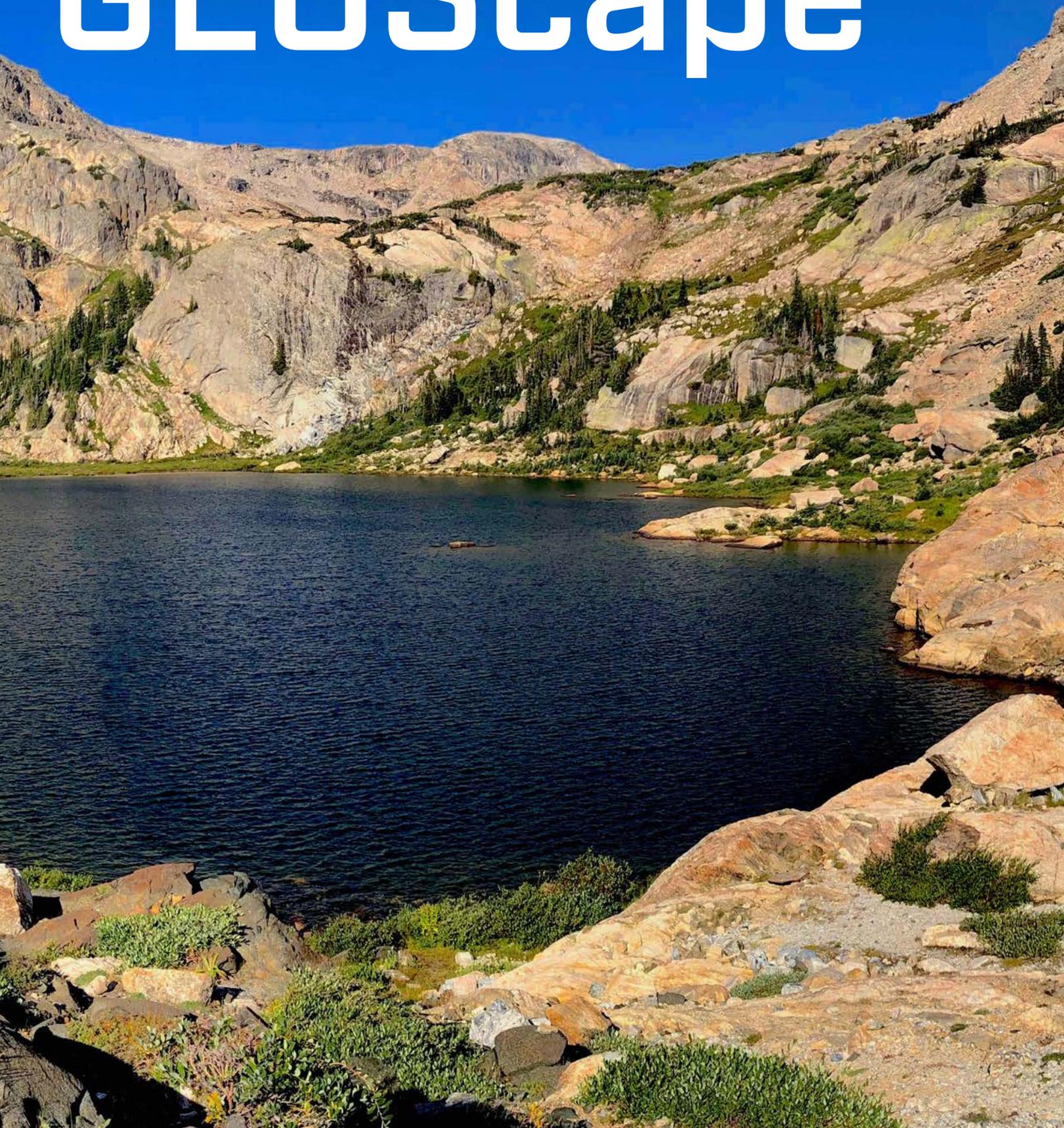




GEOSCIENCES
COLORADO STATE UNIVERSITY

2021

GEOscape



Juli Scamardo exhibiting suitable appreciation for a logjam on Indian Creek in southern Utah.



Message From Rick Aster, Department Head

Dear Alumni and Friends of the Department,

Geosciences bounced back to its more normal bustling range of activity this year, particularly in the summer and fall, despite continuing challenges from the evolving COVID-19 pandemic. Student enrollment in the department, college, and across CSU returned to (and, in some cases, exceeded) pre-pandemic levels. We successfully conducted a summer Field Camp to meet the needs of a large number of geology majors who had delayed this capstone course for a year due to challenges during 2020. Our student clubs re-engaged and began once again to host in-person seminars, field trips, and many other mentoring and community-building activities. Denver Museum of Nature and Science colleague Joe Sertich reinvigorated our undergraduate Paleontology course this spring and led a new Dinosaur Field Camp course this summer in Utah. Dennis Harry, Jeremy Caves Rugenstein, Dan McGrath, and Sean Gallen all introduced exciting new courses or evolved their in-development experimental classes toward permanent ones in whole Earth geophysics, paleoclimatology, surface and near-surface geodetic and geophysical methods, tectonic geomorphology, and Earth's critical zone.



Rick Aster enjoying the 2021 fall colors outside of Fort Collins near Pennock Pass.

2021 is shaping up to be an exceptional year for personal and institutional transition in our department and college. Two faculty colleagues, John Singleton and Lisa Stright, were promoted to associate professor and tenured (congratulations, once more, John and Lisa!). We welcomed Angela Sharpe as our new department undergraduate adviser and success coordinator, as well as a number of new affiliate and postdoc colleagues (as you'll see in this year's newsletter profiles). We are also preparing for some very notable departures. Sally Sutton, a faculty member since 1992, announced her January 2022 transition to faculty emeritus status. Sally's outstanding contributions include stints as department head, interim dean, department and college curriculum chair, associate department head, and many, many other impactful academic, search, working group, and other committees and initiatives across CSU. Her contributions to and legacy in our department and University have been both broad and deep. Our colleague Sven Egenhoff will be moving to a faculty position at the University of North Dakota to serve as director of the School of Geology and Geological Engineering starting in early 2022. Sven has established an outstanding sedimentology program and legacy of graduate student advising in our department since his arrival in 2006, and we wish him all the best in his new faculty and administrative position. We have begun searches for two new tenure-track department colleagues that we hope to complete as early as next summer, and which will be focused in petrology and sedimentology. In addition, John Hayes announced that he will be retiring in June 2022 after seven notable years as the Warner College of Natural Resources dean. John has been an exceptional colleague, advocate, and ally for our department and for the many other units across our college, and his sedulous engagement and wise counsel will be hugely missed. His many accomplishments while he was dean include the Michael Smith Natural Resources Building expansion and major developments at the CSU Mountain Campus. His successor will clearly have a challenging act to follow.

Our department and college are on the cusp of notable change, as well as continued exceptional opportunity. My sincere gratitude to our geosciences community of engaged faculty, staff, students, alumni, friends, visitors, affiliates, and others, who once more stepped up in 2021 on behalf of our thriving department. If you haven't stopped by the department recently, please do – we look forward to catching up with you!

A handwritten signature in black ink that reads "Rick C Aster".

Rick Aster, Ph.D.
Geosciences Department Head

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On the cover

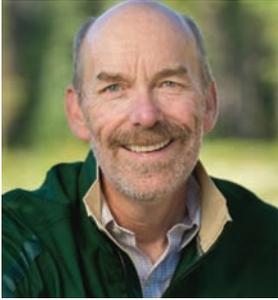
Bluebird Lake, Rocky Mountain National Park. Photo by Rick Aster.

GEOScape is the annual newsletter produced for alumni and friends of the Department of Geosciences at Colorado State University. We appreciate your continued support and welcome your thoughts.



**WARNER COLLEGE
OF NATURAL RESOURCES**
COLORADO STATE UNIVERSITY

A Note From Dean John P. Hayes



WCNR Dean John Hayes

Friends, Alumni, and Colleagues,

It is with emotion that I write these words, as this will be the last *GEOScape* note I craft.

This academic year will be my final year as dean, and I will be transitioning into retirement in June 2022.

Although I do not have formal training in geology, it has been a joy and an honor to have had the opportunity to work side by side with an incredible group of geoscientists at CSU over the past several years. I hope that during my tenure at CSU, my efforts have played some small role in helping the department advance its impacts at Colorado State and beyond. And as the snapshot of activities highlighted in this issue of *GEOScape* illustrates, the department's impacts are significant and growing.

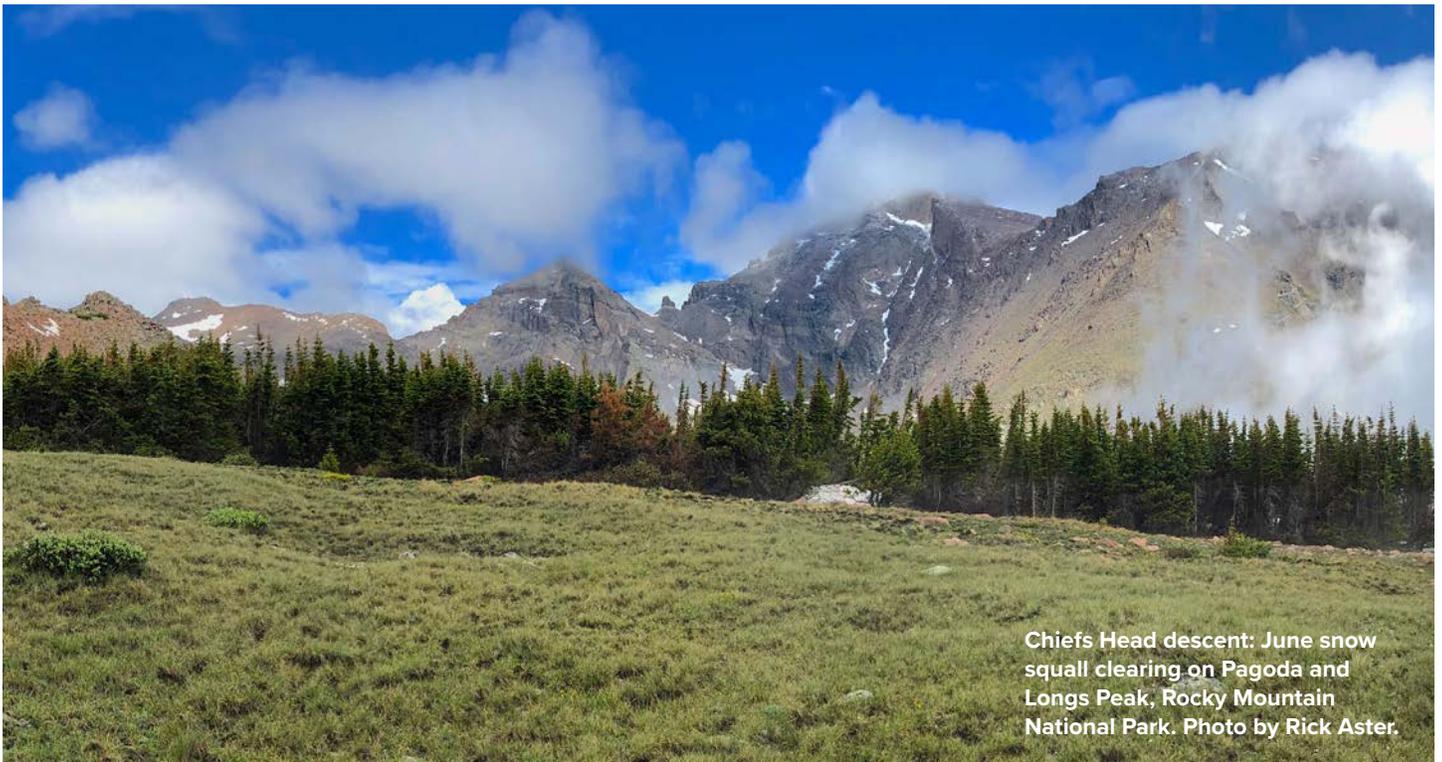
The educational programs led by the geosciences team, the outstanding graduates who have been mentored and supported by the department, and the generation of new knowledge by scientists in the department is outstanding. In the past few years, Rick Aster and the geosciences team have transformed the department, building on areas of historical strength and expanding into critical new areas of importance to science and society.

