

Department of

Newsletter 2015-16

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# GEOSCIENCES



**PennState**  
College of Earth  
and Mineral Sciences

# From the Department Head



Philanthropy.

If this were a phone call, you'd have hung up by now. Thanks for reading on! Philanthropy, or rather the cultivation of it, is often the suspected underlying motivation for not only newsletters, but for email communications and personal visits with alums, and even for treating senior faculty civilly. Let me assure you that nothing could be further from the truth! Well, okay, lots of things are further from the truth, which is that development IS an important part of why we establish and maintain relationships with our alumni. The fact of the matter is that we depend critically on gifts and endowments to provide the sort of educational experience our students deserve and to ensure that each and every one of our students can avail themselves of those opportunities regardless of their financial situation. Penn State Geosciences without you, our supporters, would be a rather bleak place to work and study.

Fortunately, you get it, and our endowment and gift funds are strong. From 2011 to 2015 the book value of our endowments has increased by 45 percent; annual giving is relatively stable. And our faculty gets it too. Approximately a quarter of our active faculty members contribute to the department, and many use automatic payroll deduction as a relatively painless way to do so.

As you might expect, our students and programs need your support more than ever. We have a large undergraduate student population clamoring for more field experiences and better, state-of-the-art laboratory experiences. We need to be able to recruit talented graduate students and faculty, and doing so requires modern, well-equipped laboratories, prestigious postdoctoral positions, early career professorships, and endowed chairs. We need to build diversity among our student body, and with the establishment of AfricaArray, the only thing we lack is sufficient funds. Our Pulse of the Earth student engagement project needs support from alumni and industry to fully achieve its goal of students communicating to the world what's happening on Earth today. And we want to help improve Earth science education at all levels through support for the Pennsylvania Earth Science Teachers Association and for the Earth science teachers enrolled in our Master of Education in Earth Sciences program. On top of this, we need your continued support of our established funds that ensure our students can learn beyond the classroom.

In this issue, besides the expected announcements of awards, honors, and other recognitions for our faculty and students and spotlights on some very special students and alumni, you'll learn about one of our student engagement projects (EQUIP), an exotic astrobiology field trip, the success of our Imperial Barrel Award team, and the retirement of some very special faculty. Hope you enjoy the issue!

Sincerely,

A handwritten signature in black ink that reads "Lee Kump". The signature is written in a cursive, flowing style.

Lee Kump

*Professor and Department Head*

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Cover: "The beauty of weathering: iron oxides formed on a mineral surface during shale weathering at 6 m deep" is a scanning electron microscope (SEM) photomicrograph (colorized) of iron oxide from the Susquehanna Shale Hills Critical Zone Observatory. Pyrite and chlorite oxidation is the leading reaction that is capable of initiating deep weathering as deep as 15m at the ridge top. The released irons during weathering are precipitated in pores/fractures as iron oxide particles. Submitted by Ph.D. candidate Xin Gu.

# Graduate Students Win at International Competition

A team of five Penn State students won second place and \$10,000 in the highly competitive, international Imperial Barrel Award (IBA) program, hosted by the American Association of Petroleum Geologists (AAPG) and the AAPG Foundation. More than 1,000 students from 132 teams, representing thirty-six countries, competed. The five Penn State students, all pursuing master's degrees in geosciences, were the first team from their regional section (Eastern) to place in the top three overall since the IBA competition started in 2007. The students — Gabriella Arroyo, Tramond Baisden, Jake Hagedorn, Scott Karduck, and Nate Stevens — each spent 60-80 hours weekly for eight weeks straight on a realistic geosciences application: oil exploration.

## The challenge: visualizing the unknown to predict the location of oil

It's a problem faced by every oil and gas company: when you can't see underground to confirm the location of oil, how do you know where to drill? Drilling can cost anywhere from hundreds of thousands of dollars (on shore) to hundreds of million dollars (off shore), so it's crucial that companies identify the best location. Oil and gas companies typically employ geoscientists to predict where the largest oil reservoirs are located—and this was the task assigned to the IBA competitors.

Each team was given a data set that included seismic information and locations of existing wells of an assigned geographic basin area. They then had to create maps of their geographic basin, conduct cost-benefit and risk analyses of drilling operations, and make strategic business recommendations about where to drill. To do this, they applied their knowledge of how rocks change over time, sea level rise, and climate history over millions of years in a specific region. The competition culminated in a 25-minute presentation to a panel of high-level executives representing many oil companies, including ExxonMobil, Shell, Schlumberger, Chevron, Chesapeake Energy Corporation, ConocoPhillips, Devon Energy, Saudi Aramco, and Anadarko.

“This is a real-world, hands-on opportunity for students to practice what they're going to be doing in their jobs. This program gives students the confidence to know that they can complete industry-specific projects and communicate in a way that's effective in a business and industry setting,” says Liz Hajek, assistant professor of geosciences and holder of the Slingerland Early Career Professorship, who served as faculty mentor to the team.

Hajek participated in the IBA competition as a student at the University of Wyoming in 2007, the first year it was held. She says it was one of the best learning experiences she had as a graduate student. “In academia, when we come across uncertainty, we may conduct more tests or take a different approach to reduce the uncertainty, but in business, you have to make a decision, no matter what. There's no right or wrong answer, either. The judges are looking for students to present a convincing argument,” she says.

The competition served as a comprehensive learning experience, says Stevens. “My teammates and I each developed years' worth of experience in a few months by virtue of working through the entire process of developing new petroleum prospects, starting at raw data and working through all the steps and finally pitching new prospects to a panel of industry experts in a high-stakes professional setting,” he says.

The eight-week experience forced students to draw on all their geoscientific knowledge gained in classes—from stratigraphy to petroleum geosystems. “Taking everything I learned from a variety of classes and pulling it into one project where I have to pool from each of those classes has been an awesome experience,” says Karduck.

## Finding the “critical moment” in Earth's past

The way oil forms is a very delicate process. Four key components have to be in place simultaneously to create a working oil system: a container for the oil (known as a “trap”); a seal so that oil won't escape its container; a porous reservoir, such as sandstone, in which oil can be stored; and an organic-carbon-rich source rock.

“When you have all four of those conditions in place, and the ideal temperature is reached at the source rock, oil resources can be generated: This is the ‘critical moment.’ This means you need to understand the timing of every geologic event,” says Karduck.

The students spent most of their time applying their knowledge to find out if that “critical moment” occurred in their region throughout Earth's history, and predicted whether enough oil had formed for drilling to be profitable. They mapped 33,000 square miles, sometimes to a depth of 15,000 feet below the ocean floor.

“We analyzed the Taranaki basin, which is located off the west coast of New Zealand's North Island. This basin was created when Pangea broke up and New Zealand and Australia took shape. The rocks that we were interested in date back as far as the Cretaceous period, so we had to



A team of five Penn State graduate students pursuing master's degrees in geosciences won second place and \$10,000 at the competitive Imperial Barrel Award competition. From left to right: Nate Stevens, Gabriella Arroyo, Tramond Baisden, Scott Karduck, Jake Hagedorn, and Liz Hajek, assistant professor of geosciences and faculty adviser to the team. Photo: American Association of Petroleum Geologists.

interpret the entire evolution of the basin for the last 100 million in order to predict whether oil would be located in the region,” says Karduck.

### Industry mentorship from alumni

Each team is allowed to work with two industry mentors, who can provide tips and advice throughout the competition. This year, two geosciences alumni served as mentors to the Penn State team: Rick Abegg, who graduated with a B.S. in earth science in 1983 from Penn State and now works at Chevron as a program characterization and definition team lead, and Tony Riccardi, who graduated with a Ph.D. in geosciences from Penn State in 2007 and now works as a geologist for BP.

