PennState
College of Earth
and Mineral Sciences

Newsletter 2020

Department of Geosciences

From the Department Head

Dear alumni and friends,

As I write this letter, COVID-19 cases are spiking across the country, and there remains great uncertainty in how the pandemic will impact us in the months ahead. Nevertheless, given the incredible efforts put forth by our faculty, staff, and students to make the best of the pandemic, I remain optimistic about the department's future. We have dedicated staff, engaged students, and talented faculty all pulling together to maintain a vibrant and productive work environment. The response from the department to the difficulties and challenges posed by the pandemic inspires me and gives me hope. To the students, staff and faculty, thank you for all you have done for the department as we struggle through the pandemic.

In this newsletter, we introduce our new faculty (p. 8), profile several students (p. 4), highlight a number of exciting research projects (p. 11), and celebrate the accomplishments of many faculty and students who received awards this year (p. 22). In addition to five new faculty members who arrived over the summer (Chris Blaszczak-Boxe, Miquela Ingalls, Brian Kelly, Kim Lau, and Max Lloyd), we also welcome Chloe Gustafson. Chloe, after completing a two-year postdoc, will join the faculty in summer 2022. Chloe is a hydrogeologist specializing in electromagnetic and other geophysical methods for addressing groundwater problems, and recently completed her Ph.D. at Columbia University.

In spite of COVID-related delays, progress has been made this year on renovating the Deike Building. Just recently, the new hydro-ecology and crustal petrology labs on the fourth floor were commissioned. New mass spectrometers were installed in the isotope geochemistry facility on the east side of the basement, and work has progressed in the west side of the basement on building new sedimentology, stratigraphy, and paleontology labs, a rock prep facility, a microscope lab, a remodeled seismic station, and field prep space for the geophysics and ice groups. And, to top things off, we have begun the initial design phase for new geochemistry labs on the fifth floor.

In other developments, a new website for the department is nearing completion, we have initiated searches for several faculty positions, and we are putting the final touches on a new five-year strategic plan, which includes a focus on addressing diversity, equity, and inclusion (DEI) in the department through establishing a DEI standing committee. The committee will advance diversity efforts across the department, provide guidance on best practices, facilitate cultural change, and help prioritize actions to achieve the department's DEI goals.

In closing, I want to acknowledge the generous support from our alumni and friends. I understand the challenges imposed by the pandemic on maintaining a healthy work-life balance. That many of you have been able to find time to support the department under difficult conditions is greatly appreciated.

Sincerely yours,

Andrew Nyblade

In This Issue...

Students in the Spotlight...

Undergraduate Student Profile:
Carl Aquino

I graduated in May 2020, but more than a decade has passed since my freshman year at Penn State. I've lived in six cities in four states, along two coasts, worked nine jobs, and started two companies. I studied at five colleges across two universities and majored in Chemical Engineering, Industrial Engineering, Music Composition, Finance, Earth Science and Policy, and Meteorology—all before completing my bachelor of science in earth sciences.

Why come back to Penn State to study climate science? There are many reasons, but one stands out in particular: in Los Angeles during fall 2017, a certain 'Avenger' was in town filming the movie *Avengers: Infinity War* and wound up being my roommate for a few weeks. One night over Chinese food, I shared that I was quite conflicted about leaving everything to go back to school. His advice changed my life: "Do the thing that you'll want to get really, really good at, because humanity will be grateful." And here I am, graduating from one of the best programs I could have ever hoped to be a part of.

Oddly enough, in some sense I am just beginning. This fall I started graduate school at Penn State in the geosciences department. It's the next step in my journey—a real mission given to me by an 'Avenger'—to save the world.

Master's Student Profile:
Hailey Mundell

I'm from a rural area in mid-state South Carolina, and I grew up on a farm with chickens and horses. I did my undergraduate studies at Clemson University, earning a bachelor's degree in geology.

My undergraduate research focused on quantum-mechanical modeling of hollandite as part of a polycrystalline ceramic waste form, with the intent to use its crystalline structure to store radioactive cesium—a common component of high-level nuclear waste streams.

At Penn State, my master's research is petrology-oriented, but still includes some computational modeling. My adviser is Andy Smye, assistant professor of geosciences, and my research seeks to constrain the impact of fluid flow through eclogite-facies metagabbros from the Tauern Window in the Alps. These eclogites have been subducted to extreme depths of about eighty kilometers and subsequently exhumed to the surface, where we can access them and perform detailed petrographic research.

During subduction, the increasing heat and pressure causes fluid to be released from the crystalline structure of host minerals as they break down—a process termed devolatilization. The free fluid, primarily water and carbon species, flows through the slab to the mantle wedge, where it lowers the melting point of the mantle. This results in arc volcanism.

The fluid might also introduce weakness into the subducted rock by raising pore fluid pressure, causing seismic and aseismic events. It's impossible to observe these events *in situ*, so petrographic research is important to understand what occurs tens of kilometers below the surface. Fluid is preserved in eclogite samples as quartz, or carbonate, veins. Around the veins, the mineralogy of the eclogite changes along a reaction selvage. The gradual change in chemistry across the reaction selvage allows detailed analysis into how long the fluid was flowing and what soluble elements it took elsewhere.

Recently, I have been focusing on comparing the garnet chemistry of vein-altered eclogites to corresponding unaltered eclogite samples taken further from the vein, using electron microprobe data.

Garnets grow as the rock is metamorphosed, preserving a compositional record of past conditions. The unaltered samples provide baseline conditions experienced by all of the rocks, which might have been obscured or modified by diffusion induced by vein activity. After clearly defining the pressure-temperature conditions and mineralogical changes experienced by all of my samples—using phase equilibria modeling—I will have a clear backdrop against which to closely analyze the changes in texture and mineralogy found in the reaction selvage around the veins. These chemical variations will allow me to interpret the timescales and length-scales of fluid-rock interaction.
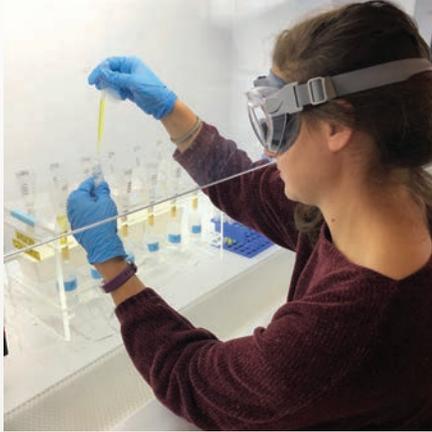
Doctoral Student Profile:
Joanmarie Del Vecchio

I didn't plan to study science in college, but I got hooked by field trips and stories of the Earth's history in an introductory geology course I took in Southern California.

I became interested in geomorphology, and as an undergraduate student I worked on projects studying how the desert landscape responded to changes in climate and tectonics. When I chose my graduate program, I was just as surprised as anyone to find myself studying a totally different landscape in Appalachia in a return to my home state of Pennsylvania.

I began as a master's student tasked with telling the story of landscape change at the Susquehanna Shale Hills Critical Zone Observatory with my adviser Roman DiBiase, assistant professor of geosciences. After a summer of mapping the steep, bouldery slopes of Tussey Mountain and studying high-resolution topographic maps of the Valley and Ridge, it was obvious this landscape's story was complex.

Previous researchers had suspected the central Appalachian landscape was heavily shaped by ancient permafrost processes that had dominated the landscape at the heights of previous glaciations. Using lidar maps and cosmogenic isotope dating, we confirmed the legacy of permafrost on central Pennsylvania's landscape and were able to hypothesize how cold-climate processes changed the pace and pattern of landscape evolution compared to warm climate periods.

During my master's thesis research, it was clear that central Appalachia had many stories to tell, and I wasn't going to begin to tell them all in a two-year project. I decided to stay at Penn State for my doctorate, and I designed an interdisciplinary research plan to better tell the story of climate, ecology, and erosion in ancient permafrost landscapes.

I have been working in the bog in the Bear Meadows Natural Area, near Boalsburg, Pennsylvania, investigating the sedimentary records on both the hillslopes and under the peat in the bog itself. I was thrilled to involve Sarah Ivory, a recently hired assistant professor who studies palynology, as I planned my project in pollen-based interpretations of the bog sediments. By combining methods to track ancient erosion and ancient ecosystem patterns, we have a holistic understanding of what Pennsylvania looked like as its landscape transitioned from glacial maxima to the warm interglacials that followed.

Working in ancient permafrost systems has sparked in me an interest in the modern Arctic, whose permafrost is both vulnerable to thaw and a potent store of carbon that, if released, could have massive implications for global climate. I loved being able to tell stories of ancient permafrost—might these stories help predict what will happen to our modern permafrost? And can studying modern permafrost landscapes further help me make interpretations from sedimentary records?

To explore these questions, I proposed a project that took me to Los Alamos National Laboratory in summer 2019. There I worked with scientists who used field remote sensing and modeling to study western Alaska's permafrost landscapes and ecosystems. The highlight of this project was fieldwork on the Seward Peninsula, where I could see permafrost landscapes thawing and changing in real time. That project affirmed my desire to use the past to help predict the future, and to be involved in interdisciplinary projects that draw connections between the living and nonliving parts of ecosystems.

As I finish up my dissertation at Penn State, I'm excited to see what the future brings. I hope I can keep doing exciting fieldwork while developing new skills and techniques. When I'm not working, I enjoy exercising, board games, and trivia with friends, and trying, but not always succeeding, to sew and crochet my own gear and clothes. I'm so grateful to have found a great bunch of colleagues and friends in the geosciences department with whom I can share science ideas and happy hours.