With even a short stroll through the third floor of the Michael Smith Natural Resources Building, it is evident that the department is a hub of intellectual excitement and discovery. It has become cliché to say “it takes a village” to foster successful programs, but the adage is certainly true in this case. The great things that are underway and much of what has been accomplished in the Department of Geosciences would not have been possible without the help and support of alumni, friends, and partners of the program. Thank you for all you have done to help move our program forward.

Though part of me yearns to stay a bit longer, the time is nearing for me to turn to other things. And as I prepare to leave, I do so with complete confidence that the next dean will take the department and the college to even greater heights. I look forward to helping advance the department's mission in the coming year, with anticipation of observing the tremendous accomplishments of the department in the years to come.

A handwritten signature in blue ink, appearing to read "John P. Hayes".

John P. Hayes, Ph.D.
Dean, Warner College of Natural Resources



Chiefs Head descent: June snow squall clearing on Pagoda and Longs Peak, Rocky Mountain National Park. Photo by Rick Aster.

2021 Field Camp students examining an outcrop of the upper Hermosa Group along Highway 550 near Silverton.





Sara Rathburn and M.S. students Sarah Dunn and Christoph Suhr coring Halligan Reservoir sediments with colleague Christy Briles, CU-Denver. Photo by Zac Haigh.



**ALUMNI NEWS &
STUDENT HIGHLIGHTS**

Warner College of Natural Resources Honors Alumnus Chris Lidstone

The department was overjoyed to have our colleague and friend Chris Lidstone (M.S., '81) honored as the 2021 Warner College Honor Alumnus. Chris is the founder of the engineering, geology, and water resource consulting firm Lidstone and Associates Inc., now part of Stantec, an engineering services company. He has more than 40 years of professional experience across a wide range of specialized, yet interrelated fields.

Chris has conducted comprehensive geomorphic and engineering studies leading to the stabilization and restoration of rivers, including the Rogue River in Oregon, the Provo River in Utah, and the Yampa River in Colorado. As a consultant to several small towns in Wyoming, he has been responsible for planning, design and construction of more than \$25 million of water and wastewater improvements.

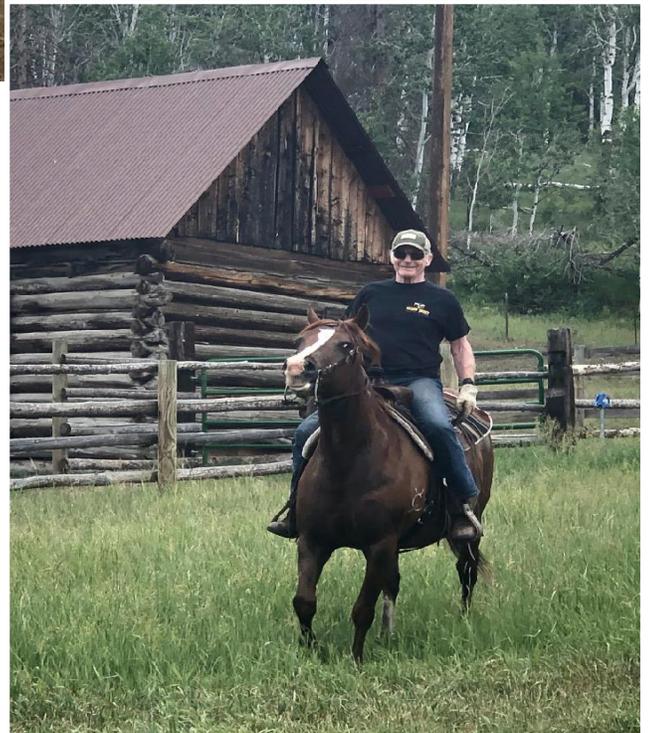
Chris serves as a cherished member of the Geosciences Advisory Council. He has served as both a guest lecturer and an affiliate faculty member in the Department of Geosciences.

In 2014, Chris and his wife, geologist Kate Laudon, established the Chris Lidstone and Kate Laudon Scholarship in Geosciences, and in 2019, they created the Chris Lidstone and Kate Laudon Graduate Fellowship in Geosciences.

Chris has been a guest lecturer for classes within the geosciences and watershed sciences courses on numerous occasions, including partnering with Roger Steining and Ernie Brown in 2020 to lead a course on the Business of Geosciences.

Chris has more than 40 years of professional experience across a wide range of specialized, yet interrelated fields.

Learn more at <https://source.colostate.edu/celebrating-the-2021-distinguished-alumni-at-csu/>



Top: Warner College Distinguished Alumnus Award recipient Chris Lidstone with Mustang Sally. Bottom: Chris and Mustang Sally on a ride.

2021 Warner College Emeritus Awarded to Tommy Thompson

Professor Emeritus Tommy Thompson was honored this year with the 2021 Warner College Emeritus Award. This honor recognizes his past and continuing outstanding global impacts in economic geology and his advising and mentorship of more than 100 (!) graduate students across his career, notably including many during his more than two decades here at CSU. Among other efforts, Tommy is currently working with our department and college in development efforts to realize the Tommy B. Thompson Economic Geology Legacy program.



Tommy Thompson and Rick Aster in the department.



Warner College Emeritus Award recipient Tommy Thompson and admirers (including many of his former students) during the 2018 Thompson Symposium at CSU.

Warner Student Ambassadors Felix Diaz & Isabela Arauz

We're pleased to have two international geology students, Felix Diaz and Isabela Arauz (both hailing from Panama), serving as Warner College student ambassadors in the John and Dolores Goodier Student Success Center this year. Warner ambassadors assist with college communications, tours, events, and much more. The Student Success Center honors John (geology, '59) and Dolores (occupational therapy, '58) Goodier for their exceptional contributions to CSU. Thank you for representing our college and department, Felix and Isabela!



Felix Diaz

Felix Diaz is a Warner College Ambassador and senior geology major (hydrogeology concentration) who previously studied at La Universidad Tecnológica de Panamá.



Isabela Arauz

Warner College Ambassador Isabela Marie Arauz is an international student from Chiriquí, Panama, entering her senior year in geology with a hydrogeology concentration.

She works with the Ambassador Program communication team in marketing and promotional pieces for the college, including in the Untold Stories Series, relating the stories of culturally and ethnically diverse individuals in the Warner College of Natural Resources.

Brianna Rick, Ph.D. Program

Investigating Cryo-Geohazards

After graduating high school, I spent the entire summer backpacking in the Ogilvie Mountains of the Yukon, Canada. We wandered over mountain passes, trudged along tussock-ridden glacial valleys, and crossed intricately woven braided streams. This incredible landscape imprinted on me a love for the Arctic, and sparked a curiosity about the processes that shaped, and continue to shape, the northern latitudes and high elevations. I was originally drawn to these landscapes through recreation but wanted to gain a scientific understanding of how they are changing and, in turn, how these changes affect humanity.

This interest led me to pursue a B.A. in geology at Carleton College, followed by an M.S. in geography at the University of Montana, where I looked at changes in permafrost and vegetation interactions on the North Slope of Alaska. I started my Ph.D. at CSU in 2018 with Dan McGrath as my adviser and am focusing on hazards resulting from changes to the cryosphere (or rather, “cryo-geohazards”), including those linked to glacial lakes and rock glaciers.

Over the past century, arctic and alpine environments have warmed nearly twice as fast as the global average, leading to pronounced physical and ecological changes. While these environments are often geographically remote, the magnitude and rate of changes have profound impacts from local (e.g., slope and infrastructure stability) to global (e.g., sea level rise and permafrost carbon release) scales. Ice is a highly sensitive component of structural integrity for many landforms in arctic and alpine environments, and warming temperatures have decreased the stability of many features (i.e., glaciers, permafrost, moraines, headwalls), leading to landslides, rock glacier debris flows, rockfall events, and glacial lake outburst floods.

A recent vivid example of such events was a February 2021 disaster in Chamoli in the Indian Himalayas that killed more than 200 people. GLOFs occur when a glacial lake dam (such as a moraine) fails or is overtopped, suddenly releasing a large volume of water into a drainage. These floods can have massive impacts on downstream ecosystems, infrastructure, and communities. For example, outburst floods from Glacial Lake Missoula nearly 12,000 years ago carved the Columbia



Brianna Rick at Mont Blanc (Chamonix, France) while attending the European Conference on Permafrost in 2018.

River Gorge and created the Channeled Scablands of Washington.

Though glacial lakes are presently at a much smaller scale, destructive GLOFs can still heavily impact downstream communities. Understanding how these lakes are changing as glaciers thin and retreat is a critical step in assessing the hazard potential and formulating hazard mitigation strategies for communities.

As part of my Ph.D. research, I use novel remote sensing tools, such as the cloud-based Google Earth Engine, to process large datasets (up to 2,500 satellite images per time period) to study the evolution of glacial lakes in Alaska over the past 40 years and to document lake drainage events to contribute to our understanding of evolving lake hazards in a changing climate. In addition, I am investigating the Lake Agnes rock glacier (near Cameron Pass outside of Fort Collins) to better understand how active rock glaciers within the Front Range act as climate-resilient cold-water reservoirs.

In Colorado, rock glaciers outnumber surface ice glaciers and cover a larger spatial extent, suggesting that they contain a larger volume of (subsurface) ice. In some mountain basins, the reduced climate sensitivity of rock glaciers (due to a thick debris cover) and their consistent cold-water input to mountain streams will likely provide a refuge for cold-water species in a warming climate. For this research, I use a combination of geophysics (seismic refraction and ground-penetrating radar), remote sensing (Structure from Motion and lidar) along with hydrochemical analysis (isotopes and ion chromatography) to understand the ice, its movement, and the water supply provided by the Lake Agnes rock glacier.

