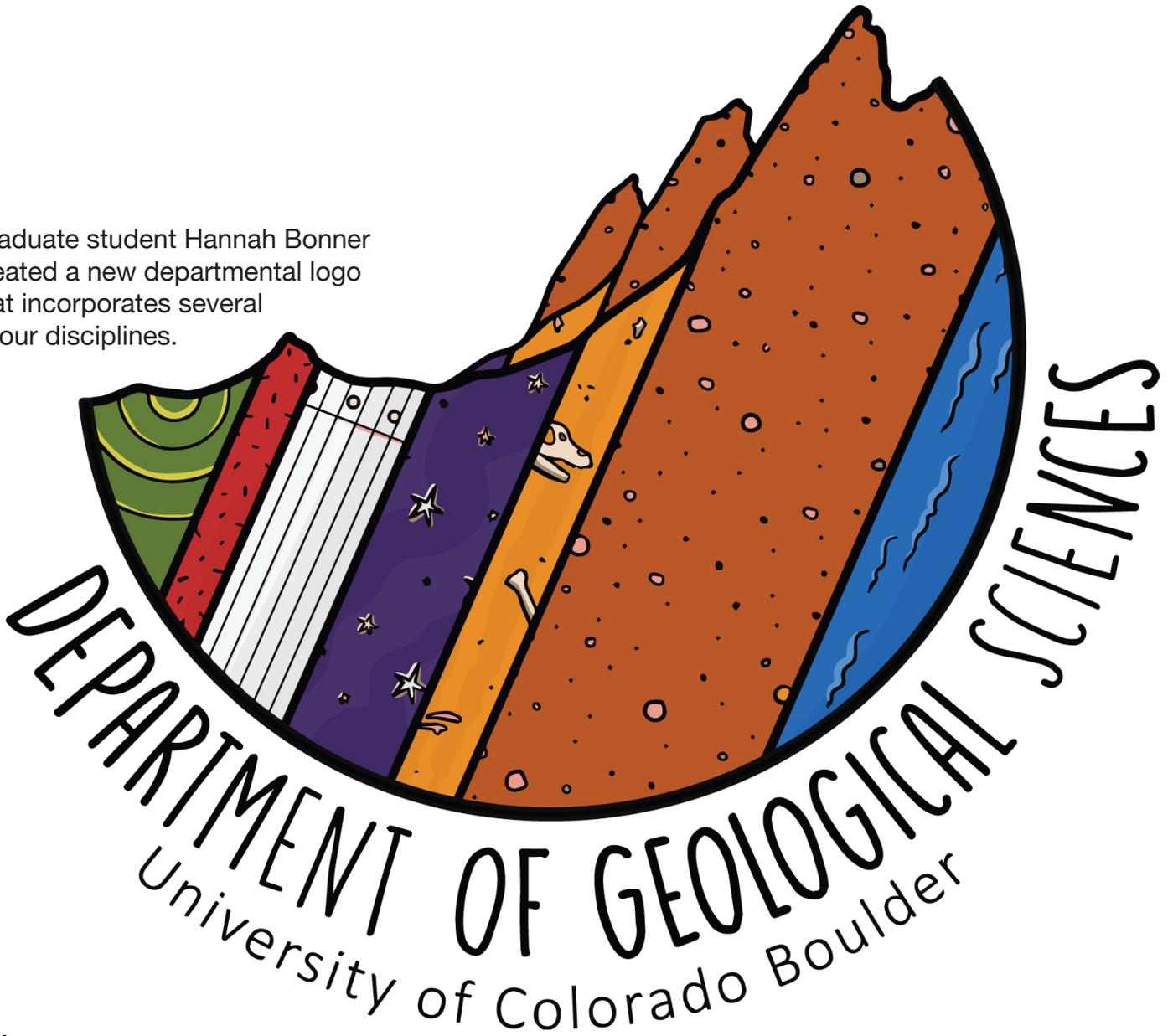


Geology News

Graduate student Hannah Bonner created a new departmental logo that incorporates several of our disciplines.



Editors:
Robert Anderson
Dan Mitchell

2020 - 2021

Chair's Corner

Robert Anderson

My what a year. Since I last wrote one of these columns, we have had to hunker down and teach, research, learn, administer, and live in the midst of the COVID crisis. We socially distanced, masked, held to rules of very few students in a classroom, and oscillated between teaching and learning remotely, to what became known as the hybrid mode – in which we could teach in person, but broadcast via Zoom to the remainder of the class. All of this took place while we grappled with social issues illuminated by the death of George Floyd, pushed to do more than acknowledge the deep-seated pain, exasperation, and entirely justified rage. And then as if that was not enough, our town endured a mass shooting in March. So there is good reason to be anxious on many fronts.

I am proud of how the Department has reacted to all of this. We held graduate defenses remotely that were remarkably well attended by parents and friends and colleagues scattered about the globe. We held graduations that celebrated the passage of students from one state of life to another, also entirely remotely. We completed a year's worth of classes taught in strange modes, and managed to maintain a semblance of our full curriculum. Thanks go to the faculty and the staff who managed the twists and turns and technological challenges of this year. We all hope of course for emergence from beneath the COVID cloak. The challenge of meeting head-on the social issues was met by better communication, and by re-tasking our enlarged diversity committee to articulate better the biases we all carry and to suggest actions that might mitigate these. We have only started. Here I thank all who have participated in these discussions, and especially those who have led the charge, including both graduate students and faculty.

The department will look different as we emerge from beneath this cloak. Several faculty members have retired or are in the midst of doing so. These include Stephen Mojzsis, Mary Kraus and Chuck Stern. As Mary and Chuck were past chairs, they carry with them a great deal of departmental history and memory. Bruce Jakosky will retire at the end of the calendar year, and David Budd is phasing out more slowly, assuring a smooth transition of the teaching of sedimentology and stratigraphy. We applaud them all for their long and illustrious CU careers. At the same time we have embraced the arrival of two new faculty members who began their careers here in Fall 2020, in the midst of this chaotic year. Brad Markle and Carolyn Crow faced down the challenges of the year and have embarked on their teaching and

research careers. I am also thrilled to announce that Shaily Rahman will join INSTAAR and our department. Shaily is an isotope biogeochemist, and is probing the depositional and diagenetic processes in a wide array of shallow marine environments using novel non-traditional isotopes. She will move from her postdoctoral position at the University of Southern Mississippi in the middle of the summer. So we will be 37 strong in the Fall.

We have a dynamite staff, and could not have survived the year without their enthusiastic acceptance of the challenges we faced. We welcomed TJ Deaton to the staff as office manager. She arrived in late summer to step into the shoes of Ruth Mansbach, who retired in April but stayed through most of the summer to help us through the transition. TJ quickly proved to us all that her deep store of skills and her bright outlook on life were perfect for the job. And what a time to begin a job – any job!

Promotions. This academic year both Carl Simpson and Seb Kopf flew through the reappointment process, taking them one step further toward tenure. Leilani Arthurs has been promoted to Associate Professor. My congratulations to them all. That there were no hiccups in any of these promotions is testament to the quality of the professors we hire in the department.

The Benson Building itself is changing as professors succeed in securing funding for renovation of labs. Boz Wing's lab now occupies what was Joe Smyth's lab in the NW corner of the 3rd floor. It is glorious to look in through the window from the hall to see numerous students powering away on biogeochemical experiments of one or another sort. Becky Flowers and Jim Metcalf are in the midst of renovations that enable laser ablation of individual crystals, further expanding the analytic capabilities of the TRaIL Lab. And Alisha Clark's lab in the basement is under construction at the moment – and will ultimately house huge presses in which she will experimentally probe the high-pressure environments of the deep mantle.

Speaking of Bruce Benson, for whom the building is named... The Bensons have decided to alter the intent of their ample endowment to focus not on an endowed chair, but instead on the support of graduate students through a set of fellowships. Starting this coming Fall, their endowment will support five Marcy and Bruce Benson Graduate Fellows at all times. The department is thrilled by this decision. We anticipate that it will enhance our success in recruiting the best and the brightest graduate students to this stellar department. It assures that the legacy of the Bensons' generosity will last forever, as each year a new Benson Fellow will finish their graduate work.

A number of our faculty received awards this last year. I will merely list them here, while some are discussed more at length elsewhere in the Newsletter. If I have missed any, I apologize; happily it is hard to keep track...

- Leilani Arthurs received the Iris Moreno Totten Geoscience Education Research Award from GSA's Geoscience Education Division.
- Suzanne Anderson received the G.K. Gilbert Award of AGU's Earth and Planetary Surface Processes section.
- Paul Weimer received the 2020 Sidney Powers Memorial Award of the AAPG.
- Seb Kopf was awarded a CAREER grant from NSF for his research titled "Uncovering the origins and biological purpose of the orphaned branched GDGT temperature biomarker".
- Julio Sepulveda was awarded a CAREER grant from NSF for his research titled "Microbial Lipidomics in Changing Oceans (MILCO)".
- Bob Anderson was elected to the National Academy of Sciences.

So it has been a busy year indeed. As summer



Aerial video down Kennicott Glacier, Alaska.
photo credit: Bob Anderson

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a deep breath, and to celebrate the greening hillsides, the red rocks and the blue sky. Geology teaches us to embrace the long view. We look forward to returning to more or less normal mode of operation in the Fall as we recover from the COVID crisis, at least locally. The Fall semester will represent a new challenge as we decide what aspects from this last year's massive social and educational experiment are worth retaining, and what aspects should be left behind. I wish you all well, and trust that you are staying safe.