Abegg has mentored all three Penn State teams who have participated in the competition to date (2012, 2014, and 2015) and says he first became involved as a result of volunteering on the Graduates of Earth and Mineral Sciences (GEMS) alumni board.

“I can remember being a student, and I think having an alum help students through process makes the experience more valuable to them. In my coaching, I tried to focus on teaching oil exploration methods I had learned on the job, so the students had more tools in their toolbox. That way, they spend less of their time trying to figure out how to do this work, and more time actually doing the science that feeds into their work,” he says.

The mentors also focused on how to communicate ideas to high-level executives, which is a necessary skill in oil and gas exploration. “It’s important in industry that you can communicate in a few minutes how much work you’ve put into a research project, and make it very clear what your recommendations are,” says Riccardi.

Hajek says that this exposure to the industry’s decision-focused communication style is vital in helping students prepare for their careers. “You can hear about the differences between communication styles in academia versus industry, but you won’t really understand it until you see how someone with a lot of industry experience is reacting. We have some of the most talented students in the world, and I just want to make sure they hit the ground running when they start their careers,” she says.

The Imperial Barrel Award is hosted annually by the American Association of Petroleum Geologists (AAPG) and the AAPG Foundation, which aim to foster scientific research, to advance the science of geology, to promote technology, to inspire high professional conduct, to increase public awareness of geology, and to enhance professional development within the field.

*by Liam Jackson, Writer/ Web Content Specialist, College of Earth and Mineral Sciences*

# Penn State Geosciences



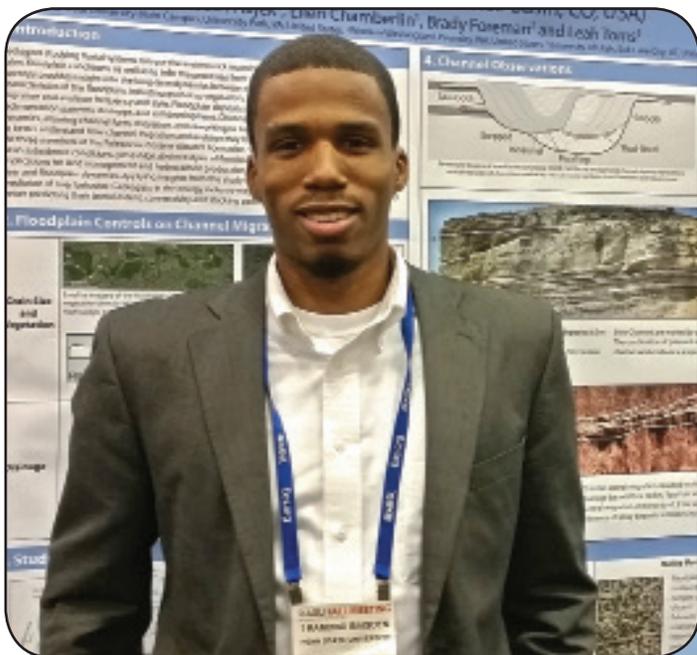
## Bachelor's Degree Student: Molly Cain

After completing my final year as an undergraduate at Penn State, I often recall my first impressions of the geosciences major. It was during a prospective student visitation day at the University that I was profoundly affected by a statement made by a professor. “For geologists,” he said, “the outdoors is their laboratory.” What began as a simple desire to work outside while pursuing my degree quickly propelled me into a journey that would ultimately lead to a passion for problem solving, particularly related to issues of water management.

As a student in Penn State's Geosciences Department, I was provided with significant opportunities to learn and advance in my academic career. In addition to participating in several field courses, I studied abroad in South Africa and Jamaica and worked as an undergraduate researcher at the Shale Hills Critical Zone Observatory. My senior thesis examined the effects of post-dam restoration reservoir filling on shallow groundwater chemistry and flow. I also

interned with the National Oceanic and Atmospheric Administration where my research focused on applications of geodetic leveling to support the sustainability of coastal wetlands facing rising sea levels. I presented my work at the American Geophysical Union's Fall Meeting in San Francisco.

This summer I began my research as an environmental sciences doctoral student at Indiana University. I will continue to do work in the area of watershed hydrology, particularly in the context of intensely managed agricultural systems. I also received a Fulbright Fellowship to study water management in Netherlands for the upcoming academic year.



## Master's Degree Student: Tramond Baisden

I was eight years old and had just spent a weekend at Sweetwater Creek State Park, half an hour from my hometown of Atlanta, Georgia. Wandering around my front yard, I picked up a pointy rock and began to investigate. After seeing Native American artifacts just a few days before, I was convinced I had found an arrowhead in my front yard! I now know it was most likely a chunk of granite, commonplace to northern Georgia, but none the less a memorable discovery for me as a young boy. This is my first vivid experience of my interest in rocks, as it wasn't until 12 years later that I took an official geology course. My love for the outdoors, combined with a keen interest in technology, led me to pursue a career in the energy industry as a geoscientist.

As a scholar in the Cooperative Developmental Energy Program at Fort Valley State University in Georgia, I earned an undergraduate degree in mathematics in 2011. I

was fortunate to earn a second bachelor's degree in geosciences from Penn State in 2013. Yes, I was quite busy—not everyone can say they earned two bachelor's degrees in the span of just five years!

# Students in the Spotlight

## Tramond Baisden (continued)

Working with my adviser Elizabeth Hajek, my master's research focused on better predicting the connectedness of fluvial reservoirs, which were deposited by ancient rivers. In addition, I was able to satisfy my craving for technology by building reservoir models using MATLAB, a software package commonly used in the sciences. From coursework and fieldwork, to real-world applications in industry internships and the Imperial Barrel Award Program, my experiences have developed my critical thinking skills and geologic intuition. These tools will be essential to my success as a production geologist for Shell when I begin my career this October!

## Doctorate Student: Flo Ling

I was born and raised in New Jersey, by parents who have always stressed the importance of an education. Despite this emphasis, they had no idea that their daughter would choose to continue schooling years past college. It started when I fell in love with chemistry in high school, when I was lucky enough to have two chemistry teachers that were both enthusiastic about their subject, and persistent in helping their students succeed.

When I arrived at Dartmouth College as a freshman, I took some introductory chemistry classes, but found that they did not excite the same amount of interest as my classes in high school. Still hopeful that I could figure out if chemistry was right for me, I took advantage of a program called the Women in Science Project (WISP) that offered research internships to freshmen female students. With WISP, I started working on a geochemistry project looking at the filtration of arsenic from water, an issue that affects many developing countries in Asia. The interest in the project led me to attend several earth science classes, and soon convinced me to become a geochemist.

After college, I decided to continue with schooling and began a Ph.D. program at Penn State with Peter Heaney, with the hopes of one day becoming a professor. Penn State has been a fantastic place to live and learn, with plenty of opportunities to explore my interests. I was able to take advantage of the internship and scholarship opportunities offered, exploring both industry and government. I was even given the chance to work at the Smithsonian Natural History Museum for nine months doing research with mineralogist Jeffrey Post, which opened doors to learning new techniques for my work. These experiences have helped me grow immensely and have shown me that academia is not the only option. They have also affirmed my choice to stay on the academic path.

My research now focuses on synthetic and natural manganese oxides. Manganese oxides are extremely common and can be found in environments such as oceans, lakes, soils, and deserts. They have applications in making batteries, cleaning contamination, and building solar cells. I study the reactions of manganese oxides with toxic metals such as lead and chromium, using synthetic samples to understand how manganese oxides may potentially help clean contaminated soils and water.

