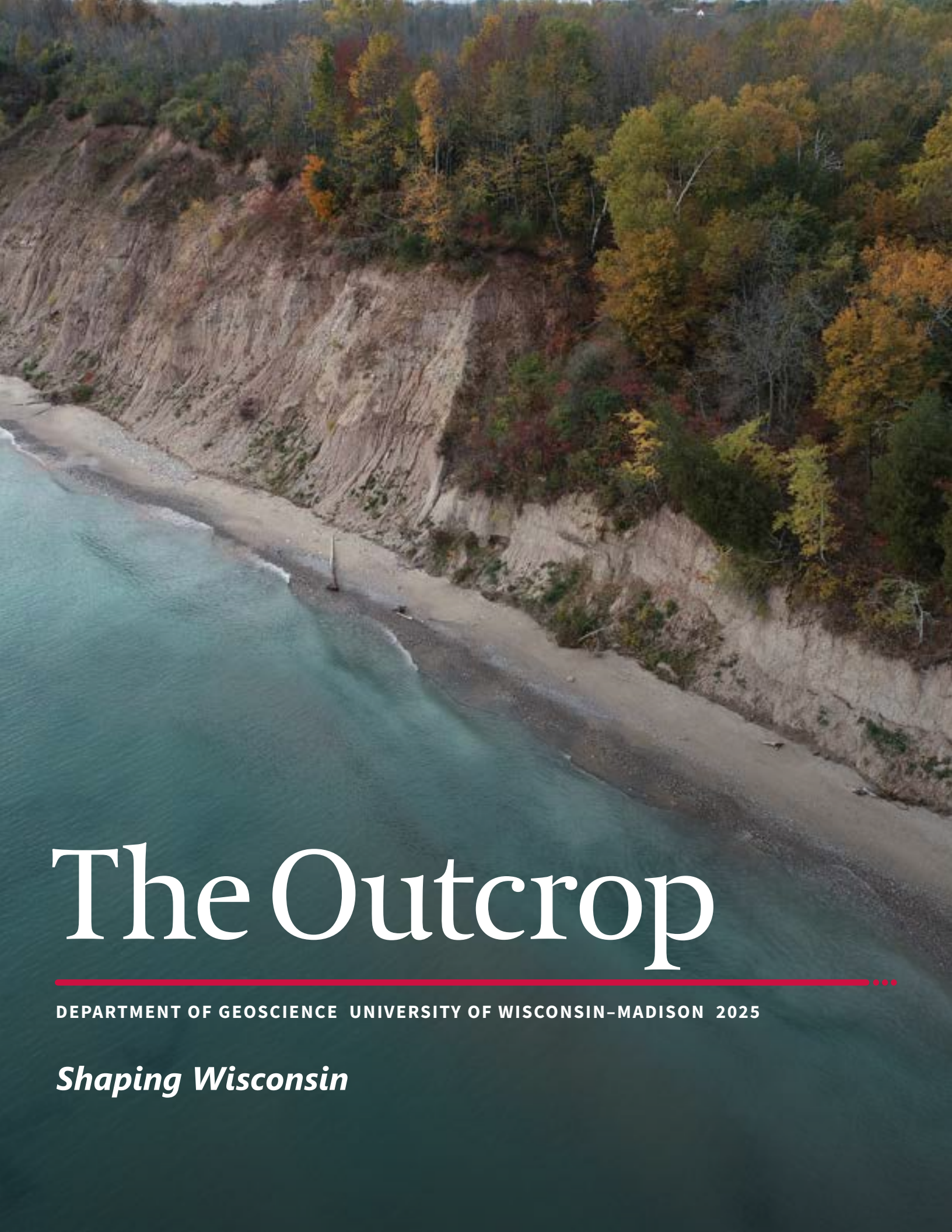

The Outcrop

DEPARTMENT OF GEOSCIENCE UNIVERSITY OF WISCONSIN–MADISON 2025

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Prof. Annie Bauer and a group of students pause during a traverse on the 2025 White Lake field course. From left to right: Annie Bauer, Ana Sotelo, Dylan Nolte, Izzy Oebser, Sophie Lee, Brooke Rodriguez, Ashley Therrien, Mariel Hood.

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Also, we'd like to hear from you! Send professional and personal updates, feedback, news, and photos for next year's *Outcrop* (will be published in the fall) to: **alumni-update@geology.wisc.edu**

To be added to the department alumni news email list, please subscribe by sending an email to: **join-geoscience-announcements@lists.wisc.edu.**

Check out *The Outcrop* on the web: geoscience.wisc.edu/geoscience/alumni-friends/outcrop

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Greetings from Madison and the Department of Geoscience!

Greetings from Weeks Hall, world Geo-Badger headquarters, where the leaves are finally beginning to change color and Fall semester classes are in full swing! As always, it's my pleasure to deliver the 2025 edition of The Outcrop, sharing the latest from our talented faculty, staff, graduate students, and undergraduate students.

If you've been paying attention to recent developments in our department, you know that Wisconsin is a renewed powerhouse in ice- and glacier-related research. Whether it be **Brad Singer**'s studies on how ice sheets impact stresses on volcanoes, **Chloë Bonamici**'s IceHaus instrumentation for studying ice fabric and structure, **Shaun Marcott**'s work to constrain glacier extents over geologic time, or **Marianne Haseloff**'s modeling of ice sheets, the mineral form of H_2O is on the minds of many of our faculty. This year, our cover story (p. 22-29) highlights the multifaceted research of **Luke Zoet** with ice yet again as a central theme. From unraveling the chronology of glacial advances, to understanding the geomorphic processes that create glacial landforms, to looking at the impact of modern coastal ice on shoreline communities, I hope you enjoy learning about the range of research carried out by Luke and his many collaborators!

The Geology Museum also deserves a special shout-out this year (p. 40-41) for the tremendous work done by its small staff of four: **Rich Slaughter**, **Brooke Norsted**, **Carrie Eaton**, and **Dave Lovelace**. I'm told that this year we can expect 65,000 visitors to the museum, making it one of the most visited attractions on campus! If you're planning a future trip to campus, make sure to stop by and see the newest exhibits including the large Vienna Meteorite, a 100+ pound behemoth and the largest iron meteorite found in the U.S. over the past 40 years.

This Fall and with a year of chairship under my belt, I can now see why the saying "change is the only constant in life" (Heraclitus, 500 BCE) has such staying power. Fresh-faced new graduate students arrive with the season, as our learned MS and PhD graduates defend their hard work and advance to the next adventure in their career. Weeks Hall continues to be updated and reconfigured, including three new high-tech teaching spaces on the third floor. Our library space will be evolving to support future research, teaching, and learning as its collections are moved to a new home. And I'm sure I've earned a few new gray hairs tracking the changes in federal funding! But I can rest easier knowing that our department can rise and change to meet the moment.

Lastly, it's no secret that higher education and the research enterprise are facing challenging times, which is why we continue to be so grateful for the generous support of our alumni. As you peruse this edition of The Outcrop, I hope you'll spend some time lingering on the "Gifts at Work" section (p. 10-13) and reading about the many undergraduates and graduate students whose studies received awards and support from our gift funds. Whether it's airfare to attend conferences and field camps, a semester's research assistantship, or scholarship funds that allow them to analyze "just one more sample", the impact of this support is felt every day in Weeks Hall. You can certainly see it in the smiling faces from the field.

Best wishes, and On Wisconsin!

Michael Cardiff
Professor and Department Chair

VOLCANOES AND GLACIERS WITH OUR GEOBADGERS

In January, BoV members Mike Porter and Steve Walter traveled with Professors Brad Singer and Eva Golos as they led a stellar group of graduate students through the land of volcanoes and glaciers in southern Chile. Our PhD candidate Pablo Moreno-Yaeger served as local guide, historian and volcano expert. The spine of the Andes provided an unforgettable backdrop as the field crew addressed diverse research topics such as subduction-related magmatic trends, seismology, deglaciation of the Patagonian Ice Sheet, and geo-hazards. And yes, the rumors are true that Mike was always the last one up the mountain and the last down, but at least he could drive a field vehicle with a manual transmission.

Members of the Board of Visitors standing outside Weeks Hall.
Front row: Marjorie Chan, Bill Morgan, Liz Dennett, Mike Cardiff, Sue Cluff, Erik Webb, Sharon McMullen
Back row: Mike Ursin, Joe Kington, Steve Walter, Mike Porter, Jody Wycech, Lanie Hart, Allie Macho

BOV MEMBERSHIP

Significant work by the BoV membership committee, led by Erik Webb, focused on a generational refresh of the candidate list for new BoV members. The Board solicited and recruited five alumni: Laney Hart, Joe Kington, Allie Macho, Sharon McMullen and Jody Wycech to serve initial 4-year terms on the BoV. Our new members have diverse backgrounds in industry, academia and public service, and they provide valuable expertise in career experience for our graduating students. An outreach committee has been formed to explore ways of supporting our students and advising the Department on current trends in the geosciences.

DISTINGUISHED ALUMNI

The Distinguished Alumni Award is presented during the Fall Banquet to recognize outstanding careers and associated contributions by our past graduates. Bill Morgan and his sub-committee headed up a solicitation effort to identify new potential awardees and the vetting process with the Department for award consideration.

As always, the Board of Visitors looks for opportunities in supporting the Department in its mission, in fostering connections amongst current and past Alumni, and representing the best in UW-Madison geoscience. Please do not hesitate to reach out to us should you have suggestions or comments.

On Wisconsin!

Mike Porter, BoV Chair
(mporterrcole@gmail.com)

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Weeks Hall 50th Anniversary Celebration and Alumni Reunion

Mike Porter

In October 2024, we celebrated the 50th anniversary of the construction of Weeks Hall with a busy alumni reunion. Board of Visitors members Mike Ursin and Steve Walter skillfully kept the Reunion Planning Committee on task in the months leading up to the big event and served as editor-in-chief of a 120-page commemorative volume marking the 50th Anniversary of the Department in Weeks Hall. Current and past Weeks Hall residents reconnected through field trips, building tours, student posters and an evening banquet held at the Pyle Center. Photo memory books of the multi-day event were sent to Lewis Weeks' children in appreciation of their family's generous support of our Department. We hope to see you all at the next reunion!

BoV member Liz Dennett presents to the many GeoBadgers who attended the 50th Anniversary celebration for Weeks Hall.

Professor Luke Zoet discusses local geology with past and present GeoBadgers in a field in rural Wisconsin.

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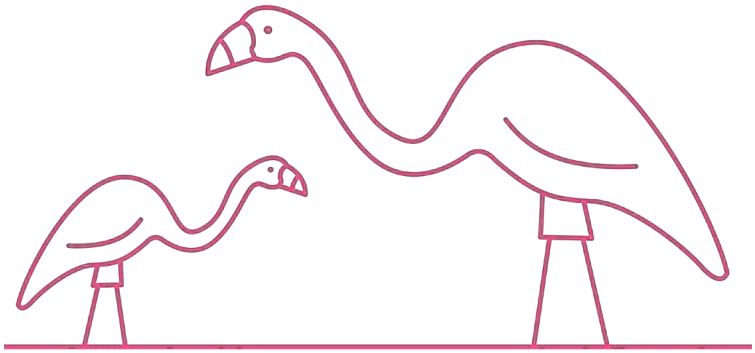
DAY OF THE BADGER

FILL THE HILL



Opportunities to engage in research provides students with valuable hands-on experience, helps them develop critical thinking and problem-solving skills, and enhances their competitiveness for graduate school and future careers. It also allows students to explore their interests, build relationships with faculty and graduate students, and refine their career goals.

Our fundraising goal this year is to endow and grow the Mark Rosin Undergraduate Research Fund to provide dedicated funding to support undergraduate research. Mark was a Wisconsin native who earned his BS at UW and went on to UCLA for his graduate degree. He then spent his professional career at ExxonMobil. He loved being in the field and teaching others about geology. Mark's experience in the department was formative and early research experiences helped shape his love of geology and sparked his career path in geoscience. For this reason, Mark's community has created a fund to provide those types of experiences for future generations of undergraduate geoscientists.

The word is out on campus about the loyalty and generosity of GeoBadgers across the country, and other colleges and departments have challenged our place at the top of the leaderboard during Fill the Hill and Day of the Badger. The department remains committed to providing Weeks denizens with exceptional opportunities in the classroom, in the field, and in the lab. These opportunities are only made possible through your support. Thank you for all you do!

The UW-Madison Deaprtment of Geoscience, 2025

DISCOVERY

Earth's First Billion Years

John Valley, Emeritus Professor of Geoscience and **Annie Bauer,** Assistant Professor of Geoscience

The Hadean (>4.0 Ga), sometimes called Earth's Dark Age, is the least understood eon, but has been proposed to encompass the first continental crust, oceans, subduction and life on Earth. Each of these theories is contentious (these features are often assumed to emerge later) because there are no known Hadean rocks. Therefore, to evaluate conditions on the Hadean Earth and to reconcile these controversies, we rely predominantly on detrital zircons and the geochemical signatures locked within them. Zircons as old as 4.4 Ga have been studied at UW by John Valley and colleagues for 25 years. Recently, Annie Bauer and Tyler Blum were funded by the National Science Foundation and joined with Valley (funded by the European Research Council) to compare the Hadean and early Archean magmatic records. We are investigating if tectonic transitions can be identified, and how to compare Hadean detrital zircon records with zircons from early Archean magmatic provinces with intact rocks.

Several papers have reported our recent progress. Emma Cameron (UW MS 2017; Cameron et al., 2024) reported new oxygen isotope data for Hadean zircons that validate our tests to identify unaltered grains. She shows that conclusions of some competing studies are based on altered and unreliable samples. One (now debunked) proposal was that zircon oxygen isotopes from the Jack Hills (W. Australia), which provides the best evidence for Hadean oceans, actually resulted from Cenozoic weathering. Care in sample selection using tests reviewed by Cameron is fundamental for all ancient zircon studies. Emily Mixon (PhD 2024 with Bauer; Mixon et al., 2023, 2024) examined Archean zircons in granitoids from the Acasta Gneiss Complex (Slave Craton) and the Saglek-Hebron Complex (N. Labrador). A major advance of Emily's work is the recognition that different tectonic settings—specifically stagnant-lid and mobile-lid regimes—coexisted in the early Archean.

Most recently, Valley et al. (in review) report trace-element compositions of 4.4 to 3.2 Ga detrital zircons from the Jack Hills, including Nb and Sc, which have isobaric interferences with Zr species and hadn't been previously analyzed at WiscSIMS. Accurate data were facilitated by new protocols developed by Blum and Kouki Kitajima (Blum et al., 2023). Ratios of U/Nb and Sc/Yb are higher in zircons from rocks formed in continental-subduction settings than from relatively dry mantle settings. Over 70% of the oldest Jack Hills

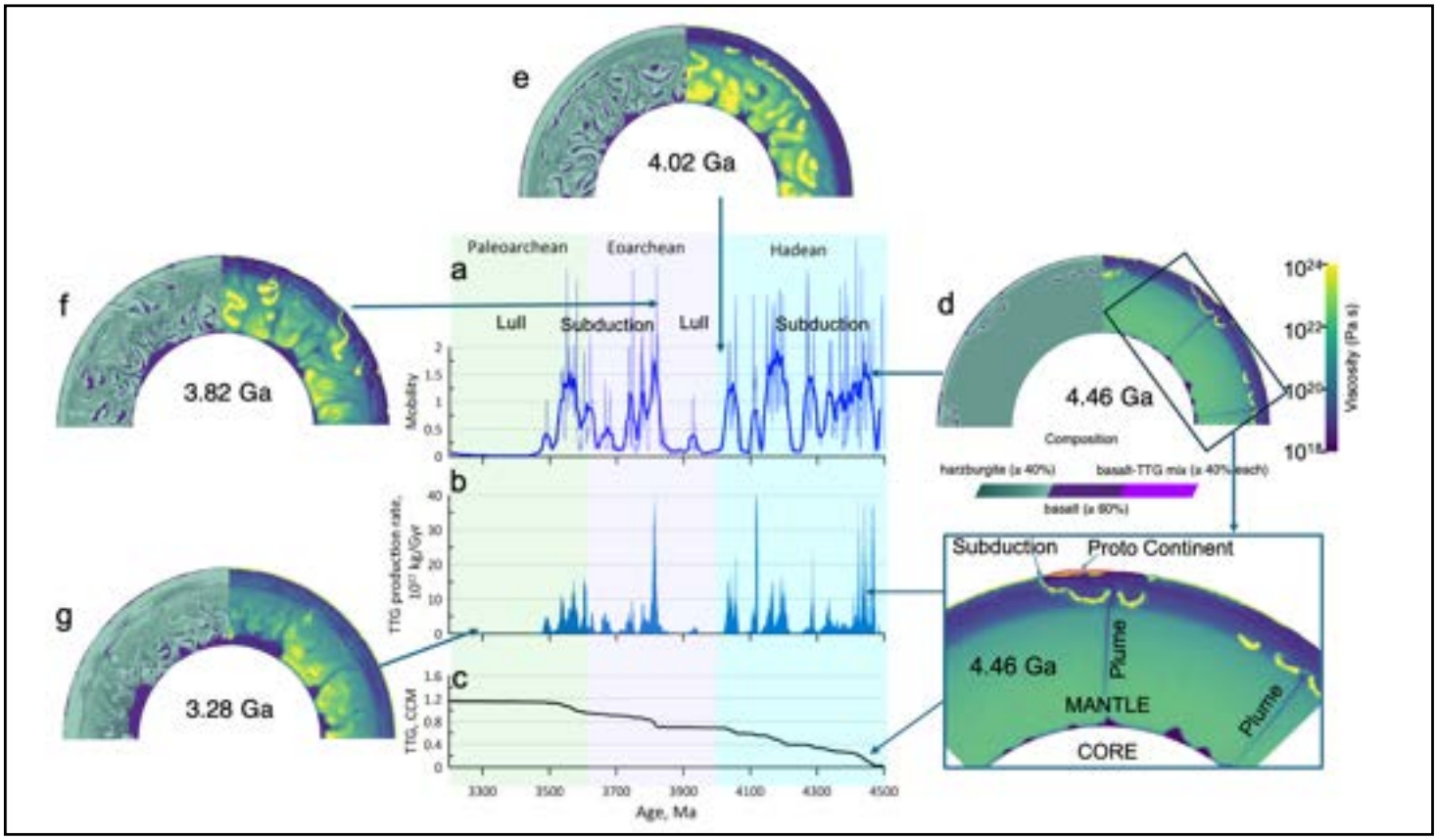


Figure 1. *Geodynamic model of early Earth evolution over time showing **a:** mobility (ratio of surface velocity and velocity of the mantle); **b:** the generation of granitic continental crust (TTG); and snapshots of Earth's cross-section (quadrants represent composition, left, and viscosity, right). Color scales for each field are shown in **d**. Figures **d** and **f** show periods of active subduction, while **e** and **g** show lulls in subduction activity where large mantle plumes are trapped beneath cold recycled material. The magnified inset from **d** shows subduction beneath a proto-continent in the Early Hadean. Modified from Vezinet et al., 2025.*

zircons studied (4.4-3.8 Ga) have elevated U/Nb and Sc/Yb consistent with modern subduction signatures. These results indicate that subduction was common in the Hadean. New geodynamic modelling by our European colleagues (Vezinet et al., 2025) shows that subduction (inclined sinking) of hydrous surface rocks is possible as early as 4.4 Ga, providing a mechanism for melting of early mafic crust to form zircon-bearing granitoids.

We are currently working on new exciting projects, so please stay tuned for updates! John is leading projects evaluating melt inclusions in Hadean zircons to determine the water content of magma and more accurate trace element partition coefficients (zircon vs. melt) to determine compositions of the (now eroded) Hadean igneous rocks. PhD student Rowan Gregoire (Figure 2) is devising projects to integrate isotope (U-Pb, Hf, O) and trace-element data for detrital and igneous zircon records. These studies will provide a stronger framework for assessing if the application of the empirical modern zircon trace element proxies are extendable back billions of years in Earth history.