With cheer, Bob

Ice cave wall, Kennicott Glacier, Alaska.
photo credit: Bob Anderson



Greetings from the Alumni Advisory Board

Dean Miller

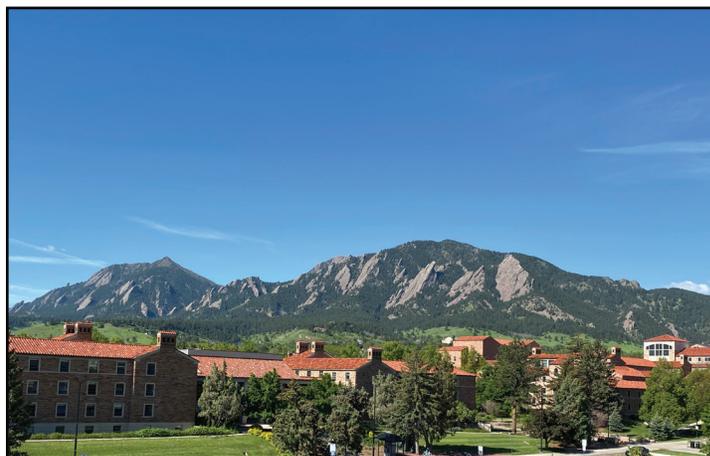
To quote Bob Anderson, “What a year.” It has been an unusual year for the Advisory Board as it has for everyone. We held our Fall and Spring Advisory Board meetings remotely. We discussed the challenges the Department faced with remote and hybrid teaching and ways to keep students and alumni engaged with the Department during the pandemic. The Advisory Board held a Zoom conference with the new graduate students to find out how their experience in the Department was affected by the remote learning environment. The Department has done a phenomenal job in dealing with the impacts of the pandemic, and the students’ feedback was very positive. But everyone is looking forward to getting together in person and returning to some semblance of normalcy.

Members of the Alumni Advisory Board and many alumni participated in three very successful Science from Your Sofa webinars sponsored by the College of Arts and Sciences, the CU Office of Advancement, and the Advisory Board. They covered many diverse topics, including Professor Rebecca Flowers discussing her research on the link between the development of the Great Unconformity and the Cambrian Explosion, and Professor Carolyn Crow discussing the new information about the history of our solar system gleaned from moon and asteroid rock samples, and what we likely will learn from future Mars missions. The other two sessions were dedicated to the future of the oil and gas industry and diverse careers in Geology, which included presentations by Advisory Board members Tim Farnham and Sean Sundermann, Professor Paul Weimer, Department alumnus Drew Scherer, and CU Alumnus David Atkins. Keep an eye out for notices about future programs, which hopefully can be held in person.

As you know, the Department’s and Advisory Board’s fundraising focus has been on graduate student fellowships. As Bob Anderson mentions in

his column, Marcy and Bruce Benson have decided to support graduate students through a set of fellowships that will be an enormous benefit to the Department. One of the challenges the Department has faced is that, despite being ranked number one in the world in geosciences, the Department has been at a disadvantage in recruiting top graduate students when competing universities could offer significant financial support for new graduate students. However, beginning this Fall, the endowment will support five Marcy and Bruce Benson Graduate Fellows. This will greatly enhance recruiting the best graduate students to the Department. This generous contribution to the Department is greatly appreciated and will create an enduring legacy for the Bensons for decades to come.

We are looking forward to our first in-person Advisory Board meeting this Fall. It will be great to see everyone in person rather than on a computer screen. It will be nice to put the past year and a half behind us. But it has been a valuable experience, especially experiencing first-hand the agility and cohesiveness of the Department faculty, staff, students, and alumni during this difficult period. We have a lot to be proud of.



Geological Sciences Advisory Board Members

Eric Anderson
USGS

Lisa Campbell
Anschutz Exploration Company

Patricia Corbetta

Tim Farnham
Shell

Dawn S. Kaback
Retired

Houston Kempton
Environmental Consultant

Dean Miller - Chair
Davis Graham & Stubbs, LLP

Harold Miller
Subsurface Consultants & Associates, LLC

Connor Newman
USGS

Shannon O’Dunn
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Penny Patterson
ExxonMobil Exploration Company

John Roesink
Jagged Peak Energy Management, LLC

Shannon Cheree Stover
BP

Sean Sundermann
Kilduff Underground Engineering

Charlie Wilson
Thornburg Investment Management

Joe Zamudio
Mineral exploration and remote sensing consultant

New Faculty

Shaily Rahman

Dr. Rahman will join CU Boulder's INSTAAR and Department of Geological Sciences in Fall 2021.

Born in Bangladesh, Shaily grew up in Saudi Arabia, the United States, and Canada. The massive arsenic contamination of drinking water supplies in Bangladesh inspired her discovery of geochemistry and earth sciences as an undergraduate in chemistry at McGill University. Shaily continued on at McGill to obtain an MSc in marine chemistry investigating the arsenic cycle in coastal systems. She then found employment as an environmental scientist at a consulting company, where she investigated the impacts of pollutants, and performed risk assessments for people exposed to radioactive waste or heavy metal contamination. After a few years, she went back to academia where love of mud led her to pursue a degree in marine biogeochemistry at Stony Brook University. For her PhD she studied the sedimentary cycle of silica, an essential nutrient for phytoplankton, in tropical deltas and mobile mud belts. Her postdoctoral work has focused on high latitude surface earth processes, marine cycles of trace elements through US GEOTRACES, and actionable science via NOAA Restore projects targeting oyster reef die off in the northern Gulf of Mexico.

Shaily will join INSTAAR and the Department of Geological Sciences where she anticipates developing studies of early diagenesis, and marine and terrestrial biogeochemistry. She will further develop and use various geochemical proxies, isotopes, and chronometers to study surface earth processes and biogeochemical cycles in understudied systems.



These will include tropical/subtropical deltas, subterranean estuaries, and high latitude systems. There are clearly many ties to the research efforts of other faculty in the Geological Sciences and at INSTAAR.



TJ Deaton Joins the Department as Office Manager

TJ joined the Department of Geological Sciences as the Manager of Finance and Business Operations in August of 2020, in the midst of a global pandemic and restrictions to on-campus work presence. She came to the department from the Office of Contracts and Grants where since 2018 she had learned the ropes of the inner financial workings of campus research as a project setup accountant. Prior to that she had been a finance manager and project accountant with a variety of investment firms, netting her deep experience with the financial world. TJ has done a great job adjusting to our ever-changing environment and has quickly proven to be one of our most valuable assets. She looks forward to the day when all department staff, faculty, researchers and students are back in person so that she can get to know the faces that go with the names!

Faculty News

Leilani Arthurs

Assistant Professor Leilani Arthurs and her team pursue research that furthers knowledge about how novices to geoscience develop more expert-like knowledge, skills, and habits of mind. Their research focuses on two sides of Geoscience Education, learning geoscience and teaching geoscience. In May 2020, Master's student Sarah Baumann completed her research concerning the development of undergraduate students' map reading skills and was the last GEOL graduate student to have an in-person defense before the pandemic imposed remotely facilitated defenses. That same semester, PhD student Carlton Mueller joined the team just before the COVID-19 pandemic took off.

In fall 2020, while the pandemic was in full swing, Master's student William Bennett also joined the team. Collette Wilfong (senior PhD student on the team), Chelsie Kowalski (part-time research assistant), Carlton, and Leilani presented their research at GSA 2020 Online. In the spring and Maymester semesters,

Jessica Perron and Joseph Taparauskas, two geology majors, independently examine an outcrop in GEOL 2700: Intro to Field during Maymester 2021.



Collette and Carlton served as teaching assistants in GEOL 1150 (Water, Energy, and the Environment) and GEOL 2700 (Intro to Field Geology), respectively, and partnered with Leilani to navigate the new world of remote or synchronous instruction.

In spring 2021, Leilani received the Iris Moreno Totten Geoscience Education Research Award from GSA's Geoscience Education Division. During AY 2020-2021, Chelsie and Leilani had two peer-reviewed articles published, one with a third author (Justin Elwonger, who started working with Leilani as an undergraduate student and is now an Earth Science certified high school science teacher). Both articles discuss drawing as a method to facilitate conceptual among students learning about groundwater. Leilani also had an article about teaching field courses remotely published in GSA Today.

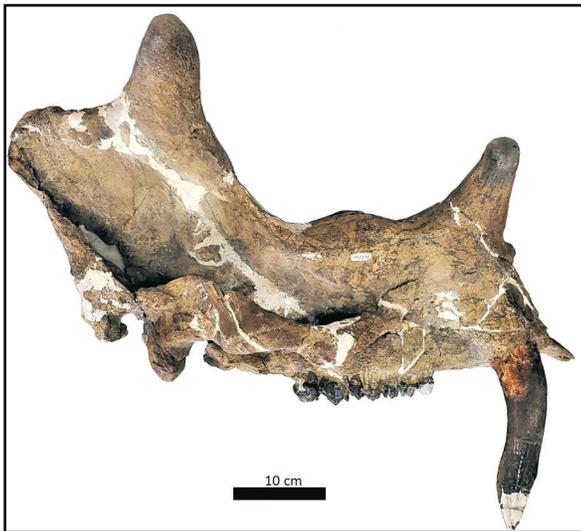
- Arthurs. (2021). "Bringing the Field to Students during COVID-19 and Beyond," GSA Today, 31, 28-29.
- Arthurs, L.A. & Kowalski, C. M. (2021). "Facilitating Conceptual Change by Engaging Students' Preconceptions during College Science Classroom Instruction," Journal of College Science Teaching, Jan/Feb 2021, 50(3), 28-35.
- Arthurs, L. A., Kowalski, C. M., & Elwonger*, J. M. (2020). "Drawing as a Method to Facilitate Conceptual Change in Earth Sciences Education," Journal of Astronomy and Earth Sciences Education, 7(1), 1-23.