Alumni Spotlight: Gale Blackmer

by Terry Engelder and David Gold, professors emeritus of geosciences

Over the years, the Department of Geosciences has celebrated the accomplishments of its former students who have gone on to administrative positions in industry and government. Gale C. Blackmer joined this illustrious group in 2015, when she was named director of the Bureau of Geological Survey and Pennsylvania's State Geologist. The bureau is one of six within Pennsylvania's Department of Conservation and Natural Resources (DCNR).

The DCNR is charged with maintain and protecting 121 state parks, managing 2.2 million acres of state forest land, providing expertise about the state's ecological and geologic resources, and providing technical assistance to benefit Pennsylvania's rivers, trains, greenways, and natural areas. From her position as bureau director, Gale contributes significantly to many of the Commonwealth's activities that involve the use and exploitation of its natural resources.

Gale holds a B.A. in geology from the University of Pennsylvania '84 and a M.S. and Ph.D. '87g '92g in geology from Penn State. At various points in her career, she worked for a geotechnical drilling contractor, a small environmental firm in Philadelphia, and a hydrogeological firm in State College. She also served as a teacher and instructor at several of Pennsylvania's undergraduate institutions, including West Chester University, Bloomsburg University, and Dickinson College. Along the way, Gale also served as an instructor at the Yellowstone Bighorn Research Association field camp and assisted in mapping exercises in Wyoming, Salt Lake City, and Alta, Utah. At Penn State she was a popular teaching assistant, a self-motivated and resourceful research student, and recipient of the best presentation in the 1992 Graduate Student Colloquium. Her peers respected her quiet demeanor, people skills, and leadership.

Gale started at the Pennsylvania Geological Survey in 1999, where her focus was on bedrock mapping in southeastern Pennsylvania. If pressed to identify a specialty, she would say it was structural geology and tectonics, although like most good mappers, she knows just enough about many disciplines to oversee and administer a wide variety of projects. Gale worked her way up from geologic scientist to manager of the mapping division before being tapped to lead the bureau in 2015.

In the literature, Gale is best known for her *Tectonics* paper, "Post-Alleghanian unroofing history of the Appalachian Basin, Pennsylvania, from apatite fission track analysis and thermal models" with Gomaa Omar from Gale's undergraduate institution and Penn State emeritus professor Duff Gold. Gale's work is based on apatite fission track analyses on twenty-nine Ordovician through Permian sandstones from the Appalachian Basin of Pennsylvania. Her *Tectonics* paper was seminal in helping scientists understand the two-phase tectonic exhumation of Appalachian Mountains.

Through Gale's work we know that the initial and larger phase of exhumation accompanied the rifting of Pangaea with the opening of the Atlantic Basin during the Triassic. One of the nice touches of her paper involved cooling history model from apatite fission track data, with maximum temperatures constrained by vitrinite reflectance, which showed that cooling began soon after the Alleghanian Orogeny, except in the Juniata Culmination region, where synorogenic cooling and unroofing started during a thrusting event that formed an underlying duplex.

This observation is notable because to this day the Juniata Culmination on the Appalachian Plateau is a region of poorer gas production from the Marcellus Shale. After almost 200 million years of relative stability on the eastern seaboard of the North American lithosphere, a second phase of exhumation started in the Miocene, leading to the present topography of the Appalachian Valley and Ridge, and the later Adirondack Dome. Unfortunately, her note on the use of deformed esterid was never published.

At Penn State, she was a self-starter and independent thinker. She had the ability to spot the anomaly and the motivation and confidence to follow up. Gale is a well-rounded geologist with exposure to courses in archaeology, research in roof-falls in underground coal mines, as well as in the thermal history evolution of strata exposed in the Appalachian Plateau.

Alumni Spotlight: Janet S. Herman

by Susan Brantley, distinguished professor of geosciences

Not too long ago I ran into Janet Herman, almost unrecognizable under her ski gear, in Steamboat Springs, Colorado. An enthusiastic but inexpert skier, Herman is a well-known Penn State alumna of the Department of Geosciences. She is highly regarded for her work on groundwater geochemistry in karst, a type of geomorphological terrain that is vastly different from the Rocky Mountains where she often hikes and sometimes skis.

Herman's work started at Penn State with her bachelor's degree in 1977 for which she wrote a senior thesis with Dick Parizek, professor emeritus of geology, about using limestone as a reactive barrier for treatment of acid waters like those stemming from mine drainage. She wasted no time thereafter earning her doctorate in 1982. Her dissertation focused on the rate of dissolution of the minerals that define karst landscapes—calcite and dolomite. Her expertise in karst—how water dissolves limestone to create caves and subsurface flow paths—has been recognized repeatedly, perhaps most obviously in 2009 when she was named the Outstanding Karst Scientist by the Karst Waters Institute. Herman currently serves as president of the institute. Her love of karst followed naturally from her work with her dissertation adviser, Will White, professor emeritus of geochemistry. Now forty-five years after her first karst field trip with Will White and his wife, Bette White, a Penn State civil engineer, Herman still regards them as close friends and colleagues.

Perhaps because she was one of only two women at Penn State's geology field camp in 1976 and one of only two women graduate students in her entering cohort in 1977, Herman has been steadfast in her work to increase diversity in the geosciences. During her entire nine-year career at Penn State, she points out that there were no women on the geosciences faculty, and only one woman was invited to give a departmental seminar. But her history at Penn State in this regard probably prepared her well for when she started her first faculty position at University of Virginia (UVA) in 1982 in the Department of Environmental Sciences, where she was the only woman on a faculty of twenty four. She rose through the ranks at UVA to become a highly regarded professor of environmental sciences, a title she still holds today.

What did it feel like to be the only tenured woman scientist in the College of Arts and Sciences at UVA when she earned that status in 1988? Herman felt strongly that she needed to help change the composition of the scientific community by training students. Luckily for UVA, Herman gets things done and does them well: she advised twenty-four women and nine men who earned thirty-three graduate degrees during her thirty-nine years at UVA. Over that same period, she advised twenty-four senior theses, of which thirteen were written by women. She received national-level recognition for her success in training women graduate students in a non-traditional scientific field in 1996 when she received the National Science Foundation's (NSF) prestigious Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring. Those who bestowed the award noted that geosciences had long been a field that largely excluded women. Herman also earned the Outstanding Educator of the Year Award from the Association of Women Geoscientists in 2008 based on a nomination developed by two women undergraduate students.

Herman remains active supervising an interdisciplinary research and education program in groundwater contamination at UVA and in pursuing research and publishing papers. She has also served as program director in the Hydrologic Sciences Program at NSF. But her interest in science does not stop at research and student mentorship; she also seeks to use her knowledge of groundwater flow and transport to help communities understand issues of water contamination, including recent work with Penn State Department of Geosciences alumnae Dorothy Vesper (now at West Virginia University) and Ellen Herman (now at Bucknell University) to convene a Karst Waters Institute conference in Puerto Rico titled, "Groundwater Contamination and Public Health."

Over the years, Herman has been an avid runner, even winning an award for most improved athlete of the year from the Charlottesville Track Club in 2007. Perhaps not surprisingly, she also worked hard to bring more women into running. In addition, after facing a bout of cancer at age 49, she became increasingly involved in fundraising for cancer research in her community. Eventually she was named one of the town's "Distinguished Dozen" by the Charlottesville newspaper and recognized as a "Woman of Strength" for her fundraising and work educating women about cancer.

When Herman joins in a cheer of "We Are…," she can truly be proud of changing who "we" are. Today, the department boasts 13 women faculty, 50 percent of graduate students and 46 percent of undergraduates are women, and the entire department is focused on increasing the diversity of the field. Herman's career as both an undergraduate and graduate student at Penn State and her subsequent career at UVA have been part of our department's history and trajectory toward greater inclusivity in the science.

Welcome New Faculty...

Christopher Blaszczak-Boxe

Blaszczak-Boxe recently joined the department as an associate research professor.

I am a lifelong educator who uses numerical-modeling platforms to assess the evolution of planets on various timescales. On the experimental front, I participate in field and laboratory studies that assess the abundance of potentially toxic substances in indoor and outdoor environments and their potential impacts on human health. At Penn State, I hope my contributions to science will span both solar and extrasolar system habitable planets and will also encompass quantifying how environmental toxins contribute to select adverse health impacts. I also plan to implement STEM-education initiatives to help increase, retain, and inevitably steer students toward science and engineering careers and disciplines.

I earned a B.S. in chemistry and a minor in math from Morehouse College in 1999 and later completed a Ph.D. in environmental science and engineering at the California Institute of Technology in 2005, along with a minor in geology, an M.S. in environmental science and engineering and an M.S. in planetary science. Since graduating, I have worked at NASA's Jet Propulsion Laboratory, the City University of New York, and various high schools within the borough of Brooklyn.

Miquela Ingalls

Miquela Ingalls recently joined the department as an assistant professor.

Growing up in North Carolina, I spent my childhood rock hopping and creating mental maps of the creeks and hills in the neighboring woods. However, I was unaware that I could make a career out of investigating land surfaces and their environments until my first semester of college. Becoming involved in undergraduate research in the Radiogenic Isotopes lab at the University of North Carolina at Chapel Hill was the best decision my 18-year-old self could have made. I was fortunate enough to spend multiple summers in Yosemite studying the impact of rock fall and rock slide events on the shape of the valley floor, and the timing of the emplacement of the El Capitan granite—the iconic monolith that greets visitors to Yosemite Valley.