The Geosciences Graduate Student Organization

Kristen Cognac – President | The Geosciences Graduate Student Organization was formed in the spring of 2021 with the mission to represent and connect geoscience graduate students at CSU. Over the past year, the GeoGSO has organized social events, collected and shared graduate student feedback, and collaborated with faculty members to update and improve department policies. They also helped to formalize the process for graduate student involvement in the department’s monthly seminar series and initiated a peer-to-peer mentoring program. The GeoGSO held their first-ever chili cook-off this fall, and they look forward to future opportunities to connect, engage, and advocate for geoscience graduate students.

Student Organization News

Teresa Langenkamp – Chapter President | In 2020-2021, the CSU American Association of Petroleum Geologists chapter hosted several events, led by President Teresa Langenkamp, Treasurer David Cammack, Vice President Elan Nahir, Secretary Ethan Andrews, and Faculty Adviser Lisa Stright. In February and March 2020 a team of five students participated in the eight-week Imperial Barrel Award competition. In May 2020 AAPG provided one of two books to its interested members: *The Prize* by Daniel Yergin or *The Quest* by Daniel Yergin. Each of these provides an important historical overview of the oil and gas industry.



Photo from Joint AAPG and SEGeophysicists meeting in Fall 2021. Top row from left to right: Teresa Langenkamp, Luis C. Escobar, Cole Sitar, Kemi Taiwo, Yasir Al Rahbi, and Adam Walsh. Bottom row: Patrick Ronnau, Erika Jaski, Shea Slonkosky, and Julie Spawn.

In March 2021, a virtual field trip to Utah was hosted with Dr. Anton Wroblewski of the University of Utah. The title of the trip was “Virtual Field Trip: Proximal to Distal Changes in Fluvial Systems (Salt Wash Member of the Morrison Fm) in Utah and Colorado”. Lastly, in May 2021 we held a small outdoor barbeque. Despite the challenges of the pandemic, the club was able to remain active. This dedication led to CSU AAPG student chapter being selected to receive the 2020-21 Outstanding Small Student Chapter Award, provided by the gracious support of Aramco Americas.

Erika Jaski – Society of Exploration Geophysicists Chapter President | The SEGeophysicists is a global nonprofit organization with the mission of connecting the world of applied geophysics to investigate issues such as energy, water, and climate. This year, our student chapter has held monthly joint meetings with the American Association of Petroleum Geologists. Our meetings have been a fun gathering for students to eat pizza and learn how to get involved with these professional organizations, their benefits, and potential career paths.

We have been discussing opportunities such as scholarships, the Imperial Barrel Award competition, and experimental learning such as EVOLVE. We hosted a guest speaker, Amanda Hughes, who presented her experience working in the gas and oil industry and how it requires skills from multiple disciplines within geology. Future meetings will include field trips to an active drilling site, demonstrations of geophysical surveys, and outreach for local high schools, and we are looking forward to continuing the effort of getting people involved and informed of opportunities in this field!



OUR FACULTY & STAFF

Our faculty and staff explore the wide world of geosciences.

NEW FACES IN THE DEPARTMENT

Patrick 'Paddy' Ball, Postdoctoral Researcher

I am a postdoctoral researcher collaborating with Derek Schutt and Wolfgang Bangerth (mathematics, and a joint faculty member in geosciences) to develop new seismic and geodynamic models of Earth's mantle. I began work at CSU this April 1, a perhaps appropriate date since I was hoping to start months earlier until pandemic travel restrictions derailed the carefully laid plans. Making up for lost time, Derek and I are constructing a new Pn-wave tomographic model to infer the physical state of the base of the crust and top of the mantle beneath the northern Canadian Cordillera using new seismic data that Derek, Rick Aster, and Canadian colleagues have been collecting over the past seven or so years. Our aim is to investigate spatial changes in lithospheric temperature structure associated with the accretion of multiple crustal blocks onto the western edge of the North American continent.



I have also begun contributing to department teaching, including working with Jerry Magloughlin to organize and run a successful GEOL 401 field trip for senior-year and graduate students to Yellowstone and Grand Teton national parks. Next semester, I will be working with Derek to teach segments of the GEOL 250 Solid Earth Geophysics course. Moving jobs always comes with teething issues; in the last few months, I have managed to clear the backlog of papers detailing work done during my Ph.D. and previous postdoc at the University of Cambridge and The Australian National University, respectively (Stephenson et al., 2021; Ball et al., 2021a,b with c currently in review). I am looking forward to wholeheartedly pursuing all projects related to my postdoc here at CSU in the coming year.



Angela Sharpe, Department Academic Success Coordinator

I am incredibly grateful to have been given the opportunity to serve undergraduate students in the Department of Geosciences, beginning as the department's new academic success coordinator and adviser. Although I have been in this position only a short time (since late summer), helping students to reach their academic and professional goals has been a passion of mine for almost 10 years. Supporting our students affords me a new opportunity to engage a wider demographic and to connect and collaborate across a wider college and campus community. This past year and a half has certainly had its ups and downs, but beginning this position has been a positive highlight. As we transition back to a new "normal", I look forward to bringing a holistic approach to engaging and supporting current and future students in academics, career awareness, and personal development and satisfaction. Prior to this position, I taught Academic English, supported students and programmatic efforts as a program coordinator, and served as an academic adviser to international students in CSU's Office of International Programs. I bring to this position a background that includes a B.S. in Environmental Science from St. Cloud State University, a B.A. in Spanish, and an M.A. in English from CSU. In my free time, I love to discover new music, read, and spend time outdoors with my husband and three big dogs.



NEW FACES IN THE DEPARTMENT

Kerstin Braun, Affiliate and Instructor

I moved to Fort Collins in June 2021 from Tempe, Arizona, (where I maintain a position as assistant research scientist at Arizona State University), and this first summer and fall have been full of new and exciting experiences. I am currently teaching an introductory class in Geology of Natural Resources, filling in for Lisa Stright while she is on sabbatical. This is the first time I am teaching a class, so there is a steep learning curve for me as much as for the students.

My main research interest is the paleoclimate of Southern Africa on glacial-interglacial timescales. This includes the monitoring of present-day rainfall stable isotopic composition to better understand the relations between stable isotopes, temperature, and synoptic conditions causing rainfall.

I apply the findings about the present-day relationships to the stable isotope record measured on stalactite and stalagmite samples from caves in the south coastal region of South Africa. The cave sites are located in different climate zones within the region, including coastal and inland sites as well as different rainfall regimes (year-round rainfall and Mediterranean-type winter rainfall).



I have trained several undergraduate students here at CSU to help me with drilling carbonate powders for stable isotope analyses and am planning to also get them involved in the processing of these powders for analyses in the lab.

I am also working with CSU's Natural Resources and Ecology Laboratory and Jeremy Caves Rugenstein to nail down preparation methods for stable isotope analyses and hopefully start analyzing some new samples soon. In addition to stable isotopes of oxygen and carbon, I am analyzing trace element concentrations (mainly magnesium, strontium, and barium) in my samples, which can be used as proxies for past changes in rainfall, as well as studying the content of sulfur and bromine in my cave deposits as proxies for past volcanic eruptions.

This work includes focusing on samples that cover the time interval around 74,000 years ago during which a devastating volcanic eruption created the immense Toba caldera in Indonesia. With my research, I am contributing to a vigorous ongoing debate concerning the detailed environmental impacts of this extremely large volcanic eruption.

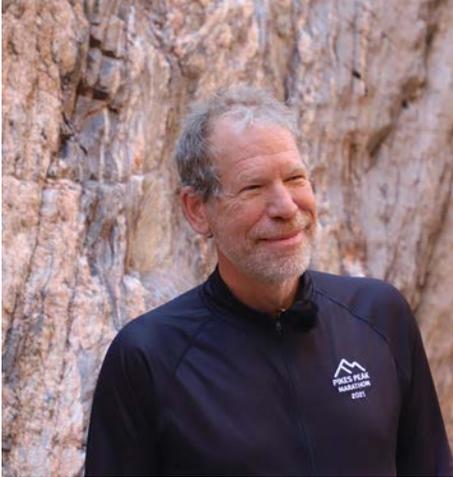


Kerstin Braun drilling speleothem core samples at Dripkelder Cave about 150 km southeast of Cape Town, South Africa.

Before drilling powders for dating and stable isotope analyses, speleothem samples are cut in half along their growth axis. This sample was found broken off at Sandkraal Cave near George, South Africa.



Longs and Chiefs Head Peaks, Glacier Gorge, Rocky Mountain National Park.



Rick Aster, Professor

As you will note throughout our newsletter, 2021 was again far from a normal year – but we all continued to persevere and adapt. This spring, I taught the Geophysical Inverse Methods class entirely online from my office using Zoom and an iPad whiteboard-like interface. This worked generically for this (math-centric) course but also reinforced for me the limitations of teaching without the personal interactions of an in-person class, particularly a small one.

It was thus wonderful to see in-person classroom learning reappear across the department and CSU this fall, albeit with indoor masking. My grad students Eric Eckert (Ph.D.) and Erika Jaski (M.S.) are making excellent progress in their NSF-supported research projects. However, their graduate student experiences have so far been entirely in-house analyzing

earlier acquired seismic data, with their field areas being off-limits to all but very limited groups of NSF-supported field teams during the 2020-2021 and 2021-2022 Antarctic field seasons.

Erika is reanalyzing data from a 100-station seismograph deployment around the active (and sometimes exploding) lava lake of Erebus volcano on Ross Island using new tools to better characterize and understand the explosive release of gas slugs at the volcano’s terminal conduit. These results will better inform a next-generation science and monitoring geophysical network that we plan to install on the volcano once Antarctic fieldwork can fully resume. Eric is taking up where my recently graduated M.S. student Hank Cole (now at the USGS National Earthquake Information Center in Golden) left off in analyzing and understanding prolific tidally triggered ice seismicity that occurs daily near the grounded margins of the Ross Ice Shelf as the shelf is lifted and flexed.

In September, I was fortunate to participate in an 11-day rafting and hiking field trip in the Grand Canyon with 21 colleagues from universities around the U.S. and Mexico, focused on structure and evolution of the canyon’s basement rocks (I was the only geophysicist!). A notable effort this year was a first-author paper in *Seismological Research Letters*, Swell-Triggered Seismicity at the Near-Front Damage Zone of the Ross Ice Shelf, published along with Hank Cole and

colleagues from five other universities. This is one of a sequence of papers led by me and collaborators studying the brittle and other dynamic behavior of Earth’s largest ice shelf with seismology, geodesy, and remote sensing, including analyzing unique seismic data that we recorded atop the shelf between 2014 and 2017.

Other papers I co-authored in 2021 covered modeling predicted tidally triggered seismic activity in the icy shell of the Saturnian moon Enceladus; remote triggering of icequakes in Antarctica by large earthquakes occurring around the planet; new seismic tomography-based mantle studies in northern Canada (with Derek Schutt, and others) and in Antarctica; and a review article for the Geological Society of London led by my colleague Ken Sims University of Wyoming covering the geological, geophysical, geochemical, and microbiological science of Erebus volcano.

In community service, I continued this year as board chair of the Incorporated Research Institutions for Seismology consortium, which supports geophysical research across the globe and operates major NSF facilities such as the NSF-USGS Global Seismographic Network. During 2022, we expect to be completing a corporate and facility merger with our sister geodetic consortium, UNAVCO. Finally, a nice surprise for me at the end of the year was the honor of being elected as a Fellow of the AGU.