Carolyn Crow

Carolyn, who recently joined the department as an assistant professor in Fall 2020, has been granted the CU Boulder Outreach Award, in collaboration with Professors Paul Hayne (APS), John Keller (APS/Fiske Planetarium), and Erica Ellingson (APS), to develop a new outreach program at CU Boulder. The program aims to engage underserved middle and high school students in Colorado with CUs cutting-edge Space Research. Prof. Crow and Prof. Hayne have helped run and support similar programs as part of the Ad Astra Academy in some of the most underserved communities in the world including the City of God, Rio De Janeiro, Brazil and Cox Bazar, Bangladesh. In these programs students engage with active research programs or NASA missions to foster curiosity and promote inquiry-based learning. We are looking forward to offering our first programs at CU Boulder in Spring 2022. More information about the CU program and the Ad Astra Academy (including the feature length documentary about the project) can be found on Prof. Crow's personal website.

Jaelyn Eberle

Jaelyn Eberle writes about an undergraduate research project: For his honors thesis in Geological Sciences, CU undergraduate Geoff Flora is studying a nearly complete skull of *Uintatherium*, an extinct rhino-sized mammal identified by its three pairs of bizarre knobby horns and saber-like canines. These large herbivores roamed the region from late Paleocene through middle Eocene time, but their skulls are very rare fossils! This one comes from the Uinta Formation in Utah. Geoff's research is supported by a Geological Sciences mentoring grant and a Student Summer Research Award from the CU Museum of Natural History. Geoff will present his research this fall at the Annual Meeting of the Society of Vertebrate Paleontology (SVP).



Complete skull of *Uintatherium* from the Uinta Formation in Utah. photo credit: Jaelyn Eberle

Becky Flowers

This past year has been both challenging and productive for the CU TRaIL (Thermochronology Research and Instrumentation Lab). The lab itself has undergone a dramatic transformation, with renovations and relocations of lab space providing a significant upgrade in its capabilities. The main lab space that houses all of our analytical equipment was renovated in the summer of 2020 to prepare the space for the equipment that Professor Becky Flowers (lab director) and Dr. Jim Metcalf (lab manager) were awarded with an NSF Instrumentation grant in 2019. This equipment includes a new 193 nm Excimer laser, optical profiling device, and custom built He extraction and measurement line all designed for in situ measurements of He, U, Th, Sm, as well as numerous other elements. The optical profiler was installed in December 2020, and the Excimer laser is scheduled to be delivered and installed in July 2021. The new He line is coming together as well, and should be ready

for testing within a few months.

The Flowers' research group has fortunately managed to stay healthy, and has continued to work on a diverse range of research projects. PhD student Collin Sturrock successfully defended his dissertation entitled "Linking the tectonic, hypsometric and geodynamic history of the central and southern Canadian shield using (U-Th)/He thermochronology and global convection modeling" in January, and now has multiple chapters of his work submitted for publication. PhD student Barra Peak also presented results from her research, and has submitted a manuscript focused on the evolution of the Great Unconformity in the Grand Canyon based on a large zircon (U-Th)/He dataset. Barra just returned from a raft trip through Grand Canyon where she was able to collect additional samples. PhD student Spencer Zeigler has begun collecting (U-Th)/He data for their project, and is preparing to submit a manuscript detailing the work they started as an undergraduate in the group using nano-computed tomography (nano-CT) to better understand He ejection in apatite. MSc student Morgan Baker is also working with nano-CT data for her project, using data from hundreds of hand-picked crystals to understand how grain shapes and levels of radiation damage affect our ability to determine He ejection in zircon. Postdoc Peter Martin, who joined the group at the beginning of the pandemic, has collected a nearly complete (U-Th)/He dataset for his NSF funded position examining the potential influence of ophiolite exhumation in Papua New Guinea on long-term climate, learning sample preparation techniques despite COVID restrictions. Additionally, Peter has put his programming skills to work and begun developing methods for better calculating and understanding uncertainties in (U-Th)/He data, a project he recently presented at a virtual Thermochronology conference and is preparing for publication. Lab Manager Dr. Jim Metcalf spent much of the last year overseeing the lab renovations and relocations while keeping lab analyses going during COVID-related research-shutdowns, and is now focusing on building a new, custom He analysis line for in situ He measurements. Lab director Professor Becky Flowers has kept busy working with current and former students on publications related to their research at CU, and is spearheading an international effort to publish a set of standards and best practices for reporting (U-Th)/He data. She continues to lead the AGeS2 geochronology grant program, and along with former student Rachel Havranek had her research on the nature of the Great Unconformity published last fall and featured in national news outlets, including CNN.

2020 Publications with TRaIL alumni related to their PhD thesis research at CU

- Baughman, J.S. and Flowers, R.M., 2020, Mesoproterozoic burial of the Kaapvaal craton, southern Africa during Rodinia supercontinent assembly from (U-Th)/He thermochronology: *Earth and Planetary Science Letters*, v. 531, <https://doi.org/10.1016/j.epsl.2019.115930>.
- Stanley, J.R. and Flowers, R.M., 2020, Mesozoic denudational history of the lower Orange River and eastward migration of erosion across the southern African Plateau: *Lithosphere*: <https://doi.org/10.1130/L1121.1>.

Shemin Ge

Shemin's enthusiasm on two research fronts, induced seismicity and climate impact on groundwater, remain unabated. She tries to find more solitude to write, besides working with her brilliant graduate students. She gathered the students in person for the first time in a long time. (image below)

rock properties is being developed to model pore pressure propagation. I look to better understand the causal mechanisms of induced seismicity and the interconnected nature of the individual mechanisms such as pore pressure propagation and Coulomb Static Stress transfer.” Lauren Salberg (2nd year MS, co-advised by Suzanne Anderson and Shemin Ge): “My research utilizes a decade of hydrologic data from the Gordon Gulch watershed (near Boulder, CO) in the development of a groundwater flow model. The model simulates groundwater-surface water interactions and is used to identify watershed-scale patterns in an effort to better understand the relationship between hydrologic inputs (precipitation and snowmelt) and system responses (streamflow and groundwater levels). Based on model results and data analysis, we observe the following: 1. Peak streamflow and groundwater levels occur in May following widespread snowmelt, 2. Groundwater is recharged primarily by one to two precipitation events each year, and 3. Approximately one-third of streamflow is supplied by groundwater.” Kelleen Lanagan (2nd year MS): “Much is still unknown about the current permafrost



L-R: Scott Stokes, Kelleen Lanagan, Lauren Salberg, and Claudia Corona. photo credit: Shemin Ge

At the gathering, Shemin asked the students to describe their research in less than 100 words. Below is what they said. Scott Stokes (1st year MS): “I study injection induced seismicity in the Raton Basin (CO, NM) through the lens of hydrogeology. I am currently investigating the effects of pore pressure increase along critically stressed faults caused by deep wastewater disposal. A numerical pore pressure model that takes into consideration spatially variable geology and depth dependent water and (top)

and hydrological conditions of the Gates of the Arctic National Park and Preserve in Alaska. I use heat conduction and groundwater flow models to simulate the effects of frozen ground on groundwater hydrology and address the question of how thermal and hydrogeologic properties of the ground may affect shallow aquifer dynamics and groundwater flow in the Nutuvukti Lake watershed.” Claudia Corona (3rd year PhD): “Extreme rainfall is expected to increase worldwide, increasing the risk of flooding,

and increasing rainwater infiltration into the ground. This past year, I used computer models to simulate a 2013 extreme rainfall event that impacted Colorado groundwater resources. Specifically, I asked: 1) How does the water-table respond to extreme rainfall? 2) How is soil water storage affected? I find that the water table remained elevated for 18 months after the event and that the soil water storage retained more water for two years after the event. The implications are that 1D models may provide useful estimates of water table fluctuations and subsurface hydro-buffer capacities in response to extreme rainfall.”

On the teaching front, Shemin taught the junior level Hydrogeology course remotely in fall 2020. Trying hard to adopt teaching remotely, she flipped (accidentally) the class, i.e., recording lectures for students to watch in prior and working with students on activity exercises during lectures. Shemin also joined the teaching cohort for an introductory level course “Water, Energy, and Environment” and taught it for the first time in spring 2021. After all is settled, she realizes what a relevant and meaningful course it is as our world undergoes a period of transition in so many ways.

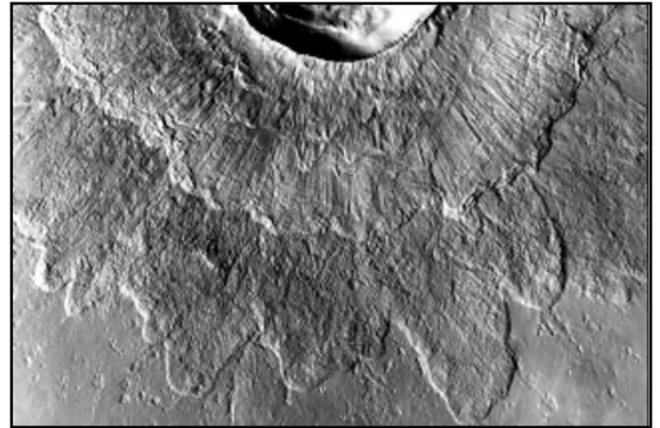


Shemin Ge

Brian Hynek

Recent work by PhD Candidate Rachael Hoover has investigated the formation processes of layered ejecta (LE) craters on Mars. LE craters are primarily found on Mars but have been identified on some other planetary bodies across the solar system (e.g., Earth, Europa and Ganymede). The primary hypothesis for the formation of these LE craters involves the impactor interacting with subsurface volatiles, and thus requires the presence of volatiles for LE craters to form. The formation mechanism is important because if volatiles are required then LE craters serve as a proxy for subsurface volatiles throughout the solar system. This is important when identifying resources necessary for human exploration.

