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SPRING 2020

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EARTH

GEOSCIENCE NEWS

For Alumni and Friends of the Department of Earth and Environmental Sciences
The University of Michigan





Greetings from Ann Arbor! This last year has passed quickly as many important events have occurred within the Department. Since our last newsletter, I have taken over the role of Chair after filling this position in an interim capacity. While it is a tremendous amount of effort, the exciting changes that are occurring with our faculty and students make it all worth it.

One of our most important accomplishments this year is the increase in our majors program to an all-time high during the Winter of 2019 (155 majors, 58 minors). This recent increase goes against national trends in geosciences. We attribute our growing numbers to several factors: strong faculty advisors that spend dedicated one-on-one time with students, and strategic placement of gateway courses with high quality instructors. In addition, this success results in part from our diversification into the environmental sciences that is attracting a new cadre of undergraduate students interested in protecting Earth's fragile systems. This field of interest complements our continuing strength in classical geological fields. Accommodating the increasing student numbers with sufficient required course offerings, including our field camp requirement, will be a challenge in the coming years. We hope this trend continues and that we are able to build on the high national and international reputation we currently hold.

Our PhD numbers have held steady and we are seeing an increase in our MS program in 2019. Many of these MS students are expected to transition to our PhD program. We have improved our recruiting of students for the prestigious University Rackham Merit Fellowships through the Fall Preview where the most qualified student applicants are encouraged to visit the Department and meet directly with the faculty. Importantly, rates of student retention and completion of the degree have increased in part through our development of professional training activities and career interchanges in which our alumni become directly involved with the students.

Substantial investments have been made to maintain world-class facilities in our building, on campus, and at our field station. Much effort has been invested in the nearly-completed renovation of our field station at Camp Davis. We have replaced the 90 year-old student cabins and are expanding our infrastructure to support this vital part of our Earth program focused on field instruction. Professor Ingrid Hendy leads the new Michigan Elemental Analysis Laboratory or 'MEAL' for short, replacing the old KECK geochemical department facility, which will be capable of serving our department researchers, as well as attracting collaborators from across campus and around the country. Asst. Professor Jena Johnson is now operational in her Michigan ExoBiology Laboratory, developed to investigate microbe-mineral interactions that explore the evolution of metabolism during the Early Earth, particularly focused on the progression of oxidation of our atmosphere in the Precambrian. With the recent completion of the Biological Sciences Building, our paleontologists took up a new home which houses state of the art classroom and specimen preparation facilities. Finally, construction is complete for a renewed, state-of-the-art Stable Isotope Laboratory serving Profs. Julia Cole, Sierra Petersen and Kacey Lohmann.

Research programs in the Department remain strong as we continue hire more diverse faculty. We have been fortunate to have numerous faculty positions approved by the College and have recently hired two new members. Zack Spica joins us from the Universidad Nacional Autonoma de Mexico. He adds to our growing geophysics research group with a focus on seismology, magnetism and volcanology. Additionally, Robert Holder will fill a gap in our geological faculty as his research in geochronology and metamorphic petrology adds to our traditionally strong programs in high temperature geochemistry.

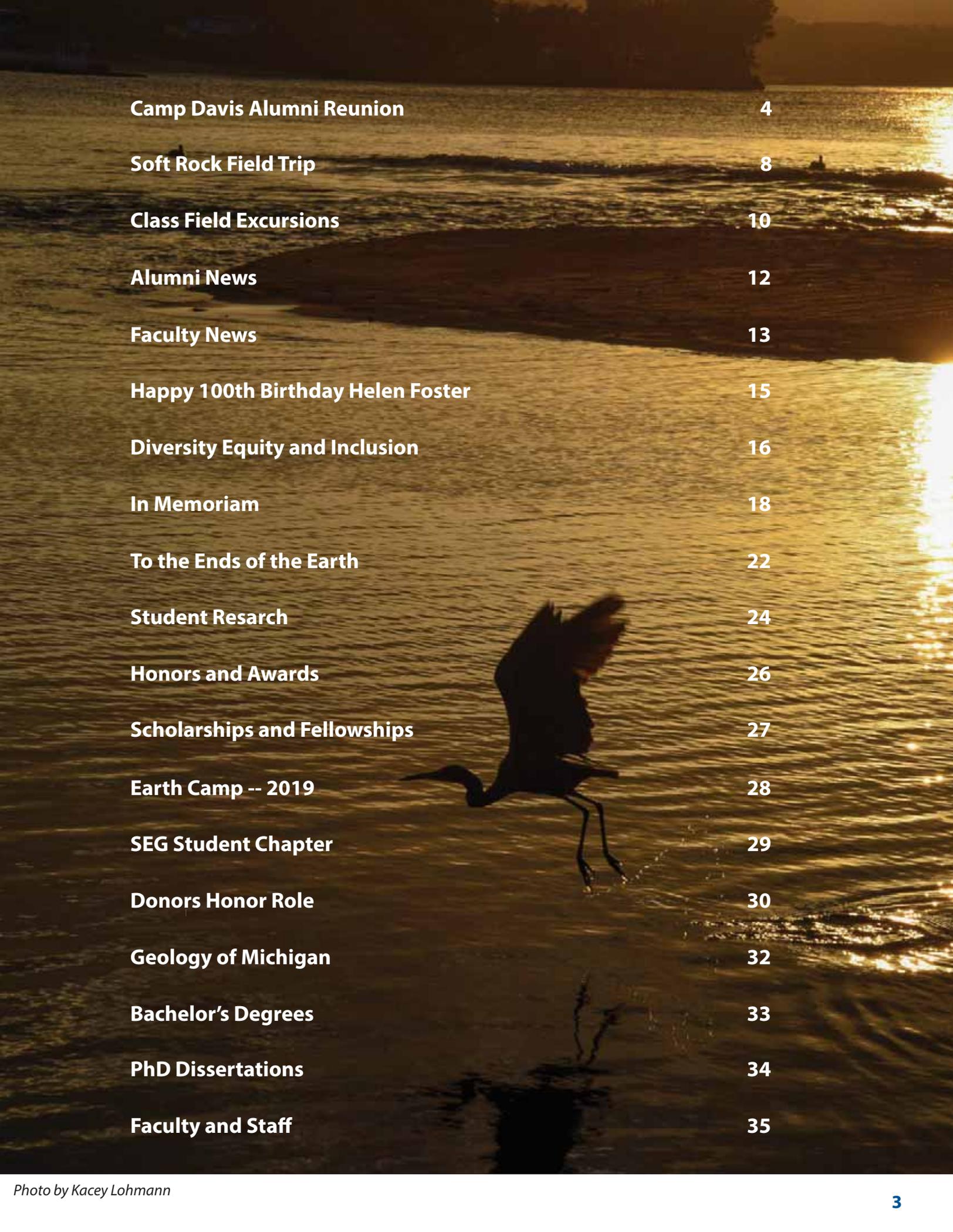
The Department has also seen the award of prestigious fellowships to two new members, Carlos Peredo and Jenan Kharbush. Carlos Peredo was chosen to be a member of the Michigan Society Fellows, a three-year position that will involve both teaching and research in vertebrate paleontology. Jenan Kharbush received the very prestigious President's Postdoctoral Fellowship, a highly competitive position that will transition into a tenure-track faculty line after two years. Her insightful research in microbial biogeochemical cycling of carbon and nutrients in aquatic systems strengthens our developing programs in geomicrobiology.

We are most proud of our alumni who have also received recognition for their contributions to the Earth Sciences. John Valley (MS '77, PhD '80) was elected to the National Academy of Sciences for his innovations and seminal ion probe research. Andrea Dutton (MS '00, PhD '03) received a coveted MacArthur Genius Award for her ground-breaking research in reconstructing past sea levels during times of global climate change.

It has been a very exciting year marked by accomplishments and opportunities for the Department. We thank all of you, our alumni and friends, for your support and commitment to the continuing excellence of the Department.

Warmly,
Marin Clark

2 COVER PAGE PHOTO: *This adventurous crew explored the beautiful Teton site of Delta Lake during the Camp Davis Alumni Reunion.*
Photo by Liz Timoszyk.

A sunset over a body of water with a bird in flight in the foreground. The sun is low on the right side, creating a bright reflection on the water. The bird is silhouetted against the water and is captured in mid-flight, with its wings spread. The overall scene is peaceful and scenic.

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Camp Davis at



90 years





The 2019 Alumni Reunion Group -- Those who have learned and loved Camp Davis from past times and those young members that

What an incredible twelve months at Camp Davis! In the last newsletter, we included a photo of the ongoing renovation of the student cabins and recreation hall at Camp Davis. At that point, we had little to show except for an incredibly muddy field scarred by some gaping trenches. As the photo on the previous page shows, the renovation project was completed this past spring. A new recreation hall and 30 new student cabins were constructed on the west side of the Camp Davis campus, in time for students to attend classes in the summer of 2019.

The new student cabins accommodate four students each, and have their own bathrooms and showers. The new recreation hall sits across from the mess hall, and has a fantastic front porch and huge glass windows with a beautiful view of “Creampuff”. The recreation hall saw multiple uses this summer, as a classroom, study hall, and movie theater. A new pool table, shuffleboard table, and foosball table are on order for arrival in the spring, with the hopes that the new building can provide some of the recreational and leisure time activities that were available in the old Johnston Hall.

We were fortunate to have several students who had taken lower-level courses at Camp Davis in past summers return this year to take their required upper level field course. Not one complained about missing the old cabins.

Praise for the new residences included “Hey, there are no more chizzlers under the beds” and “You don’t have to race from the van to the bathhouse to have a hot shower.”

We are all incredibly pleased with the support from the College and the University architectural staff in getting this important project completed, and with our local architect and contractors for keeping the project on time and under budget!

The completion of the renovation project was cause for celebration! We held a 90th anniversary reunion event at Camp in late August. Almost 80 alumni, friends, and their families spent six days



Lisa Korner, Bob Basse, Steve Henry and Krys Swirydczuk Photo by Dale Austin.



can benefit in the future. Photo by Dale Austin.

exploring the Grand Tetons and Jackson Hole region, with geology tours, hikes, rafting trips and star-gazing. U-M faculty Kacey Lohmann, Adam Simon, Ben van der Pluijm and I had a wonderful time reconnecting with former students, and reliving their experiences and memories of Camp Davis. We thought that the event was a great success and look forward to running another event sooner rather than later!