I have also started looking at natural manganese oxides, comparing them with synthetic materials, to determine whether synthetic manganese oxides are a realistic analogue for future experiments. Many of these samples were collected from an acid mine drainage remediation site in Glasgow, Pennsylvania, with the help of Art Rose, Bill Burgos, and my adviser Peter Heaney. Others were part of the Smithsonian mineral collection, a large resource of samples collected and stored for the scientific community.

I hope that any research I conduct after my time at Penn State will continue to have useful, real-world applications.



# Alumni Spotlight:



*Former president of the Graduates of Earth and Mineral Sciences (GEMS) alumni society, Rick Abegg, had the honor of officially welcoming the Class of 2015 to GEMS.*

Growing up collecting fossils from Upper Devonian delta-front sandstones in Edinboro in northwest Pennsylvania helped Rick Abegg develop an interest in geology that later turned into a career in petroleum geology. Rick credits Penn State for providing a strong educational foundation for graduate school and later a career with Chevron.

When deciding on a college major, Rick's fascination with rocks led him to pursue a degree in geology at Penn State. He picked the earth science degree because the curriculum allowed him to combine geology classes with courses in meteorology and geography, giving him a broad scientific background. The field trips to areas surrounding Penn State allowed numerous opportunities to observe field geology beyond what was introduced in the classroom, part of what makes Penn State a special place to study geology. Rick recognizes adviser Roger Cuffey for his efforts in culturing his scientific curiosity by encouraging geologic discussions of some of the many rocks he had collected as a child. Following graduation in 1983, Rick went on to receive a master's degree in geology from Southern Illinois University and a doctorate in geology from the University of Kansas where he studied carbonate sedimentology under Paul Enos. His dissertation research on Mississippian carbonates in the

subsurface of southwestern Kansas was published in Society for Sedimentary Geology's Special Publication 71: Modern and Ancient Carbonate Eolianites: Sedimentology, Sequence Stratigraphy, and Diagenesis with Rick as the lead editor. He continues today with editing of scientific manuscripts as an associate editor of the American Association of Petroleum Geologists' AAPG Bulletin.

Following two internships with Chevron, Rick started full-time employment with Chevron in 1991 as a development geologist in Midland, Texas, where he utilized his skills in carbonates. A transfer to New Orleans in 1998

allowed him to work on deep-water exploration on the Gulf of Mexico shelf, which he continued upon transferring to Houston in 2004. During this time, he experienced the highs and lows of exploration, from the Big Foot discovery in 2005 to what was the deepest dry hole in the Gulf of Mexico (recently surpassed). In 2011 Rick transferred to the Pittsburgh area to work the Marcellus Shale in southwestern Pennsylvania where he is now a team lead for a reservoir characterization group.

Rick has been a valuable volunteer for the College of Earth and Mineral Sciences and for the Department of Geosciences and has been recruiting geologists for Chevron at Penn State since 1997. In 2004, Rick was selected for a position on the Graduates of Earth and Mineral Sciences' (GEMS) Alumni Constituent Society board of directors. He has held the roles of secretary, president, and past-president for the GEMS board. Through serving on the board, Rick has been able to volunteer at TOTEMS—Total Orientation to EMS—the college's first-year student orientation program; EMEX—Earth and Mineral Sciences Exposition—the annual undergraduate recruiting event; participate in résumé/interview workshops; offered-student letter-writing campaigns; and career workshops. Rick also facilitated the

# Rick Abegg '83 Earth Science

creation of the inaugural external advisory board for the Department of Geosciences and served for several years as a member at the same time he was serving on the GEMS board.

Being on campus for board meetings and serving as president of the GEMS board facilitated other volunteer opportunities. Rick has served as a member of the Penn State Alumni Association Alumni Council, participated as a guest classroom lecturer, and mentored the Imperial Barrel Award (IBA) team. Each IBA team that he has mentored has won the East Regional competition and gone on to compete at the international level, with this year's team finishing second place overall.

"I recruit and mentor students because I very much enjoy seeing the fascinating research of students and experiencing their enthusiasm for science," said Rick. While volunteering allows him to keep in contact with students to benefit recruiting, Rick is passionate about supporting the program that provided his educational foundation and doing what he can to promote the number one geology program in the nation. Department Head Lee Kump appreciates all that Rick has done for the program, commenting "Rick's contributions to the success of our students have been huge, and his frequent presence on campus puts a welcoming, approachable and supportive face to the oil and gas industry that provides employment to so many of our students."

"It's been so rewarding to serve the college and the department, and I feel fortunate to have had the opportunity to help in any way possible," said Rick. His time on the GEMS board ends in 2016, but he plans to continue volunteering to stay connected and encourages anyone

interested in volunteering or serving as a GEMS board representative to contact Colleen Swetland (clw2@psu.edu) for further information.

Rick lives and works in Moon Township, Pennsylvania along with his wife Micki, a 1983 graduate, and three children: Kylie, 23 (now in Houston); Phil, 17; and Nick, 13). He enjoys running and coaching baseball, basketball, and football. Following the Pittsburgh Pirates and Pittsburgh Penguins allows him to fill the sports calendar between Nittany Lion football seasons.



*Geology has allowed Rick to take "field trips" around the world including a trip to Alberta during a Chevron structural geology field trip in 2006.*

## Alumni Passings

Herbert D. Duey '55, '57g

Thomas Horgos '80

Robert H. Insley '52g

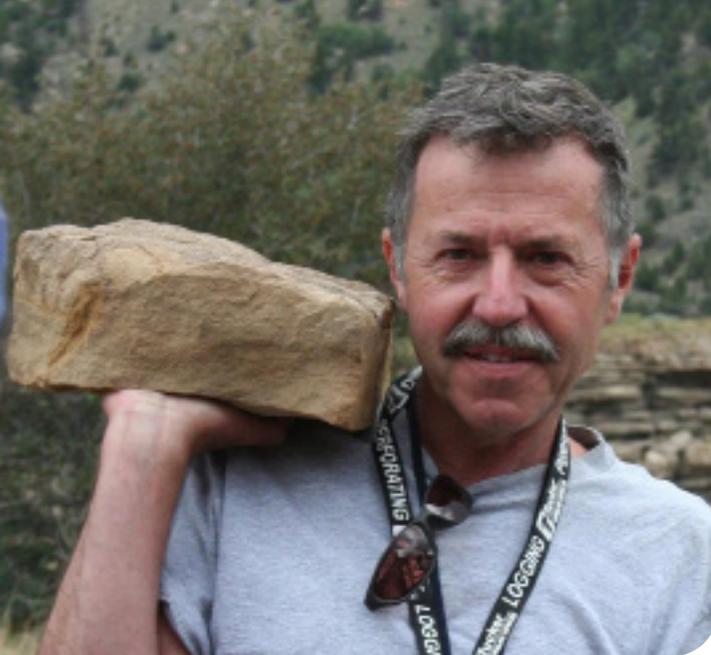
Joseph C. Knight '49

Gary D. Tate '68g

Robert T. Terriere '51g

Maurice L. Tosi '49

Harvey S. Zeiss '76g



# Rudy L. Slingerland: Thinker, Sailor, Bolder, Wry

Union (AGU) Fellow, Geological Society of America Fellow, the G. K. Gilbert Award in Surface Processes from AGU's Earth and Planetary Surface Processes Focus Group, the National Science Foundation's MARGINS

Distinguished Lecturer, and the College of Earth and Mineral Sciences' Wilson Research, Service, and Teaching Awards.

As an indication of Rudy's importance to geosciences, one colleague wrote that "Rudy is a wonderfully generous and creative colleague who spans the full range from classical stratigraphy to numerical modeling of exceptional sophistication and power. This remarkable breadth has allowed him to play a critical role in bringing sedimentary geology into a new quantitative era in which prediction and hypothesis testing take the place of descriptive interpretation." Certainly, over the span of Rudy's career, the geophysical approach to stratigraphy has gone from the fringe to the mainstream, and Rudy has been at the vanguard.

