



**PennState**  
College of Earth  
and Mineral Sciences

# Department of Geosciences



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## On the cover...

National Geographic photographer Carsten Peter (far right) takes a photograph as diver and National Geographic explorer Kenny Broad descends to the biofilms in Lago Verde in central Italy's Frasassi cave system. Penn State Professor Jennifer Macalady (left) and expedition cover Martina Gianfelice (center) wait on the steep lake shore. Photo credit: Dani Buchheister

All photos, unless noted, provided by Penn State.

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## DEPARTMENT HEAD'S MESSAGE

As another calendar year comes to a close, we take this opportunity to fill you in on some notable events and reconnect with alumni and friends. The department has had another strong year. In spite of declining geosciences student enrollments at many institutions across the U.S, our numbers have held steady at about 200 undergraduate majors in five degrees we offer. We also currently have about eighty graduate students. The department's graduate programs were, once again, ranked in the top ten by U.S. News and World Report, and our research expenditures this past year were near an all-time high. We have much to be thankful for, especially the extraordinary support we receive year-in and year-out from our alumni and friends.

In this newsletter we welcome two new professors, Isabel Fendley and Rachel Housego (p. 16), and a new museum director, Chris Widga (p. 22), we say farewell to Denny Walizer (p. 17), who retired after more than thirty years of service to the department, and we celebrate Don Fisher's twenty-five-year leadership of the field school (p. 19). Roman DiBiase, the new field school director, is busy restructuring the school to now include both a 2-credit class during spring semester to teach GIS mapping skills and a four-week (4-credit) field experience conducting mapping exercises in Utah, Montana, and Wyoming during the first part of summer. With this new structure, we are striving to make the field school more affordable and accessible to our students without lowering the expectations for field-related knowledge.

I am in my final year as department head, and one project I hope to complete before I step down next June is an updated history of the department. The last published history of the department I am aware of dates from 1988! Much has changed in the department over the past thirty-five years. Emeritus professor Rudy Slingerland has graciously agreed to help compile and edit the document. Thank you, Rudy! If you recall milestones, accomplishments, or events about the Department's structure and operation worthy of documenting, we would be very appreciative if you could bring them to our attention.

And speaking of milestones, our extended geosciences family in Happy Valley expanded this year by four with several junior faculty welcoming first-borns! Does anyone remember four new geo-babies in one year? It must be a record!

If you visit State College in the coming months, please be sure to drop by. The department offices are now located in the former dean's suite on the first floor of Deike Building.

Sincerely,



Andrew Nyblade

### Department Head

Andrew Nyblade

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## Penn State faculty join NASA mission to study samples from asteroid Bennu

Kate Freeman, Evan Pugh University Professor of Geosciences, Christopher House, professor of geosciences, and Allison Baczynski, associate research professor of geosciences, have been selected to join the NASA Origins, Spectral Interpretation, Resource Identification, and Security–Regolith Explorer (OSIRIS-REx) mission to analyze samples from the asteroid Bennu.

As part of the Participating Scientist Program, the team will receive just over \$1 million over three years to measure the abundances of stable isotopes in organic matter and organic

molecules contained within the samples. Their work will help scientists learn about the formation of the solar system and about molecules that may have contributed to the development of life on Earth.

“Isotope and molecule studies were already planned as part of the OSIRIS-REx mission, but what Penn State brings to the project is the ability to do the analyses with much smaller quantities than is possible using commercial instruments,” Freeman said. “We’ve developed methods in our lab that take us down orders of magnitude, so we can measure much smaller amounts of sample, which is perfect when all you have is a sugar packet-size of sample.” The research is supported by NASA. <https://tinyurl.com/3vb3jubx>

## Study reveals new clues about how ‘Earth’s thermostat’ controls climate

Rocks, rain and carbon dioxide help control Earth’s climate over thousands of years—like a thermostat—through a process called weathering. A new study led by Penn State scientists may improve our understanding of how this thermostat responds as temperatures change.

“Life has been on this planet for billions of years, so we know Earth’s temperature has remained consistent enough for there to be liquid water and to support life,” said Susan Brantley, Evan Pugh University Professor and Barnes Professor of Geosciences. “The idea is that silicate rock weathering is this thermostat, but no one has ever really agreed on its temperature sensitivity.”

Because many factors go into weathering, it has been challenging to use results of laboratory experiments alone to create global estimates of how weathering responds to temperature changes, the scientists said.

The team combined laboratory measurements and soil analysis from forty-five soil sites around the

world and many watersheds to better understand weathering of the major rock types on Earth and used those findings to create a global estimate for how weathering responds to temperature.

Their model may be helpful for understanding how weathering will respond to future climate change, and in evaluating man-made attempts to increase weathering to draw more carbon dioxide from the atmosphere—like carbon sequestration.

<https://tinyurl.com/yye8jh43>





## Curiosity rover finds new evidence of ancient Mars rivers, a key signal for life

New analysis of data from the Curiosity rover reveals that much of the craters on Mars today could have once been habitable rivers.

“We’re finding evidence that Mars was likely a planet of rivers,” said Benjamin Cardenas, assistant professor of geosciences and lead author on a new paper announcing the discovery. “We see signs of this all over the planet.”

In a study published in *Geophysical Research Letters*, the researchers used numerical models to simulate erosion on Mars over millennia and found that common crater formations—called bench-and-nose landforms—are most likely remnants of ancient riverbeds. <https://tinyurl.com/2y6urc5t>

## Fossils show widespread plant extinctions after asteroid wiped out dinosaurs

More than half of all plant species went extinct at the end of the Cretaceous period, according to new analysis that could influence modern conservation efforts. Sixty-six million years ago, an asteroid



the size of San Francisco crashed into a shallow sea off the coast of modern-day Mexico and plunged the world into an extinction event that killed off as much as 75 percent of life, including the dinosaurs.

But a debate remains about

how the Cretaceous-Paleogene extinction (K-Pg) impacted plant life on land, in part because global studies of the fossil record have shown that no major plant families went extinct. A new analysis of emerging fossil data from North and South America sheds light on how plants fared during the K-Pg boundary and points to a true plant extinction.

“There has been a trend in the literature to say maybe this event was bad for the dinosaurs and lots of marine life, but it was fine for plants because the major groups survived,” said Peter Wilf, professor of geosciences at and lead author. “Our review counters that idea, because everywhere we looked, more than half of the species went extinct.”

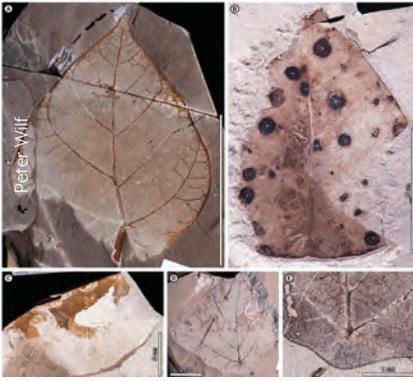
<https://tinyurl.com/4bs92ffv>

## Using machine learning, existing fiber optic cables to track Pittsburgh hazards

Existing fiber optic cables used for high-speed internet and telecommunications, in combination with machine learning, may be able to help scientists track ground hazards in Pittsburgh. The National Science Foundation awarded a \$937,000 grant to a team of Penn State and Carnegie Mellon University researchers to further develop the low-cost monitoring approach.

The effort, which is led by Tiejuan Zhu, associate professor of geosciences, relies on prior research that shows hazards such as flooding, landslides, sinkholes, and leaking pipes can be monitored at a fraction of the cost of existing methods.

<https://tinyurl.com/nhjzmpu4>



## Spurge purge: Plant fossils reveal ancient South America-to-Asia 'escape route'

The spurge family, or Euphorbiaceae, includes economically valuable plants like the rubber tree, castor oil

plant, poinsettia, and cassava. Driven by climatic changes and land movements over millennia, a group of spurges relocated thousands of miles from ancient South America to Australia, Asia, and parts of Africa.

Reported in the *American Journal of Botany*, the findings suggest that the spurge family's *Macaranga-Mallotus* clade (MMC), encompassing a common ancestor and all its descendants and long considered to have Asian origins, may have first appeared in South America when it was still part of Gondwana—the supercontinent that encompassed South America, Antarctica, and Australia—before spreading around the globe.

"Our study provides the first direct fossil evidence of spurges in Gondwanan South America," said Peter Wilf, professor of geosciences and lead author, noting that the finding contrasts with the prevailing idea that the MMC evolved in Asia.

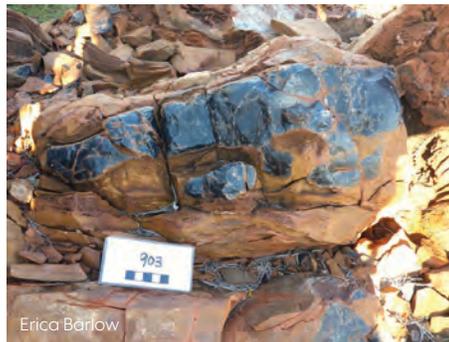
<https://tinyurl.com/t3rhjb4b>

## Window to the past: New microfossils suggest earlier rise in complex life

Microfossils from Western Australia may capture a jump in the complexity of life that coincided with the rise of oxygen in Earth's atmosphere and oceans, according to an international team of scientists.

The findings, published in the journal *Geobiology*, provide a rare window into the Great Oxidation Event, a time roughly 2.4 billion years ago when the oxygen concentration increased on Earth, fundamentally changing the planet's surface. The event is thought to have triggered a mass extinction and opened the door for the development of more complex life, but little direct evidence had existed in the fossil record before the discovery of the new microfossils, the scientists said.

<https://tinyurl.com/4ms4mrxa>



## The Vikings abandoned Greenland due in part to sea-level rise

Why did the Vikings disappear from Greenland 400 years after settling there? New research led by Harvard University and Penn State using geologic and climate records found that sea-level rise likely contributed to the Viking's disappearance from the island in the 15th century.

"Sea-level change is an integral, missing element of the Viking story," said Richard Alley, Evan Pugh University Professor of Geosciences and co-author on the study published in the *Proceedings of the National Academy of Sciences*.

Alley noted that changing sea level has always affected people, and it will continue to do so.

"Today, far more people are now vulnerable to rising seas in a warming world," he said. "To help these people, we will need a better understanding of the big drivers of sea-level rise, including melting ice, expanding ocean waters, and 'mining' of groundwater by pumping out more than is returned. But these must be combined with knowledge of local conditions, as was done in this study, because some coasts are more vulnerable than others."

