007.

"I didn't aspire to be a tenure track faculty member," Helper said. "I was interested in research, and when teaching came along, I got really interested in that. I wanted to focus on being a great teacher."

Over the years, Helper has received multiple awards for just that. He is a six-time winner of the Jackson School's Knebel Distinguished Teaching Award (the first in 1995, the last in 2021), which is determined by student vote, as well as the UT College of Natural Sciences Teaching Excellence Award in 2002, and the Jackson School's Outstanding Educator Award in 2011.

Helper got his start teaching students in the field in the 1980s, first as a teaching assistant in graduate school and later as a lecturer teaching the field methods class and field camp.

But the field camp of the `80s was very different from the camp of today. In response to the booming oil industry, enrollment at the school shot up to more than 800 students (almost three times what it is now), and field camp classes regularly had more than 100 students. The camp usually stuck to two states—New Mexico and Colorado—with students staying in ski condos or college dormitories instead of making camp each night.

By the time Helper became field director in 1996, field camp class sizes had shrunk to about half that, and the class had begun to experiment with camping. He saw an opportunity to build on that.

"I thought that we ought to further integrate camping as a means of seeing more of the Rockies and diversifying our field projects," Helper said. "With 10 years of experience, I knew we could do a lot more for less if we were willing to travel and camp more."

Helper helped transform the course into a cross-country trip from Texas to Montana, involving more instructors from

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Richard Kyle

Professor Emeritus

By Alan Gomez

RICHARD KYLE

Thomas Quintero was out of his element. The Jackson School of Geosciences undergraduate student was winding through a series of dark, cold tunnels in a gold and silver mine in Slovakia in 2018.

The mine had been modernized and Quintero had gone through rigorous safety training, but he still found himself praying for the signal that the expedition was over. Then he looked over at his mentor, J. Richard Kyle, who was standing calm, his halogen headlamp shining from his mining helmet, his voice steady and relaxed. Quintero marveled at Kyle's ability to ask probing questions of the locals and casually extract samples in that underground labyrinth.

"Despite quite literally traveling into the unknown, Dr. Kyle bravely allows his curiosity to guide his steps to the truth," said Quintero, now a project manager and geographic information system (GIS) technician at Public Management Inc. "Throughout the rest of the time I spent with him ... his scientific bravery and intellectual humility showed through."

During his 44-year career at The University of Texas at Austin, Kyle served as the C.E. Yager Professor of Geology and a researcher with the Jackson School's Bureau of Economic Geology. He traveled the world to better understand mineral deposits—how they're formed, how to spot them, and ways for local communities to benefit from identified resources.

But it's the work he did mentoring and advising students, from undergraduates to doctoral candidates, that Kyle remembers most fondly. During his career, he supervised more than 50 graduate and undergraduate thesis projects and helped guide countless other UT grads on their road to becoming professionals. Kyle served as both an undergraduate advisor and graduate advisor for the Department of Geological Sciences, and is now a graduate advisor for the Jackson School's Energy and Earth Resources, a multidisciplinary master's program. He taught courses on more than 20 different topics, most of which involved field studies and other practical aspects. And this year, the Society for Mining, Metallurgy & Exploration recognized Kyle's long record of teaching both UT students and mining industry colleagues by selecting him as the recipient of the 2023 Mineral Industry Education Award.

Kyle, who is now shifting from being a full-time professor to a part-time geological adviser at the bureau, decided to mentor students as a way to honor the many mentors he had as a student and young professional. After growing up on a family farm in Tennessee, Kyle said he never would have become the first in his family to go to college, or earn a doctoral degree, without that kind of help.

"It comes back to the issue of appreciating counsel and acting on the opportunities provided," he said.

Kyle also developed a deep interest in diversifying the field of geology by focusing on students from underrepresented backgrounds in the U.S. and working closely with students doing research abroad. He has led more than 60 regional and international field trips, working with students in China, Indonesia, Brazil, Mexico, Chile, Scandinavia, Australia and elsewhere.

"When I started out, I had this idea that there are a lot of different cultures around the world, and it would be nice to contribute to the development of some younger people within those societies, and I would benefit from learning about another interesting part of the world and its peoples," Kyle said.

As a researcher, Kyle focused on applied geosciences, particularly on the earth resources necessary to build, power and maintain cities and other critical infrastructure. Operating like a forensic scientist, Kyle studies each deposit's origin within the region's geologic history and creates a "blueprint" of identifying characteristics.

"This aids the collective effort to start looking around other parts of the region or the world to try to find similar geological settings and to hope that resource formation has come together in a similar fashion," he said.

Having visited so many locations around the world, Kyle has also worked on ways to improve mineral extraction processes. For more than two decades, he has been working with colleagues on applying high-resolution X-ray computed tomography to ore deposits, which can analyze and present a 3D rendering of a rock sample without destroying it.

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Sharon Mosher

Dean Emeritus

By Anton Caputo

SHARON MOSHER

Sharon Mosher's to-do list these days is quite impressive. It includes leading the national effort to revise the geosciences education curriculum, fieldwork and new geologic dating in the Llano Uplift, publishing papers with former students, and mentoring science leaders for the Council of Scientific Society Presidents.

Not bad for someone who is officially retired.

When people ask her about it, their reactions are almost always the same.

"They say, 'Oh, are you busier than you ever were?'" Mosher said.

All she can do is laugh.

Mosher, who was on the faculty at The University of Texas at Austin for more than 40 years and served as the dean of the Jackson School of Geosciences for more than a decade, is definitely enjoying retirement, especially having more time to swim and resume kayaking. Yes, she has plenty to do, but she said the workload pales in comparison to her time as dean.

She officially retired at the beginning of the 2021-2022 school year—becoming dean emeritus, professor emeritus and William Stamps Farish Chair in Geology Emeritus.

Since stepping down as dean in 2020, her biggest accomplishment has been to finish and publish "Vision and Change in the Geosciences: The Future of Undergraduate Geoscience Education," which was the culmination of a multiyear effort she led to help align undergraduate geosciences education with the needs of the modern workforce. Within days of going online, the document was downloaded more than 10,000 times in more than 40 countries.

Now she's leading a similar project for graduate geoscience education. The nationwide effort, funded by the National Science Foundation, had its last workshop at Stanford University in August, and Mosher hopes the final document will be out in January. After that, she's vowed that she will not take on any more massive projects.

"She has laid the law down on that one," said Christopher Keane, American Geosciences Institute (AGI) director of geoscience profession and higher education.

Keane has worked closely with Mosher on both the undergraduate and graduate effort over the past decade. During that time, hundreds of academics and industry professionals have been brought in to give feedback, analyze and synthesize data, and prepare and distribute reports.

Keane said it is the type of monumental endeavor—he estimates that 15% of the nation's geosciences faculty have been involved at some point—that could have fallen prey to infighting or died of inertia. But Mosher's vision about the need to update curriculum and the process for doing so was so strong and unwavering that it pushed through all obstacles, he said.

"I think it's a real testament to Sharon's stature in the community that she got over a thousand different people in our community to be very actively involved," Keane said. "Sharon brings a gravitas, so everyone listens."

Mosher became dean in 2009 and spent more than a decade in the role, helping build the school into one of the top geosciences institutions in the world. One of her greatest challenges was binding the school's three diverse units—the Department of Geological Sciences, the Bureau of Economic Geology and the University of Texas Institute for Geophysics—into a cohesive school with a shared identity. As she watched the class of 2022 receive their diplomas a few months ago, she was struck by how much progress has been made.

"It really meant a lot to me that every student walking across the stage said something about what the Jackson School had done for them," she said. "That made me feel so good because when I started as dean, we were really three separate units."

Dean Claudia Mora, who succeeded Mosher in 2020, said that Mosher's ability to build the school and make it a cohesive institution put it in a good position to tackle the massive challenges ahead for the geosciences.

"Sharon is a tremendous asset to this school, and her vision and work to reshape geosciences education for the future is one we should all be proud of," Mora said. "This is such an important time for the geosciences as we seek to address the energy, resources and climate issues that are facing society and, at the same time, make the world understand that geoscientists are essential for finding solutions to these complex problems."

Mosher recently attended a symposium put on by former

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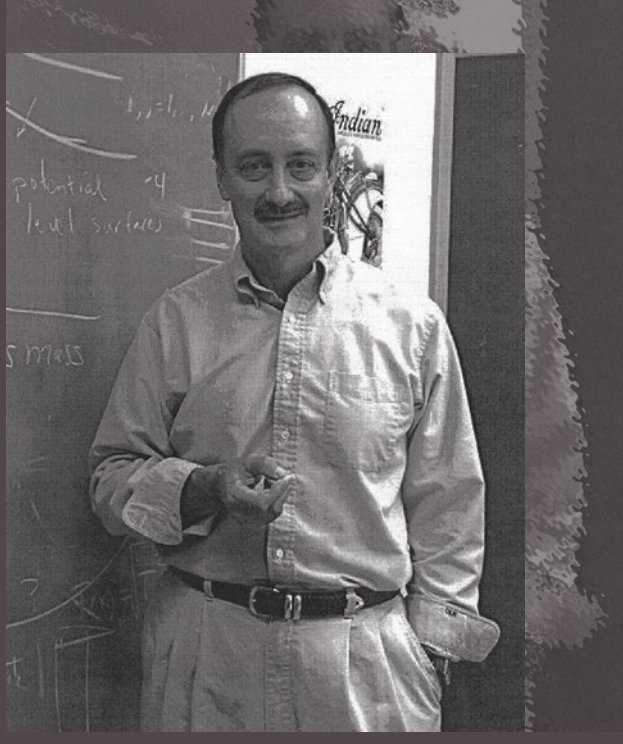
Clark Wilson

Professor Emeritus

By Kristin Phillips & Monica Kortsha

It was the ocean—more specifically, an oceanographer's slides illuminating a middle school wall six decades ago—that launched Clark Wilson into a career that included over 40 years of teaching and research, two rotations as chair of the Jackson School of Geosciences Department of Geological Sciences, and a three-year stint leading NASA's Geodynamics Program in Washington, D.C.



CLARK WILSON

"I saw nice pictures of tropical beaches and decided, 'That's it. That's what I'm going to do,'" said Wilson. "This set me on a path studying physics at San Diego and landing an internship with Shell Oil as a geophysicist. I'd never heard of that field before—at the time there were almost no undergraduate programs in this field—but I found exploration geophysics very interesting."

Wilson arrived at The University of Texas at Austin in 1976, the second geophysicist in a department loaded with field geologists, where a dissertation defense included a grilling about the properties of a rock placed in the center of the table. He soon forged relationships with other faculty members across the university who were leaders in their respective fields.

"I was very fortunate that the best people in the world were on campus, from satellite researchers in what became the Center for Space Research to colleagues in geotechnical engineering who were using seismic waves to determine the strength of soils for earthquake resistance," said Wilson. "These two happy coincidences led to a lot of pleasant and interesting problems to work on throughout my career."

And work he did. He published well over 200 research papers, many with graduate students and colleagues from across the campus. Some of his key research was in "geodesy"—a continuation of his dissertation research that used satellite data to measure variations in the Earth's gravity and connect it to air and water distribution across the planet.

Geodesy is an essential part of modern geosciences research today. However, when it was getting started, it faced skepticism from some field geologists who were used to collecting their own measurements, said Byron Tapley, the director of the Center for Space Research and a longtime collaborator of Wilson's.

Wilson's research helped demonstrate the immense value of geodesy data to geoscientists—especially data collected by NASA's Gravity Recovery and Climate Experiment (GRACE) satellite system.

Some of the highlights include identifying new areas in the Antarctic ice sheet that were losing mass, tracking changes in groundwater in California's Central Valley, and connecting the shrinking of the Caspian Sea to rising temperatures.

"They were great projects that came out of great data," Tapley said. "Those efforts were very important contributions to establishing GRACE measurements as essential for water-related studies," he said.

Wilson's close association with the Center for Space Research helped him become an expert in analyzing and applying data collected by GRACE, which Tapley oversaw from 2002 to 2017 as its principal investigator.

Wilson kept an office at the center, which is near UT's J.J. Pickle Research Campus in north Austin, so he could collaborate with Tapley and others directly involved with GRACE operations. In turn, he served as a mentor for graduate students who relied on the data for their own research. Tapley said in a few instances, this led to engineering students deciding to study geosciences instead.

In the 1990s, Wilson moved his family temporarily to Washington, D.C., to head NASA's Geodynamics Program, planning and funding international space missions. He remains a member of the GRACE mission, which is now on its second satellite system and is allowing scientists to continue to monitor the Earth's gravitational field—and thereby measure the changes in the mass of ice sheets and determine the global water budget as the climate warms.

Wilson also helped bring important instruments to Texas, including the establishment of an important superconducting gravimeter at the McDonald Observatory, which measures subsurface fluids.

Tapley describes Wilson as quiet and thoughtful. He said that his studied approach to the instrumentation behind scientific data helped him make important strides in scientific research—and demonstrate the importance of geodesy to understanding the Earth's changing character.

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NEW FACES

Eric Attias
Research Associate

Eric Attias has been an Israeli navy diver, an ROV pilot and a molecular genetics researcher. He's now a marine geophysicist and research associate at the University of Texas Institute for Geophysics, where he brings a new geophysical capability in controlled-source electromagnetic (CSEM) imaging. At UTIG, one of his first projects is ICEFLAME—an international effort to study the impacts of icesheet retreat and the dissociation of marine gas hydrates in the Antarctic Peninsula.

Hassan Dashtian
Research Associate

Hassan Dashtian rejoined the Bureau of Economic Geology as a research associate, having worked previously as a researcher with the Gulf Coast Carbon Center from May 2018 to April 2019. While away from the bureau, he held data science positions at AquaNRG and at the Computational Media Lab at UT's Moody College of Communication. Dashtian specializes in a range of computational methods, including statistical data analysis and visualization, machine learning, predictive modeling and numerical simulation.

Mahdi Haddad
Research Associate

Mahdi Haddad is a research associate at the Bureau of Economic Geology and geomechanicist with experience in modeling injection and production-induced fault reactivation. Currently, Haddad conducts research on hydraulic fracture mapping and CO_2 monitoring through two projects focused on the Devine Fracture Pilot Site.

Benjamin Keisling
Research Associate

Benjamin Keisling is a numerical ice sheet modeler at the University of Texas Institute for Geophysics. He uses archives of the past to understand Earth's ice sheets today and in the future. His is currently researching the effects of seasonality and tectonics on Earth's climate and cryosphere, and developing numerical models in advance of a UTIG-led robotic exploration of underwater glacial walls. Keisling recently convened the AGU Chapman Second National Conference on Justice in Geoscience.

Wonhyun Lee
Research Associate

Wonhyun Lee joined the Bureau of Economic Geology as a research associate. He comes to the bureau from the U.S. Naval Research Laboratory, where he was a National Research Council postdoctoral fellow. Lee's research focuses on creating numerical models that capture coastal and oceanic processes, from hurricanes and extreme weather to the effects of future climate change.

Cornelia Rasmussen
Research Associate

Cornelia Rasmussen is a research associate at the University of Texas Institute for Geophysics. She joined UTIG in 2017 as a postdoctoral researcher and was involved in creating the UT Center for Planetary Systems Habitability. Rasmussen conducts research on the evolution of planetary habitability and is developing geochemical tools for use in chemical forensics and detecting life on other planets. Previously, she worked on piecing together the longest continuous paleoenvironmental record of the Late Triassic.

Ashraf Rateb
Research Scientist Associate

Ashraf Rateb is a research scientist associate at the Bureau of Economic Geology. He joined the bureau in 2018 as a postdoctoral researcher. Rateb specializes in using geodetic and remote sensing tools, such as GRACE/GRACE-FO, InSAR, GNSS, in situ observations and statistical learning to study interactions between atmosphere, hydrosphere and solid earth. His current research focuses on climate extremes and flood predictability.

FROM PAGE 74 | Gail Christeson

from 2009 to 2020. "The pedagogy she was using —learning by doing— was exactly the kind that really makes a difference in terms of students actually learning. It was all best practices."

In 2017, Christeson was appointed associate director of UTIG and was soon involved in the institute's search for a new director. What struck Mosher about Christeson during the two-year transition was the concern she showed for the welfare of UTIG's staff and researchers.

"All three [Jackson School units] had such incredibly different characters, and of all, the institute was always the most relaxed," she said. "There's more of a comradery and interest in what each other is doing that I think Gail had a large part to do with."

According to Mosher, Christeson's leadership style makes her a natural fit for science administration. But for Christeson, the decision to take the NSF job was a chance to try something new.

"I'm just excited. Every day, I'm learning new things, and after almost 28 years at UTIG, it's fun to have a big change," she said.

Others at UTIG previously recruited by the federal agency include UTIG former director Terry Quinn.

FROM PAGE 75 | Mark Cloos

in the region. During that time, he connected with former student JR Moffett in neighboring Indonesia, and the two began a project in 1989 on the geology of Grasberg orebody that continues to this day. The orebody proved to be a supergiant copper deposit with a significant byproduct of gold. What began as a five-year project with a team of doctoral students morphed into a long-term venture co-led by Jackson School Professor Emeritus Richard Kyle that produced 18 theses and dissertations supervised by Cloos and brought about 130 undergraduate student researchers into the fold.

Cloos' army of students also took on many projects in California on subduction and transform margin geology. Many of those students chose their thesis topics by participating in one of his California field trips, with Cloos taking more than 300 UT students to see the wonders of California geology over the years.

Early in his career, Cloos taught sections of field camp in Taos and Durango when about 130 students took the summer course. Since 2005, he taught Introduction to Field Geology, a class for nonmajors that he inherited from Professor Emeritus Leon Long. But Cloos is probably best known for bringing students on his optional field trips to California and Oklahoma, which have been Jackson School fixtures for decades. It is during these trips that he says "the lights come on" for many students as they explore outcrops and then hear the geological stories behind what they are seeing.

One such student was Andrew Quarles, who earned a doctoral degree under Cloos' supervision in 1996. He remembers not knowing what to think of Cloos at first, with his "endless intense questions" and encyclopedic knowledge. But by the time Quarles graduated, Cloos had such an impact on his life that Quarles and his wife, Stacy, have now started an endowed graduate fellowship in Cloos' honor.

"Beneath that intensity was an educator dedicated to sharing and developing his students," said Quarles. "Whether you were his Ph.D. student, a student in one of his many undergraduate or graduate classes, or a part-time research assistant, you knew you were receiving remarkable and dedicated attention and encouragement."

Ketcham, who has educated scores of students himself, sums up Cloos' impact simply.

"By the end of my first semester, I decided that Mark was the kind of scientist I would aspire to be," he said.

For the full version of this story, go to ***www.jsg.utexas.edu/news/newsletter***

FROM PAGE 76 | Craig Fulthorpe

before and during each voyage. Taking a recreational cruise or sailing the high seas is not in his future.

"I don't really have much of a desire for a vacation at sea," he said.

FROM PAGE 77 | Mark Helper

across the school to teach different modules at field sites paired with their geologic expertise.

"We now go through the entire Rockies," said Jackson School Professor Charlie Kerans, who teaches the carbonate geology section of the course. "Students get to see the best of everything."

Helper later adapted parts of the field camp curriculum to help train NASA astronauts in field geology, a project that he has been involved with since 2009 but has UT roots reaching back to the Apollo program. His retirement plans include continuing to take each new astronaut class on a mapping exercise in New Mexico.