To investigate the formation process of LE craters, Rachael and Dr. Hynek used thermal inertia data to infer surface properties and grain size distributions of 50 globally distributed LE craters on Mars. They found no distinct relationship between crater type and trends in grain size, which therefore fails to provide overwhelming evidence supporting the presence of



A two layer ejecta crater on Mars. Credit: NASA

subsurface volatiles. This research result is currently under revision at the Journal of Geophysical Research – Planets. The next step in this work is to visit a terrestrial LE crater in Germany to better characterize the grain size distribution of an LE crater known to have formed in the presence of subsurface volatiles.

Professor Brian Hynek was recently awarded a grant from the National Geographic Society to climb the world’s highest volcano and study the microbial ecosystems as an analog to the Martian surface. At 22,615’, Ojos del Salado on the Chile/Argentina border provides many challenges for life, much like early Mars. It is above the Atacama desert and extremely dry, has a very high UV flux, exhibits 70°C diurnal temperature swings, and the soils are extremely carbon-poor. Yet, we hypothesize that microbial life is present in “islands of habitability”: at active summit fumaroles, in the world’s highest lake on the flank of the volcano, and on the sole glacier. This expedition will test the hypothesis that life can exist in a barren landscape that is akin to the surface of Mars throughout most of its history. Graduate student Amanda Steckel and Professor Steve Schmidt (EBIO) will also participate in the fieldwork and analyses.

Ojos del Salado on the Chile/Argentina border.
photo credit: Brian Hynek



Peter Molnar

Peter explored the brittle-plastic transition in the crust and mantle from the perspective earthquakes occurring in regions undergoing different strain rates. As is known well, to induce plastic strain of the constitutive minerals in rock at a high rate of strain, higher stresses are needed, with higher strain rates requiring higher stresses. If temperatures are increased, however, lower stresses suffice to induce plastic strain at whatever rate. Seemingly similarly, as temperature increases, stick-slip in the lab and earthquakes in the earth give way to stable sliding on sawcuts in rock in the lab or faults in the earth. Less appreciated is the laboratory observation that as temperature increases and stick-slip gives way to stable sliding, the stresses needed to cause slip also increase. It turns out that in regions that undergo relatively rapid straining, as measured by GPS for example, earthquakes occur in material of higher temperature than where strain rates are low, like intraplate settings. Thus, where strain rates are relatively high, the higher stresses needed to cause slip on fault or to deform surrounding rock plastically can cause earthquakes despite the rock being relatively warm. The brittle-plastic transition depends on both temperature and strain rate.

Julio Sepúlveda

The Organic Geochemistry Group congratulates everyone who graduated under such challenging circumstances this past year; they are so proud of all of them! Dr. Garrett Boudinot (2020), now a Research Associate at Cornell University, was the first graduate student to complete a dissertation in the group. Dr.

Katie Rempfert (2021, Templeton Lab) completed her dissertation in collaboration with the OG group, and she is now about to start a new position as a Researcher in the Pacific Northwest National Laboratory. ENVS major and GEOL minor Katelyn Eaman (2020), GEOL major Josie Marquez (2021, Templeton Lab), and EBIO Major Christopher Mulligan (2021) all graduated with honors working in the OGG lab. Katie is now a Professional Research Assistant in the group, Josie will begin a summer internship with the Department of Energy and then a new job at the USGS, and Chris will start a PhD program at UC David this fall. The OG group also mentored ENVS major Caitlin Germana (UROP) and GEOL major Brooke Holman (GEOL Mentorship) in 2020. Finally, the group saw the departures of postdocs Dr. Greg de Wet and Dr. Sarah Crump (co-advised with G. Miller). Greg is now an Assistant Professor at Smith College and Sarah is a Postdoctoral Researcher at UC Santa Cruz. They would like to wish everyone all the best in their future endeavors!

The OG group welcomed Dr. Nicolò Ardenghi (co-advised with G. Miller) as a postdoctoral researcher in the NSF-funded ILLUME project in 2020. He obtained his PhD from the University of Frankfurt in Germany. They also congratulate their Lab Manager Dr. Nadia Dildar and her husband Mahmood for the birth of their son Chaanun in April 2021. Chaanun means “Light” in Punjabi.... A beautiful name in times when the world needs so much light.

The OG group was active publishing results of their research on proxy development, microbial systems, biogeochemical cycles, and paleoenvironmental sciences. Dr. Boudinot published two thesis chapters,



The Summer of 2020 was a bad year for forest fires around the front range which capped an already tough year. This picture was taken on October 16, 2020 just outside Benson Earth Science building. photo credit: Karl Mueller

one in *Palaeogeography, Palaeoclimatology, Palaeoecology* (<https://doi.org/10.1016/j.palaeo.2020.109673>) and one in *Nature Geoscience* (<https://doi.org/10.1038/s41561-020-0633-y>), in addition to a manuscript in *Climate of the Past* (<https://doi.org/10.5194/cp-16-1807-2020>). PhD candidates Lina Pérez-Ángel and Sebastian Cantarero published their first thesis chapters in the journals *Geochemistry, Geophysics, Geosystems* (<https://doi.org/10.1029/2020GC008941>) and *Frontiers in Marine Science* (<https://doi.org/10.3389/fmars.2020.540643>), respectively. PhD candidate Jonathan Raberg got his first thesis chapter accepted for publication in *Biogeosciences* (<https://doi.org/10.5194/bg-2021-16>). Postdoc Dr. David Harning published results of his research in *Geophysical Research Letters* (<https://doi.org/10.1029/2019GL085728>) and *Climate of the Past* (<https://doi.org/10.5194/cp-17-379-2021>), and former Postdoc Dr. Sarah Crump published results of her research in the *Proceedings of the National Academy of Sciences* (<https://doi.org/10.1073/pnas.2019069118>). PhD candidate Sebastian Cantarero and Julio contributed to a manuscript published in *Nature Communications* (<https://doi.org/10.1038/s41467-021-21871-4>). Furthermore, the OGG collaboration with Dr. Stephanie Kusch (University of Köln) and her research visit to our lab yielded manuscripts published in the journals *Organic Geochemistry* (<https://doi.org/10.1016/j.orggeochem.2020.104150>) and *Geobiology* (<https://doi.org/10.1111/gbi.12446>). Lastly, as part of large international collaborations, Julio was part of a review manuscript published in *Frontiers in Marine Science* (<https://doi.org/10.3389/fmars.2020.00718>) and a collaborative research paper in the journal *Science* (<https://doi.org/10.1126/science.aay5055>).

OGG continued working on research projects in north America (G. Boudinot), Colombia (L. Pérez-Ángel and P. Molnar), the Humboldt Current System of Chile-Perú (S. Cantarero), Baffin Island (J. Raberg, S. Crump, and G. Miller), Iceland (J. Raberg, N. Ardenghi, D. Harning, and G. Miller), Baffin Bay (D. Harning and A. Jennings), and Alaska (J. Eberle). Additionally, they secured new funding from the NSF Frontier Research in Earth Sciences (FRES) Program (with N. Lovenduski, ATOC). Finally, Julio received the fantastic news that two new grants were recommended for funding. They include an NSF CAREER from the Chemical Oceanography, Biological Oceanography, and Ocean Education Programs, and an NSF grant by the Marine Geology and Geophysics and the Sedimentary Geology and Paleobiology Programs. Thanks to this support, OGG will welcome two new graduate students and one postdoc in fall 2021. They look forward to entering an exciting new era with their group as Julio goes up for tenure in the fall.

Kristy Tiampo

Kristy Tiampo and Mylène Jacquemart of Geological Sciences, as part of a collaboration with CIRES, led the development of a risk management workshop for field scientists (RMWFS) in academia. RMWFS is intended to educate these scientists about strategies, adapted from established methods from outdoor education, that recognize the importance of inclusivity and emotional safety and reduce harassment by promoting respectful, equitable, and discrimination-free environments in the field. These topics and modules are delivered using active learning techniques, scenario-based role-playing, and discussions designed to empower and prepare participants for different situations encountered during fieldwork. The workshop and results are outlined in a recent article in *EOS*, “Changing the Culture of Fieldwork in the Geosciences” (https://eos.org/features/changing-the-culture-of-fieldwork-in-the-geosciences?mkt_tok=OTg3LUIHVVC01NzIAAAF9CU98dM7WduEI-GB-_yMdJcDgEGt9IH0TRqR9ykaE1U56qMXUmTO_r1qQqDh78RAwexTDa8GFx-69-4GHC6JdANaby3zSQiR82RCz2cs).



Matthias Leopold, Lia Lajoie, and Mylène Jacquemart (left to right) pack in field equipment to an isolated part of Wrangell–St. Elias National Park and Preserve in Alaska. Field campaign challenges are exacerbated by remote environments and require additional planning to ensure a physically and emotionally safe environment that will facilitate research team success (published in Hill, A. F., M. Jacquemart, A. U. Gold, and K. Tiampo (2021), Changing the culture of fieldwork in the geosciences, *Eos*, 102, <https://doi.org/10.1029/2021EO158013>. Published on 06 May 2021. photo credit: Ethan Welty

Paul Weimer

Last September, Paul received (virtually) the Sydney Powers Medal from the AAPG, the group's highest honor. His citation read, "a research pioneer for deepwater exploration and production; visionary leader of professional societies; an inspirational educator and mentor for geoscientists all over the world; and innovator in geological outreach and public education." Recent previous recipients include Bert Bally, James Lee Wilson, Peter Vail, Bob Mitchum, Arnold Bouma, Dietrich Welte, Mitch Harris, Paul Potter, and Ken Peters.