<https://tinyurl.com/338x76x9>



# Students in the Spotlight...



Undergraduate Student Profile:

## Zachary Baran

I feel as if most kids love rocks, minerals, and fossils, and I definitely was no outlier to this. However, somewhere along the way, those interests took a back seat. When college came around, I decided to study computer science. I started college at the Penn State Hazleton campus and enjoyed it, but when the pandemic came, I suddenly had a lot of time to reflect. Despite liking my studies, I came to realize that not only was something missing, but going forward, I didn't want to spend any more time stuck inside than necessary because the quarantine causing an excess of being inside. I searched for other majors and pretty quickly decided on geosciences for two main reasons. I figured that studying the Earth would provide plenty of opportunities to get outside, so it checked that box. It would also allow me to rekindle those early childhood interests and help me find

that missing piece—passion for the subject matter that I was studying. Now in the final year of my undergraduate degree, I can confidently say that I couldn't have made a better choice. With this renewed passion, I have been trying to do and learn much as possible with my remaining time as an undergraduate. I work with Dr. Ben Cardenas in the Planetary Sedimentology Lab, and this past spring, I was able to travel to the Lunar and Planetary Science Conference to present my research present my undergraduate thesis research on modeling the erosion of paleoshorelines with implications for Mars. Through the lab I have also been able to participate in field work in the western United States, and am a co-author on a published paper. I have also worked in other labs doing various research. I also has an internship at the EMS Museum & Art Gallery collections facility. I am so grateful for all my mentors and advisers for providing these wonderful opportunities, and to have found amazing peers within the College of Earth and Mineral Sciences. I look forward to graduating by the end of summer 2024 with my sights set on graduate school to continue studying planetary geoscience, with the hope that I can do so here at Penn State. I believe that all of these experiences and opportunities have been invaluable in preparing me for that and whatever else may come next! ☘



Master's Student Profile:

## Ella Do

My early love of art made me want to capture a multitude of tiny observations from the world around me. However, I was usually one to appreciate nature from the backseat of the car. It wasn't until going to college that I ventured outdoors more, learning to grow comfortable in those spaces. That comfort became confidence, and confidence allowed for curiosity. Like many who stumbled upon geology by accident, studying earth processes both fed and fueled my curiosities about the natural world. After a serious pivot from nearly finishing pre-med track requirements, I left Tufts University with a B.S. in geoscience, a B.A. in French language, and many more questions about current geosciences endeavors and my place within that field of study.

Beginning my M.S. with Dr. Maureen Feineman at Penn State was the first step to getting some answers. Working in collaboration with faculty, researchers, and students at the University of Texas Austin, Tohoku University, and the Consiglio Nazionale delle Ricerche, my project investigates fluid behavior in the southwest Japan subduction zone. The downgoing oceanic plate—in the modern configuration, the Philippine Sea Plate—undergoes what is called “slab dehydration” with increasing temperature

## STUDENTS IN THE SPOTLIGHT

and pressure. This fluid loss is driven by diagenetic processes at shallow depths and eventually breakdown of hydrous minerals at higher metamorphic grade. We can use boron concentrations and isotope values as proxies to quantify these mechanisms of fluid loss.

Using exhumed rocks from Japan's extensive history of subduction events, we have an incredible analog for a continuous sample suite, representative of sediment evolution from initial subduction at the trench to metamorphism at sub-arc depths (up to about 37 miles). Boron serves as a powerful tool to better constrain volatile cycling in tectonic regimes where geologic, seismic, hydrologic, and volcanic hazards pose threat to human safety.

I can't begin to express my gratitude for my adviser's patience, guidance, and support. Be it for fieldwork in Shikoku, attending Goldschmidt and GSA, lab work abroad, or this incredible graduate student community—I am immensely grateful. I've come to find home in the ebb and flow of being tucked away in lab and surfacing for air—and coffee—among friendly faces. While I haven't closed the door on a future Ph.D., I look forward to pursuing a geochemistry lab position following the completion of my master's. ☘

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Doctoral Student Profile:

### Leah Youngquist

One of my favorite things about geology is the huge diversity in processes, topics, and methodologies that make up the discipline, and I think my research trajectory reflects that. As an undergraduate at the University of Oregon, my research focused on characterizing in-place weathering of bedrock in the Oregon Coast Range. Afterwards, I transitioned into numerical modeling of geochemical systems for my master's project at Yale University.

Now, I am in my fourth year of my Ph.D. here at Penn State, where I work with Don Fisher. The project that I'm working on combines aspects of my entire research history with a new structural geology perspective. My research tries to understand connections between subsurface tectonic processes and surface erosional processes in Taiwan.

Taiwan is a unique orogeny because it is host to a natural gradient in exhumation depth, where it is older and more deeply exhumed in the north than in the south. This gradient presents a unique natural laboratory in which to examine how subsurface material trajectories might influence surface processes throughout the lifetime of a mountain range. Work completed by Penn State alum Julia Carr shows that boulders, the tools of erosion, get systematically smaller from north to south, a signal that is largely attributed to rock strength that is set at depth during exhumation.

To confirm this interpretation, I use electron backscatter diffraction to determine deformation mechanisms in quartz grains from samples taken along the length of the orogen. Deformation mechanisms in quartz are temperature dependent, so serve as an estimate of where deformation takes place during exhumation. Additionally, I plan to corroborate these temperature estimates using chlorite thermometry. The temperatures determined by these methods constrain where deformation is concentrated in the crust, which, importantly, might or might not be the same as the maximum depth from which material is exhumed. Finally, after completion of field work in coming months, I will be able to perform compressive rock strength experiments to calibrate in-field Schmidt hammer measurements, on which the oft-cited rock strength-exhumation depth arguments lie.

In addition to my academic research, I am also extremely passionate about teaching! I had the opportunity to be the 2023 Summer Assistant for the DEI committee. I was motivated to apply for this assistantship by my own experience of accidentally stumbling into my love of teaching. It wasn't until I had been told how learning works and how to practically run a classroom to encourage inclusive learning that I became passionate about my role as a teacher. With this funding, I was able to create an overview resource on inclusive and effective teaching. It is my hope that this resource might inspire my fellow graduate students to embrace their roles as instructors, both now and in the future! ☘



# Q&A: Searching for life where it shouldn't exist

by Adrienne Berard

Dani Buchheister

An underwater photographer peers down the 80-foot drop to Lago dell'Orsa, one of the biofilms sampling locations in Italy's Frasassi cave system.

A team of Penn State scientists is working to solve one of the world's greatest unsolved mysteries: how life originated on Earth—and how it might have evolved on other planets. Jennifer Macalady, professor of geosciences at Penn State, is a microbiologist who studies biological interactions between the limited resources that were available on early Earth: water, atmospheric gases, and rocks. Her research takes her to some of the most hostile places for life on Earth, in search of the microbial biofilms that can survive there.

Her most recent expedition was to three lakes within Italy's Frasassi cave system, accompanied by Dani Buchheister, a doctoral student in geosciences and astrobiology at Penn State. The project was featured in the October issue of *National Geographic*. Macalady and Buchheister spoke with Penn State News to explain more about the scope of work.

**Q:** Before we get into the specifics of the expedition you led in February that is featured in the magazine, what can you tell me about your research more broadly?

**Buchheister:** We're interested in the sort of life that survives in unique, or even hostile, environments. We want to understand what that can tell us about the limits

of life in general and, more specifically, how life might exist on other planets.

**Macalady:** I would second that and add that we're particularly interested in microbes we've never met. The motivation for that is that we want to understand the diversity of this planet's microbes. The diversity we know about is limited and influenced by where we have looked. The subsurface of our planet is the least-explored habitat on Earth, so it's a natural place to look for life we've never seen before.

**Q:** And what specifically are you hoping to understand?

**Buchheister:** The most motivating part of the research for me is learning what microbes are doing to survive in these extreme environments. Take for instance this site in Italy, it's a cave lake that doesn't have a lot of movement in its waters, it's stratified, so there is layer upon layer of groundwater where biofilms are growing without detectable amounts of oxygen. The biofilms are missing a lot of the common ingredients available at the surface for microbes to grow, but by all accounts, they are alive.

**Macalady:** The microbes living deep underground have to employ different strategies than what we see on the surface. They are living under conditions that are more

## FEATURE STORY

akin to what we think early Earth was like, before the Great Oxidation Event, before Earth's atmosphere and surface were exposed to high oxygen like they are today. By studying microbes deep underground, we can learn how they get energy from an environment that doesn't have sunlight or oxygen, which are the main resources that fuel life on the surface.

**Q: How can you use that to understand how life evolved here or possibly on other planets?**

**Macalady:** We're talking about life that can manage with just rocks and water and the interactions between the two. Early Earth was such an alien place. It really was not the same planet we live on today, so there is not much of a leap between studying environments that might represent the very early Earth to thinking about environments on other planets.

**Buchheister:** This environment we're exploring inside the Earth's subsurface in Italy has a particular kind of chemistry that helps create biofilms capable of harnessing energy from almost nothing. They have a metabolism, so a big thrust of my motivation is learning more about how that metabolism works and what that can tell us about life on early Earth and the possibility of life on other planets.

**Macalady:** Something that can thrive off of a geological system, just rocks and water, is pretty special. The specific metabolism Dani is interested in is essentially a missing way of life, one that is either extinct or carried out by microbes that we have never met. There are so many better gigs for life now. There are so many other, more juicy ways of making a living. When life started or close to the origin of life, there were far fewer options. The reaction that Dani is researching is also special in the sense that scientists have imagined it being the very first metabolism on Earth.

**Q: It must be so thrilling to one the forefront of exploration like this. How does that feel?**

**Buchheister:** It's exciting because there are so many unknowns about this biofilm. What is in it? What are those microbes doing? Why are they there and how do they grow? There is so much we don't know, which is an amazing space to operate in as a scientist.

**Macalady:** It also makes it particularly challenging, because the methods used to study microbes were not designed for novel forms of life we've never seen before. A commonly studied bacterium like *E. coli* might divide in an hour and would be relatively easy to sample and analyze, but the kinds of organisms that we're looking for are very, very challenging to detect, much less grow in a lab. Persistence is required.

**Q: There's also a lot of logistical challenges involved in getting the samples to begin with, correct?**

**Macalady:** Our ability to sample deep underground is heavily dependent on collaborations with both experienced technical divers and local Italian cave explorers, who help us get to where we need to go safely. The collaboration is really fundamental, and our work would be impossible without the support of an entire team of people on every expedition. The local cavers are essentially citizen scientists who have been exploring these areas in support of our research for 20 years, and their accumulated knowledge and skill is invaluable to our research.

**Q: What goes into building those relationships, because I imagine trust is literally vital when you're working in these conditions?**

**Macalady:** That's absolutely true. We're very careful about which cavers and divers we work with, and we're very clear about the parameters of that relationship in terms of safety and appropriate levels of training. I prefer to work with divers and guides who are not overly excited or enthusiastic but are more reserved and calculated. I prefer a diver who says, "That's too complicated" or "That is going to take multiple dives and more time than you want." It's always nerve-racking when the divers are in the water, but when you have a very measured team to plan with, it is a little less stressful.