Helper's expertise isn't limited to the field. He founded the school's GIS course in 1999, teaching students how to use GPS and other digital data when the technologies were just getting a foothold in the geosciences. He also took the lead of the school's gems and gem minerals course. From 1987 to 1999, Helper taught the course with lapidary artisans Glenn and Martha Vargas, with Helper covering the science and the Vargases teaching students the craft of polishing and faceting gemstones. And when they retired, Helper assumed that role as well.

Along with the course came curatorial responsibilities for the Department of Geological Sciences' gem and mineral collections, which Helper helped take into the digital age, taking digital photos of specimens and establishing an online catalog in the early 2000s with the help of numerous undergraduate student assistants he supervised.

Being at the helm of a variety of classes, both on campus and in the field, Helper got to know students better than most other instructors, said Kerans. When undergraduates needed a recommendation letter for graduate school, they went to Helper about 70% of the time, he said.

Helper said playing a part in student success was one of the best parts of the job.

"Along with the many, many opportunities I've had to work with colleagues, being a small part of a student's future success is one of the most rewarding aspects," he said.

FROM PAGE 78 | Richard Kyle

Describing the process as "Superman X-ray vision," Kyle said such technologies not only aid in the understanding of these unusual rocks, but will help companies perform more targeted, efficient recovery of the contained resources. This ties into Kyle's interests in adaptive reuse of former mine sites and repurposing mine wastes.

He has also spent years targeting critical minerals that will be used more frequently as societies shift to lower-carbon alternative energy sources. As the world weighs the trade-offs between using hard-to-find minerals required for low-carbon energy programs and the economic and environmental issues associated with those minerals, the field finds itself at a critical stage.

"It's not just political will," Kyle said. "It has a lot to do with the availability of the natural resources that will allow these engineering challenges to be met. It's not a simple issue in any number of ways."

As Kyle eases away from his full-time job, he's looking forward to spending more time with his wife, Linda, and their two sons, Brock and Brett. He credits them for giving him the support he needed to do all the "crazy things" he did throughout his career.

FROM PAGE 79 | Sharon Mosher

students in her honor at the Geological Society of America annual meeting in Denver, where she also received the William B. Heroy Jr. Award for Distinguished Service to the American Geosciences Institute. Her immediate plans include working on unfinished research with former students, including a paper on the evolution of the Australia-Pacific plate boundary that has been on hold since she became dean in 2009. She also wants to continue to travel and conduct fieldwork.

Mosher keeps an office in the Jackson School and doesn't plan to leave it any time soon. That means she's available to faculty, students and colleagues who seek her out, but said she makes a point of not getting involved in issues around the school unless she's asked.

"I feel very strongly about the Jackson School, and I care very deeply about the undergrad and grad students, the faculty, research scientists and the staff. I mean, I really do," she said. "The school and the people within it mean a great deal to me, but I know how to let go."

For more on Mosher, see: ***www.jsg.utexas.edu/news/2019/12/the-dean***

FROM PAGE 80 | Clark Wilson

"These things come out of careful and solid work underpinning the research," Tapley said. "I thoroughly enjoyed the interactions with Clark, and they defined a valued relationship."

Wilson retired from teaching in 2021 as an emeritus professor, although he is not slowing down: If he is on campus, it's a safe bet that he cycled the five miles to campus from his home on the other side of the Colorado River. He recently translated decades of teaching experience into a new textbook based on the fundamentals of data processing, he is supervising two graduate students, and he continues to co-author research papers. He does, perhaps, have a bit more time to devote to interests outside of the university. He rediscovered his passion for rowing six years ago and was part of the sport's masters competition for a few years; he is part of the Rollingwood neighborhood's utility commission; and he is, slowly and painstakingly, restoring two Jaguar Roadsters from the 1950s. Just ask him to show you the grease on his fingers.

LEFT TO RIGHT: NATALIE GIBBS, JOHN GIBBS, JIM GIBBS AND JUDY GIBBS.

Gibbs Enters Hall of Distinction

Alumnus Jim Gibbs (B.S. '57) has been inducted into the Jackson School of Geosciences Hall of Distinction, an honor that is reserved for people who have been a part of building the Jackson School into what it is today and who have achieved exceptional standing within the geosciences in industry, government or academia.

Gibbs earned a bachelor's degree in geology in 1957 prior to serving two years in the U.S. Navy as a communications officer. After his military service, Gibbs went back to school and earned a master's degree in geology from the University of Oklahoma. He was first employed as a geologist by the California Company (now Chevron-Texaco) in New Orleans and Lafayette, Louisiana. In 1964, he opened an office in Dallas as a consulting geologist and independent oil and gas producer. He initiated drilling prospects, purchased and sold oil and gas leases, operated wells, and served as an exploration consultant to several companies.

Gibbs currently serves as chairman of the board of managers of Five States Energy, which he founded in 1985. He has served as president and an honorary life member of the American Association of Petroleum Geologists and is currently chair of the AAPG Foundation board of trustees as well as president and life member of the Dallas Geological Society. He is a frequent lecturer at professional meetings and various universities. Gibbs has been a member of the Jackson School Geology Foundation Advisory Council for over 20 years and, as a fervent supporter of geoscience education, has established a graduate fellowship at the Jackson School, as well as supported multiple other scholarship endowments.

Kerans Wins the Berg Award

Professor Charles Kerans has received the 2022 Robert R. Berg Outstanding Research Award from the American Association of Petroleum Geologists (AAPG). The award recognizes a singular achievement in petroleum geoscience research.

Kerans holds the Robert K. Goldhammer Chair of Carbonate Geology in the Department of Geological Sciences and is a senior research scientist at the Bureau of Economic Geology. He is the fourth Jackson School scientist and first faculty member to receive the award since it was first awarded in 2008.

"At this point in my career, this broad recognition for the work I, my amazing students and my colleagues at the Department of Geological Sciences and the Bureau of Economic Geology have done is important and reflects well on the substantial resources and opportunities provided by the Jackson School," said Kerans. "It is also especially nice to have colleagues who are willing to support and nominate me as well as to have an organization

PHOTOS: JACKSON SCHOOL.

like AAPG — where I have had a long association over my career — bestow the award."

Kerans established a research program at the bureau in 1985 after receiving a doctorate from Carleton University in Ottawa and completing a postdoctoral fellowship at Western Australian Institute of Technology. In 2006, he was named the Robert K. Goldhammer Chair of Carbonate Geology in the Department of Geological Sciences. He continues to be active in the Reservoir Characterization Research Lab (RCRL) consortium at the bureau that he helped to establish in 1987. It is now one of the longest-running, industry-sponsored consortiums studying carbonate reservoir systems.

Kerans' expertise is in characterizing carbonate stratigraphic successions across the geologic record. Kerans and the RCRL have pushed several new approaches to 3D visualization of outcrops as a way of better understanding complex subsurface carbonate reservoirs where nearly half of the world's remaining petroleum resource is situated. Throughout his career, Kerans has had a focus on field work that is unique: He has conducted research on major oil fields and outcrop analogs across the globe and has led countless field trips for both academic and industry groups to help others see the amazing geologic record of these marine systems.

"Charlie has compiled a remarkable record of exceptional research marked by a score of best paper awards from SEPM, AAPG and other professional organizations," said William L. Fisher, professor and Leonidas T. Barrow Centennial Chair Emeritus in Mineral Resources in the Department of Geological Sciences. "And now come the major medals in his field—first the Society for Sedimentary Geology's Francis J. Pettijohn Award in 2015, now the AAPG Berg and many more to follow — for this consummate scholar of carbonate rocks."

Lowery Earns Top Early-Career Scientist Award

Chris Lowery, a research associate at the University of Texas Institute for Geophysics, has received the James Lee Wilson Award from the Society for Sedimentary Geology. The award recognizes significant research accomplishments by an early-career scientist.

Lowery's work has led to advancements in understanding the environment of Earth's ancient oceans and its marine life. His research has revealed key moments in the Gulf of Mexico's past including the recovery of life after the extinction of nonavian dinosaurs. He is also highly active in the International Ocean Discovery Program (IODP) and recently co-founded a workshop to engage young scientists with scientific ocean drilling.

"Chris has earned national and international recognition, not just for his work as a micropaleontologist and sedimentologist but in integrating these data sets with tenets of modern life science to illuminate global change and to decipher key events in Earth's environment and climate," said UTIG Director Demian Saffer.

Lowery joined UTIG in 2016 as the first Richard T. Buffler postdoctoral fellow, and he soon made his mark mapping a barrier reef system that grew in the Gulf of Mexico over a 100 million years ago.

In 2017, he embarked on the UT-led IODP drilling expedition that explored the Chicxulub crater — the impact site of the asteroid that wiped out the dinosaurs. Lowery found microfossils buried within sediment cores drilled from the crater's peak ring, indicating that the crater was already teeming with plankton and algae just a few years after impact. He published his results in a 2018 *Nature* paper and followed it with evidence that evolution imposes a speed limit on the recovery of life after an extinction event.

Lowery also helped co-write the IODP's new science framework (a document outlining priorities for future scientific ocean drilling through 2050), and he has co-founded Demystifying the IODP Proposal Process for Early Career Scientists, a series of workshops aimed at guiding early-career scientists through the process of planning their own science expeditions. He is also a regular instructor for the Marine Geology and Geophysics Field Course, a flagship student field experience at the Jackson School of Geosciences.

"I feel like that the very best thing we can all do as scientists is to build up the next generation and pass the torch to them as early and as often as possible," Lowery said.

Bhattacharya Wins Karcher Award

Shuvajit Bhattacharya uses petrophysical log and seismic data to characterize complex subsurface geology and helps identify "sweet spots" in the subsurface for projects, ranging from oil and gas exploration to carbon storage to geothermal energy.

A research associate at the Bureau of Economic Geology, Bhattacharya has been called a "rising star" by the Society of Exploration Geophysicists (SEG). This year, the society recognized Bhattacharya's accomplishments with the 2022 J. Clarence Karcher Award.

The award recognizes people who have made "significant contributions to the science and technology of exploration geophysics by a young geophysicist of outstanding abilities." Recipients must be younger than 35 years of age the year preceding the presentation of the award.

"This award is very encouraging as a young scientist," Bhattacharya said.

Bhattacharya isn't the only Jackson School scientist to receive the award. Former postdoctoral researcher Xinming Wu received the 2020 award. Professor Sergey Fomel received the 2001 award.

Bhattacharya's research involves analyzing borehole petrophysical logs and seismic data by applying and improving on different processing techniques, such as inversion modeling and machine learning, to interpret rock types, mineralogy, and various reservoir and geomechanical properties. His paper "Seismic attribute and petrophysics-assisted interpretation of the Nanushuk and Torok Formations on the North Slope, Alaska" was the most downloaded article of 2020 in SEG's journal *Interpretation*. He developed a workflow to determine the porosity and fluid saturation and to assess the fluid storage capacity of thin-bedded, low-resistivity reservoirs, which are easily missed due to their subtle expressions on geophysical data.

He is the author of the book "A Primer on Machine Learning in Subsurface Geosciences." He has recently co-edited a book, "Advances in Subsurface Data Analytics: Traditional and Physics-based Machine Learning."

Bhattacharya said that the fundamental knowledge that grounds his research allows him to participate in various applied projects.

"Most projects I'm working on now are applied in nature with real-world applications," he said. "Fundamental seismic and petrophysical knowledge is important to all of them."

Fomel Receives Honorary SEG Membership

The Society of Exploration Geophysicists (SEG) elected to bestow honorary membership to Professor Sergey Fomel.

Honorary membership recognizes SEG members who have made "distinguished contributions, which warrant exceptional recognition." The honor is granted by a unanimous vote of the SEG Honors and Awards Committee and the board of directors.

"I am happy to be recognized," said Fomel, who has been a member of SEG since 1998 and has attended every annual meeting since he was in graduate school. "Honorary membership is considered the second-highest award at SEG and for many people marks the high point of their careers."

Fomel is an expert in seismic data analysis and is known for his commitment to open-source research. In 2006, he started an open-source project for geophysical data processing. The resulting software package — called Madagascar — has since been downloaded more

than 60,000 times and is used by organizations around the world.

Fomel is among the top 500 most-cited geoscientists in the world, according to a database run by Stanford University. Each of his papers includes links to data and software codes that allow readers to reproduce and build on the computational experiments.

In addition to his contributions to exploration geophysics research, Fomel is an active SEG volunteer, having served on the board of directors as the vice-president for publications and on several key committees. In 2020, when the coronavirus pandemic shut down his worldwide tour as the SEG distinguished lecturer, Fomel continued to deliver his talk, "Automating Seismic Data Analysis and Interpretation," remotely.

Fomel joins a respected roster of Jackson School scientists who are also elected to honorary membership. They include Associate Director of the University of Texas Institute for Geophysics Mrinal Sen, as well as Milo Backus (deceased), Robert Grabner (deceased), Bob Hardage, Paul Stoffa and Carlos Torres-Verdin.

"They were my mentors when I moved to Austin 20 years ago, which makes me particularly proud to join this distinguished group," Fomel said.

Goudge Secures NASA Early Career Award

Timothy Goudge is among the five scientists selected by NASA's Planetary Science Division to receive an Early Career Award.

The award honors up-and-coming planetary scientists and provides up to $200,000 to support research and professional development over five years. An assistant professor in the Department of Geological Sciences, Goudge plans to use the funds for a research project that combines planetary science and student outreach.

"I'm really excited about it because it's just so different from other funding opportunities," said Goudge. "It has core fundamental science to it, but also outreach and teaching aspects that I'm really keen on as well. It will push our group to do new things in that realm."

Goudge studies the geological history of Mars and has been involved with prior NASA missions to the red planet, including successfully advocating for Jezero Crater as the landing spot of the Perseverance rover. He relies on remote sensing data from a variety of sources, from satellites to uncrewed aerial vehicles (UAVs), to conduct research on the geology of Mars and Earth.

His early-career project will involve testing different UAV surveying methods at field sites in Utah and on the Texas Gulf Coast, evaluating how they fare at registering different geological features — from stacks of strata to shifting sand dunes.

The work will help determine the best, most cost-effective instruments for surveying geology on other worlds — a critical part of space exploration, said Goudge.

Goudge said he selected the field sites with alien landscapes in mind. Utah's barren rocks are like sites on Mars. And Titan, a moon of Saturn that NASA plans to visit in the 2030s, is thought to have sandy dunes similar to those along the Gulf.

Assisting Goudge on the Gulf Coast leg of the research will be students in the Jackson School's GeoFORCE program, which teaches Texas high school students from underserved areas about the geosciences through field trips. Students will learn how to conduct field work and UAV surveys, then how to process and analyze the resulting data for studying geology.

Snedden Wins Doris Malkin Curtis Medal

John Snedden, a senior research scientist at the University of Texas Institute for Geophysics (UTIG), has been awarded the Doris Malkin Curtis Medal by the Gulf Coast Section of the Society for Sedimentary Geology.

The award recognizes Snedden's numerous contributions to the study of the Gulf of Mexico and the geology that sets it apart as a superbasin. The award was established in 2007 in honor of Doris Malkin Curtis, a pioneering scientist who worked on the Gulf of Mexico for over 50 years. The medal recognizes career contributions to the understanding of the geology of this and other important basins. Snedden is the fifth geoscientist at The University of Texas at Austin to win the medal, which is the Gulf Coast Section's highest honor.

Snedden directs the Gulf Basin Depositional Synthesis project, a long-running, industry-funded research project at UTIG. He and the GBDS team have produced hundreds of geologic maps and numerous reports and papers on the basin sandstone, shale, and salt layers and its prolific hydrocarbon reservoirs, seals, and source rocks.

UTIG Director Demian Saffer said that Snedden's contributions had proved to be a rich resource for industry and academic geologists alike.

"The medal is richly deserved recognition of John's sustained foundational contributions to understanding the processes and patterns of sediment transport in the Gulf, as well as the role he has played in mentoring students and postdoctoral scholars as part of the GBDS program," he said.

Saffer highlighted Snedden's recent work characterizing the complex geology of the Gulf's southern deepwater region. The work has helped characterize untapped offshore petroleum deposits that could fuel the U.S. and Mexico as they transition to low-carbon energy sources.

In December 2020, Snedden published research laying out definitively the critical factors that support the Gulf of Mexico's status as a modern superbasin — one of a small number of prolific geologic basins that supply the bulk of the world's oil and gas. The study traced the Gulf's geologic history, from its formation among the fragments of Pangaea, to the ancient salt flats and sediment flows that created the vast energy reserves powering the U.S. today.

Other UT recipients of the medal include the Bureau of Economic Geology's Leonard "Frank" Brown and Shirley Dutton, UTIG and bureau alumnus Charles Winker, and UTIG and Department of Geological Sciences Professor Emeritus William Galloway.

Tinker Honored with Parker Medal

Each year, the American Institute of Professional Geologists (AIPG) recognizes an individual for their record of service with the Ben H. Parker Memorial Medal.

This year, the award went to Scott Tinker, the director of the Bureau of Economic Geology.

"I spend time trying to bring academia, industry professionals and governments together to work on big challenges," Tinker said. "To be recognized in this way by the professional geoscience community is truly meaningful."

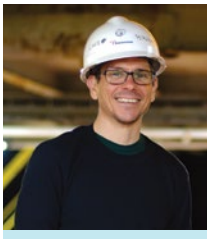
Bureau leadership is well represented among the medal's past recipients. They include former directors William L. Fisher and Peter Flawn, who also served as the president of The University of Texas at Austin from 1973 to 1985, as well as former assistant director Marcus Milling.

Tinker is a driving force for interdisciplinary and collaborative research at the bureau, working to bring together industry, government, academia and nongovernmental organizations to address global challenges in energy, the environment and the economy.

Tinker is also active in energy outreach. He founded the nonprofit

Switch Energy Alliance to promote education and awareness of different types of energy and their benefits and tradeoffs. Through the alliance, Tinker has co-produced two energy documentaries, "Switch" and "Switch On", which have been viewed by millions. Tinker is also the voice of "EarthDate," a radio program about science and nature that is featured on over 425 radio stations across the country.

Tinker received the medal at the AIPG annual meeting in August 2022.



Saffer and Scanlon Give 2022 AGU Named Lectures

The Jackson School of Geosciences' Demian Saffer and Bridget Scanlon are each to give a Bowie Lecture at the American Geophysical Union's fall meeting in December 2022. The AGU's Bowie Lectures are among the highest honors given to scientists in their fields.

Saffer was selected to present the Francis Birch Lecture, which honors scientists in the field of tectonophysics and is named after renowned American geophysicist Francis Birch. Scanlon was selected to present the William Bowie Lecture in the geodesy section, named after AGU's first president, William Bowie.

Saffer is the director of the University of Texas Institute for Geophysics and a professor at the Jackson School's Department of Geological Sciences. He and his research group focus on the mechanics of earthquake fault zones, which they study through a combination of field observations, laboratory experiments and computer modelling. He has also led five major scientific ocean drilling expeditions to investigate large earthquake faults at the Pacific "Ring of Fire."

Scanlon is a senior research scientist at the Bureau of Economic Geology, where she has worked for over 30 years. She is a world-leading authority on water research, its usage, storage and conservation. She has published over 100 articles in numerous peer-reviewed journals, including a 2022 study on water levels and use across Africa's aquifers.

Duffy Awarded Robert Mitchum Award

Oliver Duffy, a research associate at the Bureau of Economic Geology, received the 2022 Robert Mitchum Award for a paper published in the journal *Basin Research*.