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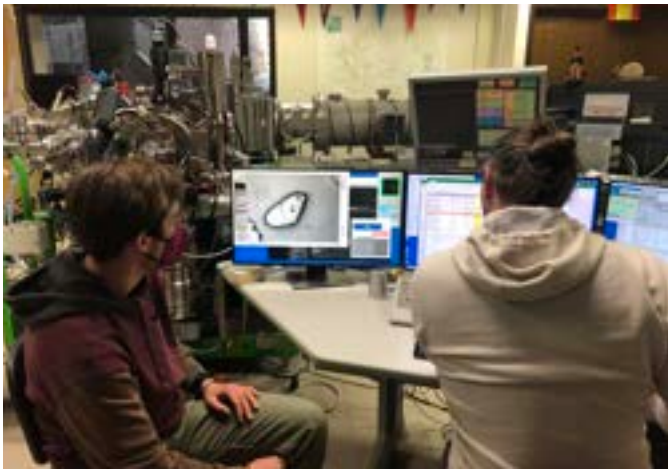

Figure 2. *The WiscSIMS Lab in Geosciences at UW. Rowan Gregoire (left) and Tyler Blum (right) analyzing a Hadean detrital zircon from the Jack Hills (shown on screen with three 10-micron analysis pits).*

DISCOVERY

Iron's surprising role in the origins of complex life

Zachary Adam, Scientist III, with **Betül Kaçar, Annie Bauer, Esther Stewart, Eric Roden,** and **Shanan Peters**

Our planet is teeming with complex life. Trees, animals, insects and mushrooms are all eukaryotes, and they all descended with modification from a single common ancestor that lived over a billion years ago. Eukaryotes emerged from the union of two microbes, a host archaeon and a symbiont bacterium that became the mitochondrion (the powerhouse of the cell). As far as we can tell, this kind of microbial union is very rare, and so the origins of complex life are one of the biggest mysteries of our planet. Oxygen has long been a hypothesized driver of eukaryote emergence, owing to the mitochondrion's central metabolic task of aerobic respiration. However, when you

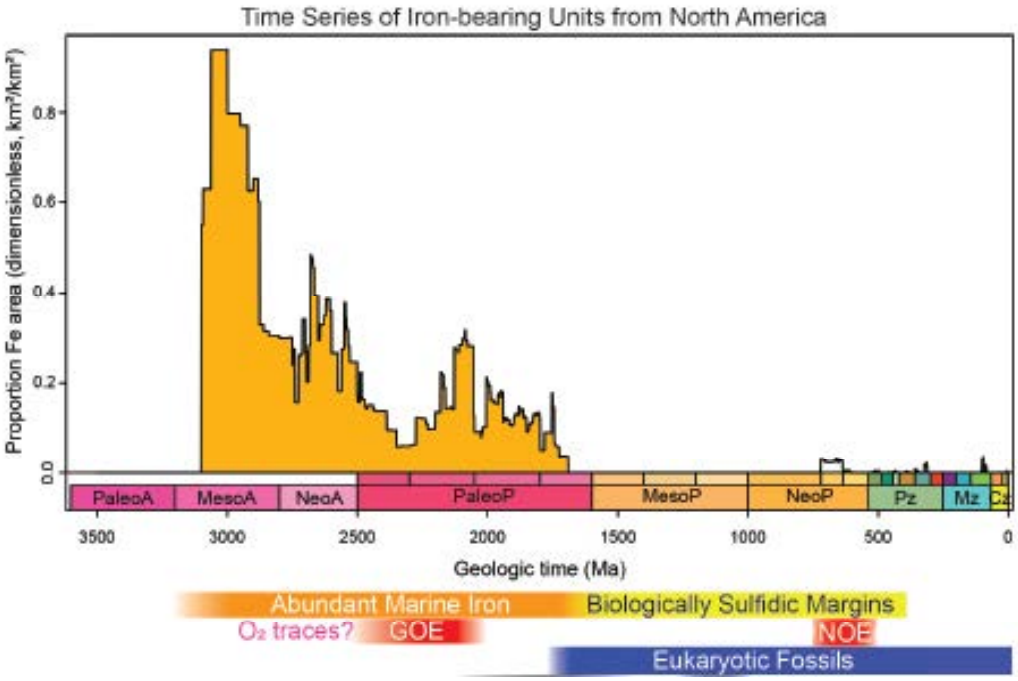

Figure 1. *Frequency of iron-rich sediments over time (orange), relative to all preserved sediments, and plotted in relation to oxygen events (red bars) and the appearance of eukaryotic microfossils (blue bar). Raw data for iron-rich sediments available at macrostrat.org.*

look at the rock record, there is a span of several hundred million years between the earliest geochemical evidence for oxygen in the environment (~3.2-2.5 Ga; Figure 1) and the oldest widely accepted eukaryotic fossils (~1.7 billion years ago; Figure 1, blue bar).

Our group (along with Kurt Konhauser at the University of Alberta and Sarah Slotznick at Dartmouth College) took another look at this gap to see if there were any other geochemical compounds that could have affected the origins of eukaryotes. Using the Macrostrat database built by Prof. Shanan Peters, we integrated a comprehensive inventory of sedimentary rocks and their lithology with the microbial biochemistry of iron to examine potential environmental constraints on early eukaryotic evolution. Notably, the oldest eukaryote fossils appear at the same time that iron-rich sediments (Figure 1, orange curves) stopped being deposited on the continental shelves of North America, 1.7 billion years ago. It's long been known that iron was deposited for billions of years, which created the 'iron formation' rocks mined in northern Wisconsin and the upper peninsula of Michigan. But iron has never been implicated as a fundamental inhibitor of early eukaryote evolution. It was generally assumed that dissolved iron was a relatively benign component of seawater that did not impact microbial ecology. Our analysis pointed out that the same environments likely to have supported microbial productivity (shallow shelf environments with lots of sunlight and nutrients from continental runoff) were also being inundated with dissolved and precipitated iron for well over a billion years. At the same time that this iron went away, eukaryotes spread worldwide.

We found that iron exerts complex and often antagonistic effects on aerobic and anaerobic microbial lineages alike (Figure 2). This means that both archaeal and bacterial progenitors to eukaryotes living in shallow water environments would have been affected. Elevated iron levels disrupt cellular homeostasis by destabilizing labile iron pools and promoting oxidative damage to bacterial lipids. Eukaryotes even have a specialized program for dying in response to overabundant iron called ferroptosis, which is widespread across diverse eukaryotic lineages. Few eukaryotic cells ever face iron at levels that would trigger this specialized form of programmed cell death, so it is unlikely to have evolved across so many different organisms by chance. Instead, ferroptosis may trace its origins to iron-rich conditions in Archaean and Paleoproterozoic seawater.

Our team's findings reframe the long-recognized temporal gap between atmospheric oxygen and the earliest eukaryotes as a consequence of iron toxicity, rather than oxygen limitation. The insight is timely. While recent breakthroughs (such as newly cultured Asgard archaea, and eukaryote and mitochondrial phylogenetics) have illuminated the genetic and physiological base of eukaryotes, all have lacked a unifying paleoenvironmental context. Our work provides that missing framework, situating molecular machinery with transformative shifts in Earth's biogeochemical evolution. At the same time, as international efforts accelerate to design the next generation of telescopes for life detection, understanding what stymies complex life is as crucial as knowing what enables it. Iron, abundant and spectroscopically active, may serve as a critical contraindicator of complex life—a potential life-relevant signal that could inform the design and interpretation of future remote sensing data collection for decades to come.

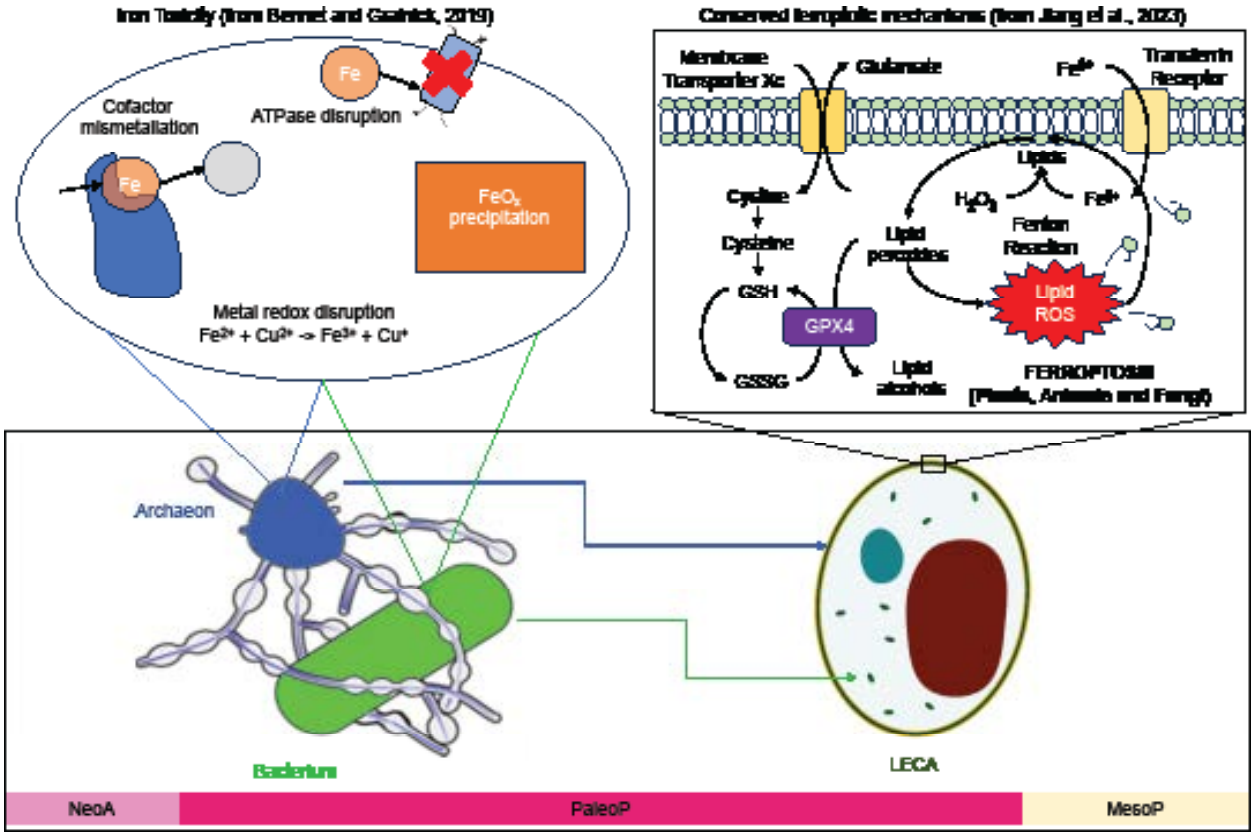

Figure 2. *An overview of disruptive effects of iron throughout endosymbiosis, from ecological associations and biochemistries of archaea and bacteria to LECA. From Adam et al., in review.*





DEPARTMENT OF GEOSCIENCE STUDENT AWARDS

UNDERGRADUATE STUDENTS

Mack C. Lake Outstanding Undergraduate Award
Mara Corum

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Distinguished Undergraduate Award
Jillian Prescott

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Outstanding Sophomore Award
Alana Ringen

• • •

Field Camp Scholarship
Ashley Marie Therrien
Colin William Farrell
Alyssa Hellrung
Molly Egan

• • •

Eugene Cameron Scholarship
Ana Sotelo
William Noguera

• • •

The Laurence Dexter Environmental Scholarship
Callie Karsten

Carl & Val Dutton Scholarship
Alissa Choi

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James J. and Dorothy T. Hanks Undergraduate Award in Geophysics
Jillian Prescott

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C. F. Schiesser Outstanding Student Research Paper Award
Jillian Prescott

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The Lowell R. Laudon Scholarship
Katie Peters

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The Paull Family Undergraduate Scholarship
Emily Sautebin

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T.C. Chamberlin Scholarship
Emily Sautebin
Mara Corum
Katie Peters
Jillian Prescott
Ollie Monson

GRADUATE STUDENTS

Distinguished Graduate Student Award
Chelsea Volpano

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Dean Morgridge Distinguished Graduate Fellowship
Andrew Jones

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C.F. Scheisser Outstanding Student Research Paper Award
Matias Romero
Pablo Moreno-Yaeger
Collin Sutton
Tianyu Zhou
Collin Roland
Fran Núñez Ferreira
Ellen Nelson
Aaron Kufner

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Sturgess Bailey Distinguished Graduate Fellowship
Pablo Moreno-Yaeger

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James D. and Stella M. Robertson Graduate Fellowship
Sophia Pinter

OB and Rita Shelburne Graduate Research Award
Sophia Pinter

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Rick and Ann Sarg Graduate Fellowship
Claire Ruggles

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George J. Verville Award
Thais Altenberg-Vaz

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Jay C. Nania Graduate Research Assistantship
Kayla McCabe

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Mark and Carol Ann Solien Fund
Thais Altenberg-Vaz

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William H. and Virgie Twenhofel Award
Evgeny Mazko
Kayla McCabe

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Tyler and Berg Excellence in Teaching Awards
Matias Romero
Pablo Moreno-Yaeger
Claire Ruggles
Yasmeen Orellana-Salazar
Campbell Dunn

ALISSA CHOI

Undergraduate student

I am deeply honored to be a recipient of the Carl & Val Dutton Scholarship this year. This financial support will contribute directly to completion of my senior thesis research, which focuses on investigating ice microstructure in ice cores from the Allan Hills Blue Ice Area, Antarctica, using cryo-EBSD instrumentation in Dr. Chloë Bonamici's lab. As part of this work, I've had the opportunity to participate in the Center for Oldest Ice Exploration (COLDEX) core processing line this summer to prepare samples for analysis. I'm incredibly grateful for the support and encouragement I've received from faculty, mentors, and peers throughout my academic journey.

MOLLY EGAN

Undergraduate student

This year, I received the Geoscience Field Camp Scholarship, which allowed me to attend Wasatch-Uinta Field Camp over the summer. Being able to spend the summer outside and in the mountains of Utah, as well as learning field mapping–an area of geology I hadn't been able to explore before this–was a great experience for me. At field camp, I was able to bring together knowledge from all different aspects of geology that I've learned in the classroom to rocks in the field, as well as see more actual outcrops than I have ever seen in Wisconsin. I am so thankful for the support that the department gave me in attending field camp!

COLLIN FARRELL

Undergraduate student

I was so fortunate to receive the Field Camp Scholarship award, which helped me attend the Wasatch Uinta Field Camp. This really helped me see my textbooks and classes come to life in front of me. I got to do real mapping exercises, unit descriptions, and create stratigraphic columns—a wide range of useful skills to further enrich my ability as a geologist. I also met a slew of other passionate geology students from across the Midwest. This large network of other geologists is extremely valuable. Overall, I wouldn't trade this experience for anything. I had a blast and learned a lot of invaluable information and skills. I would not have been able to accomplish this without the support from the Field Camp Scholarship.

ALYSSA HELLRUNG

Undergraduate student

I am incredibly grateful to have received the Field Camp Scholarship. With this scholarship I was able to attend Wasatch-Uinta Field Camp, where I learned so much more about field geology. I really enjoyed making observations at multiple outcrops and comparing them to determine large scale structures. Working in the field each day I was able to see the concepts I learned in class in the real world which was an incredible addition to my education. This course has opened new opportunities for me and I am excited to use all I learned in my future career. I am so thankful to this scholarship for helping make my field camp experience possible!

WILLIAM NOGUERA

Undergraduate student

Last year, I was the recipient of the Eugene Cameron Scholarship. This scholarship has helped me to continue my research over the summer exploring the effects of acid treatment on frictional surfaces in rocks. We hope that this will have applications in the creation of renewable energy plants such as geothermal that rely on infrastructure being built within the Earth. The experience has also helped me understand the ins and outs of being a researcher in the long term. I am incredibly grateful to the generous donors that have provided funding for myself and the geoscience education program as a whole here at Wisconsin.

JILLIAN PRESCOTT

Undergraduate student

I received the James J. & Dorothy T. Hanks Undergraduate Award in Geophysics, the T.C. Chamberlain Scholarship, and the Department of Geoscience Distinguished Undergraduate Award. I would like to express my gratitude for these awards. With these awards I was able to purchase necessary gear for assisting with fieldwork on Taku Glacier in Alaska this past summer. In addition, they have been invaluable as I'm transitioning from undergraduate to graduate school. In the fall I will begin my PhD at the Colorado School of Mines, where I will study subglacial hydrology. I'm grateful to the generous donors who have helped make these opportunities possible and made my transition to graduate school smoother. I would also like to thank my mentors at UW-Madison for their guidance and support.

EMILY SAUTEBIN

Undergraduate student

I'm deeply honored to have received the Paull Family Undergraduate Scholarship and the T.C. Chamberlain Scholarship from the Department of Geoscience this year. Since graduating with my B.S. in Geology & Geophysics and Environmental Sciences in May, I've been busy working in the environmental consulting industry supporting contaminated sediment remediation projects. A recent highlight was completing my senior thesis project. As a Holstrom Environmental Research Fellow, I spent the past year studying the microfossil record of the Paleocene–Eocene Thermal Maximum under the guidance of Clay Kelly. My work on my senior thesis project took me to the Stable Isotope Laboratory at Utah State University, where I analyzed the geochemical signatures of microfossils, and to Harrisonburg, Virginia, where I presented a poster at GSA's 2025 Southeastern Section Meeting. I also shared my research back at home at UW–Madison at the Undergraduate Symposium and the Weeks Symposium and gave a talk at the Very Early Career seminar series. I am endlessly grateful for the experiences like these and the lifelong connections that made my time in this department truly transformative.

ANA SOTELO

Undergraduate student

This past year, I had the honor of receiving the Eugene N. Cameron Award. This recognition means a great deal to me and serves as strong motivation to continue doing my best work. Over the past year, I have been working in Brad Singer's WiscAr lab to date pseudotachylyte from the Main Central Thrust Fault in order to determine the timing of fault reactivation. Thanks to this award, I am able to dedicate more time to my research, which will form a key part of my senior thesis in my final year as an undergraduate. I am deeply grateful for both the recognition and the financial support this award provides.

ANDREW JONES

Graduate student

I am grateful to have received the Dean L. Morgridge Wisconsin Distinguished Graduate Fellowship in Geology and Geophysics. Now in the final semester of my Ph.D., this fellowship has been invaluable during the last throes of writing my dissertation. My research reconstructs alpine glacier fluctuations over the past 11,000 years to provide geologic context for modern glacier retreat. I was fortunate to do fieldwork each summer in awe-inspiring mountains, working in Alaska, British Columbia, Wyoming, California, and Bolivia. But what goes up must come down. This summer, I was fortunate to walk from Weeks to the coffee shop. It is a blessing to have the time to focus on my dissertation without worrying about teaching, and I extend a sincere thank you to John and Tashia for their support and for honoring Dean.

KAYLA MCCABE

Graduate student

This year, I received the Twenhofel Research Award, the Jay C. Nania Research Assistant Award, and support from the Dott Summer Research Backup Fund. Thanks to this support, I've been able to dig deeper into my dissertation project on the Tournaisian Carbon Isotope Excursion (TICE) and the development of Waulsortian carbonate mud mounds in the early Mississippian. This funding helped me get thin sections made for detailed petrographic analysis and the ability to explore new geochemical proxies that shed light on ancient ocean chemistry. The time granted by the Jay C. Nania assistantship will also give me the flexibility to get back into both the field and the lab to collect new data—an important next step in expanding this project. I'm looking forward to presenting these results at conferences this fall and connecting with a broader scientific community. One of the most rewarding parts has been mentoring undergraduate students—whether we're working through thin section descriptions or geochemical methods, it's been a great way to share the research process. I'm really grateful for the support and excited to keep the momentum going.

PABLO MORENO-YAEGER

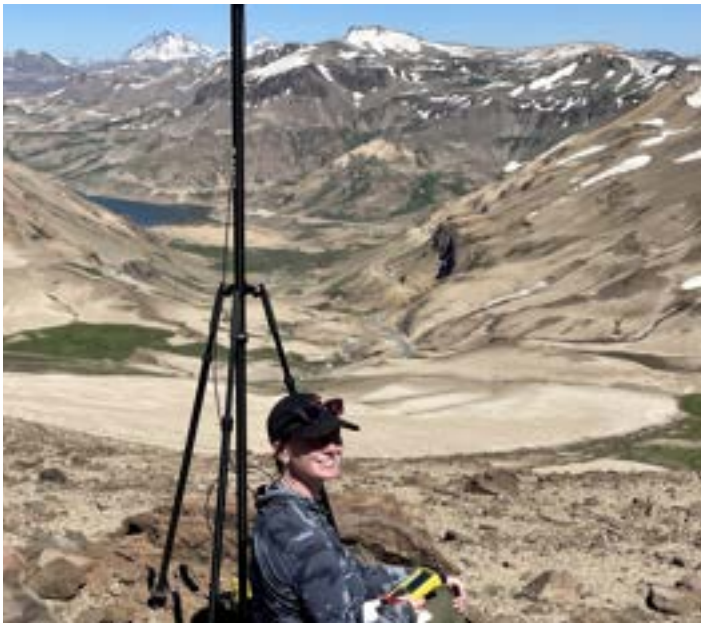
Graduate student

I was honored to receive the Sturges W. Bailey Distinguished Graduate Fellowship. This award has alleviated financial burdens and allowed me to focus fully on my research during the final semester of my PhD, which investigates how volcanoes respond to ice loading during the last glaciation. I am deeply grateful to the donors for their generosity and honored to receive awards that recognize and support the research and service of graduate students.

