



**PennState**  
College of Earth  
and Mineral Sciences

# Department of Geosciences

Newsletter 2021



# From the Department Head



Dear alumni and friends,

As I look back on another challenging year for the department, college and University, I want to convey my sincere thanks and appreciation to our dedicated faculty, staff, and students, as well as to our ever-supportive alumni and friends, for keeping our programs strong and moving the department forward in positive directions. In this newsletter, we profile several students (p. 4), pay tribute to AI GuOber, highlight a number of exciting education, research, and diversity and inclusion activities in the department (p. 12), and celebrate the accomplishments of many faculty and students who received awards (p. 27).

This past year we have made notable progress on many fronts as we recover from the pandemic, including the recruitment of students into our undergraduate and graduate programs, getting our lab and field research back on track, completing the renovation of labs in the basement of Deike, planning for another phase of major renovation involving the first, second, and fifth floors of Deike, and hiring several faculty. By the end of this academic year, we will have welcomed five new professors to our faculty, Ben Cardenas (sedimentology), Antonia Hadijmichael (data analytics, water and risk), Tushar Mittal (geomechanics,

planetary science), Anastasia Piliouras (sedimentology), and Josimar da Silva (rock mechanics, geophysics). And in 2023, Isabel Fendley (geochemistry) will be joining the faculty.

I would like to take this opportunity to highlight two additional significant achievements from this past year. In February, we added a new program in diversity, equity and inclusion (DEI) to the department to complement our undergraduate and graduate programs and bring greater focus to our efforts to improve the climate in and representation of the department. Associate Professor Liz Hajek, the inaugural associate head for DEI, is leading a dedicated committee of faculty, staff, postdocs, and students to develop new programs and activities encompassing all aspects of the department (p. 12).

In response to the growing importance of data analytics and visualization in the geosciences, several faculty (Sridhar Anandakrishnan, Tim Bralower, Chris Blaszczyk-Boxe, Brian Kelley, Max Lloyd) teamed up to develop a new undergraduate class (Geosc 210; Geoscience Data Analytics) to improve students' data skills and prepare them for advanced course work involving the analysis and modeling of large geoenvironmental data sets. This fall, Assistant Professors Brian Kelley and Max Lloyd have been teaching the course for the first time using a python-based coding platform and a variety of datasets to provide students experience with a range of data types and processing methods.

In closing, I would like to thank again everyone for the incredible support provided to the department this past year, and I look forward to hopefully seeing many of you in person in the coming year.

Sincerely yours,

A handwritten signature in black ink, which appears to read "Andrew Nyblade". The signature is written in a cursive, flowing style.

Andrew Nyblade

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**Editorial Director:** *Andrew Nyblade*

**Editor:** *Nicole Stocks*

**Contact Us:**

Department of Geosciences  
The Pennsylvania State University  
503 Deike Building  
University Park, PA 16802

Telephone: 814-865-6711

Fax: 814-867-2378

Website: [www.geosc.psu.edu](http://www.geosc.psu.edu)

Email alumni updates to  
[contact@geosc.psu.edu](mailto:contact@geosc.psu.edu)

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**COVER PHOTO**

Students and faculty conducting research in the new Deines Laboratory. See page 18 for more details.

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# Students in the Spotlight...



## Undergraduate Student Profile:

### Nancy Weinheimer

This year, I am graduating with a degree in geosciences from the College of Earth and Mineral Sciences after applying to and arriving at Penn State with different majors. I knew I wanted to study science in some way that would improve the sustainability of the human relationship with nature, but I couldn't find the right fit for me in other fields. I also knew I loved being outside and applying fundamental sciences to real time environmental problems. Luckily, a general academic adviser in the college pointed me toward the geosciences department. I was intrigued by the cutting-edge faculty research, the fieldwork opportunities in almost every course, and the inherent application of all subject matter to solving real-world problems. After meeting with Dr. Feineman and taking GEOSC 001, I knew that geosciences was exactly what I wanted to pursue. Throughout my time here, I have been involved in various research projects, even traveling to the Western Alps for fieldwork and presenting my results at the 2019 AGU Fall Meeting. I am so grateful for discovering my passion for geosciences here at Penn State!



## Master's Student Profile:

### Hanna Leapaldt

Growing up in small town in Minnesota, my affinity for lakes developed early. During grade school, my love for lakes was purely recreational and had nothing to do with science. In fact, science was my least favorite subject. Throughout high school, I switched “what I “wanted to be when I grew up” often, but a geoscientist was never an option. All I had was a simple goal of helping people in some way or another.

Eventually, I ended up getting my bachelor's degree in environmental science. Thanks to some incredible educators at my undergraduate alma mater—University of Minnesota, Duluth—I learned that surprisingly I could combine my love of lakes with my goal of helping people through a career in science. During my undergraduate studies, I did research that used lake sediment cores to help create records of climate variability in the Great Lakes region. These records can be used to help predict future climate variability in the region. I was captured by the fact that lake mud could help humans know how

to best prepare for future climate change.

Eager to stay involved with this work, I sought a master's degree working on the terrestrial paleoclimate archive. Here at Penn State, I have the opportunity to work under Miquela Ingalls, assistant professor of geosciences, doing just that. Our work is using the carbonate rich sediments of Green Lake, New York, to determine if microbes in sediment pores are changing what the sediments record.

Typically, paleolimnologists use chemical signals in lake carbonate sediment to reconstruct a history of environmental parameters surrounding the lake's region. These parameters include evaporation-precipitation balance of the region, the lake's primary productivity levels, and even past carbon dioxide levels to create a cohesive climatic history of the area. In the past, this work has focused solely on the physical and chemical contributions to the signals of the lake sediments.

Enter biology. It turns out that microbiology might contribute to lake carbonate signals just like other environmental parameters. When microbes are active in the sediment, they can cause carbonate to precipitate or dissolve. This

can change what signals the sediment records and could cause a biologic signal instead of the other typically interpreted environmental signals. My project is to use the Green Lake carbonates to tease apart the effects of biology from the effects of other environmental factors like the precipitation/evaporation balance. The end goal is to determine the characteristics of the carbonates—appearance, composition, grain size—that are more susceptible to a signal influenced by microbiology.

By determining which types of carbonates are most likely recording biologic signals versus other environmental parameters, I hope to contribute to a less exclusive or more accurate reading of lake sediment's chemical signals. This way, lake sediments will provide more informative climate records and better help predict future climate change in terrestrial spaces.

My favorite part of this work so far is the interdisciplinary nature of it. Geobiology is an up-and-coming field and very new to me. I've had the chance to do both traditional geochemical analyses and fascinating geobiological work on my samples. I've learned how to extract the DNA from the sediments so that they can be sequenced. Soon I'll get to learn how to interpret that sequenced DNA and figure out which microbial species are present in Green Lake. Since at Penn State, I've picked up that those microbes are unavoidably linked to mineral formation both past and present, so studying modern geomicrobiology seems one of the best ways to unlock even more secrets kept by the terrestrial rock record. And if I can continue to use lakes to do so, all the better.



## Doctoral Student Profile:

### Watsawan (Fai) Chanchai

I am a first-year graduate student from Phatthalung, Thailand. I enjoy warm weather and being in a paddy field. Rice is a key to my heart, but I also have fallen in love with carbonate rocks. I get excited every time I see limestones fizzing with acid, and I love that they also capture so much knowledge about ancient marine environments and past climates.

I study sedimentary geochemistry at Penn State with Dr. Kimberly Lau. The Cambrian explosion marks a major biotic turnover and involves an increase in animal disparity and diversity in fossil records. However, the role of environmental changes during the Ediacaran–Cambrian transition is strongly debated. We are using multi-redox proxies—uranium, cerium and iron—to reconstruct redox conditions across four different study areas—Nevada, Mexico, Mongolia, and South Africa. If the record of redox fluctuations is

primary and occurs globally, we can challenge the role of redox variability as a trigger to the biotic turnover.

This summer I will be working in the Laboratory for Isotopes and Metals in the Environment (LIME) to prepare my samples for rare-earth-element analysis and fly to Michigan State University to measure the iodine-to-calcium+magnesium ( $I/[Ca+Mg]$ ) ratios. Besides all the fun in lab, I will also travel to Colorado College to attend my bachelor graduation ceremony—Class of 2020. Whoo-hoo! I cannot wait to be in the mountains and meet all my friends and mentors. They are my biggest supporters and spark my interests in justice, equity, diversity, and inclusion work.

As an underrepresented student in my previous institution and major, I found a safe space with people who share similar experiences and perspectives. They listened to me and accepted me as I am. While there, I had an opportunity to grow, express my true self, and achieve my own goals. I am now part of the diversity, equity, and inclusion (DEI) committee in geosciences at Penn State because I want to amplify the voices of others, provide equitable resources, and support underrepresented groups in the geosciences. My ultimate goal is to provide accessible resources and build a community where we all can respectfully share opinions and make a positive impact in our own way.

For this past year in Happy Valley, I have gained tremendous support from faculty, staff, and our graduate students' community. Among all the uncertainties in this world, their positive energy is contagious and grounding. I am hopeful for my continuous journey here.