Rudy's quantitative approach has been highlighted in several highly regarded books including "Simulating Clastic Sedimentary Basins," written with John Harbaugh and Kevin Furlong (1994), and more recently "Mathematical Modeling of Earth's Dynamical Systems: A Primer," co-authored with Lee Kump (2011). Rudy has used the equations of motion for unidirectional fluid flow and sediment transport to explore the origin of sediment sorting by grain size and density, placer mineral concentrations, downstream fining of grain size in rivers, channel diversions onto floodplains (avulsion),

and channel bifurcations on deltas. In addition he has applied equations of shallow-marine water motion and sediment transport to explore the effects of water motion (e.g. due to tides and storms) on modern shelves and in ancient epicontinental seas including the Cretaceous Western Interior Seaway and the Devonian Catskill Sea. And beyond that, his work has combined numerical models for tectonic subsidence and uplift with those for water flow and sediment transport to simulate long-term, large-scale evolution of river systems; delta progradation; and the dynamics, stratigraphy and geomorphology of orogenic belts such as the Appalachians. Many a graduate student will recall the graduate-level course in math modeling taught by Rudy and Lee Kump as one of the most painful but, ultimately, useful courses they took at Penn State.

Rudy has been hugely important to the Department of Geosciences beyond academics and research. He has never displayed anger in public, choosing to express his "disappointment" over some issues calmly in a wry comment or two. He has informally mentored department heads and many early career faculty. In 2013, one of his former graduate students, Roland P. Sauermaun and his wife, Debra C. Sauermaun, created the Slingerland Early Career Professorship to honor Rudy for his work as a scientist, educator, and mentor.

Although Rudy's calm influence and knowledge of department history, tradition, and governance will be sorely missed, I suspect that we will see him somewhat frequently. If not, you might be able to catch him on his self-built sailboat on Bald Eagle Lake.

*by Michael A. Arthur, Professor of Geosciences*

Professor of Geosciences Rudy L. Slingerland officially retired in June of this year. Having been raised on a dairy farm in rural Bradford County, Pennsylvania, Rudy made his escape to Dickinson College from which he earned a bachelor's degree in geology, with honors. However, the conflict in Vietnam was still ongoing and Rudy joined the U.S. Navy. He served from 1969 to 1971 in the Mobile Construction Battalion (The Seabees) reaching the rank of petty officer, third class. Upon returning from military service, he enrolled at Penn State and received his master's degree in 1974 and his doctorate in 1977, both in geology. Rudy married his wife, Ellen, in 1984. He remained at Penn State as a researcher, teacher, and administrator for his entire distinguished career.

Rudy served as department head from 1997 to 2002 and as interim dean for graduate education and research in 2003. He also served on many college and department committees and taught a variety of courses, including Geosc 472 - Field Geology—the hands-on, real-world field experience affectionately known as "Field Camp."

Over his career he supervised 13 Ph.D. students, 22 M.S. students, as well as a large number of senior thesis projects. He has authored more than 70 publications in refereed journals, nearly 40 books and book chapters. Rudy's contributions have been recognized with a number of honors including American Geophysical

# Hiroshi Ohmoto's Remarkable Career

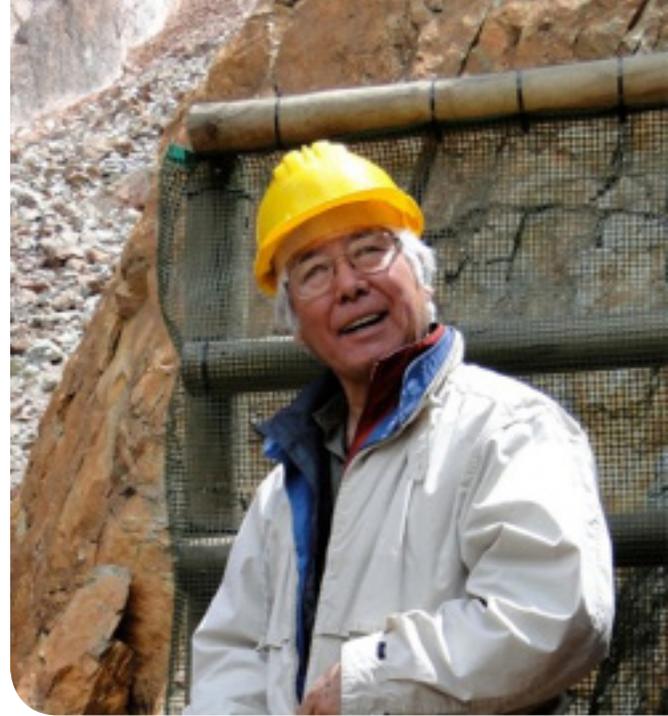
In the Geological Society of America annual meeting at Atlantic City in the fall of 1969, Phil Bethke, my friend and a mineralogist of the U.S. Geological Survey, proclaimed that I must meet someone from the University of Alberta, a geochemist named Hiroshi Ohmoto. The consequences led to his quickly joining the Geosciences Department at Penn State in 1970 bringing with him his expertise with both ore deposits and stable isotope geochemistry. His credentials were ideal, having studied with Dick Holland at Princeton for his Ph.D. and later collaborated with Dick and many more colleagues than can be listed here. Hiroshi has served also on the faculty of Princeton, the University of Alberta, Tohoku University, the University of Tokyo, and as an adjunct professor at 11 more Japanese universities. He presented honorary lectures and invited short courses at nine other institutions including Stanford, Harvard, University of Wisconsin-Madison, Göttingen, the U.S. Geological Survey, and the Canadian Institute of Mining and Metallurgy.

The Penn State Geosciences Department soon found that he was exceptionally adept at scientific administration, which led to his election first as director of the Ore Deposits Research Section and then its successor, the Astrobiology Research Center. In both programs, he coordinated research among faculty from several institutions in Canada, Japan, and the United States with that at Penn State. In our department and with his large research group, he has supervised the research of more than 80 students and postdoctoral colleagues, an extraordinary responsibility.

Many exciting discoveries resulted, such as the characterizing as a distinct class the Kuroko (Massive Sulfide)

Type of ore deposit, which are enclosed in volcanogenic or shale-carbonate host rocks. He concentrated also on the origin of banded iron deposits. His research employed isotopic methods, aqueous experiments, and extensive field work and concentrated on the early Earth to produce innovative lines of evidence on the changing nature of the oceans, crust, and mantle. A powerful investigative approach that he adopted and improved evolved from the diverse causes of fractionation of stable isotopes, particularly those that are mass independent. Among his widely recognized accomplishments were his evidences for an increase in the oxygen content of the earth's atmosphere during the Archean, clues that stimulated further studies of one of the most hotly debated problems of geological sciences.

Appropriately, Hiroshi was awarded major honors for advances stemming from his contributions to the geological and geochemical sciences. The Society of Economic Geologists presented to him the Waldemar Lindgren Award "in recognition of published research that represents an outstanding contribution to economic geology" in 1970, and their Silver Medal for "mid-career excellence in original work in the geology of mineral deposits" in 1994. The Geochemical Society gave Hiroshi the F.W. Clarke Award in 1973 "for a single outstanding contribution to geochemistry or cosmochemistry published either as a single paper or as a series of papers on a single topic." The Society of Resource Geology added their Kato Medal in 2009 and the Geochemical Society of Japan presented to him the Shibata Medal in 2013. Penn State conferred the Faculty Scholar Medal for "Outstanding



Achievement in Science and Technology" in 1981 and the College of Earth and Mineral Sciences Wilson Award for "Excellence in Research" in 2001.