SOPHIA PINTER

Graduate student

I received the Robertson Award and Shelburne Award. I earned my B.S. in Earth Sciences from the University of California, Santa Cruz in 2022, where I was introduced to paleoclimate studies. I began my Ph.D. in Geoscience at UW–Madison in 2023, where I focus on paleoclimatology through the lens of geochemistry. My research investigates how changes in past climate influenced sea level. I use fossil corals from Hawaii to reconstruct sea-level rise when melting ice sheets contributed to rapid changes. This work aims to improve predictions of sea-level response in our present and future climate scenarios. The Robertson fellowship provides me the flexibility to focus on my research and community service without the constraints of a teaching assistantship. I am especially grateful that it will allow me to travel for laboratory work crucial to my dissertation and to maintain balance in a demanding semester. The Shelburne Award helped support my participation in an upcoming scientific conference where I presented my research results so far and exchanged ideas with peers and mentors. This conference helped foster collaborations that are essential for advancing my research and will help me grow as a scientist and communicator.



CLAIRE RUGGLES

Graduate student

This year, I am deeply grateful to be the recipient of the Rick and Ann Sarg Graduate Fellowship. This fellowship will provide funding as I work to complete my graduate research and write up the results from my geophysical research on the Laguna del Maule volcanic field and Kīlauea, as well as my structural research on an Eocene pluton in the Northern Cascades. I am also grateful to have received the Stanley A. Tyler Excellence in Teaching Award for TAing 'Geology of the National Parks'. A large portion of my graduate studies has been supported by teaching assistantships, and it has brought me great joy to communicate our understanding of our planet to our undergraduate students. I have greatly valued the experience I have gained through teaching and look forward to continuing working towards a career in researching and teaching about our planet.

COLLIN SUTTON

Graduate student

I am incredibly grateful to have received the James J. and Dorothy T. Hanks Award in Geophysics. This support has allowed me to advance my dissertation research in the Subsurface Hydrophysics Lab, led by Dr. Christopher Zahasky, where I study fluid flow and transport in fractured geologic systems. Recently, we published work demonstrating one of the first laboratory-validated, graph-based flow and transport models for a naturally fractured granite core. Using positron emission tomography imaging and pulse-tracer experiments with a conservative radiotracer, we showed that transport behavior can be quantified without high fidelity models. These results revealed how network complexity in graph-based models controls their ability to represent fracture transport, providing insights into scaling these reduced-physics models toward field applications. The recognition and support from these awards have been instrumental for this experimental work. The continuous support from our department and alumni also led to my selection for the 2024 DOE Graduate Student Research Fellowship and the 2025 NSF Postdoctoral Fellowship. I am extremely thankful to the GeoBadger alumni and am happy to be one myself.

CHELSEA VOLPANO

Graduate student

I am honored to have been awarded the Distinguished Graduate Student Award in Spring 2025. This recognition was a deeply meaningful way to celebrate both academic and research achievements, as well as the service and leadership encouraged within the Geo-Badger community. Over the course of my graduate studies, I have been fortunate to contribute to research that advances our understanding of coastal processes, while also engaging in departmental initiatives that strengthen our academic community. In August 2025, I successfully defended my PhD, a milestone that represents years of collaboration, mentorship, and dedication. I am now continuing in a research position within the Department of Geoscience through 2026, where I look forward to expanding my work, publishing new findings, and mentoring students. This next chapter allows me to build on the foundation established during my doctoral studies while further contributing to the department's research mission. I am profoundly grateful for the opportunities and support provided by faculty, peers, and staff, and for the recognition made possible by the generosity of our alumni.

AWARDS

PhD candidate **Rachel Breunig** received the Best Student Presentation award at the American Water Resources Association-Wisconsin Chapter meeting in April 2025 for her talk, "Revealing flow patterns through Driftless Area stratigraphy using End Member Mixing Analysis and catchment monitoring: Wyalusing State Park, WI".

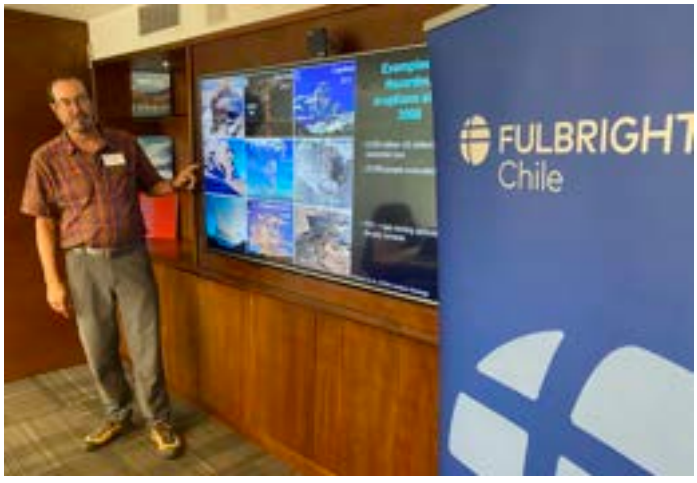
Over the past academic year, **Khalil Droubi** had the distinct honor of receiving the Joe Mancuso Student Research Award, the Eisenbrey Student Travel Award, and the Doug Duskin Best Student Paper Award for best oral presentation at the 71st Annual Meeting Institute on Lake Superior Geology held in Mountain Iron, Minnesota. These awards were in support of his research to constrain the timing and sources of lithium-cesium-tantalum pegmatite mineralization in northern Wisconsin.

While on a combined Chair's research/sabbatical leave during the 2024-25 academic year, **Brad Singer** held two international awards. He was a Fulbright Scholar at the Universidad de la Frontera in Temuco, Chile from August through December 2024. The Fulbright Scholar award allowed Brad to begin researching and writing a paper that reviews the geology, geochronology, and geochemistry of more than 80 volcanoes comprising the 1400-km-long Andean Southern Volcanic Zone.

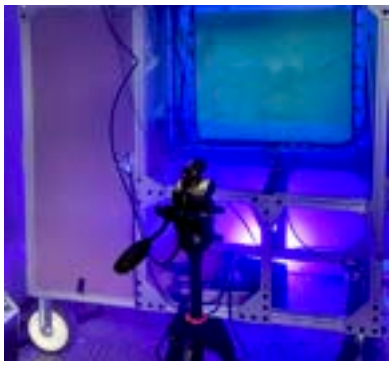
Brad was also awarded a Japan Society for the Promotion of Science Fellowship (this is Japan's NSF) and was in residence for four months at Tohoku University in Sendai from March through June. Brad was able to expand his long-time collaboration with Prof. Reishi Takashima that leverages the occurrence of hundreds of rhyolitic ash beds that contain zircon or sanidine to obtain radioisotopic dates from within a 10 km-thick section of Cretaceous forearc strata in Hokkaido. The aim is to better understand paleoenvironmental crises that punctuated a greenhouse world by improving the time scale and global correlations for this enigmatic period of earth history.

Alan Carroll received two international awards in 2025, the Wilmot H. Bradley Medal of the International Association of Limnogeology and the Francis J. Pettijohn Medal of the Society for Sedimentary Geology (SEPM). The Bradley Medal, presented in Aix-les-Bains, France, is awarded every three years to a limnogeologist who is outstanding in their field. Recipients show dedication and service to the field of limnogeology and have contributed outstanding ideas and innovation to the field, including seminal publications. The Pettijohn Medal, presented at the Geological Society of America meeting in San Antonio, Texas, is awarded in recognition of excellence in sedimentology, to persons who have a significant record of outstanding contributions in sedimentary geology, including all aspects of sedimentology and stratigraphy.

Collin Sutton received an NSF Earth Sciences Postdoctoral Research Fellowship for his project "Reactive transport in fractured networks: a bipartite graph approach for rapid and accurate prediction." Using field data from the Sanford Underground Research Facility, the project will apply a bipartite graph-based modeling framework to improve understanding of reactive processes in fractured rock. This approach greatly reduces computational costs, enabling faster and more efficient simulations of solute flow and transport. Collin, a recent graduate of the Subsurface Hydrophysics Lab under Dr. Christopher Zahasky, will collaborate with researchers at the Colorado School of Mines and Los Alamos National Laboratory during his fellowship.



Eleanor Louise received a 2025 National Science Foundation Graduate Research Fellowship and a Geological Society of America Student Research Grant for her experimental research on how freezing and thawing affect subsurface flow and transport. Using novel imaging techniques with fluorescent dye and UV lighting, she is investigating flow dynamics under freezing conditions.



In recognition of his outstanding record, **Dave Lovelace**, Museum Scientist, won the Office of the Provost's Award for Mentoring Undergraduates in Research, Scholarly and Creative Activities. Some of Dave's most impactful mentorship begins where paved roads end. Since joining the museum's staff, he has led ten expeditions to Wyoming's rugged backcountry, where he has taught roughly 50 students how to excavate fossils and interpret rock layers. Dave also uses these adventures to impart lessons in teamwork and resourcefulness, especially when facing adversity like 70 mph winds and back-to-back flat tires.

Andrea Dutton received the 2025 GSA Public Service Award. The GSA Public Service Award honors contributions that have materially enhanced the public's understanding of the earth sciences or significantly served decision makers in the application of scientific and technical information in public affairs and public policy related to the earth sciences. Over the course of her academic career, Andrea has been heavily engaged with outreach to public audiences through talks, radio, and TV appearances, regularly works with journalists covering climate and sea level change and has testified before the U.S. Congress on these topics.

Jean Bahr received the Schwartz Mentoring Award from the Geological Society of America (GSA).

Annie Bauer received an Emerging Leader Alumni Award from the University of Washington Department of Earth and Space Sciences.

Michael Cardiff was awarded a GSA Fellow Award in 2024, followed by a Vilas Mid-Career Investigator Award in 2025.

Aaron Kufner received the Marvel Ings Award for Excellence in Geoscience Education.

Rudy Molinek was recognized for his work in science communication by the National Academy of Sciences and the Geological Society of America, winning the National Academies Science Communicator Award.

Shanan Peters received the Kellet Mid-Career Award.

Claire Ruggles received the GSA Geophysics/Geodynamics Best Student Presentation Award.

Luke Zoet received the University Teaching Award.

ALUMNI AWARDS

Richard Alley (PhD 1987) received the National Medal of Science last January. An alumnus of the UW-Madison Department of Geoscience, member of the National Academy of Sciences, and co-winner of the 2007 Nobel Peace Prize, Alley studies the Greenland and Antarctic ice sheets, using ice cores to study end-Pleistocene and anthropogenic climate change.

AN ACCESSIBLE FIELD TRIP TO YELLOWSTONE NATIONAL PARK

Eva Golos, Basil Tikoff, and Seth Sutton

The Department of Geoscience has a long history of running exciting field trips that have sparked passion and curiosity in students. However, these trips often involve hiking over long distances and/or rugged terrain, and students who are not able to participate in these activities have historically been excluded from these trips, missing out on vital learning and social opportunities. The goal of this course, led by Professors Basil Tikoff and Eva Golos with graduate student instructor Seth Sutton, was to learn about designing accessible field trips that are inclusive for all students, and to organize a trip that followed these principles.

In front of Spatter Cones at Craters of the Moon National Monument. From left to right: (back row) Evgeny Mazko, Kenz Carlton, Kyrsten Johnston, Seth Sutton, Emily Palmer, Yi Ting Chen, Zoe Loschke, Professor Basil Tikoff, Stacy Nuryadi, Kaitlyn Crouch, Thais Altenberg, Taryn Isenburg, Professor Eva Golos, (front row) Ollie Monson, Logan Goulette. Photo credit: Evgeny Mazko.

During the semester-long seminar portion of the course, students explored a range of topics related to geology as well as research on accessibility. This required delving into literature that was new to them (and their instructors!) regarding the history of accessibility and best practices for trips that consider vision and hearing differences, mobility challenges, neurodivergence, experience levels with outdoors, and more. Every student brought their own perspective, empathy, and a willingness to learn and teach.

Our field trip focused on the Yellowstone Hotspot and took us through spectacular and unique geologic settings. We started our trip in the Snake River Plain, with a dramatic view of basalt flows. We spent a day exploring the volcanic cones, caves, and landscapes of Craters of the Moon National Monument. Next, we journeyed eastward to Yellowstone National Park, observing formations from the historical supereruptions of the Yellowstone Hotspot along the way. We spent several days in Yellowstone, enjoying the geysers, hot springs, and lava flows of the park. We also managed to spot some of the iconic wildlife of the park, including baby buffalo and several black bears. The adventure was rounded out with a night of camping at Grand Teton National Park, and an awe-inspiring view of the Teton Fault.

The group representing UW at the Grand Prismatic Spring in Yellowstone National Park. From left to right: (back row) Stacy Nuryadi, Professor Eva Golos, Yi Ting Chen, Seth Sutton, Taryn Isenburg, Zoe Loschke, Emily Palmer, Evgeny Mazko, (front row) Logan Goulette, Kyrsten Johnston, Ollie Monson, Kenz Carlton, Thais Altenberg. Photo credit: Evgeny Mazko.

This itinerary was of course a spectacular opportunity to view processes that reveal the unrest deep within the Earth in western North America. Just as eye-opening was exploring these sites with a lens on accessibility. We found that although each park touted accessible trails and facilities, the definition of "accessible" varied widely, and often was not in practice truly accessible to all. For instance, Craters of the Moon posted great signage on many trails, including descriptions of the surface and grade. However, a guide had told us the lava tube caves were accessible, but we found that these paths required scrambling over large blocks of rubble. Meanwhile, Yellowstone featured several long boardwalks that were great for wheelchairs but required stairs to reach them from parking lots. The consensus was that the most accessible location was the Jenny Lake trail at Grand Tetons, which included a wide, flat path and many glimpses over Jenny Lake, plus tactile displays of the geology at a wheelchair-friendly height.

Most importantly, we had a great group of students who were eager to dive into the world of accessibility research, to help plan the itinerary, and to adapt to challenges along the way. Several of them had not been able to experience a geology field trip before, and we hope that the lessons learned from this trip will open future trips to others in their position. We're incredibly grateful to the Department of Geoscience alumni and donors who contributed to the Student Field Experience Fund and make this trip possible!

FIRE AND ICE IN THE SOUTHERN ANDES

Brad Singer

On the west flank of Osorno Volcano, Chile. Standing from left to right: Eva Golos, Jack Stalla, Sam Marcus, Pablo Moreno-Yaeger, Brad Singer, Rachel Breunig, Daven Quinn, Rowan Gregoire, Tiare Guerra Catalan (Universidad de la Frontera, Chile), Campbell Dunn, Jaiden Zak, Steve Walter, Ana Sotelo Romero (not in photo, Mike Porter).

Beginning January 11, 2025, this 16-day field trip traversed 2000 km along the Southern Andes from Temuco, Chile to Perito Moreno, Argentina aiming to familiarize eleven students (nine graduate and two undergraduate) and two department alumni (Mike Porter and Steve Walter) with subduction zone volcanism and glacial geology. The group, led by Professors Brad Singer and Eva Golos, visited lava flows and tephra deposits ranging from basalt to rhyolite comprising Villarrica, Mocho Choshuenco, Osorno, Calbuco and Chaiten volcanoes on the west flank of the Andean Cordillera during the first ten days. In parallel we examined glacial deposits and landforms formed as the Patagonian ice sheet slowly advanced and grew to a thickness of nearly two km between 35 and 18 thousand years ago, and disappeared rapidly between 18 and 16 thousand years ago. This is the premier region in which to explore the impact that ice sheet loading and unloading might have had on the magma plumbing systems feeding these active volcanoes. Moreover, students gained an appreciation for both the complex growth history and hazards associated with each volcano. The aftermath of rhyolitic pyroclastic flows on the town of Chaiten following the May, 2008 eruption remains very much in evidence. We visited classic moraines bordering large proglacial lakes where we discussed the behavior of the ice sheet at these latitudes. From Chaiten volcano in Pumalin/Doug Tompkins Park in Chile, we headed south and across to the Argentine flank of the Andes where the arid climate has left intact the most complete and extensive sequence of Pleistocene-Holocene glacial deposits on the planet. On the way we spent a few hours examining the devastation wrought by a colossal debris flow on the Chilean community of Santa Lucia where 22 people lost their lives on December 16, 2017. In Argentina, we visited the enormous sets of moraines to the east of Lago Buenos Aires that have been dated extensively using cosmogenic nuclides (pioneering exposure dates were determined by Singer's group in Madison 20+ years ago). This amazing field trip was supported by the Department's Student Field Experience Fund and we are so grateful to alumni who have donated generously to this cause over the years.

Chaiten Volcano is an active rhyolite dome about 2 km across with fumaroles emanating from the summit. The dome formed within the 3-km diameter crater following an explosive eruption that began on May 3, 2008. Note the burned Nothofagus trees on the crater rim. Pyroclastic flows destroyed much of the town of Chaiten about 8 km to the south of the crater.

SED-STRAT LAB STUDENTS IN THE FIELD

Shanan E. Peters

Geosci 431 students studying cut rock layers in the field.

There are many great things about our department. One of the foremost among them, particularly for students, is the support we have for getting out into the field and the frequency with which that can happen. For many years, students in Geosci 431, the Sedimentology & Stratigraphy Lab course, have benefited from at least four different 3+ hour field labs, all taking place within a short distance from Weeks Hall. Here's the drill:

To get a sense of the modern shoreface at a scale that is bit beyond what you can see in Prof. **Robert Dott**'s well-used flow tank on the fourth floor, the class's first field trip is to one of the several beaches that flank the shores of Madison's beloved lakes. Either Picnic Point or B.B. Clarke Beach fit the bill. Which one we visit depends on the conditions, particularly on the algal and weather fronts. Assuming one of them is relatively algae free, a calm day affords great views of the bedforms while wading around the shallows, whereas a blustery day gives a great appreciation for wave propagation, breaking, and run-up on the beach and the sediment transport processes in action. The next field lab brings students to a railroad cut behind Penn Park, where they are introduced to a stratigraphic section and sedimentary structures formed in a Cambrian depositional environment not radically different from that which they just saw in live action. The section is short and covers just one unit, so attention is on bed-scale structures and gaining a footing measuring a section. Next, the group heads to the corner of Hardrock and Limestone (no joke!) in Verona, where a tall road cut exposes two Ordovician units, which give students the chance to apply both their siliciclastic and carbonate sedimentology skills. A rather prominent surface of sequence stratigraphic importance separates the two and we spend time sussing out its features. Our final field lab brings us to an exposure many Geobadgers visit more than once, the Shorewood Hills Quarry, which was turned into a small park. This outcrop shares several features in common with the previous feed stop, but it spans the Cambrian-Ordovician boundary and challenges students to think more about process that might be reflected in a rather abrupt transitions between siliciclastic and carbonates. The complete absence of animal fossils in the Ordovician is also a good puzzler and making some sense of it requires integrative and broader regional thinking. The Shorewood Hills outcrop experience is further enriched by the fact that we have hand samples and thin sections integrated into the section trace, which we devote an inside lab day to, allowing for a multi-scale take on the sedimentology and stratigraphy.

With experiences like this, it is our hope that undergraduates who focus on geology leave our program with a strong field grounding, one that they will be able to draw on, regardless of where their career might lead them.

Students analyzing a rock sample. From left to right: Emily Palmer, Ana Sotelo, Alissa Choi, Ollie Monson.

Students investigating sandstone beds. From left to right: Ollie Monson, Alissa Choi, Ana Sotelo, Emily Palmer.

GEOBADGERS GO DIGITAL IN THE FIELD AT WHITE LAKE

Shanan E. Peters, Annie Bauer, and Phil Brown

For the second year since the COVID-19 pandemic interrupted a 68-consecutive-year streak, on April 25th, 2025, a group of Geobadgers headed north to the banks of the Little White River in Ontario. The main reason for making the 10-hour, international border-crossing trip, made possible by the alumni-supported Student Field Experiences Fund, remains the same as it was the first time a UW-Madison geology class headed to the area in 1941. The unique rocks of the Paleoproterozoic Huronian Supergroup are well exposed and moderately structurally complicated, providing an excellent natural laboratory for learning about and practicing many different facets of geology in the field. In addition to devoting some pre-trip classroom time to covering regional geological context and going over the stratigraphic section and significance of the rocks, this year's group of eight students and three faculty had a new pre-trip task: become familiar with and prepare the StraboSpot field data collection application, developed with NSF support by Prof. Basil Tikoff and collaborators.