Finally, we are taking a deep breath after the excitement of the past few years and then looking towards the future. The number of majors in our department continues to grow, and with it, the size and number of Camp Davis courses. As with all walks of life, connectivity and technology is permeating educational infrastructure. We were pleased to install high-speed internet service to Camp this year, and will be thinking about how to leverage that in teaching and communications in summers to come. We will also continue to think about improvements to facilities critical to supporting our teaching mission, such as the mess hall, and as we plan for future renovations and repairs to keep Camp Davis strong for another 90 years.

If you find yourself in Northwestern Wyoming during the summer, please stop by to say hello. It's always wonderful to hear from alumni about what Camp has meant to them. We have posted photos from the 90th reunion, as well as of the new cabins and rec hall, on our website, <http://sites.lsa.umich.edu/camp-davis>, and encourage you to take a look. Thanks again to all of our alumni for their support of this project and of Camp Davis, we couldn't run this amazing program without your help.

Nathan Niemi, Director Camp Davis Field Station



The Camp Davis Mess Hall is one of the oldest buildings at Camp Davis, dating back almost 90 years. An addition to the Mess Hall that includes both a walk-in cooler and freezer was added in 1990, with the help of a generous gift by Drew Issacs and Jan Kappmeyer. The importance of a functioning dining hall to Camp Davis classes, along with changing health and building codes, brings us to a point where we need to explore options for a Mess Hall renovation in the near future. Planning efforts will take place over the next few years to determine the scope and cost of renovating the Mess Hall. Photo by Kacey Lohmann

Visit *Michigan Today* article: <https://michigantoday.umich.edu/2019/11/21/meet-me-at-camp-davis/>



SOFT ROCK SPRING FIELD TRIP GEOLOGY OF THE SOUTHEAST AND FLORIDA

Another spectacular year for the Soft Rock Field Trip. Kacey Lohmann (Prof) and Peter Knoop led a group of 22 graduate and undergraduate student on a 12 day excursion to explore the geology from Michigan to Dry Tortugas, Florida.



Kacey Lohmann and Hailey Goran (BS '20) discuss vadose alteration of coral heads in Key Largo, FL. outcrop. Photo by Peter Knoop

The trip began with outcrop studies of the lower Paleozoic carbonate and shale sequences in southern Indiana and northern Kentucky. Excellent exposures helped to give students practice in measuring stratigraphic sections and learning how to observe and document sedimentary features in the field. While it is true that Kacey Lohmann loves carbonates the most, he was blessed to find phenomenal localities of Pennsylvanian foreland basin clastics to share with the students.

While passing through the Appalachian Valley and Ridge and up into the Smoky Mountains, the geological complexity and structural diversity associated with the Alleghenian Orogeny was the primary focus, replete with the Late Paleozoic synorogenic sedimentation.



Left: *Samantha Theuer (BS '19), Rachel Antineau (BS '20) and Emily Solecki (BS '21) examine fossiliferous Ordovician Limestone in southern Indiana. Photo by Peter Knoop*

On the journey through South Carolina and Georgia, river and road outcrops of Mesozoic and Tertiary Coastal Plain sediments provided a contrast in depositional settings to those characteristic of Paleozoic sequences.

The final focus of the trip was to provide the group with a better understanding of active depositional systems in Recent environments. This included clastic dominated beach and shallow marine coastal localities that were compared to those seen in the Coastal Plain sediments of the Carolinas. Further travel southward led to the transition from clastic to carbonates which were visited in both outcrops of the 125,000 year Anastasia Limestone and local beaches around St. Augustine, FL.

This year we were also fortunate to have Robert Portell provide a guided tour through Haille Quarry where Eocene aged limestones contain abundant shallow marine fossils. This sequence also possesses excellent Neogene solution crevasses containing terrestrial vertebrate fossils.



This trip was generously supported by a grant from Shell Oil Company and by the Endowed Field Excursion Fund established by an anonymous donor. THANK YOU!!



FIELD EXCURSIONS – SOUTHEAST US AND FLORIDA

Right: Julia Belke (BS '20) examines Eocene shallow shelf carbonates at Halle Quarry, FL. Photo by Peter Knoop



We were off to southern Florida to examine Miocene phosphate deposits and Pliocene-Pleistocene shallow platform carbonates. This, of course, included stops in the Everglades and on the beach of Florida Bay before finally arriving at Key Largo. While in the Florida Keys, two snorkelling trips gave the group an appreciation and understanding of active carbonate deposition in reef dominated environments. This included trips to Key Largo Dry Rocks and to Dry Tortugas. Such experiences provided the framework necessary for the group to examine and interpret the diverse set of limestones that were seen on a day long trip through the full length of the Florida Keys, ranging from oolitic limestones formed in high energy shoals to patch reefs exposed in Windley Key Quarry.

Next year, Michigan is off to the Grand Canyon!!!!

The students thank all who have helped make these trips possible with your generous donations to the Field Excursion Fund. Thank you from all of our hearts....

HOW TO SHOW YOUR SUPPORT

Gifts to the Field Excursion Fund - #366013 will be used to defray the cost to our students of field experiences in the U.S. and abroad. Such experiences are vital to developing the geological perspective necessary to support the needs of our society in the future.

Give with the enclosed envelope or go to the Department home page and click on "Give Online".

<http://lsa.umich.edu/earth/alumni-friends/victors-campaign.html>



Exploring the shallow subtidal carbonates in Florida Bay at Flamingo, Everglades National Park. Photo by Peter Knoop

STRATIGRAPHY AND BASIN ANALYSIS

MICHIGAN AND OHIO



Above: This trip to Grand Ledge's Clay Kiln Quarry provided students with an opportunity to examine an outcrop of a Pennsylvanian-aged meander fluvial sequence replete with coal-bearing flood plain sediments. Here students are examining root traces exposed along the margin of the water filled quarry. Photos by Naomi Levin

CLASS FIELD TRIPS

Naomi Levin (Assoc Prof) took the EARTH 467 (Stratigraphy and Basin Analysis) students on two field trips this Winter term. The first was a day trip to the Pennsylvanian strata in Grand Ledge, MI in mid-March to practice measuring section and making field observations. Although it was sunny when the group left it was a cold day to be measuring section, especially next to a frozen quarry pond. But the students persevered, digging through the frozen clay-rich units and staying warm enough to make field observations in sub-ideal conditions and hone their skills with Jacob staffs and bruntons. All of this practice made the weekend trip to the Paleozoic outcrops in Ohio in early April easier and more productive. The warm weather and clear skies were also a help. The group (13 undergrads and 9 grad students) made stops in northern Ohio along the Maumee River and then focused on the Paleozoic rocks exposed east of Dayton. The trip's focus on field observations of lithology, thicknesses, water depth indicators and paleogeography culminated in a final report on the paleogeography and subsidence history of the region.



Above: Leah Marr (BS '20) measuring large scale cross stratification.

STRUCTURAL GEOLOGY

THE APPALACHIANS



Group photo on day 3 at the NW-stepping ramp anticline (or fault-bend fold) of Willis Mountain, that is marked by ridge-forming Silurian sandstone/quartzite. *Photo By Ben van der Pluijm.*

CLASS FIELD TRIPS

The 2019 Earth Structure trip led by **Professor Ben van der Pluijm** took 29 undergraduates, 3 grads and a dapper professor to the Maryland Appalachians. There were torrential rains getting there and back, but we had glorious sunny days in the field. We observed lots of folds, faults and fractures as we traversed from East to West, from the Blue Ridge into the Valley and Ridge. The image collage shows our walk to the first stop at folded and cleaved Bloomsburg/Wills Creek sandstone at Roundtop, examining outcrop-scale structures in folded Tonoloway limestone, and a large ramp anticline in Tuscarora sandstone at Wills Creek overlook. Five star dinners at the Park'nDine and World Buffet offered welcome endings to each field day.



Above: A spectacular ramp anticline in resistant mid-Paleozoic sandstone marks our last, most westward stop at Wills Mountain Narrows overlook. *Photo By Ben van der Pluijm.*

Alumni News

MAJOR PUBLICATION BY USGS ALUMNI

John H. DeYoung, Jr. (MS 1969), Nora K. Foley (BS 1978), Craig A. Johnson (MS 1981), Patricia J. Loferski (PhD 1990), Keith R. Long (MS 1984), and Robert R. Seal II (PhD 1989) are among the authors of U.S. Geological Survey (USGS) Professional Paper 1802 <<https://pubs.er.usgs.gov/publication/pp1802>>, "Critical Mineral Resources of the United States—Economic and Environmental Geology and Prospects for Future Supply," which was recognized with the 2018 Shoemaker Award for Communications Product Excellence in the Large Print Product category at the 2019 USGS Honor Awards Ceremony on May 7. The 797-page publication, released in December 2017, covers 23 mineral commodities currently among those viewed as important to the U.S. economy and national security, including some for which the United States is currently wholly dependent on imports to meet its needs. The book contains an overview of current uses of each mineral commodity, identified resources and their distribution nationally and globally, the state of current geologic knowledge, the possibilities for finding additional deposits nationally and globally, and geoenvironmental issues that may be related to production and use. The publication updates information published in 1973 in USGS Professional Paper 820, "United States Mineral Resources." The award, named in memory of Eugene Merle "Gene" Shoemaker (1928–97), considered the founder of the science of lunar and planetary geology, recognizes USGS products that demonstrate extraordinary effectiveness in communicating and translating complex scientific concepts and discoveries into words and pictures that capture the interest and imagination of the American public.