For relaxation, he was a fierce competitor when playing squash and an expert skier on black diamond, most-demanding trails. He shares a love of classical music with his wife, Koya, a professional pianist. Their dinners have been memorable for friendly interaction, delectable food, musical performances by friends, and an international atmosphere.

*by Hu Barnes, Professor Emeritus of Geosciences*



(Left) The class pointing out the distinctive black-colored band marking the Cretaceous-Tertiary (K-T) boundary on an outcrop outside Gubbio, Italy. This rock unit is evidence of a mass extinction event and global climate change in Earth's history. (Photo: Mike Arthur)

# Astrobiology in Italy

What is every astrobiologist's dream? Well, first of all, what is an astrobiologist? Astrobiologists explore the limits and evidence for life elsewhere in the universe by studying extreme forms of life here on Earth. Twelve astrobiology graduate students from Penn State ventured all over central Italy to research microscopic life that can survive and thrive in "alien" environments without sunlight or oxygen. The microbes in these places, such as caves or springs, use sulfide and other chemical compounds to eat and breathe, which is very unlike humans.

Our group, led by Penn State faculty Dr. Michael Arthur and Dr. Jennifer Macalady, came from various backgrounds, including geology, physics, microbiology, and astronomy. Focusing on the importance of tectonic activity to water flow and sustaining life, we went underground to places most would think too inhospitable for biology. Our ten days in Italy included caving in the Frassasi and Grotto Termale systems and crossing a river to reach Grotto Fredda. We conducted a slew of geochemical analyses on the cave waters and sampled the caves' microbial biofilms that grow like living shag carpets. We also visited local outcrops of the K-T boundary, which marks the large extinction event in Earth's history between the Cretaceous and Tertiary, as well as the serpentinized rocks on the beach of the northern Tyrrhenian Sea at Bonassola.

After visiting all these sites, we came to the conclusion that, in order to maintain chemical gradients that support life as we know it, tectonic activity is necessary. Although there are ways in which life could arise without tectonic activity, sustaining life over long timescales without tectonics becomes difficult. Much work remains to be done to understand life's limits on Earth and beyond, but we left Italy with new perspective, new colleagues and new questions.

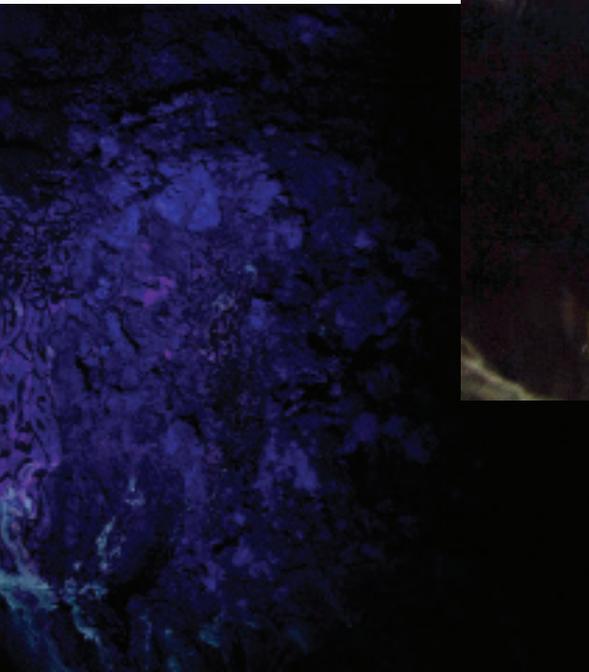
by Amanda Labrado, Geosciences Graduate Student



(Above) Mike Arthur describing the biotic and abiotic reactions that occur during serpentinization, and what tectonic activity is necessary for ophiolites to be seen. Photographed on the beach of Bonassola by the northern Tyrrhenian Sea.

(Photo: Chester Harmon)

*(Right) Collecting microbial samples for microscope analysis and analyzing water chemistry in the Pozzo di Cristali, Frasassi cave system.  
(Photo: Zena Cardman)*



*(Left) Wall of Pozzo di Cristali fluorescing under UV light.  
(Photo: Zena Cardman)*

*(Below) Microbial sample collection and water parameter analyses of a sulfidic spring entering the Sentino River, directly outside of the Frasassi cave system.  
(Photo: Zena Cardman)*



# Geosciences Field Camp 2015



In late May 2015, the Penn State Geology Field School began our annual trip out west for a six-week investigation of the geology of the intermontane western United States. Thirty-two students were led by Rudy Slingerland, Don Fisher, and Kevin Furlong and assisted by graduate teaching assistants Max Christie, Nooreen Meghani, Jason Boettger, Jacob Hagedorn, Michael Hudak, and Christine Doman. In recent years, the course has been divided into two parts with three field exercises each. The first three weeks included a stint at selected sections of the Book Cliffs in eastern Utah, where students used sequence stratigraphic concepts to interpret the sedimentary rock record. We then moved our base of operations to the Yellowstone-Bighorn Research Association facility in Red Lodge, Montana. There we completed an exercise at Elk Basin, an area familiar to many alumni, in which students use aerial photography and field mapping to develop a three-dimensional characterization of the structure of the basin. Finally, we moved to Teton Village in Wyoming where we reconstructed the Quaternary glacial geology and the active faulting along the Grand Teton mountain front. In the second half of the course, we travel to east-

central Utah to evaluate the history and landscape evolution of a volcanic province (i.e., the Challis Volcanic Series). The course was capped by a stay in the Alta, Utah area where we used maps and cross sections to estimate fault slip and shortening in the overthrust belt and to characterize the thermal history of the contact aureole of the Alta Stock.

by Don Fisher, Professor of Geosciences  
*(Top) Penn State Field Camp 2015 with the Grand Tetons in the background.*



*(Left) Rudy Slingerland completes his final summer field course after decades of field camp instruction.*



*(Left) The group discusses active Basin-and-Range extension at the Borah Peak fault scarp in Idaho.*



*(Right) The first day at the Alta overthrust belt ends with the descent from the top of Flagstaff Mountain.*



*(Left) Students ponder the buried Eocene forests exposed at the top of Specimen Ridge in Yellowstone National Park.*

# Earthquake Information Project: *Engaging Students in Real-Time Science*

Typically a first-year student in the geosciences will have their course schedule filled with a combination of core math, physics, and chemistry courses along with one or two introductory geosciences courses. Rarely do they have a chance to work on real-time responses to major events such as earthquakes. Last year, this all changed. The EarthQUake Information Project (EQUIP) provided a group of primarily first-year students majoring in geosciences the opportunity to analyze earthquakes as they occurred, investigate their impact, and develop skills in communicating those results to the public, media, and first responders. The class even involved a special visit to the United States Geological Survey's (USGS) National Earthquake Information Center (NEIC) in Golden, Colorado. There, students worked with the scientists who analyze all earthquakes that occur throughout the world and provide critical information to governments, emergency responders, and the general public and media.

EQUIP was designed to provide hands-on experience early in the students' educational career. Each student selected a specific region of the Earth subject to large earthquakes to monitor, requiring students to become familiar with the region's history of earthquakes and its plate tectonic conditions. Students reported on any notable geologic events as they occurred. To share information and details pertaining to each event, students maintained a blog that relayed real-time information on seismic activity around the world. This was done in a manner that would be accessible to the general population in layman's terms.

This blog was updated with real-time earthquakes and each student was responsible to post information of earthquakes above magnitude 4.0 that occurred in their respective region. Through developing this type of blog, students gained a better sense of how to communicate to the public about geological science. Blog posts not only had to explain the

science behind earthquakes, but had to give an overview of the human effects as well. Students needed to be critical of what information was being included and communicate it effectively. Several USGS-NEIC website features were included in the blogs; maps and diagrams helped provide a context for discussions.