Presented by the European Association of Geoscientists and Engineers (EAGE), the award recognizes the author of the best paper published in *Basin Research* during the preceding calendar year. According to the EAGE, the winning paper "must be of high scientific standard and should represent a significant contribution to one or more of the disciplines represented by that journal."

"The journal *Basin Research* has long been a key source of literature for me," Duffy said. "To be recognized by that journal, given the quality of the authors who regularly publish there, is a great honor."

The award recognizes the paper "Principles of shortening in salt basins containing isolated minibasins," which Duffy co-authored with fellow bureau researchers Tim Dooley, Michael Hudec, Naiara Fernandez (now at GFZ Potsdam) and Juan Soto along with Christopher Jackson (now at Jacobs Solutions Inc.). The paper was published in February 2021 and appeared in volume 33 of the journal.

The researchers used physical models to examine shortening styles in salt-influenced basins, finding that in settings with isolated minibasins and a high salt volume, shortening — or the squeezing of a region—induces salt flow. This flow of salt contributes to the translation, tilt and rotation of minibasins during the shortening process.

According to Duffy, the paper contributes to the fundamental understanding of salt basins worldwide, with potential application for oil and gas exploration, and energy storage in salt basins.

The award was presented in June 2022 during the EAGE annual conference in Madrid. Duffy follows in the footsteps of bureau research associate Jinyu Zhang, who received the Robert Mitchum Award in 2020.

Awards

Common Abbreviations:

AAPG ..... American Association of Petroleum Geologists
AGS ..... Austin Geological Society
AGU ..... American Geophysical Union
AMS.... American Meteorological Society
BEG ..... Bureau of Economic Geology
CPSH ..... Center for Planetary Systems Habitability
DGS ..... Dept. of Geological Sciences
GSA .....Geological Society of America
GSEC..... Graduate Student Executive Committee
JSG..... Jackson School of Geosciences
SEG ..... Society of Exploration Geophysicists
SEPM....Society for Sedimentary Geology
UTIG..... Institute for Geophysics

FACULTY AND RESEARCHERS

JAIME BARNES
GSA Fellow

THORSTEN BECKER
Director's Circle of Excellence, UTIG

SHUVAJIT BHATTACHARYA
J. Clarence Karcher Award, SEG

DON BLANKENSHIP
Outstanding Research, UTIG

OLIVER DUFFY
Robert Mitchum Award, European Association of Geoscientists and Engineers

PETER FLEMINGS
Director's Circle of Excellence, UTIG

SERGEY FOMEL
Honorary Member, SEG

TIMOTHY GOUDGE
Planetary Science Early Career Award, NASA

SEAN GULICK
Director's Circle of Excellence, UTIG

FARZAM JAVADPOUR
Top 25 Most Cited Articles in 2018, Energy & Fuels

CHARLES KERANS
Robert R. Berg Outstanding Research Award, AAPG
Lifetime Membership Award, West Texas Geological Society

STEPHEN LAUBACH
Outstanding Reviewer for Reviews of Geophysics, AGU

DAPHNÉ LEMASQUERIER
L'Oreal-UNESCO International Rising Talent
Andreas Acrivos Dissertation Award in Fluid Dynamics, American Physical Society

CHRIS LOWERY
Director's Circle of Excellence, UTIG
James Lee Wilson Award, SEPM

ASHLEY MATHENY
Outstanding Early Career Award, AMS

DEV NIYOGI
Helmut E. Landsberg Award, AMS

ALEXANDER SUN
Editors' Citation for Excellence in Refereeing, AGU Publications

DANIELLA REMPE
Knebel Teaching Award, DGS

DEMIAN SAFFER
Francis Birch Lecture, AGU

BRIDGET SCANLON
William Bowie Lecture, AGU

JOHN SNEDDEN
Doris Malkin Curtis Medal, SEPM Gulf Coast Section

SCOTT TINKER
Ben H. Parker Memorial Distinguished Service Medal, American Institute of Professional Geologists

DANIEL TRUGMAN
Knebel Teaching Award, DGS
Outstanding Reviewer for JGR: Solid Earth, AGU

LAURA WALLACE
Director's Circle of Excellence, UTIG

ERIC XIAOHUA XU
Outstanding Young Researcher, UTIG

ENZE ZHANG
Outstanding Postdoc, UTIG

PROMOTIONS

JOHN ANDREWS
Research Scientist Associate IV

OLIVER DUFFY
Research Scientist

KELLY HATTORI
Research Scientist Associate IV

PETER HENNINGS
Senior Research Scientist

TOTI LARSON
Research Scientist

PRIYANKA PERIWAL
Research Scientist Associate IV

ALEXANDROS SAVVAIDIS
Senior Research Scientist

ZOLTAN SYLVESTER
Senior Research Scientist

STUDENTS

JANA ALABDULLATIF
Chandler and Laura Wilhelm Grant, AAPG Foundation

RAWAN ALASAD
Student Research Grant Award, SEPM

WADE AUBIN
Veterans Memorial Scholarship, Rocky Mountain Association of Geologists Foundation
2nd Place Graduate Student, R.L. Folk/E.F. McBride Petrography Contest, DGS

CLAUDIA BANKS
Unrestricted Endowed Presidential Scholarship, UT
Grants-in-Aid Fund, AAPG Foundation

LUCIA BELLINO
Graduate Research Fellowship, NSF

SARAH BROOKER
Unrestricted Endowed Presidential Scholarship, UT

KRISTINA BUTLER
Outstanding Teaching Assistant Award – Spring 2022, DGS

EVAN CARNAHAN
Graduate Fellowship, Texas Space Grant Consortium
Student Research Grant, CPSH

MICHAEL CHIAPPONE
Austin Geological Society Scholarship, AGS

EDWARD CLENNETT
1st Place, Gulf Coast Challenge Bowl, SEG

ETHAN CONRAD
Respekt & Wertschätzung Scholarship, DAAD-Stiftung (German Academic Exchange Service Foundation)
Ewing-Worzel Graduate Fellowship, UTIG
Brundrett Memorial Endowed Presidential Scholarship, JSG
Summer Research Fellowship, UT Graduate School
Graduate Student Research Grant, GSA
1st Place, Gulf Coast Challenge Bowl, SEG

NICOLE CZWAKIEL
Honorable Mention, GSEC Student Service Award, DGS

HUDSON FINLEY DAVIS
Geophysical Society of Houston/Hugh Hardy Scholarship, SEG

SARAH DAVIS
Whitney Endowed Presidential Scholarship, JSG
Summer Research Fellowship, UT Graduate School
Dean's Prestigious Fellowship Supplement, UT

ARNAB DHARA
SEG Foundation/Chevron Scholarship

JACQUELINE EPPERSON
Grants-in-Aid Fund, AAPG Foundation

SAMUEL KWUN YIP FUNG
2nd Place, Best Student Oral Presentation, AMS
Whitney Endowed Presidential Scholarship, JSG

HECTOR GARZA
Graduate Student Research Award, GSA
Student Research Grant, CPSH

ANDREW GASE
Outstanding Student Presentation Award, AGU

SOPHIE GOLIBER
Ewing-Worzel Graduate Fellowship, UTIG

NICOLE GONZALEZ
Honorable Mention, Student Expo Elevator Pitch, Houston Geological Society

EVELIN GUTIERREZ
Graduate Student Research Award, GSA

JUAN GUTIERREZ
L. Austin Weeks Memorial Grant, AAPG Foundation
Charles B. and Marilyn C. Fritz Memorial Grant, AAPG Foundation
Student Research Grant, SEPM
Unrestricted Endowed Presidential Scholarship, UT

ERIN HEILMAN
Ewing-Worzel Graduate Fellowship, UTIG

ERIC HIATT
Ewing-Worzel Graduate Fellowship, UTIG
Student Research Grant, CPSH

EMILY HINSHAW
GSEC Student Service Award, DGS

COLLIN HOFFMAN
2nd Place Undergraduate Student, R.L. Folk/E.F. McBride Petrography Contest, DGS

SCARLETTE HSIA
Grants-in-Aid Fund, AAPG Foundation

SHUHUA HU
Dallas Geophysical Society/Karen Kellogg Shaw Memorial Scholarship, SEG
James and Ruth Harrison Scholarship, SEG
Charlie and Jean Smith Scholarship, SEG
Scientific and Technological Progress Award, Chinese Geophysical Society

SARP KARAKAYA
R. Randy Ray Memorial Grant, AAPG Foundation

HARPREET KAUR
Runner-up, Graduate Student Best Paper, DGS
Unrestricted Endowed Presidential Scholarship, UT

CULLEN KORTYAN
Outstanding Teaching Assistant Award – Spring 2022, DGS

ANDREW KLEIMAN
Runner-up, Master's Saturday Best Speaker, DGS

EDEN LAGNADO
"Every Drop Counts" Earth Science Scholarship, Ozarka Natural Spring Water
EVS Research Fellow, UT Environmental Science Institute
Earth Science/Jewelry Arts Scholarship, Houston Gem & Mineral Society

TIMOTHY EVAN LEONARD
1st Place Undergraduate Student, R.L. Folk/E.F. McBride Petrography Contest, DGS

JOSHUA MALONE
Graduate Student Research Grant, GSA
Unrestricted Endowed Presidential Scholarship, UT

NAOMA MCCALL
Runner-up, Graduate Student Best Paper, DGS
Unrestricted Endowed Presidential Scholarship, UT

TYSON MCKINNEY
Groundwater Field Methods Award, DGS

KEVIN MEAZELL
George C. Matson Memorial Award, AAPG
Best Technical Paper at IMAGE 2021, SEG/AAPG
Best Graduate Student Paper, DGS

NICK MESZAROS
Outstanding Teaching Assistant Award – Fall 2021, DGS
1st Place Graduate Student, R.L. Folk/E.F. McBride Petrography Contest, DGS
Vargas Endowed Presidential Scholarship, JSG

CARSON MILLER
Honorable Mention, GSEC Student Service Award, DGS

ROSALIND MOREMAN
Estwing Hammer Award, DGS

JOHN A. MORETTI
1st Place, Graduate Research Award, Texas Academy of Science
Whitney Endowed Presidential Scholarship, JSG

NEELARUN MUKHERJEE
Best Master's Thesis, Sengupta Memorial Award, Indian Institute of Technology
Dean's List, Indian Institute of Technology

ZACH MURPHY
Unrestricted Endowed Presidential Scholarship, UT

GRACE MUSSER
Postdoctoral Research Fellowship in Biology, NSF

MARIEL NELSON
Graduate Student Seed Grant, National Center for Airborne Laser Mapping
Field Outreach Grant, NSF Geo Allies
Honorable Mention, NSF Graduate Research Fellowship Program

AMBER NGUYEN
Undergraduate Prize, Mineralogical Society of America

EIRINI POULAKI
Runner-up, Graduate Student Best Paper, DGS

SIMONE PUEL
Marshall Memorial Endowed Presidential Scholarship, JSG
Ogden Memorial Scholarship, JSG
Outstanding Graduate Student, UTIG

Winner, 2022 Professional Networking and Portfolio Contest, JSG

SEBASTIAN RAMIRO-RAMIREZ
Equinor Fellow
Best Ph.D. Talk, DGS

VERONIKA REDENSEK
Unrestricted Endowed Presidential Scholarship, UT

JIALONG REN
Student Research Grant, CPSH

FERNANDO REY
Outstanding Teaching Assistant Award – Fall 2021, DGS
R. Randy Ray Memorial Grant, AAPG Foundation

WILLIAM REYES
Summer Research Fellowship, UT Graduate School

MATTHEW RILEY
Outstanding Student Presentation Award, AGU

CATHERINE ROSS
Geology Foundation Endowed Presidential Fellowship, JSG
Student Research Award, CPSH
Barringer Family Fund for Meteorite Impact Research, Barringer Crater Company

CATHERINE SCHMIDT
Austin Geological Society Scholarship, AGS

GEORGE H SEGEE-WRIGHT
Summer Research Fellowship, UT Graduate School
Whitney Endowed Presidential Scholarship, JSG

AFZAL SHADAB
Outstanding Student Presentation Award, AGU
Student Research Grant, CPSH

BRANDON SHUCK
Runner-up, Graduate Student Best Paper, DGS

SINJINI SINHA
Short-Term Research Grant, German Academic Exchange Service
University Graduate Continuing Fellowship, UT Graduate School
Off Campus Research Grant, JSG
Ingerson Graduate Research Assistance Fellowship, JSG
Runner-up, Graduate Student Best Paper, DGS

DAPHNE SMITH
Groundwater Field Methods Award, DGS

TRAVIS STONE
Unrestricted Endowed Presidential Scholarship, UT

SHADYA TALEB
Robert M. Cluff Memorial Scholarship, Rocky Mountain Association of Geologists Foundation
Research Experience in Carbon Sequestration, U.S. Department of Energy

AMBER TAYLOR
Student Research Grant, CPSH

GABRIELLE VARONA
Master's Saturday Best Talk, DGS
Geology Foundation Endowed Presidential Fellowship, JSG

DIMITRI VOYTAN
Gale White Graduate Fellowship, UTIG

WARREN WEGENER
Austin Geological Society Scholarship, AGS

CLAIRE WILLIAMS
Graduate Research Fellowship, NSF
Whitney Endowed Presidential Scholarship, JSG
Local and Regional Outreach Award, Society for the Study of Evolution
Lerner-Gray Marine Research Grant, American Museum of Natural History
Graduate Student Research Grant, GSA
Student Research Grant, Paleontological Society

EBONY WILLIAMS
Graduate Student Research Grant, GSA

SHUAI YAN
Outstanding Graduate Student, UTIG

MOLLY ZEBKER
Graduate Fellowship, Texas Space Grant Consortium
Sabins Summertime Fellowship for Remote Sensing, JSG

YU-CHEN ZHENG
Student Research Grant, CPSH

STAFF

MELISSA COFFMAN
Outstanding Staff Award, BEG

BEN HESTER
Eleanor Picard Excellence Award

JESSE HOUGHTON
Outstanding Support Staff, UTIG

JULIA LAKE
Staff Service Award, DGS Business Services Office

ANGELA REYES
Outstanding Support Staff, UTIG

ROSANNA D'SOUZA
Staff Service Award, DGS

MARK WIEDERSPAHN
Career Award, UTIG

OTHER

BUREAU OF ECONOMIC GEOLOGY
Bruno Hanson Environmental Excellence Award, Permian Basin Petroleum Association

GEOFORCE TEXAS
Special Commendation, SEG

STUDENT RESEARCH SYMPOSIUM AWARDS

The Jackson School of Geoscience's 11th Annual Student Research Symposium took place in April 2022 at the Bureau of Economic Geology's core library and rock garden. The research symposium is hosted by the Jackson School's Graduate Student Executive Committee and showcases the amazing array of research from across the school. The winners and honorable mentions are as follows:

LATE CAREER PH.D. STUDENT

1st Place: Ethan Conrad: The structural and morphological evolution of transpressive systems: insights from analog modeling

2nd Place: Nicholas Meszaros: Emergence of supervolcanism at Valles Caldera as recorded by changes in oxygen fugacity and crystal cargo

Honorable Mention: Molly Zebker: Tropospheric Artifact Estimates to Optimize InSAR Time Series Without In Situ or Weather Model Information

LATE CAREER MASTERS STUDENT

1st Place: Caroline McKeighan: 3D Interpretation, Structural Characterization, and Seismogenic Association of Faults in the Eagle Ford Region, south-central Texas

2nd Place: Gabrielle Varona: Paleogeographic evolution of the Orange and Green sands in WR 313, Deep-water Gulf of Mexico

Honorable Mention: Maximilian Ehrenfels: Intrusion and cooling history of some late-tectonic Salem granites (Namibia) as deduced from U-Pb and Ar-Ar thermochronology and implications for the Damara orogeny

EARLY CAREER GRADUATE STUDENT

1st Place: Grace Guryan: Lithologic Controls on Landscape Evolution: Modeling how the Cover Effect Influences Effective Erodibility

2nd Place: Patricia Standring: Deep Ocean Circulation in the Southern Gulf of Mexico at the Eocene-Oligocene Transition

Honorable Mention: Mariel D. Nelson: Characterizing short-term alluvial river bank erosion patterns with time-lapse airborne lidar and UAV-derived structure-from-motion topography data

UNDERGRADUATE STUDENT

1st Place: Carole Lakrout: Identifying Micro-biomes and Biomineralization in Caves

2nd Place: Reem Alomar: Seismic data matching by least-squares non-stationary triangle smoothing

Honorable Mention: Matthew Riley: Chlorine and Fluorine Abundances of Hydrous Minerals in Colorado Plateau Mantle Xenoliths: A Step Towards Quantifying the Mantle Halogen Budget

BEST REPRESENTED RESEARCH GROUP

Best Performance: Daniel Stockli Research Group

Best Representation: Rowan Martindale Research Group

HIGH SCHOOL STUDENT

1st Place: Maria Contreras and Megan Marostica: Salacia: Creating Another Earth

2nd Place: Divya Shukla and Lainie Stone: Terraforming Terrestrial Planets

Honorable Mention: Keira Boehle and Heba Dalu: Paradome: Paraterraform Your Paradise

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WE ARE GRATEFUL TO OUR DONORS, WHETHER IT IS THEIR FIRST OR 100TH TIME GIVING TO THE JACKSON SCHOOL OF GEOSCIENCES. WE WOULD LIKE TO RECOGNIZE ALL DONORS WHO HAVE DESIGNATED THE JACKSON SCHOOL IN THEIR ESTATE PLANS, DONORS WHO ARE MEMBERS OF OUR GIVING SOCIETIES, AND ANNUAL DONORS FOR THEIR LONG-STANDING FAITHFUL CONTRIBUTIONS. THANK YOU FOR YOUR CONTINUED SUPPORT TO ASSURE THE JACKSON SCHOOL PROVIDES A SUPERIOR EDUCATION TO BUDDING GEOSCIENTISTS AND CONTINUES TO LEAD THE WAY IN TRANSFORMATIVE RESEARCH.

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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David Boyles
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Ina* and Jesse* Brundrett
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Kevin Tuerff
Mark Ver Hoeve
Kathy & Steve Weiner
Wendy Weiss & Robert Mace
Pam & Rom Welborn
Raymond Woods*
John Wright*

Flawn Circle of Excellence

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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Vada & Walt* Boyle
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Chuck Caughey
Louise* & Decker* Dawson
Karen & Ed Duncan
Jacque* & Scotty* Holland
Katie* & Jack* Jackson
Angela* & Munib Masri
Kenneth Neavel
Charles Newsom
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Eleanor & Scott Petty
Terry & Elliott Pew
Rita & Jimmie Russell
Dick Stoneburner
Elizabeth & Joe* Walter
Dianne & Les White
Cathy & Chuck Williamson

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.

David Arctur
Ann & Henry Hamman
Grace & Hugh Hay-Roe
Kathleen Howard*
Mark Ver Hoeve
Kathy & Steve Weiner
Pamela & Rom Welborn
Edith & Bob Zinn

L.T. Barrow Founders Circle

The L.T. Barrow Founders Circle recognizes friends and alumni who have given cumulative gifts of $100,000 and above. Named after Leonidas T. and Laura T. Barrow, creators of the first Geology Foundation endowment in 1953, Barrow Founders Circle members honor the legacy of these two guiding spirits of geoscience education at The University of Texas at Austin.