Alumni Advisory Board - 2019



We welcomed our Alumni Advisory Board (AAB) to Ann Arbor in late October for several days of wonderful engagement among alumni, students, staff and faculty. The weekend kicked off with a speed-dating career event for undergraduate and graduate students to network with alumni. Feedback from the students was incredibly positive and they are anxious for more engaged contact with our alumni. They particularly enjoyed the diversity of

careers our alumni represent and the honest conversations they had in the absence of faculty. The AAB spent most of their Friday meeting time this year engaged in self-reflection exercises designed to help the AAB as a body better define their role for the department. A professional facilitator scaffolded and ran the agenda for a variety of individual and group activities and feedback from AAB members indicates that this was long overdue. We look forward to learning how we can maximize the return on your investment and want all alumni to know that we value your time to continually improve our department. Our annual tailgate was enjoyed despite some cool and rainy weather - our alumni are tough - and despite the loss to Notre Dame our AAB members had a great time rooting for the home team. **Go Blue.**

IF YOU WANT TO RECEIVE E-NEWS, UPDATE YOUR ALUMNI PROFILE

Email: michigan-earth@umich.edu

FACULTY NEWS

Stable and Clumped Isotope Paleo-Climatology-Oceanography

Sierra Petersen (Asst Prof) recently developed the Stable & Clumped Isotope Paleo-Climatology Paleo-Oceanography (SCIPP) Laboratory. It is growing in personnel and instrumentation. Since July we've added three new people **Allison Curley (MS)** and **Heidi O'Hora (MS)** and **Julia Kelson, NSF Postdoc**. We've also added a brand new mass spectrometer "Maisie", a Nu Perspective with NuCarb carbonate preparation device, which will measure the clumped isotopic composition of carbonates, predominantly fossil shells to determine past ocean conditions. We are very excited about this instrument, as it will dramatically increase our sample throughput, and lower the sample size so we can study questions like: *What was the temperature seasonality in past greenhouse periods, and How has freshwater runoff into marine systems, and therefore the hydrological cycle, changed over time?* Sierra hosted the whole group for a welcome potluck dinner at the beginning of the school year.



SCIPP Laboratory celebrated the start to the school year with a welcome potluck supper
Left to right back row: Jade Zhang, Allison Curley, Serena Scholz, Steve Wedel, Jon Hoffman, Becca Heaman
Left to right bottom row: Matt Jones, Julia Kelson, Heidi O'Hora, Sierra Petersen

Nathan Sheldon (Prof) It was a busy year for his lab group, with fieldwork ranging in time from the Archean to the present-day and in space from Wyoming to the Faroe Islands (see articles from PhD students **Bekah Stein (PhD Cand)** and **Becca Dzombak (PhD Cand)**). It was also a year of comings and goings, with undergraduate research assistants **Maggie Hammond (BS, 2019)** and **Aliah Wright-Johnson (BS, 2019)** graduating, as well as **Katy Rico (PhD, 2019)** completing her PhD. Katy was awarded the internationally competitive Wares Postdoctoral Fellowship to work with Dr. Nagissa Mahmoudi at McGill University. Starting in fall 2019, the research group welcomes new MS student **Melanie Shadix** who did her bachelor's at the US Air Force Academy, as well as undergraduate researcher **Fiona Fox (BS '20)**. Nathan continues to be extremely fortunate to work a great group of talented undergraduate and graduate student scientists



Front row (l to r): Becca Dzombak, Katy Rico, Amelia Jelic, Bianca Gallina, Aliah Wright-Johnson. **Back row (l to r):** Bekah Stein, Zoey Plonka, Sonya Vogel, Nathan Sheldon, Maggie Hammond. *Not pictured:* Jordan Tyo, Katie Seguin

EARTH Students, Faculty, and Alumni Participate in Field Trip in Nevada and California

In May 2019, 30 students and faculty from 14 institutions (including four current U-M students, two faculty, and three alumni) convened in Las Vegas for a five-day field trip through western Nevada, Death Valley, and the Mojave Desert, California. The participants were biologists, geologists, and paleontologists with varying expertise and areas of study, but all were united by their interest in understanding links between landscape dynamics and mammal diversity in North America. The purpose of the field trip, sponsored by a National Science Foundation Research Coordination Network grant and awarded to UM Professor **Catherine Badgley (Prof. EEB)**, was to bring biologists and geologists together to teach each other about the modern landscapes, geological history, fauna, and flora of the western interior.

The field trip began in Tonopah, Nevada, where participants learned about the modern small mammals that inhabit the western interior and how their communities change along elevation gradients. The next two days were spent in Death Valley National Park, where U-M Professor **Nathan Niemi (Prof)** explained the geology and complex structural history of the region. Participants saw



Group Photo of near Tonopah, Nevada during conference to explore control of mammal diversity to landscape dynamics

how plant communities changed over a 5,000-ft elevation gradient and at springs that provide water in the arid environments of Death Valley. On the last day, participants visited the Miocene deposits of Rainbow Basin near Barstow, California. These deposits preserve a rich fossil record of mammals that lived in a basin that was structurally similar to the basins in Death Valley and western Nevada. These modern landscapes and their faunal and floral communities are possible analogs of the ancient environments and extinct animals and plants represented in the deposits of Rainbow Basin and elsewhere in the region.

Left: Nathan Niemi (Prof)
describing the structural controls on landscape development in Death Valley.



Helen Foster: Living Life Well for 100 Years

by Lily Gontart

Born on December 15, 1919, in Adrian, Michigan, and now living in Carson City, Nevada, Helen Foster is an extraordinary centenarian. She spent her life quietly breaking barriers and making her way, as well as a name for herself, in the field of geology. Helen's passion for geology and the places she worked and studied shaped her extraordinary life. "I was never treated any differently than the men and I was always paid the same," she says. "Several times in my life I was just at the right place, at the right time."



Helen was the eldest of two girls, and her parents Stanley and Alice instilled curiosity and independence in their daughters. The senior Fosters also shared their passions with their daughters. The family took fishing and camping trips in Northern Michigan, and the girls learned to drive at an early age. By the time Helen was twelve, she was chauffeuring her mother around Adrian at the wheel of her mother's Model-A Ford. A couple of years later Stanley, an aviation enthusiast, took his daughters to the Detroit Air Show where the trio went for a flight in a Ford tri-motor plane.

The Foster girls' carefree Michigan childhood end abruptly with the death of their father in a plane crash in October 1936 shortly before Helen's seventeenth birthday. The 1936–37 school year was important. It was Helen's senior year and she had to keep studying, no matter how much she missed her father. The support of her mother, their extended family and friends, Helen graduated as salutatorian of her senior class and was offered scholarships to Adrian College and the University of Michigan. She decided to head to Ann Arbor, and in October 1937, she began general studies at the university.

Like many first-year students, the initial weeks were a struggle, but slowly her scores improved with every Blue Book test she took. When she returned to Adrian for Christmas vacation, she passed her time studying the local geology. She took a course in Pleistocene glaciation in the spring of 1938. Part of the course was a field trip to Kelleys Island in Lake Erie to study the glacial grooves of the island's limestone bedrock. This trip secured Helen's interest in geology as a college major and possible life pursuit. A practical woman with a sense of adventure, Helen completed a Bachelor of Science, a Master's and then a PhD in geology at the University of Michigan. When World War Two came to an end, and jobs for geologists were becoming scarce, on the advice of the chair of the Department of Geology at UM Professor Kenneth K. Landes—who Helen describes as her "great benefactor"—she applied for and accepted a teaching position at Wellesley College in Massachusetts. Helen followed Professor Landes' advice because the job would provide her with a steady income and give her time to do field work in the summer. While at Wellesley, one of Helen's former UM classmates working with the Military Geology Branch in Tokyo, Japan, got in touch. The friend wanted to return to the USA to get married, but her supervisor wouldn't let her go unless she found a replacement. Within a few months, Helen flew off to Japan.

After an indirect route from Washington (DC) through four states before reaching Hawaii, then a flight to Johnston Island and on to Kwajalein Atoll in the Marshall Islands then to Guam, Helen finally landed in Tokyo in April 1948. In June of that year, the Fukui earthquake struck. One of Helen's first projects was assessing the effects of the earthquake. Over the following nine years, Helen worked out of the Tokyo office. At the end of her time there, spent a year and a half as the chief of the Ishigaki-Shima field party, an island in the Yaeyama Archipelago in the East China sea, two-hundred-and-fifty kilometres east of Taiwan.

During her years in Japan, Helen continued her forays into the landscape, hiking (solo or with friends), up volcanoes (more than once during an eruption) and along trails. More often than not, she was the only woman at the field camp, in the office or at a conference.

When Helen completed her work in Japan in 1958, she went to work in the MGB's Washington office to finish her report on Ishigaki-Shima. There she met Bill Holmes. He who was finishing a study of the physiography and glacial geology in an area in east central Alaska. He needed someone to complete the mapping of the bedrock exposed in the area. That's how Helen ended up in Alaska in the summer of 1960. That would be the first of Helen's many summers in Alaska, including time spent working on the effects of the Anchorage earthquake of 1964. But, most of her twenty-four field seasons were spent in Alaska she was a project chief or team leader of geological mapping projects of central eastern Alaska, east of Fairbanks. When Helen retired from the USGS Alaska Branch in 1986, she'd worked for the survey for thirty-eight years.

Helen's travels and adventures didn't end when she retired. She pursued her longtime interest in polar exploration and took trips to Antarctica with friends. She's also travelled to every continent in the world. It's hard to summarize a century of living, but as Helen turns one-hundred, she is literally one of the last of the trail-breaking twentieth-century geologists and an extraordinary example of a life well-lived. If you're lucky, you catch her taking lunch at Denny's, or walking along one of her favorite Carson City trails, or even driving her Toyota Forerunner. Because, this adventurer is still living life on her own terms.

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Diversity Equity and Inclusion Highlights of the Department's Effort

The DEI Committee: Selena Smith, Jena Johnson, and Jackie Wrage

The Department of Earth & Environmental Sciences community has been active in working to create a more diverse, inclusive, and equitable student body and workplace! Some highlights from this past year include our Fall Preview event, outreach efforts, and professional development activities for our students.