**Buchheister:** I should add that, in my experience so far, the divers are genuinely excited about the work once they get a sample back up on dry land. It is intense focus on our respective tasks before that moment, but afterwards there is this amazing, celebratory mood when everything is accomplished the way we set out to do it. It's been awesome to experience that.

**Q: What are the next steps for the team?**

**Macalady:** We're planning a trip back to the same site in Italy to do more thorough cataloguing of the chemistry of the lakes, as well as leaving behind some dataloggers that will track chemistry in the water over time, while we're not there. We are also experimenting with a remotely operated submersible vehicle that one day could take the burden off of human divers in the research.

**Buchheister:** Since we're able to go there only so often, we're only getting a momentary snapshot of the system. We're hoping that by leaving dataloggers behind, we can see over a few seasons whether or not there are substantial changes in the chemistry of those waters that can have implications for what the microbes are doing down there. So, a lot of future work in the field is going to be oriented around understanding the environmental context of where these microbes are growing. And of course back in the lab, a lot of patient waiting for microbes to grow using only water and rocks. ☘

# Ears to the ice: Icequakes in Antarctica linked to ocean tides

by Matthew Carroll

When the ground rumbles in Antarctica, it may be an icequake—like an earthquake but caused by the movement of ice, not rock. A new study led by Penn State researchers found that these seismic events are driven by ocean tides at a major ice stream in West Antarctica.

Seismic monitors captured more than 2,200 icequakes over a five-year period at the Foundation Ice Stream in West Antarctica. Ice streams are fast-flowing regions of ice that act like a drainage system carrying ice from the land to the ocean. The scientists found that the icequakes largely occurred during spring tides, which follow a new or full moon and are characterized by larger tide height range.

“Tides are driven by the orbits of the moon and Earth, and it’s fascinating to be able to make a connection between tides and ice processes on Earth,” said Erica Lucas, who conducted the research while earning her doctorate in geosciences from Penn State.

They found the large majority of the icequakes at the Foundation Ice Stream occurred around the grounding line—the zone where the ice sheet transitions from sitting on bedrock to floating on the ocean. These floating ice shelves act as buttresses, preventing land ice from flowing into the ocean, so understanding the processes happening in these regions is especially important, the scientists said.

“If we can better understand the physical processes of ice flow then that’s another piece of the puzzle in understanding ice mass loss from Antarctica,” Lucas said. “Observing these icequakes at the Foundation Ice Stream may be one piece of the bigger puzzle.”

Previous studies of tidal impacts on ice at the grounding line have relied on smaller datasets. The researchers benefited from a longer-term dataset collected on the Polar Earth Observing Network (POLENET). POLENET is a National Science Foundation-funded network of GPS and seismic stations installed across Antarctica.

“This study, although focused on just one ice stream in Antarctica, points to the growing importance of icequakes for investigating grounding line processes and understanding the dynamics of glaciers,” said Andrew Nyblade, professor and head of geosciences, co-author of the study, and Lucas’ adviser.

Using the data, the scientists observed a distinct seasonal shift in the time of day the seismic events occurred and that this was best attributed to the shift in the timing of daily high tide throughout the year. They reported their findings in the *Journal of Geophysical Research: Earth Surface*.

The icequakes may be caused as stress accumulates between ice and bedrock on the steep hillslope located near the grounding line, the scientists said. As the tide rises, ice is being pushed upward, causing stress to build and then release, or slip. This process is known as “stick-slip.”

“The Schmidt Hills slope, adjacent to the grounding line of the Foundation Ice Stream, may be an especially favorable location for seismic activity because the slope may sit above the water level at low tide and become a drier surface,” Lucas said.

The scientists said further work could involve placing seismometers directly at the site to gather more precise data.

“I think it’s exciting to find icequakes in new places,” Lucas said. “They could be happening all over, and we just don’t have instruments to observe them. So whatever information that we can pull from the data that we already have is very important.”

Also contributing were Richard Aster, professor, Colorado State University; Douglas Wiens, professor, Washington University in St. Louis; Terry Wilson, professor emeritus, Ohio State University; and Audrey Huerta, associate professor, Central Washington University. The National Science Foundation supported this work. ❧

# Weaving Data Viz into Science and Engineering Education

University students in science and engineering are increasingly aware of the importance of the need to have data visualization and communication skills. Regardless of their future career choices, they understand that data skills are key.

However, few STEM majors include data visualization in their curricula. Higher education typically only offers students seminars on how to design a good research poster and students are, for the most part, left to learn data visualization skills on their own.

Graduate students who generate their own data also tend to perform more advanced data analysis and have complex stories to tell with their data. Often, they are working with datasets that hold many dimensions, lots of nuance, or uncertainty. Learning about data visualization at that level is as much about design as it is about science communication: distilling the key messages of one's research and making difficult decisions about what content should be sacrificed at the altar of good design and a clear message.

Antonia Hadjimichael, assistant professor of geosciences, sought to address that need. She developed the Data Viz for Scientists and Engineers course, designed to provide undergraduate and graduate students in the college with a design and communication foundation.

“Personally, data visualization and visual communication in general has become increasingly important in my work,” Hadjimichael said. “I study climate impacts on water resources and planning for the future, which often requires the exploration of large simulation modeling experiments and large datasets with many dimensions. This has pushed me to be more inventive and thoughtful with how I communicate my scientific results. I have seen direct benefits from becoming a better visual communicator in my conference posters or talks. These are skills I want my own graduate students to pick up, but also, as an educator, I felt it important that new crops of students get some formal training on this.”

Hadjimichael spent more than a year conceptualizing this class and taught it for the first time during the spring 2023 semester.

“My vision from the beginning was to teach all I would want someone else to teach me when I was in college,” Hadjimichael said. “Some of it was very fundamental to design in general, like use of color and how some color scales match different types of data better than others. Some of it was very practical to what STEM jobs entail—in academia or industry. For example, how to save Python figures into scalable vector images instead of raster images, or

how to guide your audience through a complex graphic using animations and annotations in PowerPoint. Some of it was just about getting them to be visually creative, even if we don't know how to get there yet with coding or software skills.”

The students who took the course were in the physical sciences and most had no prior background on design or aesthetics, nor did they have advanced web coding skills, but they wanted to learn just enough to be better visual communicators.

“While my students' backgrounds made planning the course more challenging, it kept the course focused on just the key skills that are most directly useful to scientists and engineers: coding simple analysis and charts in Python and creating more complex visualizations



*Students working collaboratively on a project using paper and glue to physically depict data.. Photo credit: Antonia Hadjimichael*

and infographics in Adobe Illustrator.” Hadjimichael said. “The goal was to stretch them a little on Python and also introduce them to some practical aspects of using software like Illustrator.”

Another dimension that strongly shaped the class was constructive criticism and feedback during the process of making the visuals, emphasizing growth more than strictly defined “correctness”.

“In most STEM education, students deliver an assignment and receive back a grade, with some instructor comments on what was wrong,” Hadjimichael said. “There’s little space for exploring weird ideas or being creative in a way that’s not formulaic. So, I wanted to emphasize a growth mindset and give the students a space to explore and try out design ideas in a low-stake environment before they submitted their final project.”

This process turned the classroom into a learning community where every student came to understand that the creative process is messy and iterative—and it is through this iteration that we learn from our audience about what works.

“Even though the final products were graded on having applied design principles from the class, all other homework was assessed on the basis of showing growth instead of perfection,” Hadjimichael said. “For example, demonstrating how they used feedback and on the quality of feedback they gave their peers.”

Hadjimichael said this classroom environment was a great introduction to real-life situations, where data visualization practitioners lean on a supportive community as they practice and refine their skills.

“From conversations with the students, they saw the feedback element of this class as essential to their growth and success,” Hadjimichael said. “When reflecting on this experience, this course design approach allowed for deeper and more meaningful learning, through building a sense of community and belonging. I loved how open and comfortable students were to express their thoughts, even if critical, about the designs and how they appreciated the importance of self-improvement and helping others. ☘

## Deaths from Natural Disasters: Highlighting the Global Divide

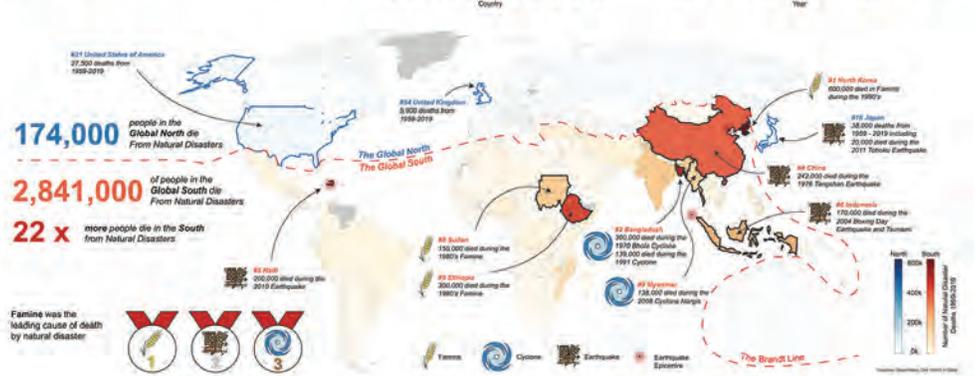
Author: **Rory Changleng**  
Email: rorychangleng@psu.edu



The vast majority of people who die from natural disasters are in the Global South.

Only 4.3% of people who died from natural disasters during 1959-2019 were killed in countries in the Global North, despite containing 25% of the world population.

If population is taken into account, 4 times more people should die in the Global South compared to the North. The actual figure is 22 times.



*Upper photo: A final project infographic created by student Rory Changleng. This was the final class deliverable, which required students to show at least eight dimensions of a dataset.*

*Lower photo: Students reviewing ideas and giving feedback at a show-and-tell discussion.*

*Photo credits: Antonia Hadjimichael*

Article is an excerpt taken from an article written by Antonia Hadjimichael and published in *Nightingale Magazine*, the journal of the Data Visualization Society. <https://nightingaledvs.com/weaving-data-viz-into-science-and-engineering-education/>



## EARTH'S CRUST, TECTONIC PLATES GRADUALLY FORMED, GEOSCIENTISTS FIND *by David Kubarek*

The Earth's crust continued a slow process of reworking for billions of years, rather than rapidly slowing its growth some 3 billion years ago, according to a Penn State-led research team. The new finding contradicts existing theories that suggest the rapid formation of tectonic plates earlier in Earth's history, researchers said. They published the research in *Geochemical Perspectives Letters*.