NEIC, located on the campus of the Colorado School of Mines, is the government agency responsible for locating and analyzing all global earthquakes larger than a



*Members of the 2015 EQUIP Team.*

threshold magnitude. It is also the primary United States agency to advise our government on earthquake events and hazards.

At NEIC, the group met with Harley Benz, the scientist in charge of the NEIC. Benz provided students with an overview of the facility, explained the mission of the NEIC, and arranged for the group to work with other scientists in the facility. Benz also took our group to one of the global seismic network stations located in an abandoned gold mine in the mountains west of Golden. Here students saw the other side of the seismic detection network — the seismometers and the necessary satellite-based communication system to deliver the data to the NEIC facility.

The students also met with one of the NEIC professional seismic analysts — the group of scientists who work around the clock to locate and analyze earthquakes. Analysts demonstrated how they respond in real time to earthquakes. Benz and one of the seismic analysts, Jana Pursley, assisted the students in locating and analyzing their own earthquake. Although these were relatively small earthquakes within the United States, the same tools and protocols were used to determine the location and magnitude of each event. Each of the students now has the earthquake they analyzed recorded as part of the permanent USGS database. Students explained that this experience helped to shape their understanding of how data is processed, and how the types of information they learned in class are applied to real-world situations.

One student explained, “EQUIP was structured completely differently from other classes. The course blog allowed us to be in charge of what we learned, strengthening our discussion skills during each group meeting. Each of us developed a sense of independence, which not only improved our confidence in other classes, but also inspired us to take charge of our education in courses more focused on lecture rather than discussion. The class was strongly focused on teamwork. We helped each other with different topics and in doing so, created a very positive and welcoming environment.”



*Members of the 2015 EQUIP Team at the Idaho Springs seismic station with Harley Benz, scientist in charge of the National Earthquake Information Center (standing.)*

To sum up the impact of this course, one EQUIP member stated, “I have learned how to apply certain aspects of the class to my other classes in order to better understand the material. Instead of simply saying ‘I don’t understand this concept’ and expecting the instructor to go over everything that I am having trouble with, I now know how to engage in an actual discussion. I can now say ‘This is what I do understand and I think the other part goes like this, can you explain where I am wrong?’ I am no longer timid when it comes to asking clarifying questions. I’m also able to discuss class concepts with fellow students much more efficiently. We’re able to explain topics to each other by tying them in with what’s familiar to us. I feel much more comfortable with learning about science, and my grades show it.”

EQUIP was sponsored by the Department of Geosciences, which provided funding for travel to the USGS-NEIC. The course was led by Kevin Furlong, professor of geosciences, with assistance from Matthew Herman, a Ph.D. candidate in geosciences. For further information on the course, please contact Kevin Furlong at [kpf1@psu.edu](mailto:kpf1@psu.edu).

by the 2015 EQUIP Team: Priyanka Bose, Jenny Miller, Robert Miles, Ross Myers, Gina Sarkawi, Stephan Snyder, Kass Ulmer, and Xuwei Zhong

# 47th Annual Graduate

*2015 Graduate Colloquium Photo competition winner*



*Photo by Rhiannon Vieceli.*

## **Other Photo Entries**



**Polecat Bench, Wyoming;**  
*Photo by Elizabeth Denis.*



*Photo by James Neely.*

# Colloquium Photo Contest



**Bighorn Recreation Area, Wyoming;**  
*Photo by Elizabeth Denis.*



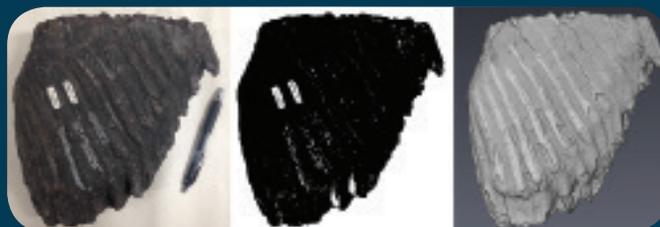
*Photo by Erica Pitcavage.*



**Delicate Arch, Utah;**  
*Photo by Elizabeth Denis.*



**Walking Shell Beach, Australia;**  
*Photo by Elizabeth Denis.*



*Photo by Greg Smith.*



*Photo by Mike Hudak.*



*Photo by Erica Pitcavage.*



*Pinnacle City, Australia;  
Photo by Elizabeth Denis.*



*Photo by Erica Pitcavage.*

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# Student Finds Starfish Fossil in Happy Valley

Anna Whitaker, a rising sophomore in Geosciences and a Schreyer Scholar, recently went searching for fossils and made an impressive discovery. Fossils have been prolific at the flank of Tussey Mountain above Pine Grove Mills, just minutes away from the campus, but this find — a starfish from the Ordovician (485-444 Ma) Reedsville Formation — is perhaps a first!

Duff Gold, professor emeritus of geosciences, and Charlie Miller, a Penn State alum, were assisting Whittaker at the site. Miller commented, “This area of Tussey Mountain has been known to yield some of the finest fossils from the Reedsville Formation. At many central Pennsylvania localities, Reedsville fossils are disarticulated so that extrication is difficult. In contrast, some biozones here are weathered enough so fossils easily separate out.”

Miller went on to explain that fossils at this site have been prolific, both in actual numbers and in taxa. Straight-shelled cephalopods, normally rare at most sites, are more common here. Fossil taxa include brachiopods, pelecypods, bryozoans, crinoids, trilobites, gastropods, cephalopods, and graptolites.

He added, “I don’t think any starfish fossils have previously been found in the Reedsville Formation. Some are known from the correlative Martinsburg Shale at Swatara Gap, but not from here. This is a very interesting find!” Emeritus Professor Roger Cuffey confirmed Anna’s identification.



*(Above) A photo of the starfish fossil found by geosciences student Anna Whitaker. The fossil was found just minutes from campus near Pine Grove Mills.*

## eCareer: A Job Networking System Available For Geosciences Alumni

There are many diverse employment opportunities available to geosciences students and alumni. Job opportunities are available in industry, government agencies, private consulting companies, and universities.

We use the eCareer online scheduling system to manage industry recruiting in the department, we and invite you to learn more about how eCareer could help you, our Geosciences alumni, too!

To get started with eCareer, create a profile and upload a current résumé. You can use eCareer to apply for positions of interest, register for information sessions, connect with recruiters from companies of potential interest, and even schedule interviews.