Fall Preview

We brought 15 first-generation, underrepresented, and/or DEI-committed prospective graduate students to our department on November 1st for our annual 'Fall Preview' event in conjunction with Astronomy & LSA. This recruiting event gets better each year! After a welcome dinner including three of our grad students, the Preview attendees had a whirlwind Friday starting with a welcome and department introduction by Grad Chair Naomi Levin, an application and admissions workshop led by Selena Smith and Jena Johnson, individualized lab tours given by grad students, faculty meetings, lunch with grad students, Smith Lecture, a poster reception at the Michigan League featuring current graduate student research, and a walking tour of Ann Arbor led by Jackie Wrage, Kevin Velez, and Jenny Bowen. A huge hit this year was the introduction of current grad student 'buddies' assigned to each participant, which helped our visitors feel even more welcome. Our Fall Preview event not only provides an abundance of advice and Michigan connections to promising recruits who care about DEI issues, but it also shows our current students and the broader Earth science community that we are ever striving to be more inclusive.

Fall Preview Participants and their EES grad student buddies pose for a photo before lab and building tours



Outdoor Field Equipment Library

A new initiative is being started by EES graduate students and GeoClub aimed at making field camps and field trips more accessible to undergraduates. Equipment for field work can be expensive which limits participation by some students. To overcome that, as well as promote a more sustainable "reuse" culture, a "field equipment library" is taking donations of field gear (tents, sleeping bags, sleeping pads, hiking boots, mess kits) that is in good condition. Students who cannot or do not want to purchase new equipment will be able to borrow gear and return it to the department at the end of the excursion. If you're interested in donating anything please contact GeoClub-presidents@umich.edu

Local Outreach

The Association for Women in Science (AWIS) at the University of Michigan hosted the 2nd annual Young Scientists' Expo (March, 2019) at Forsythe Middle School in partnership with the Scientist Spotlight from the U-M's Natural History Museum. The Expo is a combination of a traditional science fair in which students display posters of their own science projects as well as an interactive experience where middle school students, their families, and other members of the community can interact with scientists from the University of Michigan. This year, over 40 graduate student volunteers mentored students on their science projects for 3 months leading up to the Expo and ~ 80 students entered posters. To make science projects and the Expo accessible to more students, AWIS provides materials for student experiments as well as poster boards and other supplies, including a 'Science Passport'. At the Expo, with over 350 attendees, EES graduate students participated in poster judging and led science demonstrations during both an after school sessions and at the Expo.

A 3-person team of first-year EES graduate students put on a mineralogy demo at the Young Scientists' Expo to teach students about how crystals grow from a melt. By melting and slowly cooling pure bismuth metal, they grew large crystals from a liquid melt in front of the students' eyes. The students (as well as their parents) were amazed at how easily the complex geometric bismuth crystals grew from the liquid surface and the demonstration was a favorite among students. All the students were especially delighted when they were allowed to take one of the smaller crystals home as a memento of the event, with one student exclaiming, "I'm going to add this to my rock collection!"

Inclusivity at Conferences

Two EES students went to the Society for Advancement of Chicanos/Hispanics and Native Americans in Science (SACNAS) Conference in October 2018. This conference creates an environment where scientists of color are welcomed, supported, and celebrated, as noted by our students. Professional development support was plentiful, and keynote talks delivered by first-generation scientists touched on their experiences navigating academia. Additional sessions addressed diversity and climate issues. ADVANCEGeo (an NSF-funded partnership of Earth Science Women's Network, Association of Women Geoscientists, and the American Geophysical Union, to improve climate in Geosciences) was there, presenting on harassment and bystander intervention, which helped emphasize that the Earth Sciences field really cares about improving the culture for everyone.

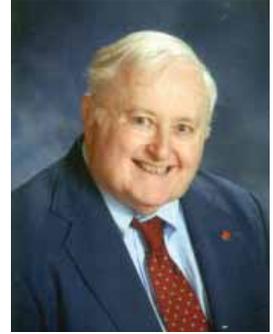
Five EES undergraduate and graduate students from the U-M Society of Economic Geology went to the Prospectors & Developers Association of Canada (PDAC) annual conference in Toronto, Ontario in March 2019. This conference featured an Aboriginal Program, where the students saw presentations on community-based monitoring in Chile, how companies are engaging with local communities in Ecuador, and Inuit student apprenticeships in Greenland. Broadly, the group learned best practices in including indigenous communities when undertaking mining work, particularly including both sides in the conversation and forming a partnership.



*Earth graduate students **Colleen Yancey** and **Allison Pease** showing a captive audience how bismuth crystallizes from a melt during the Young Scientists' Expo at Forsythe Middle School in Ann Arbor*

IN MEMORIAM

Robert “Bob” Guy Corbett



Robert, “Bob” Guy Corbett, 84 of Normal IL, passed away on Saturday, July 27, 2019 at his home. Bob was born on March 13, 1935 in Chicago, Illinois to Thomas “Cy” and Dorothy Huttman Corbett. He married Gail Rushford on August 31, 1959 in Albuquerque, NM. Bob attended Harvard College and then the University of Michigan where he received his **B.S. (1957), M.S. (1958) and Ph.D. (1964)**. Bob’s dissertation, *The Geology and Mineralogy of Section 22 Mine, Ambrosia Lake Uranium District, New Mexico*, was the definitive study of the United States’ largest uranium mine at the time.

Bob started his career as an Assistant Professor in the Department of Geography-Geology at West Virginia University. He later went on to be an Associate Professor and later a full Professor in the Department of Geography-Geology at the University of Akron. He became Chairman of the Geology Department, and served as Coordinator of Research. In 1989 Bob moved his family to Normal, Illinois and worked at Illinois State University as a Professor of Geology and Department Chair of Geography-Geology. Bob retired from ISU in 2001.



After retirement, he continued his relationship with the American Institute of Professional Geologists and served as an appointee to the State of Illinois Board for Licensing Professional Geologists. In recognition of his contributions, he received the Martin C. Van Couvering Memorial Award from the American Institute of Professional Geologists (AIPG) on October 9, 2007. Throughout his career, he was an active researcher. He published more than 60 professional publications including co-authoring of *Geology of Casper Mountain, Wyoming*, 1989, a U.S. Geological Survey Professional Paper. On April 18, 2015, he was elected to membership in the College of Arts and Sciences Hall of Fame in recognition of his exemplary achievements at ISU.

Besides his work at the University, he enjoyed leading raft trips down the Grand Canyon for geology students and made several trips to Hawaii National Parks studying the volcanos. Bob was a member of First Christian Church, Bloomington and was a life-long Cubs Fan.

*Reprinted from: Calvert & Metzler Memorial Home
Bloomington Chapel Obituary*



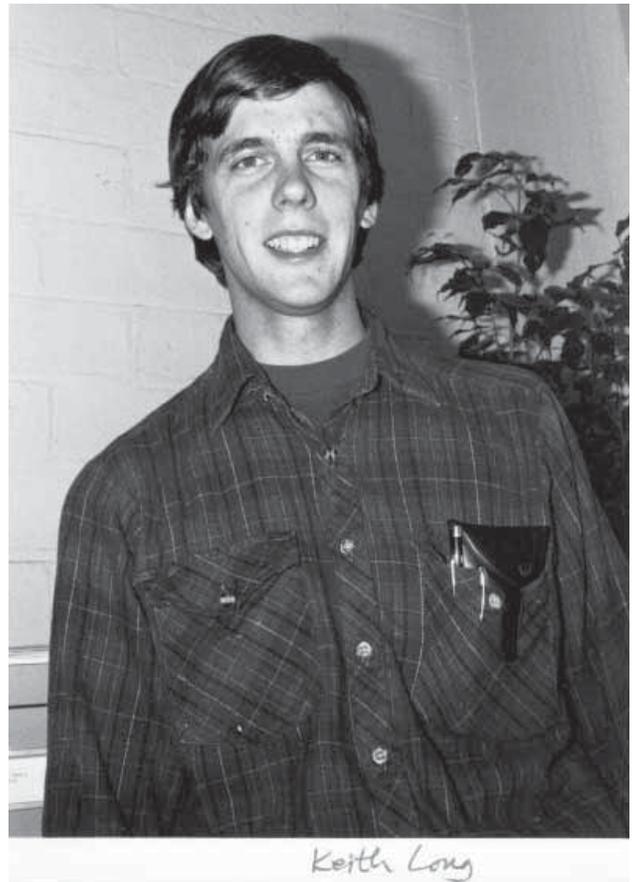
Keith Richard Long

Keith Richard Long (MS '84) passed away on 29 March 2019 in the presence of his devoted wife Kay in Tucson from complications related to colon cancer. Born to Walter A. Long and Edith Berridge in Wichita Falls, Texas, Keith grew up in Santa Clara, California and graduated from University of California Santa Cruz with a double major of a B.S. in Earth Sciences and a B.A. in Political Economy (1979). He completed his M.S. in Geology at the University of Michigan (1984) under the direction of **Prof. Bill Kelly** on the *Ground Preparation and Zinc Mineralization in Bedded and Breccia Ores of the Monte Cristo Mine, North Arkansas*. He subsequently received his Ph.D. in Mineral Economics at The University of Arizona (1988). He married Kay Ellen Lindley in Tucson on October 2, 1999.

Keith joined the U.S. Geological Survey in Tucson in 1988, to work in the Center for Inter-American Mineral Resource Investigations where he participated in cooperative studies in Central and South America, especially Mexico and Bolivia. Keith devoted his career to studying mineral resources and specialized in the economic aspects of mineral resource assessment. The focus of his research in recent years included work on the economics of porphyry copper deposits, economic filters for evaluating mineral deposits, the environmental aspects of historical mine tailings, and characterization of rare earth element deposits and significant metal deposits of the U.S. He wrote over 100 publications ranging from country-specific studies of the mineral resources of Bolivia and the United States to work identifying and classifying abandoned mines in California. Keith also published an English-Spanish dictionary of mining and geologic terms. He ended his career as a Research Specialist in rare earth minerals.

He was active in professional societies including the Society of Economic Geologists, Arizona Geological Society, the Mining History Association, and the International Assoc. of Mathematical Geologists where he served as Editor for *Natural Resources Journal*. He presented numerous, well-researched talks on minerals and mining history.