The work may help answer a fundamental question about our planet and could hold clues as to the formation of other planets, according to lead author Jesse Reimink, assistant professor of geosciences.

"The dominating theory points to an inflection point some 3 billion years ago, implying we had a stagnant lid planet with no tectonic activity before a sudden shift to tectonic plates," Reimink said. "We've shown that's not the case."

*Above photo: Geologists collect samples of ancient continental crust along the Arctic Coast of Canada. Penn State Ph.D. candidate Rory Changleng and collaborator Dr. Graham Pearson pictured with a Found Bush Hawk floatplane in the background. Photo provided by Jesse Reimink.*

To chart the formulation of the Earth's crust—or the crustal growth curve—researchers turned to more than 600,000 samples comprising the Earth's rock records database. Researchers across the globe—including at Penn State—have analyzed each rock sample in the record to determine geochemical contents and age. Researchers chose the rock records over mineral samples, which informed the theory of a more sudden formation, because they said the rock record is more sensitive and less prone to bias on those time scales.

Knowing that the reliability of the mineral record decreases through time, researchers recreated the crustal growth curve using the rock records. To do that, they developed a unique method for determining how igneous rocks dating to millions of years ago were reworked and reformed over time: experimentally demonstrating how the same rock could change in

different ways over time. Rocks can be reformed a number of ways, such as weathering into sediments or being remelted in the mantle, so researchers used this experimental data to inform novel mathematical tools capable of analyzing the rock records and working out the differences in sample changes.

“We calculated how much reworking has happened by looking at the composition of igneous rocks in a new way that teases out the proportion of sediments,” Reimink said.

They used these calculations to calibrate the reworking documented in the rock records. Then, researchers calculated Earth’s crustal growth curve using the new understanding of how the rocks were reformed. They compared the newly calculated curve to the rate of growth gleaned from mineral records by other experts.

Reimink and his team’s work indicates the Earth’s crust follows the path of the mantle—the layer on which the crust sits—suggesting a correlation between the two. It’s not the first time geoscientists have suggested a more gradual crustal growth, Reimink said; however, it’s the first time the rock record has been used to back it up.

“Our crustal growth curve matches the mantle record of growth, so it seems like those two signals are

overlapping in a way that they did not when using the mineral record to create the crustal growth curve,” Reimink said.

Reimink cautioned that the research improves on what researchers understand, but it’s not the be-all and the end-all for crustal growth research. There are simply too few data points to speak to the vast time and space of the Earth’s crust. However, Reimink said, further analyzing the existing data points may help inform investigations of other planets. Venus, for example, has no tectonic plates and could be a modern day example of early Earth.

“When did Earth and Venus become different?” Reimink asked. “And why did they become different? This crustal growth rate plays into that a lot. It tells the how, what and why of how planets evolved on different trajectories.”

Joshua Davies, of the University of Quebec at Montreal; Jean-François Moyen, of the University of Lyon, France; and D. Graham Pearson, of the University of Alberta, Canada, contributed to this research.

The Natural Sciences and Engineering Research Council of Canada supported this research in part. ☞

## Searching for 6 M-year-old hominins in the southern Rift Valley, Kenya

In August 2023, Associate Research Professor Erin DiMaggio and senior geosciences undergraduate student Abby Mensch spent two weeks studying the geology of 6-million-year-old fossil sites in southern Kenya. Their work is part of a collaborative project investigating a period in Africa (~6 to 8 million years ago) when the chimpanzee and hominin lineages diverged. Their international and diverse team of 30 people comprises geologists and paleontologists, a support crew, leaders from the Maasai community, and students from the U.S. and Kenya.

DiMaggio and Mensch spent most days measuring and describing stratigraphy sections, mapping geology, and collecting volcanic ash samples for radiometric dating and correlating fossil sites. Evenings were spent organizing samples and maps, integrating data, and planning the next day’s adventure. A highlight of their field season was the cross-disciplinary learning among the team each day and sharing experiences and cultures around the campfire at night.

DiMaggio, Mensch, and Penn State geosciences undergraduate student Zharia Hill presented their work on tephra geochemistry from Kenya at the GSA Connects conference held in October 2023. ☞



*Celebrating a great field season! (Left to right) Ruth Kaptai (National Museums of Kenya), Abby Mensch (Penn State), Rahab Kinyanjui (National Museums of Kenya), Erin DiMaggio (Penn State), Faith Selewuan (Kiambu National Polytechnic), and Ashley Hammond (American Museum of Natural History).*

## Meet our new faculty



### Isabel Fendley

I am a geochemist and I use laboratory and computational tools to study the environmental effects of volcanoes from recent volcanic eruptions to ancient large igneous provinces, the largest-scale volcanic activity on Earth.

Growing up, I loved dinosaurs and dreamed of becoming a paleontologist like I saw in the movie

*Jurassic Park*. During my undergraduate studies at McGill University, I started volunteering at the Redpath Museum of natural history where I picked microfossils out of matrix and sorted them taxonomically. I was captured by the idea that scientists were capable of understanding and reconstructing past ecosystems and climates. As I continued, my interests shifted towards the rocks

surrounding the fossils, and the geochemical signals left behind by changes in climate and environment.

My Ph.D. research at the University of California, Berkeley, and undergraduate research at McGill University both focused on the environmental changes at the Cretaceous–Paleogene mass extinction, which wiped out the dinosaurs. This period experienced significant environmental change due to the Chicxulub asteroid impact and the Deccan Traps Large Igneous Province in India.

My postdoctoral work at the University of Oxford in the UK moved back in time from the Cretaceous to the Jurassic period, when the Karoo and Ferrar Large Igneous Province eruptions resulted in global warming and the Toarcian Oceanic Anoxic Event.

My research is now focused on the intersection between volcanology and (paleo)environmental science. I use scientific understanding of modern volcanoes, particularly their emission of volcanic gases, to help us investigate how eruptions in the past influenced environmental changes such as climate change and ocean acidification. ☞



### Rachel Housego

I am from Ocoee, Florida, a small town just outside Orlando. Despite growing up on a peninsula, literally surrounded by water, I did not think about pursuing water science as a career until I participated in research as an undergraduate at the University of North Carolina at Chapel Hill. I spent a semester at the

UNC Institute of Marine Sciences field site in Morehead City, North Carolina, where I modeled the interactions between sedimentation and oyster reefs and completed a collaborative capstone project about the influence of canal system hydrodynamics on water quality.

Being immersed in these research projects enabled me to experience how hydrodynamics can be used as a lens to understand patterns in an array of interdisciplinary topics. I also loved getting to spend time in different marine environments, from the middle of the Atlantic Ocean to salt marshes and beaches on the coast, so this experience was foundational in leading me to pursue a career in environmental research.

During my Ph.D., I studied the hydrodynamics of groundwater in a North Carolina barrier island system in response to multi-hazard (waves, tides and rain) storm events. Residents of the Outer Banks are accustomed to flooding in their communities by storms, because of the low land elevation of the barrier islands and proximity to the ocean, but they were puzzled by floods that appeared several days after a storm. These “sunny day flooding” events occur when the level where the ground is saturated with water reaches the land surface.

My research improved forecasting of these groundwater-driven flooding events and expanded the understanding of aquifer-ocean exchanges. I also worked with the town of Duck and the town of Nags Head to design a community science phone app, iFlood, to collect reports of coastal flooding on the North Carolina Outer Banks and help the towns improve coastal hazards management in their communities.

After my Ph.D., I was a postdoc at the University of Delaware where I worked on a variety of projects related to salinization of coastal freshwater resources due to ocean surges and groundwater pumping. At Penn State, I am excited to expand the scope of my research to tackle interdisciplinary groundwater research topics from the mountains to the coasts and build new community-based research partnerships. ☞

## Meet our new staff



**Sara Peterson**

Alumni Awards and  
Stewardship Coordinator



**Laura Rush**

Administrative Support  
Assistant

**Jennifer Houser**

Graduate Program  
Coordinator

## DENNY WALIZER RETIREMENT

Everything I could say about Denny would be a superlative...

This man has been dedicated in every way—to the department and college, his family and farm, and his craft—exhibiting skill, knowledge, and caring for all in his encounters.

In 1991, I came to Penn State's Department of Geosciences as the head. At the urging of Hiroshi Ohmoto, I hired Denny as a research technologist to support the mass spectrometers for our stable isotope group, which was expanding by the addition of Kate Freeman, who showed up in the department to begin her awesome career on the same day that Denny started here. So, the rest is history.

Denny has served in the department and college in so many more ways than as a mass spec technician. He grew into an all-around resource to the department in service to faculty and graduate students and others. He oversaw and shepherded many laboratory renovations, for example.

But, to me, Den was not just an employee, but a friend with whom I have a kinship—a love of stable isotope geochemistry, farming, and family—the family part is an appreciation of the close ties among our geosciences colleagues and the many graduate students we co-supervised in various ways. Denny, Enjoy your “retirement” in every way. You will be profoundly missed!

**Michael Arthur**, professor emeritus of geosciences

“Denny, we both started our jobs at Penn State on the exact same day, thirty-two years ago. I marvel at how far we have traveled together since, as partners in science and in education. I owe you so much, and the expanse of my gratitude is hard to express.

The outpouring of appreciation from students and colleagues is a just small token of your impact. Quite literally, generations of students benefited from your patience, guidance, and deep knowledge of instruments. They, and I, also benefited immeasurably from your collegiality, good humor, and kindness.”

**Kate Freeman**, Evan Pugh Professor of Geosciences



“Denny, I am not sure it is possible for you to fully appreciate the impact you have had on the lives of those that have come through the labs at Penn State. You are a model of ingenuity, generosity, kindness, persistence and hilariously good company.”

**Cesca McInerney**, University of Queensland

*Hiroshi Ohmoto (left) and Denny Walizer at the retirement celebration for Walizer.*

# 2023 Field Camp

by Roman DiBiase



snowpack lingering into July, Assistant Professor Max Lloyd and Professor Kevin Furlong introduced students to exercises focused on the record of the Neoproterozoic Snowball Earth event exposed at Antelope Island and deformation along the Wasatch Fault. Also joining the group was postdoc Leila Joyce Seals, who is developing a contextual co-curriculum to support diversity, equity, and inclusion in geosciences.

The 2023 co-curriculum included historical information about the Field Camp study areas and field journaling in which students described their place-based observations of the American West. The

The Penn State Geosciences Field Camp completed a successful six-week trip to the intermountain west in summer 2023, with twenty-nine students departing State College in June for a tour of Montana, Wyoming, Idaho, and Utah before returning to Pennsylvania.

Assistant Research Professor Erin DiMaggio led the first exercise studying late Cretaceous sediments at Elk Basin from the base camp of the Yellowstone Bighorn Research Association in Red Lodge, Montana. The students then investigated the Quaternary history of Jackson Hole, Wyoming with Associate Professor Roman DiBiase.