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Annell Bay & Robert Suchecki
Patricia Boyd
David Boyles
Ina* & Jesse* Brundrett
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Susan Cage
Carlotta Chernoff
Betsy & Richard Chuchla
John Clinch
Billy Cotner
Pamela & Barnes Darwin
Caroline & Tim* Denison
Mary Anne & Bill Dingus
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Sally & Ralph* Duchin
Connie & Byron* Dyer
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Carol & Jim Farnsworth
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Cala Ferrand & Al Haertlein
Lisa & Erik Hanson
Janet Harman & Kent Mayes
Charlene & Dean* Henney
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Sara & David Martineau
Alicia & David Martineau
Colleen & Art* Maxwell
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Susan & Jack Mayfield
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Cynthia Oualline
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Marsha & Gregg Robertson
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Dorothy Sumner*
Sherry & Gary Thompson
Allyson & Scott Tinker
Julia Trimble & Tim Diggs
Allison & Bryan Wagner
Anita & Charles* Weiner
Wendy Weiss & Robert Mace
Mike Wiley*
Mary Wilkinson
Pinar Yilmaz

Hill Society

The Hill Society honors friends and alumni who have given $10,000 or more over their lifetime in support of the Jackson School. This society is named after Robert T. Hill, the first professor and chair of the Department of Geology and a founding member of the UT Mineral Survey, which would later become the Bureau of Economic Geology.

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Ellen & Gene Ames
Debbie & Jim Anderson
Patricia & Malcolm Bailey
Carol & Rod Baker
Dan Barker*
Louise Barnes
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Donna & Ken Barrow
Kim Bates
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Mary Poteet & Chris Bell
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Philip Bennett
Earl Bescher*
Daphne & Cletus Bianchi
Ann & John Bookout, III
Judith & Douglas* Bostwick
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Ann & Doug Brown
Thais Freda Bullard*
Tom Burke
Denise Butler
Robert Bybee*
Sarah Bybee*
Corinne* & Toby* Carleton
Susan & Bill Carlson
Emma & Edward Cazier
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Terry Huffington & Ralph Dittman
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ALUMNI NOTES

1950's

Theodore Stanzel (B.S. '56) writes, "There was only limited travel for the past year. We made a tour of the monuments in South Dakota. One of many 'should see' places in this great country. Health is good. That is of great importance in my life."

Leslie P. White (B.S. '56) says, "Dianne and I continue to 'age in place' in SW Austin. JSG—Number 1!—Again, Still, Always. We are so proud of our School. We are happy to see the increase in teaching and research at the White Family Outdoor Learning Center. I greatly enjoyed participating in the Final Feast of Hydro Camp. This summer's weather has emphasized our need to continue our understanding of hydrology."

1960's

Russell Harmon (B.A. '69) writes, "He and Karen Steinhoff Harmon '70 are both retired and still living in Raleigh (NC), but presently considering a move to New York's Hudson River Valley to enter into an apple cider venture with son Jonathan, an Expedia executive in New York City. Jonathan's twin bother, Brendan, is a 5th-year assistant professor of landscape architecture at LSU. Before Covid, we were traveling internationally, but haven't yet returned to doing so. Karen and Russell are two of four partners in a small company that specializes in non-destructive chemical analysis by different field-portable spectroscopic techniques. Each spring term for the past four years, Russell has been part of a 3-person teaching team for the Junior Profession Development Seminar in the Department of Marine, Earth, & Atmospheric Sciences at NC State University and has continued to be actively engaged in geochemical research, most recently applying field-portable laser induced breakdown spectroscopy (L!IBS) to real-time geochemical analysis in the field to study rock varnish formation in Owens Valley, CA and the elemental chemistry of mica in Carboniferous age Li-pegmatite mineralization in the Appalachian Mountains of southwestern NC." Russell can be reached at rsharmon@ncsu.edu.

William Feathergail Wilson (B.S. '60, M.A. '62) shares, "At the age of 87 I am still working as a geologist in groundwater and petroleum. I was a graduate student working under Dr. R. L. Folk. My latest project is an Ellenburger research well in northern Kerr County, Texas. We have just drilled 90' into clastic filled sinkhole within the Ellenburger which was unexpected at 740'. I am involved with groundwater district working on a well field in the Carrizo in Caldwell County and several other projects. I owe my life long career to Dr. R. L. Folk and all of the other professors at UT. I graduated with a B.A. in English, B.S. in Geology, and M.A. in Geology - 1958, 1960, 1962."

1970's

Arthur Bresnahan Busbey III (B.S. '75, M.A. '77) (Instructor '82-85) shares, "He and Janet (B.S. in Zoology with Chemistry minor, '76, B.S. in Geology '77) live in Fort Worth where he is entering his 5th year as Chair of the Department of Geological Sciences at TCU. Art figures he has about two more years before retirement. They have started to do much more traveling, especially when trying to escape the heat. If anyone is in the Fort Worth area and wants to visit one of the best meteorite museums in the world, come by TCU and see the Monnig Meteorite Gallery - free of charge. Their eldest daughter, Sara, and her husband are permanent residents of London (both UK citizens) and provide a great base of operations for Art and Janet when they visit. Our youngest daughter Laralen lives in Fort Worth. Howdy to old friends and a special Howdy to Ernie Lundelius who was one of my 660 instructors when we did six weeks in the Marathon Basin."

Roger Callaway (B.S. '77) says, "I have identified a hitherto unknown to me, characteristic of time; it goes in jumps. My COVID vaccine trial was at the end of 2020. I got a positive test courtesy of an exposure from a family member, in 2021, and now way into 2022, I found the trial is soon ending. The additional testing for that positive test in 2021 clearly showed the Forces of Darkness being defeated by an alert but not hysterical immune system with no symptom except a runny nose. So a hop skip and a jump and I hope I'm pretty much through the first plague of the 21st century. My sort of emeritus involvement with the mine I first worked at in 1983 seems to have come to a final end. Through careful experiment I can report that when using a tablesaw, it is best when traversing near the saw blade, if each hand is manipulating its own push stick. All goes well and best wishes and gratitude to UT."

Patricia Wood Dickerson (B.A. '70, Ph.D. '95) writes, "Field work in the Big Bend continues with gusto and visible results. A session in BBR SP with close colleagues yielded intriguing data that are now in press in a GSA memoir. Hoping that more will appear in an Elsevier text on world rifts (now in review). On the horizon -- an exciting project to investigate tectonic/hydrogeologic relations along the Rio in Chihuahua (if the gryphon that guards NSF funds

smiles on our bi-national proposal). In the meantime, no presentations at meetings during the CRUD-19 hiatus -- have missed the stimulating repartee. Smithsonian trips resumed with a return to Machu Picchu and the Galapagos. To stroll and swim among all the winging, waddling, and paddling creatures in the Galapagos conjured a near-mythic world. Then June 2022 brought an early summer view of Iceland, as well as a deeply sobering vista of SE Greenland during the flight home -- have never seen so much bare bedrock along the King Frederik VI Coast. In August 2023 I'll gleefully migrate poleward to instruct on an Alaska trip, under the granitic gaze of Denali. Here in the conterminous US, my GeoRef bibliographic work in the UT geology library goes on, in collaboration with most congenial colleagues in Alexandria (VA) -- discoveries for the research world at large and for my own studies. Always more to learn!"

Marvin (Jack) Droddy (Ph.D. '78) shares, "I have been retired from Baker Hughes for three years now; still miss my XRD, SEM and core testing 'gadgets.' Our daughter just graduated from UT with a BFA degree and is pursuing a career in fashion photography; son works for an auto dealer in nearby Conroe. I enjoyed checking out the new and improved Jackson School, having a snack on the Stephen Clabaugh patio, and seeing the new BSM center."

Murray Felsher (Ph.D. '71) shares, "It has been several years since I've provided an updated summary to JSG. I am happy to do so now. The years have flown by too quickly as I knew (but didn't believe) that they would. Natalie and I have just celebrated our 61st wedding anniversary. Both of us are in good health. Our three children are married and all are pursuing successful professional careers. Our oldest grandchild is entering graduate school this fall. Our youngest is a high school sophomore. Newly married, I arrived in Austin in August, 1961, and defended my dissertation under Bob Folk in April, 1971. The intervening ten years were eventful, to say the least. A rather eclectic set of positions ensued. These included post-doctoral appointment, university teaching, Washington DC jobs at NSF-funded CEGS/AGI, Headquarters EPA (senior staff geologist) and Headquarters NASA (chief, geological and energy applications), newsletter publisher (Washington Remote Sensing Letter), consultant and contractor (satellite remote sensing) to federal agencies and aerospace companies, professional society and industry organization leadership. Following Dr. Folk's death on June 4, 2018 I was honored to join with my good friend and fellow grad-student office-mate Miles O. Hayes in compiling 'remembrances' of Dr. Folk we collected them from his friends, colleagues, and former students, and making the resulting memorial available worldwide. Upon completion of that document I found myself still writing about 'Luigi,' unable to simply walk away from an overflowing fountain of memories. In many instances those memories spoke to the significance of my own life experiences as they were influenced by Robert L. Folk. And when Covid-19 hit, I used some of the resulting 'down-time' to compose a series of 75 short essays that summarized our continuing friendship over the years. So thus was produced, *Just Plain Folk: A Recollection That Includes Several Of The Experiences And Communications Shared With R.L. Folk Between 1961 And 2018, Presented In Both His Words And My Words*. As I write this note I am offering the completed manuscript for commercial publication. Hopefully, before too very long, it will be available at your local bookstore. (Note that I said 'bookstore.' I am neither a Luddite nor am I an atavistic troglodyte. However, I do relish my role as an 85-year-old who still ranks the printed word far above the ephemeral electron.)."

Robert S. Kier (Ph.D. '72) writes, "I am mostly retired; just working on a project or two for old clients. Still live in Austin, as do my children, their significant others, and grandchildren. Slip off to a cabin in Bandera when I get a chance. I have lunch with some 'old geologists' (and some not so old) a couple of times a month to talk about various subjects. Life is good."

David Kirchner (B.S. '74) David lives in Phoenix, Arizona with his retired geologist wife, Kathy. Their two sons are out on their own and taking good care of themselves. Kory: a geologist. Kody: a mechanical engineer. David is consulting and providing technical assistance to law firms in support of environmental-related cases. David serves voluntarily as an elected member of the Advisory Council of the UT Geology Foundation. He founded his private consulting firm, BASIN & RANGE HYDROGEOLOGISTS, INC. in 1987. If you ever find yourself in Phoenix, please give him a call or text: (602) 840-3333. David can be reached at kirchner@basin-and-range.com.

Peter Megaw (B.A. '76, M.A. '79) says, "Missing my friends from Austin days and watching in amazement as the 'little' silver vein we found in Zacatecas, Mexico (it has blossomed to over 6 meters wide since the attached picture was taken) is moving into production as what should become the world's largest primary silver producer. It's expected to produce over 20 million ounces per year, with enough gold and base metals to cover the cost of operations. That'll make a lot of solar panels! Almost as cool as

becoming a grandparent! Take Care Everyone...and Hook Em!"

M. Gary Thompson (B.S. '75, M.A. '77) says, "I have been retired from ExxonMobil for 11 years now. I am still waiting for the 'relaxation' to begin. Always busy with the home, farm, ranch, and now our first grandchild. He recently turned one year old."

Douglas Toepperwein (B.S. '74) shares, "I recently retired from Sage Energy after over 30 years and am now getting used to spending more time at home. My wife Mary Anne and I recently completed a remodeling project on our house in Fair Oaks, northwest of San Antonio where we have lived since 1982. I continue to periodically get involved with geological-geophysical consulting projects for Sage and other companies, but our current goal is to spend more time sailing, hiking, and traveling. I can be reached at dougt@satx.rr.com."

James Willrodt (B.S. '77) says, "All the family has been fine, no Covid issues since the pandemic. Our youngest, Alec, UT 2017, is getting married this December. Our daughter, Ericka, UT 2013, has left NYC to come back to Texas and continue her career at reasonable living prices. We have just returned from a fabulous France trip with a few days in Paris and a week at Castle Marouatte in the southwest of France. More fun with the Porsche group this fall in Arkansas. Retirement has been good. Hello to all the old classmates of 1977/1978."

1980's

Patricia Bobeck (M.A. '85, Ph.D. '17) shares, "This year has been a hopeful return to normal. In addition to keeping my finger on local hydrogeology by swimming daily at Barton Springs, I have tried to keep in contact with national and international organizations. I wrote a Rock Stars article on Henry Darcy for the GSA's monthly magazine, GSA Today. The History and Philosophy Division of GSA drafted me to serve as an officer and also asked me to present at the 2021 GSA meeting. I talked about Henry Darcy Locales in Dijon, France to highlight the sites where he made his major contributions. I was then invited to write up the presentation as a contribution to the Geological Society of London special publication entitled Geology's Significant Sites and their Contributions to Geoheritage. The Association of Earth Science Editors (AESE) also asked me to serve as an officer and this activity has put me in contact with a new group of interesting geoscience/language professionals. In addition, I continue to translate and edit geologic literature, much of it for the French geological survey. With pandemic travel restrictions fading, I was able to go to France for the summer. My project this year is research for an English geologic guide to Paris. Several years ago, Dennis Trombatore suggested this project to me, in fact telling me I was the only person who could fill this hole in the geologic literature. He held up The Seven Hills of Rome, a popular book written by another UT alum, Grant Heiken, as an example. I spent much of the summer reading historical sources in Paris' specialized libraries and photographing geologic sites such as artesian wells and abandoned gypsum quarries. I also continue to work on Abbé Paramelle's contributions to geology by locating sites where he found water and bringing attention to them. Paramelle found water in 10,000 places in France between 1832 and 1854, without formal geologic training or a geologic map. He used knowledge he gained by walking - for years - on the limestone plateaux of the Department of Lot and observing where the rainfall went. In so doing he observed the basics of karst before that word entered the geologic lexicon. At the end of his career, he wrote a book explaining his observations and method. The book was published in 1856 and translated into German and Spanish shortly thereafter, but not English until I did it as part of my dissertation. Paramelle was famous, and the book was a best-seller. It was reprinted six times and was used as a textbook until the 1970s. As part of my dissertation, I visited archives in the 40 departments where Paramelle worked, and I located some of the 10,000 sites. To follow up on that work, I am collaborating with the U. of Bourgogne to study two sites in Côte-d'Or, analyze them with geophysics, compare geophysics to what Paramelle saw, write them up in both English and French journals, and give public lectures in the Dijon area. Within the project I also plan to set up an interactive map of France to show Paramelle sites, and perhaps eventually identify and characterize a large number of them. My goals are to focus public attention on groundwater, give Paramelle his due for finding water for his thirsty parishioners and many others, and honor the long and illustrious history of French water research."

Steve Carlson (M.A. '84) shares, "I retired June 2021, after a full 37-year, 9-company career. I got to travel the world and work some very interesting basins. Working from home for over a year (COVID!!) before retirement allowed me to ease into having more free time. Now just relaxing, reading, smoking cigars on the back deck, riding my bike, shooting pool with my son, hanging with the grandsons, loving life. Ran/walked the Cap 10,000 this year, first time since '99." Steve can be reached at steve_carlson@windstream.net.

Richard Carroll (B.S. '80) writes, "Still employed and working the Delaware Basin."

David Chow (B.S. '85) writes, "I've started a second career after retiring from the oil industry. I am an Adjunct Physics Instructor at Houston Community

College. My daughter and I are going to New York City for vacation before fall semester starts."

Michael Clark (B.A. '89) shares, "For 2022...a new job and new adventures await!"

Fred Crawford (B.S. '83) says, "Maggie and I are enjoying retirement on our little farm in Western North Carolina. Our vegetable garden gives us great fresh produce, blueberries, and apples. Fresh eggs from the chickens and honey from the hives on a warm country biscuit are all I need these days. When I'm not on my tractor I'm hiking or whitewater kayaking. Life is good."

Tatiana Frierson (B.S. '85) writes, "I have the pleasure of serving as CEO of Inspirus (a Sodexo Company). We help companies retain their most important asset... their people. We have the Inspirus Connects platform that helps connect, celebrate and recognize your employees with one unified platform to deliver an enhanced employee experience. Really enjoying the role ... especially as our tag line says, 'Bring Joy to Work, One Experience at a Time!' Last month I also had the honor of being recognized in the *Dallas Business Journal* 2022 Women In Technology award. Hope all the 1980 geo dogs are doing well... ping me on LinkedIn and let's catch up!" Tatiana can be reached at tatiana.frierson@sodexo.com.

Susan Williams Haas (B.S. '86) shares, "I moved from the PAC NW to Austin in 2020 and two of my three adult children live in Austin now as well. I'm also a grandma with two grandsons that live in NYC. I work as a full-time musician. I teach piano, group piano, and harp, privately and at Armstrong Community Music School, sing and play the guitar as a silly Early Childhood Music Teacher, record and perform publicly on the harp for pop gigs and also work as a music booking agent for hiring bands, DJs, solo acts or entertainers anywhere in Texas. My passion is in the field of vibroacoustic therapy, using various harps as tools of healing and in the service of well-being and peace. Having almost completed my internship/residency hours for full certification as a Certified Clinical Musician, I look forward to years of playing in hospitals and hospices at the bedside of patients, including the tiniest ones of all in neonatal intensive care."

Susan Hovorka (M.A. '81, Ph.D. '90) says, "I am still (since 1998!) working on Carbon Capture and Storage (CCS) at BEG. The only change is that the topic has become popular!"

David Johns (M.A. '83) says, "I retired in 2020 after 31 years with the City of Austin, and Pam retired last year after teaching special ed at Austin ISD. We are both enjoying our free time. Enjoying grandkids, swimming at Barton Springs, volunteering, and seeing local live music as much as Covid allows, and some traveling shows: Stones, Who, and hopefully Bruce in February. Traveling some: the Yellowstone Old Faithful geyser basin in winter was amazing and small boat cruising the Alaskan inside passage in August with the Traveling Longhorns." David can be reached at johnsfamily1908@sbcglobal.net.

Richard (Rick) Kolb (M.A. '81) writes, "I retired July 15, 2022 after eight years in the oil patch and 32 years as an environmental and engineering geology consultant. For the past year I worked part-time and volunteered weekly by helping to build houses with Habitat for Humanity and driving a Red Cross truck to pick up and deliver blood. By the time you read this, I hope to be on a 3-month cross-country motorcycle trip (or have completed it) to clear my mind of work and think about what to do next. In May, my daughter, son, and I rode my motorcycles to Austin, where they live, and I rode back on the third bike, 3,800 miles over 16 days as a dry run for my upcoming 10,000-mile trip."

Vince Kluth (B.S. '86) says, "Enjoying life as a full-time church administrator for Mission Bible Church (mission-bible.net). My wife and I celebrated 26 years of marriage. Our oldest daughter graduated from Liberty University with a degree in computer science, summa cum laude, this past May, and she's getting married this fall. Our middle daughter is an accomplished pianist and is supporting the Authentic Scripture Foundation while completing her BS Business Administration degree. My son is a senior in high school, and still enjoys trapping raccoons; he just sold his first full-face Scottish Sporan to a bagpipe playing friend of mine. Look me up, would be good to reconnect with some folks."