Folded pegmatitic dikes, Vishnu Schist, Grand Canyon. Photo by Rick Aster



Sean Bryan, Senior Instructor

The past year has been eventful and challenging as we dealt with the pandemic impacts on our courses and University operations.

During the 2020-21 academic year, my large (450-550 student) Introductory Physical Geology lectures transitioned to a fully online format. I got used to creating lecture videos from my kitchen table and meeting with students over Zoom/Teams. Due to limited classroom capacities on campus, our GEOL 121 introductory labs ran in a hybrid format, with sections split in half and students alternating between in person and online labs. While not ideal, this format allowed us to be in-person for the labs that most necessitated it (for example, interacting with minerals and rocks), as well as to differently explore topics that lend themselves better to the online format (for example, analysis of GPS data, hydrography, and climate topics).

I was hugely impressed by the flexibility and dedication of our GEOL 121 geosciences teaching assistants over the last year (Andrew Bolton, David Cammack, Nick Chohan, Kristen Cognac, Valerie Doebly, Johanna Eidmann, John Kemper, Eyal Marder, Alex Marr, Lindsay Mota, Kivanc Sabunis, Juli Scamardo, Christophe Simbo, Siânin Spaur, and Kemi Taiwo) as they dealt with shifting schedules and alternating formats in

the midst of a global pandemic. And I'm pleased to report that Siânin Spaur was awarded one of the Geosciences Outstanding TA awards for 2020-2021!

A few additional highlights for me over the past year included working with a great group of graduate students (Kristen Cognac, Erinn Johnson, John Kemper, Juli Scamardo, and Siânin Spaur) on the NSF-funded initiative URGE, attending (virtually) the Earth Educators Rendezvous, working with a other educators to create new introductory geology lab activities that promote inquiry, and helping with the development of a new minor within the Warner College focused on diversity and inclusion in the natural resources.



Jeremy Caves Rugenstein, Assistant Professor

This past year, I fully established my laboratory and group (the GeoPAST group – the Geosciences PAleoclimate and Earth System Theory group) and have received several small internal grants that have helped me to build out my instrumentation. I received a Colorado Water Center grant to purchase four precipitation samplers that will be used to sample our isotopic measurements.

Three of these samplers have now been installed (one at the Main Campus weather station, one at the Mountain Campus, and one at the home of my

collaborator in Truchas, New Mexico, Scott Aby).

These samplers will provide monthly averaged measurements of precipitation isotopes that will be used to understand potential seasonal moisture changes that we observe in the geologic record. I also received a grant from the CSU Office of the Vice President for Research, in collaboration with more than 10 faculty across CSU, to purchase a ThermoDionex Ion Chromatograph that will be used exclusively for freshwater stream chemistry work. This IC will be installed in a newly renovated laboratory space, MSNR 306B. Our group's collaborations continue to grow, including hosting for the next two years a visiting speleothem researcher from Arizona State University, Kerstin Braun.

I also hired a new postdoc, Tyler Kukla, who is currently finishing his Ph.D. at Stanford University and will join us in January 2022. Tyler will be working on understanding the coupling between climate and the long-term carbon cycle. My two M.S. students (Siânin Spaur and Ellie Driscoll) continue to make substantial progress.

Ellie has put together one of the largest compilations of terrestrial stable isotope data, which will be incorporated into a soon-to-be-released searchable online database of stable isotope data (partly coordinated by the GeoPAST group and hosted by CSU's Geospatial Centroid group). Siânin was awarded a small NSF grant to date a large number of ashes in her study area outside Española, New Mexico, which will provide one of the highest-resolution terrestrial paleoclimate records ever produced.

Lastly, I am preparing to teach a new graduate class (Paleoclimate) in Spring 2022 that will be co-listed with the atmospheric sciences department and co-taught with atmospheric scientist Scott Denning.



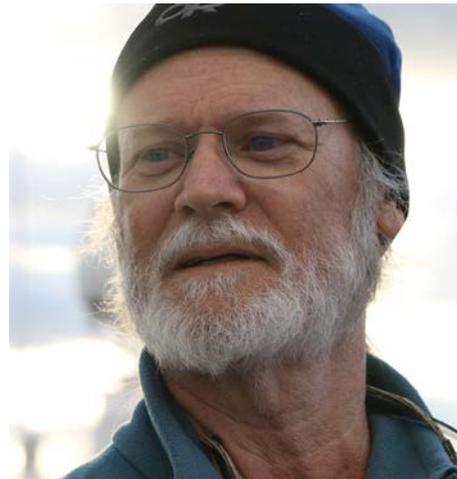
Sven Egenhoff, Professor

I was stuck at home during the first half of the year while teaching a seminar on Disasters in Earth History online because of the pandemic. Luckily, despite continued indoor masking, I am now back to teaching Sedimentology and Stratigraphy in person in fall although, admittedly, it is unclear what else this pandemic will evolve into and/or bring in the future.

I have been working on multiple articles this year, some of which have been submitted to journals but none has been published yet. However, I did make progress on either graduating my graduate advisees or bringing them close to graduation in 2021: Russell Thomas, graduated with an M.S. focusing on the sedimentology of an Upper Ordovician succession in Sweden (Ålleberg) at the end of September, and James van Hook will be next in line. (However, as James is working a full-time job with a petroleum company in Denver, which he obtained in February of this year (!), it is difficult to predict when exactly that will be).

The Fall 2021 semester will most likely be my last one at CSU after being on the faculty here for 16 years. I am expecting to begin a new position at the University of North Dakota in Grand Forks, which will allow me to continue to focus on the Williston Basin, which has been a main research interest for more than a decade, and I hope that at least one of my current graduate students will accompany me

north and east to complete a Ph.D. on the sedimentology of the Bakken depositional system. This summer, I again led Field Camp, and while our CSU capstone course had many special challenges during this second COVID-19 summer, we all survived well. As I wrap up my activities at CSU, I look forward to keeping my connections with the department to help graduate my current graduate students, who will continue at CSU, and to build continued collaborations once I am at UND.



Dennis Harry, Professor

This year, I was delighted to offer a new course on Whole Earth Geophysics. The class is designed to give a holistic (albeit introductory) view of planet Earth's structure, composition, and formation from core to atmosphere. The course was well received, but I learned that I need to cover the first 10 billion years of the universe's history more quickly if I am to leave time for the most recent four (the ones that involve Earth). I also taught an undergraduate/graduate seminar, continuing our geodynamics group's recent seminar focus on the rheology of the Earth's lower crust and upper mantle. My Applied Geophysics class is underway this fall, with a mix of students interested in topics ranging from geophysical imaging of archeological sites to resource management (water, energy, and mineral) to distinguishing temperature and composition variations in the mantle. M.S. student Manny Guerzon

graduated after completing his thesis on formation of the southwestern Australia deepwater Mentelle Basin. Manny's work was presented at the 2021 Annual GSA Meeting, and a paper is currently in preparation.

Former M.S. student Chris Wenman had his paper on the tectonic and stratigraphic evolution of the Victoria Land Basin in Antarctica published, and former Ph.D. student Sumant Jha has a second paper from his dissertation currently in review that explores the geodynamic causes of subsidence in the southern Victoria Land Basin. The works of Chris and Sumant continue with current Ph.D. student Micah Mayle, who has abstracts in the 2021 GSA and AGU meetings describing his work developing geodynamic models to investigate the causes of magmatism in the West Antarctica rift basins. Micah has corresponding papers in preparation, which we anticipate will be submitted this spring. Beyond classes and graduate students, my own activities have focused largely on helping the U.S. geodynamics community to develop a vision and plan for research into rifts, rifted margins, and oceanic ridges over the next decade.

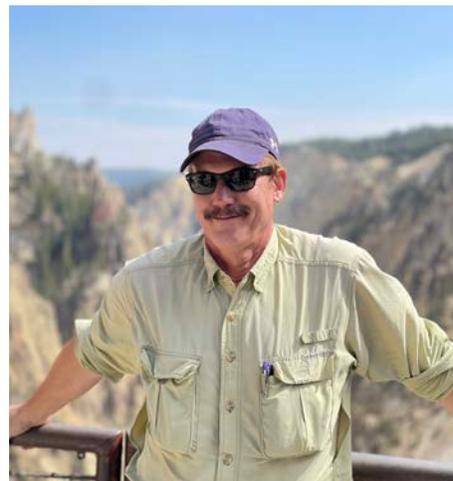
With 11 other U.S. scientists, I co-hosted an NSF-funded workshop in Summer 2021 to develop a science community vision for a program to follow the now-expired NSF GeoPRISMS and RIDGES programs. The (unexpectedly virtual) workshop was attended by more than 300 scientists, and our organizing committee is currently engaged in creating a report of the findings and recommendations that we will communicate to NSF in the spring of 2022. A new development this year is my engagement as co-leader of a combined academic/industry/government effort to archive the enormous industry seismic reflection dataset that has been acquired over decades of petroleum exploration. Our group has so far attracted great interest from industry, NSF, DoD, DOE, and USGS. Our formal planning efforts were launched at a Town Hall at the 2021 AGU Fall Meeting.



**Sean Gallen,
Assistant Professor**

It's been yet another exciting year at CSU, and despite some pandemic-related disruptions, the past year went relatively smoothly. Our geology majors course, Introductory Geology for Scientists and Engineers (GEOL 150), went off without a hitch, my Critical Zone Science undergraduate course saw a big jump in enrollment, and I successfully piloted a new undergraduate class on Data Analysis and Programming in the Earth Sciences. John Singleton and I also co-led the Geology of the Rocky Mountain Region (GEOL 401) field trip to southern Colorado in the spring. I had the pleasure of teaching a week of Field Camp in Cañon City, Colorado, over the summer – it was great to get back in the field with a large group of motivated students. My research group continues to push projects forward on tectonics and landscape evolution in Colorado, Puerto Rico, and the Mediterranean region. While fieldwork for my international projects has been postponed due to the pandemic, I did a fair amount of local fieldwork with a great group of colleagues at CSU, studying the impact of the 2020 Cameron Peak Fire on hydrology and geomorphology in the Poudre River Basin. I also spent some time in the field with John Singleton, Sven Egenhoff, and Lisa Stright to study the Fountain Formation and its record of the Ancestral Rocky Mountains. I also enjoyed many hours modeling landscapes in MATLAB

this year. I was fortunate to receive a five-year NSF-CAREER award to study the development of topography and geodynamics of the Calabrian subduction zone in southern Italy. With this grant, I will be able to expand my research group by supporting two new Ph.D. students and a number of undergraduates. Internationally, I've been working hard with a large group of scientists to move the NSF-supported Subduction Zones in Four Dimensions forward. This effort continues to develop, and the next year promises to be an exciting one for SZ4D. By the end of 2022, we hope to identify focus sites and lay the groundwork for what we hope will become a new program-level initiative at the National Science Foundation.