Professor Don Fisher and Associate Research Professor Maureen Feineman guided the students through mapping the Challis Volcanic Series at the Wildhorse site in Idaho. And with a record Utah

graduate teaching assistants for this course, Rory Changleng, Brandon Fong, Kate Grosswiler, Sarah Jonathan, Kate Meyers, and Leah Youngquist, were instrumental to its educational and logistical success. As part of ongoing efforts to make Field Camp more accessible, in 2024 we are transitioning from six weeks in the summer to a four-week summer course supplemented with a new 2-credit class in the spring semester. ☘

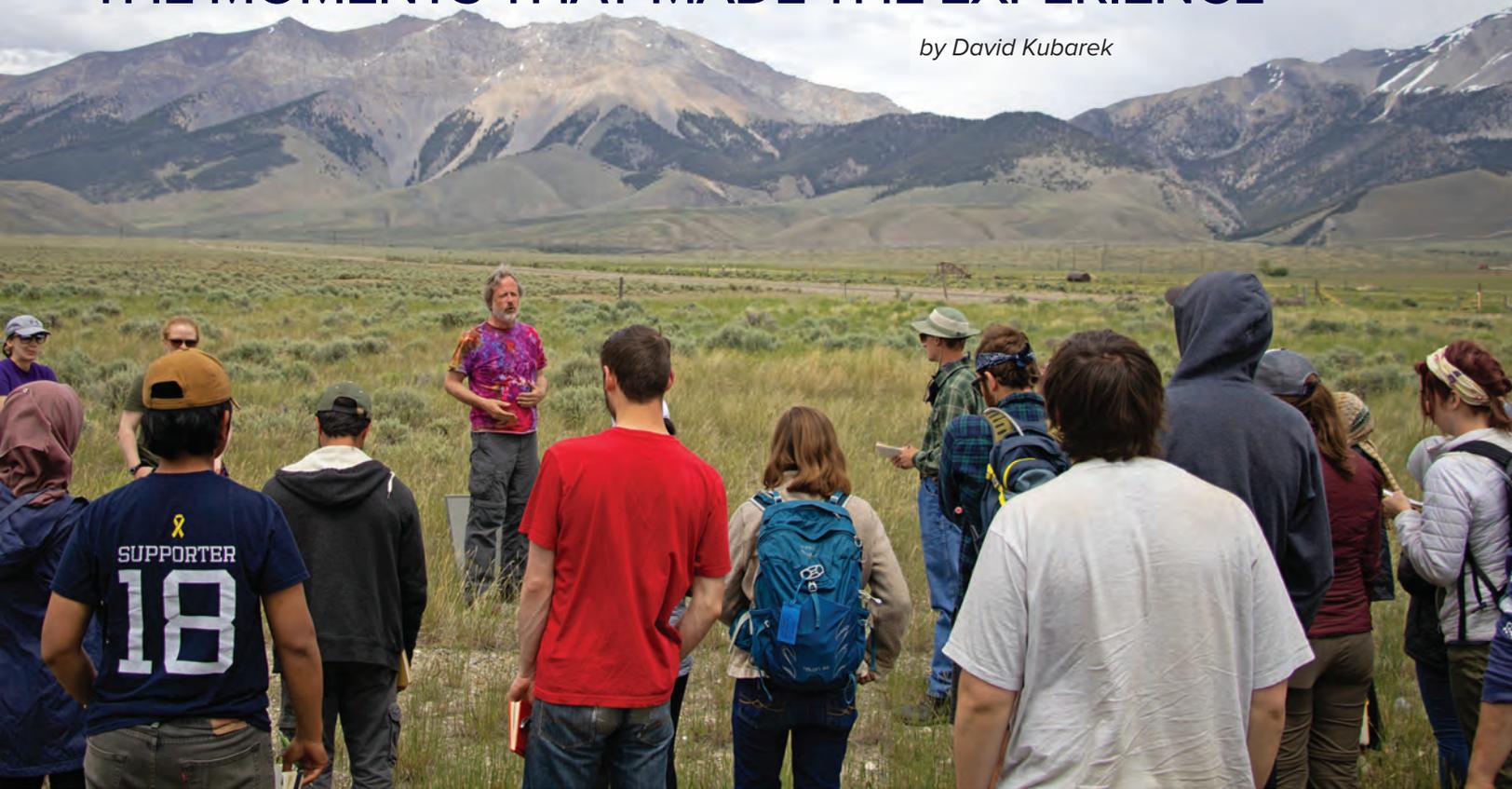
*Upper photo: 2023 Geosciences Field Camp in front of the 1925 Gros Ventre Landslide near Jackson Hole, Wyoming. Photo Credit: Roman DiBiase*

*Lower photo: Students helping to show the dip direction of Cretaceous sediments exposed in Elk Basin, Wyoming. Photo Credit: Erin DiMaggio*



# IN 25 YEARS OF FIELD CAMP, FISHER SAYS IT'S THE MOMENTS THAT MADE THE EXPERIENCE

by David Kubarek



If you train your eyes on the vast outcrop of the Rocky Mountains, you can see the remnants of our planet's history. It's a span that dwarfs nearly anything Earthly, including the twenty-five years Don Fisher has been surveying these rocks with students during an annual rite of passage for all geosciences majors in the College of Earth and Mineral Sciences: Field Camp.

But outside of geological time, it's quite a feat for the professor of geosciences.

Since 1998, Fisher has been using these rock outcrops and other areas to show juniors and seniors what they've been learning for years in textbooks. They also learn tools they'll need in the field such as GIS, mapping and geological interpretation. Fisher says they travel west each summer because the drier climate unearths the same forces at play as in Pennsylvania without the biology hiding all that geology.

Fisher took over for David "Duff" Gold, professor emeritus of geosciences, and he said he learned a lot from Gold, an affable jack-of-all-trades scientist who was ever patient with the students.

"He is a great guy," Fisher said. "He knows a lot about all kinds of different aspects of geology and he loves hanging with the students. He created an environment

where field camp was something students looked forward to, and I wanted to continue that."

Field camp was something that drove Fisher himself into a career as a field geologist. As an undergraduate, he spent several weeks in Scotland. After that, he was hooked.

## A day in the field

When Gold ran field camp, it began at Penn State and a van full of students spent two weeks traveling across the country, a bucket list for many even outside the major. But when Fisher took over, he quickly inherited a problem: Field camp was becoming too costly and the time commitment for students was becoming prohibitive. He trimmed the eight-week program down to six still retaining the bulk of the lessons.

Students visit places such as the Grand Tetons and the Rocky Mountains, traversing four states. Sometimes, they stay in ski resorts offering off-peak deals on summertime slumber or research facilities such as Yellowstone Bighorn Research Association. Other times, as such the case in Idaho, they're completely off the grid and primitive camping, relying on satellite phones in case of emergencies.

## FIELD CAMP

Fisher said it's in those remote areas where he gets to know best the students he's already seen in class. And that's where they get to know each other.

"These are the kinds of things that have been associated with field camp for the past one-hundred years: sitting around the campfire and talking with each other," Fisher said. "And I've always enjoyed that part."

Working together in the field, students comb the landscape, completing exercises that often take a few days. One goal, Fisher said, is studying the surface and then trying to surmise what's happening underneath. It's a feat he said that's made much easier thanks to the lack of vegetation.

"In Pennsylvania there are great outcrops, but most of them are associated with road cuts," Fisher said. "There isn't a three-dimensional aspect to the exposures that allow you to think in those dimensions, which is an important take home from field camp. Students begin taking maps and cross sections and put together a three-dimensional view of what the Earth is doing. They're making interpretations of the subsurface."

### Fisher's impact

In his time, Fisher made his mark on field camp. First, he changed the way it was funded to make it more accessible to all students. He also scrapped for funds to help students with the cost of camping gear and travel.

He brought in experts in the department to lead their respective lessons. Instead of one faculty member covering a diverse array of topics, lessons were sectioned off so that students could be taught by some of the leading experts in each area. One great example of that was in GIS.

"We've had a lot of students who have graduated from Penn State and in their professional lives have found ArcGIS to be a useful skill," Fisher said.

Fisher also upgraded safety measures to reduce injuries from the demanding terrain, conditions and remoteness of the experience. Field camp faculty developed a safety plan modeled after ExxonMobil's.

For all that's changed, Fisher said some aspects of field camp will always stay the same.

"We still go to the same places our alumni from as far back as the 80s will remember," Fisher said.

### Future bright for field camp

Fisher, who may still make an appearance at field camp, leaves the program in capable hands. Roman DiBiase, an associate professor of geosciences who uses tools such as drones and GIS to understand geological changes on the surface, will take the reins.

As he surveys his field camp memories, Fisher says DiBiase has a lot to look forward to. It's a chance to help students hone their skills ahead of beginning their careers. But it's also a chance to mentor students, and to share experiences few get to have.

In that, it's hard for Fisher to pick just one memory that stands out. But the hike to Flagstaff Mountain is one that comes to mind.

"When we get to the top of the mountain, we always take a group photo," Fisher said. "I think some of my favorite memories are students wanting to get a picture with me there because that happens very late in the trip. At that point, it feels like people are saying goodbye and thank you for the experience, and there's a feeling like it's mutual." ❧



*Don Fisher (front row - 5th from left) at 2010 Field Camp.*



## Penn State hosts International Geobiology Course

Penn State hosted the International Geobiology Course (IGC) this summer, which ran from July 16 to July 21.

Now in its twentieth year, IGC is an immersive, multidisciplinary summer course that explores the co-evolution of the Earth and its biosphere, with an emphasis on how microbial processes affect the environment and leave imprints in the rock record.

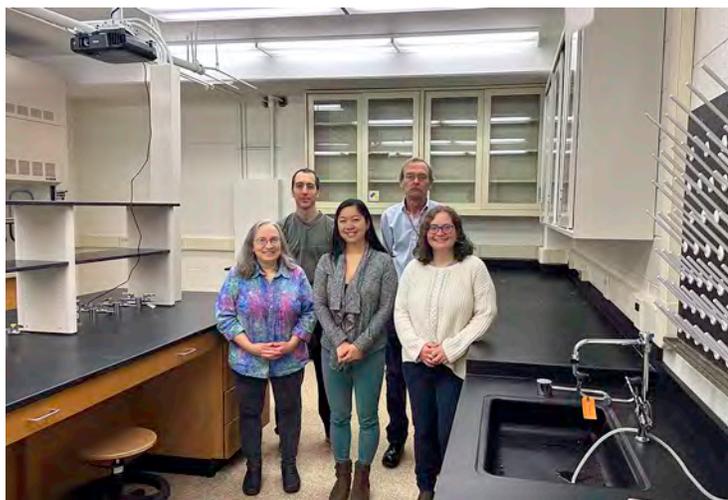
Penn State received an award from the Agouron and Simons Foundations to fund IGC for the next five years. The course had previously been run by University of Southern California and more recently by Caltech.