Following graduation with my undergraduate degree in geology, I worked for the United State Geological Survey in Bozeman, Montana, tagging fish to track how the native and invasive populations adapted to human-imposed changes in the drainage structure of the Snake River. I had no idea at the time how geology and biology— seemingly operating on vastly different time scales—could so greatly influence each other, and how important this idea would be to my later work.

For my graduate studies at the University of Chicago, I used terrestrial carbonate sediments from Paleocene-Eocene lake and soil deposits to reconstruct the timing of the uplift of the Tibetan Plateau. The carbonate-based proxy for elevation relies on carbonate minerals faithfully recording the oxygen isotope composition of ancient rainwater, which changes with altitude. However, I learned that lacustrine carbonate can record layered chemical fingerprints of local hydrology, biology, and climate.

Brian Kelley

Brian Kelley recently joined the department as an assistant professor.

I grew up in northeastern Ohio on the edge of woodlands that were crossed by streams and dotted with small lakes. These natural areas became the setting for childhood adventures of curiosity and exploration. Summer vacations were spent on the beaches of North Carolina, where I developed a lasting fascination with the ocean.

Following high school, few of my childhood friends attended college, so I initially followed suit and went to work. Years later, I returned to the classroom as a non-traditional student. An early course in oceanography led to a degree in geology and ultimately to a Ph.D. at Stanford University. During my graduate field work in carbonate sedimentology and stratigraphy, I spent six months in southern China surrounded by limestone mountains in a dramatic karst landscape.

After earning my graduate degree, I worked for ExxonMobil in Houston, where I studied some of the largest carbonate reservoirs in the world. My work took me to Spain, Kazakhstan, Alaska, the Middle East, and the Bahamas. I developed an understanding for the challenge of meeting the energy demands of a growing world population while mitigating climate change, protecting the environment, and preserving biodiversity. This is the fundamental problem that current and future generations of scientists must help to solve.

I could be classified as a sedimentologist, a marine geologist, or a paleobiologist, but I think of myself more generally as an Earth scientist. I am broadly interested in the co-evolution of Earth environment and its inhabitants, in both the modern and ancient, across timescales that range from decades to millions of years.

My ongoing research uses coral reefs and other carbonate sediments to investigate Earth-system evolution. Reefs have excellent fossil and stratigraphic records, but they are also ecologically fragile. Like a canary in a coal mine, they can be an important indicator of marine ecosystem health. I am currently investigating the causes and consequences of environmental disturbance in early Mesozoic oceans that contributed to end-Paleozoic extinction and the global absence of coral reefs for millions of years. The parallels to the modern ocean and the effects of anthropogenic climate change are both striking and alarming. I am grateful for the opportunity to join the Department of Geosciences at Penn State. I was drawn here by the people. The students, faculty, and administrative staff have created a culture of collegiality, curiosity, and exploration that I am proud to be a part of.

Kimberly Lau

Kimberly Lau recently joined the department as an assistant professor.

Growing up in California's Bay Area with parents who loved visiting natural history museums and camping in the nearby state and national parks, I was inspired to wonder how our Earth and its diverse landscapes and inhabitants had transformed into the way they are today. As an undergraduate student at Yale University, I knew I was interested in the environment and evolutionary history but had only vague ideas about how one could study these topics. After all, the naturalists I read about at those natural history museums and park visitor centers—John Muir, Charles Darwin, and so on—seemed to have jobs that didn't quite exist in the modern world.

Taking a History of Life course at Yale changed my misconception of what the field of geology encompasses. Studying the earth sciences connects the notion of environments and biology evolving in parallel and invites a new dimension of thinking by broadening how time and space are considered. For my senior thesis, I studied the distribution and diversity of New York's state fossil, the eurypterid.

A postdoc saw my final presentation and asked if I had considered doing some isotope measurements to determine the environmental conditions where the molted eurypterid carapaces were deposited. I hadn't, but filed away that tidbit while I worked as an environmental consultant in the Boston area.

After several years of working, I was ready to consider graduate school, and I decided that I wanted to use geochemistry to provide context to evolutionary patterns in the fossil record. With this in mind, I started a Ph.D. at Stanford University, where I studied how carbonate isotope proxies can inform us of how the degree of scarcity and instability of oxygen in the oceans correspond to periods of animal extinction and evolution. I continued to investigate these paleoenvironmental proxies during my postdoc at UC Riverside and then at the University of Wyoming.

Max Lloyd

Max Lloyd recently joined Penn State as an assistant research professor in geosciences.

I am a low-temperature geochemist who uses measurements and models to study how molecules record their own histories, and what such records can teach us about Earth surface and near-surface processes in the present and past. I'm looking forward to integrating my skillset—position-specific and multiply-substituted isotope geochemistry, biogeochemistry, and gas-source mass spectrometry—into a department that is renowned in these and related fields. Together, I expect we'll make significant advances while training the next generation of world-class geochemists.

Raised by a tech worker and a food writer in Silicon Valley, California, I met C++ before cursive and my first exposure to the scientific method happened in the kitchen; early investigations into the time-temperature path that yields the perfect soft-boiled egg led to an interest in cooking, experiment, and cooking experiments, that persists today.

I earned my undergraduate degree at Amherst College in central Massachusetts, where I was first exposed to seasons—fall lives up to the hype—and the geosciences. I majored in geology due to an enthusiasm for how principles from chemistry and physics could explain key features of the observable world, such as the location of deserts and the makeup of the atmosphere. Following an influential summer undergraduate research fellowship at Woods Hole Oceanographic Institute, I chose to pursue a Ph.D. and career in geochemistry due to an interest in discovering new tools with which we can study past versions of Earth that are not directly observable.

I received my Ph.D. in geochemistry from the California Institute of Technology in 2018. My graduate work took me into the field in western Utah and the eastern Swiss Alps, and into the lab, where I paired classic chemical derivatization techniques with the latest generation of gas-inlet isotope ratio mass spectrometers. I leveraged these pairings in my dissertation to study the transformations that occur at an intra-molecular level in two forms of carbon—carbonate minerals and kerogen—in the shallow crust. Such intramolecular isotopic transformations allowed us to distinguish, for example, carbonate strata that have been buried two vs. three kilometers deep and subsurface coal beds that have been degraded by microbes versus by heat and time alone.

I spent the last two years as an Agouron Geobiology Postdoctoral Fellow at the University of California, Berkeley where I used a technique developed during my Ph.D. and applied it in a new direction; to understand how the dynamics of photosynthesis in trees are recorded in the wood they produce. The fossil wood archive extends back to the Mesozoic, so this ongoing work has the potential to provide insights into how plants responded, on a metabolic level, to some of the key changes in Earth's climate state. On a personal level, this work has expanded my research directions to include not just the outcrop but also the biota that overgrows it.

Having just moved to State College, I am enjoying living in a gorgeous place with sufficient water for plants and people alike, and cooking with the delicious produce grown nearby. In my free time, expect to find me exploring the surrounding trails by foot or bike. I am looking forward to teaching and advising the department's students this fall, in whatever form virtual or in-person our interactions take place.

Geoscientist's professorship to drive research on landscapes, hazards

Roman DiBiase won't soon forget the name of an early mentor when he began his career at Penn State in 2014.

He was recently named the Rudy L. Slingerland Early Career Professor of Geosciences, a distinction that honors the now retired geosciences professor and will help fund DiBiase's research studying how landscapes erode over geologic time, shaping mountains and in an instant leading to hazards from fires, floods, and landslides.

DiBiase's research includes Southern California, where he investigates how wildfires lead to stronger mudslides. In Pennsylvania, his work maps the impact of climate and land use on the landscapes of the Shale Hills Critical Zone Observatory. In Taiwan, he tracks how sediment moves in rivers to understand how mountain ranges erode and help predict flooding hazards.

These research projects are funded through the National Science Foundation, DiBiase said, but this professorship will improve computing capacity for his research group. Improving computing power to crunch data is critical, he said, because the ability to chart centimeter- to meter-scale changes of kilometer-size areas can be accomplished in days through the use of drones, lidar-equipped planes, and satellite imagery, all producing vast amounts of data. Similar data collection a decade ago, if even possible, could take months or longer.

These technologies let DiBiase collect billions of data points for land and water surfaces—data as detailed as the size of gravel and boulders—but much of the land surface isn't accessible by air due to the forest canopy. That's where computing power comes in. In areas that are free of vegetation, imagery from drones sample the ground surface at

even higher resolution, filling in gaps in data missed through lidar mapping.

"In Pennsylvania, we've relied on airborne lidar scanning," DiBiase said. "Most data are of the canopy, but 5 or 10 percent of your scans will be of the ground. And then you can use that to reconstruct a high-resolution map of the ground surface. This is really important because it's so critical for picking out landforms that you can't see walking around on the ground."

Across the board, technologies are advancing for geoscientists. This professorship will help DiBiase keep pace.

"Two developments that together catapulted this research and now pervade just about every aspect of geosciences are inexpensive, high-quality drones and the ability to process the images themselves," DiBiase said. "We can take a collection of photographs to build realistic 3-D models. This has exploded in the past five or ten years."