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# Undergraduate Scholarships & Awards

**Baker-Hughes Scholarship Award:** Robert Miles and Natasha Nagle

**Thomas F. Bates Undergraduate Research Enhancement Fund:** Brandon Clark

**Joseph Berg Award for Undergraduate Research in Geosciences:** Jacob Cipar, Joseph Gentilcore

**Barton P. Cahir Award:** Audrey Dunham, Zachary Richard

**Frank Dachille Memorial Award in Geochemistry:** Jordan Chapman

**David M. Demshur Undergraduate Research Endowment:** Angela Bertagni, Craig Pezak, Zachary Richard, Peter Vigilante

**Edwin L. Drake Memorial Scholarship:** Jacquelyn Fyock, Mercedes Gainor, Jacob Germanoski, Brandon Grau-Reish, Megan Haney, John Hribik, Michael Lacroce, Zachary Miller, Marian Peters, Dominic Pimpinella, Kimberly Schmid, Patrick Shepherd, Alexander Strohl, Emily Vasko, Theodore Wilson, Shawn Woll

**General Field Camp Fund:** Cecilia Cullen, Elizabeth Mizikar

**General Scholarship Endowment in Geosciences:** Cecilia Cullen, Sara Tomko

**David P. "Duff" Gold Undergraduate Scholarship Fund:** Cecilia Cullen, Alexis Golestani

**John C. and Nancy Griffiths Scholarship:** Angela Bertagni

**James and Nancy Hedberg Scholarship:** Timothy Harper, James Lamarca, Elizabeth Meyer, Craig Pezak

**Scholarship from the Arthur P. Honess Memorial Fund:** Adam Benfield, Audrey Dunham, Chelsea Eyer

**Benjamin F. Howell, Jr., Award:** Jordan Bell, Alexis Golestani

**Kappmeyer-Isaacs Field Camp Award:** Anthony Marze, Zachary Richard

**Scholarship from the Ronald A. Landon Endowment in Hydrogeology:** Zachary Richard, William Rosenow

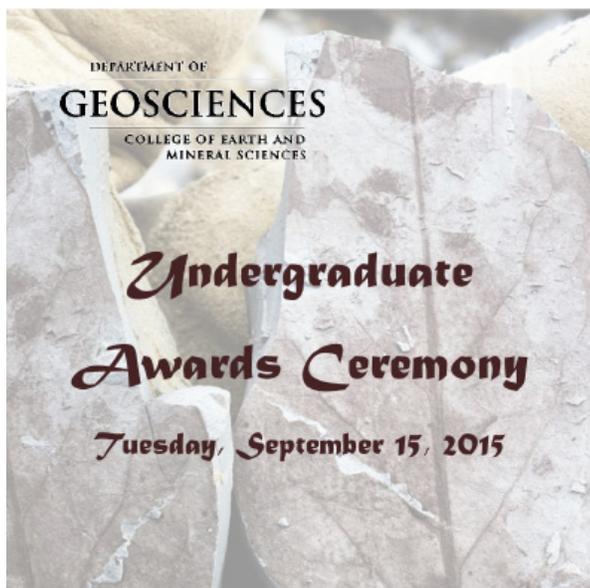
**Earle S. Lenker Fund for Field Studies in Geology:** Karl Gerstnecker, Allison Krieder

**Thomas Kenneth "TK" Reeves Scholarship:** Elizabeth Roddy

**Reif Undergraduate Summer Field Camp Award:** Brandon Clark, Laura Hartman, Michaeline Yates

**Robert F. Schmalz Award:** Samuel Collitt, Jingjun Liu, Nicholas Riqueros

**Dr. David E. Vaughan and Mrs. Julianne Vaughan Field Camp Fund:** Sara MacDonald, Erin Peeling



**2016 Graduate Colloquium  
March 18-20**

# Graduate Scholarships & Awards

**Chesapeake Energy Scholarship in Geosciences:** Martin Jiminez, James Neely, Uyen Nguyen, Sheila Trampush, Yang Xu

**ConocoPhillips Graduate Fellowship:** Elizabeth Denis, Abby Kenigsberg

**John C. and Nancy Griffiths Scholarship:** Amanda Labrado

**Hess Corporation Exploration & Production Technology Scholarship:** John Leeman

**Charles E. Knopf, Sr., Memorial Scholarship:** Garrett Brown, Peter Ilhardt, Erica Pitcavage, Jennifer Estrada

**Krynine Memorial Award:**

**Fall 2014:** Gabriella Arroyo, Ellen Chamberlin, Piyali Chanda, Max Christie, Elizabeth Denis, Christine Doman, John Fegyveresi, Helen Gall, Jacob Hagedorn, Matthew Herman, Michael Hudak, Katelyn Huffman, John Leeman, Caitlin Livsey, Nooreen Meghani, Peter Miller, Rosemary Oakes, David Oakley, Kerry Ryan, Judith Sclafani, Gregory Smith, Sheila Trampush, Robert Valdez, Rebecca Vanderleest, Austin White-Gaynor

**Spring 2015:** Piyali Chanda, Max Christie, Elizabeth Denis, Christine Doman, Michael Donovan, Emily Doyle, Helen Gall, Chester Harman, Khadouja Harouaka, Nick Holschuh, Heather Jones, Amanda Labrado, John Leeman, Florence Ling, Caitlin Livsey, Tarun Luthra, Muammar Mansor, Rosemary Oakes, Matthew Oxman, Kiya Riverman, Laura Rodriguez, Judith Sclafani, Robert Valdez, Anna Wendt

**LeBlanc Fellowship:** James Neely

**Marathon Alumni Centennial Award:** Evan Greenberg, Benjamin Madara, Sheila Trampush

**NASA Earth and Space Science Fellowship:** TBA

**NSF Fellowship Recipient:** Allison Karp

**Hiroshi and Koya Ohmoto Graduate Fellowship:** Emily Doyle, Rosie Oakes

**Richard R. Parizek Graduate Fellowship:** Beth Hoagland

**Scholten-Williams-Wright Scholarship in Field Geology:** Kiya Riverman

**Shell Geoscience Energy Research Facilitation Award:** Garrett Brown, Ellen Chamberlin, Martin Jiminez, Abby Kenigsberg, John Leeman, Ben Madara, Uyen Nguyen, Sheila Trampush, Robert Valdez, Yang Xu

**Richard Standish Good Graduate Scholarship:** Laura Rodriguez, Peter Ilhardt

**Donald B. and Mary E. Tait Scholarship in Microbial Biogeochemistry:** Muammar Mansor, Christine Doman

**Teaching Assistant Award:** TBA

**Barry Voight Endowment:** Helen Gall

## 2015 Graduate Colloquium Awards

### Oral Presentation by a Ph.D. Student

(Post-Comprehensive Exam)

First: John Leeman

Second: Nick Holschuh

### Oral Presentations by a Ph.D. Student (Pre-Comprehensive Exam)

First (tie): Rosie Oakes

First (tie): Max Christie

First (tie): Matthew Herman

### Oral Presentation by an M.S. Student

First: Greg Smith

Second: Austin White-Gaynor

### Poster Presentation (M.S./ Ph.D)

First: Rebecca Vanderleest

Second (tie): Uyen Nguyen

Second (tie): Gabriella Arroyo

### Energy Related (M.S./ Ph.D)

First: Shiela Trampush

Second (tie): Tramond Baisden

Second (tie): Peter Miller

These candidates were selected from an impressive group of participants. We want to thank Shell Corporation for the continued support of Colloquium with prize funds and general support.

# 2015 Corporate Donors

We want to take this opportunity to thank each of the companies listed below for giving to the Department of Geosciences over the past year through direct gifts and matching funds. Through our partnership with these companies, we are able to provide monies for student scholarships and fellowships, student travel funds, student research funds, special field trips, and many other important educational activities.

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ExxonMobil Foundation, Inc.

Fidelity Investments Charitable Gift Fund  
GE Foundation  
Groundwater & Environmental Services, Inc.  
Halliburton Foundation, Inc.  
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Schlumberger Technology Corporation  
Schwab Fund for Charitable Giving  
Shell Oil Company  
Verizon Foundation  
Wells Fargo Foundation



# 2015 Annual Donors

We want to take this opportunity to thank each person listed below for giving to the Department of Geosciences over the past year. With the enrollment in the department rising each year, the growth in our award and scholarship endowments is vitally important to our students. Your support also allows the department to maintain and upgrade our research labs and equipment.