The Penn State course featured immersive training in geobiology based on field experiences in central Italy and at Green Lake, New York. Students were instructed by leading scholars, and gained hands-on experience using world-class geochemistry, biology, and materials research facilities on the Penn State University Park campus.

Students explored cave-forming microbial ecosystems, biosignatures in modern and ancient thermal springs, anaerobic phototrophy, how biology shapes carbonate sedimentation and marine platforms, and biogeochemical responses to catastrophic impacts and climate upheavals. Student gained experience with state-of-the-art metagenomic methods, isotopic analyses, lipid and pigment biomarkers, imaging spectroscopy, microscopy, field methods, and computational and data analytical methods.

The course also included a mini symposium, Life on the Edge, that featured six speakers from U.S. universities and NASA.

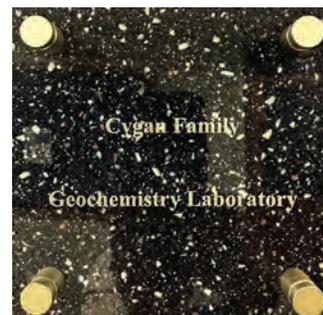
The Penn State IGC is directed by Kate Freeman, Evan Pugh Professor of Geosciences, and Jennifer Macalady, professor of geosciences. Applications for the 2024 IGC are due by February 10, 2024. See: <https://sites.google.com/psu.edu/igc-psu> ☘



### CYGAN FAMILY UNDERGRADUATE GEOCHEMISTRY TEACHING LABORATORY

The newly renovated lab was made possible by a generous gift from Randall T. Cygan (M.S. '80 and Ph.D. '83 in geochemistry and mineralogy) and Donna Cygan.

Faculty and staff who will be using the lab: (front row (L to R) Laura Liermann, Kim Lau and Isabel Fendley; back row (L to R) Matt Fantle and Steve Swavely.



# NEW MUSEUM DIRECTOR PULLS FROM THE PAST, READIES COLLECTIONS FOR FUTURE

by David Kubarek



Chris Widga didn't set out to be a museum director. It's a role that found him carefully and slowly, much like an archaeologist excavates through millennia an inch at a time.

A young Widga liked science, but he wasn't obsessed with digs and dinosaur bones. He didn't think much about archaeology, geosciences, and paleontology, or even museums such as the EMS Museum & Art Gallery. Instead, he saw his future freestyling as a jazz musician, a performer behind the trombone.

After growing up in Nebraska, he attended the University of Missouri-Kansas City's Conservatory of Music for two years while traveling the state for gigs, taking advantage of the then shortage of trombone players in the region. Two years later, he switched to anthropology at the University of Nebraska, where a summer volunteer experience found him for two weeks in a hole in the badlands of Nebraska, searching for 10,000-year-old bison bones. He loved it and that experience led to yet another shift, this time to paleontology.

## A path to museums

Widga shifted to science because he thought it would be more stable than music. But he soon found the leap not as big as he thought.

"Musicians and scientists both take something that is highly technical and do something creative with it," Widga said. "There are a few more creative constraints in science, but you're still dreaming up how to test something out, or visualize processes that are tough to see, which is not all that different from jazz."

In graduate school, at the University of Kansas, Widga dug deeper while finding another passion: museums.

"I was working in the museum the whole time. They are

just one of many tools in the paleontological toolkit. Museum research collections are fantastic resources," Widga said. "Museum collections of fossils allow us to go from measurements on bones, to species-specific climate responses, to changes in ecosystems—then back again."

Widga was a geology curator at the Illinois State Museum before becoming head curator at the East Tennessee State University Gray Fossil Site & Museum. He became director of the EMS Museum & Art Gallery in August.

The EMS Museum & Art Gallery boasts a vast and varied collection of roughly 20,000 items, from gemstones, to industrial safety equipment, to paintings of industry.

"The collection here is so diverse and unique," Widga said. "I have a strong background in geology and paleontology but this museum also includes fine art and historic artifacts that tell the human side of the story. That really appealed to me."

## A vision for EMS

Widga says the museum is there to serve the interests of the college. It's there to help researchers continue their work. Because it's visited by K-12 students, it's there to help them discover majors within the college. His vision is to advance on these fronts while expanding the collection to better represent modern research in EMS. That includes meteorology and atmospheric science, geography and AI, energy and sustainability, and materials science and engineering.

"We are going to spend a lot of time in the coming months asking our community what they want from their museum," Widga said. "Because the museum has to be relevant to the people that it serves."

## A solid foundation

Widga said two things attracted him to the job. First, he knew the museum was on a solid foundation. Through his research work, he frequently worked with retired director Russell Graham and Julianne Snider, long-time assistant director for exhibitions and collections who recently retired as interim director.

The duo and many others worked diligently to expand the collections, protect existing collections through securing grants and made strides towards digitizing the collections.

The second thing that attracted him to EMS was something Graham and Snider frequently talked about: The Penn State culture.

He said it's something that stood out when he talked with them or interacted with some of Penn State's more than 700,000 alums. They all talked about a team approach to student-centered education.

"I've been in academia long enough to know that this is rare," Widga said. "I was curious to find out more about how Penn State created something where everyone feels included and part of the team."

## For generations to come

As with anyone who works on geological timescales, Widga knows his work is just part of the process. He's not just building the museum that he wants, or that researchers or the public want. He's adding to something that came before him and will outlive his contributions.

"One of the most important parts of managing a museum is to see it as a multigenerational institution," Widga said. "In the present, you're concerned about satisfying stakeholders and reaching your audiences. But you're also protecting and preserving a collection to ensure that it stays relevant to future generations." ❧

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## Laura Guertin, Bradywine Earth sciences professor, gives the Lattman Lecture

Laura Guertin, distinguished professor of Earth sciences at Penn State Bradywine, gave the department's 2023 Lattman Visiting Scholar of Science and Society Lecture in November.

Scientists use a range of communication tools to connect with audiences. Guertin's talk, "A creative approach to science storytelling with quilts," discussed using a more creative approach, such as quilts, to tell stories of science.

Guertin took the audience on a journey of when she first started combining her hobbies in the creative arts with her science storytelling skills, and how her field experiences in Alaska, Louisiana, and a two-month ocean expedition in the South Atlantic Ocean are being shared with quilts displayed in a variety of venues—including on the front door of her house.

Guertin's research focuses on how technology can enhance teaching and student learning in introductory-level geoscience courses for non-science majors. Her blog focuses on geoscience education and outreach, science communication and technology tools in the classroom, online and in the field.

The Lattman Visiting Scholar of Science and Society lecture series was created to engage undergraduate students in a broad range of scholarly issues. It was endowed by friends and associates of Laurence Lattman, a geosciences educator who taught at Penn State from 1957 to 1970. During that time, he developed a geology course for non-geology majors, Geological Sciences 20: Planet Earth, which he taught to more than 24,000 students. ❧



by Matthew Carroll

Beth Stump boarded a helicopter in Louisiana that buzzed across the Gulf of Mexico and landed on an oil drilling platform in the middle of the sea—there was no turning back, she was now a geoscientist.

“Here I am a relatively recent college graduate with a meteorology degree and the next thing you know I’m on a helicopter going to a Pennzoil production platform,” Stump said. “The whole thing was kind of surreal. I remember telling my mother I was going to do it and she said, ‘where are you going to sleep—are you going back to shore every night?’”

Since that opportunity more than twenty-five years ago, Stump has carved out a career as a geoscientist working for the largest energy companies in the world. Today, she is the global geological and geophysical manager at Chevron, overseeing subsurface characterization support for the planning, design and drilling of oil and gas wells across the world.

But her path may have taken decidedly different turns if not for a single chat with Eric Barron, former Penn State president and then director of the Earth System Science Center—the precursor to the Earth and Environmental Systems Institute.

“I was an undergrad and the only way I could afford to stay in my apartment over the summer and not go home was if I had a job and could pay rent,” Stump said. “In a rare moment of boldness, I walked into ESSC and asked the admin if I could have a minute with Dr. Barron because I had a question.”

Stump introduced herself, said she was interested in the work the center was doing on climate modeling and wondered if she could be a help as a summer intern.

“He said yes on the spot,” Stump said. “As I was leaving, he asked what my major was. I said meteorology and he said, ‘oh good, that will come in handy.’”

After graduation, and in part thanks to the experience gained from her internship, Stump got a job as a technologist with Peter Flemings, then a professor of geosciences at Penn State, who was

working on a large project with industry to drill a well in the Gulf of Mexico and investigate why a field over a fault zone had been overproducing.

For Stump, it meant flying down to Louisiana and boarding a helicopter for an offshore oil platform.

“It was a tremendous experience and I thought ‘wow, I don’t know if there is anything cooler than getting to drill wells and figure out if you are right,’” Stump said. “You have this geologic hypothesis, and you are going to gather data and figure out if you are right and then you are going to apply that knowledge to future operations.”

Inspired and seeking to make a career of doing science, Stump enrolled in graduate school to study geosciences at Penn State. She said she found like-minded individuals as she got to know the scientists and engineers who worked in industry.

“They weren’t just cogs in a corporate machine,” she said. “All of the industry geologists I interacted with when I was at Penn State were really interesting characters. They knew about lots of different things

and maintained their individuality. They were very much still scientists.”

And so after graduating in 1998, Stump took a job at Texaco as a development geologist in the Gulf of Mexico shelf field. She joined Chevron when the companies merged in 2001 and has been with the company—doing science—ever since.

“My work has afforded me the opportunity to travel the world,” she said. “It’s been a great opportunity for me to interact with lots of different people who don’t necessarily look like me or sound like me and I’ve enjoyed it very much. That’s why I want to come back to Penn State to talk to students about what’s possible and introduce them to career paths that may not be on their radar screens.

Today, Stump leads the geosciences external Penn State alumni advisory board and serves as Chevron’s executive sponsor to the University.

“It’s been exciting coming to really understand the full breadth of the interactions we have with Penn State and trying to encourage more partnerships



**Beth Stump '93 '98g**

# Alumni News

## Robert J. Bodnar '85

Bodnar, who is the C. C. Garvin Professor of Geochemistry and University Distinguished Professor in the Department of Geosciences at Virginia Tech, was elected to the U. S. National Academy of Sciences.

## Michael Cronin '11 '20g

Cronin, who is a reservoir engineer at ExxonMobil, received the 2023 Offshore Technology Conference Emerging Leader Award. He also won the 2019 Cedric K. Ferguson Medal from the Society of Petroleum Engineers International. He also currently serves as editor-in-chief of SPE's journal, *The Way Ahead*.