As has been the case for most of the history of the UW-Madison White Lake field course, mapping bedrock geology is the primary activity. Paper topographic maps and notebooks, air photos, and a Brunton compass had long been the tools of the trade. Successfully finding your way through the woods and swamps with this kit (not to mention finding any outcrops) did carry with it a certain sense of accomplishment for some, and confidently navigating the landscape is an important skill, but it also means lots of time and attention spent on orienteering, rather than working on the geology. This year, things would be a little different.

StraboSpot can be pre-loaded onto iPads/iPhones with a variety of mapping resources, including satellite imagery and topographic basemaps. With GPS capabilities built in, these maps are more than passive guides: there's a little blue dot indicating exactly where you are on them. Moreover, the device's built-in compass and accelerometers are capable of doing almost everything a Brunton does, but it's often much easier to take a more accurate measurement. The device also takes geo-located photos, which can be annotated live, and geo-located notes including explicit estimates of salience and certainty (e.g., Tikoff et al., 2023, GSA Today 33(7); Nelson et al., 2023, J. of Geology 131(4)) can be added to all field "spots," resulting in a breadcrumb trail of richly documented outcrops. At the end of the field campaign, all of your georeferenced notes, including annotated photos, can be exported to a PDF. The only real new hassle: electrons. They're needed, all the time, and they are not easily had along the Little White River. The sound of a small generator was a regular part of evening camp life this year.

Students work on their maps, in a hybrid StraboSpot-paper modality, after a long day in the field. Collaboration is an integral part of the White Lake experience. Clockwise from top: Brooke Rodriguez, Mariel Hood, Izzy Oebser, Ashley Therrien, Ana Sotelo, Soren Sheridan, Sophie Lee, Dylan Nolte.

Overall, 2025 was a successful first-go at a digital transition for White Lake, thanks to Prof. Tikoff's effort on StraboSpot and his generous help in getting us up and running. The instructors also learned a lot and are eager to further improve the student experience and shift the emphasis of the course a little bit. One big motivation is that almost everywhere on Earth has been mapped to at least some extent. Going into "terra incognita" has some pedagogical value, but this is not a problem that most geologists today will ever face. Instead, a key challenge of the future is knowing how to efficiently amass and leverage what has already been done, identify possible shortcomings and new problems, and plan where to go and what to do next in the field. Folding some of these elements into the course, while being efficient and maintaining a strong emphasis on field fundamentals, will keep Geosci 457, the White Lake field course, in its place as a valuable and unique part of our curriculum. Finally, it is important to note that although times and technologies change, the connection between the many generations of students who have experienced White Lake remains strong. The woods and the rocks remain largely the same, the campfire still crackles, and the river still babbles, providing an ever-present backdrop to the laughter and chatter that photo albums and stories of years past inspire.

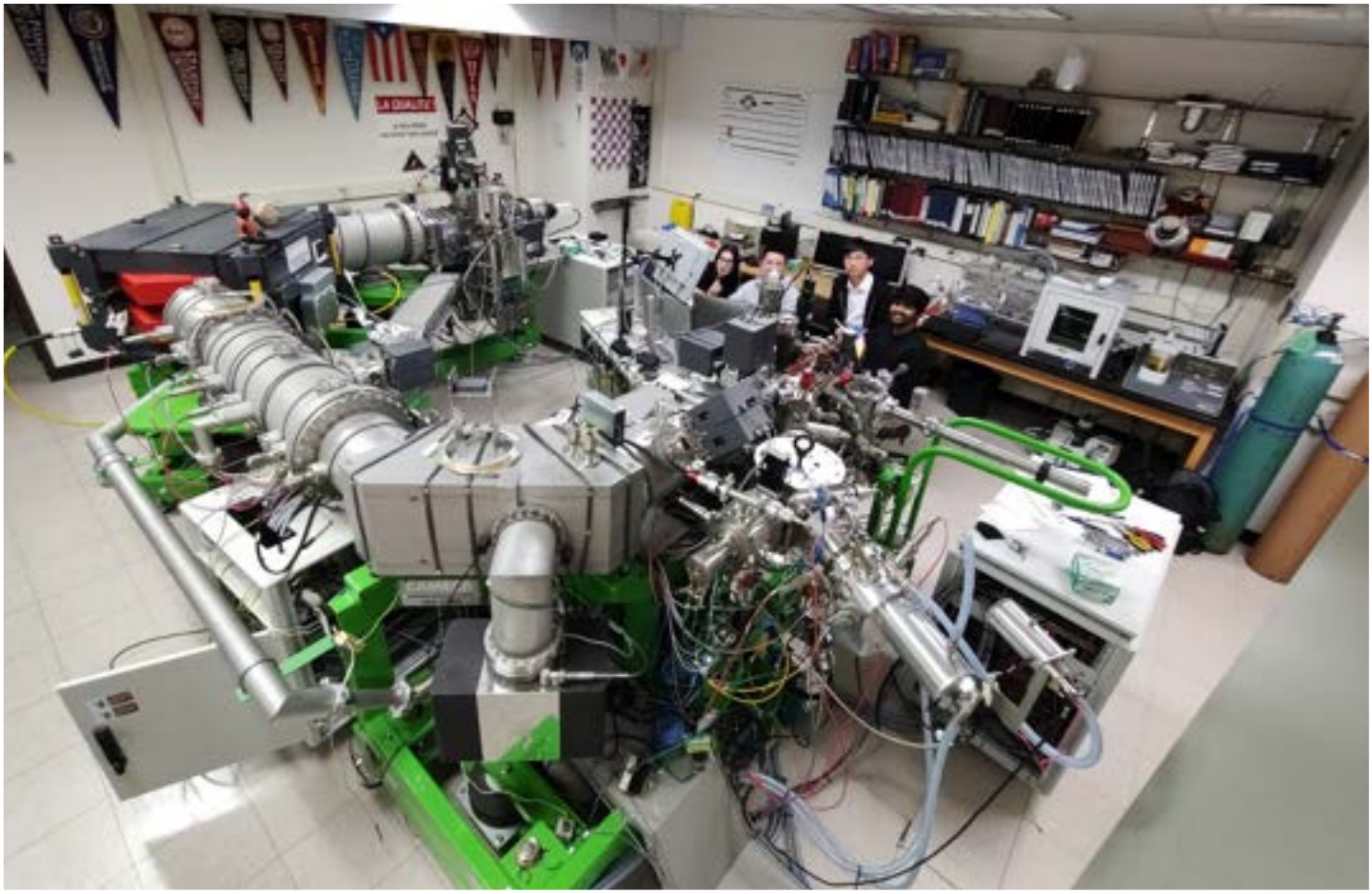
The 2025 White Lake group, and our hosts the Zieglers, in front of the sign-bearing cabin that appears in nearly identical group photos going back decades. From left to right: (back row) Phil Brown, Hanny Ziegler, Kevin Ziegler, Soren Sheridan, Izzy Oebser, Ana Sotelo, Brooke Rodriguez, Mariel Hood, (front row) Ashley Therrien, Annie Bauer, Sophie Lee, Dylan Nolte. Not shown: Prof. Shanan Peters, who took the photo.

WiscSIMS Lab Update

Chloe Bonamici

The WiscSIMS Lab continues to operate as the premier in situ stable isotope analysis lab in the US under the leadership of Distinguished Scientist **Noriko Kita**, faculty PI **Chloe Bonamici**, professor emeritus **John Valley**, and Scientist **Kouki Kitajima**. In addition to its long-term status as a community-supported facility through the National Science Foundation, WiscSIMS was this year designated a Planetary Science Enabling Facility by NASA. Over the last year, WiscSIMS has operated for 34 weeks of analysis of oxygen isotopes, carbon isotopes, hydrogen isotopes, trace elements, U-Pb dating, and aluminum-magnesium dating. Thirteen of those weeks were devoted to data collection for student and postdoc projects supervised by Geoscience Department faculty (**Annie Bauer**, **Chloe Bonamici**, **Shaun Marcott**, **Selva Marroquín**, **Basil Tikoff**, and **Laurel Goodwin**), as well novel research on the one-and-only Baraboo syncline by the Wisconsin Geological and Natural History Survey. Another 14 weeks of analysis were conducted in collaboration with researchers from the wider geoscience-cosmochemistry communities outside of UW-Madison. Instrument scientist **Kouki Kitajima** continued to upgrade instrument automation capabilities while also developing new methods for more rapid and small-spot analysis. Instrument scientist **Tyler Blum** advanced a unique high-mass resolution trace-element analysis for improving provenance studies of ancient to modern zircons. Technicians **Mike Spicuzza** and **Bil Schneider**, along with engineers **Peter Sobol** and **Neal Lord**, kept the WiscSIMS running smoothly through many weeks and types of analysis. More information about the lab, including publications and theses, is available online (https://wiscsims.geoscience.wisc.edu).

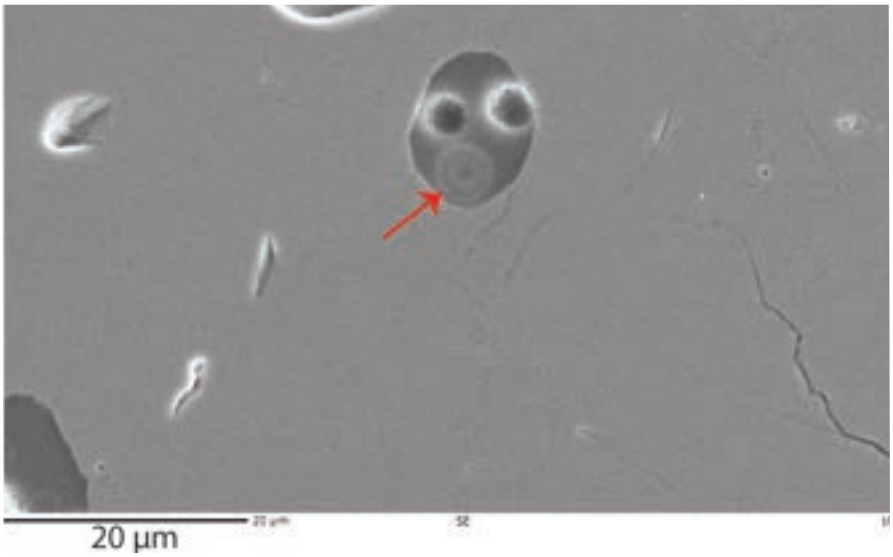
NSF support for WiscSIMS has been continuous in 3-year increments since 2008 and is renewed through next year, though the home funding program—EAR Instrumentation and Facilities—has been shut down with no information to labs about transfer of its funding portfolio. WiscSIMS will continue to work to maintain funding for its expert personnel and unique scientific capabilities.



Graduate students from the University of Chicago collect meteorite oxygen isotope data with WiscSIMS scientist Mingming Zhang and WiscSIMS postdoc Megan Hammett.

Cameron and Wilcox Electron Microbeam Labs Update

Will Nachlas



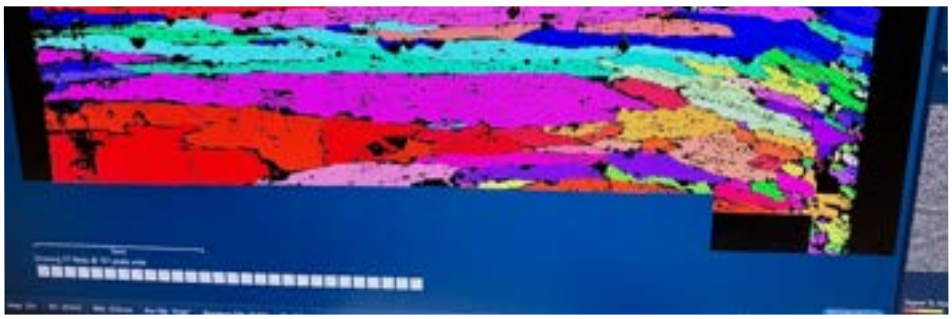
A secondary electron image shows a ring of carbon deposited at the beam spot location where an EPMA measurement was made of 11 elements in a hydrous melt inclusion in zircon. The beam diameter was set to 1 µm and the measurement was placed carefully to avoid the wall of the zircon host crystal and two SIMS pits within the inclusion.

A normal day in the Electron Microbeam Labs sees data generated on up to four E-beam instruments, sometimes simultaneously. The Cameca SX-Five microprobe delivered to our Department in 2014 remains one of the most elite pieces of EPMA equipment in the world. With the cessation of commercial sales of the Cameca microprobes announced by Cameca's parent company in 2022, the options for commercial EPMA instruments have become very limited. The large spectrometer Cameca microprobes, which have been on the market as the first commercial microprobe in 1959 using the original Castaing spectrometer design, offers the superior combination of high spectral resolution and long-term stability. Combined with several in-house modifications to the vacuum system, anti-contamination system, and secondary detectors, this instrument has proven itself a valuable tool that provides cutting-edge analytical measurements to geologists and other researchers at UW-Madison and contract services performed for academic and industry clients across Wisconsin and internationally.

The Field Emission Gun (FEG) electron source that was installed in Sept. 2022 has provided a stable electron beam for close to three years. The "always ON" electron gun enables data collection around the clock, which allows projects to be booked nearly continuously, with any available downtime preciously allocated for testing and method development. Over the last fiscal year, the SX-Five microprobe averaged 33 hours of billable beamtime over each of 50 weeks. Some recent publications include chemical analysis of melt inclusions in zircon (Gonzalez et al., 2025, Chemical Geology), some of Earth's oldest crystals of titanite and apatite (Droubi et al., 2025, G-Cubed), and mineral alteration during extensional shear deformation (Roig et al., 2025, Earth and Planetary Science Letters). The microprobe is also utilized by researchers in materials science, physics, chemistry, medical physics, and mechanical engineering. Complex materials brought to the lab by these researchers provide opportunities to learn new ways to operate the instrument. Some recently developed methods include quantification of low C in steel, trace Nb in thin film superconducting interfaces (Kim et al., in review, Nature Physics), and O vacancy concentration in novel ceramics used in solid oxide fuel cells (Meng et al., 2025, Chemistry of Materials).

This is not the only one-of-its-kind instrument in our facility. Last year saw completion of a multi-year effort to build the first electron microscope dedicated to crystallographic analysis of water ice using electron backscatter diffraction (EBSD). After the first successful dataset was acquired last summer, we are now regularly analyzing a wide variety of different ices including glacial ice cores, experimentally deformed ice, an array of hailstone and graupel ice precipitates, and other fabricated ice materials. See the photo below showing enormous inch-long ice crystals synthesized by PhD student Natasha Morgan-Witts!

Our workhorse SEM in room 308 continues to run reliably and after 20+ years of steady operation, has been officially deemed Super-User status by our Hitachi engineers. Thank you to all who contribute to making the Electron Microbeam Labs a busy and exciting place for advancing science research and education.



EBSD crystal orientation map shows an aggregate of high aspect ratio crystals of synthetic ice. The color corresponds to the 3D orientation of the crystal lattice and indicates that single crystals grew over an inch in length with little to no change in direction. Image credit: Natasha Morgan-Witts.

SHAPING WISCO

Luke Zoet

Wisconsin's rich geologic history has shaped the state's surface. From glaciers that covered the majority of the state to the coastal effects of the Great Lakes, there is a vast array of landforms that bear the mark of recent geologic activity. This year marks my tenth year living in Wisconsin and as a faculty member in the Department of Geoscience at UW-Madison (Figure 1). Over that span, our group has worked on a wide range of problems, but a continuing theme through my time at UW has been understanding processes that have shaped Wisconsin. Wisconsin is a great location to study, especially as two of our group's main research disciplines are glacial and coastal processes. In many instances, our work has brought us to amazing locations around the world (Antarctica, Greenland, Norway, Iceland, New Zealand, to name a few), and while these places have unique features that can help us answer fundamental questions in geosciences, so does Wisconsin.

One difficulty in studying glacier mechanics is that many of the most important processes (from both a dynamics and geo-

logic standpoint) are found at the bed of the glacier, where the ice meets the underlying substrate. In modern glaciers, like Antarctica, this ice-bed interface is exceedingly hard to reach, and therefore studies often use a variety of geophysical techniques to look through a glacier in order to examine its bed. These geophysical investigations can provide great insights into the mechanics of modern-day glaciers, but the difficulty of collecting data often leaves us spatially limited to the narrow windows exposed via geophysics. However, information about the dynamics and kinematics of glaciers are also stored in the landforms they create, and Wisconsin has an abundance of these. So, if we can analyze these landforms with an eye towards glacial mechanics, we can extract certain types of information that will inform directly on glacier dynamics. Therefore, by studying the surface of Wisconsin, we can learn about the processes active at the bed of large ice sheets (like Antarctica and Greenland) without the complications of 2 miles of ice between us and our study site.

In addition to the past activity of glaciers shaping Wisconsin

Figure 1. *Students on Washington Island as part of the annual GEOSCI 920 trip. From left to right: (front row) Kai Hu, Eric Giese, Charlie Dougherty, Natasha Morgan-Witts, Jack Zoet, (back row) Noah Brown, Jaiden Zak, Mara Corum, Shuong Hu, Mendota Hu, Jillian Prescott, Sam Marcus, Dougal Hansen, Marianne Haseloff, Kayla Hubbard, Campbell Dunn, Luke Zoet, Andrew Jones, Matias Romero, Mae Wallace.*

there is modern widespread geomorphic change from coastal processes along the Great Lakes. As humans have developed infrastructure along the lakeshore, these regions have become critical parts of our state for commerce and recreation. However, they also undergo widespread erosion from coastal processes active in the Great Lakes. Namely, the bluffs that back 70% of Wisconsin's Lake Michigan shoreline are subject to increased rates of coastal erosion at times when Lake Michigan water levels are elevated. The last and most severe instance of this was from 2013-2020, where water levels rose from record lows to highs. This increase in water level drives the zone of wave attack landward and allows the waves to erode the toes of the coastal cliffs (bluffs) and dune-backed beaches. We can use the shorelines' active erosion (and recovery) to study fundamental questions in coastal science that can be difficult to examine on marine coasts, because the change in base water level is much slower than within the Great Lakes.

My goal with this article is to take a tour through Wisconsin and talk about various projects we've completed that investigate processes responsible for shaping the state. This work has been completed with a series of students, postdocs, and colleagues, and all of these projects have been done in collaboration with **J. Elmo Rawling** from the Wisconsin Geological and Natural History Survey. It's no small coincidence that many of our Wisconsin projects are co-located with the counties that Elmo has mapped. Much of this work follows in the footsteps of people that have worked within the state prior to our group, namely **Dave Mickelson** and **John Attig**. I will largely organize the following sections by landform type and provide a bit of context as to how the landforms were created and some text on our new studies about them.

Drumlins

Perhaps the most prominent geologic feature in Wisconsin is the drumlin. Drumlins are subglacial landforms that are created as ice flows across the landscape, eroding, depositing, and sculpting the land until a shape resembling a half-buried egg remains. While curiously drumlins don't form everywhere, the Green Bay Lowlands have one of the most populated drumlin fields in North America, with around 14,000 drumlins scattered across the region. These "half-buried eggs" don't always maintain a constant shape as the ice overrides. Often, they become longer in the direction of ice flow and narrower in the direction perpendicular to flow, causing the elongation ratio (the length of the drumlin's long axis divided by the length of its short axis) to change in time and space. Drumlins are likely the most well-studied of all glacial landforms, and their formation process has been hotly debated for almost a century. In many instances, the elongation ratio is used as a proxy for fast glacier flow, where drumlins with long elongation axes are believed to indicate regions where the ice was flowing fast, whereas small elongation ratios indicate the ice was moving slowly. However, despite the widescale use of this assumption, it is unclear if it's correct. To investigate this problem, we

Figure 2.
(Left) Fran Nunez and Natasha Morgan-Witts in front of the Cable Esker in Cable, WI. (Right) Fran Nunez halfway up the Cable Esker measuring sediment grain size distributions.