# In Memory: Dr. Albert Guber

by Michael Arthur, Terry Engelder, Hiroshi Ohmoto, Rudy Slingerland, and Barry Voight, all professors emeritus

The June 1963 newsletter of Penn State's College of Mineral Industries announced that a visiting professor of geology had been appointed for the spring term in the Geology and Geophysics unit of the colleges' Division of Earth Sciences. That visiting professor was Dr. Albert Lee Guber, a promising young paleontologist who recently graduated from the University of Illinois and was coming off a National Science Foundation postdoctoral fellowship at the Universities of Stockholm and Uppsala and Imperial College, London. It marked the start of an influential thirty-four-year career of teaching, research, and service. Al Guber retired in 1996 as professor emeritus of geology and died January 16, 2021, in Fredericksburg, Virginia, at the age of 85.

Al was born and raised in Heidelberg, Pennsylvania, south of Pittsburgh in the Pennsylvanian coal measures, where he first developed an interest in geology. He received his B.S. degree in geology from the University of Pittsburgh in 1957 and his doctorate in geology from the University of Illinois in 1962 with a dissertation somewhat enigmatically entitled, "*Some Richmond (Ordovician) Ostracodes from Indiana and Ohio.*"

After arriving at Penn State, Al continued his early work revolving around problems of sexual dimorphism, population structure, and taxonomy of Ordovician Ostracodes. But given his geological expertise he was quickly drawn into studies of western Pennsylvania coals, showing for example, that their sulfur content could be predicted by knowing the origin of their covering shales. By the early 1970s it had also become clear that Al was a superb teacher, particularly at the undergraduate level. In 1972 he helped create, and became the director of, Penn State's ten-week field and lab program at the Wallops Island Marine Science Consortium on the Virginia Eastern Shore. It was Al's conviction that hands-on problem definition, data collection, and hypothesis testing was the best training one could give the next generation. Consequently, the new program consisted of a sequential curriculum in marine engineering, coastal geology, and coastal



biology and ecosystems, all organized around particular problems to be solved by the students in the field and lab. Al conducted interviews during the winter quarter and selected about fifty students from a range of discipline backgrounds including biology, geology, geophysics, Earth science, education, and business. Al and the students then spent the spring term living and working together at the Wallops Field Station as other faculty came and went. As one student said, "The program was what a university should be all

about but never usually is—a place for learning and working together towards a mutual understanding of some process or processes."

In recognition of this innovative and effective program, Al received Penn State's highest teaching award in 1974, the Lindback Award for Distinguished Teaching. His continuing efforts were also acknowledged by the college's Wilson Teaching Award, and in 2020 his former students endowed the Al Guber Program Fund in the College of Earth and Mineral Sciences in recognition of his life-long impact.

## Reflections from emeriti faculty

Although all of us were fond colleagues of Al, we knew him in different ways. Rudy Slingerland was initially a student early in Al's teaching and research career. Mike Arthur first met Al when he came to Penn State as department head in 1991, and Al held the position of associate head for undergraduate programs in the department. Rudy, Mike, and Barry Voight taught with Al in the Wallops Marine Science Program over parts of its history—Rudy and Barry during its early phase as a term course on coastal ecology, engineering, and geology, and Mike in its last few years as a three-week long component of a more extensive Marine Science curriculum. Hiroshi Ohmoto worked closely with Al during the multi-year Kuroko research project, and Barry and his family were close friends with Al and his family. Al was Terry Engelder's undergraduate adviser and was instrumental in guiding him into the geosciences.

In 1977, Hiroshi had just returned from a sabbatical leave in Japan where his research focus was the origin of the Kuroko deposits, which were thought to be formed by submarine hydrothermal fluids that were discharged in shallow marine basins. The “evidence” was the findings by some paleontologists of microfossils of “shallow-sea” benthic foraminifera in mudstones that were interbedded with the massive sulfide ores. However, he was unhappy with the shallow-sea model. As Hiroshi says, “I took the list of foraminifera fossils from the Kuroko district to Al and asked if he would evaluate the data. Al found that the list contained widely different groups of foraminifera, some that lived in shallow seas and some that lived in very deep oceans and suggested the only plausible explanation for such mixtures is that the formation environment for Kuroko deposits was a very deep seafloor where shallow-sea sediments were transported as turbidites. After the Kuroko Project, our research interests went separate ways, but our friendship endured, with conversations about our respective fields, football and wine, and our families. Beyond the science and the teaching, we most remember Al as a wonderful colleague and friend.”

Barry and MaryAnne Voight said, “Al and Nancy and their two kids, Al Jr. and Lisa, were favorite persons of ours since the 1960s at Penn State. We have many memories of dinners and random visits to their Boalsburg home, and to Al’s Master Gardener productions in his backyard farm. He was such a generous and kind guy! And talented too, in his office work, and in his cellar wine laboratory! What is chemistry for, if not for that? At home with his vineyard and after grape collection expeditions, he demonstrated great skill with developing white wines, and thereby had earned many wine society awards. We commonly returned home from his place in Boalsburg with fresh veggies in a stuffed bag, and bottles of fresh good wine in our pockets. Upon hearing of his death, we went to our Atherton Street wine store and got bottles of fine New York State white with which to toast this memory. We’d much rather have gotten an Al original, but we can’t get them anymore.” Al was an accomplished amateur wine maker and ranked among the American Wine Society’s top fifteen amateurs for several years.

Mike Arthur said, “I arrived at Penn State in early 1991, and Al retired in 1996, but it seemed as though we had known each other for decades. After Al grilled me about my interest and dedication to teaching undergraduates, it didn’t take long before Al had me teaching Geosc 040, Oceanography, and the Wallops 3-week course in the Marine Science Program. Soon we were taking trips to wineries near Lake Erie to procure wine grapes for fermenting and talking extensively about departmental issues, teaching, and geology.”

Rudy Slingerland said, “As a young graduate student, I had the pleasure to watch Al sit in the faculty office at Wallops and kibitz with Gene Williams and Bob Schmalz. It was clear Gene and Bob loved Al for his earnestness, his enthusiasm for our science and the teaching of it, and for his warm and caring concern for his colleagues and students. Could we all be such good colleagues...”

Terry Engelder said, “My wife of 51 years, Janice (Wicks), and I knew Professor Albert Guber almost from the beginning of his distinguished career at Penn State. Our long relationship started soon after his arrival in Happy Valley in the early 1960s.

I arrived on campus early in the fall of 1964 as an athlete, a recruited distance runner. The academic nature of the University was not a major factor in my decision to enroll at Penn State. Furthermore, I had no idea that the Division of Earth Sciences, of which Al Guber was a member, was one of the more highly ranked academic units with a focus on geosciences in the nation. At the time Al was the low man on the faculty totem pole and was charged with advising new students and talking to those who might walk in randomly off the street. Although I had not declared as a geosciences major, Al recommended the usual courses for an incoming freshman who had an inkling that geology was his cup of tea. Arguably, the biggest effect that Al had on me was indirect at best. I met my future wife, Janice Wicks, the semester she was taking Al’s general education class, GEOSC 40. Al was a good cook and brought his passion into the classroom. In GEOSC 40, he was asked how the folds of the Appalachian Valley and Ridge were formed. Back then, gravity tectonics was the favorite explanation, championed by Penn State’s Rob Scholten. Al used a thin crust of pie dough sliding on a base of flour. Lifting the end of the table, Al got the dough to slid downhill against piece of wood clamped to the edge of the table. The pie dough wrinkled in a series of folds much like the view of the area around State College from an airplane at 35,000 feet. Years later Al and his wife, Nancy, were our hosts when we returned to State College on a house-hunting trip, and we actually got to eat a piece of that pie.”

After retirement Al and Nancy continued to live in Boalsburg where Al served on the Boalsburg water board for years. They ardently followed Penn State and Pittsburgh sport teams, particularly Penn State women’s basketball. In 2010 they moved from State College to Virginia to be closer to family and where Nancy preceded Al in death. Al is survived by his daughter, Lisa D’Albis and her husband Michael, Al’s son Albert Lynn Guber and wife Kendra, a sister, Marlene Gibson of Pittsburg, Pennsylvania, and his five granddaughters, Alexandra, Brianna, Olivia, Chenin, and Kate.

# Fund honors legacy of geoscientist who started Wallops Island course

by David Kubarek

There's an old adage that goes if you can instill in someone a piece of advice, a bit of knowledge, then through them that lives forever. What you started passes on through generations.

That's fitting for the life and legacy of former Penn State geoscientist Al Guber, who died in January after leaving a lasting mark for decades on his students.

There's perhaps no greater example than the students who took part in Guber's ten-week "live-in" field program to study the coastal and marine ecosystems at Wallops Island located on the Eastern Shore of Virginia.

Many former students who attended Guber's course in 1977 still keep in touch—even organizing a forty-year reunion in 2017—and are grateful for the impact Guber had on their lives.