## Ying Cui '14

Cui is a shipboard scientist for International Ocean Discovery Program Expedition 395: Reykjanes Mantle Convection and Climate: Mantle Dynamics, Paleoceanography and Climate Evolution in the North Atlantic Ocean. She received an American Fellowship from the American Association of University Women and was recently promoted to associate professor in the Department of Earth and Environmental Studies at Montclair State University.

## Catherine Hanagan '19

Hanagan graduated in August with a Ph.D. in geophysics from the University of Arizona. Her dissertation "Earthquake Stress and Strain Through High Resolution Data Analysis: Aftershock Triggering, Afterslip, and a Novel Borehole Strainmeter Array" focused on earthquake processes.

## Leonard Konikow '69g '73g

Konikow retired from the USGS in 2013 after forty-two years as a research hydrologist but remains active professionally. He was elected to the National Academy of Engineering in 2015 and has served as editor-in-chief of Groundwater journal since January 2020.

## Ned Mamula '81g

Mamula, wrote the book *Groundbreaking, America's New Quest for Mineral Independence*, which was

published in 2019 and focuses on critical minerals. He is currently working on a second book on *Geology, Minerals, Metals and Rebuilding America's Supply Chain Power* due out sometime next year.

## Kent E. Newsham '78

Newsham was appointed to the EMS Development Council, effective July 1, serving on the Industrial Engagement Committee. He was also promoted as Occidental's Petrophysics Fellow – one of seven globally – which is Oxy's highest technical achievement. As global chief of staff in petrophysics, he leads Oxy's Petrophysics activity in the Energy Transition via Direct Air Capture, EOR Net Zero Oil and Carbon Dioxide Sequestration projects.

## William Ross Snook '79

Snook retired in 2015 and became a New Hanover Township Supervisor in Montgomery County, Pennsylvania. He serves chair of the township's Environmental Advisory Board. He also is a Penn State Master Watershed Steward who serves on the Advisory Committee for Montgomery County Master Watershed Stewards. He is integrally involved in his community's efforts to negate flood damage and to maintain water quality through effective stormwater management.

## George Stephens '80g

Stephens retired after thirty years of federal service, twenty-six with NOAA's National Environmental Satellite, Data and Information Service where he mostly focused on remote sensing of natural hazards. His consuming avocation has been folk and traditional music and he credits Rick Sweigard ('84 Mining Engineering) for encouragement.

## Don Woodrow '57

Woodrow retired from Hobart and William Smith Colleges in Geneva, New York as a geology professor in 2001 but since then has been teaching the Intro Geology course and lab at Berkeley City College in Berkeley, California. While at Penn State, he ran the mile, two-mile and half mile, both indoor and outdoor, plus cross-country.

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between Chevron and the University," she said. "I think Penn State has a lot to offer and Chevron has a lot to offer, in terms of introducing folks to the energy transition and all the ways people can get involved."

It's an exciting time in the energy industry, as companies like Chevron focus on the need to develop lower carbon solutions, Stump said.

"What I tell geosciences students is we need them to be part of the solution," Stump said. "Pretty much everything you can think of requires some sort of geosciences knowledge and understanding—certainly carbon storage and utilization, certainly geothermal and even hydrogen storage—as well as critical minerals required for all these EV batteries. We certainly have a part to play." ❧



*Penn State 1969 and 1970 summer field camp alumni reunion held October 2021 in Tucson, Arizona. (Back Row): John Grimes, Bob Lanning, Judy Malkames Bishop, Ihor Kunasz, Roger Cuffey, Bill Fuchs, Dick Turpin, Karen Wenrich, Lenny Wildrick, Joe Jellick, John McCormick, Art Thorn, Larry Bennett, Joe Head, George Burgess, Connie and Mike Arden, (Front Row): Harriet Grimes, Minuen Odom (Lanning), Zenia Kunasz, Vicki Fuchs, Naomi McCormick, Margaret Thorn, Linda Billera (Bennett), and Susan Burgess.*

## 1969 AND 1970 FIELD CAMP ALUMNI REUNION

*by Karen Wenrich*

Classmates Bob Lanning, Lenny Wildrick and Karen Wenrich got together for a visit in April 2020 just as COVID-19 was ramping up and planned a geology reunion, assuming the pandemic would be over by the fall of 2020. Locating fellow geology classmates seemed like it should have been easy, but it wasn't. For help, the group contacted Roger Cuffey and Duff Gold, who were always dear to all of us, and who have kept in contact with many of us over the years. Roger informed us that we were mistaken, that by his calculations the pandemic would not be over by October 2020 nor even by the following April. How right he was.

Roger said that because the classes of '69 and '70 were his first students after he had arrived at Penn State, he remembered us well and would love to come and join us for the reunion. And so he did. In the ensuing one and half years while we waited for the pandemic to wane, we tracked down thirty-five of our forty classmates from the two classes. Reunion plans were made for October 2021.

Sixteen classmates and nine spouses braved potential pandemic and travel cancellations to attend the reunion at Karen Wenrich's and Lenny Wildrick's ranch in Tucson, Arizona. Everyone arrived and stayed for four days. Roger drove all the way from State College to Tucson over a period of several days; we all assumed that he stopped at every bryozoan locality across the US. Class members came from all ends of the U.S.: Bob Lanning and Minuen Odom came from Springfield, Missouri; George and Susan Burgess from Fairbanks, Alaska; Mike and Connie Arden from Galveston, Texas; Larry Bennett and Linda Billera from Golden, Colorado; Bill and Vicki Fuchs from Reno, Nevada; John and Harriet Grimes from Womelsdorf, Pennsylvania; Joe Head from Marion, North Carolina; Joe Jellick from Columbus, Ohio; Judy Malkames Bishop from Miles City, Montana; John and Naomi McCormick from Cedar Falls, Iowa; Art and Margaret Thorn from Lititz, Pennsylvania; Dick Turpin from Gilbert, Arizona; Ihor and Zenia Kunasz and Karen Wenrich and Lenny Wildrick from Tucson, Arizona.

The reunion included lectures, field trips, dining, and visiting local sites.

Phil Pearthree, Arizona State Geologist, and Marie Pearthree, Central Arizona Water Conservation District, explained how Tucson went from a water disaster with serious land subsidence/fissure development and a

# Faculty Awards



## ELIZABETH HAJEK

Received the Wilson Award for Outstanding Service from the College of Earth and Mineral Sciences



## PETER HEANEY

Received the George W. Atherton Award for Excellence in Teaching, Honorary Award from the Eastern Federation of Mineralogical and Lapidary Societies



## JAMES KASTING

Named a Penn State Atherton Professor



## KIMBERLY LAU

Received a Sloan Research Fellowship



## ANASTASIA PILIOURAS

Received a 2023 Wilson Research Initiation Grant from the College of Earth and Mineral Sciences



## CHRISTELLE WAUTHIER

Elected as President-elect for the Natural Hazards section of the American Geophysical Union



## PETER WILF

Named an AAAS Fellow

depleting aquifer system to one of the two showcase cities in the U.S. for bringing back their groundwater supply system through artificial recharge.

Phil Pearthree led a fantastic field trip to the Picacho Peak area to view ten feet deep subsidence fissures caused by water withdrawal. Then Asarco provided us with a tour of their Silver Bell Copper Mine with two of their geologists. We were treated to geological discussions and stops to crawl around on the rocks and collect copper minerals.

That evening all of us gathered at Lil Abner's Steak House, an 1800's Butterfield stagecoach site, for an outdoor grilled meal accompanied by a country western band. Saturday, Karen and Lenny hosted an outdoor party in Tucson's gorgeous October weather on the ranch patio and yard. On Sunday, attendees went on their own for local site visits, such as the Sonora Desert Museum.

Roger drove the 2200 miles back to Penn State from Tucson, and despite battling a snowstorm in the Midwest, he had a great time, according to Duff. It was a great time for all of us, and we are so glad, as one of our classmates said, that we were able to give Roger a "good sendoff", since he passed away three months later, in January 2022. ☘

## ALUMNI PASSINGS

Mr. Walter M. Cox '57

Mrs. Ruth G. Deike '56

Mr. David M. Demshur '77

Dr. Lawrence J. Drew '64

Dr. Francis O. Dudas '90

Mr. William R. England '59

Dr. William M. Flock '60

Mr. Robert G. Graf '56

Mr. John R. Ketcha '69

Mr. Bruce H. Neilson '74

Dr. Allison R. Palmer '46

Dr. George R. Rapp, Jr. '60

Dr. Allan F. Schneider '51

Mr. Thomas S. Semple '70

Dr. Charles J. Spengler '65

Mr. David J. Stuart '48

Dr. David A. Vacco '09

Mr. Terence M. Wolf '81

Mr. Richard K. Yoder '69

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# TRUSTEE SCHOLARSHIP AND ENDOWMENTS

*Alley Family Graduate Scholarship in the Department of Geosciences*

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

*Dr. Hubert Barnes and Dr. Mary Barnes Professorship in Geosciences*

*Joseph Berg Award for Undergraduate Research in Geosciences*

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

*Barton P. Cahir Award Endowment in Earth and Mineral Sciences*

*R.J. Cuffey Fund for Paleontology*

*David M. Demshur Undergraduate Research Endowment in Geosciences*

*David M. Diodato Geosciences Fund*

*Frank and Lillie Mae Dachille Memorial Award in Geochemistry*

*Katherine H. Freeman and Mark E. Patzkowsky Graduate Research Fund*

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

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

*General Scholarship Endowment in Geosciences*

*Geosciences Enrichment Fund*

*John C. and Nancy Griffiths Scholarship in Geosciences*

*Arthur P. Honess Memorial Award*

*Baker Hughes Natural Gas Research Fund*

*Benjamin F. Howell, Jr. Award in Geosciences*

*Heller Marcellus Shale Research Initiative Endowment*

*James and Nancy Hedberg Scholarship in Geosciences*

*Charles E. Knopf, Sr. Memorial Scholarship*

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

*Kappmeyer-Isaacs Field Camp Award*

*The Paul D. Krynine Memorial Fund*

*Earle S. Lenker Fund for Field Studies in Geology*

*Earle S. Lenker Graduate Fellowship in the Department of Geosciences*

*Lattman Visiting Scholar of Science and Society Endowment*

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

*Ronald A. Landon Endowment in Hydrogeology*

*Maureen and Dennis Maiorino Undergraduate Scholarship in the Department of Geosciences*