DiBiase said the technology also allows geoscientists to more easily assess previously uncharted waters. Sections of river canyons in Taiwan, for example, are treacherous for researchers to survey in the field yet can be accessed by drones.

DiBiase said it means a lot to him to earn a distinction named after Slingerland, a geoscientist with similar research interests who helped him begin his Penn State career. He said Slingerland, who he keeps in contact with, taught him about Pennsylvania landscapes and prepared him for teaching geosciences field camp, the annual capstone summer course, to geosciences students.

Shale Hills: An outdoor laboratory offers insights into the critical zone

When Penn State students and citizen scientists came together to collect water samples throughout the Shaver's Creek watershed in September 2019, they were taking part in research that began in the 1960s at a twenty-acre outdoor laboratory called Shale Hills.

Located in Penn State's Stone Valley Forest, Shale Hills boasts steep, forested ridges and a shallow stream that runs along the valley floor. The site sits on Rose Hill shale, a common rock formation, and hosts a one hundred-foot flux tower, water and soil sensors, wells, and boreholes, the deepest of which extends 146 feet into soil and bedrock.

Shale Hills is one of three main research sites that comprise the Susquehanna Shale Hills Critical Zone Observatory (CZO). The CZO is part of a National Science Foundation program that supports nine observatories from California to Puerto Rico.

Scientists use the term "critical zone" to describe the porous boundary layer extending from the bedrock to the treetops where terrestrial biota live. It's where humans grow crops, raise livestock, and find drinking water and resources like lumber, granite, and iron ore. The Susquehanna Shale Hills CZO brings together researchers from across Penn State who study how rock, water, soil, air, and living organisms interact, and how the interactions affect humans and in turn how humans impact these interactions.

"The idea behind a critical zone observatory is that if we can go to one place and measure all the geological, chemical, and biological processes occurring in the Earth's surface, maybe we can combine all those measurements to really understand those processes," said Susan Brantley, distinguished professor of geosciences and lead investigator of the Susquehanna Shale Hills CZO. "It has been very successful. You can understand much more about erosion by incorporating wind and tree species into your thinking as a geologist. We even bring in human activities to our models."

The Susquehanna Shale Hills CZO began in 2007 at the Shale Hills site. The researchers' goal then was to understand how fresh water affects surface processes. The CZO expanded in 2014 to include the entire sixty-four-square mile Shaver's Creek watershed, including the 331-acre Garner Run site in Rothrock State Forest. Herb Cole, professor emeritus of plant pathology and environmental microbiology at Penn State, gave the researchers permission to install equipment on his 160-acre working farm, also located in the watershed, in 2017.

The expansion gave the researchers the opportunity to study the processes that occur on four geologies—Rose Hill shale, sandstone, limestone, and calcareous shale—as well as how agriculture affects these processes.
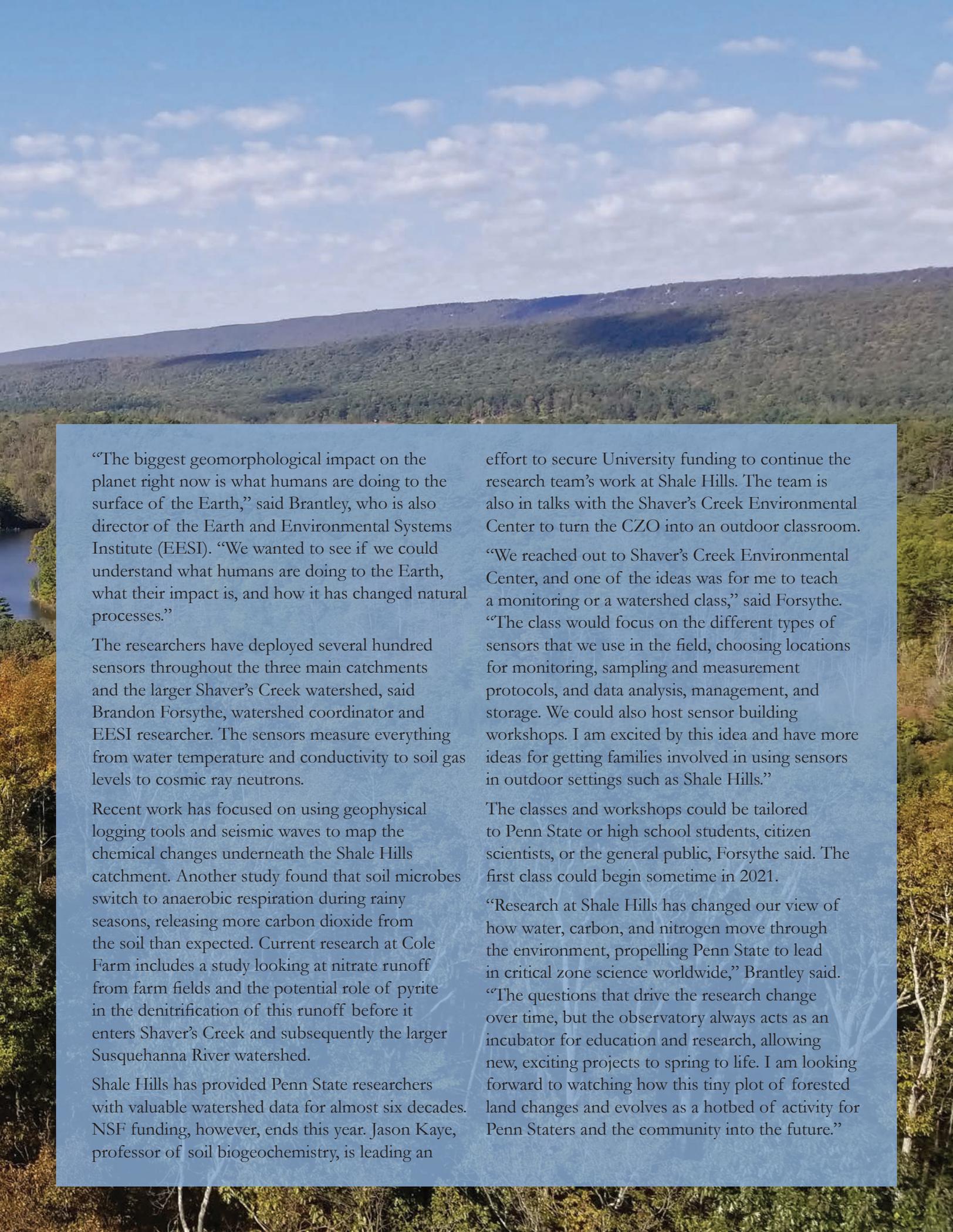
"The biggest geomorphological impact on the planet right now is what humans are doing to the surface of the Earth," said Brantley, who is also director of the Earth and Environmental Systems Institute (EESI). "We wanted to see if we could understand what humans are doing to the Earth, what their impact is, and how it has changed natural processes."

The researchers have deployed several hundred sensors throughout the three main catchments and the larger Shaver's Creek watershed, said Brandon Forsythe, watershed coordinator and EESI researcher. The sensors measure everything from water temperature and conductivity to soil gas levels to cosmic ray neutrons.

Recent work has focused on using geophysical logging tools and seismic waves to map the chemical changes underneath the Shale Hills catchment. Another study found that soil microbes switch to anaerobic respiration during rainy seasons, releasing more carbon dioxide from the soil than expected. Current research at Cole Farm includes a study looking at nitrate runoff from farm fields and the potential role of pyrite in the denitrification of this runoff before it enters Shaver's Creek and subsequently the larger Susquehanna River watershed.

Shale Hills has provided Penn State researchers with valuable watershed data for almost six decades. NSF funding, however, ends this year. Jason Kaye, professor of soil biogeochemistry, is leading an

effort to secure University funding to continue the research team's work at Shale Hills. The team is also in talks with the Shaver's Creek Environmental Center to turn the CZO into an outdoor classroom.

"We reached out to Shaver's Creek Environmental Center, and one of the ideas was for me to teach a monitoring or a watershed class," said Forsythe. "The class would focus on the different types of sensors that we use in the field, choosing locations for monitoring, sampling and measurement protocols, and data analysis, management, and storage. We could also host sensor building workshops. I am excited by this idea and have more ideas for getting families involved in using sensors in outdoor settings such as Shale Hills."

The classes and workshops could be tailored to Penn State or high school students, citizen scientists, or the general public, Forsythe said. The first class could begin sometime in 2021.

"Research at Shale Hills has changed our view of how water, carbon, and nitrogen move through the environment, propelling Penn State to lead in critical zone science worldwide," Brantley said. "The questions that drive the research change over time, but the observatory always acts as an incubator for education and research, allowing new, exciting projects to spring to life. I am looking forward to watching how this tiny plot of forested land changes and evolves as a hotbed of activity for Penn Staters and the community into the future."

New Argentine fossils uncover history of celebrated conifer group

Newly unearthed, surprisingly well-preserved conifer fossils from Patagonia, Argentina, show that an endangered and celebrated group of tropical West Pacific trees has roots in the ancient supercontinent that once comprised Australia, Antarctica, and South America, according to an international team of researchers.

"The *Araucaria* genus, which includes the well-known Norfolk Island pine, is unique because it's so abundant in the fossil record and still living today," said Gabriella Rossetto-Harris, a doctoral student in geosciences and lead author of the study. "Though they can grow up to 180 feet tall, the Norfolk Island pine is also a popular houseplant that you might recognize in a dentist's office or a restaurant."