That gratitude was paid back with the establishment of the Al Guber Program Fund, which promotes experiential learning opportunities within the college. The fund is expected to increase and later provide direct financial assistance for students within the college.

Kent Newsham, who graduated in 1978 with a degree in geosciences, is one of the members of the Wallops class of 1977. He said the course was

a chance for him to get to work closely with Guber and other faculty members, learn the rigors and ropes of field work, and research and to advance his geosciences career.

Newsham, who is a chief petrophysicist at Occidental Petroleum, said Guber's dedication to the course and to his students was great for those interested in the field but came at the expense of Guber's own career.

"He had this tremendous vision and yet as an untenured professor at the time it cost him personally. I'm convinced of that," Newsham said. "But on the flip side, I think everybody recognized Al as our



Students who attended Al Guber's 10-week Wallops Island course in 1977 recently created the Al Guber Program Fund in his honor. Former Penn State geoscientist Guber died in January after leaving a lasting mark for decades on his students.

*Photo courtesy Kent Newsham.*

consummate educator, and we want to honor and celebrate him for that.”

For years, beginning in the late 1970s, Guber oversaw the Wallops Island course. As director, each year he interviewed more than 600 interested students for about 60 slots. Those selected students—pulled from a diverse variety of disciplines—traveled to the island to take part in a week of condensed coursework, followed by field and group work along the Wallops and Assateague coastlines.

The course was a chance to learn about coastal ecology and work with others outside of their disciplines, much like they would do in the field.

Brian Dade, a 1978 graduate in mineral economics and Earth sciences, said the course was an intense exposure to marine engineering, coastal oceanography, geology, and ecology. He said the course encouraged students to design and conduct their own field studies, rather than simply handing them assignments. That process—and the chance to work with scientists and be exposed to the research—helped in his path to becoming a geoscientist. He returned to Penn State and earned his master’s degree in geology in 1983. He retired in 2016 as an associate professor of Earth sciences at Dartmouth.

“These were all hugely formative experiences for me, ones in which Professor Al Guber figured large as a dedicated educator, a dedicated scientist with broad-ranging interests, and a thoughtful mentor and ‘troop leader’ for his students,” Dade said.

Janet Kappmeyer, a 1979 graduate in geosciences, remembers her first year at Penn State taking a

course with Guber. She originally dreamed of majoring in music—driven by her love of the flute—but “fell back” on an interest in geosciences. Guber’s passion for the science solidified hers, and she changed her major to geology immediately.

“He just explained things so clearly and made all aspects of geology really interesting to me,” Kappmeyer said. “He spent a fair bit of time on plate tectonics, which I just found so incredible. And it was fairly early on in the acceptance of that theory.”

In that course, Guber showed pictures of some of the world’s most fascinating geological sites. One slide included Wallops Island, and that caught Kappmeyer’s attention. She made a note to apply for the Wallops program as soon as she was eligible, her sophomore year.

Her work at Wallops led to a career as an environmental consultant after working a brief time with Exxon’s offshore exploration group. About fifteen years ago, she earned a degree in viticulture and enology from the University of California, Davis. She now works for Constellation Brands, a major beverage producer. Coincidentally, home winemaking is a hobby she and Guber shared.

Kappmeyer said she learned a lot during her Wallops experience. That’s something she had a chance to thank Guber for personally before his passing. One thing that stuck with her most was the concept of the knock-on effect. That’s when a seemingly small change to the environment can cascade down to create massive changes elsewhere.

At Wallops Island, an example of the knock-on effect they learned was when offshore jetties catch

southward-bound sediment they rob the coastline to the south and create massive erosion. It’s similar to when an educator captures your attention and puts your life on a completely different career path. And the concept is something that drove her career, particularly focusing on the environmental impact of engineering projects.

“Everything is hyperconnected,” Kappmeyer said. “And when you perturb the system in one place, you can really force change in another place. I think, for me, that was probably the key takeaway. I mean, there were so many wonderful, little tidbits that we learned. But I think that overall overarching issue was really prevalent, at least for me as a physical scientist.”

*Contributions to the Al Guber Program Fund will advance “A Greater Penn State for 21st Century Excellence,” a focused campaign that seeks to elevate Penn State’s position as a leading public university in a world defined by rapid change and global connections. With the support of alumni and friends, “A Greater Penn State” seeks to fulfill the three key imperatives of a 21st-century public university: keeping the doors to higher education open to hardworking students regardless of financial well-being; creating transformative experiences that go beyond the classroom; and impacting the world by serving communities and fueling discovery, innovation and entrepreneurship. To learn more about “A Greater Penn State for 21st-Century Excellence,” visit <https://greaterpennstate.psu.edu/>.*

# Couple establishes fund to support student research in interdisciplinary science

by Francisco Tutella

Marilyn Fogel, who graduated in 1973 with a degree in biology, may have come to Penn State for the football games, but she left with an appreciation for the interdisciplinary research that would define her career.

Now, she and her husband, Christopher Swarth, aim to get more Penn State students engaged in interdisciplinary research through the establishment of the Marilyn L. Fogel Student Research Fund in Biogeosciences.

Biogeosciences combines the fields of geoscience and biological science to answer questions about the modern world and living ecosystems as well as the beginnings of life on Earth. The couple's \$25,000 gift will support research activities for undergraduate and graduate students affiliated with the Earth and Environmental Systems Institute in the college and will have a particular emphasis on enabling field or laboratory research focused on geology, ecology, meteorology, biogeochemistry, climate science, and geography.

"Chris and I are thrilled to have the opportunity to create an endowed fund that promotes biogeosciences in the Earth and Environmental Systems Institute," said Fogel. "We know the importance of providing opportunities for students to experience thinking outside of a traditional scientific field and open their minds to a new way of critical thinking."

Fogel enrolled at Penn State as a biology major, but she found her calling as a biogeochemist after taking several classes that sparked an interest in the study of the origins of life, including courses in paleobotany, coal petrology, and physical geology.

Two courses in particular had a profound impact on her career trajectory. Fogel took part in Penn State's Wallops Island Marine Science program in its inaugural year in 1972. The program, with its emphasis on fieldwork on the island's marshes, beaches, and coastal waters, confirmed for Fogel that she wanted to do research with a fieldwork component.

She also enrolled in an organic geochemistry class taught by the late Peter H. Given, professor emeritus and first chair of the former Fuel Science Program in the Department of Materials Science and Engineering. There she learned to apply her knowledge of chemistry to understand the biological, environmental, and ecological processes that shaped life on Earth.

"I was fascinated with the instruments, the methods and the papers that I encountered in that class," said Fogel, who would apply this knowledge throughout her career studying tiny particles called stable isotopes to understand the processes that shaped modern and ancient ecosystems. "When I started in geochemistry, I wasn't at all interested in using stable isotopes for my research, but that certainly changed when I went to graduate school."

Fogel received her doctorate in botany and marine sciences from the University of Texas at Austin in 1977 and shortly thereafter became a staff scientist at the Geophysical Laboratory at the Carnegie Institution for Science in Washington, D.C. She worked there for thirty-five years, becoming a leading expert in stable isotope chemistry and a pioneer in the emerging biogeosciences field.



Her work has led to breakthroughs in multiple disciplines, including paleoecology and climate change, astrobiology, and modern ecosystem studies.

Swarth holds bachelor's and master's degrees in zoology and biology and spent his career directing nature reserves, first as director of the Jug Bay Wetlands Sanctuary in Maryland and then as reserve director of the Merced Vernal Pools and Grassland Reserve in Merced, California, up to his retirement in 2016.

In 2013, Fogel became a professor at the University of California, Merced, and in 2016 accepted a position at UC Riverside, where she is professor emerita in Earth and planetary sciences and still directs the Environmental Dynamics and Geo-Ecology Institute.

Fogel and Swarth have made gifts to the Earth and Environmental Systems Institute over the years and have appreciated the notes and photographs they've received from students whose research they have supported.

"The specifics you hear back about how your money was used makes you feel good and makes you realize that your funds were needed and used to accomplish important education and research," said Swarth.

# Deep, slow-slip action may direct largest earthquakes and their tsunamis

by Andrea Elyse Messer

Megathrust earthquakes and subsequent tsunamis that originate in subduction zones like Cascadia — Vancouver Island, Canada, to northern California — are some of the most severe natural disasters in the world. Now a team of geoscientists thinks the key to understanding some of these destructive events may lie in the deep, gradual slow-slip behaviors beneath the subduction zones. This information might help in planning for future earthquakes in the area.

“What we found was pretty unexpected,” said Kirsty A. McKenzie, doctoral candidate in geosciences,

Unlike the bigger, shallower megathrust earthquakes that move and put out energy in the same direction as the plates move, the slow-slip earthquakes’ energy may move in other directions, primarily down.

have moved, accumulating that slip deficit,” said Kevin P. Furlong, professor of geosciences. “For these slow-slip earthquakes, the direction of movement is directly downward in the direction of gravity instead of in the plate motion directions.”

The researchers have found that areas in New Zealand, identified by other geologists, slow slip the same way Cascadia does.