Bruno Maldonado (B.S. '82) writes, "Hello Longhorns. While I spent many years working internationally, that all came to a halt in 2020 due to Covid. However, I continue to employ my geoscience skills consulting and prospecting in the Texas Gulf Coast. My current focus is defining and drilling prospects in the Austin Chalk utilizing seismic attributes to define microfractures. I have been involved in the drilling of a total of 5 wells, all

successful in finding grease. On a more personal note, Patricia and I recently attended the 2022 SIPES Convention in Deer Park, Utah. Included is a photo of a guided field trip we took in the mountains of Utah. Patricia keeps telling me I should retire already. My response to her is that I enjoy employing geoscience technology and do not see it as a job. I am sure I will retire someday, but for now I am still having fun. Hook 'Em."

David Martens (B.S. '84) David can be reached at domartens@comcast.net.

Mark W. Martin (B.S. '84) writes, "Retired and looking for new pastimes!"

Anne Smith Miller (B.A. '83) shares, "Highlights of my first year of retirement included trips to Olympic National Park and Acadia National Park. If you would like to get in touch, please send an email to aesmiller@sbcglobal.net."

Ginger Braswell Miller (B.S. '87) writes, "After 30 years of living out of state, we finally made it back to Texas. We have found a quiet place 6.7 miles from Blue Bell Creameries where we can see the stars at night. Enjoying the country, mostly empty nesters. Two are on their own, and two with one foot in and one foot out. Conveniently located between AUS and IAH in case the travel bug hits. We have a blessed life!"

David Charles Noe (M.A. '84) says, "Greetings everyone, especially the Dirty Dozen gang and friends from the early 80's at UT! In 2022, I have gone from leading tours in Colorado to working on drilling rigs in Alabama! I joined OMI Engineers of Huntsville AL as a staff geological engineer. We conduct geotechnical, geological, and environmental studies. I am learning a lot about residual red-clay soils and karst topography! Huntsville is a fascinating and beautiful place, and Jo Ann and I are enjoying our time here. We are also planning our wedding, which will occur in April 2023!" David can be reached at dcnoe@hotmail.com.

Luke Brian Primrose (B.S. '83) says, "Settling in nicely after retiring from Marathon. We spent over three wonderful years in Africa before coming home for good. It seems we are busier than ever with six grandkids, one just graduated from college and one going into kindergarten. Debbie and I spend as much time as possible at the fishing cabin and have managed a couple Flying Longhorns adventures which we highly recommend. In the little spare time left, I do a bit of consulting which helps keep me engaged. Planning an excursion next year that will take us through my GEO 660 areas, Taos and Silverton - I think I missed a few minerals for my collection my last time there!"

Paul Kevin Smith (B.S., '84) says, "I'm an Adjunct Professor of Exercise Science and Student Development at Austin Community College, and also a Personal Fitness Trainer and Yoga Instructor at Allen's Capital Fitness." Paul can be reached at paulkevinsmith@aol.com.

Stephen Speer (M.A. '83) shares, "Life is good in the Lowcountry of SC..... despite all of the nonsense going on around the world. I hope this newsletter finds all of the Dirty Dozen and others in our class doing well. Cheers!!!!"

Burgess Stengl (B.S '85) writes, "I have successfully completed one year back in the Municipal Solid Waste Permits Section of the TCEQ. I began my career in solid waste in the same Section 28 years ago, so I have gone full circle. I plan to finish out my career with the agency in a few years, so retirement is in sight! My wife of 42 years, Angela, and my three kids and four grandkids are doing fine, and the kids all live within a few hours of us so we see them often. We usually all meet to enjoy Lake Somerville. Greetings to all my fellow grads from the Class of '85!" Burgess can be reached at Burgess.Stengl@tceq.Texas.gov.

Ted Stout (B.S. '85) shares, "Retired from the National Park Service in October 2020. Look for my pictorial history of 'Craters of the Moon National Monument' coming out in November."

1990's

Kenneth (Keg) B. Alexander (M.A. '90) Keg has recently moved to Perth for a job as Geothermal Resources Lead for Fortescue Future industries. He is pursuing geothermal energy opportunities worldwide to provide renewable power for green hydrogen and green ammonia production.

Keg can be reached at Kenneth.alexander@fmgl.com.au.

John Genuise (M.A. '91) writes, "After a fulfilling EHS career in industry, I am now enjoying academia again as the Director of Environmental, Health, and Safety at the University of North Texas in Denton. My geology passion is fulfilled these days through pre-travel research and field excursions during trips, diving reefs, and also locally with the Dallas Paleontological Society. Our Marine Biologist Daughter (UT '18) and Meteorologist Son (OU '21) patiently listen to my on-trail geology explanations during our hikes, and my fishing friends feign interest in the geology around them. My best to all, and if you find yourself near Lake Lewisville, or just to connect, look me up on LinkedIn. I guarantee there is only one John Genuise on there."

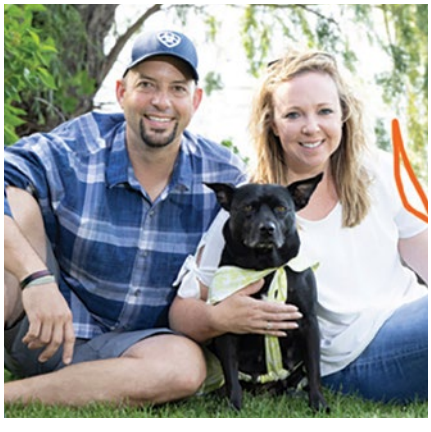
Mark Graebner (Ph.D. '91) can be reached at graebner@sbcglobal.net.

Daniel McConnell (B.S. '95) says, "Well, they say you can't go back.... not entirely true. I lived in Baltimore when the Brood X cicadas emerged two cycles ago (34 years!). I remember it as amazing. The waves of sound pulsing across the city in the evenings were so loud and eerie. Once we were vaccinated, we booked a nice AirBnB row house across from a big park on the backside of Johns Hopkins U. for the last part of May 2021 for a working vacation. I somehow convinced Beth that this was a good idea! She liked it. It was a good idea and was great to go back. Waves and waves of intense cycled sound would roll across the treetops. It was surreal. As for the family, our daughters are doing well. They have chosen Los Fusiles, 'future upstanding sons-in-law,' and show their beaus what successful strong women are each day. The young men don't know how lucky they are! As for work, I have come to the time in my career when I have been turned out by the company where I created quite a bit of value for many years. That's the nature of large companies. There will come a time when one will be cycled out, but I can't complain. I've had a good run managing a successful marine site characterization consulting group and later, traveling the world on the technical talk circuit for marine geochemical surveys for oil and gas exploration, gas hydrates, and marine minerals. So, like many proud, unemployed, geologists in Texas, I have set up a consulting company for technical contract or business development work. I consult in areas such as marine CO2 sequestration site surveys, high resolution marine geophysics data acquisition and interpretation for offshore windfarm developments and oil and gas, gas hydrate exploration, and marine mineral resource surveys. I continue to be active in the professional community representing the Society for Mining, Metallurgy, and Exploration on the Board of Directors of the Offshore Technology Conference, the Offshore Site Investigation and Geotechnics Committee of the Society for Underwater Technology, and with advisory roles for NSF and the US Department of Energy." Daniel can be reached at d.mcconnell@geomarineresources.com.

Warren Wiemann (B.S. '98) is working in the Semiconductor Manufacturing, Engineering and Design, Technical Manufacturing, and Materials Science fields. Warren can be reached at Jameswiemann@gmail.com.

2000's

Paul Kirby (B.A. '02) writes, "I've been with DBS&A for over 16 years. I am still enjoying working with public water systems and groundwater conservation districts. I recently went to Italy for the first time and had a short tour of Pompeii - AMAZING. Can't wait to go back, see more, and climb Vesuvius!"



Chris Lauer (B.S. '05) says, "After spending seven years as an environmental consultant, I am about to celebrate 10 years at Plains All American Pipeline in Houston, TX as an Environmental Remediation and Compliance Specialist in the HSE group. In addition to remediating oil impacts to shallow soils and groundwater from current and newly acquired assets, I also help with environmental liability reviews and risk analysis on acquisition, divestitures, and existing assets. I am helping to modify the expectations of what an acceptable environmental risk is at a large oil and gas company." Chris can be reached at cjlauer@paalp.com.

Tip Meckel (Ph.D. '03) Tip continues working at the Bureau of Economic Geology - Gulf Coast Carbon Center, where he has been for 16 years. His offshore geologic carbon storage work was featured recently in *WIRED Magazine*. He spent part of the summer acquiring marine seismic data at the Chicxulub impact crater in cooperation with UTIG scientists.

Alessandra Millican (B.A. '11) shares, "After 31 years in Texas, I moved to a cooler climate, and I'm proud to call Denver, Colorado my new home. I have stepped away from the oil and gas industry to be the Renewable Energy Lead for Esri and manage the industry globally, working with renewable energy companies of all shapes and sizes around the world. In my spare time, I actively enjoy summiting

14ers around the great state of Colorado, falconry, whale watching, and reading any novel I can get my hands on. This year I was honored to be chosen as the International Keynote Speaker for the prestigious OLGENAS International Geolympiad for the Universitas Gadjah Mada in Indonesia. I am considering an MBA program with a Renewables focus at OU, but will always be a proud longhorn at my core." Allesandra can be reached at amillican@esri.com.

Thuan Phan (B.S. '06) is residing in southern Norway.

Jonathan Skaggs (B.S. '01) Jonathan has been in the environmental consulting industry for 21 years and is currently a senior geologist with GSI Environmental Inc. in Austin. He enjoys helping clients solve complex environmental problems and is a professional geoscientist in both Texas and California. Jonathan can be reached at jmskaggs@gsienv.com

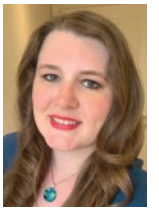
2010's

Margaret Marie Behnke (B.S. '12) Maggie can be reached at maggiebehnke31@gmail.com.

Benjamin Thomas Breeden III (M.S. '16) says, "I received my Ph.D. in Geology in August 2022 from the University of Utah, where I studied the reptile fossils and chemostratigraphy of Lower Jurassic shallow marine strata in Shimonoseki, Japan for my dissertation research. I was awarded a National Science Foundation Earth Sciences Postdoctoral Fellowship and will continue to study the early Mesozoic vertebrate fossil record in western Japan under the mentorship of Dr. Makoto Manabe at the National Museum of Nature and Science in Tsukuba, Japan."

Ted Cross (B.S. '11) shares, "I am happy to announce that I married the lovely Naomi Sosner in December 2021! The two of us have lived in Austin over the past couple of years, and it is great to be back in the old stomping grounds. I have been applying my geoscience and petroleum industry knowledge as Director of Product Management at Novi Labs, a data analytics and machine learning startup in town. I would love to hear from you! I can be reached at 210-385-9631 or tcross88@gmail.com."

Thomas "Hal" Hundley (M.S. '17) and Bridget Pettit Hundley (B.S. '15) share, "After experience working with Eagle Oil & Gas and Oasis Petroleum, Hal graduated with an MBA from the UT McCombs School of Business in May 2022. Bridget spent four years at ExxonMobil, first in the Exploration Company working on international unconventionals, and most recently at XTO as an operations geologist in the Midland Basin. Our son, Beau, was born 12/29/2021! We have relocated to Denver as of this summer, where Hal will start work as a Business Consultant with EY-Parthenon. Hal's email is halhundley@gmail.com. Bridget will be starting the job search for openings in January 2023. Please contact bridgetphundley@gmail.com if you know of any Denver-based or remote geoscientist openings. Hook 'em!"



Darby Lee (B.S. '19) writes, "I have been promoted to Controller and Geophysics Associate of Forensix Consulting."

Frank Morgan (B.S. '11) says, "Enjoying life and great food in Houston, TX. My wife and I, along with our dog, Little Larry, moved to Houston within the past year to continue my employment with Century Natural Resources, focusing on oil and gas exploration in the Powder River Basin, WY." Frank can be reached at frankmo0053@gmail.com.

Esben Pedersen (B.S. '18, M.S. '20) Esben can be reached at esben.s.pedersen@exxonmobil.com.

Andrew Stearns (B.S. '18) Andrew can be reached at Andrew.Stearns@TGS.com.

Kelsi Ustipak (M.S. '15) says, "I've been in Minneapolis, MN since 2017. After working in environmental consulting for three years, I started working for the state at the Minnesota Department of Transportation. There's more geology going into building infrastructure than one might have imagined! I oversee contaminated soil and groundwater investigations on future road projects and help manage contaminated materials on active construction projects. It's complicated and interesting and I learn something new every day. I have recently been recognized by the American Institute of Professional Geologists with the John Stewart Early Career Professional Award. I credit the amazing career advice and networking opportunities provided at the Jackson School with helping me gain the confidence to direct my career and help others along the way. My husband Peter and our dog, Bigby, are so fortunate to be comfortable, happy, and together with family and friends. I am grateful to a great many people at JSG. Thank you all!" Kelsi can be reached at Kustipak@gmail.com.

Jackie (Jaclyn) Watters (B.S. '15) says, "I participated in undergraduate research with Dr. Joe Levy at UTIG. After graduating, I worked in sales for one year in El Paso and then in the environmental engineering industry for two years in New Jersey as a geologist. There I was part of the effort to clean up superfund sites and other contaminated groundwater sites in New Jersey, New York, Pennsylvania, and West Virginia. This led to my interest in developing skills as a hydrologist. As of Fall 2020, I am now a graduate student at Rutgers University Department of Earth and Planetary science. Here I am contributing to projects studying the hydrology of ancient Mars, modern New Jersey, and the Brazilian Amazon."

2020's

Tomas Fuentes-Afflick (M.S. EER '22) Tomas is an Electric Vehicle Advisor at NRG Energy in Houston. He can be reached at tomasfa@utexas.edu.

Friends

Richard Buffler says, "We continue to enjoy living in Santa Fe and still traveling some. Come see us." Dick Buffler and Christine Boss, B.S. in Geology, 1959.

Tom Patty shares, "Field studies searching for sand, gravel and crushed stone has slowed over the past two years, giving me more time to visit grandchildren and my two great grandchildren. So traveling to Denver and Dallas has been often. Trips to California to visit younger sister with health issues have now halted with her passing in early August. Hopefully, the drought will end for the Central Texas area and yard watering can be reduced. Meanwhile, I'm still active with the WJE petrographic laboratory with new hires and building expansion has been a result in office growth after 41 years. I can still be reached by emails (tspgeorockl@gmail.com or tpatty@wje.com) or cell phone 512/438-9129."

Professor Emeritus, James Sprinkle writes, "2021 was my 8th year of retirement, and this was mostly a quiet stay-at-home year without much travel to conventions or trips for field work. The three joint papers that were in-press in the fall of 2020 were published this spring, including a surprise use of our new, little, fossil starfish on the cover of the Journal of Paleontology 2nd issue. Typically, I would come in to UT on Sunday afternoons to check e-mail and work on research projects or send back manuscripts I had reviewed. More recently, after getting Covid-19 shots early in 2021 and two boosters in November and April, 2022, I've been coming in on Wednesday and Sunday afternoons to get more work done. Last fall I wrote a Presentation of the 2020 Paleontological Society's Harrell Strimple Award (Best Amateur Paleontologist) to Linda McCall, who was a UT undergraduate and Geology Major for a few years in the mid-1970s, and a long-time member of our local fossil club. This award Presentation has now been published in a late 2021 Journal of Paleontology issue. My colleague Tom Guensburg and I (plus three other authors) had a medium-sized paper just published in the Russian Paleontological Journal on the diversity and distribution of Early Ordovician crinoids. Finally, another long-term joint project with Peter Jell in Australia was published in the Australian paleontological journal Alcheringa, based on two enigmatic Middle Cambrian echinoderms with fused basal cups and thousands of newly-etched, silicified plates from higher in the theca. We tried to reconstruct how these now more complete specimens would look as living organisms. Two new stalked echinoderms that were attached to the sea floor were also found in these new plates, and were described and illustrated. In the fall of 2021, Sprinkle and Jell presented a talk on this now-completed project at the 2021 GSA Annual Meeting in Portland, OR. In the spring of 2022 (my 9th year of retirement), Tom Guensburg and I published another medium-sized paper on the oldest simplified crinoids known from the Early Ordovician. In May, G.K. and I drove up to southern Oklahoma with members of our local fossil club, to revisit some of our best collecting localities, including the spot where the complete starfish was found in April, 2019 (no luck this time). I also have abstracts submitted with two other authors for a talk on Cretaceous crinoids from south Texas at an international meeting, and for a talk about how I taught a newly proposed paleobiology model at the 2022 GSA Annual Meeting in Denver, CO."

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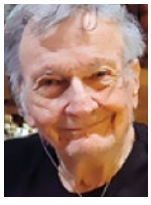
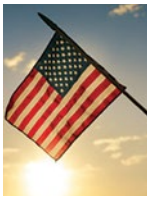
MEMORIALS

William Andrew "Bill" Akersten (B.S. '64, M.A. '67), 83, Pocatello, ID, passed away on May 11, 2022. Bill, the only child of Henry and Irja Helena Akersten, was born on December 11, 1938 in Highland Park, Michigan, and raised in Ashtabula, Ohio, where he acquired his love of the natural world. He graduated from Edgewood High School in Ashtabula, attended The University of Texas at Austin as a National Merit Scholar, obtaining his bachelor's and master's degrees in geology with an emphasis on vertebrate paleontology under the guidance of Ernie Lundelius. In 1972, he completed his doctorate on early fossil geomyids at the University of Michigan as a student of C.W. Hibbard. He began his professional career as Project Scientist at the Rancho La Brea Tar Pits in Los Angeles in 1972, where he supervised the scientific excavation and educational programs. He led a field trip for UCLA graduate students to East Azerbaijan Province, Iran, in the mid-70's. He was instrumental in the exhibit concepts and design of the Page Museum of La Brea Discoveries, which opened in 1977. He later worked as Curator of Pleistocene Mammals at the National History Museum of Los Angeles County where he focused on the Sabertooth cat, before moving to the Idaho Museum of Natural History in 1985. Here he curated the fossil collection, taught classes at Idaho State University, did summer fieldwork collecting fossil remains throughout Idaho, including the Mammoth dig at Tolo Lake near Grangeville, and mentored undergraduate and graduate students in biology, geology, archaeology, and paleontology until his retirement as Professor Emeritus in 2009. Bill was a life-long member of the Society of Vertebrate Paleontology and an active member of the Western Association of Vertebrate Paleontologists. In 2018, the Idaho Museum of Natural History honored Bill as a Natural History Hero, and in 2019 former student Dr. L. J. Krumenaker named a new species of Cimolodonta, a multituberculate mammal that he found in the Wayan Formation after Bill: Cimolodon akersteni. Questions about his ongoing research should be directed to Dr. Mary Thompson or Dr. L. J. Krumenaker, who are helping the family with his papers. Bill enjoyed reading, hunting, fishing, observing wildlife, and studying the natural world. His family was his pride and joy, and he bragged about their accomplishments at every opportunity. Bill is survived by his wife of 50 years, Carol Sue Vander Brook, daughter Holly Marjorie (Oscar Bambolo), four grandsons and two granddaughters.