Araucaria grew all around the world starting about 170 million years ago in the Jurassic period. Around the time of the dinosaur extinction, sixty-six million years ago, the conifer became restricted to certain parts of the Southern Hemisphere, said co-author Peter Wilf, professor of geosciences and associate in the Earth and Environmental Systems Institute (EESI).

Today, four major groups of *Araucaria* exist, and the timing of when and where these living lineages evolved is still debated, Rossetto-Harris said. One grows in South America, and the other three are spread across New Caledonia, New Guinea, and Australia, including Norfolk Island. Many are now endangered or vulnerable species. The Norfolk pine group, the most diverse with sixteen species, is usually thought to have evolved near its modern range in the West Pacific well after the Gondwanan supercontinent split up starting about fifty million years ago, Rossetto-Harris added.

Researchers from Penn State and the Museum of Paleontology Egidio Feruglio in Argentina, found the fossils at two sites in Patagonia—Río Pichileufú—which has a geologic age of about 47.7 million years, and Laguna del Hunco, with a geologic age of about 52.2 million years. They analyzed the fossil characteristics and compared them to modern species to determine to which living group the fossils belonged. Then they developed a phylogenetic tree to show the relationships between the fossil and living species. They reported their findings in a recent issue of the *American Journal of Botany*.

A leafy branch fossil of *Araucaria pichileufensis*, showing detail of the small, overlapping leaves that give the branch segment a characteristic rope-like appearance. Credit: Gabriella Rossetto-Harris.

Unlike the monkey puzzle trees of the living South American group of *Araucaria*, which have large, sharp leaves, the Patagonian conifer fossils have small, needle-like leaves and cone remains that closely resemble the Australasian Norfolk Island pine group, according to the researchers. They also found a fossil of a pollen cone attached to the end of a branch, which is also characteristic of the group.

"The new discovery of a fossil pollen cone still attached to a branch is rare and spectacular," said Rossetto-Harris, who is also an EESI Environmental Scholar. "It allows us to create a more complete picture of what the ancestors of these trees were like."

The researchers used fifty-six new fossils from Río Pichileufú to expand the taxonomic description of *Araucaria* pichileufensis, a species first described in 1938 using only a handful of specimens.

"Historically, scientists have lumped together the *Araucaria* fossils found at Río Pichileufú and Laguna del Hunco as the same species," Rossetto-Harris said. "The study shows, for the first time, that although both species belong to the Norfolk pine group of *Araucaria*, there is a difference in conifer species between the two sites."

The researchers named the new species from Laguna del Hunco, *Araucaria* huncoensis, for the site where it was found. The fossils are about 30 thirty million years older than many estimates for when the Australasian lineage evolved, according to Rossetto-Harris.

The findings suggest that fifty-two million years ago, before South America completely separated from Antarctica, and during the first few million years after separation was underway, relatives of Norfolk Island pines were part of a rainforest that stretched across Australasia and Antarctica and up into Patagonia, said Rossetto-Harris.

The change in the *Araucaria* species from the older Laguna del Hunco site to the younger Río Pichileufú site may be a response to the climatic cooling and drying that occurred after South America first became isolated.

"We're seeing the last bits of these forests before the Drake Passage between Patagonia and Antarctica began to really widen and deepen and set forth a lot of big climatic changes that would eventually cause this version of *Araucaria* to go extinct in South America, but survive in the Australian rainforest and later spread and thrive in New Caledonia," Rossetto-Harris said.

The study shows how tiny details can provide the definition needed to reveal big, important stories about the history of life, Wilf added.

Leaf litter from an Australasian-type Araucaria growing at the Huntington Library, Art Collections, and Botanical Gardens, San Marino, California. Pictured are the three types of tree organs, leafy branches, pollen cones and cone scales that are preserved as fossils at Laguna del Hunco and Río Pichileufú, Patagonia, Argentina. Credit: Gabriella Rossetto-Harris.

Photos may improve understanding of volcanic processes

A team of Penn State researchers studied Telica Volcano, a persistently active volcano in western Nicaragua, to both observe and quantify small-scale intra-crater change associated with background and eruptive activity. Credit: Google Earth.

The shape of volcanoes and their craters provide critical information on their formation and eruptive history. Techniques applied to photographs—photogrammetry— show promise and utility in correlating shape change to volcanic background and eruption activity.

Changes in volcano shape—morphology—that occur with major eruptions are quantifiable, but background volcanic activity, manifesting as small volume explosions and crater-wall collapse, can also cause changes in morphology and are not well quantified.

A team of Penn State researchers studied Telica volcano, a persistently active volcano in western Nicaragua,

to both observe and quantify small-scale, intra-crater change associated with background and eruptive activity. Geologists consider Telica 'persistently' active because of its high levels of seismicity and volcanic degassing, and because it erupts on less than ten-year time periods.

The team used direct observations of the crater, photographic observations from 1994 to 2017 and photogrammetric techniques on photos collected between 2011 and 2017 to analyze changes at Telica in the context of summit crater formation and eruptive processes. They used structure-from-motion (SfM), a photogrammetric technique, to construct 3-D models from 2-D images.

They also used point cloud differencing, a method used to measure change between photo sampling periods, to compare the 3-D models, providing a quantitative measure of change in crater morphology. They reported their results in the journal Geochemistry, Geophysics, Geosystems.

"Photos of the crater were taken as part of a multidisciplinary study to investigate Telica's persistent activity," said Cassie Hanagan, lead author on the study. "Images were collected from our collaborators to make observations of the crater's features such as the location and number of fumaroles or regions of volcanic degassing in the crater. For time periods that had enough photos, SfM was used to create 3-D models of the crater. We could then compare the 3-D models between time periods to quantify change."

Using the SfM-derived 3-D models and point cloud differencing allowed the team to quantify how the crater changed through time.

"We could see the changes by visually looking at the photos, but by employing SfM, we could quantify how much change had occurred at Telica," said Peter La Femina, associate professor. "This is one of the first studies to look at changes in crater morphology associated with background and eruptive activity over a relatively long time span, almost a ten-year time period."

Telica's morphological changes were then compared to the timing of eruptive activity to investigate the processes leading to crater formation and eruption.

Volcanoes erupt when pressure builds beyond a breaking point. At Telica, two mechanisms for triggering eruptions have been hypothesized. These are widespread mineralization within the underground hydrothermal system that seals the system and surficial blocking of the vent by landslides and rock fall from the crater walls. Both mechanisms could lead to increases in pressure and then eruption, according to the researchers.

"One question was whether or not covering the vents on the crater floor could cause pressure build up, and if that would cause an explosive release of this pressure if the vent were sufficiently sealed," Hanagan said.

Comparing the point cloud differencing results and the photographic observations indicated that vent infill by mass wasting from the crater walls was not likely a primary mechanism for sealing of the volcanic system prior to eruption.

"We found that material from the crater walls does fall on the crater floor, filling the eruptive vent," La Femina said. "But at the same time, we still see active fumaroles, which are vents in the crater walls where high temperature gases and steam are emitted. The fumaroles remained active even though the talus from the crater walls covered the vents. This suggests that at least the deeper magma-hydrothermal system is not directly sealed by landslides."

The researchers further note that crater wall material collapse is spatially correlated to where degassing is concentrated, and that small eruptions blow out this fallen material from the crater floor. They suggest these changes sustain a crater shape similar to other summit craters that formed by collapse into an evacuated magma chamber.

"What we found is that during the explosions, Telica is throwing out a lot of the material that came from the crater walls," La Femina said. "In the absence of magmatic eruptions, the crater is forming through this background process of crater wall collapse, and the regions of fumarole activity collapse preferentially."

The team collaborated with Mel Rogers, assistant research professor at the University of South Florida. Hanagan, now a graduate student at the University of Arizona, completed this research as part of her Schreyer Honors College honors thesis and Department of Geosciences senior thesis.

Watch video on YouTube: https://www.youtube.com/watch?v=UxSNXa5oydo

COVID-19 doesn't curb field camp 'rite of passage' for geosciences students

Drone footage, Google Earth, other technologies employed to recreate traditional experience

In a field exercise, geosciences student Katie Reilly moved from point to point, analyzing surface geological formations, hoping to gain insight into the environmental conditions that formed portions of the Rocky Mountains.

For experienced undergraduate students in geosciences, this capstone field camp is a rite of passage. Each year, dozens of students usually spend six weeks exploring the topography and geologic features of the Western United States, analyzing firsthand the expression of forces that they've spent years learning.

What was different for Reilly? She never left her home.

She is one of a handful of students to fulfill the field camp requirement amid the global COVID-19 pandemic thanks to the swift and skillful work of faculty members in the department. There, experts spent weeks leading up to the course creating a virtual experience using Google Earth, drone footage, images, and datasets to create a learning experience much like the traditional one.

Going virtual

Faculty members knew in March that the pandemic might threaten a course that's traditionally experienced by students piling into vans and camping out—often off the grid—for weeks. So, they got to work inventorying available material.

One perk was that more than one-hundred others were hoping also to create their camps in virtual form. They became a resource. But Penn State's field camp, which is different than most because it's a capstone course—an end cap to education rather than an introduction into fieldwork—meant faculty members would have to create much of the experience on their own.

It helped that Roman DiBiase, Rudy L. Slingerland Early Career Professor of Geosciences, had amassed high-resolution imagery of places such as the Teton Range and Bighorn Basin, and Julia Carr, a geosciences graduate student

who assisted with the course, flew drones during previous field camps. So, students could zoom in, using digital tools, close enough to measure grain sizes in the formations, or zoom out far enough to get a bird's-eye view.