“But there are subduction zones that don’t have these slow-slip events, so we don’t have direct measurements of how the deeper part of the subducting plate is moving,” Furlong said. “In Sumatra, the shallower seismic zone, as expected, moves in the plate-motion direction, but even though there are no slow-slip events, the deeper plate movement still appears to be primarily controlled by gravity.”

Slow-slip earthquakes occur at a deeper depth than the earthquakes that cause major damage and earth-shaking events, and the researchers have analyzed how this deep slip may affect the timing and behavior of the larger, damaging megathrust earthquakes.

“Slow-slip earthquakes rupture over several weeks, so they are not just one event,” McKenzie said. “It’s like a swarm of events.”

According to the researchers, in southern Cascadia, the overall plate motion is about an inch of movement per year and in the north by Vancouver Island, it is about 1.5 inches.



Map of the Cascadia subduction zone. Credit: Public Domain

Subduction zones occur when two of the Earth’s plates meet and one moves beneath the other. This typically creates a fault line and some distance away, a line of volcanoes. Cascadia is typical in that the tectonic plates meet near the Pacific coast and the Cascade Mountains, a volcanic range containing Mount St. Helens, Mount Hood, and Mount Rainier, forms to the east.

According to the researchers, a megathrust earthquake of magnitude 9 occurred in Cascadia in 1700 and there has not been a large earthquake there since then. Rather, slow-slip earthquakes, events that happen deeper and move very short distances at a very slow rate, happen continuously.

“Usually, when an earthquake occurs, we find that the motion is in the direction opposite to how the plates

“We don’t know how much of that thirty millimeters (one inch) per year is accumulating to be released in the next big earthquake or if some movement is taken up by some non-observable process,” McKenzie said. “These slow-slip events put out signals we can see. We can observe the slow-slip events going east to west and not in the plate motion direction.”

Slow-slip events in Cascadia occur every one to two years, but geologists wonder if one of them will be the one that will trigger the next megathrust earthquake.

The researchers measure surface movement using permanent, high-resolution GPS stations on the surface. The result is a stair step pattern of loading and slipping during slow-slip events. The events are visible on the surface even though geologists know they are about

twenty-two miles beneath the surface. They reported their results in Geochemistry, Geophysics, Geosystems.

“The reason we don’t know all that much about slow-slip earthquakes is they were only discovered about twenty years ago,” Furlong said. “It took five years to figure out what they were and then we needed precise enough GPS to actually measure the motion on the Earth’s surface. Then we had to use modeling to convert the slip on the surface to the slip beneath the surface on the plate boundary itself, which is bigger.”

The researchers believe that understanding the effects of slow-slip earthquakes in the region at these deeper depths will allow them to understand what might trigger the next megathrust earthquake in the area. Engineers want to know how strong shaking in an earthquake will be, but they also want to know the direction the forces will be in. If the difference in direction of slow-slip events indicates a potential change in behavior in a large event, that

information would be helpful in planning.

“More fundamentally, we don’t know what triggers the big earthquake in this situation,” McKenzie said. “Every time we add new data about the physics of the problem, it becomes an important component. In the past, everyone thought that the events were unidirectional, but they can be different by forty or fifty degrees.”

While the slow-slip events in Cascadia are shedding light on potential megathrust earthquakes in the area and the tsunamis they can trigger, Furlong thinks that other subduction zones may also have similar patterns.

“I would argue that it (differences in direction of motion) is happening in Alaska, Chile, Sumatra,” said Furlong. “It is only in a few that we see the evidence of it, but it may be a universal process that has been missed. Cascadia exhibits it because of the slow-slip events, but it may be fundamental to subduction zones.”

## Creating an inclusive department

The department’s new Diversity, Equity, and Inclusion (DEI) committee formed in spring 2021. The committee aims to coordinate, expand, amplify, and support efforts to broaden justice, equity, diversity, and inclusion (JEDI) within our community. The committee includes faculty, staff, post doc, graduate student, and undergraduate student representation, and serves as a resource and sounding board for the department

Committee members include: Liz Hajek associate head for DEI, Sridhar Anandakrishnan professor, Chris Boxe, associate research professor, Chelsie Bowman, postdoctoral scholar, Cameron Brown, undergraduate student, Fai Chanchai, graduate student, Maureen Feineman, associate research professor, Kim Lau, assistant professor, Angelina Santamaria, undergraduate student, Nicole Stocks, alumni relations and industry recruiting coordinator, and Jasmine Walker, graduate student.

Realizing our departmental vision of building a truly inclusive and supportive environment requires both cultural change and broader representation within our community. To these ends, the DEI committee aims to engage in activities such as: supporting undergraduate and graduate admissions and recruitment efforts; developing, reviewing, and revising departmental policies and practices for recruiting, hiring, and mentoring; supporting efforts to secure external funding for DEI-related programs including research opportunities for undergraduates (REUs); facilitating relationship-building and scientific partnerships with faculty and students at minority serving institutions and the Penn State Commonwealth campuses; improving awareness and

knowledge of JEDI-related issues among department community; help with literacy and skill building for individuals; and organizing activities and events to build community and increase feelings of appreciation and inclusion of all members of the department.

Nationally, the urgency of prioritizing JEDI progress in geosciences was elevated by the NSF-funded Unlearning Racism in Geosciences (URGE) initiative in early 2021. URGE had approximately 4,500 participants in more than 300 groups or “pods” spanning a wide range of geoscience departments, organizations, and companies. This program included scholarly readings, personal accounts, interviews with experts, and practical tips organized around important themes of how racism impacts geoscience.

The curriculum was designed to prepare groups to take actionable steps to dismantle systems that perpetuate the exclusion of Black people, Indigenous people, and people of color (BIPOC individuals) in geoscience communities. Penn State geosciences participated with an active pod of more than twenty-five members spanning all ranks of the department.

In addition to producing draft deliverables (view online at: <https://urgescience.org/pods/penn-state-geosciences/>), this experience provided community building opportunities by allowing different groups of students, faculty, and post docs to engage and get to know one another.

During the year, the DEI committee will be facilitating expanded engagement with the URGE program for the department as a platform for continued education, discussion, community engagement, and policy change.

# Penn State alum Lenker committed to an affordable geosciences field camp experience

by David Kubarek

Earl “Skip” Lenker is passionate about lifelong learning. After graduating from Dartmouth College in 1956 and earning his doctorate in geosciences from Penn State in 1964, the lifelong educational journey continued.

He spent his career in education, first teaching at Cornell University before moving on to teach at Wilton High School in Connecticut.

Since retiring, Lenker has focused his philanthropy on helping students advance their careers. His support to Penn State touches several areas. Within the department, Lenker has established a fund to help undergraduate students cover the costs of the six-week field camp experience, which is a requirement for all geoscience bachelor of science majors, and endowed a graduate student fellowship. He has also provided funding for undergraduate student interns who help care for The Arboretum at Penn State.

Lenker, who conducted trace element analyses during his career and spent notable time in the field, understands the importance of hands-on learning for students. He even has attended Penn State field camp to lead some of the exercises.

“Throughout my career I’ve always been drawn to sharing with students what excites me about the field of geology,” Lenker said. “It’s something I enjoyed at the college level, and the high school level, and continue to do through Penn State’s field camp.”

Penn State’s commitment to field camp, said Donald Fisher, professor and director of the field camp, comes at a financial expense for the students. However, he said the ability to gain field experience while participating in hands-on learning more than outweighs the costs.

The field camp endowment created by Lenker is a tremendous financial resource that helps to offset the costs of tuition and travel for many students, making the field camp affordable.

Fisher said the pandemic—which forced a virtual field camp experience in 2020 and a more regional approach in 2021—showed educators the importance of the Western U.S. field experiences provided by the camp. He said field camp is a chance to live out the lessons they learned in class. And the dry, exposed outcrops of the Rocky Mountains offer an unparalleled view of the geological forces at play. Students gather data by day and, using software such as ArcGIS, analyze their data by night.

“These are spectacular places with great rock exposure,” Fisher said. “Students are able to explore landscape processes that are very difficult to study in the east. Out west, it’s easy to find places where students can map, and, on their own, figure out what the geology of the area is simply by surveying the outcrop.”

Fisher said financial assistance opens doors for more diversity in geosciences. Organizers have been able to minimize costs by utilizing ski resort lodging in the offseason and have a longstanding partnership with Yellowstone Bighorn Research Association. Students camp and cook their own meals for much of the trip. But tuition, travel, and the inability to work during the summer make field camp prohibitive for some.

Helping students get the most of their Penn State experience, said Sue Powell, director of development and alumni relations for the college, has been Lenker’s passion for decades.

She said Lenker understands that many universities throughout the country have reduced or eliminated their field camp due to financial constraints, and he’s determined to not let that happen at Penn State.

As a former graduate student, Lenker also knows the connections these students make with both faculty members and graduate students whom they shadow during the experience.

Powell hears from alumni countless vivid, life-changing memories they had while participating in field camp. That’s no surprise, she said, given that field camp comes as they’re nearing the end of their college experience and beginning to define their own career paths.