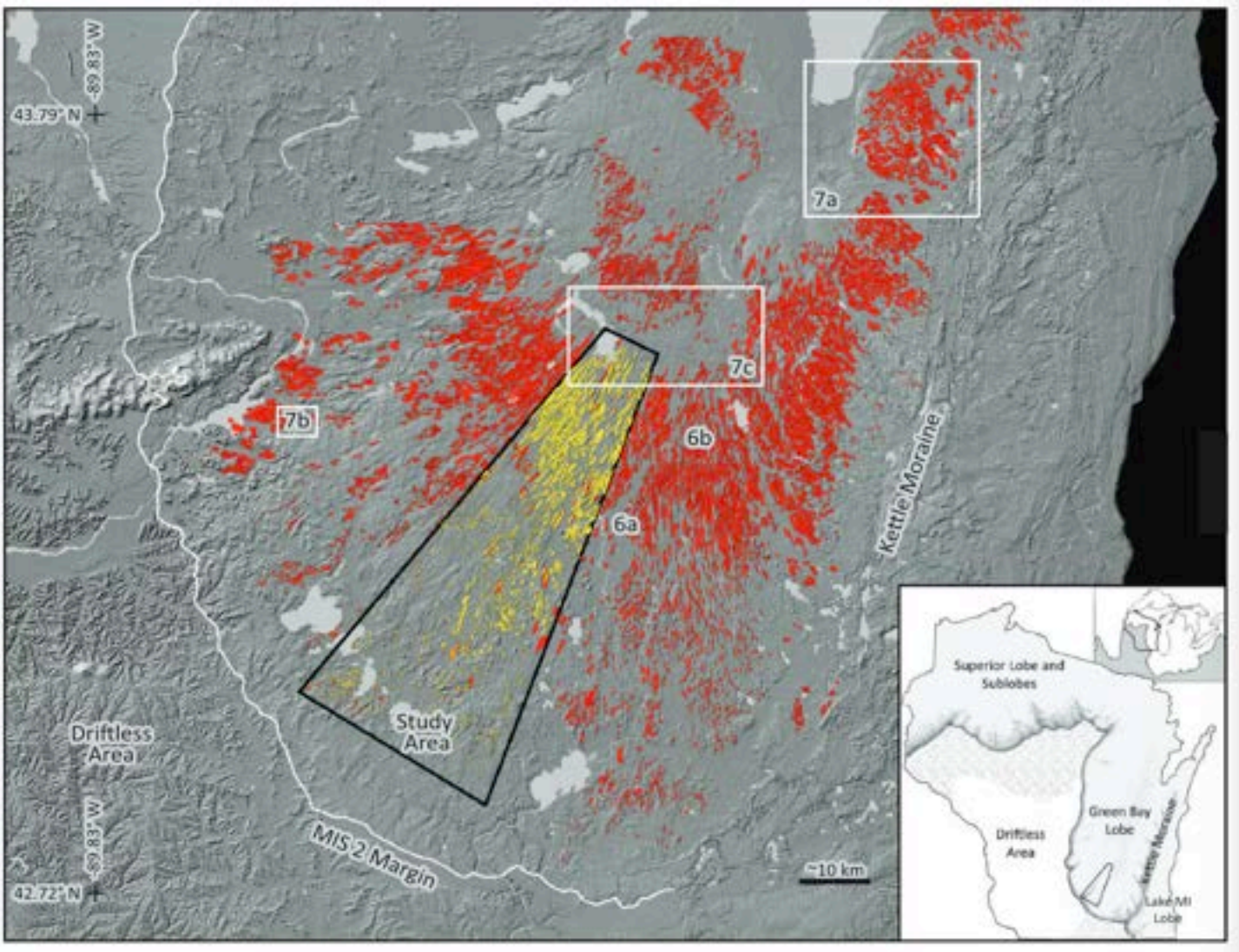


Figure 3. ***Distribution of drumlins across the Green Bay Lowlands (Zoet et al., 2021).***

used high-resolution lidar data to map over 14,000 drumlins in the Green Bay lowlands, and from this, we determined how their elongation ratio varied in space from north to south within the footprint of the Green Bay Lobe (GBL). We found a distinct pattern of the elongation ratio increasing as you moved to the north[1]. This alone is an interesting finding, but doesn't provide much to test theories on drumlin formation. What is really needed is a way to estimate how flow speeds vary in space for comparison to the elongation ratios of the drumlins. Therefore, building on the chronology constructed by previous investigators, we devised a new way to estimate the spatial variation in the glacier flow speed and the duration of ice cover for any given drumlin. Ultimately, we found that it's not the flow speed of ice that dictates drumlin shape, but instead the total displacement of the ice that moved over the drumlin. So, ice moving 1 km/yr for 1000 years would do more to shape the drumlin than ice moving 10 km/yr for 10 years.

Eskers

Meltwater that makes its way to the base of glaciers can localize and form subglacial channels that are oriented in the direction of ice flow. Along with water flowing through these subglacial meltwater channels is the sediment it carries, which can be deposited along the channel bed. Once the glacier retreats, it leaves behind a sinuous ridge of sediment that was the channel bed, and these ridges are called eskers. Eskers provide information about water flowing at the base of glaciers, and knowledge of subglacial hydrology is of utmost importance for understanding how fast glaciers will move, because if the water is highly pressurized it can effectively float the glacier off its bed. While the presence of eskers signifies there was abundant water at the glacier base, it hasn't been possible to extract information about the pressure conditions under which the water flowed, which is perhaps the most important part of the problem. To address the issue, we worked on an esker in Cable, Wisconsin, which formed beneath the Lake Superior Lobe[2]. Cable Esker was actively being mined for sand and gravel, exposing a large (~20 m) face of sediment stretching the full height and width of the esker. Francisca Nunez spent many days climbing up and down the esker face, building a detailed stratigraphic record of the various units and measuring grain size distributions of the sediments within the various units. Fran created a new method by which the grain size of the sediment could be used to estimate the water flow velocity, and beneath the glacier water flow velocity is driven by the pressure gradient. With some information about the geometry of the glacier, Fran was able for the first time to use an esker deposit to provide actual numbers on the pressure field beneath a glacier. From this work, she showed that eskers likely just form in tunnels near gla-

Figure 4. *Abe Sorber and Atsu Muto collecting seismic data across a tunnel channel near Plover, WI.*

cier margins and not in tunnels that are extending tens of km under the ice, counter to the traditional viewpoint of esker formation.

Tunnel channels

Sometimes when channelized water flows under the ice, it does so as large episodic floods instead of the relatively constant flow that forms eskers. These large episodic flows have so much power that instead of depositing sediment and forming an esker, they instead erode tunnels or canyons into the underlying sediment. Along the western margin of the GBL, there are ~60 of these features that stretch from the margin to ~15 km inland. Each one was formed by a large flood that carved out the channel, and the landforms left are called tunnel channels. We used a combination of active source seismic techniques, drill cores, and numerical modeling to investigate these tunnel channels[3]. We found that their subsurface expression is nearly 6x greater than their surface expression and that it would have required about 60 days of flooding (likely through several flooding events) to produce one channel. The water source to erode the tunnel channels was likely sourced from both small subglacial lakes and large supraglacial lakes that drained at the same time and funneled huge volumes of water to and along the bed. Then when the ice retreated from the region, the ice buried within the tunnel channels melted and the modern-day surface depressions from tunnel channels were left at the surface.

Kettles

When ice retreats, it can leave behind blocks of ice that break off from the ice margin. These blocks of ice can become buried in sediment that is flushed out the front of the glacier by proglacial streams. The sediment that surrounds and buries the ice insulates the block from the atmosphere, causing it to melt slowly, perhaps taking hundreds to thousands of years. As that ice block buried by sediment melts, it leaves behind a depression where the ice block once lived, and these depressions are called kettles. The shape and size of the kettle depression is directly dependent on the size and depth to which the ice block was buried, and when the kettles fill in with water from the surrounding groundwater table, they form kettle lakes (the source of many of Wisconsin lakes). Despite the prevalence of kettles, there had been no quantitative studies to determine the link between the ice block that made the kettle and the kettle shape itself. To study this process, Jillian Prescott conducted a set of experiments where she created ice spheres of different radii and then buried those ice spheres in a large sandbox at different depths[4]. She then used a laser scanner to measure the resulting depression that formed once the buried ice had melted. What we found was that the depth-to-width ratio of the kettles is greatest when

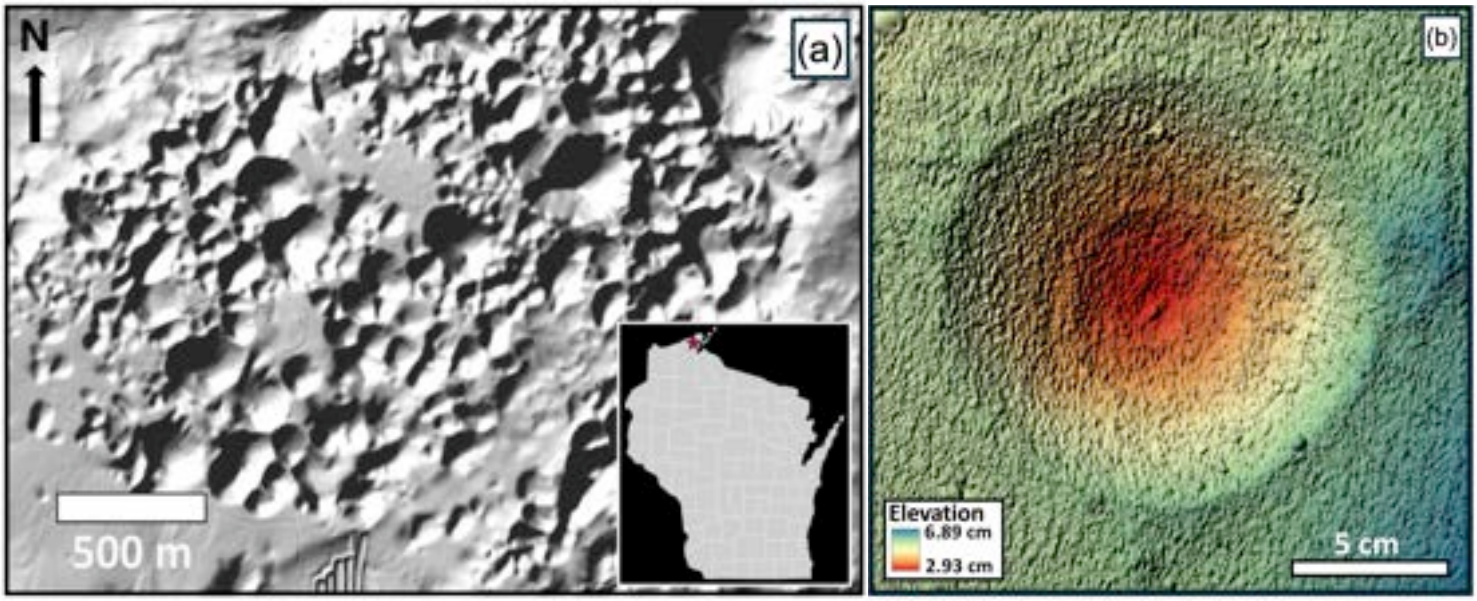


Figure 5. ***a.*** *Kettle depressions near Bayfield, WI.* ***b.*** *3D scan of a kettle formed in a laboratory experiment in which buried spheres of ice were melted and the resulting depression was scanned. Both figures are from Prescott et al. (2025).*

the ice is buried right below the surface, and as the ice block is buried deeper, the resulting depression gets wider and shallower. We also found an expression for the volume of the depressions depending on the size and burial depth of the ice sphere. With these laboratory results, we were able to create a set of equations that would allow us to take the width and depth of natural kettle depressions and estimate the ice block size and burial depth that formed them. We applied our techniques to a kettle field near Bayfield, Wisconsin, and in doing so, determined the distribution of ice blocks that broke off the retreating Lake Superior Lobe in that region.

GBL chronology

As the ice advanced and retreated from Wisconsin, it left behind a series of moraines that mark its chronological history. Using cosmogenic exposure dating techniques, in which ^{10}Be isotopes can be isolated from quartz-bearing rocks, my colleague Shaun Marcott can estimate the time a given portion of rock has been exposed to the atmosphere (not buried by ice). This information provides a means to build a chronology of glacier advance and retreat in regions like the GBL, where it has been traditionally difficult to obtain numerical dates due to a lack of carbon material for use in dating. Using these techniques, Liz Ceperley determined that the Arnott Moraine near Keene, Wisconsin, was much younger than previously interpreted from relative dating techniques[5]. This exposure technique, however, is not limited for use on moraines but can also be applied to bedrock exposures. Through new sample collection and utilization of older samples collected by Dave Mickelson, Jeremy Brooks has been able to put together an improved reconstruction of the GBL that showed it grew to its maximum extent by 26 kybp then was stable until 20 kybp when it started to retreat slowly until 18 kybp, whereupon the rate of retreat rapidly increased[6]. These new dating techniques have greatly improved our knowledge of the timing of ice advance and retreat within the state.

Coastal erosion

The advance and retreat of ice in and out of the state not only shaped the land but also formed the Great Lakes that abound the eastern and northern parts of the state. The abundant glacial action also deposited thick packages of till (sediment) upon which the Great Lakes waves have been eroding since the ice retreated. We have spent the past 8 years studying the erosive efforts of these waves through the use of drones and boats to make elevation models of the shore change. Chelsea Volpano uses these elevation models to drive numerical modeling that determines how these coastal processes are moving sediment in the nearshore[7]. On land, Russ Krueger found that certain portions of the bluffs can become unstable when oversteepened[8] and Collin Roland found that winter conditions greatly accelerate

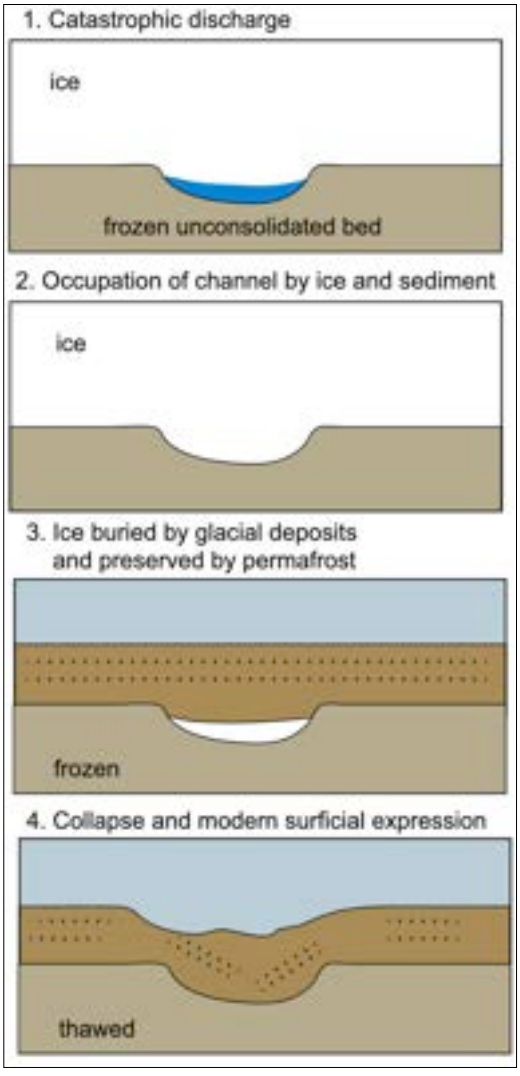


Figure 6. *Progression of tunnel channel formation (Zoet et al., 2019).*

erosion by trapping groundwater behind frozen bluff faces only to release it when the temperature rises[9], leading to large-scale bluff failures in the early springtime. That sediment is then carried into the water, where along- and cross-shore currents can move the sediment around[10]. Through measuring and modeling sediment movement in the lakes, Chelsea has found that sandy beaches like Point Beach State Park recover when water levels lower but that the bluff-backed beaches like those near Port Washington simply cannot accumulate enough sand to stabilize themselves and so they do not recover when water levels drop and instead continue to erode. This motivates different management strategies for these two different beach types.

Coastal ice

Wisconsin's coast has an element that most well-studied coastlines do not: winter! With winter, coastal ice can form along the shoreline and disrupt normal ice-free sediment transport conditions. To examine this, we spent several winters climbing on the nearshore ice of Lake Superior surrounding the Bayfield Peninsula in northern Wisconsin, where Stef Dodge collected ice cores to examine sediments entrained within the ice and measured beach geomorphic change resulting from the coastal ice[11,12]. We found large troughs that were eroded into the lakebed, but often these were found in water too deep for waves to access, leaving many questions. To address these questions, we built a wave tank in a freezer and Stef ran experiments on a scaled version of this ice complex to watch how it altered sediment transport[11]. We found that the ice front was directing wave energy to the lakebed, allowing it to scour the bed in locations where waves would otherwise not have eroded the bed. Chelsea Volpano then built a numerical model that demonstrated what we had observed in the field and lab[13]. She also showed that there is an optimal position in which the ice can terminate to maximize the effect on sediment transport, specifically ice terminating at the same point where waves break will lead to maximum sediment transport. This work provides a framework for how cold coasts should be managed differently than their warm counterparts.

Figure 7. *(Above) Jeremy Brooks, Shaun Marcott and Andy Jones collecting samples for ^{10}Be analyses near Observation Point, WI.*

Figure 8. *(Left) Coastal erosion. Chelsea Volpano setting up the drone boat she uses to image lakebed bathymetry near Lion's Den park in Ozaukee Co, WI.*

In conclusion

The sense of place in Wisconsin is strong, and the landscape is such that it provides many more questions than we could ever hope to approach. The fact that there are so many basic science questions that can have far-reaching significance, from the fundamentals of glaciology to more applied questions such as if homes might fall into Lake Michigan within just a few hours of Madison, is amazing. I've worked on a lot of projects in Wisconsin, and I expect I'll work on a lot more because the sorts of things that have shaped Wisconsin are interesting. I've been to some of the most beautiful and remote field sites in the world, but when people ask me where I most like to work, I generally reply, "I'll let the students go to the exotic field locations, because I would rather just be digging holes in the dirt in northern Wisconsin with Elmo."

Figure 9. *Coastal ice. Drilling ice cores in lake ice near Port Wing, WI. In the photo is Luke Zoet (front), Luke Milner (left), and Stef Dodge (right).*

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[1] Zoet, L. K., Rawling, J. E., Woodard, J., Barrette, N. & Mickelson, D. M. (2021). Factors that contribute to the elongation of drumlins beneath the Green Bay Lobe, Laurentide Ice Sheet. Earth Surface Processes and Landforms, doi:10.1002/esp.5192.

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ANNIE BAUER

It's been an active year in the ICP-TIMS lab! Researcher **Mike Tappa** supervised the overhaul of the air handling system in our clean lab and has been working on method development in support of internal and external researchers. Newly minted Dr. **Esther Stewart** defended her PhD thesis in April and is wrapping two manuscripts with exciting geochemical evidence from the Nonesuch Formation, Midcontinent Rift, supporting her interpretation of deposition in a restricted seaway. Along with collaborator **Zach Adam** and colleagues at Dartmouth, we have been busy in the field in Montana studying the geochemistry, provenance, and paleobiology of the Mesoproterozoic Belt Supergroup. PhD student **Emily Palmer** continues to push forward projects applying the U-Th-Pb system to track the presence and timing of oxidative weathering in the Proterozoic. PhD student **Rowan Gregoire** has been up to his elbows in carefully targeted SIMS (gathered in collaboration with **Tyler Blum**, **Kouki Kitajima**, and **John Valley**) and LA-ICP-MS data of detrital zircons from the Beartooth Mountains, WY, and Jack Hills, Western Australia. **Annie Bauer** is the lead on a recently published paper with **Clark Johnson**, **Eric Roden**, former Geobadger **Weiqiang Li**, and collaborators at Penn State demonstrating extreme oxidative weathering of volcanic rocks in Russia that postdate the Great Oxidation Event and which temporally correspond with a large flux of U to the oceans and mantle. Annie was pleased to finish her six-year term co-chairing the Gordon Research Conference on Geochronology this summer and also to travel to University of Washington to receive an 'Emerging Leader' Alumni Award from the ESS Department. Our group has just been funded by the NSF to investigate Paleoproterozoic stratigraphy in the Francevillian Basins of Gabon, and we are looking forward to applying U-Pb geochronology and Sr isotope stratigraphy to those rocks!

CHLOE BONAMICI

It has been a dynamic and satisfying year for the Petro-Geochem Group, with several projects coming to completion and other gaining momentum. **Claudia Roig González** wrapped up her dissertation on stable isotope signatures of fluid-fault interactions and became the first fully fledged PhD of the Petro-Geochem Group. She has moved on to postdoctoral research at the University of Bologna – congratulations, Claudia! **Taryn Isenburg** successfully defended her MS thesis project utilizing zircon geochemistry to backtrack the tectonic setting of 1.4 billion-year-old volcanic tuffs of the Picuris Mountains of New Mexico. Former postdoctoral researcher **Suzanne Autrey-Mulligan** published her new pressure estimates for Proterozoic metamorphic rocks of the Grand Canyon in Geology. PhD student **Khalil Droubi** did field work in the deserts of California and Arizona with collaborators to launch a new project on intense fluid fluxing of the crust above the Farallon slab during the Laramide Orogeny. **Noah Brown** joined us this summer to start his PhD project on the quantitative crystallography of ice. NSF Postdoctoral Fellow **Amy Moser** completed eight lab experiments to deform our favorite geochronometry mineral titanite. Stay tuned for rainbow-colored maps of squished titanite next year!