**Jerry Magloughlin,
Associate Professor**

This past academic year: one for the books or one we'd just as soon forget? That was and remains a common thought as we returned to campus last fall in the midst of the pandemic and continued the effort to adapt to limits on classroom time and direct contact with students. Personally, some classes, such as my online Introductory Geology course (GEOL 110), were hardly affected, while others, such as Optical Mineralogy and Mineralogy, required many adaptations and compromises. The ongoing effects of the pandemic, not just for our present students but for our incoming students over the next few years, remain a

looming issue. I taught my usual Optical Mineralogy and Mineralogy courses last fall, and my Microtectonics course in the spring, along with a return to a very large, socially distanced (read: widely spread-out students) classroom (the Lory Student Center ballroom!) for our GEOL 122 Introductory Geology course. Summer brought a return to our summer offering of Physical Geology, along with another larger section of our online course, which has generally done very well during the coronavirus era, attracting students from around the country, including some new majors. I enjoyed some gorgeous weather (somewhat less smoky than Colorado) in the Cascades for fieldwork in August.

A highlight for the mineralogy students, absent last fall, was a return to the Denver Mineral show, which this year featured Colorado's own rhodochrosite royalty, the Alma King and Alma Queen. This fall remains intensely busy, with courses and research and a variety of service work. I remain very involved with the future of our CSU Libraries, evolving given the current realities and the future of information access, through the Faculty Council Committee on Libraries. Here's to hoping we can all ditch the masks in 2022! This fall, I led our Geology of the Rocky Mountains course, GEOL 401, to the Tetons and Yellowstone (photo next page) with the able and enjoyable assistance of postdoc Paddy Ball.

Despite a limited mask mandate, it was another amazing visit to our nation's first national park. We took advantage of the long Labor Day weekend and enjoyed three full days inside Yellowstone national park. It was one of our first major field trips since the COVID-19 crisis began last year, and despite a mask mandate for the more crowded parts of the parks, it was very enjoyable to be out and to see the active geology of Yellowstone. Lingering smoky vistas remained in early September, yet the weather was otherwise perfect, and clear nights allowed laser-pointer assisted star parties at Grant Village, with elk bugling in the



Students of GEOL 401 Field Trip course at Yellowstone National Park.

distance and a campfire burning (s'mores, of course). The geysers cooperated in fine fashion: Great Fountain Geyser produced a terrific eruption, and we joined a late-season crowd for two eruptions of Old Faithful.



**Dan McGrath,
Assistant Professor**

Last winter started out with an ambitious NASA remote sensing campaign testing L-Band InSAR for snow remote sensing at Cameron Pass (and 12 sites throughout the Western U.S.). COVID-19 cut the campaign short in March, but the preliminary results are very promising, and we're gearing up for a follow-up campaign this winter with partners from NASA, Boise State, and University of New Mexico.

Randall Bonnell defended his M.S. in June and was awarded a NASA FINESST fellowship to support his Ph.D., which

will be primarily focused on radar-based snow remote sensing. Bri Rick continues to make good progress on her Ph.D. research examining cryo-geohazards (see her highlight on page 10 of this newsletter). She's harnessed the power of Google Earth Engine to analyze the entire Landsat archive to produce a detailed record of changing glacial lakes in Alaska.

We also managed to squeeze in some fieldwork at her Lake Agnes rock glacier field site this summer, where we collected ground-penetrating radar surveys to elucidate the interior structure of the glacier and conducted repeat Structure from Motion drone flights to quantify glacier deformation and velocity. Lucas Zeller's planned fieldwork in Alaska was canceled due to COVID-19, but colleagues at USGS managed to collect some of the necessary in situ datasets. His research is focused on quantifying the emergence velocities of Wolverine Glacier in the Kenai Mountains to inform how to best derive seasonal mass balances from repeat geodetic products.

Christoph Suhr (co-advised by Sara Rathburn) completed an ambitious USGS EDMAP-funded mapping project and collected some fascinating GPR surveys of the valley-fill at the CSU Mountain Campus (despite both COVID-19 restrictions and closures due to last year's Cameron Peak fire). I'm excited to be starting a new NASA-funded collaborative research project (13 PIs and >100 team members in total!), focused on understanding cryospheric and hydrologic changes in High Mountain Asia. We'll be quantifying changes in historic glacial lake extent and predicting future glacier and lake extents and detailed glacial lake outburst flood hazard assessments. Finally, I've enjoyed developing and teaching a new Environmental Geophysics class this fall that provides new opportunities for students with a variety of professional interests to learn about both surface and near-surface geophysics.



Photo: Sara Rathburn conducting fieldwork along the Fnjoska River in north Iceland, measuring root characteristics of the native tea-leaved and woolly willow.

Sara Rathburn, Professor

Spring semester 2021 marked the start of my sabbatical and preparations to spend four months in Iceland as a Fulbright Scholar. Fully vaccinated and with a temporary Iceland resident permit in hand plus lots of paperwork from the Fulbright Commission, I boarded a 90% empty plane to Reykjavik at the end of March. All my documentation satisfied the immigration folks, and I stepped out into the bracing Icelandic air feeling disoriented by the freedom but jubilant after such great seclusion during a long pandemic year.

After two weeks of mandated masks in public, Iceland lifted restrictions and I moved into an office at the University of Iceland to begin my work with colleagues at the university and the Icelandic Forest Service. That week also marked the first of four trips to see the volcano in Geldingadalir, where I collected my own baby MORB! My Fulbright research investigates how afforestation along rivers in Iceland increase bank stability and limit channel erosion. Once the winter conditions subsided, I conducted fieldwork along four rivers in Iceland within national forests where afforestation has occurred. I measured bank properties and root characteristics along cut banks to determine which species of plants

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impart the greatest increase in bank cohesion.

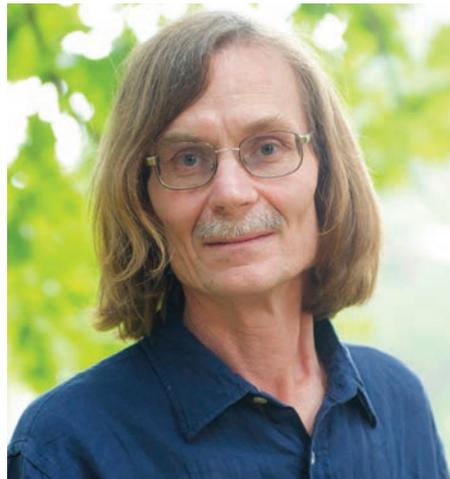
I am still working up the data and planned to present at the research at AGU in December. My time as a Fulbright Scholar in Iceland was vital, challenging, and inspirational, and I am grateful for the opportunity to meet an amazing cohort of other Fulbrighters and become part of the local Reykjavik community. I particularly appreciate the Icelanders' penchant for geothermal pools, fresh fish, their "þetta reddast" attitude that everything will work out in the end, and all who welcomed me into their homes and assisted me with my research. I plan to return to Iceland in May to present at the Nordic Geological Conference, ski some of the north Iceland snow, and see the volcano one more time!

I am still enjoying my sabbatical this fall semester and savoring the time to think, get caught up on research, submit manuscripts, and continue to work with my graduate students. Ph.D. student John Kemper submitted his first manuscript for publication to a special issue on sediment connectivity and is working hard on a second, presenting the use of XRF to fingerprint sediment from source watersheds in the Little Snake Basin. Celeste Wieting (Ph.D.) is embarking on her last field effort to collect functional traits of invasive vegetation species along the Rio Grande in Big Bend National Park as well as getting her first manuscript submitted.

Christoph Suhr (M.S., co-advising with Dan McGrath) is, as I write this, busy preparing his thesis on busy preparing his thesis on post-glacial alluvial dynamics to give to his committee before he leaves for Portland where he will give a talk at the 2021 GSA meeting. I admitted new student Sarah Dunn (my fourth graduate student from Whitman College!), and Sarah and I completed fieldwork the week after she arrived, including coring a reservoir within the Cameron Peak burn area. Sarah's thesis will assess post-fire impacts on flow and sediment dynamics within the upper Poudre River Basin as part of a collaboration with others

throughout Warner College of Natural Resources.

In addition, I am working with the city of Fort Collins to understand the disturbance history of the North Fork watershed recorded in the sediments in Halligan Reservoir, and I continue to work at CSU's Mountain Campus investigating the effects of the 2020 Cameron Peak Fire on sediment loading to the South Fork River and supporting efforts to build a long-term research site.



John Ridley, Associate Professor

Field teaching and fieldwork remained variably difficult through the year for me, including less fieldwork than I would have liked. During the spring semester, for instance, the city did not allow group field trips on their public lands, but at least the county did. Some improvisation was thus required for giving the students a good field experience in our Field Methods course.

The year was also marked by a number of my prodigal part-time graduate students more actively working on their research. The changing employment environment for geologists was probably a major prompt for some – it is always good to tie up loose ends and potentially to move onto new projects.



Mike Ronayne, Associate Professor

As part of broader efforts to characterize groundwater recharge in the Denver Basin, my group recently completed a three-year monitoring project focused on groundwater-surface water exchange and heat transport along Front Range streams.

In May, Matt Tyrrell published his undergraduate honors thesis on the thermal properties of streambed sediments. Ph.D. student Kristen Cognac led our study of the temporal variability in streambed water fluxes and the associated implications for groundwater recharge. I also continued as an active participant in the hydrologic monitoring at CSU Mountain Campus, which has been a wonderful place to work this year.

Among other activities, we are building a hydrogen-oxygen stable isotope dataset to track interacting groundwater and surface waters in this mountain watershed. This year, I taught graduate courses in groundwater modeling and geostatistics, as well as a grad-level seminar on subsurface solute transport.



Bill Sanford,
Associate Professor

Teaching during the pandemic has become more comfortable with experience. This spring, I taught Environmental Geology remotely, which does make it more difficult to interact with the students one-on-one. Fortunately, this fall, I am teaching Hydrogeology face to face, which I enjoy very much, as I am able to meet with the students in person. For the past few years, I have collaborated with the National Park Service to hire a CSU employee to assist the NPS in many aspects of hydrogeology, including creating a database of the groundwater resources for national parks in the Western U.S. In March 2021, I hired Nicole Vandaele for this position, who earned an M.S. from the Colorado School of Mines and has several years of project management experience and has been a great addition to the team. My current research focuses on the contribution of groundwater contributions to stream baseflow in high-elevation snowmelt-dominated headwater systems.

My M.S. student Amber Lidell successfully defended her thesis during the summer, which was on the effectiveness of novel low-cost specific conductance sensors to provide data to estimate baseflow in several headwater basins in the Medicine Bow-Routt National Forest surrounding Steamboat Springs. My current M.S. student, Nick Chohan, is continuing our work in the Senator Beck Basin in the San Juan

Mountains of Colorado to understand the importance of wetland drainage to maintain streamflow following snowmelt. Initially, we discovered that there was discharge measured at a stream gauge at the mouth of the watershed even though another researcher in the basin observed that the stream was dry above the wetland. To better investigate the hydrogeology, we installed pressure transducers to measure water table fluctuations within the wetland and sensors to measure specific conductance and document when the stream dries above the wetlands.