John M. Aaron	James D. and Nancy Marshall Hedberg	Thomas D. Olszewski
Richard B. and Cynthia R. Alley	Ellen K. Herman	Evelyne Parizek
Lance C. Anderson	Jeffrey A. Sitler and Janet S. Herman	Robert S. Pekarik
Charles E. Angerman	John W. and Letitia J. Hess	Thomas K. and Janice Pearlstein Reeves
Heinrich Bahlburg	Roberta M. Hotinski	Linda Turnley Reif
Joseph W. and Glenda S. Berg	Christopher H. House	Anthony L. Riccardi
Claude E. Bolze	David W. and Stephanie Quay Houseknecht	John H. Rowland and Virginia Bramble Vincenti
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Charles A. and Patricia A. Brinkley	Jacqueline E. Huntoon and Chris L. Wojick	Ira D. and Kathryn C. Sasowsky
David R. and Marcia Buss	Solomon and Esther E. Jarmell	Martin A. and Josephine Connolly Schoonen
Karen R. Campbell	Janet C. Kappmeyer and Andrew M. Isaacs	Stephen O. and Barbara Stire Sears
John H. Carman	Lawrence G. Kodosky	Irvin C. and Amy Willcox Shambaugh
Matthew B. Clark and Erika Tobias Clark	Leonard F. and Phyllis Konikow	Christopher A. Shuman
Lucy Curran	Garry M. Kramchak and Sharon Kinble-Kramchak	Barry S. and Claudia Siegal
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Terry and Karen Engelder	Earle S. Lenker	Robert M. Cohen and Karen L. Stierman
James A. Ewart	Timothy A. and Amy Leon Guerrero	Ronald W. and Janet L. Stingelin
Martin B. Farley	Chris and Eliza R. Marone	Carl H. and Sheryl Holgate Taylor
Robert L. and Marjorie Folk	Jeffrey S. and Virginia Marshall	Kenneth H. and Brenda E. Turner
Kevin P. Furlong	Joseph T. and Janet D. McNally	Stephen J. Urbanik
Kevin N. Gallagher and Vanessa L. Balint	Craig L. Millard	David E. and Julianne Russin Vaughan
Robert M. Glazier and Azita Farjam	Frank A. and Carolyn J. Moorshead	Dorothy J. Vesper
Lloyd S. Grearson	Timothy B. Mullen and Cindie Lynch Mullen	Timothy D. Watson
Charles H. and Karen Grenot	Thomas J. Nicholson	Matthew L. Werner, III
Albert L. Guber	Tye J. Numelin	William E. and Deborah Wertz
Weixing Guo and Yuejih Xue		Timothy S. White
John H. and Susan Steele Guswa		

# Alumni News

**Bill Abriel '75, '78g** has been named 2015-2016 president-elect of the Society of Exploration Geophysicists (SEG) board of directors. Abriel assumes duties this fall.

**Nathan Barber '10** is a software engineer with River, Environment, & GIS Solutions at the Tennessee Valley Authority (TVA). Barber is part of a team, including hydrologists/water resource engineers/software engineers, working to implement a hydrologic software package called Delft-FEWS (Flood Early Warning System). FEWS will help TVA run and manage a variety of reservoir, rainfall/runoff, and water quality models while providing a useful hydrologic-data-inspired interface for its modelers.



(Above) **Gil Brenner '62g** (right) with Irwin Rose, a world-renowned chemist who recently passed away. Brenner was working with Rose, who won the 2004 Nobel Prize in Chemistry, on a project with amino acids. Brenner is emeritus faculty in geological sciences at SUNY New Paltz. Photo taken in Irvine, California.

**Alicia Cruz-Urbe '14g** has accepted an endowed professorship at the University of Maine to begin in the fall of 2015. She will be the Edward Sturgis Grew Assistant Professor of Petrology and Mineralogy in the Department of Earth and Climate Sciences.

**Sharon Calpin Hill '92** obtained an M. Ed. in science and the public from SUNY Buffalo State in 2010. Hill is chief of the Permits and Technical Section of the Bureau of Mining Programs of the Pennsylvania Department of Environmental Protection. She is a science writer and speaker known for her research on topics such as questionable claims, natural anomalies, and the paranormal. She created and runs a very popular blog (DoubtfulNews.com), and maintains a Wikipedia page for her skeptical/critical thinking activism.

(Right) **Jacqueline Huntoon '90g** has been named provost and vice president for academic affairs at Michigan Technological University. Huntoon has been dean of Michigan Tech's Graduate School since 2005 and associate provost since 2011. She is also a professor in the Department of Geological and Mining Engineering and Sciences. Huntoon is a member of the American Society for Engineering Education and has been elected a Fellow of the Geological Society of America. At Penn State, she serves on the Department of Geosciences' Advisory Board.



**Tracy Obarsky '02** has been working as operations geologist in the oil and gas industry at Lewis Energy Group in San Antonio, Texas.

**Shuhei Ono '01g** is the Kerr-McGee Career Development Professor of Biogeochemistry at the Massachusetts Institute of Technology (MIT). He joined the MIT faculty in 2007. Ono has been promoted to associate professor with tenure, effective July 2015.

**Irvin Shambaugh '64** has completed his fiftieth year as an independent researcher in the field of psychometrics. Shambaugh has directly developed or made significant modifications to over 100 aptitude, interest, and knowledge tests. These measurements allow individuals to make better vocational and educational decisions. He has worked with a number of testing companies and foundations, although primarily with Aptitude Inventory Measurement Service (AIMS), the nonprofit he helped to found in 1976 based in Dallas, Texas.

**Annie Tamalavage '13** is working on a graduate degree at Texas A&M University in the Oceanography Department, College of Geology and Geophysics, with a focus on biomarkers/geochemical proxies in coastal sinkhole paleo-environmental reconstructions. She has completed an internship with the American Geophysical Union (AGU) in DC, as well as two internships at ConocoPhillips in Houston, Texas. Tamalavage was recently elected to serve on the AGU leadership council for a two-year term.

# Faculty Awards and Recognition



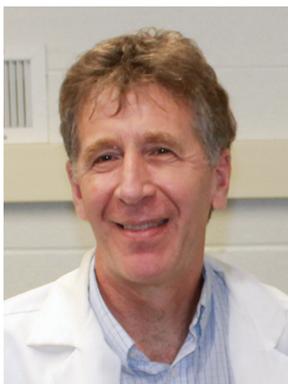
## Richard Alley

Honorary Doctor of Science,  
University of Chicago  
Punxsutawney Weather  
Discovery Center Hall of Fame  
2015 BBVA Foundation  
Frontiers of Knowledge Award  
in the category of Climate  
Change



## Chuck Ammon

Fellow of the American  
Geophysical Union



## Timothy Bralower

College of Earth & Mineral  
Sciences' Wilson Award for  
Outstanding Service



## Katherine Freeman

Penn State Distinguished  
Professor



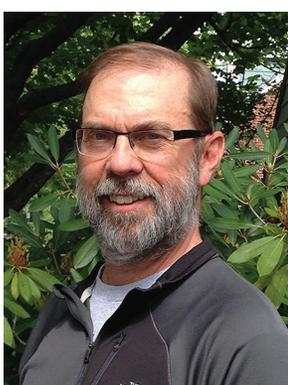
## Elizabeth Hajek

National Science Foundation  
Faculty Early Career  
Development Program  
(CAREER) award



## Michael Mann

*Economia* magazine list of 50  
Leading Finance Leaders,  
Influencers and Innovators  
Pongo Award, Orang Utan  
Republik Foundation  
Named Highly Cited Researcher,  
Institute for Scientific  
Information (ISI)



## Mark Patzkowsky

Fellow of the Paleontological  
Society

## Department Rankings

The U.S. News & World Report's ranking for America's Best Graduate Schools ranks our Earth Sciences program sixth in the nation overall. Within the Earth Sciences, Geology is tied for first place, Environmental Sciences is tied for second place, Geochemistry is ranked second, and Paleontology is ranked eighth.



**PennState**  
College of Earth  
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