This was also a year of progress and changes in the analytical labs that I oversee. The Ice Analysis Lab performed its first successful electron backscatter diffraction (EBSD) measurements on ice. **Will Nachlas**, **Bil Schneider**, and **Peter Sobol**, along with the help of PhD students **Natasha Morgan-Witts** and **Noah Brown**, worked tenaciously through the final technical challenges to push the ice EBSD capability over the finish line. Check out Will Nachlas' electron probe lab update for more details and exciting pictures. Several collaborations with **Luke Zoet** looking at the ice microstructure in natural glaciers, hailstones, experimentally deformed ices, and analogs of extraterrestrial ices are already on the docket.

The WiscSIMS Lab was renewed in its NSF funding and continues to operate as National Facility for stable isotope analysis. With this funding cycle, I take over as faculty PI and head of the WiscSIMS Oversight Board from John Valley, who continues to advise the lab and manage his own research.

Members of the Petro-Geochem research group. From left to right: Chloe Bonamici, Amy Moser, Khalil Droubi, Ollie Monson, Alyssa Hellrung, Taryn Isenburg.

MICHAEL CARDIFF

In summer 2024, I was able to do some memorable travel around Wales, UK with my family – including visiting my namesake of Cardiff (pictured), many beautiful coastal cities, and the Eryri National Park. But soon enough, it was time to return from the land

Mike Cardiff with son Brenyn Cardiff at the Cardiff well, Cardiff Castle, Cardiff, UK

of mist, slate, and dragons to UW-Madison – the land of research, teaching and service.

On the research front, our group continues to engage in field-based work across the state. We are continuing to help the community on French Island, WI as it works to manage a PFAS-contaminated aquifer (see 2023's Outcrop) in Western Wisconsin. Graduate students **Sam Kershner** and **Paul Summers**, along with colleagues from the USGS and the State Geological Survey, participated in a major field campaign to collect geophysical, hydrologic, and contaminant data supporting these efforts. Graduate student **G. Graham**, meanwhile, is putting their modeling skills to work assessing how increased extreme precipitation is causing groundwater-driven lake flooding in Northern Wisconsin. **Rachel Breunig** (MS, 2022, co-advised with Ken Ferrier) continues in her PhD work analyzing data from expansive instrumentation in the Driftless (Wyalusing, WI), where the co-evolution of hydrology and landscape is expanding our understanding of Critical Zone processes.

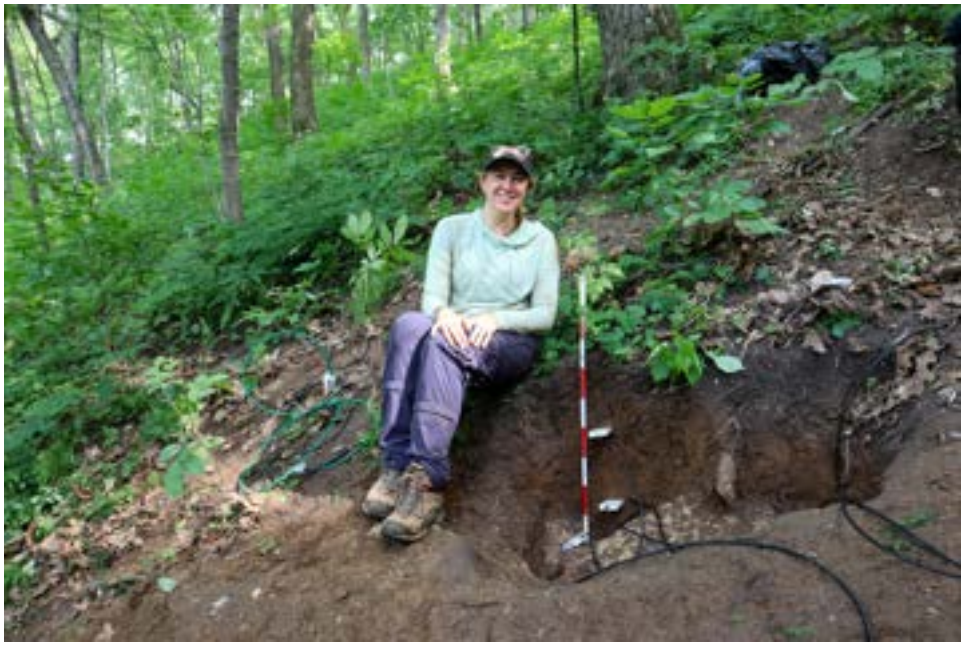
With new hydro-colleague **Athena Nghiem** arriving and teaching for the first time this year, our ability to consistently offer—and think about expanding—our hydrology course offerings is greatly enhanced. Groundwater Flow Modeling and Contaminant Hydrogeology have undergone significant revisions over the past year to prepare students in the latest Python / FloPy-based modeling techniques, and we expect to offer a new introductory-level water-focused class soon! We continue to hear from our alumni about the high demand for well-trained hydrogeologists across industry, government, and research agencies, so training our undergraduates and MS students continues to be rewarding.

It's nice that I've been able to take a break from service this past year. Well, other than being Department Chair, which has meant running our 50th-year Weeks Hall anniversary celebration, leading faculty meetings, submitting numerous tenure and promotion dossiers, navigating the changes to the federal funding landscape, monitoring multiple remodeling projects, and so on. As usual, support from **Michelle Szabo** (Department Manager) has been invaluable in helping when all these balls are in the air at once. And now that I'm working more with our administrative systems, I understand every day how much credit staff members **Sue Hyatt**, **Cindy Luo**, **Shirley Baxa**, **Lisa Theo**, **Josh Benish**, and **Bryan Wathen** deserve for steering this ship and making sure that finances, award spending, our graduate program, our computers, and our building (respectively) keep working. It's been a ride, and I'm glad they're on it with me.

ANDREA DUTTON

After multiple years of construction, 2024-2025 saw an exciting new phase in the development of my lab: we hired a lab manager and installed our Nu Plasma 3D mass spectrometer! Lab Manager + Researcher Dr. **Emily Mixon** joined our group in August 2024. We have been busy troubleshooting (both the instrument and the lab space) and working our way towards method development.

In the meantime, my graduate students have been busy completing research projects and carrying out a range of impressive science communication work. **Alex Villa** (co-advised by Steve Meyers) defended her PhD in August of 2024 and moved to Bremen, Germany for a research position at MARUM. PhD candidate **Rudy Molinek** is currently writing up his dissertation after traveling to the University of Florida to complete a final round of paleomagnetism data collection with our collaborator **Rob Hatfield**. Alongside his science, Rudy completed the AAAS Mass Media Fellowship in 2024 with Smithsonian Magazine. His science communication work has been recognized by the National Academy of Sciences and the Geological Society of America. PhD Candidate **Mel Reusche** (co-advised by Shaun Marcott) traveled to Mexico in January 2025 to complete a second season of fieldwork in the caves at Rio Secreto to learn more about past sea level



Cardiff group member Rachel Breunig with hard-fought installation on a 45° slope, for soil moisture monitoring

history on this coastline of the Yucatan Peninsula. She presented this work at AGU 2024. **Sophia Pinter** completed the second year of her PhD and has already assembled an impressive dataset of U-Th ages of fossil corals recovered from IODP Exp 389: Hawaiian Drowned Reefs. She presented her work at the IODP post cruise meeting in Hawaii in August 2025 (supported by the Shelburn Award for conference travel). In the spring, Sophia was awarded the James D. and Stella M. Robinson RA.

NSF Postdoctoral Fellow Dr. **Kyle Fouke** (PhD UT-Austin) just joined our lab group and will be combining observations of nanoscale carbonate petrography using super high resolution autofluorescence microscopy with U-Th dating of fossil corals from several sites around the globe that are in our sample collection to answer questions about ephemeral exposure during past sea level oscillations. Welcome, Kyle!

We received media coverage in The Guardian and Forbes that includes a critical review of what +1.5°C means for polar ice sheets and work highlighting the asynchronous contributions to sea-level from individual ice sheets during the last interglacial. I have been busy coordinating the dating team of the IODP Exp 389: Hawaiian Drowned Reefs to provide a chronology to reconstruct past sea level change as well as climate records from the corals and evidence of reef response to changing climate and sea level. This work is supported in part by a grant from the Australian Research Council which will facilitate collaboration with some of our international colleagues.

KURT FEIGL

This year, I continued to work on geothermal energy. As described in the cover article of Outcrop 2022, the WHOLESCALE project has been measuring and modeling the San Emidio geothermal field in the Basin and Range Province of northwestern Nevada. The project is named WHOLESCALE in (yet another forced) acronym that stands for "Water & Hole Observations Leverage Effective Stress Calculations and Lessen Expenses". Between 2020 and 2024, the project was supported by the Geothermal Technologies Office of the U.S. Department of Energy.

Professor Dutton delivers her oral testimony at a U.S. Senate hearing in January 2024.

The team is strong because we combine expertise from two universities, two national laboratories, and one industry partner. At the University of Wisconsin-Madison, the WHOLESCALE team includes faculty members **Kurt Feigl**, **Mike Cardiff**, **Cliff Thurber**, **Herb Wang**, as well as **Jesse Hampton** and **Hiroki Sone** in Civil and Environmental Engineering (all of whom have been affiliated with the Geological Engineering – GLE – Program). We rely on exceptionally competent staff members, including Distinguished Instrumentation Engineer **Neal Lord** (B.S. Electrical and Computer Engineering & B.S. Computer Science 1987, and Instrumentation Engineer **Peter Sobol**. Participating graduate students have included: **Zirou Jin** (Ph.D. GLE 2022), **Collin Roland** (Ph.D. Geoscience 2025), **Ben Jahnke** (M.S. GLE 2022), **Samantha Kleich** (M.S. GLE 2024), **Anya Wolterman** (M.S. CEE 2025), and **Oddy Mudatsir** (working toward Ph.D. in GLE). Thanks to **Sabrina Bradshaw** (B.S. Geology & Geophysics 2005, M.S. GLE 2008), **Michelle Szabo** (B.A. 1993) and **Chelsie Propst** (B.A. Voice & Opera, 2012; Ph.D. Musicology & Ethnomusicology, 2017), the technical and financial reporting is complete.

The WHOLESCALE results support the working hypothesis that increasing pore-fluid pressure reduces the effective normal stress acting across fault zones. During normal operations, pumping in deep production wells decreases fluid pressure and thus increases the effective normal stress on faults. During planned shutdowns, the cessation of production increases pore-fluid pressure and reduces the effective normal stress. The WHOLESCALE products include: three articles published in the open-access, peer-reviewed scientific literature, two master's theses, 20 presentations or papers at scientific conferences, and 17 data sets available on public repositories. I'm looking forward to writing several more papers on the topic.

KEN FERRIER

Associate professor **Ken Ferrier**'s Earth Surface Evolution group had an eventful year! Congratulations are due to **Rachel Breunig**, who won a Best Student Presentation award at the Wisconsin American Water Resources Association meeting in spring 2025. She continues to make progress investigating the influence of bedrock erosion and sediment deposition on crustal stresses around volcanoes in Chile as part of the IF-AMPS project, led by PI **Brad Singer**. With Rachel's co-advisor Professor **Mike Cardiff**, she has been collecting hydrologic and geochemical data investigating the influence of atmospherically deposited sediments on Critical Zone hydrology, geochemistry, and topography

at Wyalusing State Park in southwestern Wisconsin. She has recruited a number of Geobadger students to help out with field assistance, including mentoring undergraduate student **Ella Flattum**—a visiting researcher supported through the Freshwater@UW summer research program—during the exceptionally rainy summer of 2025, which made field work substantially muddier than expected.

Aidan Lewandowski continued working in our group as a research intern on developing a model for the coupled evolution of topography and sea level, with the aim of improving interpretations of past and present sea-level changes. She completed her work with our group in summer 2025 and is moving on to start a PhD in the Earth and Planetary Sciences department at the University of California Santa Cruz. Congratulations Aidan!

UW Geology Museum Associate Director **Brooke Norsted** has been doing an exceptional job leading an outreach program for students at Bayview Community Center supported by Ferrier's NSF CAREER grant. Finally, Ferrier, **Eva Golos**, and **Marianne Haseloff** published a new data compilation of course requirements for geoscience undergraduate majors at peer institutions across the United States, which helps put our own department's undergraduate program in context and which is publicly available at https://zenodo.org/records/13368469.

Eryck and Eva discovered a seismic station on Mocho Choshuenco, during the field trip to Chile, January 2025 (see more on page 17).

EVA GOLOS

This has been an exciting year for the seismology group! We wrapped up the Alaska Broadband Accessory Deployment for GEophysical Research (Alaska BADGER) experiment in November 2024. For two years, we had deployed eleven broadband seismographs on the Kenai Peninsula of Alaska, listening to earthquakes all over the world to perform seismic imaging of the subduction zone beneath the Cook Inlet. My collaborators at the University of Washington also finished data collection on fiber-optic cable in the Cook Inlet, which incorporates a new and exciting form of seismic investigation known as Distributed Acoustic Sensing (DAS). Now that the data are all collected, the fun work can begin of processing data, comparing our traditional land-based seismographs to the DAS dataset, and exploring the processes that occur at one of the Earth's most dynamic plate boundaries.

We had the exciting milestone of the first student graduation in the group. Congratulations to **Eryck Ochoa** for successfully defending his Master's Thesis in June 2025. Eryck's research explored a tricky and mysterious seismic signal called tremor, which has been observed in certain subduction zones. His work is an important contribution to seismologists' understanding of where and how earthquakes, tremor, and other seismic evidence of tectonic plate motion happen. We'll miss Eryck's positive presence, his field geophysics expertise, and his talents as a field trip grillmaster. We wish him the best of luck in his next role with the New Mexico Seismic Network.

This fall I am thrilled to welcome three new PhD students to the group: **Emmanuel Irumhe**, **Elizabeth Sunday**, and **Christina Lamar**. We are also joined by a postdoc researcher, Dr. **Siddharth Dey**. And of course, a warm welcome back to campus for our two continuing undergraduates, **Mustafa Aleid** and **Elizabeth Lucas**. I'm excited for the next stage in the group's evolution. Please stop by Weeks Hall 106 to meet the new swarm of seismologists!

LAUREL GOODWIN

This year's report highlights evidence of the value of local, national, and international collaborations to both graduate education and the advancement of science. It begins at home base, looking back with appreciation to Spring, 2023, when **Eric Stewart** of the WGHNS contacted the Structural Geology and Tectonics group with the goal of getting graduate students involved in an investigation of the South Range and Baxter's Hollow faults, which he had identified in outcrop and drill core, respectively, in the Baraboo Hills. PhD students **Matt Aleksey** and **Kaitlyn Crouch** jumped at the opportunity to get involved. Both found evidence of multiple episodes of faulting and fluid-rock interactions, which they recently explored further via oxygen isotope analysis in the WiscSIMS facility, pulling Prof. **Chloe Bonamici** and Research Scientist **Tyler Blum** into the study. Evaluation of these recently collected data is still underway; a foundational observation is that the South Range fault records interaction with a wider range of fluid sources than those recorded by the Baxter's Hollow fault.

In addition to making progress toward their PhDs, Kaitlyn and Matt have both learned from, and gained professional experience through, association with the excellent scientists at the survey. They are included as co-authors on a new map that was recently published. This collaborative effort has advanced our understanding of the nature of the Baraboo orogeny, which Emeritus Professor **Gordon Medaris**, Prof. **Brad Singer** and Scientist III **Brian Jicha** from our department, and **Esther Stewart** from the WGHNS, first defined in a Geoscience Frontiers paper in 2021. For Matt and Kaitlyn, the experience of working with professionals outside our department has been a valuable part of their education.

Back in 2010, **Evan Earnest**, co-supervised with Basil Tikoff, completed an M.S. in the Mt. Isa Inlier of Australia. His work integrated microstructural and finite strain analysis of veins that served as strain markers in a series of turbidite sequences we learned about from Professor Tom Blenkinsop, then on the faculty at James Cook University. That field camp served as home base for Evan's field work, providing food

and company as well as safety. Christie Gopon also built on his work. PhD student **Kyrsten Johnston** integrated all of these efforts, conducted additional analyses, and put together a paper that has just been resubmitted with revisions to the Journal of Structural Geology. Christie, now in Austria, and Evan, who completed a PhD in Hydrology at the University of Massachusetts after graduating from UW and recently took a position in development of hydrothermal energy in Utah, are coauthors. Tom, now at Cardiff University, is also a co-author who provided valuable commentary, questions, and revisions.

MARIANNE HASELOFF

This year we have seen a lot of changes in the glaciology group. Dr **Kai Hu**, who started his postdoctoral researcher position in summer 2023, moved on to a new position at McGill University in September 2025. During his time in the glaciology group, he worked on the dynamics of the Lake Superior Lobe of the Laurentide Ice Sheet, a water-terminating glacier that flowed through what is now Lake Superior. His results demonstrate that the opening of lake spillways during the ice sheet's climate-driven retreat (ca. 20,000 years ago) explains temporary advances of the ice sheet in a warming climate.

Also graduating from the group is **Campbell Dunn**, who defended her MSc thesis on subglacial hydrological pathways this summer. Subglacial hydrological conditions strongly influence how fast ice sheets move. These speeds can range from a few meters per year up to 1000 meters per year. Where ice flows on top of "soft" (that is, deformable and erodible) beds, for example till, these pathways can be simultaneously melted into the ice and eroded into the underlying bed. Campbell's thesis showed that the morphology and behavior of such conduits significantly differ from those found on other glacier beds. We wish Kai and Campbell all the best in their next endeavors!

We also welcomed several new members to the group: **Jaela Allen** is returning to the group as a PhD student, after having worked in the lab as an undergraduate researcher in summer 2024. Jaela graduated from Miami University in Ohio with a major in geology and a minor in mathematics. For her PhD she will work on modelling the dynamics of marine ice streams.

In addition, three undergraduate students joined the glaciology group this summer to work on their first research projects, and all of them will continue working with us during the school year: **Alexandra Spies** is a senior majoring in mathematics and physics, who is exploring feedbacks between ice temperature and flow which might arise from rough glacier beds. **Zoe Loschke** is a sophomore in Computer Science who is investigating the role of subglacial water flow on glacier dynamics. **Bethany Jarvis** is a sophomore in Data Science and she investigated the dynamics of surging glaciers in Svalbard, which oscillate between slow and fast flow. Her research was funded through UW's Letters & Science Summer of Excellence in Research (LASER) Program.

STEPHEN MEYERS

The Heising-Simons CycloAstro Project continues to be a source of excitement and productivity in the Astrochron Lab. Graduate Student **Ridwan Ajibade** successfully defended his MS thesis in October, which investigated Earth-Moon history using Bayesian analysis of cyclostratigraphic records from the Permian (290 Ma) and Proterozoic (2.5 Ga). His results provide powerful new constraints on our understanding of the Earth-Moon System. Dr. **Alex Villa** (UW Geoscience PhD, 2024) is now a postdoc at MARUM in Bremen, Germany, and we continue to collaborate on Eocene-Oligocene cyclostratigraphy & paleoceanography using IODP Expedition 390/393 cores from the subtropical South Atlantic (for which Alex was a shipboard scientist). Postdoc Dr. **Margriet Lantink** has been generating and evaluating new datasets for Proterozoic cyclostratigraphy, such as the 1.2-billion-year-old Hakatai Shale in the Grand Canyon, demonstrating that these iconic rocks hold answers to ancient astronomically-forced climate change and the history of the Solar System. Margriet's CycloAstro postdoc finishes at the end of August, and she has won a prestigious Veni award from the Dutch Research Council, to continue her investigations into the mysteries of the Proterozoic.