During a late summer visit, we observed that upstream of the wetlands, there was no water flowing. However, the stream was flowing just downstream, and we could see seeps emanating from the wetland. We collected water samples from wetland wells, from the seeps, and within the flowing stream reach to study and analyze for their composition of the stable water isotopes. These observations are consistent with the hypothesis that drainage from the wetland in the Senator Beck Basin has a significant role in maintaining streamflow following the end of snowmelt.

One aspect of the study is to compare the amount of and timing when baseflow in the stream becomes significant between wet/average/dry years based on amount of snow and the end of snowmelt season. Preliminary investigation has shown that baseflow in the stream dominates flow earlier during dry years than during wet years. Related to this, I was a coauthor on a manuscript in the journal hydrology on characterizing the snow accumulation phase to investigate spatiotemporal snow water equivalent distribution to provide insight into snowfall patterns and establishing monitoring stations to measure these attributes. Finally, I was asked to propose a session for the GSA joint meeting of the Cordilleran/Rocky Mountain section on “Groundwater Contribution to Flow in Headwater Streams.” The session was accepted, and the meeting will be held in March 2022 in Las Vegas. In addition to my teaching and research, I am serving as our department representative to the CSU Faculty Council and as the Warner

College representative to its Executive Committee.



Derek Schutt,
Associate Professor

This year, I welcomed postdoc Paddy Ball and new Ph.D. student Aziz Bankher to my research group. Paddy and I are working on estimating mantle temperatures and compositions through various means. We are mapping Pn (topmost mantle P wave) velocities to estimate mantle temperatures in China, the U.S., and Australia, and comparing these predicted temperatures to those recorded by mantle xenoliths and predicted by seismic S-wave tomography. He and I are also looking at different groups of mantle xenoliths, and estimating the effects of composition on seismic velocities. This is part of a multimillion-dollar, NSF-funded proposal to create a geodynamical reference Earth model.

Additionally, Paddy and I are starting a new project to map Pn velocity in the Mackenzie Mountains in northwest Canada. This should provide some important constraints on the thickness of the lithosphere, which in turn will bear on the mechanism producing current uplift. Aziz still has to choose his research, but we currently think he will do a project in passive source seismology in the Saudi Arabia region. I also have two M.S. students graduating this semester. David Cammack is finishing up his studies of attenuation in the Mackenzie Mountain region. Kivanc Sabunis is measuring mantle fabrics via shear wave splitting in

British Columbia and, after his defense, will start a Ph.D. at Southern Methodist University. I am also pleased to announce that past M.S. student Andrew Bolton (who graduated in December 2020) and my colleagues have just published a paper, Evidence for Asthenospheric Flow Rotation in Northwest Canada: Insights from Shear Wave Splitting in *Geophysical Journal International*, which documents and discusses shear wave anisotropy in the Mackenzie Mountains measured using distant earthquake signals.

From a teaching standpoint, I completely flipped the Global Seismology course in Fall 2020 – each class session is now devoted to active learning and group problem-solving, while lectures have been video recorded and students now watch them before class. This creates a system where the higher thinking skills in Bloom’s Taxonomy are done in a supervised setting, whereas the lower skills are presented before class. This has been particularly useful in the time of COVID-19, as students can attend class both in person and online. I will take what I’ve learned in the Global Seismology course and apply this to the larger GEOL 250 The Solid Earth course in the spring. Finally, colleagues and I have just finished up a small NSF-funded project to produce modules for a seismology course that we will share with the educational and seismological community.



John Singleton,
Assistant Professor

This past year, my research shifted primarily to projects in Colorado. I have become very interested in structures associated with the Ancestral Rocky Mountains, and our research in the Sangre de Cristo Mountains has taken off. M.S. student Cole Sitar has been mapping brittle-plastic shear zones along the western flank of the range near Crestone as part of a USGS-funded EDMAP project.

These shear zones likely originated during Laramide contraction and were subsequently reactivated as normal-sense shear zones during late Oligocene extension. This project is now funded by the National Science Foundation, and the scope of the research has expanded. In Fall 2021 I organized a student-led research seminar focusing on various aspects of the tectonics of the Sangre de Cristo Mountains (see Page 29). I love working in this area – these mountains are rugged and challenging, but the geology is spectacular.

There is so much to learn, and my students and I will probably be working there for years to come. A major highlight from 2021 was seeing Skyler Mavor complete his dissertation (which he defended in October). Skyler has played a huge role in the success of our research project in northern Chile, leading our effort to map a 70 km-long stretch of the Atacama fault system. M.S. student Erinn Johnson also recently completed her thesis, which focused on the Ouray fault – an Ancestral Rocky Mountain structure in southwest Colorado.

I had 35 students in Structural Geology (GEOL 372) this spring, and I taught two Field Camp projects this year: one in Temple Canyon (Cañon City) and the other at Lime Creek (south of Silverton). I enjoyed both weeks, and it was great to see how much the students’ mapping skills improved during the course. This fall, I taught Field Geology of the Colorado Front Range (GEOL 201) and an experimental 500-level course titled “Brittle Structural Analysis.” Starting in January, I will be on sabbatical. My family and I are planning to spend the year in Chile, where I have a research connection and some ideas for new projects.



Lisa Stright,
Assistant Professor

2021 has been a year full of exciting milestones and changes. An upper-level Petroleum Geology course that I was slated to teach in the Fall 2020 was moved to the Spring 2021. The move was precipitated by the pandemic and my need to help my elementary-aged children with at-home learning. My children returned to school in person in the spring, which allowed me to teach Petroleum Geology in-person, although we often shifted from in person back to online due to the continued impact of COVID-19.

In May 2021 I received tenure and became an associate professor, and I am spending the 2021-22 academic year on sabbatical. My goals for sabbatical are to expand my research into CO² sequestration projects through new collaborations and exploration of funding opportunities; to brush up on my programming skills; to prepare our research sedimentologic database for distribution to our sponsors; and to delve into topics that interest me, such as equity in energy and the future challenges facing our students in areas of geologic natural resources. We are currently in the third year of phase 3 of Chile Slope Systems. We were not able to do fieldwork in the beginning of 2021, but instead used the opportunity to work through the mountain of data that we have from previous years fieldwork.

This year, M.S. students Andrew Ruetten and Teresa Langenkamp completed their master's degrees. Andrew's thesis work characterized reservoir-scale fluid flow patterns and tested the ability of stochastic geocellular modeling to accurately predict these flow patterns. Teresa used Andrew's model for forward seismic modeling to better understand the information content in inverted seismic data for predicting facies rock properties for modeling.

I accepted two new M.S. students this year, Patrick Ronnau and Luis Carlos Escobar. These students will be working on modeling and machine-learning projects. The student American Association of Petroleum Geologists chapter at CSU, led by M.S. student Teresa Langenkamp, worked hard to find activities that could be done safely. Teresa led our small AAPG chapter to an award with the AAPG (see note on Page 11). The club will pick up with many of the postponed field activities this year, pursuing opportunities from rig trips with local drillers to local field trips to explore outcrops that teach about subsurface reservoirs.



**Sally Sutton,
Associate Professor**

With Ph.D. student Christophe Simbo and other colleagues, I continue to focus on understanding geochemical rock-water interaction, particularly related to aquifer storage and recovery. ASR, which has



Top: Sally Sutton with faculty admirers at her October retirement party. Bottom: Sally and grad students at Sally's fall retirement party. Left to right, back row: Luis Carlos Escobar Areanas, Eyal Marder, Alex Marr. Front row: Kristen Cognac, Kemi Taiwo, Sally Sutton, Christophe Wakamya Simbo.

seen increased use in Colorado in recent years, utilizes aquifers to store surplus water that can then be recovered when needed by pumping. The seasonality of snowmelt-derived water makes many Front Range communities excellent candidates for ASR, and it is especially promising as an alternative to constructing more large-scale surface reservoir projects. Christophe is beginning to work on geochemical modeling of rock-water interactions during ASR in a carbonate aquifer in Texas and plans to deploy a novel method for downhole measurement of redox potential in groundwater.

A question in any proposed ASR operation is whether interaction of oxidized injected water with a reduced native water could result in mobilization of metals, e.g., arsenic or uranium, from the host rock. We are beginning to address this with a combination of geochemical analyses and geochemical modeling. In addition to the continuing ASR-related work, new M.S. student Alex Marr is following up on a project of John Ridley's M.S. student Anne Ji. Alex is looking at the relationship

between changes in fluvial deposits and arsenic contaminated flood plain sediment downstream from the Homestake gold mine in South Dakota. Alex also just completed a very successful internship with the Colorado Geological Survey.



Ellen Wohl, Professor

Well, 2021 was better than 2020, which was not too difficult an achievement. CSU returned to in-person classes, although we all remain masked indoors. Grad students Sarah Hinshaw, Emily Iskin, and Juli Scamardo were able to complete planned fieldwork in the continental U.S. Sarah cored flood plain soils and measured large wood in Colorado, Oregon, and Utah, seeking to quantify carbon storage associated with stage 0 river restoration projects while staying ahead of the wildfires. Emily mapped flood plain heterogeneity along rivers large and small in Colorado, Kansas, and Washington. Juli once again risked permanent desiccation by working in southwestern deserts during summer break, this time coring flood plain soils and mapping spatial heterogeneity along ephemeral channels in the Canyonlands region. Grad student Rich Knox held down the fort, so to speak, at his computer. Rich has now completed his assessment of the spatial distribution of artificial levees in the continental U.S. When each child in his daughter's elementary school class was asked to describe what dads were good at, Rich's daughter reported that dads were good at typing.

Anna Marshall successfully defended her

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M.S. thesis in person, which was delightful after the previous year of Zoom defenses. Anna is now continuing in the program for her Ph.D. Having looked at wood in the relatively small Little Beaver Creek (it only seems large during snowmelt peak flows and when sampling transport at 2 a.m.), and in an even smaller flume at the ERC, Anna will now go big with work on the Swan and Flathead rivers in Montana. New M.S. student Mickey Means-Brous

joined the group and will be continuing the distinguished lineage of those working at Little Beaver Creek in the South Fork Poudre River catchment.

Much of our local Cache la Poudre watershed burned during the 2020 Cameron Peak Fire, providing a unique opportunity to examine post-fire logjam and sediment dynamics in a watershed we've been studying for years. Mickey will

be determining what the brook and brown trout in the creek think of the situation. Otherwise, all is well. I am actually even starting to miss international plane flights (a little), although not the commute to and from DIA. I am also becoming used to/ resigned to giving a lot of Zoom talks to audiences on other continents at strange hours of the night in the U.S. Mountain Time Zone. I guess it beats jet lag.



Celeste Wieting contemplating erosion along Deadman Wash, Wupatki National Monument. Photo credit: John Kemper.

Judy Hannah and the Geological Resources Inventory Team

The GRI currently employs eight CSU research associates (including four department alumni) and two CSU geology student interns. Over the past 21 years, the GRI has trained and employed 40 interns. This year, the GRI map team shifted from production of new map products to ramping up efforts to update the massive archive of GRI legacy digital geologic-GIS maps to modern data formats and standards. This effort updated 108 legacy maps in 36 parks, ranging north to south and east to west across the nation: Yukon-Charley Rivers National Preserve (Alaska) to Everglades National Park (Florida) and Cape Hatteras National Seashore (North Carolina) to Haleakalā National Park (Hawaii).