Erin DiMaggio, assistant research professor, Donald Fisher, professor, and Andrew Smye, assistant professor, joined in constructing the bulk of the Western U.S. course while Dave Yoxtheimer, assistant research professor, designed a portion of the course focused on Pennsylvania geology related to the natural gas industry.

"We looked at our objectives for field camp and how we could best fulfill them," Fisher said. "One great thing about field camp is getting students out there, thinking on their own, and collecting all their data in the field, and having to interpret it. We knew that virtually we could expose them to datasets in different field areas where they could collect their own data using GIS and other tools."

Course creators were quick to point out that the virtual experience won't replace traditional field camp, but it's a great tool to have for unique situations, and also increases the accessibility of the experience of field camp.

The concept of students applying what they know to understanding and solving geological problems was still a key component of the course.

"One of the main goals is for students to synthesize what they have learned in their geosciences courses," DiMaggio said. "They're using these skill sets to solve real-world problems—pulling from their geoscience knowledge to interpret earth processes."

Student experience

Reilly, a senior, said she was looking forward to field camp, so, naturally, the idea of it being canceled or offered virtually weighed on her. She praised faculty members for their efforts.

Students in the virtual geosciences field camp used drone footage, Google Earth, images and mapping software to recreate traditional scenes such as the Elk Basin, shown here in 2018. Credit: Julia Carr.

"Although online, the faculty and teaching assistants did a great job integrating 'virtual' field images into Google Earth tours, so it felt as close to physically being there as possible," Reilly said. "I was surprised that the information provided about our areas of study was so accessible."

The lack of travel time and additional access to course instructors, she said, gave her more experience in using the digital tools of a geoscientist, with software such as ESRI ArcGIS and Adobe Illustrator.

Because field camp is so immersive, faculty members kept to a tight schedule. Students began around 9 a.m. with course instruction followed by independent exercise and a review session before being given assignments to carry through the evening. Faculty and teaching assistants also staffed a Zoom room throughout that time, so students had constant access. The 2-to-1 student-to-expert ratio meant students had even more access versus the traditional offering.

Varsha Swami, a senior, also was concerned the virtual experience wouldn't live up to what other students had previously experienced, but she soon found that the carefully picked resources guided her virtual experience.

"The Google Earth tours have to be my favorite," Swami said. "These tours were designed in a way where we were given pictures of a location with questions to guide our thinking. This was very useful because we could take a look at the pictures ourselves, make observations and then interpret from there."

Yoxtheimer, who led students for three weeks on a virtual crash course of Appalachian geology, said students may have missed out on some unique field camp experiences but gained powerful tools used by modern-day geoscientists. His portion of the course taught students how to study the geology of the region and write reports on the viability of energy extraction.

"I entered when the field was largely an analog world," Yoxtheimer said. "But nowadays there's so much information at your fingertips that you can really go out and do a desktop analysis or do a lot of upfront work before you even go out into the field. These students gained more cutting-edge skills than they might have otherwise if they had just been sweating it out along an outcrop. They surely had a different experience, but I don't think it was a lesser experience in the end."

3-D model of the stratigraphy at Elk Basin. Credit: Julia Carr.

Greenland bedrock drilling project to understand past, future ice sheet melting

Bedrock that lies below the ice sheet could reveal untold secrets about when the ice last retreated, laying the foundation for better models of future sea level rise

The Greenland Ice Sheet holds enough water to raise sea levels nearly twenty-four feet, yet it remains difficult to predict the rate of melt and possible tipping points in the stability of the ice sheet.

Climate change is now causing Greenland to shed ice rapidly, and even a few feet of sea level rise may have grim implications for coastal cities and low-lying islands. A new project aimed at drilling through the ice to the underlying bedrock promises to reveal the ice sheet's past in unprecedented detail and enable more accurate predictions of how it may add to rising seas in the twenty-first century.

Scientists from Penn State, Columbia University, the University at Buffalo, and the University of Massachusetts at Amherst recently received a $3 million research grant and $4 million in field operations support from the National Science Foundation for the project, called GreenDrill. This ambitious five-year endeavor aims to uncover the exact extent, timing, and frequency of periods when the Greenland Ice Sheet was much smaller or completely gone.

Researchers from Penn State will lead the start of the project, and Sridhar Anandakrishnan, professor of geosciences, will be a key primary investigator throughout the project.

"Students and researchers at Penn State will conduct seismic, radar, and other geophysical investigations to determine the properties of the ice and rock beneath Greenland," said Anandakrishnan. "This work will help guide the locations of the drill and samples."

The project will enter an entire zone of the earth that scientists have yet to systematically study, said Joerg Schaefer, a geochemist at Columbia's Lamont-Doherty Earth Observatory and a co-leader of the project.

"We'll recover samples from basal ice and sub-ice bedrock comparable to the moon rocks in their rareness and preciousness," Schaefer said. "They will tell us directly about the past, and therefore the modern and future stability of the Greenland Ice Sheet."

The project has the potential to reinvigorate U.S. ice-drilling efforts in the Arctic. The last major effort, the Greenland Ice Sheet Project 2, ceased in the mid-1990s.

The scientists will use the new ice-sheet data to test the hypothesis that northern Greenland is more sensitive to Arctic warming than the southern part. The data will also inform the project's substantial climate and ice sheet modeling component, which aims to develop the next generation of robust and better-calibrated model predictions of Greenland's future melt scenarios.

Left: Large cracks in the surface of the Greenland Ice Sheet, called crevasses, reveal ice sheet flow from inland to coast. The GreenDrill team's bedrock research could unearth new details about the ice sheet's history and how it might respond to global warming, impacting sea level rise. Credit: Jason Briner, University of Buffalo.
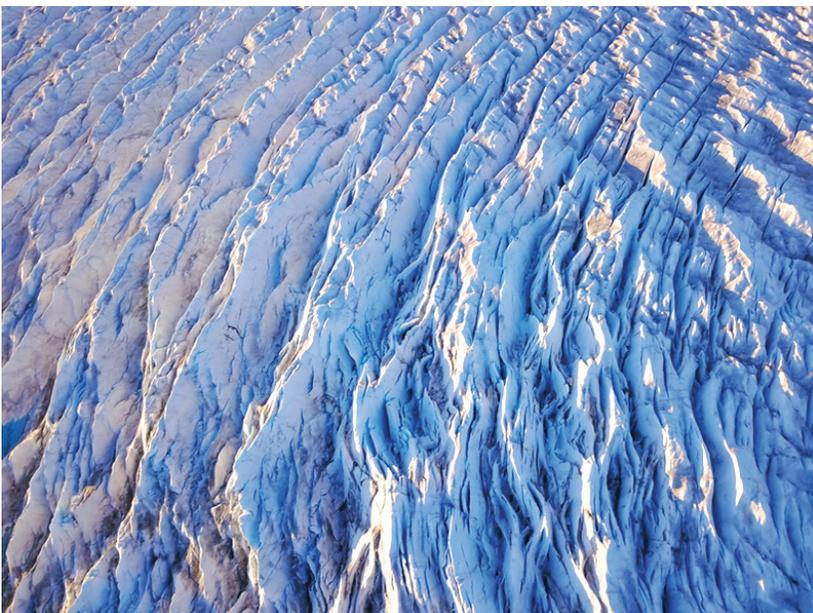
DRILLING INTO BEDROCK— AND HISTORY

Scientists are heading to Greenland to study a largely unexplored frontier: the bedrock that lies below the Greenland Ice Sheet. The GreenDrill team will bore through the ice in four areas of northern Greenland (mapped) to recover bedrock samples that lie beneath. Chemical clues in the rock could reveal new details about how the ice sheet responded to past periods of global warming. The data could improve predictions of global sea level rise in the 21st century.

GREENDRILL IS LED BY: *Lamont–Doherty Earth Observatory at Columbia University | University at Buffalo | University of Massachusetts Amherst | Penn State*

The project is funded by the National Science Foundation

VICTORIA FJORD
HIAWATHA MARGIN
PRUDHOE LAND
DRONNING LOUISE LAND
GREENLAND
500KM

Scientists are heading to Greenland to study the bedrock that lies below the Greenland Ice Sheet. They will be looking for clues in the rock that could reveal new details about how the ice sheet responded to past periods of global warming. The data could improve predictions of global sea level rise in the 21st century. Credit: Bob Wilder, University of Buffalo.

"For a long time, the climate science community has not paid enough attention to contributions from Greenland to sea level rise," said Gisela Winckler, a Lamont geochemist and GreenDrill co-principal investigator. "Now, it is increasingly clear that Greenland is like a canary in a coal mine, and this project will hopefully help us figure out potential impacts on sea level."

GreenDrill's extensive multi-year field campaign begins in 2021, stewarded by Nicolás Young, a Lamont geochemist, and Jason Briner, a University of Buffalo geologist, both GreenDrill also co-principal investigators. Recovering a series of cores at four locations in northern Greenland is the primary goal of these expeditions. Each site consists of a transect that starts at the ice-free edge of the island and moves inland, where the team will bore through hundreds of meters of ice to reach the bedrock below.