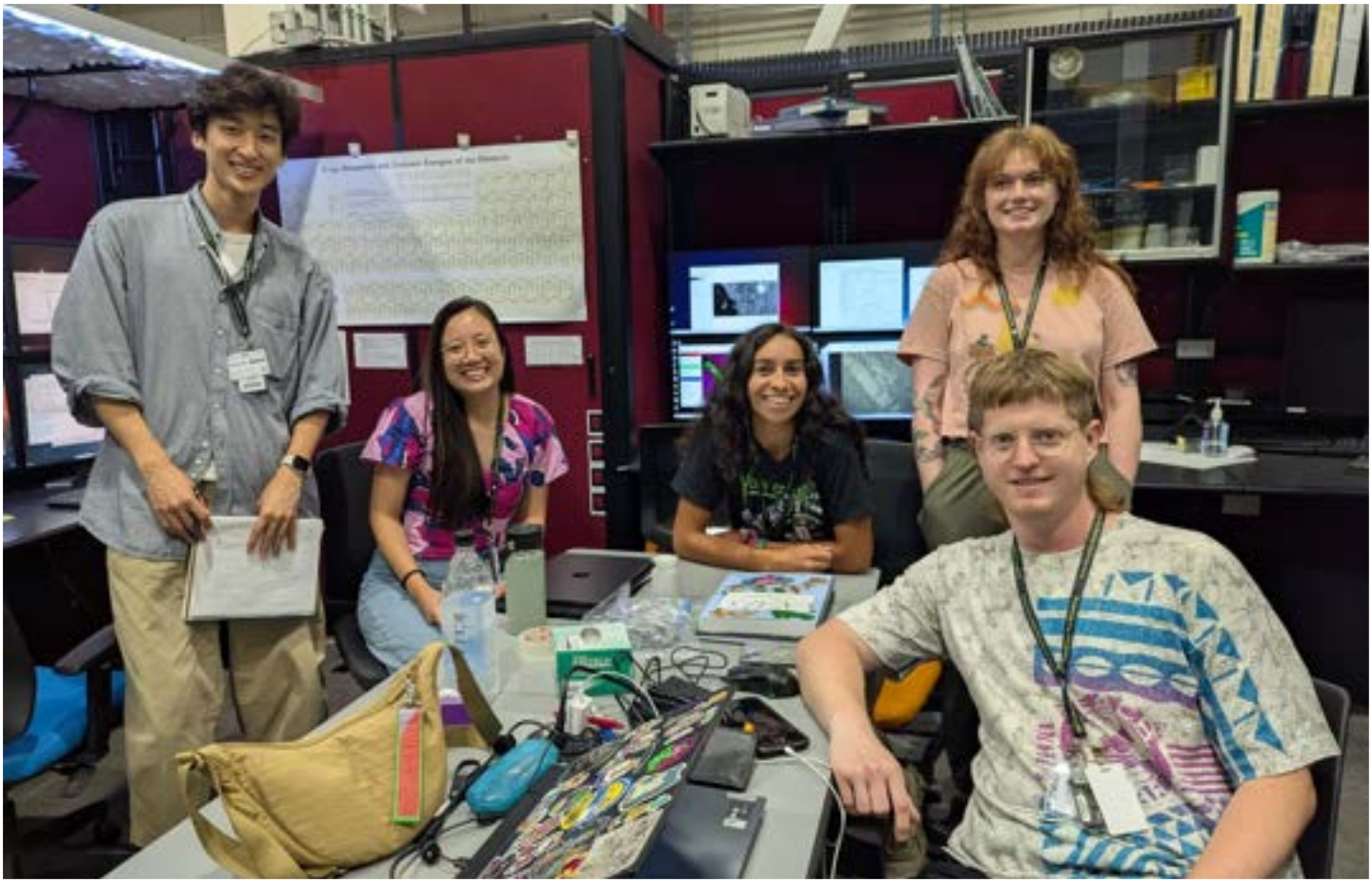
Honorary Fellow Dr. **Nick Sullivan** (UW Geoscience PhD, 2022) started a new postdoc at Pennsylvania State University in September, and in April he published his dissertation chapter that introduces a new model for Antarctic Ice Sheet evolution on the million-year timescale (Sullivan et al., 2025, Science Advances). Some additional research highlights include a CycloAstro Project publication on the history of the Earth-Moon System over the past 650 million years using Bayesian analysis of cyclostratigraphic records (Wu et al., 2024, Science Advances), and a BioDeepTime Project publication that uses the 'spectral continuum' from fossil pollen data to evaluate the response of vegetation to climate changes across a range of timescales (Fastovich et al., 2025, Science). This research was led by Dr. David Fastovich (UW-Geography PhD) and includes collaboration with Dr. **Jack Williams** (UW-Geography).

I spent fall 2024 at Lamont-Doherty Earth Observatory and then finished my Guggenheim Fellowship/sabbatical leave in January. I am very grateful for the opportunity provided by UW-Madison and the Department of Geoscience, to travel and work with colleagues at institutions across the planet during my research leave. It has been wonderful to return home and reconnect with our UW community – I look forward to sharing what I've learned over the coming years!

ATHENA NGHEIM

This has been an exciting and eventful first year for the Water And Trace Element Research (WATER) lab, led by **Athena Nghiem**! Our group investigates the biogeochemical cycling of trace elements, and how they impact important reservoirs and resources, such as groundwater.

We grew rapidly in size since Fall 2024, with **Juyong Bak** (Geoscience PhD student), **Logan Goulette** (Geoscience MS student), and **Savannah Finley** (PhD Candidate, Environmental Chemistry and Technology program, Civil and Environmental Engineering) all joining the group. We were busy setting up in the shared laboratory space with Prof. **Eric Roden** and hard at work on many new projects!



Ngheim group photo at microprobe beamtime at GSECARS at the Advanced Photon Source. From left to right: Juyong Bak, Professor Athena Nghiem, Savannah Finley, AnnaBeth Thomas, Logan Goulette. Photo credit: Nancy Lazarz at GSECARS (Advanced Photon Source, Argonne National Laboratory)

Bak is working on a collaborative Swiss National Science Foundation-funded project entitled "DeltAs", investigating long-term changes in arsenic pollution in the deltas of Vietnam. Arsenic (As) contamination occurs naturally in South/Southeast Asia, but can be anthropogenically exacerbated, e.g., by groundwater pumping. We are focused on understanding sediment geochemistry and integrating it into reactive transport modeling to explain these dynamics on a large scale. Based on decadal-scale changes in groundwater As measured by our collaborators at ETH Zurich, three sites were selected for coring and Juyong performed field work (during the monsoon season!) to collect cores in Hanoi, Vietnam with the support of our essential collaborators at the Hanoi University of Science. Athena also joined!

In addition, we also received an award for beamtime to perform synchrotron analyses at Advanced Photon Source at Argonne National Laboratory! Juyong is investigating the redox speciation that leads to As release and the whole group joined for X-ray absorption spectroscopy and microprobe measurements.

Logan is working investigating arsenic contamination in groundwater – but here at home in Wisconsin! Logan has started some exciting modeling work predicting arsenic speciation. Certain species of arsenic have faster mobility in the subsurface and can lead to faster contamination. Logan was awarded a GSA student grant to validate their model (congratulations Logan!) and we also successfully received funding from the WI DNR to explore this important topic further!

Savannah is a current NSF Graduate Research Fellow and kickstarted a new project investigating molybdenum – essential at low concentrations but toxic at high concentrations – in southeastern Wisconsin. There, sources of molybdenum in groundwater have been highly debated between anthropogenic vs. geogenic, but no measurements of the solid phase yet existed. She has been collaborating with the WGNHS and the excellent core repository facilities. Savannah also mentored an undergraduate from the Freshwater@UW Summer Research Opportunity Program (Malinda Batassa) to conduct groundwater sampling in southeast WI.

We also started a community-engaged project in Richland County with funding from Water@UW and the Morgridge Center for Public Service! Logan spearheaded the pilot groundwater sampling campaign and mentored two undergraduates in the LASER program (**Mohamed-Kheyr Abdikarim Ahmed** and **Fernanda Saavedra-Alonso**). Finally, in Fall 2025, we will be joined by **AnnaBeth Thomas**, who starts her post-doc with us! We are excited to celebrate the 1-year anniversary of our lab and are looking forward to next year!

SHANAN PETERS

Hello Geobadgers! News from the Macrostrat group is incremental, but all positive. Research Scientist **Daven Quinn** is still leading the charge towards a major technical overhaul and infrastructure shift for Macrostrat, in addition to serving as lead P.I. on two NSF awards focused on linking Macrostrat to Prof. **Basil Tikoff**'s StraboSpot and the Stanford-hosted SGP database. The technical backend/frontend work for these projects bring with them many challenges, most of which have been overcome. But, we have still not quite made the transition to "Macrostrat 2.0," which will eventually run in our campus CHTC. Hopefully Macrostrat 2.0 ships this fall and next year's report will highlight our success. This transition and our NSF project work is being helped along by Programmer Analyst **Amy Fromandi** and computer science student **David Sklar**.

Rockd App (check it out on the mobile App stores!) continues to be a huge success. Over 173K accounts have now been created and average daily usage of the App involves hundreds to thousands of individuals from around the globe. In recognition of this reach, alumni **Bill Morgan** and **Martin Shields** helped us to secure a small, but extremely fortuitously timed grant from the AAPG Foundation to update Rockd and add a column viewing feature. Undergraduate computer science major Gil Friedman, who discovered our group via my Geosci 110 Evolution & Extinction honors section, helped developed some ML-based image recognition and assessment tools for our backend deployment, with support by an award from the UW Honors program.

On the science front, Ph.D. candidate **Evgeny Mazko** continues to amass an exciting comprehensive macrostratigraphic dataset for the eastern European and Siberian platforms, and he was involved in a side project this summer on sandstone petrology in Macrostrat, with support from a retired energy industry professional interested in Macrostrat's take on the problem. Ph.D. candidate **Aaron Kufner** is poised to defend his thesis on all-things metoposaurid, but he was also a key player in a study that made quite a splash! Working with **David Lovelace** in the Geology Museum and others, they published a paper on the oldest known dinosaur fossil from North America. Former student **Daniel Segessenman** also published a paper in Precambrian Research on macrostratigraphic analyses of carbonate sedimentation in the Ediacaran and the Shuram-Wonoka carbon isotope excursion. Former student Shan Ye continues work with the group as well and we hope to soon submit a manuscript on the Cretaceous system in North America, which was part of his dissertation. As for me, I still serve as the technical lead for the Paleobiology Database, with Programmer Analyst **Michael McClennen** taking point on implementation. Remarkably, we just received a 3-year NSF Geoinformatics award, which will ensure the PBDB is able to grow into the future. A couple of other collaborative, Macrostrat and PBDB-grounded studies were also published this year. As always, I will close with a nod to our alumni, whose generous support helps our department in many ways. Thank you!

BRAD SINGER

Following a second stint as Department chair from 2020 through 2024, a much-needed year of leave was in order, for which I greatly appreciate support from our college (Chair's research leave) and university (sabbatical leave). I received a Fulbright Scholar award to begin a review synthesis of the geology, geochronology, and petrology of the 80 volcanoes that comprise the Andean Southern Volcanic Zone. I was based at the Universidad de la Frontera in Temuco, Chile from August through December, 2024. In addition to advising the research of PhD student **Pablo Moreno-Yaeger** and MS student **Jack Stalla** on Villarrica and Osorno volcanoes and how each responded to the rapid disintegration of the Patagonian Ice Sheet between 18 and 16 ka, I was able to explore many regions of Chile on my gravel bike. During January, 2025, I also led a 16-day field trip along the Southern Andes that is described elsewhere in this issue.

From March through June, 2025 I was a Japan Society for the Promotion of Science Invitational Fellow in residence at Tohoku University, Sendai, Japan. I continued to expand research on the chronology of the enormous Cretaceous sedimentary system preserved in Hokkaido with collaborator Reishi Takashima. As in Chile, **Teri Boundy** joined me with her gravel bike for many long rides along the coast and in the mountains of Honshu. Perhaps our most memorable ride was the 5000-foot climb over 17 miles from Fujikawaguchiko to the 5th station of the Subaru Line, the highest paved road on Mount Fuji Volcano at 8000 feet high. I can highly recommend blending research with cycling in both Chile and Japan.

Brad and Teri on a 30-mile gravel bike traverse through Conguillo National Park, Chile. The 9200-foot high Llaima Volcano on the skyline is among the most active in all of Chile.

HUIFANG XU

Graduate student **Tianyu Zhou** continues studying Precambrian iron formation process with a focus on the effect of carbon dioxide levels on the formation process of carbonate BIFs. Visiting graduate student **Jianru Cheng** worked on a new proxy of carbonate dryness index (CDI) based on anhydrous carbonate minerals (calcite, dolomite and magnesite) for characterizing hydroclimate changes recorded in Deep Springs Lake, California (https://doi.org/10.1029/2024GL114377) and stromatolites from the Green River Formation, Wyoming to reveal decade-scale to centennial scale climate changes. The new CDI proxy can record extreme drought events better than traditional tree ring methods for estimating soil moisture when tree records did not exist in the studied sites.

I worked on measuring dolomite growth rates in the presence of dissolved silica as a catalyst. We used flow-through fluid cell and in-situ XRD methods at Argonne National Laboratory to study dolomite growth on seed crystals at different temperatures. I also collaborated with Prof. **Shuhai Xiao** of Viginia Tech and former graduate Dr. **Seungyeol Lee** of Chungbuk National University on understanding mechanisms for exceptional preservation of phosphatized embryo-like microfossils from the Ediacaran Doushantuo Formation (https://doi.org/10.1130/G53415.1). A key finding is the presence of a thin (~1 nm), conformal coating of amorphous silica intimately associated with crystallographic facets of the fluorapatite nanocrystals. The silica sheathing may have contributed to the long-term preservation of the embryos by helping to protect the nanocrystals from recrystallization and potentially enhancing structural stability during processes such as diagenesis and low-temperature alteration. It highlights the critical role that nanoscale interactions and mineral coatings can play in preserving and stabilizing the micro- and ultrastructures of phosphatized microfossils.

CHRIS ZAHASKY

It has been an exciting year for the Subsurface Hydrophysics Lab. New graduate student **Mady Erb Suciu** joined the group in July 2025. She is spearheading a new collaborative project with **Matt Ginder-Vogel** (Civil and Environmental Engineering) and **Madeline Gotkowitz** (WDNR, PhD UW-Madison 2015) to investigate radium mobility and aquifer flow dynamics in groundwater wells supplying small municipalities in Southeastern Wisconsin. The research is exploring processes that lead to radium mobility and elevated concentrations in drinking water, including impacts of well construction and water use. In addition to working on geogenic contaminants, our group continues to expand research on PFAS fate and transport in groundwater systems. **Paul Summers** completed his M.S. degree titled "New modeling frameworks for assessing risk and uncertainty associated with long-term PFAS contamination in groundwater" in August 2025 and is sticking around to do a PhD. **Adam Ornelles**, a second-year PhD student, is running complex meter-scale column experiments that mimic groundwater table fluctuations to better understand the impact of transient water saturation conditions on PFAS transport through the vadose zone.

Two students in the group received prestigious national awards this year. **Eleanor Louise**, a second-year MS/PhD student, was awarded an NSF Graduate Research Fellowship in Spring 2025 and is working to study how subsurface flow and transport is impacted by freezing and thawing cycles. Eleanor is currently conducting experiments in collaboration with Luke Zoet to examine the process of cryosuction, which describes capillary flow under freezing conditions. This research will help improve the current understanding of flow dynamics in cold regions and areas that are impacted by freeze-thaw events, like Wisconsin. **Collin Sutton** spent the fall of 2024 at Los Alamos National Laboratory as a part of a Department of Energy Office of Science Graduate Student Research Fellowship and defended his PhD in June 2025 (the first PhD graduate out of the Subsurface Hydrophysics Lab)! Collin was awarded an NSF postdoctoral fellowship titled "Reactive transport in fractured networks: a bipartite graph approach for rapid and accurate prediction". Collin will work with researchers at Colorado School of Mines and Los Alamos National Laboratory, where the project aims to combine field data from the Sanford Underground Research Facility with a new graph-based modeling framework to improve our understanding of reactive fluid and solute transport in fractured rock.

Vy Le (right) and Geoscience undergraduates Callie Karsten (middle) and Audrey Wallander (left) doing field work on Blackhawk Island along the Wisconsin River.

PhD student **Vy Le** has been busy mentoring undergraduate students, including UW-Madison undergraduate students **Callie Karsten** and **Audrey Wallander**. This summer, she also supervised **Sarah Daley**, a Water@UW Summer Research Opportunities Program (SROP) Fellow. Vy is working on a project titled 'Quantifying the Impact of Spatial and Temporal Variation in Hyporheic Zone Fluxes on Phosphorus Transport and Release in Wisconsin Streams and Rivers'. This summer the project received a four-year funding extension from the Freshwater Collaborative of Wisconsin, a new state program leveraging the 13 University of Wisconsin institutions and the Wisconsin Idea to lead the global community in addressing freshwater challenges.

EMERITUS FACULTY AND STAFF

JEAN BAHR

Jean and Tom's 2025 travel adventures included a trip to Cyprus in April to see the famous ophiolite exposed in the Troodos Mountains and the ancient copper mines in the surrounding foothills. At the end of the geology trip, we spent a few days in Larnaca and Paphos exploring archeological sites and history museums. We also enjoyed a stopover in London en route. We returned from Cyprus and immediately began a move from our condo on the San Francisco Peninsula to a cute, one-story house in north Berkeley. We hope that this will be our last major move. It is within walking distance of lots of great restaurants, easily accessible to the UC campus for lectures, concerts, and other activities, and two blocks from BART that takes us into San Francisco. Between the Cyprus trip and the move, we didn't manage to get to Madison this spring. However, we do plan to make it to Wisconsin in the fall for an extended stay. Before that, we have another geology trip, this one to the southern French Alps with many of our Association for Women Geoscientists friends. Jean is looking forward to seeing former students and colleagues at the GSA meeting in San Antonio where she will be receiving the Hydrogeology Division Mentor Award.

Jean Bahr on the rocks in the Troodos Mountains

DAVE MICKELSON

Dave and Vin continue to live in Madison part time and about half-time an hour west in Mineral Point. They are still leading a few field trips for the Wisconsin Natural Resources Foundation and a couple of other organizations. A high point of this summer for was a revisit to Glacier Bay, AK where Dave did his Ph.D field work in 1969 and 1970 (and where many former students have visited)! Things have changed!! The Burroughs Glacier is still there but is now less than 1 km long. It will disappear by the end of this summer to be replaced by a mile-long lake and lots of alders! Dave presented a paper on the ice disappearance in a small symposium when there. Vin and Dave enjoyed a great day tour to Johns Hopkins Glacier, then had a short visit in CA with long-time friends Bill and Ann Newman.

CLIFF THURBER

Five years after retiring from teaching, I am quite happy continuing to do seismology research on a range of topics. My collaboration with research scientist Hao Guo continues to be quite fruitful, with new developments in the areas of seismic attenuation and earthquake source properties. I continue to work on data from the WHOLESCALE project led by **Kurt Feigl**, finding remarkable patterns in the space-time distribution of induced seismicity following shutdowns of the geothermal power plant at San Emidio, Nevada. I am also working on a new approach to joint tomographic inversion combining body-wave data, surface-wave dispersion data, and Rayleigh wave ellipticity data. I continue to collaborate with former post-doctoral scientists **Xiangfang Zeng** and **Haijiang Zhang**, and enjoyed visiting them in Wuhan and Hefei, respectively, the past two years.

On the personal side, travel to see our younger daughter and her family in Australia is a top priority. We are fortunate that our older daughter and her family are close by in Madison. It is wonderful having four grandchildren, I just wish two of them weren't so far away. Wildlife is our other travel priority, with recent trips to Brazil and Tanzania being the main highlights.

JOHN VALLEY

John Valley continues to enjoy his sabbatical-like research. He has funding from ERC (European Research Council) to collaborate with colleagues in Madison, France and Germany. His group is especially interested in zircons and melt inclusions (MIZs), trapped as glass within zircons of all ages (Hadean to Pleistocene). These tiny time capsules record clues to the growth and evolution of Earth's crust but are complex to decipher. Three ERC post-docs graduated to Research Scientist positions over the past year. **Kei Shimizu** is at the NASA Johnson Space Center in Houston; **Laura Crisp** is at ANU, Canberra, Australia; and **Joe Gonzalez** is at the NY Geological Survey in Albany. Kei's study built on work by **Jake Klug** and **Brad Singer**. He showed that water content is preserved in MIZs at Laguna del Maule (Chile), but that many zircons are older than the 20 ka rhyolites that enclose them. Joe has optimized high-pressure heating experiments to homogenize devitrified MIZs in 3.3 Ga zircons from the Barberton Greenstone belt (S. Africa). **Emily Mixon** defended her PhD last year advised by **Annie Bauer** and **Tyler Blum**. She used SIMS analysis of zircons to constrain crustal growth and tectonic settings in the Archean. Emily is now a Research Scientist working with

Andrea Dutton. In June, John submitted a paper reporting trace elements in zircons that suggest subduction (but not necessarily plate tectonics) was active throughout the Hadean. These analyses were facilitated by new WiscSIMS procedures developed by Tyler and Kouki Kitajima. In January, John hired **Huili Zhang** (PhD, Nanjing University) and **Jin Lui** (Associate Professor, Jilin University) to continue the ERC project. They both moved to Madison before the inauguration. Fortunately, the ERC funding comes from Europe and is not subject to the whims of Washington, which otherwise have us tied in knots with worry. Since January, John has joined with other members of the National Academy of Sciences in signing three open letters to the Trump Administration, to Congress and to Secretary Rubio requesting strengthened support of science and medicine, and immigration rights for students and scholars. Unfortunately, things seem to be veering in the other direction.