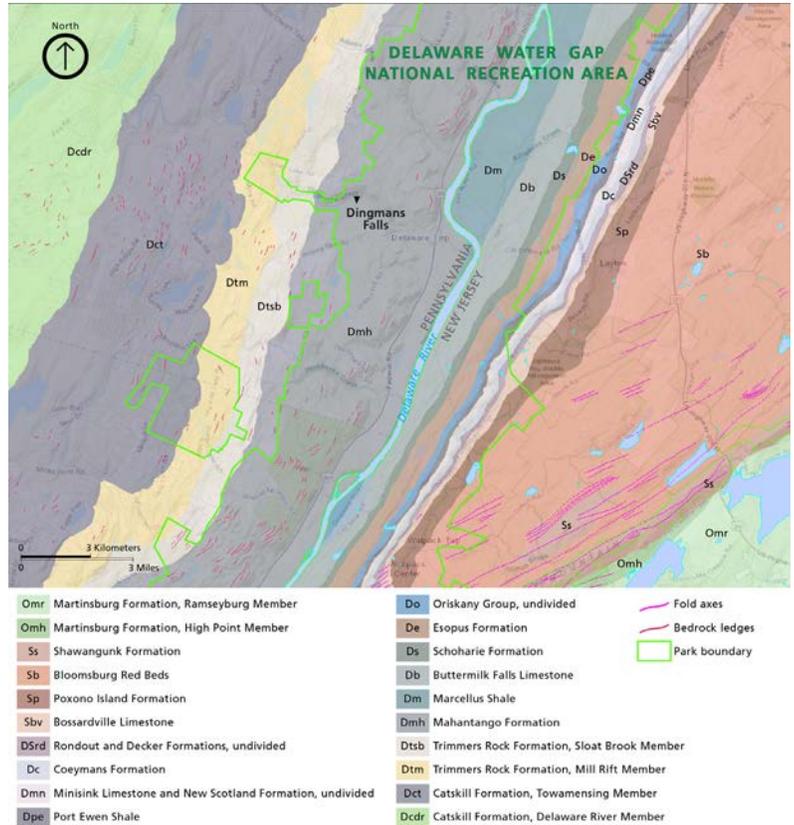
A significant 2021 accomplishment for the map team is the update of the GRI GIS data for Delaware Water Gap National Recreation Area (Pennsylvania and New Jersey). The team updated eight legacy maps and added a new digital surficial geology map (made up of 11 component maps).

The largest and perhaps most complex project completed was the update of 18 detailed maps covering Yosemite National Park and Devils Postpile National Monument (California). Along with updating legacy maps, the map team started producing maps in additional product formats to support more diverse end users. In addition to ArcGIS and Google Earth, data formats now also include ArcGIS Pro and Open Source (Geopackage and QGIS) product formats.

In the past year, the GRI report team completed reports for the following four parks:

John Muir National Historic Site – The historic site interprets the entirety of John Muir, beyond his legacy in conservation, and preserves the home and a portion of the fruit ranch and land where Muir lived with his family in Martinez, California, from 1880 until his death in 1914. Muir is buried onsite. Muir’s public career as a nature writer began with geology and glaciology as his subjects, which is notable for the historic site’s geologic heritage. The historic site’s geologic history spans at least 145 million years; its oldest bedrock is the Cretaceous Great Valley sequence. Today, the site is influenced by the San Andreas Fault system. In addition to earthquakes, geologic issues include erosion, flooding, and slope movements.

Kennesaw Mountain National Battlefield Park – The battlefield park preserves and interprets the landscape of the American Civil War battles of Kolb’s Farm and Kennesaw Mountain (1864), and the last Confederate defense of Atlanta against



In 2021, the GRI map team updated eight legacy maps and compiled a new digital surficial geology map (composed of 11 component maps) into the GRI GIS data for Delaware Water Gap National Recreation Area (Pennsylvania and New Jersey). The figure shows a portion of the GRI QGIS product zoomed into the Dingmans Falls area (see accompanying photograph). Graphic by Trista Thornberry-Ehrlich (CSU research associate and GRI team member) using base imagery from ESRI World Topographic Map.

Union Maj. General William T. Sherman. The defensible “mountains” are the result of a geologic history spanning 470 million years, including differential weathering and erosion of igneous and metamorphic rocks of the Appalachian Mountains. The battlefield park’s geologic heritage incorporates the construction and placement of earthworks, a Civilian Conservation Corps stone quarry, building stone (sourced elsewhere) used in monuments, and carvings in ultramafic rock. Geologic issues comprise erosion, fluvial features, and processes including storm runoff on developed lands, and earthquakes.

Lake Clark National Park and Preserve – The park protects a region of dynamic geologic and ecological processes that create scenic mountain landscapes, unaltered watersheds that support the largest sockeye salmon (*Oncorhynchus nerka*) run in the world, and habitats for wilderness-dependent fish and wildlife. The park is situated on the geologically active southern margin of Alaska where the tectonic process of subduction creates volcanoes of the Aleutian arc, including the park’s

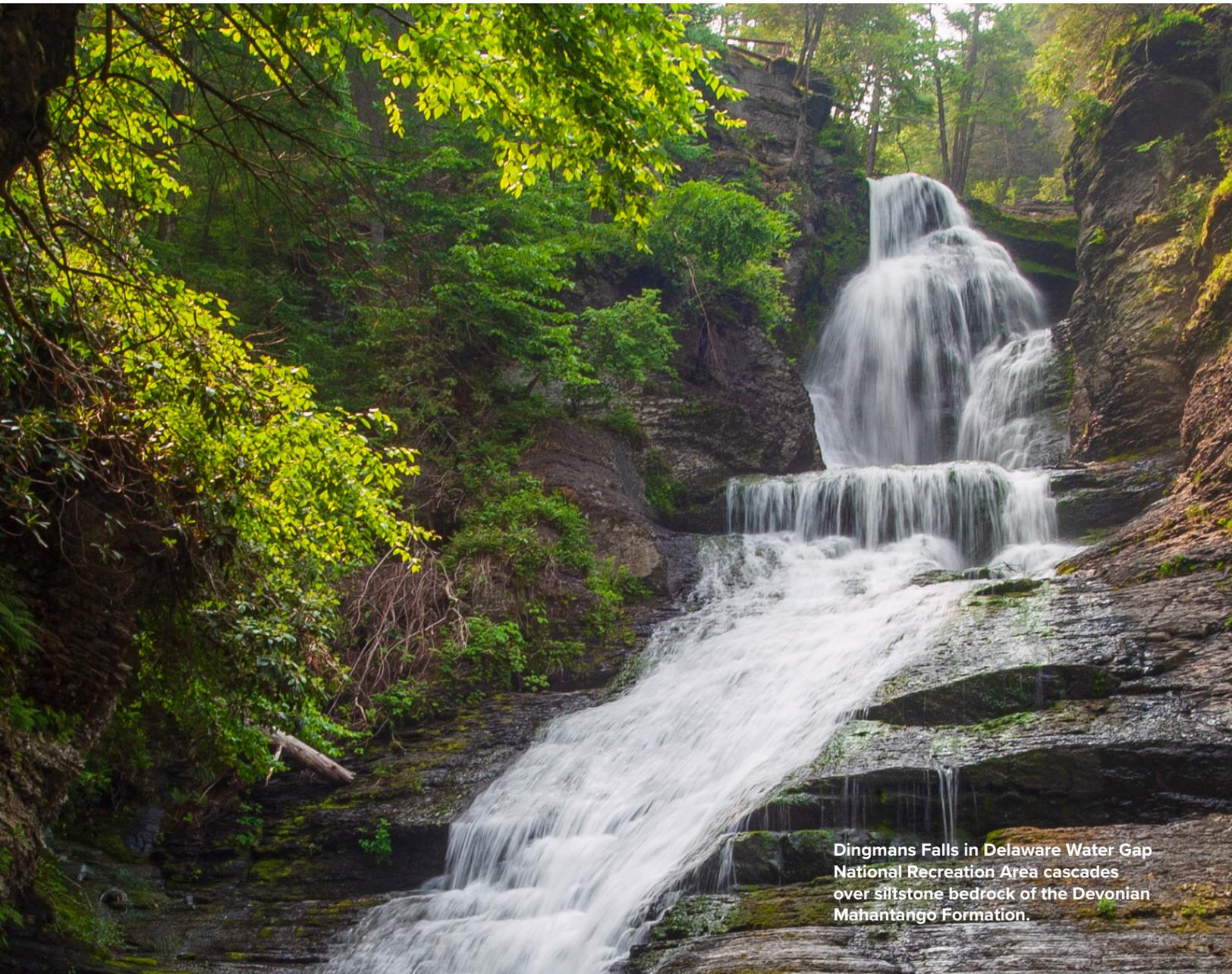
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active Redoubt and Iliamna volcanoes. The park's mountains provide a barrier to moist air from the Gulf of Alaska and consequently are centers of glacier formation. Geologic issues include volcanic hazards, earthquakes, landslides and rockfalls, tsunamis, active and abandoned mineral development, coastal oil and gas operations, protection of paleontological resources, glacier monitoring, and coastal geomorphology and sea level changes.

Redwood National and State Parks – The parks are part of the California Coast Ranges, a northwest-oriented chain of nonvolcanic mountains bordering the Pacific Ocean. The parks' geologic story encompasses 200 million years, starting in the Jurassic Period. Its geologic heritage includes the California Gold Rush (1848-1855), contributions to the theory of plate tectonics, more than 40 years of geomorphic research, and the lineage of the coast redwood (*Sequoia sempervirens*). Geologic issues include landslides, coastal and offshore

geologic resources management, active faults and earthquakes, restoration of the Redwood Creek watershed and estuary, and tsunamis.

Another product provided to park managers is a poster of the GIS data draped over a shaded relief image of the park and surrounding area. The poster is not a substitute for the GIS data but is supplied as a helpful tool for office and field use. This year, six posters were completed for the four park units above; Lake Clark National Park and Preserve had separate posters for bedrock and surficial geology, and Redwood national and state Parks had separate posters for the north and south portions of the parks. Progress was also made on posters for at least 10 other National Park System units, including national battlefield parks, national preserves, national historical sites, national recreation areas, national rivers, national monuments, and national parks, in states from Alaska to Georgia.



Dingmans Falls in Delaware Water Gap National Recreation Area cascades over siltstone bedrock of the Devonian Mahantango Formation.



John Kemper surveying at Wupatki National Monument, Arizona. Photo by Celeste Wieting.