Bennie Kuno Balke (M.A. '58) passed away on September 21, 2021. He was born in Sealy, Texas on July 3, 1932 to Lillian and Bennie Bert Balke. The eldest of three brothers, Bennie grew up among pumping stations and tank farms of South Texas. After graduating from Alice High School, Bennie went to Texas A&M University (Class of '53) where he studied geology. After a tour of duty in the Army, he then went to The University of Texas at Austin to pick up his master's degree in geology. For the next thirty-five years, Bennie worked in exploration for Shell Oil Company. His work took him to the four corners of the world—visiting over 30 countries and on three separate occasions living overseas. While at A&M, Bennie met the love of his life, Jannette Henry of Sherman, Texas. They married on June 16, 1954, and enjoyed nearly 64 years of marriage. Together they raised three children, seven grandchildren, and two great-grandchildren. They shared a love of art, travel, and many long-lasting friendships. After retiring from Shell, Bennie and Jan moved to Niwot, Colorado, and then to Bryan, Texas to be closer to their children. Bennie was preceded in death by his loving wife, Jannette, his parents, and his brothers, Richard and Franklin. He is survived by his son Nathan Balke (wife Charlotte), his son Kevin Balke (wife Nancy), his daughter Vanessa Cunningham (husband Jim); six grandchildren, and two great-grandchildren.



Steven Edwin Blesch (B.S. '59), 84, passed away on January 20, 2022. He was born in Evansville, Indiana, on June 3, 1937, and was preceded in death by his parents, Edwin G. and Helen L. Blesch, and daughter Adell Chambers. He is survived by his wife of 62 years, Marlene "Marti" Louise Blesch, his children and their spouses Jamie Larie and husband Kelly Kitchens; Steven Edwin Blesch, II; Leslie Christine and husband Justin Morris; ten grandchildren, and twenty-four great-grandchildren. Steve graduated from The University of Texas at Austin in 1959 with a bachelor's degree in geology and mathematics. He and Marti then moved to Hobbs, NM where he spent the majority of his oil and gas career working in the oil fields throughout Southeastern New Mexico and West Texas. In 1989 he and Marti opened The Prairie Rose Café where they served family-style food to the Hobbs community until closing the restaurant in 2014 and retiring. Steve was the kindest, most loving of fathers, a man of integrity in all his dealings. He was most notable for his faith in Jesus Christ, his readiness in prayer, and his generosity and willingness to help those in need.



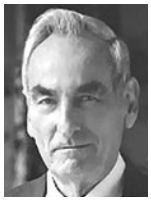
Colonel Roy Allyn Brown, U.S. Army Ret. (B.A. '56), 90, of Fredericksburg, Texas and Washington, North Carolina, died July 29, 2022. Mr. Brown was born in New Gulf, Texas, son of the late Roy Calvin Brown and the late Elizabeth Joy Robinson Brown. He married the former Marianne Louise Schur who survives. He attended Bowling High School in Bowling, Texas. He continued his education and received a B.S. in Geology from the University of Texas, a B.S. in Engineering at Rolla School of Mines, an MBA from Boston University, a master's degree in mathematics from Boston University, and was a Licensed Professional Engineer (PE) in Civil Engineering. Mr. Brown served his country in the U.S. Army, retired at the rank of Colonel, and worked with the Army Corps of Engineers. He was an instructor in math and business for Boston University, teaching soldiers oversees. Mr. Brown was a lifelong model airplane builder and flyer. He belonged to the American Model Airplane Association and the Model Engine Collectors Association in Europe and Texas. He published several articles for the AMA Model Aviation Magazine and Model Airplane News. Surviving along with his wife of 61 years are his sons: Roy A. Brown, Jr. (wife Sharon), Christopher P. Brown, and Richard "Mac" Brown (wife Karen); and his grandsons: Roy A Brown III, Kyle M. Brown, and Kevin G. Brown. Mr. Brown was predeceased, along with his parents, by a grandson: Steven Grant Brown.

Raymond Wilson Cozby, Jr. (Coz) (B.A. '58, B.S. '61) was born in Grand Saline, Texas, on October 18, 1934, and passed away on February 27, 2022. Coz grew up in Grand Saline, Texas. Coz graduated Salutatorian of Grand Saline High School and in 1953, he began nine glorious and memorable years at The University of Texas at Austin, graduating in 1961 with multiple undergraduate degrees. During his time at UT, he was a proud member of the Phi Gamma Delta fraternity where he made lifelong friends. For two years, Coz was a walk-on for the Texas Short Horns freshman football team and played intramurals as quarterback for the remainder of his college career. His SAE opponents never quite understood how the Fijis were able to have a 9-year undergrad as their quarterback. As an only child from a tiny town, UT and the Phi Gams were instrumental in shaping his future and remained incredibly important to him throughout his life. Upon graduation, Coz obtained D.D.S and M.S.D. degrees at Baylor College of Medicine and began a private pediatric dentistry practice in Tyler in 1967. He was elected and served as President of the Southwestern Society of Pedodontists and received numerous service awards. He practiced successfully for over half a century. Coz had many passions, most notably he loved hunting and fishing, athletics, the University of Texas, and Camp Longhorn. He particularly loved Manaus on the Amazon River in Brazil where he fished for Peacock bass over five decades – his last trip completed just weeks before his death with one of his sons. An early adopter of running in the 1970s, Coz ran four full marathons in Dallas, Houston, Big Sur, and the New York Marathon, which he completed alongside his daughter. Coz also competed in triathlons for over 30 years, finishing over one hundred triathlons and duathlons. Nationally ranked in his age group, he remarked, "When you're so old, you always get a trophy." Coz was an avid sports fan and his love for the Longhorns was unmatched, notably in his attendance of over sixty Red River Rivalries dating from 1952. Coz began attending Camp Longhorn on Inks Lake in 1941 as a six-year-old and stayed multiple terms that first summer. Coz remained a Camper, Campselor and Counselor for twenty-three years until 1964. Coz instilled in his children his love of UT, Camp Longhorn, athletics, and the outdoors. His last year of life was full of family special occasions including two grandchildren's weddings, watching two granddaughters in the Rose Festival in Tyler, and the Baptism and first birthday celebration of his first great-grandchild. Coz met Darlene Kirkley and was immediately smitten with her beauty and charm, and after 10 years of dating, they were married in 2004. Coz and Darlene enjoyed many happy years together. Coz was preceded in death by his mother, Margueritte Elizabeth Potts Cozby, and his father, Dr. Raymond Wilson Cozby, Sr. He is survived by his wife Darlene Cozby, and his three sons, Ray Cozby (wife Mary Ann), Chris Cozby, Drew Cozby (wife Beth), and his daughter, Gleith Cozby; step children, Denise Cumming (wife Frances Craig), John Kirkley (wife Kristin), and KK McKenzie (husband Ryan); many grandchildren and a great-granddaughter. Coz also leaves behind loyal companion, Georgia, his beloved white Labrador.

Henry Thompson "Tom" Donaldson (B.A. '58) passed peacefully on June 27, 2022. Tom was born to Chase Donaldson and Eleanor Thompson on July 11, 1931 in Bridgeport, Conn. The family moved to Washington D.C. and Tom attended Asheville School where he graduated high school valedictorian. He was captain of the track team with a specialty in the hundred-yard dash. Tom went to Brown University and continued with his success in track and field. He joined the U.S. Naval Reserve and spent two years in the Navy on the USS Snowden DE246, traveling to Cuba, Panama and Newfoundland. Tom went on to attend the University of Texas, receiving his Bachelor of Science in Petroleum Engineering. After graduation from UT, he worked for Champlin Oil in Oklahoma City. That's where he got his first dog, Orbit, raced his Porsche 911, and played a marginal left field for the Ogalala Clothiers. Tom returned to Washington, D.C. and started his career in finance. It was in Washington that he met his wife of 61

years, Sheila Reybold Donaldson. Married in 1960 after five dates, they continued their love for one another until his parting. Tom continued his career in finance, growing his business and client base over the years. Having had a summer home for 20 years on Southport Island, they followed their love of the state and moved permanently to Falmouth in 1984. In his last days, Tom was visited by many of his friends and acquaintances that shared similar stories of Tom's open, non-judgmental character and kindness. Tom is survived by wife Sheila; daughter, Suzanne (husband Steve), son, Douglas, (wife Julie); and three wonderful grandchildren.

Gail Leo Duffin (B.S. '56), 89, passed away on May 15, 2022 in Austin. He was born on September 25, 1932 in San Antonio to John Leo and Agatha Jurecez Duffin. Gail was married to the love of his life Vivian Zimmermann Duffin for 66 years. He leaves his three daughters, Monica Michon married to Mark, Nancy Enyeart married to Steve and Darlene James married to Bill; two sons, Ron Duffin married to Teresa and Stephen Duffin married to Reesa; nine grandchildren, and three great-grandchildren. He is preceded in death by his parents, John and Agatha Duffin, five brothers, and his three sisters. Gail attended Central High School and St. Mary's University in San Antonio. He continued his studies at The University of Texas at Austin where he graduated with a Bachelor of Science degree in Geology in 1956. Gail worked for the State of Texas at the Water Development Board as a hydrologist and he retired as a Colonel in the Army Reserves. He was a founding member of St. Thomas More Catholic Church, where he was a member of the Knights of Columbus and a small faith group that met weekly. Gail was a devoted husband, a great father and grandfather. He loved the Longhorns and attended many basketball and football games with his sons. Golf was another passion, and he played weekly with his foursome on Tuesdays. One of his greatest pleasures was having family gatherings at his favorite Mexican Restaurant, Camino Real.



Don Dunbar, Jr. (B.S. '51) was born in San Angelo on August 10th to Don and Francis Corley Dunbar. Don was their second of two children and remained a great friend with his big sister Sue Spradlin all of her life. The family moved to Corsicana, Texas in 1931, where Don graduated from Corsicana High School in 1945 and enrolled at The University of Texas at Austin. While at UT, Don played in the Longhorn Band, pledged Delta Tau Delta Fraternity, and completed his B.S. in Geology in 1951. Don moved to Midland, Texas in 1951 to work as an oil scout for Union Oil Company and was moved to Amarillo where he was the sole employee. Drafted in 1952, Don was stationed at the San Jacinto Ordinance Depot in Channelview, Texas. While defending the Houston Ship Channel, he attended law school in the evenings and spent weekends in Corsicana running the family oil business. After leaving the service, Don took a job with Lion Oil Company in Abilene before becoming an independent geologist and managing the family oil business. In 1957, Don met and married Judy Dipuccio, his wife of 32 years. Don was active in the West Texas Geological Society and was instrumental in establishing and serving as the first President of the Permian Basin Graduate Center - which provided continuing education opportunities to the geologists working in the area. He served as the Committee Chair for Troop 51 and raised three Eagle Scouts. He also volunteered for the City of Midland Swim Team. As their children were moving off to college, Don and Judy moved to Austin where they enjoyed living on Lake Austin. They returned to Midland in 1985 and remained there until Judy passed on January 12, 1989. Don returned to Corsicana where he continued to work in the oil business. He also began dating his former high school sweetheart Marian Wheelock. Don remained in Corsicana, enjoying being a Delt Dinosaur, studying Clan Dunbar genealogy, and attending St. John's Episcopal Church. In November 2017, Don moved to Tomball, Texas to be near family. Don is preceded by his parents, his sister Sue Spradlin, his wife Judy, nephew Scott Spradlin and wife Paula, and nephew Donald Spradlin. Don is survived by his children and their families: Don and Sandra Dunbar, Doug and Lynn Dunbar, David and Kathy Dunbar, Heather Dunbar; daughter Kathleen, and nine granddaughters and five grandsons.

Clarence "Stacey" Eastham, Jr. (B.S. '60) passed away on December 16, 2021 at the age of eighty-four. Born in Galveston, he loved fishing and spending time with family on the Gulf Coast. He lived in Houston until he retired to Colorado in 2006. Graduating from The University of Texas at Austin, he went on to serve in the United States Navy as Commander, and then as a long-time reservist. He was a stockbroker for many years at Dean Witter Reynolds and Sunbelt Securities. Stacey would be quick to say that his career and accomplishments paled in comparison to his family and English bulldogs. In his retirement, his favorite spots were fishing the rivers of northern Colorado and watching for whales off the Nantucket coast. His character was his most defining quality, being a friend to everyone, and always doing the right thing. Stacey is survived by his wife Susan, his son, Clay, and his four sisters, Betty Simpson, Sally Chapoton (Buck), Ruth Flournoy (Dan), and Mary King (Carl); daughters, Emily Heurman (Scott), Kristi Ison (Stuart) along with four grandchildren and many nieces and nephews.

Thomas (Tom) Jewell Freeman, Jr. (MA '62), 88, passed away September 17, 2021 at Lenoir Woods in Columbia, Missouri.

Tom was born in Miami, Florida on September 30, 1932 to Tommy and Ethel (Bell) Freeman. He was raised in Hot Springs, Arkansas, and was married to and is survived by his wife of 66 years, Peggy Holt Freeman. On the tail end of a hard-scrabble childhood in Hot Springs, Tom joined the United States Marine Corps when he was 17 and served in the Korean War. After the war the G.I. Bill sent him off to college at the University of Arkansas. He decided on pursuing degrees in geology from the University of Arkansas and the University of Texas. Tom was hired by the University of Missouri in 1962 on a short-term teaching assignment, and then after a brief stint back in Arkansas working for the Arkansas Geologic Survey he was offered a full-time, tenure-track position back at Mizzou in 1964. Tom's career was always a source of both welcomed challenges and enormous fulfillment in his life. He was Chairman of the Geology Department for many years, and he did an extensive amount of teaching and field work in Spain. Additionally, he was the resident geologist at the West Indies Marine Biology Lab on St. Croix, Virgin Islands; he worked on the Glomar Challenger Deep Sea Drilling Project Leg 44; he was the Director of the Mizzou geology field camp (Camp Branson) in Wyoming numerous summers; and he is the author of three student laboratory and field manuals that are still in publication. But no aspect of Tom's career was as important to him as the student. He truly loved his students and teaching. Outside his busy career Tom enjoyed playing racquetball and his many rides on his BMW motorcycle (one with Peggy on the back touring Europe). Other activities he enjoyed with his two boys were playing ice hockey at the ICE Chalet and playing banjos in Mountain View Arkansas. He delighted in spending time with his three grandsons. Above all else, Tom was a truly beloved husband, father, grandfather, friend, and role model. Tom is also survived by his son Tom (wife Dawn), and her daughter Hartley (Chad); son Rob (wife Nancy) and their three sons Thomas (Kelsey), Scott (Jess), and Jack; his sister Shirley Boyajian and brother Bob Freeman; nephew Steve Boyajian (Julie); and brother in law Jack Holt, Jr. (Jane) and his daughters Kelley and Candace (David).

Charles Hardy Gregory, II (B.S. '96, M.S. '04), 90, of Austin, Texas passed away on Monday, November 29, 2021.

Paul Ramon Gucwa (M.A. '71, Ph.D. '74), 74, graduated Franklin & Marshall College with a B.A. in Geology, and The University of Texas at Austin with an M.A. and Ph.D. in Geology. He worked as a geologist in the oil and gas industry for 47 years at Marathon Oil Company, British Petroleum, Maritech Resources, and Bahamas Petroleum Company; from 2013 to the time of his death, he worked at Roxanna Oil Company as their Executive Vice President. He also founded Texas 3 Star Energy Investment and served as its president for almost two decades. He was instrumental in helping organize and run StemForce Bahamas, a four-year summer geology-focused STEM program for Bahamian students jointly coordinated by the Jackson School of Geosciences and the Bahamas Ministry of Education from 2014 to 2018 to increase the number and diversity of high school graduates entering STEM fields and to help young minds reach their full academic and personal potential. He was a beloved father, grandfather and brother who cared profoundly about the people around him, and he will be deeply missed. He is survived by his three children, Jennifer Gucwa, Christina Gucwa and Michael Gucwa.

Weldon Woolf Hammond, Jr. (B.A. '60, M.A. '69, Ph.D. '84) passed away on July 2, 2022. Weldon was born May 17, 1937 in San Antonio. His father, the late W. W. "Doc" Hammond was a petroleum geologist who worked in the oil fields in South Texas, the Permian Basin, North Central Texas, Wyoming and the Mideast. His mother, Thelma Vandever Hammond, was a homemaker and a school teacher. The family originally moved to a small farm on the outskirts of San Antonio, and Weldon attended Alamo Heights Schools from the 1st to the 12th grade. Upon graduation and at the age of 17, he enlisted in the U.S. Navy Reserve as an Electronics Technician striker. The Navy soon rewarded him with a scholarship and an appointment as a Midshipman and presented him with a set of orders to the Naval ROTC Unit at The University of Texas at Austin. Weldon graduated from UT with a bachelor's degree in geology, was commissioned as an ensign and sent on active duty in the North Atlantic. He served on several ships as a Main Propulsion Assistant, Damage Control Assistant and as First Lieutenant. Weldon never lost his love for the sea, serving throughout the world in several active duty and reserve assignments. He was recalled to active duty in the Persian Gulf War. He retired from the Navy after 30 years of service with the rank of Captain. In 1963, he married the love of his life, Linda Lou Cowden. They met in high school and after a courtship that covered several continents and many years, they were married in Dallas. Weldon earned a master's degree in hydrogeology and a Ph.D. in Engineering Geology and Hydrogeology from The University of Texas at Austin. His civilian work began in Texas in Matagorda County on irrigation projects and ground-water availability studies and soon took him over most South and Central Texas, New Mexico and Alaska. In 1977, he accepted a faculty position at a newly established university on the outskirts of San Antonio ... UTSA. He served as a faculty member in the Division of Earth and Physical Sciences, Division Director of the combined programs in Geology, Chemistry, Physics and Environmental Sciences, the Department Chair of Geological Sciences, and as the Interim Dean of the combined Colleges of Sciences and Engineering. He was the founding director of the Center for Water Research and held the Amy and V.K McNutt Endowed Distinguished Professorship in Hydrogeology for 12 years. His most satisfying work was

locating and developing public water supply wells in impoverished areas in Honduras, Guatemala, Nicaragua and Mexico. In addition, he worked on large-scale agricultural irrigation projects and public water supply projects for villages in several Mexican states. His primary academic research areas were in isotope hydrogeology and shallow geophysical applications to the occurrence of groundwater. He was a member of numerous professional and scientific organizations. In addition, he served on the Joint Texas Senate and House Water Resources Advisory Committee and the Texas Water Development Board's statewide Ground Water Availability Modeling program. He volunteered and taught science and math enrichment programs to migrant farm workers' children in the Eagle Pass school district, traveling to Eagle Pass once a week for two years. He was a member of Hermann Sons and the German Texas Heritage Society, the Veterans of Foreign Wars, the Sons of Confederate Veterans, served as the camp adjutant for the Alamo Guards, and was a member of the Descendants of Mexican War Veterans. UTSA and the community established the Dr. Weldon W. Hammond Jr. Endowed Distinguished Professorship in Hydrogeology in his honor. Surviving him are his wife of 60 years, Linda, sons Weldon W. Hammond, III, Rory Cowden Hammond, Sr. (wife Deborah); five grandchildren and four great-grandchildren. He is also survived by his sister, Susan H. Martin (James).