Paul is currently serving as the President-elect for the American Geosciences Institute (AGI); his term as President extends from October 2021 to October 2022. His activities this year included chairing the Strategic Outlook Committee, and serving on the Search Committee for the new Executive Director, and working on Earth Science Week for next fall.

Last fall, he taught two sections of the senior-level field class in sedimentary geology, and they met in the

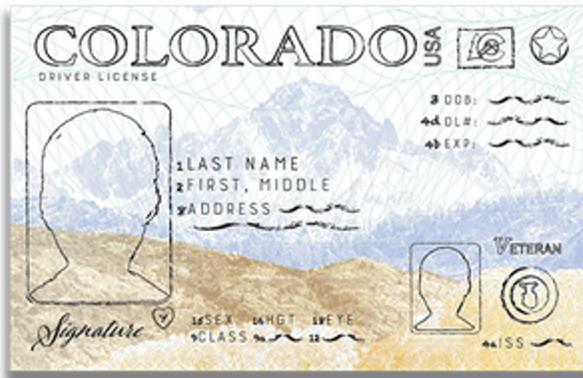
field during non-smoke filled days. In the spring, he taught a course in unconventional resources.

Paul is hoping that sometime during 2021, he will find the time to begin working on the massive backlog of papers that has developed from before and during Covid.

During Covid, the Interactive Geology Project (IGP) team continues creating geo-animations and videos for K-12 Education and Public Outreach. Watch this space...

Beginning fall 2021, the front of all new Colorado driver's licenses will include a photograph of Mt. Sneffels, an Oligocene stock (27.0 Ma) intruding Oligocene volcanic flows (28.6-28.2 Ma). The lower 60% of the photo is Paul's MS thesis area from 42 years ago (Upper Cretaceous Mancos Group, Quaternary landslides). The DMV chose to not include his annotations or cross sections.

And finally, the biggest and most pleasant surprises of his past two years were the births of two grand-daughters. Buena suerte, Grand-dude.



Colorado Driver License mockup



Original art

Bob Anderson elected to National Academy of Sciences

This year's batch of 120 new members in the National Academy of Sciences includes two professors from CU: Frances Bagenal, professor emeritus of astrophysical and planetary sciences, and our own Bob Anderson. Election to the academy is based "on the strength of their distinguished and continuing achievements in original research". Bob's work has ranged across the discipline of geomorphology, from the saltation of sand grains and their arrangement into ripples and dunes, to the formation of marine terraces in tectonically active settings, to the evolution of alpine landscapes in the face of repeated glaciation. Congratulations to Bob.



Suzanne Anderson wins G.K. Gilbert Award of AGU's Earth and Planetary Surface Processes section

Given to one senior scientist each year, this award recognizes sustained and outstanding contributions to the field of Earth and planetary surface processes. The award honors G. K. Gilbert, a pioneer in modern quantitative geomorphology. In his citation, Josh Roering of the University of Oregon states "Suzanne Anderson works on (and defines) the interface between geomorphology, hydrology, and geochemistry; her creative and novel scholarship and strong leadership in the critical zone community have vastly expanded and enriched surface process research and inspired colleagues and students to tackle interdisciplinary topics." He goes on to say that "As a central player in critical zone research, Suzanne established the Boulder Creek Critical Zone Observatory (CZO), where a limited footprint existed previously. Such work requires a ridiculous amount of time, patience, and vision, and Suzanne's efforts led to a welcoming and inclusive platform for others to collaborate and forge discovery. With dedication and care, Suzanne's outreach opened

up the critical zone to a new and more diverse generation of scientists." The Boulder Creek CZO has indeed represented a significant effort in which many researchers in various units at CU have been involved over the last decade. Given the recent release from that leadership role, we look forward to her further contributions to the department's research on the planet's surface. Congratulations to Suzanne.



Paul Weimer wins the 2020 Sidney Powers Memorial Award of the AAPG

Since 1945, the Sidney Powers Memorial Award is given annually in recognition of distinguished and outstanding contributions to, or achievements in, petroleum geology. It is AAPG's most distinguished award. Paul is also ramping up as the president – elect of the American Geosciences Institute (AGI), whose mission it is to represent and serve the geoscience community by providing collaborative leadership and information to connect Earth, science, and people. We salute Paul's contributions, both past and future.



Mary Kraus retires after 37 years as a professor

David Budd



Mary Kraus will retire on June 30th, 2021, after 37 years of service to the University of Colorado, Boulder. Mary joined the faculty as an assistant professor in 1983. Although not the first female faculty member in the department, she

was the first to be promoted to the rank of full professor and the first to serve as Departmental Chair (2003-2009). The Department flourished during her time as chair – several new initiatives were spawned (e.g., the Science Education Initiative), a variety of governance issues were reformed, and during a campus-wide career merit exercise, the Department was ranked 3rd best in the College of Arts and Sciences. Shortly after stepping down as chair, Mary served 5 years as Associate Dean for Science in the College of Arts and Sciences, and for the last 5 years she has been Vice Provost and Associate Vice Chancellor for Undergraduate Education. In the latter role she spear-headed initiatives for improving advising of undeclared majors and improving the first-year experience. Professionally, Mary also served as an officer in GSA's Sedimentary Geology division, General Co-Chair of the 1999 GSA annual meeting, co-Editor of the Journal of Sedimentary Research, President of the Society of Sedimentary Geologists (SEPM), and as a Councilor on GSA's executive board.

Mary's research expertise is in fluvial sedimentology and she used the Paleocene and Eocene alluvial deposits of Wyoming's Bighorn Basin as her laboratory. She is most well-known for her work on paleosols – their recognition and interpretation, and their value as archives of ancient floodplain paleohydrology. Much of her work in later years was in collaboration with other geoscientists who sought to understand how dramatic and rapid changes in climate affected the nature of and rates of biotic change in continental systems. In recognition of her research achievements and service to the Sedimentology community, Mary was awarded Honorary Membership in the Society of Sedimentary Geologists (SEPM) in 2014.

Prior to moving into administrative positions, Mary was an active educator within the Department. Annually she taught History of the Earth, an introductory course most taken by non-majors, and the undergraduate major-track course in sedimentology (sedimentology and stratigraphy

since the mid '90s). She also offered graduate courses in Continental Sedimentology (centered around a 5-day field trip to Wyoming) and Advanced Sedimentology. The latter two were core courses for all students in the sedimentology & stratigraphy program, as well as many of those in paleobiology and Quaternary geosciences (e.g., INSTAAR). Over 35 MS and PhD students completed degrees under Mary's supervision, and went on to successful careers at the USGS, in the oil industry, as environmental geoscientists, in government positions, and in academic positions.

We wish her well in her retirement, and look forward to fruitful interactions with her as an Emeritus professor.

Chuck Stern retires

With the overwhelming support of the department's faculty, Chuck has been promoted to Emeritus Professor status, an honor many felt was long overdue. Chuck joined the department in the fall of 1979 and was Chair between 1998 and 2003. He developed and taught lab and field courses in petrology and volcanology to undergraduate geology majors, cosmochemistry to planetary geology graduate students, and natural hazards and catastrophes to undergraduate students from many different departments. During his 42 years he guided 24 graduate students and 10 undergraduate honors theses. He published over 200 papers on research topics related to the generation of magmas erupted from volcanoes along convergent plate boundaries, the relation between magmatism and the formation of economic ore deposits, the implications of the chronology of tephra deposits for evaluating volcanic hazards and as a tool for paleoclimate research, and the identification of the sources and regional distribution of obsidian in archaeological sites. Most of his field research work was conducted in Patagonia, but also included projects in Iran and Colorado. Chuck is survived by his wife Alex, his three children Nico, Paloma and Francisca, and two grandchildren Owen and Noah who now take up most of his attention.

GEOL 4711 field geology class at their field base camp, the tasting lounge at the Coors Beer Factory in Golden, CO



Trailblazers

Alisha Clark

While walking through the halls of the Benson building, the typical posters on the walls present new research from the next generation of geoscientists - our graduate students and postdocs under the guidance of the Department of Geosciences faculty. Soon, a new suite of posters presenting the research and history of trailblazers in the geosciences and related fields will be added to the hallways. These posters are the final product of students who participated in Trailblazers (GEOL 5700-107) with Alisha Clark during the Spring 2021 Semester. A major goal of this course was to expand our appreciation for the history of the geosciences, and in particular, to acknowledge the legacy of individuals from underrepresented groups.

Trailblazers is a new graduate level course that was inspired by the social justice movements of the summer of 2020 and conversations about diversity, equity and inclusivity for the geosciences and within the university more broadly. The Oxford-English Dictionary defines Trailblazer as “a person who is the first to do or discover something and so makes it possible for others to follow.” In this course each participant chose an historical example of underrepresented scientists in the geosciences (and related sciences – astronomy, engineering, mathematics). The ground rule we set as a class for choosing “an historical example” was that the individual must be retired. We learned about their scientific accomplishments, and about what motivated

them, what barriers stood in their way, and what we can do to make the geosciences more inclusive, equitable and diverse.