Keith was an intelligent, thoughtful, kind, devoted person with a quiet sense of humor. An avid reader, he was interested in the natural sciences, history (especially world history, technology, military, mining, and Biblical archaeology). He was respected and admired by his colleagues and friends continue to respect and admire him for his contributions to the science.



Published in the Arizona Daily Star on April 7, 2019



Paul Pomeroy

On February 24, 2019, Paul Pomeroy set sail for eternity completing 87 years of scientific research, ocean voyaging, and a full family life. He was born on August 14, 1931 to Barbara Green and William Octave Pomeroy in Portland, Maine. He graduated from Deering High School, Portland, ME in 1949. He received his B.S. in Geophysics from the Massachusetts Institute of Technology in 1953. Following that, he served as an officer at the Air Force Cambridge Research Laboratories where he did research in the Arctic and North Africa. Upon completion of his Air Force service in 1956, he began graduate studies at Lamont Observatory of Columbia University and received his Ph.D. in Seismology in 1963. His research into the possibility of distinguishing underground nuclear tests from earthquakes resulted in his being featured in a Time Magazine article.

Dr. Pomeroy joined the University of Michigan as Professor and Director of the Seismological Observatory in 1968 to implement a program for graduate students based on the new discoveries of continental drift and sea floor spreading. He left the university in 1971 to live for a time on the island of Vieques, Puerto Rico, and to pursue his interest in ocean sailing. Later, he joined the New York State Geological Survey. He was appointed as an Adjunct Professor at the State University of New York in 1974. In 1976 he formed Rondout Associates, a private consulting firm, where he served as

Research Seismologist and President. In 1990, he began to serve as a member of the United States Nuclear Regulatory Commission's Advisory Committee on Nuclear Waste. In 1995 he was appointed Chairman of that body in Washington, D.C.

In 2004 Dr. Pomeroy closed Rondout Associates to devote his time to his twin interests: open ocean sailing and the collection and repair of antique clocks. In 1994 he bought his beloved sailboat, Sally IV, a 36' Cape Dory aboard which he completed five trips between his home on the Hudson River called Ice House Landing and St. John, U.S. Virgin Islands.

In 1954 he married Lois Burnham who survives him. He is also survived by his five children: Claire (Bill Robertson), Anne (Ed Seliger), Susan, Paul William, Jr. (Suzanne Fillback) and Mike (Cori Rattelman). He has seven grandchildren: Katy Pomeroy-Carter, Cassidy Pomeroy-Carter, Risa Pomerselig, Noah Pomerselig, Ethan Pomeroy, Atti Rattelman and Ziyen Rattelman. He was proud of the accomplishments of his children, loved his home on the edge of the Hudson River, supported his wife in her career and lavished love on his Golden Retrievers, especially Midas. He was equally happy pitting his courage against a stormy sea or lazing in a Caribbean harbor after an arduous ocean voyage. May his spirit sail on forever.

Reprinted from the Poughkeepsie Journal, 26 February 2019

Jeanne E. Harris



As a freshman at the University of Michigan, Jeanne found that she was required to take one year of a lab science. Having taken biology, chemistry, and physics in high school, she was looking for something different. Her Aunt Margie suggested geology. Margie was the first woman Chief Judge of a District Court in Michigan and Margie's sister Nealie was the second woman Federal Appeals Court Judge. Jeanne thought she would follow in her aunts' footsteps and go to law school. But her class in historical geology changed everything. The course involved field work, core descriptions, and research on the Michigan Basin. and as she said. "I was hooked."

After graduation in 1968, Jeanne was told she needed a Master's degree as there had been no jobs in geology for the past ten years. Again, Aunt Margie pushed her. "If you like it, you will figure out a way to use it." And she did. Mentors and role models make a difference, a lesson Jeanne brought to her work with the Association for Women Geoscientists (AWG).

Before getting into the oil and gas industry, she worked for universities, institutes, and laboratories in fields as disparate as development disability, zooplankton, using earthquake seismology to study underground nuclear blasts, seismic identification of artillery, coal mines, and salt solution mining. Her career in oil and gas began in 1975 as a geophysicist with Mobil Oil Corporation. She went on to become Area Geologist and Team Leader for Natural Gas Corporation of California and Assistant Exploration Manager of Equity Oil Company. Faced with widespread layoffs in the industry, Jeanne braved the bleak climate, and with her husband, Robert Groth, established their own oil and gas company in 1986. In Jeanne's book, obstacles are meant for leaping over, not barriers to progress.

Throughout her working life, Jeanne immersed herself in five diverse roles: geologist, participant in professional societies, friend, mother, and spouse, succeeding in each arena. Her most important geologic accomplishment was the discovery of the Greasewood Field in Wyoming, which was significant because it opened up a whole new play concept. She credits marrying Robert as "the best decision I ever made." Their son, David, is a star entrepreneur in his own right. Jeanne's many contributions to AWG, AAPG, and RMAG, have been recognized with numerous awards, including A WG-Denver Woman of the Year, AWG Distinguished Service Award, the PG&E Community Service Award, RMAG and AAPG Distinguished Service Awards, AAPG Long Service Award, and Honorary Memberships in both RMAG and AAPG.

Jeanne's enthusiasm for and dedication to AWG is unchallenged. She was a founder of AWG and the A WG Foundation, serving as the second president of the Foundation. She credited her experience in A WG with teaching her about organizations and people. She helped create almost every early AWG committee and chaired all but one. But her first love was always the AWG Foundation's Chrysalis Scholarship, which has now been named in her honor, the Jeanne E. Harris Chrysalis Scholarship. She helped create the scholarship committee and chaired it for 20 years. Since Chrysalis began in 1989, more than 80 women have received funding to complete their education. Thanks to the establishment of an endowment to support Chrysalis scholarships, her legacy will live on in the lives of countless future women geoscientists. And because Jeanne was a loyal friend to all, her legacy will also live on in the hearts of those who have known her.

To the Ends of the Earth

Through a Rackham International Research Award, biogeochemistry Ph.D. candidate Rebecca Dzombak is looking for insight into the future of Earth’s climate in the ancient soils of Iceland, Scotland, and the Faroe Islands.

The first time Rebecca Dzombak set foot in Iceland, her mind was focused squarely on other worlds. A doctoral candidate in the Continental Environments Research Group led by biogeochemist Nathan Sheldon, in the Department of Earth and Environmental Sciences (EES), she had come to the North Atlantic nation to study its soils, produced by millennia of weathering and erosion of the basalt rock that forms the foundation of the island, as part of an astrobiology grant. While the soil where she was working supported little vegetation aside from moss and lichens, thanks to numerous hot springs it boasted thriving communities of microbes. Dzombak intended to use this primordial landscape to better understand the soil processes that led to the proliferation of life on early land some 500 million years ago. That, in turn, would shed light on how these same processes might occur elsewhere, on other planets in the universe.

At the same time Dzombak was collecting soil samples in Iceland, another EES research team led by geochemist Rose Cory was working on the northern slopes of Alaska with a more terrestrial focus—the potential impact of climate change on the high-latitude soils of North America. Thanks to previous research collaboration, Dzombak was keenly aware of their work, and she couldn’t help but draw parallels between the two settings. When she returned to Michigan, she did so with many more earthbound questions.

STUDENT RESEARCH HIGHLIGHTS



While no place on Earth is free from the effects of climate change, those effects are not spread evenly. Current models predict high-latitude regions like Iceland will see more pronounced warming, leading to more significant disturbances of the environment and ecosystem. This will lead to the increased release of carbon, in the form of carbon dioxide and other gases, from soil, further exacerbating the warming process. As soils are the largest repository of carbon at the Earth’s surface, understanding more precisely how they will respond to a changing climate is paramount to understanding much of Earth’s future.

“The more time I spent in Iceland, the more I realized what a great place to work it was, and how many scientific questions its landscape suggested,” Dzombak says. “Getting a better handle on how high-latitude soil sinks will play, and have played, a role in moderating climate change is a really important question in understanding our planet’s future.”

Thanks to a Rackham International Research Award, as well as a grant from the University of the Faroe Islands, Dzombak will return to Iceland, as well as Scotland and the Faroe Islands, this summer. While there, she will collect soil samples from relatively under-researched areas at risk to the predations of climate change.

“North America and continental Europe have roughly a century of soil science behind them, but that kind of work didn’t start in Iceland until the 1980s, and in the Faroes, until the 1990s,” Dzombak says. “We still have a lot to learn about their chemical and nutrient makeup. Once we’re able to determine what they’re like now, we can start to ask questions about how they will change in the future.”

Each of her three research locations will give Dzombak the opportunity to explore a different set of soil conditions. Northern and western Iceland play host to peat bogs, wetlands, and permafrost, all particularly vulnerable to disturbances in the soil cycle caused by climate change. In the Faroe Islands, Dzombak will take samples across the entire breadth of the country, made possible by its limited geographic footprint, greatly increasing the available soil data on the small

island chain. Finally, at sites in northwest Scotland, Dzombak will have the opportunity to work with preexisting carbon dioxide flux monitors, which measure the volume of carbon gases being released from the soils, as well as changes in that volume over time. While there, she will also study soil in a relatively unique setting—fjords.

“Fjords are small and a little weird,” Dzombak explains. “They only make up about one percent of the oceans, but they have an outsized effect on carbon burial. They’re narrow and deep, with freshwater filtering down from the top and seawater at the bottom. It’s an ideal setting for carbon to settle in the sediment, rather than cycling back out. We’re going to look at whether climate change may cause that long-dormant carbon to be released.”

In addition to looking at the current state of soils, Dzombak will also be peering into the past by examining paleosols—fossilized layers that preserve the soil from prehistoric periods. The Faroe Islands in particular have well-preserved paleosols which, much like their present-day counterparts, have not yet been well studied.

“We can use paleosols to approximate past climate conditions,” Dzombak says. “Temperature, precipitation, plant life—each gives us some idea of the environment going back 55 million years to a time when the Earth was warmer and sea level was higher. It’s a good analog for present climate change.”

While her research questions are complex, the methods for answering them still require some good old-fashioned muscle. Using an auger, Dzombak will dig down into the soil at each site, collecting samples at regular intervals in order to understand how they may have changed over time. She will then send the samples back to the Continental Environments Research Group at U-M for geochemical analysis.