Miles Oren Hayes (Ph.D. '65), 87, died on March. He was a retired Professor of Geology (1972-1984) and Department Chair (1973-1977) University of South Carolina, and founder, president, and chairman of Research Planning, Inc. (1977-2020) based in Columbia, SC. He is survived by his devoted wife of 46 years, Jacqui Michel, daughters Joy E. Hayes and Mya S. Hayes, grandchildren J.J. and Alma Gonzalez-Hayes, and James Glenn Worley, who was like a brother to him. Miles was born in Oakley, North Carolina, the fourth child of Norman E. and Ora B. Hayes. He loved baseball and was a star player and student at Oakley High School and Berea College, the school where tuition is free and all the students work 15 hours a week. Because he changed majors after his sophomore year (from Agriculture to Geology), it took him five years to get his degree. In his fifth year (1956), his work assignment was to be the assistant baseball coach under head coach, Monarchy White. At a pay rate of 15 cents an hour, he claimed to have set the record as the lowest-paid college baseball coach in history. Miles earn a master's degree in geology from Washington University in St. Louis and a Ph.D. in Geology and Marine Science from The University of Texas at Austin, studying under the great professor, Robert L. Folk. His life work was set when Hurricane Carla (1961) tore up the Texas coast and destroyed his beach and offshore monitoring stations. Taking advantage of such an event, Miles ultimately produced the seminal study, Hurricanes as Geologic Agents, a widely cited treatise. Navy grants to study coastlines of the world at the University of Massachusetts (1964-1972) and a growing coterie of graduate students solidified his reputation as a rising star in the earth sciences. The University of South Carolina recruited Miles to the Department of Geological Sciences and also got an instant research group of graduate students and funded post-doctoral graduate instructors, the Coastal Research Division. In barely 20 years, Miles supervised 72 master's and Ph.D. graduates who worked on projects around the world. Miles Hayes is often referred to as the Father of Coastal Geomorphology, the study of landforms, because of his intuitive understanding of the origins of today's coast. He published widely on the role of tides and waves in barrier island formation, clearly and cleverly explaining why islands in South Carolina and other coasts are shaped like a chicken drumstick, unlike the straight beaches of Texas or Long Island which look more like skinny hot dogs. His aerial photos were breathtaking and his artistic sketches of beaches were legendary. Miles was able to attract the best and brightest students because of his unique blend of scientific integrity, global experience, and high standards. Miles worked in 40 countries and on every continent, including Antarctica, where he was honored with the naming of Hayes Head, a prominent coastal headland. He designed and taught a course for petroleum geologists and geophysicists on Modern Coastal Environments, with over 3,000 students participating in class lectures and field trips along the amazing South Carolina coast from 1976-2006. In 1997, he received one of geology's highest honors, the Francis B. Shepard Award for sustained excellence in marine geology. In 2016, he received the Distinguished Alumnus Award from Berea College. Miles wrote many scientific articles, but he was most proud of two memoirs: Black Tides (1999), about being an oil spill scientist working on many large spills; and Coastal Heroes (2011), a tribute to the work that he and his students and associates conducted. Miles and Jacqui published beautifully illustrated books on the coastal geology and ecology of five areas: South Carolina, Central California, Georgia, Southern Alaska, and Oregon and Washington, drawing on their passions for fly fishing and bird watching around the world. In the second half of his career, Miles' private company, RPI, focused on applied research related to the search for oil, oil spill science, spatial analysis, and coastal restoration. Miles' greatest legacy is likely to be the hundreds of earth scientists he inspired through his teaching and infectious love of nature.

Captain Larry Hebert, USN Retired (B.A. '58) passed on March 8, 2022. Larry was the child of Ruth and Barney Patton. He grew up on the outskirts of Houston. From a young age, Larry dreamt of flying and joining the US Navy. That dream was partially realized during his college years at The University of Texas at Austin upon receiving an ROTC scholarship. After graduation in 1958 with a B.S. in Geology, Larry received his commission as an ensign in the regular Navy. In 1961,

he was accepted as an aviation student and his career was launched. Some of his first assignments were flying reconnaissance missions in Vietnam. In that same year Larry met and then married his wife of over 60 years, Betty Colleen. Together they raised three children, Michelle Bearmar (Douglas), Lawrence (Maureen Driscoll) and Michael. He was very proud of his six grandchildren. Larry retired from his naval career after 28 proud years of service, a true patriot who loved his country. Larry loved camping and fishing, and these pastimes lasted throughout his life. He loved cabinetry and was a renaissance man when it came to all things related to gadgets and being a handyman. He was an exquisite and detailed model builder. An eagle scout himself, Larry was scoutmaster of his sons' troop. He spent many years in the church choir. He loved attending theater and concerts with his beloved wife. A consummate scholar of history, especially ancient history, it is this field he chose to pursue a master's degree after retirement. An avid reader of everything, his favorites being current events, history, science fiction and science fantasy. He and Betty enjoyed partaking in Petaluma's social clubs, especially cooking groups and current event discussion groups. Larry was a man of many talents but nothing exceeded his love for his wife, Betty Colleen.

Nancy Kathleen Howard (B.A. '90), 82, of Austin, Texas passed away on Sunday, April 24, 2022.

Danny Katzman (B.S. '85) passed away on August 14, 2022. He was born in Odessa, Texas on December 1, 1960 to Israeli emigrants Arie and Ziporah Katzman and grew up playing with bullfrogs, racing slot cars, and listening to Bob Dylan. He attended Permian High School in Odessa, then attended the University of Texas in Austin. On a geology field trip to Taos, he fell in love with New Mexico skies and rocks and decided to move after receiving his bachelor's degree in Geology in 1985. In Taos, he taught himself to fly fish in remote streams, learned to taste the earth, and to appreciate the culture and people. He continued his education at the University of New Mexico where he earned his Master's degree with honors in Geology and Earth Sciences. Danny's passion for the environment spanned a thirty-year career, leading him from the New Mexico Environment Department, to Los Alamos National Laboratory, to Sealaska Technical Services, part of N3B where he recently retired from his role as Chief Scientist and Program Manager for Groundwater Remediation for N3B's Water Program. Danny's long standing knowledge of the environment and his unique ability to transform complex topics into understandable information made him the perfect interface to support staff and outreach programs. In September 2013, Danny married Darcy Pedersen, and they, along with Darcy's son Ean, shared a loving and adventurous life together, often revolving around food. Danny's zest for life was apparent in everything he did, from providing site tours at work to pressing autumn apples for cider at home. His garden was always bountiful with uncommon and surprising vegetables. He had an insatiable need for good music. He liked learning new things and doing things that would connect him to the earth in some way. Recently, he began carving spoons after learning about it from his nephew Matt. He'd also begun volunteering for a local organic farm, wanting to contribute to causes that helped the local community. He had a large, unmistakable presence that could not be ignored, and he will be missed dearly.

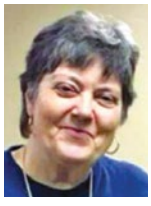
Robert "Bob" Alan Keahey (B.A. '57), 91, passed away on June 28, 2022. Bob loved his family, his friends and his faith. He was well known for his kindness, compassion, quick wit, and great sense of humor. Bob was born in San Antonio on Feb. 8, 1931, moments after his twin brother, Dick, and to the joy of parents Thomas Jefferson Keahey and Grady Hall Keahey and sister Pat. Bob spent his early years living on a farm in Natalia. Bob's father died when he was only 8, so his mother moved the family to San Angelo to be near relatives. Bob grew up in San Angelo where everyone in town knew and loved "the twins." He graduated from San Angelo High School where he met and fell in love with Dorothy Gay Blanks. Bob and Gay were married for 54 years, but their partnership in marriage had to wait when Bob and Dick were drafted into the same unit of the U.S. Army during the Korean War. After his service, Bob graduated from The University of Texas with a degree in geology. He enjoyed working in the oil and gas industry for many years. He was active in the Texas Geological community, receiving honorary membership into the South Texas Geological Society in 1998 for his contributions to the field. In 1954, Bob married Gay. Together, they raised five children and devoted time to their community and church. Bob served as an elder at both Concordia Lutheran and Mt. Calvary Lutheran churches. He was a beloved Sunday School teacher, well known to many classes of ninth-grade students. Bob is preceded in death by his beloved wife, Gay, his twin brother Richard, his sister Patricia, and his son, David. He is survived by son, Robert (Karla), and daughters Susan (Bob), Holly (Ben) and Hilary; daughter-in-law, Melissa Keahey, nine grandchildren and one great-grandchild. The grandchildren lovingly called him "Buddy."

Don M. Kerr, Jr. (B.S. '60) was born October 11, 1937 to Clarice Green Kerr and Don Kerr, Sr. in Kilgore, Texas, and died January 5, 2022. From an early age, Don enjoyed golf. While at Kilgore High School, he was captain of the golf team and an outstanding golfer, winning many awards, two club championships, and a golf scholarship to the University of Texas to play for Harvey Penick. After graduating with honors from UT, Don pursued a career in construction. He was Vice President and Chief Contracting Officer for Spaw-Glass, Inc. before forming his own commercial

construction company, Kerr Construction Services. Later, he was an expert witness in construction litigation throughout the state. Always interested in photography, he also became an accomplished landscape photographer. Don was a past president of the University Area Rotary Club, and a member of the Houston Photochrome Club, the Texas Toastmasters' Club, and the geology honor society Sigma Gamma Epsilon. He was a member of Memorial Drive Presbyterian Church. Don was preceded in death by his son, Dalton Kerr, and his parents. He is survived by his wife of 55 years Marilyn Perkinson Kerr; his daughter and son-in-law, Colby and Jeremy Doyle; along with "the light of his eyes," his three granddaughters.

Dale P. Kohler, Jr. (B.A. '80), 67, of Austin, TX, passed away on October 24, 2021. Dale was born in Indianapolis, IN on October 22, 1954 to Dale and Jean Kohler. He was born two months early and weighed less than three pounds at birth. He often told the story of his father reading scientific journals and constantly monitoring his oxygen levels while he was in the hospital after birth and credits him for saving his eyesight. The family moved to San Antonio in 1960 (Dale would say he got to Texas as fast as he could) where Dale graduated from Jefferson High School in 1973. He went on to graduate from the University of Texas with a degree in geology. Dale began dating his wife Jan in 1974 when they worked together at The University Drug Store. Jan would always make sure to send Dale, a delivery boy, to the safest neighborhoods to deliver medicines to the customers. They were happily married for over 42 years, except for one incident involving Dale growing mutton chops for the Alamo movie. Dale worked for TCEQ/TNRCC/Water Commission for over 35 years before retiring in 2018. He was an accomplished Toastmaster as well as an extra in several movies and TV shows including Bernie, The Alamo, and Friday Night Lights. He loved photography, and if you asked him to send you one of the photos he took, he would insist on editing it to perfection first. You could often find him sitting out in his backyard hand feeding peanuts to the squirrels that he named Laverne and Squirrely. He was an aficionado of all things Texas history, which started with The Alamo where he worked in college. He would attend the Dawn at the Alamo on March 6th every year with his close group of fellow Alamo friends. Left in the wake of his big life are his wife Jan, his two children Adam and Rebekah, (spouses Samantha and John), his brother Robert, and nieces and nephews. He was an amazing Grandpa (aka Grampa aka Papa) to his four granddaughters. He loved to spend time with his family and was always coming up with fun things to do. He set up themed movie nights, created backyard haunted houses, curated an extensive fairy garden collection, built a backyard restaurant, and made regular field trips to the Bob Bullock Museum. He tailgated often for UT home games, attended many Spurs games, and traveled to places near and far like Big Bend with Adam, Nashville with Rebekah, and Niagara Falls and Alaska with Jan. Dale served as a youth group leader and in almost every role on the church council at Church of the Savior where he was a member for over 35 years.

Kenneth Glenn Martin (M.A. '61) died in Vincennes, IN on November 6th, 2021, just shy of his 85th birthday. With him at the time of death was his wife of 30 years, Karen Jo Mangiaforte Martin. Ken was born on November 11, 1936 in Pontiac, IL, the son of Morris Glenn "Abe" and Elise French Martin. He grew up in Carbondale, IL and graduated from Carbondale Community High School in 1954, where he was student council president, a member of the National Honor Society, co-captain of the football and baseball teams, and awarded ten letters in athletics. In 2018, Ken was inducted into the CHCC Athletics Hall of Fame. Ken earned a B.S. in Geology in 1959 from Louisiana State University. While at LSU, he was a member of the Sigma Alpha Epsilon fraternity, played starting guard on the varsity basketball team, and lettered in basketball. In 1961, Ken earned his M.A. in Geology from the University of Texas. Ken later served as a guest lecturer in petroleum geology at LSU, UT, and SMU. Ken began his petroleum geology career with Amoco in San Angelo and then moved to New Orleans in 1963, where he spent his entire oil and gas career. In 1968, Ken formed an independent oil company, Kenmore, with two partners, which eventually became one of the fifty most successful domestic oil and gas companies in 1972. In 1973, Ken founded Martin Exploration Company and was honored as one of the top entrepreneurs and business leaders of New Orleans. He was also recognized for exceptional service to the American petroleum industry. In 1982, Ken was inducted into the American Academy of Achievement at the Banquet of the Golden Plate. He was a former member of Metairie Country Club and the Krewe of Bacchus and supported the New Orleans Museum of Art, the Boy Scouts of America, and St. Martin's Episcopal School where he named the Martin Family Library. In 1992, Ken and Karen moved to Horseshoe Bay, TX and Ken was a real estate investor and developer. More recently, they lived in Georgetown, TX and were active in Sun City before relocating to Vincennes, IN. Ken was preceded in death by his parents and his brother, Russell W. Martin. He is survived by his wife, Karen; children, Elisabeth M. Armstrong, Jeffrey G. Martin, and Taylor R. Martin; eight grandchildren and many other family members.



Susan Deutsch Morris (B.S. '70) passed away on Wednesday, Sept. 22, 2021.

Wade C. Ridley (B.S. '53, M.A. '55) passed away on September 11, 2021. He was born October 15, 1929 in Houston to Ronald and Eloise Ridley. Wade graduated from Lamar High School in Houston where he was President of the National Honor Society, Treasurer of his senior class and basketball letterman. He attended The University of Texas at Austin where he was a member of Sigma Gamma Epsilon, the National Earth Science Fraternity and Kappa Sigma Fraternity. His college career was interrupted when he joined the Marine Corps and attended boot camp at the Marine Corps Depot in San Diego and then Officer Training School in Quantico. As a Second Lieutenant he was stationed at Camp Lejeune, North Carolina as an Artillery Officer. Prior to joining the Marine Corps, he had a blind date with Mary Kincey Gunter who was a senior at Austin High School. Wade and Mary courted by airmail, and on October 6, 1951, they were married in the National Cathedral in Washington, DC. Wade finished his tour of duty with the Marine Corps and moved back to Austin with Mary to finish his degree. He received his B.S. and M.A. in Geology and was hired by Humble Oil and Refining Company. Wade and Mary moved to Tyler in 1954. In 1960, he left Humble and joined up with his best buddy Allen Locklin. They formed Ridley and Locklin Operating Company and had a very successful career together. In 1980, Wade formed Ridley Oil Corporation from which he retired in 2018. Wade was very active in community, political, and industry affairs. He was President of the Chamber of Commerce, Founding Member of the All Saints Episcopal School Board, University of Texas at Tyler Development Board, East Texas Hospital Foundation, and Medical Center Hospital Board Member and Chairman. He was also on the Board of Directors at First City National Bank at Tyler and served the Republican Party in numerous positions at the local and state level. He was preceded in death by his parents, Ronald and Eloise, and brothers LT Thomas P. Ridley and Robert Kay Ridley. He was also preceded by his wife Mary Kincey Gunter Ridley and wife JoBeth Trantham Ridley. He is survived by his son Thomas P. Ridley II and wife Celia and daughter Courtney Page Ridley and spouse, Lisa. He has seven grandchildren and seven great-grandchildren.

George Sealy, Jr. (M.A. '53), 95, died peacefully on July 23, 2022. He was born in Galveston on May 4, 1927, the son of George and Eugenia Taylor Sealy. George began school in Galveston but left at the age of eight to live on a ranch outside of Uvalde, Texas with his grandparents. During his four years at the ranch, he attended a one-room schoolhouse where he excelled academically. George later moved with his grandparents to San Antonio; he attended San Antonio Academy and Texas Military Institute where he was National Honor Society President and Cadet Battalion Commander. In 1944, George entered Princeton University. George's studies were interrupted by WWII. Following OCS, he was sent to the Pacific where, as a 2nd Lt. at the age of 19 and prepared by his 6 years in military school, he commanded a company of the prestigious Philippine Scouts. Returning to Princeton University, George initiated the formation of Princeton's Rifle Team. He lettered in that endeavor; the team went undefeated. After graduating from Princeton with honors, George attended the University of Texas where he earned his master's degree in geology, and where he began dating Ann McSween. George moved to Houston and began his career with Humble Oil and Refining Company (Exxon Mobil). In 1952, he married Ann, and they raised two sons and twin daughters. The family had many excursions in their RV, spent leisure time at their bay house in Jamaica Beach on Galveston Island and on their farm near Columbus. Ann and George also made numerous trips to England, Scotland and Europe before her death in 1993. At Humble (Exxon) George's career began in the Exploration Department; however, he spent most of his years in the Production Department. He became Operations and Planning Coordinator for the Production Geological Group in Headquarters, Exxon USA. He loved his work, but in 1985, after 33 years of service, he retired early to travel more with Ann. His last RV was a luxury bus which he took to UT football games, dove hunting trips, and visits to the Texas border. After Ann's death, George sold his bus but continued his trips with hunting buddies, his tennis group, supper clubs and other friends. In 1995, George and Dorothy Falkenberg began their close relationship. They had worked together at Exxon since 1953. George and Ann were members of St. Martin's Episcopal Church where George served on the Vestry, was president of St. Martin's Foundation, was on the Board of St. Martin's Endowment, served as Senior Warden, and was presented the St. Martin's Star Award. He also was a member of the Executive Association of Houston (and past President), The Petroleum Club and The Houston Country Club. He served as the Executive Vice President of The Sealy and Smith Foundation in Galveston. For over 30 years he served as Managing Partner of Sealy Land Company and President of the George and Magnolia Sealy Foundation. George was pre-deceased by both parents and by his wife of 41 years. He was also pre-deceased by his sister Eugenia (Jeannie) Sealy Cross and her husband Oliver; by his brother Lane Taylor Sealy and his wife Marty; and by brother-in-law and sister-in-law Paul and Linda. He is survived by his son George Sealy IV and wife Lita; daughter Amanda Sealy Frenzel and husband Todd; daughter Elizabeth Ann Sealy ; son William Robert Sealy and wife Susan. He is survived by six grandchildren, two great-grandchildren and numerous nieces, nephews and cousins. George is also survived by Dorothy Falkenberg of Houston, who has been his dearest friend and devoted companion since 1995.

Russell G. Slayback (B.S. '59), 85, of Greens Farms, died on June 20. Russ was born on September 19, 1936, in New York to Russell B. Slayback and Doris (Dolly) E. Gardner. He earned a B.S. in Geology from Rensselaer Polytechnic Institute in 1959. By 1960, Russ began work as a hydrogeologist for Leggette, Brashears & Graham Inc. (LBG), where he later became Vice President and Director before ultimately ascending to President and Chairman of the Board. Russ also worked to expand the scope of geoscience through his volunteerism. He held twenty different positions at the American Institute of Professional Geologists (AIPG), including as the national president. In addition, Russ served in several positions at the American Geosciences Institute (AGI), including as the foundation's chairman and the president of the Institute. While in his role as Chairman at AGI, Russ championed the creation of the endowed AGI Fisher Congressional Fellowship. Russ also sat on The University of Texas at Austin Jackson School Geology Foundation Advisory Council, rising to chairman. Russ was honored with many awards throughout his career, with some of the most notable being the AIPG Martin Van Covering Award, the AIPG Ben H. Parker Medal, the William B. Heroy, Jr. Award for Distinguished Service to AGI, the AGI Medal in Memory of Ian Campbell, and the Russell G. Slayback Award of the AIPG Northeast section. Russ joins his beloved Judy, the light of his life, who he has missed dearly. He is survived by his daughters, Leigh Reed and Lynn Sikora; and his four adored grandchildren. He was also blessed with a cherished son-in-law, Rob Reed. Russ is also survived by his dear sister, Ava Burkard.