The scientists covered this term were Marie Tharpe, Marguerite Williams, Annie Easley, Inge Lehmann, Florence Bascom (and students), Hypatia, Vera Rubin, Mary G. Ross, and Annie Jump Cannon. We found that there were three major work modes for the Trailblazers: the individual researcher, some with students (e.g., Inge Lehman, Marguerite Williams, Annie Jump Cannon, Florence Bascom); the longtime duo (Marie Tharpe, Vera Rubin, Hypatia); and the research team member (Mary G. Ross, Annie Easley). We also found that our chosen Trailblazers followed non-traditional career paths, and were active in giving back to their communities, frequently through teaching or mentoring. While many faced unfair and unreasonable requirements for success, often in the forms of institutionally sanctioned racism and sexism (e.g., Florence Bascom had to attend classes behind a screen so as to not distract the male students while studying for her Ph.D. at Johns Hopkins), each person had advocates and allies throughout their careers. This is perhaps the most important role many of us can play to increase inclusivity and equity. Another common theme was an emphasis on teamwork and establishing relationships outside of the work hierarchy. Annie Easley, for example, described working on the holiday play and participating in the Skiing Club at NASA as having helped to create a sense of belonging and equality for all employees.

Trailblazers in Our Midst
Recognizing Trailblazers in Math and Science

Marguerite Thomas Williams
(1895 - 1991)

Biography
Little is known about her early life but in 1916, Williams graduated from a teacher-training program at the Normal School for Colored Girls with a scholarship to Howard University. While at Howard, she was mentored by Black biologist, Dr. Ernest Everett Just and worked full time as an elementary school teacher while earning her B.A. in Geology. After graduation, she became an assistant professor and chair of Geography at the Miner Teachers College (MTC). She taught courses on geology and social sciences. During this time, Williams completed her Master's degree from Columbia University in 1930 and then her Ph.D. from the Catholic University of America in 1942. After graduation, she was promoted to full professor at MTC and started teaching night classes at Howard University. She kept both positions until retiring in 1955.

Science!
Williams' dissertation *A History of Erosion in the Anacostia Drainage Basin* studies erosion from both natural processes (flooding) and human activity in the Anacostia River in Washington D.C and surrounding areas
Williams found that natural processes were not enough to account for the erosion taking place. Beginning with the colonists, the drainage basin was under heavy influence from agriculture and deforestation of the region
She was one of the first to investigate the effects of human activity on erosion
Map of the Land Utilization of the Anacostia River Basin created by Williams from her PhD dissertation

Legacy
By being the first African-American to achieve a PhD in Geology, she laid the steppingstones for other minorities to follow in her footsteps
Additionally, Williams spent her life directly sharing the knowledge of geosciences with future generations
Photo of Williams (right) teaching a group of students at Miner Teachers College
Did Williams have a bigger impact on society through research or teaching?

She was the first African-American person to earn a doctorate in geology in the United States
She spent most of her career teaching courses on geology and the social sciences

University of Colorado Boulder
Trailblazers GEOL 5700 Spring 2021

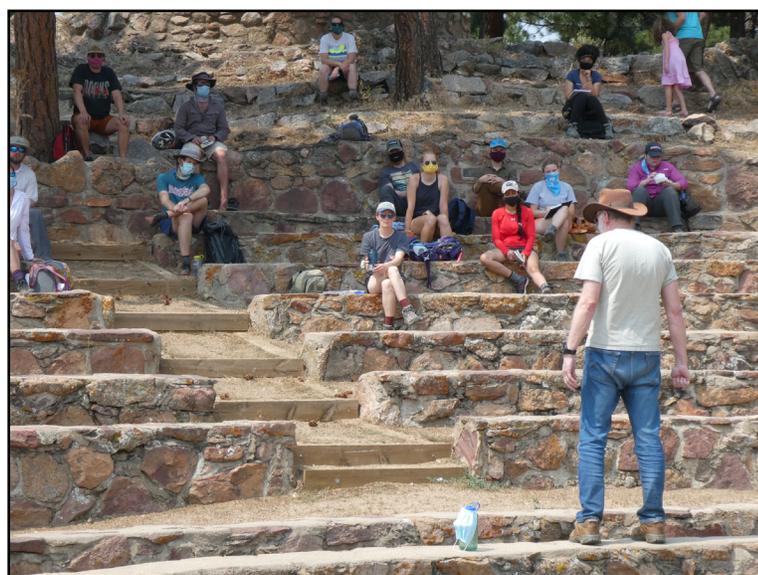
Figure: The Trailblazers poster for Dr. Marguerite Williams, the first African-American to earn a doctorate in the geosciences in the United States. Work of graduate student Melia Kendall.

In the Field



2020 Bill Bradley New Graduate Student Field Trip.
photo credit: Lon Abbott

Mitchell and Bob on Gothic mountain in the Crested Butte area I did with three undergraduate students for their Honors projects.
photo credit: Lon Abbott



Prof. Craig Jones teaching during the 2020 Bill Bradley New Graduate Student Field Trip. photo credit: Lon Abbott

Colorado wild fires studied in two geology field courses

Irina Overeem

The 2020 wildfire season in Colorado was catastrophic. The smokiness and ash fall was experienced by almost everyone in the State. In Boulder county, the Calwood Fire swept extremely fast through the foothills on a windy day in October. It burned over 10,000 acres. As field courses were required not to stray far from campus in the pandemic Spring semester and Maymester 2021, Professors Overeem and Trower decided to study the geomorphic and sedimentary effects of this wildfire.

Twenty undergraduate students in two separate field courses learned how to map burn severity, quantify post-fire soil water repellency, and ran experiments to measure infiltration.

In collaboration with Boulder Open Space, Calwood Education Center and scientists of the USGS, we selected gully systems modeled to be prone to debris flows once hit by intense summer rainstorms. For several of these gullies, we collected data on terrain characteristics, side slopes, lithological, grain size and grain size. Students installed time-lapse cameras in key sites to monitor mass movements over the summer. Two additional sophisticated monitoring stations with an automated raingauge, rainfall-triggered video cameras and geophones were installed by the USGS. Our undergraduate students assisted in the data collection at these sites. With this data now in hand, we now wait for the summer storms, in the hopes of learning more about debris flow dynamics and their controls in the Front Range.



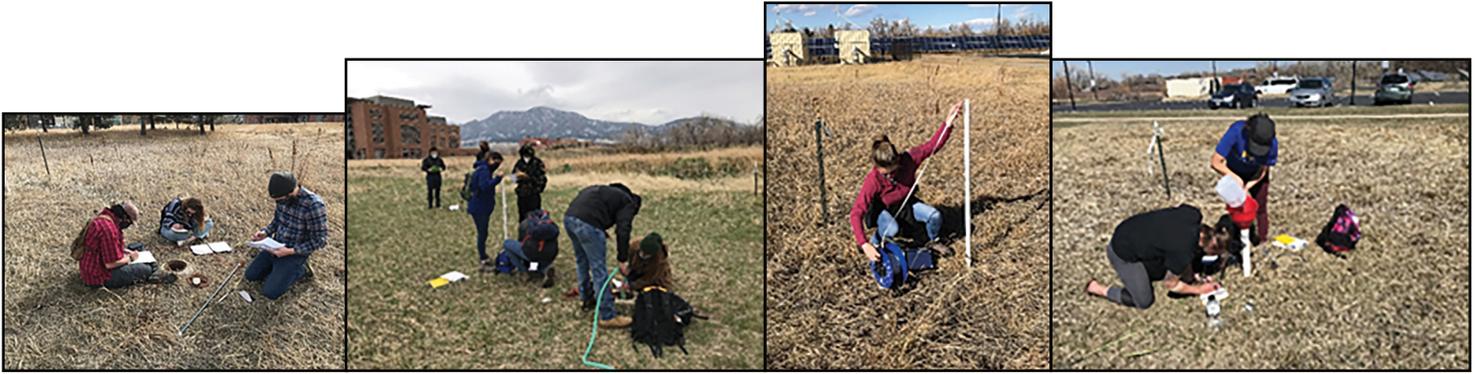
Undergraduate students Lauren Simmons and Maddie Schwarz are shown running an infiltration experiment to measure soil hydrophobicity in Geer Canyon, Boulder Open Space, affected by the Calwood Fire. photo: Irina Overeem



Undergraduate students Chris Knauss and Yousef Alnasrallah, with help of teaching assistant Vanessa Gabel, are measuring gully cross-sections in a severely burned part of Geer Canyon, Boulder Open Space. These cross-sections are nearby a debris flow monitoring station of the USGS. Models indicate that there is a high likelihood that these channels will funnel debris flows triggered by intense rainstorms later in summer of 2021. photo: Irina Overeem

Field Hydrology Class during COVID

Gordon McCurry



The Methods in Field Hydrogeology class continued into its sixth year this spring, using a hybrid format of remote lectures conducted via Zoom and in-person field labs. Since vans could not be used for field trips, Instructor Gordon McCurry modified the field labs to make full use of a research well field located on the East Campus, where students conducted four sets of field lab experiments. In the process, they became familiar with field equipment and data analysis software used in groundwater studies, along with field planning and health-and-safety protocols. Students also got practice writing technical reports through the lab reports they submitted with each field effort. Consistent with our discipline, the students enjoyed the hands-on aspects and practical problem-solving associated with the field data collection activities.