During testing, Dzombak will run the samples through a mass spectrometer in order to see their elemental composition. Of special interest to Dzombak are the levels of iron and phosphorous present, as they are key limiting nutrients in both aquatic and terrestrial environments. Once she has the percentages of these minerals, she can look further to determine their phase.

“That lets us know how easily the minerals could be accessed by microbes, and what kinds of larger changes that might cause for the environment or farmers using the soil,” she says.

By better understanding the role of soils in climate change, Dzombak hopes to provide new tools to better prepare for the challenges a changing climate will bring.

“As the climate changes and these high-latitude regions warm, we’re going to see changes in available nutrients, which will change the soil microbial community, which will change the overall stability of the soil and ultimately circle back around to further changing the climate,” Dzombak explains. “It turns out there’s a lot more science that needs to be done here, and to be able to contribute to that is such a privilege.”

*Article by James Dau. Discover Rackham
<https://rackham.umich.edu/discover-rackham/to-the-ends-of-the-earth/>*



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Research Scholarship and Experiences

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LEFT: *Rebecca Dzombak taking notes during her sampling expedition in Iceland.*

Catherine Seguin (BS '20) and her grad student advisor **Becca Dzombak (PhD Cand)** donned floppy sun hats and set out into the beautiful Moab desert to sample biological soil crusts. These communities, which comprise microbes, fungi, and algae, are crucial for nutrient cycling in dry biomes. My senior thesis work will analyze phosphorus cycling in the crusts, which has been studied far less than its carbon and nitrogen counterparts. Arid environments are expected to expand with climate change, so understanding drylands' nutrient cycles will help us predict regional changes in fertility.

Photo on Right: Catherine finding the perfect sample.



Kirk Townsend (PhD Cand), who is working with Marin Clark, spent the last year readying a manuscript for publication and wrapping up fieldwork for two projects. In the manuscript, now accepted in *JGR Earth Surface* (pending revisions), he back-calculates rock strength from hillslope morphology and landslide distributions to demonstrate that rock strength and topographic relief co-evolve in the early stages of mountain building. In March, Kirk travelled to the South Island of New Zealand to collect samples for low-temperature thermochronology and cosmogenic radionuclides with the goal of understanding how the faults involved in the 2016 Kaikoura Earthquake evolved through time. At the end of the summer, Kirk made his sixth and final fieldwork trip to the Western Transverse Ranges in southern California, where he is working to understand the inter-dependencies of erosion rate, rock strength, and the height of these mountains in this tectonically youthful region.

Colleen Yancey (PhD Cand) spent the summer out on Western Lake Erie performing Harmful Algal Bloom (HABs) cruise monitoring. Each week she collected water samples to be analyzed for community composition, community respiration, hydrogen peroxide concentration, along with many other chemical measurements. This work was in collaboration with the Cory lab where fellow graduate student **Dhurba Pandey** completed much of the chemical analyses. The goals of this research include understanding the drivers of shifts from non-toxic to toxic bloom phases, as well as classifying the plethora of complex molecules (toxin and non-toxin) produced by these communities. This year was an especially intense bloom with lots of biomass and dissolved organic matter.



Second year PhD graduate student **Fabian Hardy** earned an honorable mention by the National Science Foundation for his graduate research fellowship proposal that focused on Miocene fossils preserved in ash layers in central Nevada.

Second year PhD graduate student **Jackie Wrage** jump-started her graduate studies by spending part of her summer with collaborators in Germany learning to conduct experiments to simulate volcanic processes and is now analyzing the compositions of diffusion-couple experiments that simulate magma mixing between mafic and felsic material at magmatic conditions of subduction zones, to understand the mobility of sulfur and metals.



After teaching at Camp Davis, **Mara Page (PhD Cand)** rushed back to Ann Arbor to catch a flight to Nairobi, Kenya. Mara spent four weeks at the National Museums of Kenya collecting samples of tooth enamel from the fossil teeth of African herbivores. The herbivores lived along side early hominins in the Ologesailie Basin, in the Southern Kenya Rift, during a period of time when hominins were developing more sophisticated tool culture and engaging in complex behaviors such as trading or traveling long distances to gather materials. Mara will use stable isotope analysis of the teeth to investigate ecosystem dynamics in the basin, which might point to biotic or abiotic pressures affecting the organisms that lived there. Mara also descended into the rift valley to visit the field localities of the fossil teeth during an inspiring weekend excursion with colleagues.

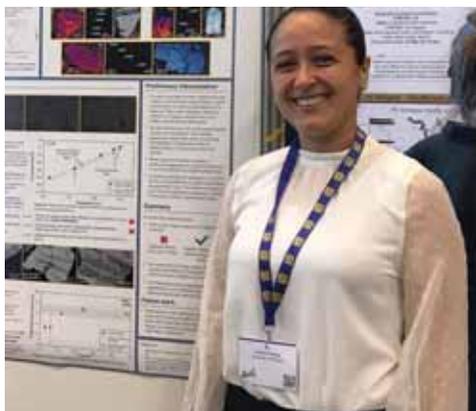
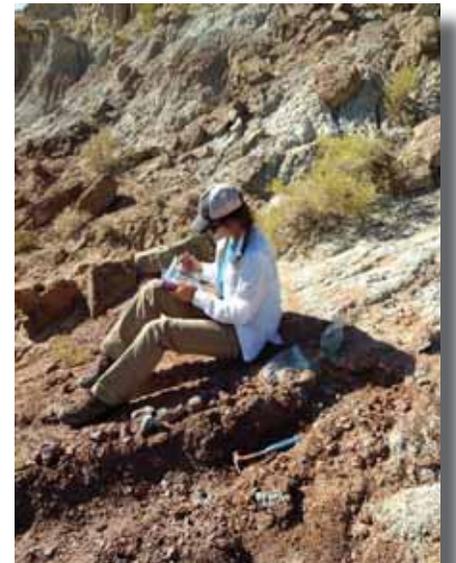
Heidi O'Hora (MS) is working in the Stable and Clumped Isotopes for Paleoclimate and Paleoceanography Lab to reconstruct climate surrounding the Cretaceous–Paleogene mass extinction with fossil shells from Southeast Netherlands. She aims to use her research as a natural CO₂ emissions experiment to determine how the whole globe responds climatically to increasing atmospheric CO₂ and to apply this information toward better understanding modern climate change and predicting future long-term consequences. Heidi hopes to travel to the Netherlands next Summer to collect more shell samples from the quarries and caves at which the Maastrichtian rocks and K–Pg boundary outcrop.

Wrapping up her first year at UM, **Sarah Katz (PhD Cand)** conducted field work at Lake Junín in central Peru this summer. Over the past year, Sarah has worked to characterize the isotopic composition of waters from the Junín Basin. She is particularly interested in understanding how triple oxygen isotopes ($\Delta 17O$) track local processes, such as evaporation, in the system. In addition to collecting water samples, Sarah also sampled modern lake carbonates for $\Delta 17O$ analysis during the field season. In the picture to the right, Sarah is preparing an Ekman grabber to collect recently deposited sediments at Lake Junin where she is sampling sedge mats ringing the exterior of the lake that was formed in glacial valleys carved into the eastern Andes (background).



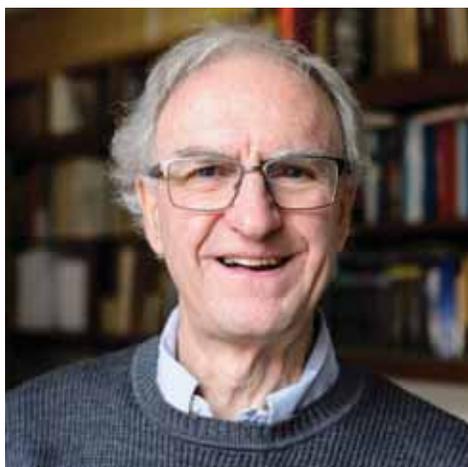
Jackie Wrage (PhD Cand) spent the summer in Hannover, Germany, performing high temperature/high pressure experiments with collaborators at the Institute für Mineralogie to study how sulfur partitions between phases in subduction zone magmas. I also got to go help teach at the Coastal, Ocean and Environment Summer School in Ghana (COESSING), where I got to experience a new culture, teach, and interact with the people of West Africa.

This summer, **Bekah Stein (PhD Cand)** got Wyoming bonus time while at Camp Davis to collect Early Eocene Climatic Optimum rocks from 50 million year old floodplains. As a part of a larger Green River Early Eocene Climatic Optimum project, Becca has been thinking a lot about the Wasatch and Bridger Formations and spent several days in June and September collecting fossilized soils (paleosols) and floodplain mudstones from outcrops near Rock Springs, Wyoming. One component of her field work included sampling a >2 kilometer transect of candy-striped Wasatch Formation paleosols to look at ecosystem-wide organic and bulk chemistry variability. She also took temporally high-resolution samples of Bridger Formation floodplain mudstones, leaf mats, lignites, and charcoaled wood for organic isotope analyses. It was a productive and adventurous field season and we ended the field excursions with backpacks filled with rocks. She is looking forward to the results of her chemical analyses on these rocks!



Juliana Mesa (PhD Candidate) is one of Professor Becky Lange's students. She's currently working on the Western Mexican Arc in Mexico and the Benton Range in California. She uses geochemistry and experimental petrology to understand anomalously Mg-rich olivine in intraplate basalts, plagioclase megacryst growth in basalts, and high-silica rhyolites segregation and ascent through the upper crust. Juliana was part of the Summer 2019 Sierra Nevada field trip organized by Professor Lange. This past Summer Juliana also attended the annual Goldschmidt conference, where she presented a poster on her research as well as a pop-up talk on Diversity, Equity and Inclusion in science.

JOHN W. VALLEY ELECTED TO NATIONAL ACADEMY OF SCIENCES



John Valley (PhD '81) was elected in 2019 to the National Academy of Sciences. Congratulations!!!!