Powell said Lenker wants to protect and promote these out-of-classroom experiences.

“His ultimate goal is to help students and have a positive effect on their education,” Powell said. “Dr. Lenker’s legacy for undergraduate education will allow for this beloved tradition to continue for many years to come.”





Class at Taughannock Falls, New York. Credit: Don Fisher

## Field Camp 2021

The Penn State Summer Field School in Geosciences has been hampered by travel restrictions over the last two years due to the ongoing COVID-19 pandemic, and we were unable to travel out to the intermontane Rocky Mountains familiar to many recent alumni.

Nevertheless, in summer 2021, we incorporated new field exercises in the Appalachians along a transect from upstate New York, across the Valley and Ridge province of Pennsylvania, to the Piedmont province of Maryland. These field trips supplemented a set of virtual exercises developed over the past two years in response to the pandemic. By integrating geologic datasets—geochronology, paleomagnetism, isotopic data—with virtual field trips in Google Earth, the students applied many of the principles they learned in the core of our undergraduate curriculum. Along the way, they also honed their skills in using GIS and other software tools used by professional geologists.

The first half of field camp, taught by Erin DiMaggio and Roman DiBiase, began with virtual exercises that involved mapping, stratigraphic analysis, and cross section construction in the Bighorn Basin. Another virtual exercise explored the tectonic and glacial geomorphology of Jackson Hole at the foot of the Teton

Range, building on field data collected during previous class trips. There were two local field exercises in central Pennsylvania, and the course culminated in a camping trip to the Finger Lakes region of upstate New York, with exercises focused on the stratigraphy of middle Paleozoic and Quaternary landscape evolution.

Don Fisher, Andy Smye, Maureen Feineman, and Jesse Reimink taught the second half of field camp. It included virtual exercises related to metamorphism in the Western Alps; the structural, volcanic, and thermal history of the Pioneer core complex region in Idaho; cross section construction in the Sevier overthrust belt; and the isotopic systems of the Western Cordillera.

Field exercises included the stratigraphic record of the Taconic orogeny and the metamorphic and geomorphic history of Great Falls and the Maryland Piedmont region—with a guest appearance from Professor Emeritus Rudy Slingerland and Columbia Professor Terry Plank.

Next year, with Penn State now back to in-person teaching, we intend to return to a field-based course in Montana, Wyoming, Idaho, and Utah. Many of our efforts over the last two years with GIS and new datasets will be used to enrich these field exercises.

# Barnes Professorship

A new endowed professorship in the department honors the legacy of husband-and-wife Penn State researchers, one a distinguished professor emeritus in the department.

The Dr. Hubert Barnes and Dr. Mary Barnes Professorship in Geosciences was funded with a \$1 million gift from the Barnes family.

“Penn State could not have been nicer to us throughout our careers,” Hubert Barnes said. “We both believed this endowment was a fitting way to give back and to support the work of the excellent faculty in the geosciences department. There’s a reason our department is ranked among the best in the world, and the evidence of that are the people.”

Hubert Barnes joined Penn State in 1960 and retired as a distinguished professor in 1997. In his retirement, he has continued his research and often works from his office in the Deike Building. He was named an honorary alumnus in 2016. Barnes received his bachelor of science from Massachusetts Institute of Technology in 1950 and his doctorate from Columbia University in 1958.

Mary Barnes, who died in 2017, was a research assistant at Penn State who studied radioactive waste disposal and cement chemistry. She received a bachelor of science from Swarthmore College in 1948 and a doctorate in chemistry from Penn State in 1966.

Barnes said he hopes the endowment helps the department continue its work teaching about natural resources and geochemistry.



## Brantley named inaugural Barnes Professor

Susan Brantley, professor of geosciences and director of the Earth and Environmental Systems Institute, was selected to receive the inaugural Dr. Hubert Barnes and Dr. Mary Barnes Professorship in Geosciences.

“Hu Barnes is one of the most well renowned and highly regarded geochemists in the world,” Brantley said. “I hope I can live up to his example of excellent science.”

The Barnes’ gift represents the first endowed professorship in geosciences. It joins an early career professorship already established in the department—the Rudy L. Slingerland Early Career Professor of Geosciences.

Brantley is a world leader in studying the chemical, physical and biological interactions that occur between rock, water, air, and living organisms in the thin layer of earth known as the critical zone. The critical zone extends from the tallest trees to the deepest groundwater and the complex reactions that happen there impact life-sustaining resources like food production and water quality.

Brantley received a bachelor of arts in chemistry, a master of arts in geological and geophysical sciences, and a doctorate in geological and geophysical sciences,

[www.geosc.psu.edu](http://www.geosc.psu.edu)

all from Princeton University.

“Susan Brantley is an exceptional scientist and leader, and this professorship is a well-deserved recognition,” said Lee Kump, John Leone Dean. “It is fitting that Hu Barnes, another remarkable geoscientist, and his late wife Mary made this position possible. We thank the Barnes family for their tremendous generosity.”

“I was genuinely happy to have both Hu’s and Mary’s names as part of this professorship,” Brantley said. “I was the first woman to get tenure in geosciences at Penn State, so having ‘Dr. Mary Barnes’ in the name feels right. And Hu Barnes was the doctoral adviser for my doctoral adviser, David Crerar. This truly brings my career full circle.”



# Global pollen samples reveal vegetation rate of change

by Andrea Elyse Messer

Ancient pollen samples and a new statistical approach may shed light on the global rate of change of vegetation and eventually on how much climate change and humans have played a part in altering landscapes, according to an international team of researchers.

“We know that climate and people interact with natural ecosystems and change them,” said Sarah Ivory, assistant professor of geosciences and associate in the Earth and Environmental Systems Institute. “Typically, we go to some particular location and study this by teasing apart these influences. In particular, we know that the impact people have goes back much earlier than what is typically accepted as the case. However, we haven’t been able to observe the patterns created by these processes globally or long-term.”

Over the past one hundred years, researchers have collected datasets of fossil pollen samples from coring existing and dried-up lakes. In the current study, rather than looking at collections from individual sites, the researchers looked at the world-wide compilation of pollen data. They examined 1,181 fossil pollen sequences using a statistical approach that is an extension of standard practices, but that uses a 500-year rolling window to determine how much and how quickly vegetation changed through time in locations around the world.

One early, major change in vegetation is seen when the most recent glaciers began to melt. Pollen changes during this period show significant vegetation change. Although there were humans around at the time, they mostly lived in what are now the tropics or were widely dispersed. The magnitude of vegetation change seen suggests that at this point, climate changes were responsible.

Another major signal of vegetation change appears with the expansion of agriculture, which is usually considered to have occurred 3,000 to 4,000 years ago.

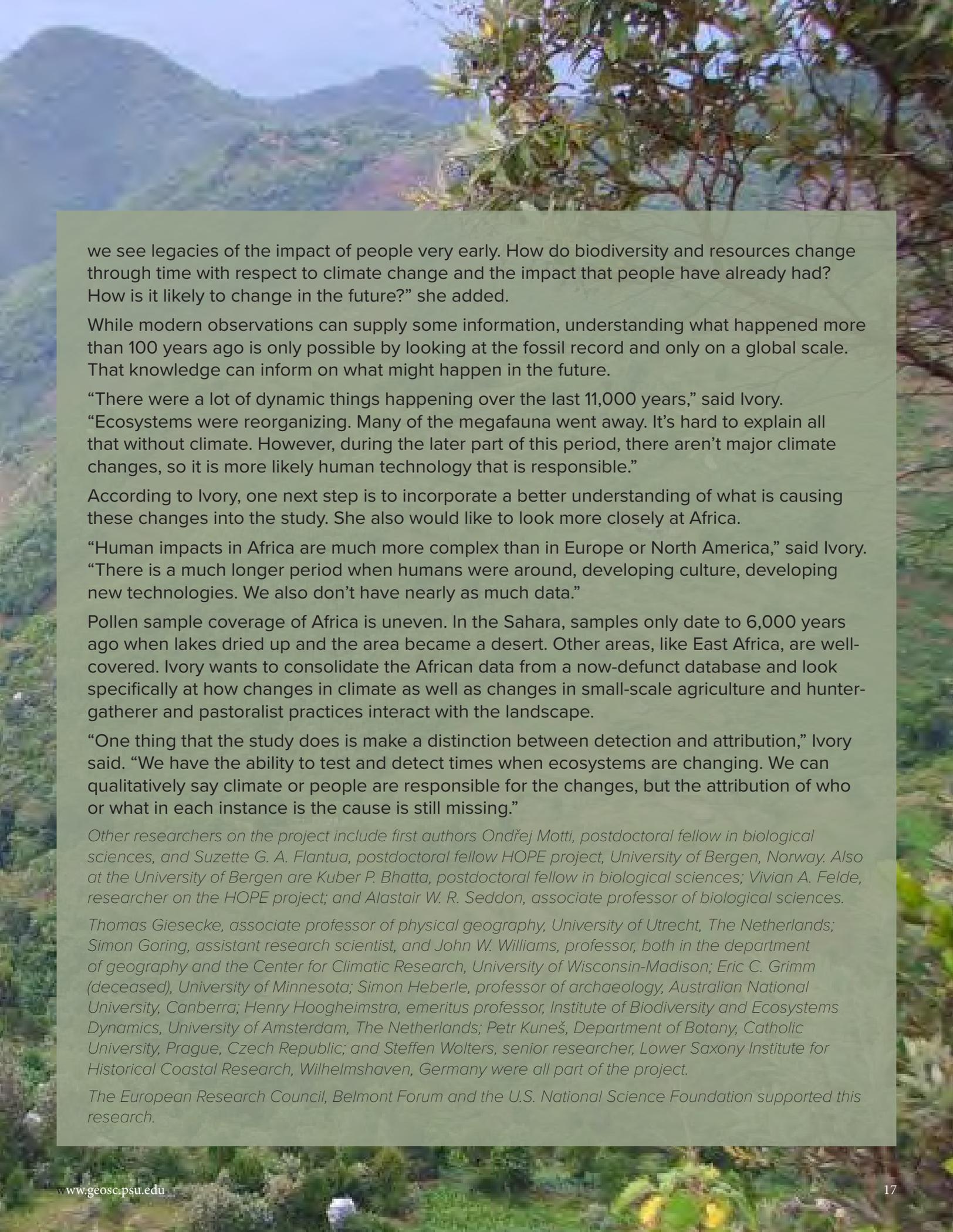
The researchers reported in the May 21 issue of the journal *Science*, “We detect a worldwide acceleration in the rates of vegetation compositional change beginning between 4.6 and 2.9 thousand years ago that is globally unprecedented over the past 18,000 years in both magnitude and extent.”