Graduate student Kyren Bogolub instructing students in the GEOL 3330 Geophysics class. Students are collecting hammer seismic data on the Benson South Lawn. photo credit: Anne Sheehan



GEOL 3330 Geophysics class, Spring 2020, collecting hammer seismic data on the Benson South Lawn. photo credit: Anne Sheehan

Below - Prof. Anne Sheehan and UNAVCO field engineer Brendan Hoge download data from a GPS station near Empire, Colorado. Data from this station and others are used to measure the very slow extension of the Rio Grande Rift as well as surface deformation associated with other tectonic and hydrologic processes. photo credit: Anne Sheehan





internet-equipped tents set up in the parking lot west of the Benson building for outdoor studying during Fall 2020. photo credit: Anne Sheehan



Field geology in the age of coronavirus - 2020 Bill Bradley New Graduate Student Field Trip. photo credit: Lon Abbott

Prof. Bob Anderson teaching during the 2020 Bill Bradley New Graduate Student Field Trip. photo credit: Lon Abbott



Outstanding Undergraduate Student Awards

Outstanding Geology Major - Philip G Worchester Scholarship

Sabrina Kainz

Outstanding Geology Major - Kolber Scholarship

Kat Goen
Fraklin Duffy
Keely Lawrence

Outstanding Senior - Gustafson Endowed Scholarship Award

Emma Grace Devin

Outstanding Senior - Bruce Curtis Scholarship Award

Jessica Ghent
Ella Hall
Baylee Ann Sergent

Outstanding Senior - Kenneth Allen Johnston Memorial Award

Josie Marquez
Madeline Schwarz

Outstanding Student - Stephen Evans Award

Jessica Ghent
Jake Spies

T. Keith Marks Scholarship Award

Keely Lawrence
Natalie Kissner
Edward Riccio
Connor Vartanian

Graduate Student Awards & Fellowships

Bruce & Marcy Benson Award

Enrique Chon
Anne Fetrow
Jamie Glass
Sarah Leventhal
Austin Sorscher

CU Grad School Award

Claudia Corona
Lina Perez-Angel

Penny Patterson Award

Abby Eckland
Sarah Leventhal

Bruce Curtis Award

Tyler Wickland

Stephen Evans Award

Enrique Chon
Lina Perez-Angel

Kelleen Lanagan won the best student lightning talk prize at CU's 15th Annual Hydrosciences Symposium.

Panorama view of an RG17 GPS station, Empire, Colorado. photo credit: Anne Sheehan



Graduate Student First-authored Publications

Fetrow, A. C., Snell, K. E., Di Fiori, R. V, Long, S. P., Bonde, J. W. (2020). Early Sevier Orogenic Deformation Exerted Principal Control on Changes in Depositional Environment Recorded by the Cretaceous Newark Canyon Formation. *Journal of Sedimentary Research*, 90 (September), 1–22. <https://doi.org/10.2110/jsr.2020.52>

Jacquemart, M. and Tiampo, K.: Leveraging time series analysis of radar coherence and normalized difference vegetation index ratios to characterize pre-failure activity of the Mud Creek landslide, California, *Nat. Hazards Earth Syst. Sci.*, 21, 629–642, <https://doi.org/10.5194/nhess-21-629-2021>, 2021.

Pérez-Angel, Lina C., Julio Sepúlveda, Peter Molnar, Camilo Montes, Balaji Rajagopalan, Kathryn Snell, Catalina Gonzalez-Arango, and Nadia Dildar. “Soil and Air Temperature Calibrations Using Branched GDGTs for the Tropical Andes of Colombia: Toward a Pan-Tropical Calibration.” *Geochemistry, Geophysics, Geosystems* 21, no. 8 (2020): e2020GC008941.

Pérez-Angel, L. C. (2020). Measuring past terrestrial temperatures with bacterial lipids. *Nature Reviews Earth & Environment*, 1(10), 499-499.

Raberg, J., Harning, D., Crump, S., de Wet, G., Blumm, A., Kopf, S., Geirsdóttir, Á., Miller, G. and Sepúlveda, J.: Revised fractional abundances and warm-season temperatures substantially improve brGDGT calibrations in lake sediments, *Biogeosciences Discuss.*, 1–36, doi:10.5194/bg-2021-16, 2021.

Wernicke, L. J., & Jakosky, B. M. (2021). Martian hydrated minerals: A significant water sink. *Journal of Geophysical Research: Planets*, 126(3), e2019JE006351.

Zawaski, M.J., Kelly, N.M., Orlandini, O.F., Nichols, C.I.O., Allwood, A.C., and Mojzsis, S.J., The Isua (Greenland) “relict stromatolites” cannot be confidently interpreted as original sedimentary structures: *Earth and Planetary Science Letters*, v. 562, 2021

Attention Alumni

By completing and mailing in this form, you can help us do a better job of keeping up with you, your whereabouts, and your career or family news. We all enjoy reading about classmates and not-so-close-mates who survived Boulder in whatever era! So send us some news or some recollections—we promise to use them.

Name _____ Date _____

Address _____

Degree(s) (years and institutions) _____

Current Position/Employer _____

News About Yourself/Family/Friends _____

Mail to: Geology News, Department of Geological Sciences, 399 UCB,
University of Colorado, Boulder, CO 80309-0399

Or Email your Alumni News to:
GeoAlum@Colorado.EDU

Graduate Student Research, Outreach, and Recognitions

Ciara Asamoto originally set out to culture nitrate reducing bacteria under different environmental conditions to better understand how this impacts the isotopic signature of denitrification in nature. However, due to the pandemic, she could not analyze these samples since these analyses are performed outside of CU Boulder. Instead, the funds from the Geological Sciences Graduate Fellowship award were used to preemptively pay for isotopic samples to be analyzed in the future.

In the meantime, Ciara has been working on other aspects of her research. First, she has been constructing genetically modified strains of bacteria to better constrain the isotope effects of nitrate reductases under different growth rates. Additionally, she is developing strains that express different versions of nitrate reductases to begin understanding how nitrate reducing enzymes and their isotopic signatures may have evolved through time. Ciara plans to resume analyzing isotope samples in the Fall using the funds received from this award.



Graduate student Tom Clifford performs maintenance on earthquake seismic station at Rocky Mountain Arsenal, Colorado. photo credit: Anne Sheehan

Anne Fetrow was awarded a Geological Sciences Graduate Fellowship award in Spring 2020 to pursue further field work for her dissertation project entitled, “Developing an isotopic framework for palustrine carbonate formation to inform paleoclimate and environmental research”. Wetland (palustrine) carbonates are an important, but understudied component of the terrestrial sedimentary record and preserve key information about climates and environments of the past, particularly warmer portions of geologic history. This project seeks to

better understand why and when carbonate minerals, such as calcite, precipitate out of solution and are deposited in wetland and pond environments. Anne’s project is based in wetland ecosystem in central Spain, Las Tablas de Daimiel, where these kinds of sediments form naturally. She has used some of the funds from the Geo Sci Grad award to recover samples and some monitoring equipment from the field site during pandemic shutdowns, and for analytical costs needed to gather isotopic data from these water and sediment samples. Anne intends to use the rest of the funds to return to the field site to gather further samples and reestablish monitoring activities once international travel is routine again.

Jonathan Raberg

BrGDGTs are a class of lipid biomarkers that are used in sedimentary archives to reconstruct temperature and pH as far back as the Cretaceous. Despite their widespread application in terrestrial and marine settings across the globe, the microbial producers of these lipids are unknown, hindering our ability to understand and refine these proxies through laboratory experimentation. An award from the Department of Geological Sciences has funded a new research effort aimed at identifying potential microbial producers of brGDGTs. These studies combine ongoing lipidomic research performed in the Organic Geochemistry Laboratory (led by Jonathan Raberg and Julio Sepúlveda) with new genomic efforts in the Department of Ecology and Evolutionary Biology (led by Sarah Gering and Noah Fierer) to examine the relationships between brGDGT distributions and microbial communities in over 30 soils and lake surface sediments from Iceland and the Eastern Canadian Arctic. While their research is ongoing, the data generated thus far show intriguing connections between bacterial taxonomic units and brGDGT lipids, which the researchers hope will aid in the identification of the elusive producers of these key paleoclimatic biomarkers.

During July 2020, **Mike Zawaski**, supported by a Geological Sciences Graduate Fellowship award, travelled to the Stillwater Complex in Montana to search for additional outcrops of a proposed glacial deposit from the Archean with detrital zircons. With about 40 lbs of samples, he crushed the samples in Benson’s Rock Shop and separated the zircons using heavy liquids and the Frantz machine in the Long Lab. After finding a few dozen zircons with Dr. Steve Mojzsis’ help, he sent his prepared grains to

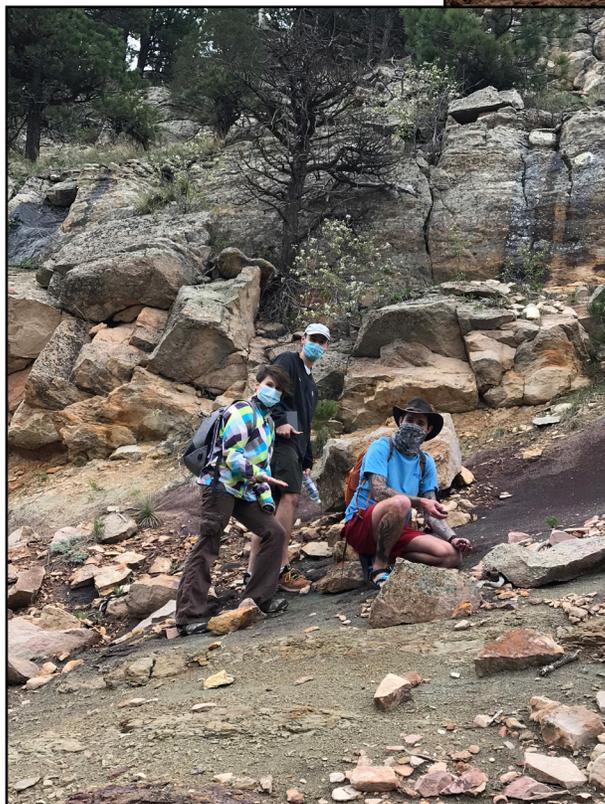
UCLA for U-Pb dating on their Secondary Ion Mass Spectrometer (due to COVID-19 he was unable to travel and analyze the samples himself).