Get-together of current and former Badger geophysicists at the 2024 Annual Meeting of the Seismological Society of America in Anchorage, AK. Clockwise from left: Guoqing Lin (University of Miami), Summer Ohlendorf (National Tsunami Warning Center), Hao Guo (UW-Madison), Eva Golos (UW-Madison), DJ Miller (Sandia National Lab), Ben Heath. Ellen Syracuse (Los Alamos National Lab), Jessica Feenstra (Golder Associates), Cliff Thurber (UW-Madison), Chad Trabant (EarthScope Consortium), Renata Hart (University of Washington), Mike Brudzinski (Miami University), and Jeremy Pesicek (USGS Volcano Disaster Assistance Program).

Observing ice-dammed lava flows on the east flank of the Mocho Choshuenco volcano during the January 2025 field trip in Chile (see page 17 for more details). Photo credit: Rachel Breunig

COLLECTIONS

It is our honor to be the new home of the extensive mineral collection of Distinguished Alumnus **Stephen Guggenheim** (PhD 1976). This impressive assortment of nearly 900 minerals is impeccably curated and reflects a lifelong passion. Assembled with a mineralogist's eye from localities around the world, Steve personally collected many of his specimens. In grade school, he fashioned a homemade blacklight with his father to find fluorescent material from Franklin, New Jersey. On a trip to Bancroft, Ontario, he and his wife battled biting flies to pick apatites out of billion-year-old host rock. Adventurously, he traveled to Picher, Oklahoma, a town that is now so toxic from lead and zinc mining that it was evacuated and declared uninhabitable in 2009, to find galena that the area was known for. We are grateful to Steve for entrusting us with his wonderful collection and to **Huifang Xu** for helping facilitate this donation.

Beyond the 1,000 specimens on display, the Geology Museum's holdings are vast, with over 250,000 objects in the whole collection. Museum Curator **Carrie Eaton** routinely tackles a smorgasbord of requests to borrow specimens for wide ranging projects. This year, UW Art professor Helen Lee curated an exhibition titled "Spheres of Influence: Glass Across UW" which included a dozen Geology Museum specimens. Our materials were also checked out by UW-Madison intro biology labs, an Edgewood College paleontology course, and by **Zach Adam** for use in his class "Planetary Microbiology: What Life Here Tells Us About Life Out There".

It takes a steady hand to number and catalog specimens! Museum student worker Grace Grahek has been working on upgrading the storage and data for fossils in our collection. One method used is to write specimen numbers on archival rice paper and then carefully glue these thin strips to the specimens. Here she is working on mosasaur ribs from the Niobrara Formation.

Ward's Science is a company familiar to many teachers as a supplier of scientific materials for classrooms. Its origins stretch back to the 1800s when naturalist Henry Ward would travel the world collecting and making replicas of specimens to then sell to museums. Our glyptodon is a "Ward's" specimen, purchased and put on display in 1888. This past year we upgraded our glyptodon display, adding a replica piece of tail ring along with new signs to help visitors learn about this peculiar creature. Along with the glyptodon signage, two other museum "old timers", the Deinotherium (also on display since 1888) and Wisconsin Mastodon (unveiled in 1915) got new placards that provide visitors with fresh information on these familiar fossils.

Under Carrie's guidance, a number of undergraduate students collectively devote around 1,000 hours each year to helping curate and care for the collection. This year a special shout-out goes to **Annemarie Goncalves** who provided critical help to the Fossil Preparation Laboratory by cataloging specimens from previous field seasons, doing the careful work of connecting field notes and numbers with freshly cleaned fossils. She then ensured that the specimens and all of their data were safely and securely stored in the repository and collections database. This "behind the scenes" work is critical to successful publications, and in this case supported geoscience PhD student **Aaron Kufner** and Museum Scientist **Dave Lovelace**.

RESEARCH AND FIELD WORK

As the saying goes, "when it rains it pours", and this year was a soaker for **Dave Lovelace** and the museum's research enterprise! Three important publications came out, two of which introduced newly named fossils, Ninumbeehan dookoodukah and Ahvaytum bahndooiveche, and one (by lead author **Aaron Kufner**) described the taphonomy of a Triassic bone bed found in Wyoming. Both Ninumbeehan and Ahvaytum represent the success of five years of relationship-building with the Wind River Reservation, resulting in the elders and school-aged children naming these two creatures.

Field crew members Alex Garcia-Gonzalez and Jack Gardner proudly hold a field jacket containing a discovery from the Hoopla site in Wyoming.

Remarkably, Ahvaytum bahndooiveche is the oldest dinosaur in the northern hemisphere. Known from a single element, that piece is now the most important and valuable ankle bone (or astragalus) in the museum's collection! By examining this specimen closely, Dave and his co-authors concluded this new dinosaur is a very early-diverging sauropodomorph around 15 million years older than the next oldest one.

This year also saw the global premier of the What's in a Name Documentary, which captures and shares the museum's scientific partnership and work with the Northern Arapahoe and Eastern Shoshone Tribes in Wyoming. Directed by **Ethan Parrish** (PhD 2024), this film debuted at the Society of Vertebrate Paleontology annual meeting in fall of 2024. Since then, it has been shown at the Wisconsin Film Fest, nominated for Best Wyoming Documentary at the Wyoming International Film Festival and is slated to be available online by end of 2025.

The documentary was also shown on the Wind River Reservation (WRR) this summer when our field crew was invited to attend and present at the 65th Annual Eastern Shoshone Powwow. Dave and the students hosted a showing of the documentary and set up

hands-on tables where community members could learn about our collaborative work and practice cleaning fossils themselves. Over the past year our team also worked with Fort Washakie School students in a year-long project that will lead to the creation of a display in their school about fossils found on their reservation.

Following the powwow, the field crew was treated to excavating in one of the most scenic spots our team has done work. Called "Hoopla" because the students who named it in 2019 thought the prospect of finding bones in this place sounded like a lot of hoopla, it has thankfully lived up to the hype! Surveys in the past few years identified a productive layer and this summer many tantalizing isolated elements were found, representing a number of different critters. This site has lots of promise and we're looking forward to another summer of discoveries ahead.

OUTREACH

Like clockwork, at 6:30 pm on the fourth Tuesday of each month, Museum Director **Rich Slaughter** unlocks the Lowell R. Laudon Lecture Hall, flicks on the lights, and fires up the projector—ready to welcome local rock hounds and geology enthusiasts to the Madison Gem and Mineral Club meeting. Since 2001, Rich has hosted over 230 meetings for this civic group, which is one of the pillars of geoscience education in Dane County. This year, as a demonstration of their commitment to supporting the next generation of geoscientists, they are launching an undergraduate scholarship fund in honor of local legend, Burnie Franke, who opened Burnie's Rock Shop in 1962 and was a founding member of the club.

Museum Associate Director **Brooke Norsted** continues to run a bi-weekly "Geology Club" for kids aged 5-11 at Bayview Community Center as part of **Ken Ferrier**'s NSF CAREER grant. Located less than a mile from Weeks Hall, Bayview is a nonprofit organization providing affordable housing and supportive services to 300 low-income residents, primarily immigrants and refugees. Over the grant's five-year duration, the after-school activities are following a "source to sink" theme with this past year focusing on beaches. Kids made sandstone (with sugar, sand, and water), investigated porosity, and practiced being sand detectives (matching sand with its source rock).

Brooke also debuted a new outreach tool, the Deep Time Shuffleboard, at the Wisconsin Science Festival in the fall. This game was fabricated and launched with funding from one of **Brad Singer**'s NSF grants and now is rolled out for museum events and can be taken off-site as well. The bright, fun gameboard was designed and painted by local artist Emily Balsley and features Wisconsin geological events. Players slide a puck down the deck, landing on an event (perhaps the formation of Baraboo quartzite or the tropical Paleozoic seas) and then they get to learn about and hold a specimen that captures that time period (cross-bedded quartzite! 450-million-year-old sea creatures!).

As a part of Deep Time Shuffleboard, players get to see specimens that correspond to the spot they landed on the gameboard. Here Anna Martin (dressed as Daphne from Scooby Doo) shows a dinosaur vertebra at the Museum's Behind the Scenes Night (an event close to Halloween, so costumes are encouraged!).

Rich Slaughter and local rockhounds at a meeting of the Madison Gem and Mineral Club, one of more than 230 gatherings he has hosted of this group.

DISTINGUISHED ALUMNI AWARD

EVAN K. FRANSEEN

For Significant Contributions to the Fields of Carbonate Stratigraphy and Sedimentology and as an Advocate for Geoscience (William Morgan, citationist)

Evan K. Franseen received his B.S. (1981), M.S (1985), and Ph.D. (1989) in geology from the University of Wisconsin-Madison where he studied carbonates under Lloyd C. Pray, first in the Permian Guadalupe Mountains of West Texas and New Mexico (M.S.), and then in southeastern Spain where he worked on Miocene carbonates and, not incidentally, met his future wife Michele while doing fieldwork.

He joined the Petroleum Research Section at the Kansas Geological Survey (KGS) as a research scientist and later formed and was head of the Stratigraphic Research Section. In 2007 he attained a joint appointment as a Professor in the Department of Geology at Kansas University (KU) and Senior Scientific Fellow at the KGS and also became a co-director of an industry-sponsored consortium at KU. He retired in May of last year and holds emeritus status with both organizations.

His research primarily focuses on the sedimentology, sequence stratigraphy, and diagenesis of carbonate and mixed carbonate/siliciclastic systems in outcrop and the subsurface, including the Cambro-Ordovician, Carboniferous, and Permian, of the Midcontinent and Permian Basin, and Oligocene, Miocene, and Pliocene carbonate systems of southeastern Spain and the Caribbean.

In particular, his work on the mixed carbonate/siliciclastic systems of the Miocene of Spain yielded landmark contributions to the quantification of controls on sequence architecture, including paleoslope, accumulation rate, paleoclimate, rate and amplitude of sea level change, as well as the pinning point technique for quantifying relative sea level history.

Evan has authored more than 200 scientific publications and reports, convened numerous conferences, and edited 3 books; leading to his receiving nine "excellence of presentation" awards at national and international meetings and four acknowledgments of excellence and best paper awards for papers published in key professional journals. He received the Honorary Membership Award from the Society for Sedimentary Geology (SEPM) in 2023.

Teaching, training, and mentoring have been important components of his activities, with most of his research involving graduate students, having served as an advisor for ~30 graduate students.

He has been an advocate for geoscience by serving on numerous geoscience committees, leading society-sponsored field trips, and as SEPM Councilor of Sedimentology (2009-2011), SEPM President (2013-2014), and by being on the editorial board of Geology and as an Associate Editor for Palaios. In addition, he has served this Department as a Member of the Board of Visitors.

Evan and Michele make their home in Lawrence, Kansas, but with frequent trips to southeastern Spain.

ALUMNI NEWS

Christy Smith

I had a wonderful (solo road) trip to Wisconsin for our Half Century Celebration for the Class of 1975. Great fun at all events: the day of learning with Bill Morgan introducing Andrea Dutton and her talk on climate change, the tour of the Kohl Center, the ice breaker at Tripp Commons in the Memorial Union, and the Half Century Dinner where we were inducted into the Half Century Alumni Club. Then, of course, the Badger game preceded by the Badger Bash. Sunday we finished up with the farewell brunch at the Fluno Center. It was all very well organized and provided a very busy, educational, and meaningful weekend for those participating. I'm sorry we didn't get a chance to visit the department. This was one of my few trips to Madison where a visit was NOT made. However, our hearts and minds were there in our conversations and reminiscing on classes and professors past. Randy Billingsley, Bill Morgan, Doug Nease, and myself were "representing."

Weeks Seminar Speakers 2024–2025

Fall 2024

September 6, 2024
Dept. of Geoscience, UW-Madison
Chair's Welcome & Research Group Lightning Talks

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September 13, 2024
Ross Maguire,
University of Ilinois
Shallow magma accumulation below Yellowstone Caldera

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September 20, 2024
Mike Kipp, Duke University
How precisely can we quantify oxygen levels in the ancient ocean?

• • •

September 27, 2024
Kevin Rosso, Pacific Northwest National Lab
Ion relaxation dynamics at mineral-water interfaces: Understanding electrical geophysical signatures of the subsurface

• • •

October 4, 2024
Sophie Nowicki,
University of Buffalo
Understanding and projecting the Antarctic and Greenland ice sheets: a community challenge

• • •

October 11, 2024
Roger Creel, Woods Hole Oceanographic Institute
Retreat, regrowth, and rapid thinning: reconstructing the Holocene history of the Antarctic Ice Sheet

October 25, 2024
Till Wagner, UW-Madison
Birth, life, death, and legacy of icebergs

• • •

November 1, 2024
Mike Gurnis, Caltech
The churning interior of planet Earth—a view of the Pacific over the Cenozoic

• • •

November 8, 2024
Summer Praetorius, USGS
Paleoceanographic insights into the viability of a coastal route for early human migrations into North America

• • •

November 15, 2024
Joanna Millstein,
Colorado School of Mines
From crevasse to iceberg: Investigating fracture processes and calving on Antarctic ice shelves

• • •

November 22, 2024
Sid Hemming,
Columbia University
Probing Antarctica's glacial history with marine sediments from iceberg alley

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December 6, 2024
Jonathan Caine, USGS
Bedrock geology of and damage along the Eastern Denali Fault Zone, Southwest Yukon, Canada

Spring 2025

January 24, 2025
Tissa Illangasekere,
Lawrence Berkeley National Lab
Multi-scale experimentation and modeling for problem solution in water and environmental systems–Challenges and opportunities

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January 31, 2025
Jeremy Rugenstein,
Colorado State University
Tracking the interaction of tectonics and climate in Asia using sedimentary stable isotopes

• • •

February 7, 2025
Julie Bowles,
UW-Milwaukee
Constraining eruptive timing: Paleomagnetic approaches

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February 14, 2025
Blair Schoene,
Princeton University
Assessing the role of volcanism in the end-Cretaceous mass extinction

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February 21, 2025
Annie Bauer, UW-Madison
The tectonic regimes of the earliest continents

• • •

February 28, 2025
Bob Anderson, University of Colorado Boulder
Climate as seen through the lens of Colorado's glaciers

March 7, 2025
Ellen Currano, University of Wyoming
Investigating forest response to a global warming event 56 million years ago, while challenging the face of science

• • •

March 14, 2025
Jie Xu,
Arizona State University
Transition metal-sulfide chemistry: Exploring hidden pathways in Earth evolution

• • •

April 4, 2025
Alberto Reyes,
University of Alberta
Diamond mines, kimberlite craters, and paleoclimate proxies: snapshots of past "greenhouse" environments in arctic Canada

• • •

April 11, 2025
Linda Kah,
University of Tennessee
Unravelling the mysteries of the Mesoproterozoic

• • •

April 18, 2025
Madeline Schreiber,
Virginia Tech
Biogeochemical drivers of manganese cycling in drinking water reservoirs

GIFT GIVING GUIDE

The department's great need continues to be the ability to fill the gaps in funding between extramural research support ("grants") and University-supplied funds to support faculty, students, and staff in research, professional development, travel, and to remain on the cutting edge for research and teaching.

GIVING PRIORITIES

- *** New * The Mark Rosin Undergraduate Research Fund:** To provide dedicated funding to support undergraduate research
- **The Kay Fowler-Billings Fund:** To fund community efforts to increase and improve department climate
- **Terra Fund:** Our most flexible fund used to activities and items not covered by a specific fund
- **Robert and Nancy Dott Geoscience Fund:** Dedicated to funding student summer research activities
- **Sharon Meinholz Fund:** Helps defray the cost of student conference attendance

Visit geoscience.wisc.edu/geoscience/giving
for a complete list of funds and their UWF number or to make a secure gift with your credit card

How your gifts were spent recently

- **$325,000**: Graduate student scholarships, awards, & research stipends
- **$17,800**: Undergraduate student awards
- **$16,830**: Graduate summer field & lab research
- **$50,000**: Seed capital for equipment purchases
- **$20,000**: Student conference travel & registration
- **$2,000**: Exemplary teaching assistant awards

Examples of impacts for giving levels

- **$10–$100:** Summer field camping fees/gas
- **$100–$1,000:** Student conference travel & field gear
- **$1,000–$50,000:** Graduate student research support
- **$50,000–$500,000:** New faculty start-up assistance
- **$500,000+:** Named student fellowship
- **$1 million+**: Transformative gifts such as named professorship ($5 million) and building or room renovations

If you prefer to send a check, please include the fund number and designation on the memo line and make it payable to the University of Wisconsin Foundation. Send it to:

UW Foundation
U.S. Bank Lockbox
P.O. Box 78807
Milwaukee, WI 53278-0807

Alternatively, scan the QR code at right to make a donation.

For more information about giving, please contact Director of Development Mae Saul:

giving@geoscience.wisc.edu
608-216-6274

Professor Brad Singer presenting the day's itinerary on a field trip in Villaricca, Chile, January 2025.

Degrees Conferred: Fall 2024 – Summer 2025

Geology & Geophysics Bachelor's Degrees Completed

Ashton D.H. Brubaker
Mara Corum
Kip Buter Fabish
Sierra Cale Freiberg
Annemarie Marta Goncalves
Ollie Monson
Emilie Nogosek
Jillian Sophia Prescott
Soren C. Sheridan
Ashley M. Therrien
Skyeanne Ellen Tompkins
Emily Arianna Sautebin
Elisabeth Anne Slaga

Geoscience Graduate Degrees Completed

MASTER'S DEGREES

Campbell Nicole Dunn
Yasmeen Orellana Salazar
Emily Palmer

DOCTOR OF PHILOSOPHY

Jeremy Brooks
Esther Stewart
Collin Sutton
Chelsea Volpano

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DEPARTMENT OF GEOSCIENCE

September 2025

1 Mike Cardiff (Department Chair)
2 Alexander Kiner
3 G Graham
4 Luke Zoet
5 Elizabeth Sunday
6 Kyrsten Johnston
7 Kurt Feigl
8 Laurel Goodwin
9 Selva Marroquin
10 Andrea Dutton
11 Eva Golos
12 Bill Morgan
13 Athena Ngheim
14 Marianne Haseloff
15 Sam Marcus
16 John Valley
17 Steve Meyers
18 Josh Benish
19 Claire Ruggles
20 Ridwan Ajibade
21 Ellen Nelson
22 Sophia Pinter
23 Seth Sutton
24 Emily Palmer
25 Tayrn Isenburg
26 Emmanuel Irumhe
27 Rowan Gregoire
28 Sally Stevens
29 Yasmeen Orellana-Salazar
30 Thais Altenberg
31 Jaela Allen
32 Mara Corum
33 Ann Everest
34 Huili Zhang
35 Kayla Hubbard
36 Jaiden Zak
37 Hanna Konavaluk
38 Kayla McCabe
39 Maya Garces Roselli
40 Noriko Kita
41 Megan Hammett
42 Vy Le
43 Reachel Breunig
44 Neal Lord
45 Khalil Druobi
46 Basil Tikoff
47 Kenz Carlton
48 Jack Stalla
49 Juyong Bak
50 Daven Quinn
51 Dave Mickelson
52 Lisa Theo
53 Brooke Norsted
54 Emily Mixon
55 Brian Jicha
56 Pablo Moreno-Yaeger
57 Mike Spicuzza
58 Sarah Trevino
59 Jeremy Brooks
60 Bennett Wilson
61 Bil Schneider
62 Clay Kelly
63 Rich Slaughter
64 Tyler Blum
65 Logan Goulette
66 Mike Tappa
67 Brian Wathen
68 Carrie Eaton
69 Eleanor McFarlan
70 Sam Kershner
71 Paul Summers
72 Matias Romero
73 Kouki Kitajima
74 Jin Liu
75 Will Nachlas
76 Noah Brown
77 Peter Sobol
78 Kyle Fouke
79 Hao Guo
80 Shanan Peters
81 Ken Ferrier
82 Annie Bauer