They add that “the scale of human effects on terrestrial ecosystems exceeds even the climate-driven transformation of the last deglaciation.”

Ivory noted that humans were influencing vegetation long before agriculture became a major factor.

While researchers have known of humanity’s influence on the environment, and on vegetation in particular, previous studies have been on a local or regional scale. As early as 700,000 years ago hominids used fire and 8,000 years ago extensive agricultural land use, showing human influence on vegetation changes far into the past.

“People have a presence, they are everywhere,” said Ivory. “Even in places that are not very urbanized or might appear to be quite wild, often in the archaeological and fossil pollen record,



we see legacies of the impact of people very early. How do biodiversity and resources change through time with respect to climate change and the impact that people have already had? How is it likely to change in the future?” she added.

While modern observations can supply some information, understanding what happened more than 100 years ago is only possible by looking at the fossil record and only on a global scale. That knowledge can inform on what might happen in the future.

“There were a lot of dynamic things happening over the last 11,000 years,” said Ivory.

“Ecosystems were reorganizing. Many of the megafauna went away. It’s hard to explain all that without climate. However, during the later part of this period, there aren’t major climate changes, so it is more likely human technology that is responsible.”

According to Ivory, one next step is to incorporate a better understanding of what is causing these changes into the study. She also would like to look more closely at Africa.

“Human impacts in Africa are much more complex than in Europe or North America,” said Ivory.

“There is a much longer period when humans were around, developing culture, developing new technologies. We also don’t have nearly as much data.”

Pollen sample coverage of Africa is uneven. In the Sahara, samples only date to 6,000 years ago when lakes dried up and the area became a desert. Other areas, like East Africa, are well-covered. Ivory wants to consolidate the African data from a now-defunct database and look specifically at how changes in climate as well as changes in small-scale agriculture and hunter-gatherer and pastoralist practices interact with the landscape.

“One thing that the study does is make a distinction between detection and attribution,” Ivory said. “We have the ability to test and detect times when ecosystems are changing. We can qualitatively say climate or people are responsible for the changes, but the attribution of who or what in each instance is the cause is still missing.”

*Other researchers on the project include first authors Ondřej Motti, postdoctoral fellow in biological sciences, and Suzette G. A. Flantua, postdoctoral fellow HOPE project, University of Bergen, Norway. Also at the University of Bergen are Kuber P. Bhatta, postdoctoral fellow in biological sciences; Vivian A. Felde, researcher on the HOPE project; and Alastair W. R. Seddon, associate professor of biological sciences.*

*Thomas Giesecke, associate professor of physical geography, University of Utrecht, The Netherlands; Simon Goring, assistant research scientist, and John W. Williams, professor, both in the department of geography and the Center for Climatic Research, University of Wisconsin-Madison; Eric C. Grimm (deceased), University of Minnesota; Simon Heberle, professor of archaeology, Australian National University, Canberra; Henry Hoogheemstra, emeritus professor, Institute of Biodiversity and Ecosystems Dynamics, University of Amsterdam, The Netherlands; Petr Kuneš, Department of Botany, Catholic University, Prague, Czech Republic; and Steffen Wolters, senior researcher, Lower Saxony Institute for Historical Coastal Research, Wilhelmshaven, Germany were all part of the project.*

*The European Research Council, Belmont Forum and the U.S. National Science Foundation supported this research.*

# Penn State researchers look to build on Deines legacy in lab named in his honor

by David Kubarek



The Peter Deines Isotope Mass Spectrometry Laboratory was dedicated on Oct. 28 in a ribbon-cutting ceremony officiated by (L to R) Andrew Nyblade, head of the department; Melissa Deines, wife of the late Peter Deines; Eric Barron, President of Penn State; Lora Weiss, senior vice president for research; Katherine Freeman, Evan Pugh University Professor of Geosciences; John Hellmann, associate dean for graduate education and research emeritus; and Lee Kump, John Leone Dean in the College of Earth and Mineral Sciences.

A recently dedicated lab at Penn State bears the name of a longtime geosciences faculty member, Peter Deines, who used isotope geochemistry to better understand processes deep within the Earth.

The facility, which is housed in a newly renovated portion of the basement of the Deike Building, features state-of-the-art equipment designed to benefit the research of the geosciences department at Penn State, and beyond. The lab features a large suite of instruments that can analyze isotopes within a wide array of molecules and minerals.

Several of the instruments were developed by Penn State researchers and are truly one-of-a-kind worldwide, with the ability

to analyze diverse isotopes and elements in solids, liquids, and gases in very trace quantities, even at the nanomolar or picomolar scales. One instrument can



measure if two isotopes are right next to each other in a mineral, and another can measure trace isotopes and elements carried in some of Earth's oldest minerals. Few labs have the same wide-ranging capability all in one location.

The lab features a high-mass accuracy and high-mass-resolution mass spectrometer that is being used in novel ways to measure isotope fingerprints within organic compounds. Researchers are using such position-specific isotope patterns to chart the origins of carbon molecules from microorganisms, ancient oceans, and from the solar system, delivered by meteorites.

At the dedication, Freeman said it was fitting that the facility be named after a scientist and educator who used these same technologies and light stable isotopes to drive his research addressing diverse geological problems. Freeman said the facility links researchers around the world to Penn State due to the powerful and new mass spectrometry tools for determining isotopes within molecules.

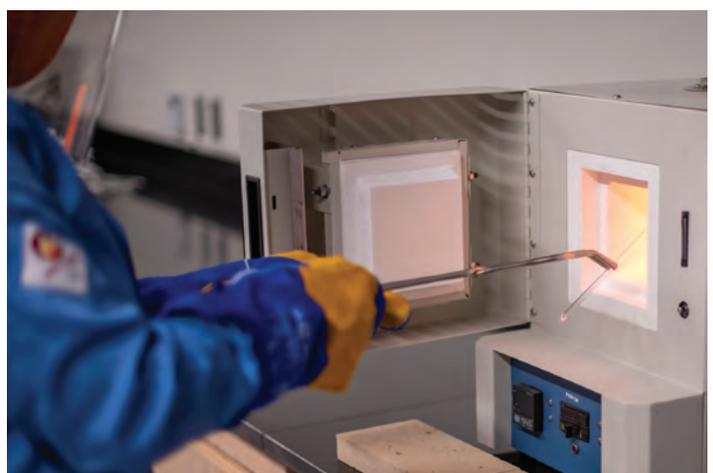
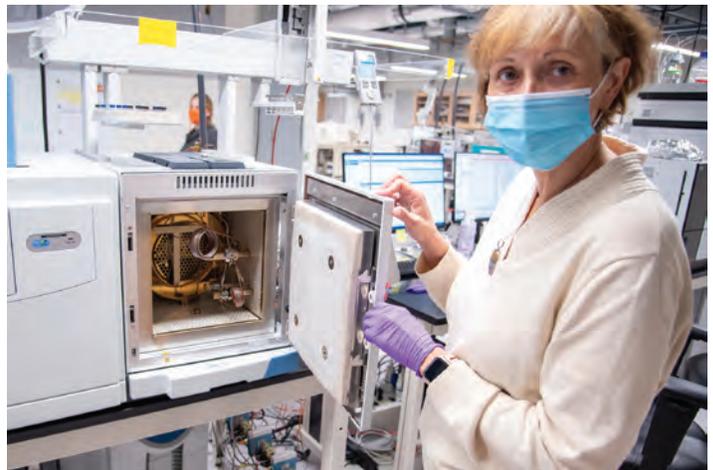
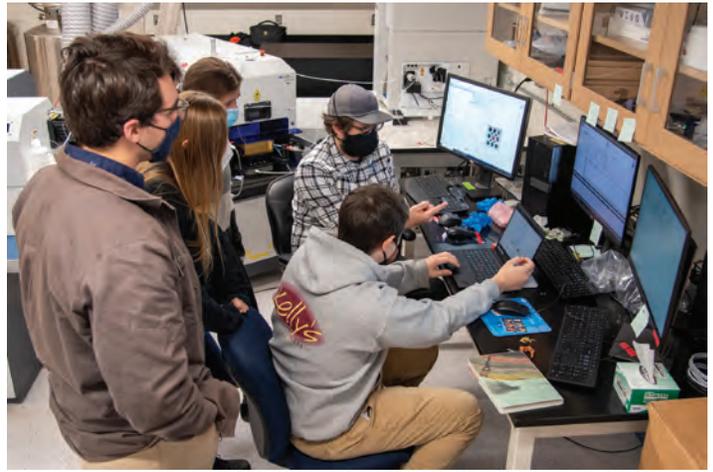
“Peter Deines represented the best of what a Penn State faculty member has to offer, and he is missed by those of us who were lucky to know him,” Freeman said. “But his scientific legacy at Penn State is already being carried forward by a new generation of geochemists who are precisely measuring all kinds of isotopes in all kinds of samples. I am genuinely delighted that they can now do so in a space that bears his name.”