Their grains revealed more concordant dates from 3200 – 2750 Ma \pm 16My. The Th:U ratios match typical values for igneous zircons. Therefore, they interpret them to be detrital. These results support an approximate age of 2750 Ma for the Stillwater diamictite. The significance of these results are that their dates match the proposed ca. 2.9 billion year old diamictites from the Pongola Supergroup (South Africa). If the Stillwater and Pongola sediments are glacial and of similar age, this could be important as Earth would have been in the midst of the Faint Young Sun Paradox at the time and a climate conducive to large scale glaciation might cause some reexamination of that model.



Stillwater Complex, Bobcat Creek, MT. Mike on an outcrop looking for sedimentary textures amongst all the lichen.

Undergraduate student Sarah Brookins and graduate student Rachel Havranek discuss soil horizons at a field site in the Oglala National Grassland, Nebraska in May 2021. This field work is a part of a larger project under Dr. Katie Snell to better understand how calcium carbonate nodules form in fine-grained soils.



GEOL 2700 TA Carlton Mueller engages students in thinking about possible past depositional environments that could explain what they observe today. photo credit Leilani Arthurs

Your generous support helps to fund many of our graduate programs and research initiatives enabling our graduate students the ability to positively impact the world around us. Thank you!

Degrees Awarded

(Fall 2020- Spring 2021)

BA Geology Majors

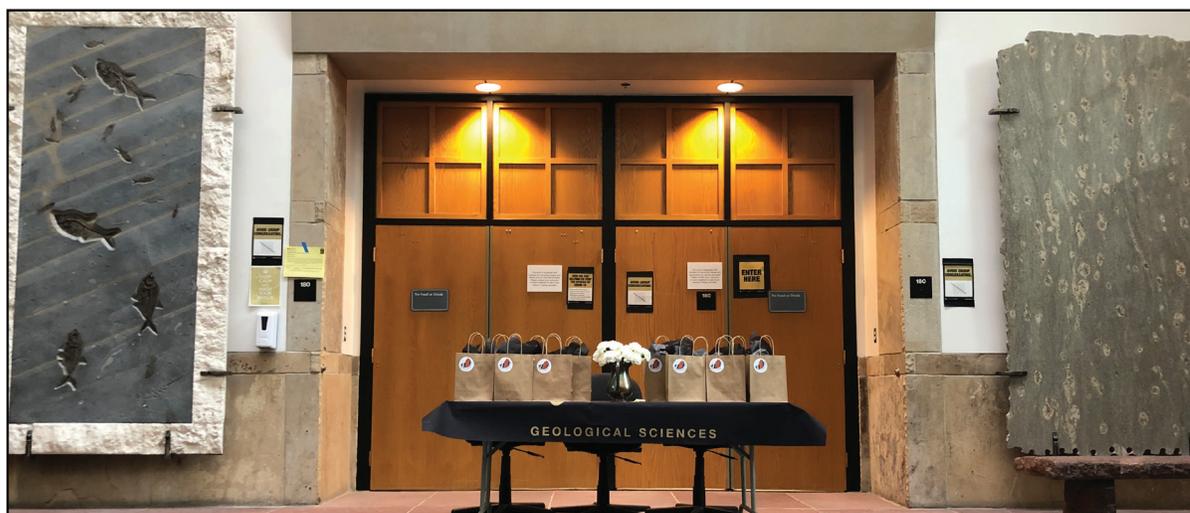
Rachel Anne Aidala
Ghadah Mohammad Alharbi
Duaa Aljaroudi
Dalia Abdulaziz Al Maghlouth
Charles Christopher Anderson
Christopher Andrews
Emily Barfield
Drew Brown
Sean Clarke
Kayleigh Elizabeth Cornell
Emily Cosgrove
Christopher George Dehoyos
Elizabeth Demers
Emma Grace Devin
Rachel Jewell Donati

Anthony Green
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Jessica Ghent
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Andres Lopez Alba
Abigail Lukacic
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Johnathon Cole Schubert
Madeline Schwarz
Baylee Ann Sergent
Lauren Simmons
Carly Ann Trimbach
Camila Villamil Arango
Rachel L. Ward
Daisy White
Patrick Wyatt
Tianyi Zhao
Michael Noah Zona

Graduating with honors

| | Advisor(s) | Thesis |
|---|----------------------|--|
| Drew Brown - cum laude | Dr. Lizzy Trower | Little Ambergris Cay, a Case Study for Ooid Rich Island Development on the Turks and Caicos Carbonate Platform. |
| Jessica Ghent - summa cum laude | Dr. Greg Tucker | Effect of volcanic lithology on erosional morphology in a post-fire setting. |
| Josie Marquez - magna cum laude | Dr. Alexis Templeton | Exploring Lipid Biomarker Profiles of Sulfate Reducing Bacteria in Low-Temperature Serpentinizing Systems Utilizing Batch Cultures. |
| Madeline Schwarz - summa cum laude | Dr. Karl Mueller | Automating measurement of extensional fault/ fold scarp geometry and resurfacing in Reykjanes, Iceland: Implications for fault scaling and growth. |
| Baylee Ann Sergent - cum laude | Dr. Tom Marchitto | Trace Metal Chemistry of Pteropod Shells: Biomineralization and Temperature Influences. |



During COVID-19, traditional department graduation swag was given out at timed intervals a day before the ceremony. Maddy Atteberry and Kara Bajdas handed out the bags to most of our graduating class. photo credit: Maddy Atteberry

MS Candidates Graduating with Degrees

| | Advisor(s) | Thesis |
|-------------------------|--------------------|--|
| Joseph Sean Butterfield | Dr. Brian Hynek | Investigating Stepped Fans at Lake General Carrera as a Martian Analogue. |
| Tom Clifford | Dr. Anne Sheehan | Investigations of Seismic Velocity Variations with Ambient Noise Interferometry in Greeley, Colorado. |
| John Douglas Gemperline | Dr. Brian Hynek | Unlocking Mercury's Geological History with Rembrandt Basin |
| John Todd Ohman | Dr. Michael Willis | Greenland Inland Traverse Hazard Assessment: Characterization of Change in Northwest Greenland |
| Mel Zhang | Dr. Anne Sheehan | Insight Into Subsurface Structure Using Sp Arrivals from Local Earthquakes in the Northern Hikurangi Subduction Zone, New Zealand. |

PhD Candidates Graduating with Degrees

| | | |
|------------------------|---------------------------------|---|
| Kyren Rix Bogolub | Dr. Craig Jones | Geophysical characteristics of the High Plains of Colorado and the Sierra Nevada, California. |
| Abigail Hughes | Dr. Jim White & Dr. Tyler Jones | Ice Core Water Isotope Records: Analysis of High-Resolution Greenland Ice Cores and Experimental Determination of Post-Depositional Effects on Surface Snow. |
| Aaron Hurst | Dr. Bob Anderson | Bedrock River Erosion by Plucking. |
| Mylène Jacquemart | Dr. Kristy Tiampo | Geodetic analysis of mountain hazards: Improving our understanding and assessment of glacier and landslide hazards in the face of climate change. |
| Daniel Blake Nothafft | Dr. Alexis Templeton | Subsurface Microbial Ecosystems and the Origin of Methane in Serpentinites of the Samail Ophiolite, Oman |
| Steven Plescia | Dr. Anne Sheehan | Geometric Considerations in Seismic Studies of Earth's Upper Crust |
| Nadine G Reitman | Dr. Karl Mueller | Strain Across Scales: Exploring Geologic and Geomorphic Evidence of Past Earthquakes |
| Kaitlin R. Rempfert | Dr. Alexis Templeton | Influence of Geology and Geochemistry on Microbial Dynamics and Associated Lipid Biosignatures in a Subsurface, Serpentinite-hosted Ecosystem. |
| Colin Piwonka Sturrock | Dr. Rebecca Flowers | Linking the tectonic, hypsometric and geodynamic history of the central and southern Canadian shield using (U-Th)/He thermochronology and global convection modeling. |
| Mike Zawaski | Dr. Steve Mojzsis | Chemical and Structural Investigations of Sedimentary Environments and Proposed Stromatolites. |

In Memoriam

Whitney A. Bradley (Geol'50; MS'52)

Harold L. Dunn Jr. (Geol'54; MS'55)

C. Howard Ellis (MGeol'58)

Erika Stoeckly Saltzman (Geol'36; MA'38)

Keene Swett (MGeol'61)

Elizabeth Tomlinson Ehrlich (Geol'46)

Alumni and Emeritus

Kenneth Carpenter

Kenneth graduated with a BA in geology at CU in 1980, worked at various museums around the country afterwards, and then came back to CU to get my PhD in geology in 1996. I just recently retired as the director of the Prehistoric Museum, Utah State University. I am looking forward to catching up on various projects, including completing a textbook on continental paleoecology begun by the late Dr. Judith Harris, who was my mentor at CU in the 1970s.

Kenneth Carpenter, PhD
Adjoint Curator
University of Colorado Museum
Boulder, CO 80309
publications: https://www.researchgate.net/profile/Kenneth_Carpenter3



Photo credit: etvnews.com Traci Bishop

**Your generous support helps to fund many of our graduate
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Spherical projection of the Benson Earth Sciences building. photo credit: Karl J. Mueller



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