From these cores, the scientists will investigate pieces of Greenland's surface rock for the information they can yield about the ice sheet's past. When bedrock is free of ice, detectable isotopes produced by the interaction of cosmic rays with the nucleus of certain atoms accumulate in the upper layers of the rock after decades of exposure to the open sky. Analyses of these isotopes will show when and how the ice sheet receded.

Rob DeConto, a climate scientist at the University of Massachusetts at Amherst, will integrate the findings into models that simulate the ice sheets' physical processes and future behavior.

"It's absolutely critical that we know how much ice Greenland lost in the past—and this is still very uncertain," said DeConto. "GreenDrill will help reduce this uncertainty. This knowledge of the past informs us about the ice sheet's overall sensitivity to a warming climate and, hopefully, even how fast the ice sheet might melt in the future."

The project includes an extensive education and outreach component devoted to encouraging diversity and inclusion in the geosciences. Undergraduate students and early career scientists will be recruited to participate in the research.

The researchers see the project as a vital first step toward uncovering how ice sheets behave and respond to a warmer world.

"GreenDrill represents a new frontier in geoscience," said Schaefer. "I think it could be developed into a much broader flagship project that attracts scientists from other disciplines and expertise, and eventually covers all of Greenland."

Other scientists involved in GreenDrill include Lamont postdoctoral fellow Benjamin Keisling and education coordinator Margie Turin.

Undergraduate Scholarships & Awards

Joseph Berg Award for Undergraduate Research in Geosciences:
Mingsong Chen, Emily Kiver, Allysa Temple, Sydney Young

Barton P. Cahir Award:
Kelly Asselin

Frank Dachille Memorial Award in Geochemistry:
Dana Bloomfield, Abra Gold

Edwin L. Drake Memorial Scholarship:
Albina Alzhanova, Eric Anderson, Eric Jordan, Nate Lisanti, Whitney Marshall, Varsha Swami

General Scholarship Endowment in Geosciences:
Cassandra Barcz, Samuel Dikeumunna

David P. "Duff" Gold Undergraduate Scholarship Fund:
Qianyi Lu, Cissy Ming, James Regensburger

John C. and Nancy Griffiths Scholarship:
Joseph Barbusca, Kelly O'Donnell

James and Nancy Hedberg Scholarship:
Eric Anderson, Riley Foster, Angela Rodriguez, Angelina Santamaria, Edward Spagnuolo, Elijah St. Pierre, Faith Wotorson, Xiaoyu Zou

Arthur P. Honess Memorial Fund:
Abdulaziz Almansour, Mason Barner, Eric Kratzinger, Joseph Larock, Sarah Lehman, Margaret Maenner, Garrett Paley, Hunter Reeves, Daniel Teed

Benjamin F. Howell, Jr., Award:
Alexa Cunfer, Halina Dingo, Christian Erikson, Raheel Hadi, Elias Schroeder

Kappmeyer-Isaacs Field Camp Award:
Daniel Teed

Ronald A. Landon Endowment in Hydrogeology:
Austin Dilla, Katherine Wotus

Earle S. Lenker Fund for Field Studies in Geology:
Al Reem Alshimmari, Sam Elliot, Katie Reilly

Maureen and Dennis Maiorino Undergraduate Scholarship:
Brooke Allen, Amanda Bassett, Mathew Clifford, Kevin Johansson, Anna Lee, Hannah Luckenbaugh, Sarah Perez, Kathleen Shank

Thomas Kenneth (T.K.) Reeves, Jr. Family Scholarship:
Ali Wicks, Katerina Wood

Timothy and Cindy Mullen Scholarship in Geosciences:

Perez Family Undergraduate Scholarship:
Raquel Ellis

Robert F. Schmalz Award:
Melanie Barber, Holden Bell, Matthew Bromley, Olivia Budnovitch, Leevi Hansen, Maximillian Kasian, Lauren Moran, Leah Motimaya, Joshua Pangelinan

Julie and Trem Smith Family Undergraduate Scholarship: *Raquel Ellis*

Daniel and Deborah Stephens First-Time Endowed Scholarship:
Sabrina Blacklock, Allison Clark, Emma Stolinas

John and Elizabeth Holmes Teas Scholarship Fund:
Cameron Brown, Taylor Rosen, Nancy Weinheimer

Tim and Courtney Watson Undergraduate Scolarship:
Raquel Ellis

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Symantec Corporation
Verizon Foundation
Wells Fargo Foundation

Graduate Scholarships & Awards

Alley Family Graduate Scholarship:
Julia Carr, Joanmarie Del Vecchio, Michael Forgeng, Ian Lee

Chevron Scholarship:
Jacob Cipar, Troy Ferland, Xiaoni Hu

The Michael Loudin Family Graduate Scholarship in Geosciences:
Claire Cleveland, Copeland Cromwell, Victor Garcia, Judit Santana Gonzalez, Kaitlyn Horisk, Sofia Johnson

Krynine Memorial Award:
Safiya Alpheus, Benjamin Barnes, Adam Benfield, Chas Bolton, Shelby Bowden, Claire Cleveland, Elisabeth Clyne, Charlotte Connop, Clarissa Crist, Troy Ferland, Michael Forgeng, Judit Gonzalez Santana, Xiaoni Hu, Kayla Irizarry,Kalle Jahn, Heather Jones, Ian Lee, Erica Lucas, Kirsty McKenzie, Sierra Melton, Hailey Mundell, Emily Schwans, Samuel Shaheen, Andrew Shaughnessy, Srisharan Shreedharan, Kirsten Stephens, Claire Webster

Hiroshi and Koya Ohmoto Graduate Fellowship:
Julia Carr, Judit Santana Gonzalez, Kalle Jahn, Ian Lee, Hailey Mundell

Marathon Alumni Centennial Graduate Fellowship:
Raphael Affinito, Sarah Jonathan, Nolan Roth

Richard R. Parizek Graduate Fellowship:
Joanmarie Del Vecchio, Michael Forgeng, Samuel Shaheen, Srisharan Shreedharan

Scholten-Williams-Wright Scholarship in Field Geology:
Shelby Bowden, Kirsty McKenzie

Shell Geoscience Energy Research Facilitation Award:
Safiya Alpheus, Benjamin Barnes, Tsai-Wei Chen, Jasmine Eatmon, Troy Ferland, Xiaoni Hu, Mary Reinthal, Srisharan Shreedharan, Clay Wood, Zi Xian Leong

Richard Standish Good Graduate Scholarship:
Claire Cleveland, Aoshuang Ji, Mary Reinthal, Samuel Shaheen

Donald B. and Mary E. Tait Scholarship in Microbial Biogeochemistry:
Benjamin Barnes, Julia Lafond

Barry Voight Endowment:
Victor Garcia, Sofia Johnson

Awards, Recognitions, and Service

- **Adam Benfield** - Center for Landscape Dynamics Research Award
- **Julia Carr** - Grand Prize winner (one of eight) for the 2019 AGU Data Visualization and Storytelling Competition
- **Si Chen** - Stipend from the ASTRO research program at Oak Ridge National Laboratory (ORNL) and a free admission to NX School (National School on Neutron and X-ray Scattering)
- **Joanmarie Del Vecchio** - Winner of the 2019 Wiley Award from the British Society of Geomorphology
- **Alejandra Domic** - (postdoc)- Marie Curie award granted by the National Academy of Sciences of Bolivia
- **Jasmine Eatmon** - College of Earth and Mineral Sciences Graduate Fellow for Science Advocacy and Diversity for 2019-20 and 2020-21
- **Jasmine Eatmon** - College of Earth and Mineral Sciences Jay M. and Katherine Definis Outstanding Student Leadership Award
- **Troy Ferland** - 2019-2020 GSA Charles A. and June R.P. Ross Research Fund Recipient.
- **Victor Garcia** - GSA Graduate Geoscience Research Grant
- **Katie Horisk** - Cleveland Museum of Natural History Hoskins Grant
- **Sofia Johnson-Gutiérrez** - College of Earth and Mineral Sciences Graduate Fellow for Science Advocacy and Diversity for 2020-2021
- **Kirsty McKenzie** - AGeS2 Geochronology Research Award from GSA to quantify differential uplift across the Yaquina Bay fault, Oregon using Optically Stimulated Luminescence (OSL) of marine terraces sands.
- **Collin Oborn** - Earned an Honorable Mention for his NSF graduate student research fellowship application
- **Karen Pham** - National Science Foundation Graduate Research Fellowship Program
- **Emily Schwans** - Member of the Science Organization Committee for the International Thwaites Glacier Collaboration (ITGC) Next Generation meeting last year, a key effort as part of the large international ITGC.
- **Srisharan Shreedharan** - Schlanger Ocean Discovery Fellowship awardee for the 2019-20 year
- **Guangchi Xing** - Dr. and Mrs. S. Norman Domenico Scholarship by SEG

2020 Trustee Scholarships & Endowments

Alley Family Graduate Scholarship in the Department of Geosciences

Arthur P. Honess Memorial Award

Baker Hughes Natural Gas Research Fund

Barry Voight Volcano Hazards Endowment in the College of Earth and Mineral Sciences

Barton P. Cahir Award Endowment in Earth and Mineral Sciences

Benjamin F. Howell, Jr. Award in Geosciences

Bruce Miller Scholarship in the College of Earth and Mineral Sciences

Cannon Family Graduate Symposium Award in Geosciences

Charles E. Knopf, Sr. Memorial Scholarship

Chesapeake Energy Corporation Annually Funded Scholarship in Geosciences

Daniel and Deborah Stephens First-Time Endowed Scholarship

David M. Demshur Undergraduate Research Endowment in Geosciences

David M. Diodato Geosciences Fund

David P. "Duff" Gold Undergraduate Scholarship Fund in Geosciences

Donald B. and Mary E. Tait Scholarship in Microbial Biogeochemistry

Dr. David E. W. Vaughan and Mrs. Julianne S. Vaughan Field Camp Fund in the Department of Geosciences