Fittingly, Freeman said, the lab could unlock clues to solving questions Peter Deines strived to answer in his career, including the evolution of the Earth's interior, the origins and fates of diverse forms of carbon, and novel ways to measure isotopes in molecules and minerals.

Much of the space houses the Freeman Research Group, including equipment supporting the NASA-funded Astrobiology Center for Isotopologue Research (ACIR), which looks to shed light on ancient climate, the carbon cycle, microbial biogeochemistry, and the signatures of life on Earth and beyond.

Several early-career researchers have also had a hand in shaping the facilities, including Andrew Syme and Jesse Reimink, who co-direct the geochronology lab; Miquela Ingalls, who researches how terrestrial environments respond to climate change and Max Lloyd, who researches isotopic geochemistry.

Nyblade said the lab is a “tremendous investment” in the department by the university, and reflects Penn State's deep commitment to the geosciences, for which the department is most grateful.





Penn State alum Rachel Kronyak poses next to a hot spring in Yellowstone National Park on a field trip to study biosignatures and astrobiology in the western U.S. Kronyak is now part of the NASA Perseverance rover team searching for signs of ancient life on Mars. (Photo provided by Rachel Kronyak)

## Penn State alum makes tracks on Mars as Perseverance rover springs to life

by Matt Carroll

In its first weeks on Mars, NASA's Perseverance rover captured dazzling highlights, from video of its own dramatic landing in February to the first audio recordings from the red planet, the sounds of wind blowing and the rover's laser zapping rocks.

But of all the breathtaking sights and sounds beamed back to Earth, one image stands out for Penn State alum Rachel Kronyak—tire tracks in the red Martian dirt.

Kronyak, a systems engineer at NASA Jet Propulsion Laboratory, helped plan the rover's first drive, a thirty-three-minute mobility test on March 4 that covered about twenty feet and created those tracks.

"The photos that came back showing the wheel tracks on the ground behind us after our first couple drives were so exciting to see," she said. "It really makes us feel like we're explorers, seeing new places for the first time. It's just surreal."

Kronyak is part of a team that works with scientists and engineers from around the world to decide what commands to assign the rover each day and then sends the instructions some 150 million miles to the surface of Mars to be carried out by Perseverance.

"It's a delicate balancing act," she said. "We have to manage the scientific objectives to explore and collect as much data as possible with the engineering constraints like battery life and storage capacities.

There's definitely a lot of teamwork every single day; it's a really incredible job."

The team will spend at least the next Martian year, about two years on Earth, guiding Perseverance on its mission to search for signs of ancient microbial life in Jezero Crater, an area believed to be a lake in Mars' deep past.

"We've spent a lot of time preparing for this moment," Kronyak said. "Now that the dust has settled and the

rover is on the ground, we get to do our job. And it's been really incredible to be part of this."

### The long road to Mars

For as long as she can remember, Kronyak dreamed of being an astronaut. But it was her time at Penn State, she said, that placed her on the career path to become a Martian.

At an orientation before her first semester, Kronyak learned about the Women in Science and Engineering Research (WISER) program that could place her in a research laboratory right away. Overcoming her nerves, she applied and was accepted into the program, administered by the NASA Pennsylvania Space Grant Consortium.

"To have that research program specifically for first-year students was the greatest thing for me," said Kronyak, who received her bachelor's degree in geobiology from Penn State in 2014.

"When you go to a big school, it can be overwhelming to find your place, but those lab experiences at Penn State really set me up for my future. Without that, I have no idea where I'd be today, to be honest."

Through the program, Kronyak was paired with her future adviser, Christopher House, professor of geosciences and director of the Penn State Astrobiology Research Center.

"With her interests in geology and astrobiology, it was a pleasure to work with Rachel and to get her involved with authentic, hands-on research early in her University education," House said. "I'm proud to see how her career has developed and of her accomplishment in joining the Perseverance rover team."

Kronyak said her work in House's lab inspired her senior thesis, which in turn led to internships with NASA. Those experiences convinced her to attend graduate school at the University of Tennessee, where she earned her doctorate in geology and began working on the NASA Curiosity rover program, a previous mission to Mars.

After graduating, Kronyak was hired by NASA, where

she has continued working on the Curiosity mission, alongside House, and now on the Perseverance mission.

"I'm always nostalgic when I get to do an operations shift with Curiosity, and it's even more fun because my adviser from Penn State, Chris House, is on the team as well," Kronyak said. "It came full circle and working together is so much fun."

### Mission on Mars

After months of planning and preparation, there was nothing left to do for Kronyak but sit in her living room and anxiously watch the NASA livestream of Perseverance's landing on February 19.

"I was at home in my apartment watching on TV just like everybody else because of COVID-19 restrictions," she said. "It was surreal, but I was jumping up and down and almost in tears when we got the touchdown confirmation signal. I'll never forget that moment."



The NASA Perseverance rover captured an image of its own tire tracks in the Martian dirt during its first drive on March 4 in Jezero Crater. (Photo credit: NASA/JPL-Caltech)

The joy and excitement quickly turned to the realization that all eyes would now be on the surface operations team. It would be Kronyak's turn to return to the office for the twelve-hour shifts that determine the course of the rover's actions on any given day.

"Perseverance is sort of the latest and greatest in rover technology and we're building upon what we've learned

with previous missions," she said. "With this mission, the goal is to search for signs of ancient life at our landing site."

That's a big task. But the rover is equipped with sensitive instruments that can drill rock samples and test them for things like small traces of ancient organic material. The rover also is the first that can store those samples, which may someday be returned to Earth for further study.

"We've spent so much time looking at the landing site from orbit and making guesses and hypotheses about what we'll find," Kronyak said. "Now we get to test those hypotheses and see how these rocks formed. There are so many things to be excited about."

# Undergraduate Scholarships & Awards

**Thomas F. Bates Undergraduate Research Enhancement Fund:** Sarah Lehman

**Joseph Berg Award for Undergraduate Research in Geosciences:** Olivia Budnovitch, Emmy Gardner, Joshua Karas, Arnav Lund, Angelina Santamaria, Faith Wotorson

**Barton P. Cahir Award:** Maya Kita

**Frank Dachille Memorial Award in Geochemistry:** Asala Al-Wadhahi, Yurik McCray

**David M. Demshur Undergraduate Research Endowment:** Abra Gold, Ryan Kratzinger

**Edwin L. Drake Memorial Scholarship:** Dana Bloomfield, Cameron Brown, Michelle Burns, Austin Dilla, Raquel Ellis, Ryan Kindelberger, Qianyi Lu, Oliver Marra, Kelly O'Donnell, Eddie Spagnuolo, Nicholas Walter, Matt Wileyto, Aimee Zimmerman, Elliot Zou

**General Scholarship Endowment in Geosciences:** Devon Chenot, Timothy Kuklis, Ethan Lionetti, Garrett Paley, Victoria Paul, Zachary Taylor, Amanda Urist

**David P. "Duff" Gold Undergraduate Scholarship Fund:** Bradly Crouthamel, David Early, Eric Kratzinger, Kenneth Wasiulewski

**John C. and Nancy Griffiths Scholarship:** Neel Bishop, Emma Cox, Kathleen McGowan, Ali Wicks

**James and Nancy Hedberg Scholarship:** Thomas Baney, Amanda Bassett, Samuel Dikeumunna, Matthew Felici, Caroline Newman, Isabella Plotkin, Hunter Reeves, Edward Spagnuolo, Megan Vinella