ANNUAL AWARDS – 2019

Eugene and Elizabeth Singer Award for Academic Excellence in Geology: Kristen Hayden

Camp Davis Field Geologist Award:

Bianca Gallina
Lily Matlof

Alumni Undergraduate Award: Bianca Gallina

Undergraduate Academic Excellence Award:
Serena Scholz

Outstanding Graduate Student Instructor Award:

Mark Robbins
Margaret (Meg) Veitch

John Dorr Graduate Academic Achievement Award:

Brian Konecke
Ross Maquire
Spencer Washburn

GeoClub Best Professor: Greg Dick

Geoclub Best Graduate Instructor: Mark Robbins

Turner Award Proposal Gold Star Award:

Phoebe Arron
Rebecca Dzombak
Sharon Grim
Kirk Townsend

Turner Award Proposal Golden Nebula Award:

Natalie Packard

SUPER GENIUS



Andrea Dutton (MS 2000, PhD 2003) was among the 26 winners of this year's 'genius grants' awarded by the MacArthur Foundation in Chicago. She was recognized for her reconstructions of sea level using fossil corals, foraminifera and belemnites during past intervals of significant climate change. The award gives \$625,000 of 'no strings attached' funding to U.S.-based creative people in any field. Of the 26 winners only seven were scientists. Andrea received her PhD working with Professor Kacey Lohmann, making good use of the Stable Isotope Geochemistry Lab. Her Ann Arbor connections have led to collaborations with Kacey, Bruce Wilkinson and Sierra Petersen. After more than a decade as a faculty member at the University of Florida, Andrea is now enjoying a Fullbright Fellowship in New Zealand. Upon returning from her Fullbright, she will be taking a new position on the faculty of the Department of Geology and Geophysics at the University of Wisconsin - Madison.

Donna Jurdy (PhD 1974) has been elected Chair of GSA's Geophysics and Geodynamics Division.

Sarah Katz (PhD Cand) has won a GSA Kerry Kelts Student Research Award

Nathan Niemi (Prof) was elected as a fellow of the American Association for the Advancement of Science



Student group on Florida Spring Field Trip returned back to shore after examination of sediments and fauna in Florida Bay.
Photo by Peter Knoop

Scholarships and Fellowships 2019

Camp Davis Scholarships

Richard F. Sidder Fund Scholarship: I. Stiver

Jillian Drow Memorial Endowed Scholarship: P. Dotson

Kornfield Family Camp Davis Scholarship: K. Hildwein, H. Kalis, J. Mati, R. Mount, S. Theuer, O. Thomas

Judith H. Turneaure Memorial Scholarship: H. Troup, C. Turner, S. Wais, A. Wright-Johnson, J. Zion

Shell Camp Davis Scholarship: B. Anruzzi, A. Balogh, A. Bascom, E. Boswell, a. Caroen, E. Chinchak, E. Cox, Z. Engle, M. Frank, G. Gowman, R. Harley, b. Heintzelman, S. Hoffman, S. Kinnison, B. Klingel, W. Kominars, K. Koshurba, L. Kuzee, N. Laframboise, V. Markel, L. Marr, C. May, a. McGuffie, E. Michaelson, N. Mooney, I. Obuchowski, H. Pantaleo, S. erton, L. Pinkham, Z. Plonka, L. Potter, R. Prchlik, M. Rader, S. Robinson, C. Seguin



Graduate Fellowships

Alumni Earth and Environmental Sciences Fellowship: J. Andrews, M. Cook, F. Hardy, M. Liu, K. Matsunaga, M. Page, D. Pandey, A. Pease, M. Rodriguez, Y., Si, C. Yancy

Reynolds M. Denning Memorial Fellowship: B. Konecke, Y. Si

Joseph and Anna Drobek Scholarship: J. Andrews, B. Wang

William Herbert Hobbs Fellowship: D. Pandey, M. Robbins

Russell C. Hussey Scholarship: R. Dzombak, F. Hardy, M. Veitch

Earnest A. Novak Scholarship: G. Han, A. Thompson, C. Yancey

NSF: Broadening Pathways: E. Pillar, P. Rubio, J. Vails, J. Wadley

Henry N. Pollack Endowed Graduate Fellowship in Geological Sciences: P. Aron, M. Cook

Shell Oil Company US Fellowship: X. Du, S. Kim, Y. Wang

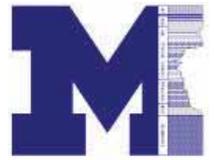
Chester B. Slawson Memorial Scholarship: W. Bender, N. La Cruz, A. Pease, M. Rodriguez

Judith H. Turneaure Memorial Scholarship: N. Packard

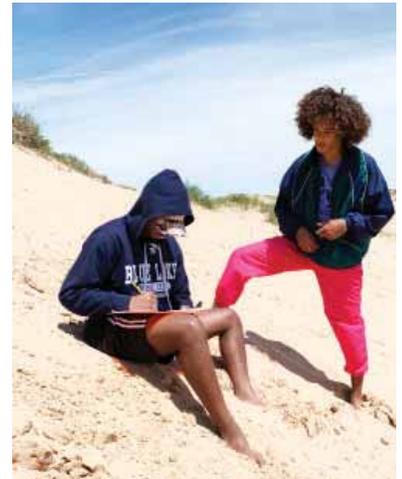
Stewart R. Wallace Fellowship: M. Page, Z. Quirk



EARTH CAMP - 2019



Left: *EARTH CAMP Students on the coast of Lake Michigan.*



Right: *Idrees Schieber, a transfer student to U-M from MSU and sophomore Earth and environmental science major, worked with Earth Camp as an instructor this year.*

Earth Camp, our department's high-school outreach program that aims to attract top high school students from underrepresented populations to the geosciences, has expanded to now include an Earth Scholars component for Earth Camp alumni attending the University of Michigan. This fall we welcomed our second cohort of Earth Scholars to UM for a total of eight Earth Camp alumni now at U-M. We are thrilled to have them here and with the overall success of the program. It is exciting new territory for our outreach efforts to have a number of Earth Camp alumni at UM. There were a number of highlights this past year:

Earth Camp ran two, week-long experiences this summer – one for rising 10th graders in Ann Arbor and Sleeping Bear Dunes, and the other for rising 11th graders on a geology field trip to Mackinac Island and various Upper Peninsula locations. For the first time, we had two Earth Camp alumni (who are now U-M sophomores) return to Earth Camp as instructors. This has been a long-term goal of the Earth Camp program and it was exciting to see Idrees and Erica come “full-circle” with the Earth Camp program. Next summer we plan to have Earth Camp at full capacity – this involves three different week-long experiences. The group who travelled to the UP this summer will travel to Grand Teton and Yellowstone National Parks, the group who travelled to Sleeping Bear Dunes will head north to the UP, and we plan to bring in a new cohort of rising 10th grade students.

There are now eight Earth Camp alumni at U-M (5 sophomores and 3 freshmen), one of whom is a transfer student from MSU majoring in our department. We recognize the value of transfer students, and we are excited to have recruited an Earth Camp alumna to major in earth science. Increasing the number of transfer students is another long-term goal of the Earth Camp program and we plan to continue to focus on this pathway into our department. Our eight Earth Scholars are thriving at U-M. Three are majoring in Earth and environmental sciences, four are majoring in another STEM field, and one is a public policy major with an Earth and environmental science minor. Three are currently working in labs in our department and two more are planning to start in January. Laboratory experiences are an important component in the pipeline to recruit and retain the best students and a great way to engage students in our department.

Lastly, we were accompanied on our Upper Peninsula trip by videographers and photographers from Michigan Creative, a marketing agency. Earth Camp is featured in one of the “This is Michigan” videos funded by The University of Michigan. Please check it out online: <https://impact.govrel.umich.edu/earth-camp/>

Earth Camp continues to be offered at no cost to participants and our successful summer crowdfunding campaign raised over \$11,000 to help fund this important program. Thank you to everyone who donated. We are actively seeking support for future Earth Camps to keep this pathway into the geosciences open. If you, or your organization are interested in sponsoring an Earth Camp student, please contact jennamun@umich.edu.

If you would like to help support the future of EARTH CAMP, please give to the Departmental Fund: Student Outreach Programs #325538



Society of Economic Geologists Student Chapter

Jackie Wrage (PhD Cand) and members of the SEG student chapter had a busy fall inviting, organizing and hosting two speakers to campus for multi-day career events for undergraduate and graduate students, and taking a field trip to Michigan's Upper Peninsula where they toured the Eagle Cu-Ni mine near Marquette and spent time with AAB member Dan Wiitala learning about the work that his environmental science and engineering company North Jackson Company does. Their underground tour of Eagle mine included meetings with geologists from around the area in consulting, exploration, and ore processing careers. Bob Mahin, the industry sponsor of our SEG student chapter, hosted the students at a meeting of the Society for Secondary Enrichment, and took the students on a tour of local geology including 2.7 Ga pillow basalts, the Black Rocks area of Presque Isle, and the world-famous outcrop of 1.8 Ga banded iron formation of the Nagaunee Formation on Jasper Knob in Ishpeming, Michigan.



In September, Jackie Wrage organized and hosted Bob Mahin, exploration manager at the Eagle Cu-Ni mine in Marquette, MI and a Fellow of the Society of Economic Geologists, for a two-day career networking event with undergraduate and graduate students. Bob discussed the importance of resume writing, interview preparation, cover letters, networking, and the variety of environmental, geology and regulatory jobs in the mining industry.

In November, Jackie Wrage hosted Dr. Edith Wilson who visited our department for two days of career sessions focused on opportunities for geoscientists in renewable energy. Dr. Wilson spent over 30 years in the oil and gas industry and switched gears to renewable energy after founding Rock Whisperer, LLC in Tulsa, OK, in 2011. She hosted undergraduate- and

graduate-focused career sessions, a workshop, a resume review period, and met with students for 1-on-1 and small group meetings. Over 20 undergraduate and graduate students got personalized insight into the types of careers available for energy geoscientists, how to transfer more traditional skills to the renewable energy sector, and how to market themselves to both large and small companies.