Earle S. Lenker Fund for Field Studies in Geology

Edwin L. Drake Memorial Scholarship

Frank and Lillie Mae Dachille Memorial Award in Geochemistry

Fund for Excellence in Lithospheric Geodynamics in the College of Earth and Mineral Sciences

General Scholarship Endowment in Geosciences

George L. Ellis Scholarship

Geosciences Enrichment Fund

Geosciences Research Fund In Honor of Hiroshi Ohmoto

Heller Marcellus Shale Research Initiative Endowment

Hiroshi and Koya Ohmoto Graduate Fellowship in Geosciences

James and Nancy Hedberg Scholarship in Geosciences

Janet C. Kappmeyer and Andrew M. Isaacs Experiential Learning Fund in Marine Sciences in the Department of Geosciences

Jesse A. Miller Trustee Matching Scholarship in the College of Earth and Mineral Sciences

John and Elizabeth Holmes Teas Scholarship Fund

John C. and Nancy Griffiths Scholarship in Geosciences

Joseph Berg Award for Undergraduate Research in Geosciences

Julie and Trem Smith Family Undergraduate Scholarship

Kappmeyer-Isaacs Field Camp Award

Kent and Helen Newsham Geosciences Endowment in the College of Earth and Mineral Sciences

Lattman Visiting Scholar of Science and Society Endowment

Maureen and Dennis Maiorino Undergraduate Scholarship in the Department of Geosciences

Michael G. Loudin Trustee Scholarship in the College of Earth and Mineral Sciences

Michael Loudin Family Graduate Scholarship in Geosciences in the College of Earth and Mineral Sciences

Newsham Family Undergraduate Scholarship

Open Flow Gas Supply Corporation Endowed Program Fund in Geosciences

Perez Family Undergraduate Scholarship

Petroleum Geosystems Enrichment Fund

Pottorf Endowment for Graduate Excellence in Geosciences

R.J. Cuffey Fund for Paleontology

RADS Equipment Fund for Field Studies in Penn State Sedimentary Geology

Reif Undergraduate Summer Field Camp Endowment

Richard B. and Cynthia R. Alley Faculty Enhancement Program Fund

Richard R. Parizek Endowment for Field Study in Geosciences

Richard R. Parizek Graduate Fellowship

Richard Standish Good Graduate Scholarship in the Department of Geosciences

Robert F. Schmalz Award in the Department of Geosciences

Ronald A. Landon Endowment in Hydrogeology

Rudy L. Slingerland Early Career Professorship in the College of Earth and Mineral Sciences

Scholten-Williams-Wright Scholarship in Field Geology

South Jersey Resources Group Endowed Program Fund in Geosciences

St. Mary Land and Exploration Endowed Program Fund in Geosciences

The Paul D. Krynine Memorial Fund

Thomas F. Bates Undergraduate Research Enhancement Fund for Geosciences in the College of Earth and Mineral Sciences

Thomas Kenneth (T.K.) Reeves, Jr. Family Scholarship

Timothy and Courtney Watson Undergraduate Scholarship in the College of Earth and Mineral Sciences

Timothy B. and Cindy Lynch Mullen Scholarship in Geosciences

Timothy D. Watson Fund in Geosciences

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    Ms. Carolyn R. Stacy-Wilkin

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Note: This list is the compilation of contributiins received between July 1, 2019 through June 30, 2020.

Alumni News

Rick Abegg '83

Abegg has been selected to a position on the Exploration Review Team (ERT), Chevron's corporate exploration assurance team. The ERT assures standardized and consistent risk and volume assessments for the Chevron's worldwide exploration portfolio and reviews results of exploration wells. Abegg has relocated to The Woodlands, Texas, where he is currently working remotely from home.

John Ackerman '75

Ackerman received U.S. Patent 10,532,935 Water Harvester and Purification System and Method of Making and Using Same in January 2020. He was elected Fellow of theAmerican Society of Civil Engineers, Class of 2020. He was also elected Fellow, formerly known as the Distinguished Member Award,of theSociety for Mining, Metallurgy & Exploration, Class of 2021.

John Crook '81

Crook retired in April 2020. He was the former senior vice president of Environmental Health and Safety at Diversified Gas and Oil.

Rebekah Hoffner '14

Hoffner went on to graduate school at Philadelphia University, now called Thomas Jefferson University, to obtain a master's degree in disaster medicine and management. Currently, she is the emergency management coordinator at Primary Children's Hospital in Salt Lake City, Utah. She is responsible for all disaster preparedness planning, training, mitigation, and response. She wanted to work at a children's hospital because of THON and feels a strong connection to the hospital because of her experiences at Penn State.

Daniel Hummer '10

The past year has been extremely eventful for the Hummer family, but everyone is well. An exciting project assisting the American Museum of Natural History in New York to develop a new mineral exhibit occupied a portion of Hummer's 2019, as did some new research on the statistics of mineral compositions and symmetry types. Hummer continues to teach as a geology professor at Southern Illinois University, but with only online classes this fall. Last July, the Hummersmoved into a new house that better accommodates their growing family, and includes wonderful space for his father-in-law and his mineral and element collections.

Ken LaSota '77

In 1998, LaSota was elected mayor of the Borough of Heidelberg. He has since been reelected five times and is serving his twenty-second year as mayor. Heidelberg is located in Southwestern Pennsylvania, six miles southwest of Pittsburgh, has a population of 1,237, and was founded in 1903. LaSota was named Pennsylvania Mayor of the Year for 2020 by the Pennsylvania State Mayors Association.

Kent Newsham '78

Newsham was promoted to senior director of subsurface characterization and application and chief of petrophysicist last fall as part of Occidental Petroleum's (Oxy) acquisition of Anadarko Petroleum. He directs Oxy's rocks and fluids and petroleum systems teams and provides technical and career guidance to sixty global Oxy petrophysicists.

Newsham and Ronald Chemali, were awarded a provisional patent for the development of the Pulsed Neutron Scanner, PNS. Oxy is partnering with Core Labs for the development and commercialization of the PNS. The system will allow continuous measurement of whole core or core samples using a high-energy neutron accelerator and high-precision $CeBr3$ neutron detectors. The elastic portion of the measurement will provide elemental yields while the inelastic portion will provide porosity and water saturation information. Continuous measurement of whole core will occur while the core cylinders are still in the sleeves, providing rapid measurement and results. Measurements will include spectral gamma ray, continuous mineral composition, total porosity and total water saturation. The reduced cycle time, hours to days, will allow for results to impact operations decisions, which is not the current norm for most core tests. The minimal exposure time to evaporative processes will yield greater precision and accuracy of fluid saturations, currently one of the greatest challenges in tight oil and organic mudstone reservoirs.

Phil Throwbridge '13

Throwbridge is currently working for the University of Louisiana at Lafayette and the Louisiana National Guard. This past spring the team he is working with won an award from the National Military Fish and Wildlife Association.

Alumni Passings

Mr. Gregory Baron '58
Dr. Jen-Ho Fang '61
Dr. J. Chris Kraft '51
Mr. Everett K. Kaukonen '51

Dr. John W. Mgonigle '65
Dr. Howard P. Ross '63
Dr. Dale R. Simpson '56
Mr. Ronald F. Spamer '71

Faculty Awards

Charles Ammon
- G. Montgomery and Marion Mitchell Award for Innovative Teaching

Sridhar Anadakrishnan
- Wilson Award for Excellence in Research

Timothy Bralower
- George W. Atherton Award for Excellence in Teaching

Roman DiBiase
- Rudy L. Slingerland Early Career Professor of Geosciences

Katherine Freeman
- Nemmers Prize in Earth Sciences from Northwestern University

Michael Mann
- Stephen Schneider Lecture, American Geophysical Union (AGU) Fall Meeting
- World Sustainability Award, MDPI Sustainability Foundation
- Ten Most Influential Earth Scientists, Academic Influence
- Elected to National Academy of Sciences
- Louis J. Battan Author's Award, American Meteorological Society (AMS), for "The Tantrum that Saved the World"
- Top 100 Twitter Accounts, The Climate Group

Byron Parizek
- Delta Mu Sigma Honor Society's Susanne Waitkus Faculty Award for Academic Excellence

Christelle Wauthier
- Faculty Early Career Development Program (CAREER) Award from the National Science Foundation

Tieyuan Zhu
- E. Willard and Ruby S. Miller Faculty Fellow 2020

PennState
College of Earth
and Mineral Sciences

Department of Geosciences
The Pennsylvania State University
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About the cover

Graduate students in GEOSC 572 Field Stratigraphy hike toward Guadalupe Peak in Guadalupe Mountains National Park in Texas. The course, sponsored by Shell and taught by Mark Patzkowsky and Liz Hajek, teaches field-based data-collection methods for stratigraphy and sedimentary geology. The Guadalupe Mountains field trip offers students firsthand experience measuring and collecting data from siliciclastic and carbonate rocks deposited on a passive margin during the Permian, and shows students how stratigraphic prediction is relevant for understanding Earth history and exploring for energy resources.