John Frank Snell (B.S. '66), 87, passed away on Oct. 16, 2021. He was born on Sept. 7, 1934 in San Angelo to Casbeer Snell and Margaret Josephine Alexander Snell. He lived in Rankin, Texas until he was seven years old and moved to Lampasas with his family. He graduated from Lampasas High School in 1952. While in high school he was on the football, basketball and track teams. John grew up hunting and fishing with friends and often talked about catching catfish, hunting deer and raccoons. John held a number of interesting jobs in his youth; notably, he worked as a ridge runner fighting fires in Idaho and as an oil field surveyor in Tyler where he knew Elvis Presley and allegedly went on a double date with him. He enlisted in the Navy in 1956, completing the flight-training program in Pensacola, FL. After his two years in the Navy, he owned and worked a hunting ranch in Del Norte, CO. He sold the ranch and spent a summer on a yacht sailing from Florida to Corpus Christi. John graduated from The University of Texas at Austin in 1966 with a bachelor's degree in geology. He married Leah Ann Weaver on September 17, 1966 and they lived in Corpus Christi while John worked for Coastal States. John and Leah then moved to Tucson, AZ, where John worked as a geologist for Pima Copper Mine. They later moved to California where John worked for Kaiser Cement and was credited with expanding the Kaiser Cement plant and Limestone Mine in Cupertino, CA. He also developed the first bituminous coal mine in Texas. In 1977, John and Leah moved to Lampasas where John worked as an independent contractor, invested in oil and gas wells, prospected for gold in Arizona, and raised and raced quarter horses. While his children were young, John became involved with youth soccer and helped organize the youth soccer association. John rarely—if ever—missed a sporting event when his children were involved. John was an avid supporter of the Hancock Springs swimming pool and worked tirelessly to ensure the pool remained open when it was at risk of closure. John was known to swim laps and visit with the other swimmers well into his 80s. He was proud to assist numerous high school students with their rock collections for science class. John also developed an interest in arrowheads and Native American artifacts and became actively involved in finding and identifying such relics on his property. This eventually led to a number of volunteers led by the University of Texas Gault School of Archaeological Research conducting excavations on his property in an attempt to form a timeline for the presence of the earliest inhabitants of Lampasas County. John was married to Leah for 55 years and family was very important to him. John was preceded in death by his parents, sister Daphne Snell Kofman, and brother Casbeer Snell, Jr. John is survived by his wife; son, Lewis and wife Michelle; daughter Margaret (Meg) Bloch and husband Mike; brothers Maynard Duwain Snell and MA Snell, and three grandchildren.

Robert Earl Stowers (B.S. '61), 93, of Eagle Lake, Texas passed away on July 7, 2022. He was born in Houston on December 7, 1928 to James Earl Stowers Jr. and Edythe Lorene Scott. He was married to Evelyn Martha Mokry for 66 years at the time of his passing. Robert had a career as a geologist/geophysicist in international oil and gas exploration. He had worked for Texaco, CALTEX, Amoseas, Houston Oil and Minerals, Tenneco Oil, Plains Resources, and San Jorge International. He later started his own consulting company, Apex International. His passions included oil exploration, world travel, genealogy, hunting and fishing, ranching, cooking, Texas Longhorn sports, dogs, and most of all, his family. He was a member of Sea Scouts, The United States Air Force, University of Texas Alumni Association, American Association of Petroleum Geologists, Society of Exploration Geophysicists, Mid-Coast Santa Gertrudis Association, past president and member of Eagle Lake Noon Lions Club, founding member of Eagle Lake Preservation Alliance Inc, former board member of Stowers family of America, and for the City of Eagle Lake, he served on the following boards: Airport Advisory Board, Housing Committee, Park

Committee, and Planning and Zoning Committee. Robert was preceded in death by his father James, his mother Edythe, sister Jeanne Galvan, brother-in-law Ralph Galvan, Jr, and nephew Ralph Galvan III. He is survived by his wife Evelyn Stowers, son Robert E. Stowers, II and wife Lisa, daughter Eve Lucas and husband Robert, son Scott Stowers and wife Janith, and five grandchildren. Robert is also survived by niece Vicki Galvan Hoeltzel (Mike).

Billy Dean Watson (B.S. '58) passed away at 91 on Sunday, November 21, 2021. Bill was a loyal husband, father, grandfather, and great grandfather whose life touched all who knew him. His sense of humor could light up any room and made family gatherings so memorable. Bill was born in 1930 in Mexia, Texas, where he grew up on Main Street with his parents and younger brother. During grade school he developed a love for playing the trumpet that continued throughout his life. After graduating high school in 1948, Bill entered the U.S. Navy where he played trumpet in the Navy School of Music in Washington D.C., and the Navy Fleet Band, both in San Diego and Honolulu. He worked his way through college, attending North Texas State while playing in the Lab Band, and then in the Longhorn Band at the University of Texas, where he graduated in 1958 with a B.A. in Geology. Bill then began a 25-year career in the petroleum industry and served as regional sales manager of the Gulf Coast for Sperry Sun Drilling Services. Bill met and married his wife Jean in 1975 and celebrated their 46th wedding anniversary this year. They enjoyed golfing, bowling and music, and he played his trumpet in several community bands and orchestras, most recently in the Sugar Land Baptist Church Orchestra where they attend church. Others included: Missouri City Pops Band, Singing Men of Texas Orchestra, Longhorn Alumni Band, Missouri City Baptist Church Orchestra, Sugar Creek Baptist Church Orchestra and The Silvertones. Bill is preceded in death by his parents Jim and Jewelle Watson; Jean's parents David and Irene Ligon; brother Jim Watson; daughter Terri Melancon; great-grandson Hunter Watson; and niece Kimberly Watson. He is survived by his wife Jean; his sons and daughters in-law Jimmy Watson; Mark and Dawn Watson; Randy and Linda Watson; and David and Tina Watson; 13 grandchildren with spouses and several great-grandchildren and other family members.

Donald Winston, II (M.A. '57, Ph.D. '63) lived a long and incredible life. He died on March 2 just shy of his 91st birthday. Don was born in Washington, D.C. on April 4, 1931. Shortly thereafter, his parents, Frederick S. Winston and Elizabeth M. Winston returned to their hometown of Minneapolis, Minnesota, where Don spent his youth. He attended The Blake School and spent his summers on Lake Minnetonka. Don graduated from Williams College in 1953 with a degree in geology. After earning his Ph.D. in Geology from The University of Texas at Austin, Don accepted a junior faculty position at the University of Montana in 1961. In the summer of 1960, Don attended the International Geological Congress in Copenhagen, Denmark. In the days after the congress, he met a wonderful woman who captured his heart. Don's years of persistent attention paid off when Bente B. Nielsen agreed to visit him in Montana in 1966. They were married a year later and started a family. The family originally lived in the Jocko Canyon, east of Arlee, and later split their time between the Jocko and Missoula. Don became a passable chess player, and Bente learned to steer canoes and schooners. Don was an early and steadfast supporter of Bente's life project, Sussex School. Don was a loving and supportive father. In the Jocko, early days with the family were filled with hiking, fishing, cross country skiing, gardening, bedtime reading, watching the chickadees feed, and home-cooked breakfasts (eggs and pancakes) every morning. He encouraged each of his children (and then grandchildren) to set their own course and do what they loved. For Don, that was geology. Don's far-reaching research contributions and dedication to geology made him one of Montana's finest and most productive scientists. With his students and colleagues, he developed a clear understanding of the previously enigmatic Belt Supergroup, a fifty thousand foot-thick group of billion and a half year-old sandstones, siltstones and carbonate rocks that now cover much of western Montana, parts of Idaho and western Canada. Don and his colleagues identified and explained Belt sedimentary structures and the processes and environments that formed the rocks. Countless students have trudged with Don across a coastal mudflat, over a desert playa, or up a steep mountain to see one more outcrop before collapsing into camp. Don will be remembered as an inspiring teacher and role-model for budding geologists. With characteristic enthusiasm, Don shared his ideas openly and honestly with decades of students, whose theses and dissertations were subjected to many rounds of Don's editorial green ink. He taught what good science by good people should look like, arguably his greatest contribution to the profession of geology. For a time, he and Bente sailed a three-masted schooner in the Baltic Sea while Don spent a sabbatical at Blindern University in Oslo and researched the geology of the fjords. Later, geology took Don to the playa lakes of Mexico, the outback of Australia, the wild rivers of Siberia, and - for over 20 years - the inscrutable sand ripples of Netarts Bay, Oregon. Many trips were shared with Bente and the family: remote villages in China, a congress in Moscow, the sand dunes of Namibia, and the mountains of Peru. To extend his field research well into retirement, Don raised a herd of llamas, which he packed into the mountains of western Montana and beyond. Don is survived by his wife of 54 years, Bente, and his two children, Tor (wife Linda) and Francisca (husband Karlton Gross), and three grandchildren. He is also survived by his brother Frederick Winston (wife Eleanor), and family, as well as Cindy Thompson, partner of

Don's late brother Neil. Finally, he is survived by his sweet golden retriever, Kai: "The best dog I've ever had."

Friends

Robert H. (Bob) Cuyler was born in San Antonio during World War II. Parents Dr. Robert H. Cuyler, Sr. and Dr. Esther S. Cuyler preceded him. Bob's father was killed in a military aircraft accident when he was five weeks old and he grew up with his mother in his grandparents' home. He became a Christian at Trinity Baptist Church in San Antonio as a teenager, attended public schools in San Antonio and graduated from The University of Texas at Austin with a BBA Degree in Finance, and a graduate finance program at Indiana University. After college, Bob worked for a San Antonio-based insurance company, where he met his first wife, Linda Marie Cuyler. They had two sons and she passed away when Bob was 32 years old; their sons were four and five years old. Bob was a single widower for eight years. Bob is survived by his wife Patricia Lynn Cuyler, son Chris Cuyler (wife Wendy), son Kevin Cuyler (wife Stephanie), son Josh Cuyler (wife Amanda), nine grandchildren and one great-grandchild. Bob was a husband, father, grandfather, outdoorsman, computer programmer, hunting and fishing guide, bank executive and director, rancher, missionary to India, Nepal and Uganda, and also a builder. He was the Director of Pulse ATM Network in Houston, an instrument and multi-engine, commercial pilot, a Texas real estate broker, a church finance committee member, and an information technology manager. Bob also served on the UTSA College of Business Advisory Board, church Sunday School director and Chief Financial Officer. Bob was a member of the San Antonio Area Metal Detecting Club, Business and Professional Toastmasters, and San Antonio Chapter 35 of the Experimental Aircraft Association.

Gerald Horace Baum, 89, of Austin, Texas passed away on Friday, September 17, 2021.

Dean Henney of Livingston, Texas, born in Perrinton, Michigan passed away on September 25, 2021 at the age of 86. He was predeceased by his parents, Harrison Henney and Mereta Henney (Davis); his siblings, Paul Henney, Eileen Henney Hoppa and Robert Henney; and his son Michael Alan Henney.

He is survived by his wife Charlene Henney; his brothers, Wayne Henney (Phyllis) and Dale Henney (Janet); his sons, Todd James Henney (Peggy) and Lawrence Lee Henney (Kimberly); his daughter-in-law Susanna Mae Henney; and his nine grandchildren and three great-grandchildren. He is also survived by numerous other relatives and friends.

Harry Lucas, Jr. was born on February 25, 1932 in Orange, Texas to Mildred Bland Lucas and Harry Lucas, Sr. Harry and his younger brother by two years, Philip Bland Lucas (Sr.), grew up and attended schools in the shadows of oil boom town Beaumont, Texas. Harry attended classes at The University of Texas at Austin in the fifties and graduated from Lamar College (University) in Beaumont with a degree in mathematics. After teaching math for a while at Lamar, he founded Lucas Petroleum Group based in Beaumont and Houston. As a young student at UT, it was a class in topology (maps) under Professor R. L. Moore (1882-1974) that had a lasting and transformational effect on Harry's overall approach to life. Moore's use of the Socratic method in the classroom focused on the individual student's ability to be inquisitive and self-searching in solving challenging math problems on their own aided Harry later in life.

Peter O'Donnell, Jr., a noted Dallas philanthropist, died peacefully at his home on October 10 at age 97, surrounded by his family. His loving wife of 68 years, Edith Jones O'Donnell, predeceased him in 2020. O'Donnell was a lifelong resident of Dallas and graduated from Highland Park High School. He received his bachelor's degree in mathematics and was elected to Phi Beta Kappa at The University of the South in Sewanee, Tennessee. Following his service in the U.S. Navy in World War II, he received his Master's Degree in Business Administration from The Wharton School at the University of Pennsylvania. Upon returning to Dallas, he decided to undertake three major endeavors: investments, politics and philanthropy. He married Edith Jones O'Donnell in 1952. She grew up in Abilene, graduated from The Hockaday School and from The University of Texas at Austin. He always considered their marriage a blessing. They shared a passion for encouraging people to do their best work. While Edith's great love was the arts, O'Donnell was fond of saying that Edith's encouragement and involvement made everything possible. Some knew O'Donnell best for his longtime leadership in changing Texas' political landscape. It began with the 1958 election of Congressman Bruce Alger, followed by Senator John Tower, William P. Clements, Texas' first Republican governor in over 100 years, and the election of his friend, George H.W. Bush, as Vice President in 1980. Peter and Edith created the O'Donnell Foundation in 1957. At the first meeting, they determined that the most fundamental value in our country is education and that they would focus on four areas: math; science and engineering education; medicine, arts and music education; and improving K-12 education by improving the K-12 teacher corps. They also decided that their donations would be anonymous. O'Donnell's vision to create a high-tech economy in Texas based on science and engineering was implemented over

many years. In higher education, the O'Donnell Foundation provided the challenge grant that created 32 One Million Dollar Chairs in science and engineering at The University of Texas at Austin. O'Donnell also developed the plan creating the Institute for Computational Engineering and Science, now considered one of the top computational research institutes in the world. O'Donnell helped UT Austin get a running start on the next big thing in high performance computing. In 1985, with his encouragement, UT Austin acquired the powerful system, a CRAY X-MP, which made UT Austin the first university in Texas to have a supercomputer. With the O'Donnell Foundation's continuous contributions, the center now operates two of the most powerful university supercomputers in the U.S. Frontera, 10th fastest globally, and Stampede2. O'Donnell noted, "That's leverage. High performance computing is changing everything." O'Donnell also devoted many years to helping build a great medical school at UT Southwestern Medical Center. Recent O'Donnell contributions to UT Southwestern include $36 Million to help establish the Peter O'Donnell, Jr. Brain Institute for advanced research into treatment and prevention of all brain diseases and a $45 million contribution to obesity research and prevention. O'Donnell also had a vision for The University of Texas at Dallas to become the MIT of Texas. He worked tirelessly, using his political muscle to make UTD a four-year institution. The O'Donnells later gave $17 Million to endow the Edith O'Donnell Institute of Art History, the largest gift ever given to an art history program. In public education, O'Donnell founded the Advanced Placement Incentive Program, now taught in public schools in 36 states. The program dramatically increases the number of high school students, especially Hispanic and African-American students, who pass college-level exams in math, science and English. In 2004, O'Donnell co-founded The Academy of Medicine, Engineering and Science of Texas (TAMEST) with the Honorable Kay Bailey Hutchison and Nobel Laureates Michael S. Brown, M.D., and Richard E. Smalley, Ph.D. With more than 320 members, 10 Nobel Laureates and 16 member institutions, TAMEST is composed of Texas based members of the three National Academies, bringing together the state's brightest minds in medicine, engineering, science and technology to foster collaboration and advance research, innovation and business in Texas. In 2005, O'Donnell was appointed to the National Academy of Sciences Committee that produced "Rising above the Gathering Storm" which recommended priorities the U.S. should take to ensure its ability to compete in the 21st century. O'Donnell is survived by three daughters: Ann O'Donnell, Carol Kradolfer (Lyle), and Ruth Mutch. He is also survived by six grandchildren and two great grandchildren.

Gwyndolyn W. Shive 103, of Austin, Texas passed away on Saturday, March 5, 2022.

Faculty and Researchers

Sigrid Mary Louise Clift (B.A. '88, B.S. '89), 72, of Austin passed away on Sunday, April 10, 2022, supported by her husband of 48 years Bill Clift, daughter Brook Davis, and granddaughter Imani Davis. Sigrid's ability to love unconditionally and her infectious laugh and glowing smile will always live in the hearts and minds of anyone who knew her. Born as the only child to Bill and Louise Jackson on October 30, 1949, in Weatherford, TX, Sigrid spoke fondly about her childhood and the different cities in which her family resided. She especially cherished the experiences and friends her family formed at Nouasseur Air Force Base in Morocco near Casablanca from 1959–1961. The last five decades of Sigrid's life were spent in Austin, TX where she found tremendous joy as a wife, mother, sister-in-law, aunt, grandmother, and friend. She was actively engaged and involved with her family and community in a variety of ways including Girl Scout leader, PTA and Booster Club member, and class field trip leader. A stay-at-home mom throughout her 20s and 30s, Sigrid at the ripe age of 39 was able to utilize her B.S. in Geology from The University of Texas at Austin and begin her incredible 24-year career at the University's Bureau of Economic Geology, the State Geological Survey of Texas. A prolific author, Sigrid was lead or secondary author of numerous publications. Her work comprised many research projects, and during her last 15 years she served as the Bureau's Public Information Geologist. In this role, Sigrid frequently appeared in various media outlets, responding to all questions related to geology. For her contributions, she earned a number of awards including the Jackson School of Geosciences' Outstanding Staff Award and Outstanding Service Award. Sigrid especially enjoyed her work in education outreach at the Bureau and the Jackson School, particularly GeoFORCE, a K–12 outreach program designed to increase the number and diversity of students pursuing STEM degrees and careers, especially the geosciences. Her excitement and delight preparing for, during, and after each summer program was palpable. An enduring theme throughout Sigrid's career was her admiration for colleagues, and the pleasure she derived from working in collaboration with others. Shortly after retirement, Sigrid was diagnosed with Alzheimer's-type dementia and greatly enjoyed home visits from many of her Bureau friends. These visits meant the world to Sigrid, and her family will forever be grateful.

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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, research scientists, faculty and staff affiliated with JSG and its research units are encouraged to submit.

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Print Preferred Email Address in Alumni News?
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❍ No

Class Notes for the 2023 Newsletter

Attach a separate sheet or use the online form at **www.jsg.utexas.edu/alumni** for longer entries.

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LESLIE (B.S. IN GEOLOGY) AND DIANNE WHITE

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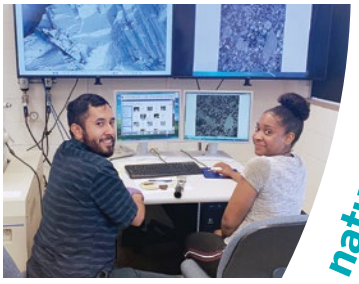


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