**Arthur P. Honess Memorial Fund:** Renan Beckman, Halina Dingo, Gabriel Felker, Logan Fowler, Robert Hull, Thomas Lutz, Madeline Murtaugh, Ryan Orłowski, Sarah Perez, Sunday Siomades

**Benjamin F. Howell, Jr., Award:** Hannah Luckenbaugh, Margaret Maenner, Molly McHale, Luke Stoej, Allysa Temple

**Kappmeyer-Isaacs Field Camp Award:** Sarah Lehman, Ryan Kratzinger, Molly Mchale

**Ronald A. Landon Endowment in Hydrogeology:** Cassandra Barcz, Katerina Wood

**Maureen and Dennis Maiorino Undergraduate Scholarship:** Courtney Aubain, Anna Lee, Jacob Manion, Kacper Orpik, Alysha Ulrich, Riley Wian

**Timothy and Cindy Mullen Scholarship in Geosciences:** Abdulaziz Almansour, Joe Barbusca, Robin Carbaugh, Ryan Orłowski

**Perez Family Undergraduate Scholarship:** Raquel Ellis

**Reif Undergraduate Summer Field Camp Endowment:** Cissy Ming, Nancy Weinheimer

**Rober F. Schmalz Award:** Sarah Davis, Riley Foster, Eathan Gottshall, Jiahao Guo, Jacob Irwin, Justin McGowan, Hrishi Mohan, Riley Paul-Cook, Connor Russell, Seamus Smith

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

**Daniel and Deborah Stephens First-Time Endowed Scholarship:** Sabrina Blacklock, Tom Delaney, Audrey Gonzalez, Kurt McAuliffe, Emma Rose, Samantha Rowe, Ben Smith

**John and Elizabeth Holmes Teas Scholarship Fund:** Cameron Brown, Taylor Rosen, Emma Stolinis

**Dr. David E. W. Vaughan and Mrs. Julianne S. Vaughan Field Camp Fund:** Cassandra Barcz, Gabby Mengen, Taylor Rosen

**Tim and Courtney Watson Undergraduate Scholarship:** Raquel Ellis

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# Graduate Scholarships & Awards

**Alley Family Graduate Scholarship:** *Kathleen Grosswiler, Sierra Melton*

**Chevron Scholarship:** *Benjamin Barnes, Charlotte Connop, Chanel Deane*

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

**Krynine Memorial Award:** *Raphael Affinito, Shelby Bowden, Watsawan Chanchai, Si Chen, Dongyoun Chung, Charlotte Connop, Kaelie Contreras, Chanel Deane, Michael Forgeng, Victor Garcia, Kathleen Grosswiler, Gabriella Harris, Emma Hartke, Machel Higgins, Kayla Irizarry, Ian Lee, Zi Xian Leong, Sierra Melton, Hailey Mundell, Youki Sato, Emily Schwans, Samuel Shaheen, Andrew Shaughnessy, Garrett Shepherd, Alexander Thames*

**Hiroshi and Koya Ohmoto Graduate Fellowship:** *Watsawan Chanchai, Kathleen Grosswiler, Kayla*

*Irizarry, Hanna Leapaldt*

**Marathon Alumni Centennial Graduate Fellowship:** *Youki Sato, Garrett Shepherd*

**Richard R. Parizek Graduate Fellowship:** *Adam Benfield, Julia Carr, Samuel Shaheen*

**Scholten-Williams-Wright Scholarship in Field Geology:** *Charlotte Connop*

**Shell Geoscience Energy Research Facilitation Award:** *Raphael Affinito, Benjamin Barnes, Shelby Bowden, Troy Ferland, Youki Sato, Junzhu Shen, Garrett Shepherd*

**Richard Standish Good Graduate Scholarship:** *Claire Webster*

**Donald B. and Mary E. Tait Scholarship in Microbial Biogeochemistry:** *Hanna Leapaldt, Samuel Shaheen, Claire Webster*

**Barry Voight Endowment:** *Shelby Bowden*

## Awards, Recognitions, and Service

**Carl F. Aquino** - EMS Graduate Fellows for Science Advocacy and Diversity (EMS-GFSAD)

**Adam Benfield** - LacCore Visiting Graduate Student Program • R. J. Cuffey Fund for Paleontology

**Julia Carr** - George H. K. Schenck Teaching Assistant

**Fai Chanchai** - On to the Future Award (GSA)

**Si Chen** - Mineralogical Society of America Grant in Crystallography from the Edward H. Kraus Crystallographic Research Fund

**Katie Horisk** - Honorable Mention NSF Graduate Research Fellowship • Elsevier Organic Geochemistry Research Scholarship

**Kirsty McKenzie** - Outstanding Student Presentation Award (OSPA) at AGU 2021

**Sierra Melton** - First Place in the Physical Sciences and Mathematics category of the Penn State

Graduate Exhibition 2021 • NASA Pennsylvania Space Grant Consortium Graduate Fellowship

**Esther Munoz** - Nominated for the Sloan Fellowship • president of the Penn State Chapter of the Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS), which received the 2021 Outstanding Marketing award from Penn State's Student Affairs.

**Karen Pham** - Fulbright Research Grant (Oslo, Norway)

**Garrett Shepherd** - Marathon Alumni Centennial Graduate Fellowship • Shell Geosciences Energy Research Facilitation Award • Paleontological Society Stephen Jay Gould Student Research Award

**Kirsten Stephens** - Penn State ICDS Virtual Symposium 2020, 1st place Virtual Poster, Fall 2020 • vVMSG Annual Meeting 2021, 2nd place Talk presentation, Spring 2021

# 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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*Note: This list is the compilation of  
contributiins received between July 1, 2020  
thru June 30, 2021*

# Alumni News

## **John (Jack) Crook '81**

Crook retired as senior vice president of Diversified Gas & Oil. He was an Earth Sciences major and is now enjoying retirement, camping and golf.

## **Daniel Hummer '10**

Hummer is currently a professor of geology at Southern Illinois University. He recently assisted in designing a permanent exhibit at the American Museum of Natural History in New York showing the evolution of minerals from the big bang to the present.

## **Kent Newsham '78**

Newsham was selected to be in the inaugural class of fellows at Occidental. His new title is Oxy Fellow, Worldwide Chief Petrophysicist. He is also on the

Technical Advisory Board and the Technical Reserves Review team.

## **George Veni '94**

Veni is the executive director of the National Cave and Karst Research Institute and president of the International Union of Speleology (UIS), which functions as the United Nations of countries conducting cave exploration and science. He is currently engaged deeply in the biggest cave and karst project ever: the International Year of Caves and Karst. This is a global effort to reach and teach people about the many values of caves and karst that everyone benefits from, and it is being organized by the UIS.

## Alumni Passings

Dr. Paul B. Barton, Jr., '52  
Mr. Edward H. Boyle, Jr., '75  
Dr. Robert C. DeVries, '53  
Karl E. Francis, Ph.D., '59  
Mr. Charles H. Grenot Jr., '87  
Dr. Charles A. Landis Jr., '61  
Mr. Gregory L. Leitzel, '80  
Dr. Floyd E. Miller, Jr., '64  
Dr. Robert N. Miller, '77  
Mr. James G. Palacas, '57  
Jeffrey R. Parsons, Ph.D., '61  
Mr. Daniel E. Popovich, '65  
Dr. Della M. Roy, '49  
Mr. James A. Schad, '75  
Dr. Chester M. Smith, Jr., '59  
Mr. Donald A. Smith, '56  
Mr. Frederick C. Teti, '84  
Ms. Kathy West, '88



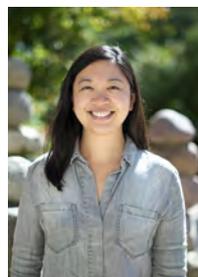
Class of 2021 Field Camp - students investigating sedimentary structures and the impact of jointing on bedrock river incision at Buttermilk Falls State Park, NY.

# Faculty Awards



**Susan Brantley**

- Recipient of the Dr. Hubert Barnes and Dr. Mary Barnes Professorship in Geosciences
- Elected to American Academy of Arts and Sciences



**Kimberly Lau**

- Recipient of the 2021 the GSA Geobiology and Geomicrobiology Division Award



**Derek Elsworth**

- Selected as the inaugural G. Albert Shoemaker Chair in Mineral Engineering



**Jennifer Macalady**

- Appointed director of Penn State's Ecology Institute



**Brad Foley**

- NSF Career Award



**Michael Mann**

- Long-listed, Wainwright Prize for "The New Climate War"
- Honorary Doctorate of Science, Bard College
- Leo Szilard Lectureship Award from the American Physical Society



**Katherine Freeman**

- Recipient of the 2021 Arthur L. Day Medal from GSA



**Andrew Smye**

- NSF Career Award



**Tanya Furman**

- Elected president of the Education Section of the American Geophysical Union



**Christelle Wauthier**

- NSF Career Award



**Elizabeth Hajek**

- Appointed Associate Department Head for Diversity, Equity, Inclusion
- President-elect of the Society for Sedimentary Geology



**Timothy White**

- Elected as a Fellow of Geological Society of America

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