Generous Supporters of the Department 2019

The Department would like to acknowledge the generous corporate, foundation, and individual gifts it has received over the last year (July 1, 2018– June 30, 2019). These gifts are invaluable in supporting our graduate and undergraduate programs, our education and outreach efforts, and for attracting and retaining the highest quality faculty and staff. To all those that have given -- **Victors for Michigan --THANK YOU AND GO BLUE!**

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Another wonderful response from our alumni, students and faculty on Michigan's Giving Blue Day. You all helped support the Department to keep it strong and sustainable.

This year for Camp Davis we had 41 donors who provided a whopping \$36,365 plus \$1,115 University Leadership Prize. *Special thanks to the anonymous donor who gave \$30,000.*

The Earth Strategic and other funds had 75 donors providing \$20,471 plus \$1,025 University Leadership Prize.

YOU HELPED US BECOME WINNERS AGAIN. THANK YOU!!!



GEOLOGY OF MICHIGAN: NEW COURSE OFFERING AT THE *BIOLOGICAL STATION* BY MICHELA ARNABOLDI

This summer semester, from the end of June to mid-August, Michela Arnaboldi with the help of Ashley Hamersma, offered Geology of Michigan as a field-class at the University of Michigan Biological Station, in Pellston, Michigan. Students had the opportunity to explore the traditional subjects covered in Intro Geology both in the classroom and in natural settings around Northern Michigan.

Over the course of 8 weeks, we explored rivers, sand dunes, rock outcrops, waterfalls, beaches, forests, soils, alvar, groundwater, lakes, moraines, and hunted for erratics, pebbles, and fossils. We traveled all over the Northern Lower Peninsula and the Upper Peninsula from Alpena, Petoskey, and Charlevoix all the way to Drummond Island, Narnia, Munising, and Marquette.

Through our daily trips, we deepened our understanding of the long and complex geological history of our state and were able to make connections between the geology of the area and the biology and ecology of Northern Michigan.

Students completed a research project that was presented at the UMBS Research Student Symposium, participated in the first UMBS GeoBioBlitz, and learned the basics of rock and mineral identification by compiling a rock collection which culminated into a 'Best Rock Competition' voted on by the whole UMBS community.

As an added bonus, artist in residence Cathy VanVoorhis, a lecturer in Stamps at U-M, gave us weekly watercolor lessons and taught us to draw and color rocks.

These amazing students embraced life at the station while learning geology. By the end of the semester we had all become avid rock/mineral/fossil collectors and could barely wait to see what other wonderful treasure the Great Lakes, especially Lake Superior, would reveal to us that day.

On a personal note, I can attest to the fact that you'll never stop hearing Bruce's booming voice in your head in front on any outcrop or rock: "Lick the rock!"

Recipients of Earth and Environmental Science Undergraduate Degrees Academic Year 2019

BACHELOR OF SCIENCE HONORS THESES

Emily Boswell

Mid-Pliocene Paleotemperature Reconstruction: Evaluation of the Sclerochronologic Isotopic Record of Molluscan Bivalves from the Pinecrest Beds of the Tamiami Formation, FL and the Yorktown Formation, VA.

Zachary Brodkey

Using sulfur in apatite to determine the pre-degassed oxygen fugacity of the 1991 Mount Pinatubo Eruption, the 1982 El Chichón Eruption, and the 28 Ma Huerto Andesite of the San Juan Volcanic Field.

Sara Leon

Mercury Contamination of Channel Bed Sediment in the South River, VA

Sally Ruan

The oxygen and hydrogen isotope evolution of snow, firn, and ice throughout a melt season on Wolverine Glacier, AK

MAJORS

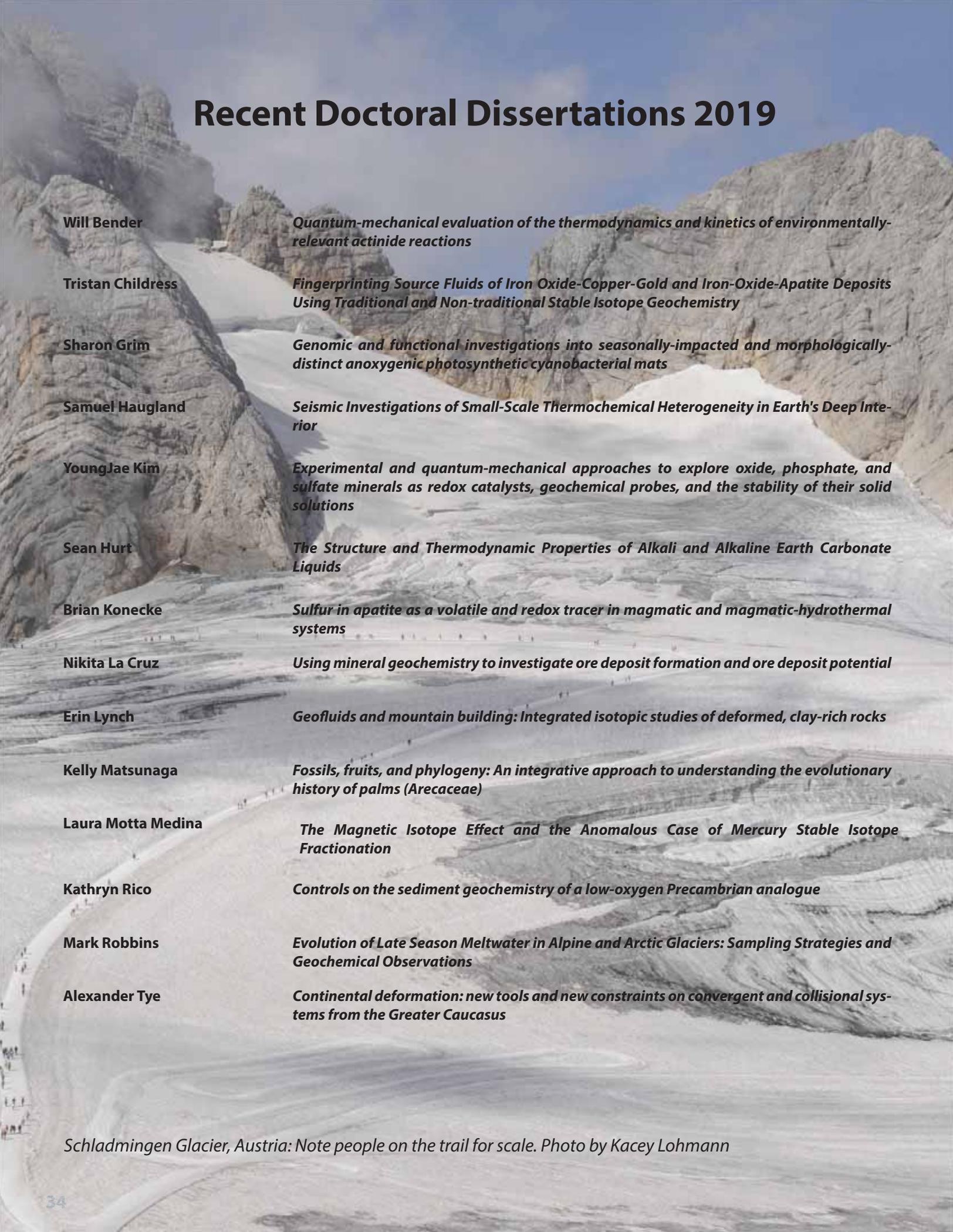
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Brennan Booker
Emily Boswell
Zachary Brodkey
Emily Cox
August Danz
Ian Donnelly
Elizabeth Drippe
Thomas Flynn
Bianca Gallina
Kelsey Golembieski
Trevor Goodrum
Ashley Hamersma
Bradley Heintzelman
Keith Hildwein
Ryan Horwitz
Jamie Lackner
Ari Lew
Sophie Lin
Kajsa Lundeen
Ariana Mann
Elizabeth Michaelson
Logan Murphy
Elliot Nichols
Sirawich Pipatprathanporn
Zoey Plonka
Rose Popma
Alec Reznich
Sally Ruan

Kendall Schissler
Serena Scholz
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Cassandra Jordan
Stacy Kaneko
Emma Kaznowski
Kajsa Lundeen
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Renee Soulliere
Samantha Theuer
Lydia Whitbeck
Heather Young
Danielle Ziaja

Recent Doctoral Dissertations 2019

- 
- Will Bender** *Quantum-mechanical evaluation of the thermodynamics and kinetics of environmentally-relevant actinide reactions*
- Tristan Childress** *Fingerprinting Source Fluids of Iron Oxide-Copper-Gold and Iron-Oxide-Apatite Deposits Using Traditional and Non-traditional Stable Isotope Geochemistry*
- Sharon Grim** *Genomic and functional investigations into seasonally-impacted and morphologically-distinct anoxygenic photosynthetic cyanobacterial mats*
- Samuel Haugland** *Seismic Investigations of Small-Scale Thermochemical Heterogeneity in Earth's Deep Interior*
- YoungJae Kim** *Experimental and quantum-mechanical approaches to explore oxide, phosphate, and sulfate minerals as redox catalysts, geochemical probes, and the stability of their solid solutions*
- Sean Hurt** *The Structure and Thermodynamic Properties of Alkali and Alkaline Earth Carbonate Liquids*
- Brian Konecke** *Sulfur in apatite as a volatile and redox tracer in magmatic and magmatic-hydrothermal systems*
- Nikita La Cruz** *Using mineral geochemistry to investigate ore deposit formation and ore deposit potential*
- Erin Lynch** *Geofluids and mountain building: Integrated isotopic studies of deformed, clay-rich rocks*
- Kelly Matsunaga** *Fossils, fruits, and phylogeny: An integrative approach to understanding the evolutionary history of palms (Arecaceae)*
- Laura Motta Medina** *The Magnetic Isotope Effect and the Anomalous Case of Mercury Stable Isotope Fractionation*
- Kathryn Rico** *Controls on the sediment geochemistry of a low-oxygen Precambrian analogue*
- Mark Robbins** *Evolution of Late Season Meltwater in Alpine and Arctic Glaciers: Sampling Strategies and Geochemical Observations*
- Alexander Tye** *Continental deformation: new tools and new constraints on convergent and collisional systems from the Greater Caucasus*

Schladmingen Glacier, Austria: Note people on the trail for scale. Photo by Kacey Lohmann



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