*Timothy B. and Cindy Lynch Mullen Scholarship in Geosciences*

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

*Hiroshi and Koya Ohmoto Graduate Fellowship in Geosciences*

*Open Flow Gas Supply Corporation Endowed Program Fund in Geosciences*

*Dr. Gregory and Mrs. Mitra Pavlin Fund for Graduate Research Innovation*

*Petroleum Geosystems Enrichment Fund*

*Pottorf Endowment for Graduate Excellence in Geosciences*

*Richard R. Parizek Endowment for Field Study in Geosciences*

*Richard R. Parizek Graduate Fellowship*

*RADS Equipment Fund for Field Studies in Penn State Sedimentary Geology*

*Reif Undergraduate Summer Field Camp Endowment*

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

*Robert F. Schmalz Award in the Department of Geosciences*

*Daniel and Deborah Stephens First-Time Endowed Scholarship*

*Julie and Trem Smith Family Undergraduate Scholarship*

*Richard Standish Good Graduate Scholarship in the Department of Geosciences*

*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*

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

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

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

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

*Timothy D. Watson Fund in Geosciences*

# UNDERGRADUATE

## Scholarships & Awards

**Joseph Berg Award for Undergraduate Research:** Ziyao Chen, Ciaran Costello, Erin Martin, Connor Sipe, Gabriel Vanderbrink

**Barton P. Cahir Award Endowment:** Nicolaas Weggelaar

**Frank and Lillie Mae Dachille Memorial Award in Geochemistry:** Owen Purcell, Joshua Rechenberg

**General Scholarship Endowment:** Zachary Baran, Mackenzie Barker, Alexis Kennedy, Samantha Rowe, Sophia Seck

**David P. “Duff” Gold Undergraduate Scholarship Fund:** Logan Madden, Abigail Mensch, Pj Przybylski, Hollin Williams

**John C. and Nancy Griffiths Scholarship:** Zharia Hill, Ethan Merckx, Jacob Miller, Seanna Pryor, Akira Regotti

**James and Nancy Hedberg Scholarship:** Olivia Adams, Andrew Allen, Heather Bittle, Kailee Blum, Gavin De Mars, Emma Enos, Olivia Friend, Molly Gulden, Lindsey McMackin, Hrishi Mohan, Grace Roti, Zachary Terefenkor

**John and Elizabeth Holmes Teas Scholarship Fund:** Emma Stolinias, Sarah Kummerfeldt, Ryan Zaff

**Arthur P. Honess Memorial Award:** Amrita Anand, Kathryn Brodeur, Alexander Cerminaro, Asa Hollenbeak, Arnav Lund, Madison McEvoy, Rahil Mohd Zaid, Sophia Wood, Zoe Zenker

**Benjamin F. Howell, Jr. Award:** Neel Bishop, Carlin Blash, Emily Stoller, Collin Taylor

**Ronald A. Landon Endowment in Hydrogeology:** Sabrina Blacklock, Bridget Reheard

**Maureen and Dennis Maiorino Undergraduate Scholarship in the**

**Department of Geosciences:** Sarah Ambrozak, Cortney Aubain, Charles Confessore, Kaitlin Dasovich, Regan Davis, Marsella Degnan, Seth Farabaugh, Sarah Fetter, Noah Opferman, William Palumbo, Alexander Peppiatt

**The Millennium Scholars Program:** Katerina Taylor, Rasha Elwakil, Zharia Hill, Bridget Rehard, Ava Yurchak, Saia Pride

**Perez Family Undergraduate Scholarship:** Raheel Hadi, Rylan Morgan, Jalen Scott, Alexander Waldman, Dylan Wilt

**Thomas Kenneth (T.K.) Reeves, Jr. Family Scholarship:** Austin Arnold, Gabriel Jauregui, Tommy Lutz, Jeffrey McGuckin, Dean Sanwirja, Noah Sheldon, Nile Williams, Ava Yurchak

**Robert F. Schmalz Award:** Charles Confessore, Claire Martin, Sydney McCarthy, Ariel Ratsep, Matthew Roy, Zane Saylor, Benjamin Smith, Xiyao Song, Octavia Szkutnik, Elizabeth Tofte

**Julie and Trem Smith Family Undergraduate Scholarship:** Madison Bailey, Grace Boyle, Dylan Cornett, Stiles Costello, Alexander Czczulin, Olivia DiPrinzio, Isabella Ferreira, Alexander Filetti, Amanda Gardner, Aubree High, Angelina LaRose, Lindsay Leber, Kurt McAuliffe, Gemma Morrison, Evan Piznar, Alysha Ulrich, Allison Welch

**Daniel and Deborah Stephens First-Time Endowed Scholarship:** Armitra Anand, Grace Druschel, Jacklynne Karlowicz, Cooper Klose, Mo Wales

**Timothy and Courtney Watson Undergraduate Scholarship:** Cris Kocian, Kevin Lastowka, Joseph Miller, Kaitlyn Toth

**Field Camp Awards**

**The Edwin L. Drake Memorial Scholarship:** Sarah Fetter, Matthew Roy, Noah Brian Sheldon, Caroline Claire Spengler, Emma Elizabeth Stolinias, Cole Everett Temple, Zachary Terefenko, Amanda Urist, Alexander Waldman, Dylan Wilt, Frank Yetnick, Zoe Elizabeth Zenker

**General Scholarship Endowment in Geosciences:** Gabriel Ryan-Oscar Felker

**Earle S. Lenker Fund for Field Studies in Geology:** Luke Benson, Alex Czczulin, Halina Dingo, Zili Huang, Gabriel Jauregui, Haeseo Lee, Cris Kocian, Maximiliano Leon, Arnav Inesh Lund, Abigail Mensch, Joseph George Miller, Riley Paul-Cook, Joshua Nicholas Rechenberg

**Timothy B. and Cindy Lynch Mullen Scholarship:** Grace Boyle, Alexander Paul Cerminaro

**Reif Undergraduate Summer Field Camp Endowment:** Charles James Confessore, Gavin Rex De Mars, Caitlin Dooley, Matthew Hayden Roy, Katrina Mackenzie Taylor

**Dr. David E. W. Vaughan and Mrs. Julianne S. Vaughan Field Camp Fund:** Sabrina Rose Blacklock, Gabriel Ryan-Oscar Felker, Alex Waldman, Frank Yetnik

# GRADUATE

## Scholarships & Awards

### **Alley Family Graduate Scholarship:**

*Thomas Givens, Caleb Norville*

### **Cannon Family Graduate Symposium Award:**

*Hanh-Tu Ella Do, Luis Alejandro Giraldo Ceron, Emily Schwans, Kate Meyers, Samuel Shaheen*

### **Chevron Scholarship:**

*Watsawan Fai Chanchai, Rory Changleng, Charlotte Connop, Ran He, Aristotle Monteiro, Karen Pham, Garrett Shepherd, Nolan Roth*

### **R.J. Cuffey Fund for Paleontology:**

*Eric Hasegawa, Edward Spagnuolo, Amanda Willet*

### **Charles E. Knopf, Sr. Memorial Scholarship:**

*Dani Buchheister, Enock Bunyon, Rory Changleng, Hanh-Tu Ella Do, Juliana Drozd, Claire Hines, Yusuke Kubota, Fran Meyer, Aristotle Monteiro, Caleb Norville, Edward Spagnuolo*

### **The Paul D. Krynine Memorial Fund:**

*Roger Ort, Nolan Roth, Youki Sato, Erik Schoonover, Samuel Shaheen, Noshin Sharmili, Claire Shaughnessy, Adam Stone, Leonie Strobl, Miranda Sturtz, Jasmine Walker, Tengxiang Wang, Emily White, Clay Wood, Leah Youngquist*

### **Hiroshi and Koya Ohmoto Graduate Fellowship:**

*Dani Buchheister, Fai Chanchai, Brandon Fong, Kaitlyn Horisk, Young Cheol Kim, Fran Meyer, Roger Ort, Miranda Sturtz*

### **Earle S. Lenker Graduate Fellowship:**

*Rory Changleng, Hanh-Tu Ella*

*Do, Eric Hasegawa, Kayla Irizarry, Caleb Norville, Karen Pham, Claire Shaughnessy, Adam T. Stone*

### **Michael Loudin Family Graduate Scholarship:**

*Raphael Affinito, Yusuke Kubota, Leonie A Strobl, Alexander B. Thames, Emily White, Leah Youngquist*

### **Richard R. Parizek Graduate Fellowship:**

*Adam Benefield, Dani Buchheister, Enock Bunon, Emma Hartke, Denali Kincaid, Fran Meyer, He Ran*

### **Pottorf Endowment for Graduate Excellence:**

*Hee Choi, Charlotte Connop, Kate Grosswiler, Gabriella Rosseto Harris, Claire Hines, Hanna Leapaldt, Esther Muñoz, Erik Schoonover, Emma Hartke, Ian Rui Jie Lee*

### **Shell Geosciences Energy Research Facilitation Award:**

*Raphael Affinito, Watsawan Fai Chanchai, Charlotte Connop, Tsai-Wei Chen, Gabriel Dos Santos, Karen Pham, Youki Sato, Erik Schoonover, Ran He, Frances Meyer, Garrett Shepherd, Leonie Stroble*

### **Richard Standish Good Graduate Scholarship:**

*Roger Ort, Samuel Shaheen*

### **Barry Voight Volcano Hazards Endowment:**

*Shelby Bowden*

## Awards, Recognitions & Service

**Dani Buchheister:** Cave Conservancy Foundation's Graduate Fellowship in Karst Studies

**Enock Quarshie Bunyon:** EMS Centennial Travel Award

**Kayla Irizarry:** Ford Foundation Predoctoral Fellowship

**Juliana Kristine Drozd:** NSF Graduate Research Fellowship, Marilyn L. Fogel Student Research Fund in Biogeosciences

**Sierra Michelle Melton:** NASA FINESST (Future Investigators in NASA Earth and Space Science and Technology) Grant, P.E.O. Scholar Award, American Society for Photogrammetry and Remote Sensing (ASPRS) Ta Liang Memorial Award

**Karen Pham:** EMS Centennial Graduate Research Travel Award, GSA Geoarchaeology Division Albritton Award, Mellon Mays Predoctoral Research Development Grant, Traveling Geologist Fieldwork Scholarship

**Erik Jeffrey Schoonover:** GSA Student Research Grant, The Barringer Family Fund Grant for Impact Crater Research, Best Student Presentation Award at the North American Workshop on Laser Ablation

**Ava Spangler:** NSF Graduate Student Research Fellowship, Earth and Environmental Systems Institute Scholar

**Adam Stone:** Travel Grant from AGU for a Conference in Cyprus

*Back cover: Students analyzing Archean rocks that underlie Neoproterozoic "snowball Earth" glacial deposits at Antelope Island, Utah during Field Camp. Photo credit: Kevin Furlong*



# PennState

## College of Earth and Mineral Sciences

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