DEPARTMENT NEWS

Collaborative Geoscience Research in the Sangre de Cristo Mountains of Southern Colorado

John Singleton

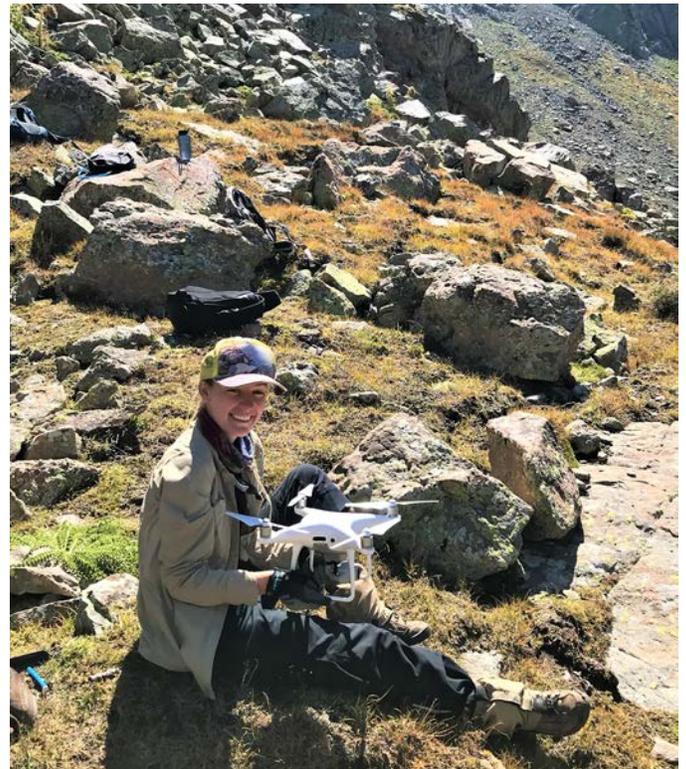
During 2021, I helped initiate a multidisciplinary geoscience research program in the Sangre de Cristo Mountains, centered around student-led research projects. The Sangre de Cristo Mountains in southern Colorado record a spectacular geologic history that encompasses every major aspect of tectonism in the Rocky Mountain region: Proterozoic (1.8–1.4 Ga) protracted deformation, magmatism, and metamorphism; Pennsylvanian-Permian shortening and clastic sedimentation associated with the Ancestral Rocky Mountains; Late Cretaceous-Early Paleogene shortening associated with the Laramide orogeny; and middle to late Cenozoic extension associated with the Rio Grande rift. This geological diversity lends itself to a wide array of research topics and multidisciplinary collaboration, as well as formative field research for our students.



During early Summer 2021, fieldwork and preliminary research with undergraduate students was supported by the Ethridge Sedimentology Endowment and the Mineralogy/Gems Research fund, and in Fall 2021 I led a research seminar (GEOL 492/692: Tectonic Studies of the Sangre de Cristo Mountains) involving seven students (three undergraduate and four graduate) and collaboration with fellow faculty Jerry Magloughlin and Sean Gallen. Major goals of this seminar were to provide research experiences for undergraduates and opportunities for graduate students to expand their research skills, and to help forge new collaborations across the department.

Student research project topics in the seminar included Ancestral Rocky Mountains sedimentation and deformation, penetrative strain and anomalously high-grade metamorphism in Pennsylvanian strata, deformation associated with Oligocene magmatism, and the complex thermal history evidenced across the eastern flank of the range.

Students completed fieldwork over Labor Day weekend and met regularly throughout the semester to discuss relevant papers and their research progress. At the end of the semester the students gave research presentations to a broad audience via Zoom (including USGS geologists and faculty from other universities with interests in the region), and several students plan to present their research results at upcoming GSA meetings. This research has recently significantly expanded with grant support from the National Science Foundation, and this research seminar will now continue in Fall 2022 and 2023 semesters, with a shift to include surficial processes research projects in 2022 (led by Sean Gallen).



Top: John Singleton (left) with undergraduate students Sammy Malavarca and Benji Byars inspecting an Oligocene intrusive contact in the Sangre de Cristo Mountains near 13,000-foot elevation. Bottom: Emily Perman preparing to launch a drone at a high-elevation field site.

Mineralogical Analysis of Possible Retrogressed Garnet Peridotite, Washington

Jerry Magloughlin

This project (Jerry Magloughlin and M.S. student Demi Girot) is focused on petrographic, mineralogic, and scanning electron microscope study of two large peridotite bodies in the northern Cascade mountains of Washington state.

These two bodies, both a few hundred meters in length, are in a terrane known to have experienced moderately high pressure, but the bodies contain evidence for the former presence of garnet, which, if verified, would indicate potential ultra-high pressure conditions and much more dramatic tectonic interaction during the Cretaceous orogeny that affected a wide swath of terranes now in the Pacific Northwest.

Petrographic work so far has identified cm-scale chlorite pseudomorphs, some with chromite inclusions, consistent with syn-tectonic (accretionary?) deformation of these ultramafic bodies, along with dramatic deformation of enstatite, including isoclinal folding consistent with very high temperature strain. SEM work continues on small scale textures and mineralogy to evaluate the hypothesis that these two bodies were garnet peridotites prior to being incorporated into the Cretaceous orogen.

Special thanks to our supporters of the Ethridge Sedimentology Endowment and the Mineralogy/Gems Research fund for enabling us to support these research programs!

Advancing Diversity, Equity, and Inclusion in Geosciences

Dan McGrath and Sean Bryan

The department continued to develop its Diversity, Equity, and Inclusion activities over the past year, including with a new faculty and student committee chaired by Dan McGrath, and in participation with group workshop efforts led by WCNR's dynamic diversity Director Rickey Frierson. Department and college faculty and staff also participated in a Cost of Poverty Experience workshop this October, that explored (with an extensive role-playing exercise) and discussed barriers to student and life success for students from all backgrounds who encounter financial, child care, medical, and other off-campus challenges.

The DEI Committee will be coordinating a new travel award next spring to support professional development activities related to DEI topics for our students. Dr. Jeremy Caves Rugestein has been coordinating a college-DEI initiative/collaboration between WCNR and Navajo Technical University in New Mexico, which is the largest tribal college in the U.S. that included a fall visit to Crownpoint, New Mexico.

The goal of this initiative is to mentor and support NTU students in research experiences, with the ultimate goal of encouraging them to pursue graduate degrees at CSU or elsewhere. Ultimately, the DEI Committee, working with all members of our department and University community, seeks to increase the accessibility, equity, and inclusiveness of all aspects of our

educational opportunities.

Geosciences as a discipline is the least ethnically and racially diverse of the STEM fields. While some progress has been made in the past several decades in the proportion of undergraduate degrees awarded to underrepresented minorities, these increases have been uneven and have not corresponded with increases in the proportion of doctoral degrees. The geosciences' lack of diversity limits our discipline's ability to fully serve community needs and educate tomorrow's geoscientists to solve the challenges of the 21st century.

During the spring of 2021, faculty and graduate students in our department took part in a nationwide, NSF-supported initiative called URGE, a communitywide journal-reading and policy-design curriculum to help improve accessibility, justice, equity, diversity, and inclusion in our discipline. Through the initiative and the ongoing work of our Diversity, Equity, and Inclusion Committee, our department is examining and revising policies and procedures to create a more inclusive and equitable environment, including admissions and department professional mentoring.

The URGE website (urgeoscience.org/) contains a variety of readings and recorded discussions, and you can view policy proposals from the CSU Geosciences URGE Pod at (urgeoscience.org/pods/csu-geosciences/).

Dinosaur Paleontology Field Camp

Joe Sertich, Department Affiliate and Denver Museum of Nature and Science

Southern Utah's Grand Staircase-Escalante National Monument is among the most challenging, and rewarding, spots for digging dinosaurs anywhere in the world, and it was a perfect spot for our first-ever Dinosaur Field Camp.

During a typical day, a hearty early morning breakfast is followed by a two-mile trek across some of the most rugged and scenic badlands in North America, passing by the mudstone slopes and sandstone ledges of a 76-million-year-old subtropical forest once teeming with life. Once at the excavation site, tarps are pulled to reveal yesterday's discoveries and work begins anew, each swing of the rock hammer promising the possibility of a new bone. Cries of excitement are followed by the bustle of fellow diggers, eagerly peering over shoulders to see the latest find. After frantic note-taking and mapping, plaster bandages are quickly prepared and wrapped around each bone to protect them for their journey back to camp, then home to Colorado.

This past July, I was lucky enough to return to these badlands where I have worked for more than 15 years, this time with two teams of CSU geosciences (and anthropology) students. As part of an ongoing partnership between the department and the Denver Museum of Nature and Science, we created this Field Camp course (GEOL 380A3) to build on strong interests in paleontology by immersing students first-hand in active dinosaur research. My work in Grand Staircase-Escalante is the cornerstone of the Laramidia Project, a long-term field study investigating the influences of tectonic and climatic changes on terrestrial ecosystems during the Late Cretaceous, a time notable for its abundant horned and duckbilled dinosaurs and early tyrannosaurs.

I have been studying these ecosystems for the past 17 years in Utah, New Mexico, Colorado, and Texas, uncovering dozens of dinosaurs and other ancient animals new to science and have always dreamt of sharing the excitement of discovery with students. This season a week of preparatory lectures introduced students to the history and hypotheses of the research, along with a thorough background in field safety and field paleontology. They were then treated to a behind-the-scenes tour of the labs and geology/paleontology collections of DMNS, following the journey of a dinosaur fossil from its arrival at the museum through its cleaning and preservation, to its identification and storage, and ultimately to its use in scientific research.



With the background and logistics complete, the most amazing dinosaur field experience in North America awaited. I buzzed with excitement in the days leading up to the expedition, filling the DMNS gear trailer with a fully stocked kitchen, 700 pounds of plaster, and 200 gallons of water. Assisted by the skilled DMNS fossil preparators, we would not only provide the essential scientific training, we would also include valuable skills in camp management and communal cooking!

Two groups of five CSU students each spent seven days immersed in remote fieldwork, exploring the badlands of the Kaiparowits Formation while learning critical skills in geologic interpretation, data-collection, and note-taking. Days could

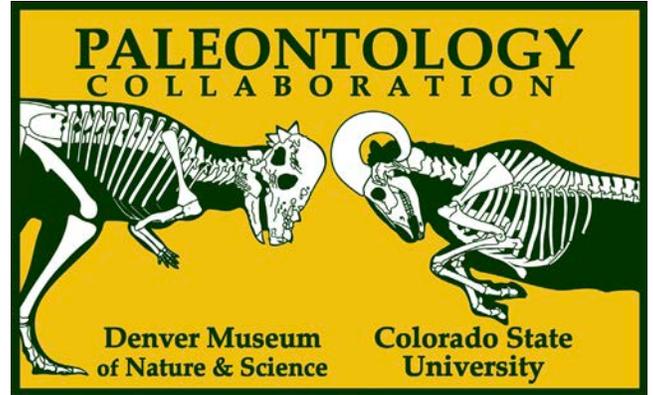
Top: Geology student Patrick Gillette works through stubborn mudstone with hammer and awl. Bottom: Following a difficult first day of (sometimes blister-inducing) quarry opening with picks and shovels, the Week 1 student team winds down for the day. Left to right: Tut Tran, Kalila Garrison, Nathan Hollars, Hunter Sims, Joe Sertich (DMNS and CSU), Taylor Muir, and Ashley Patterson.

swing wildly from scorching hot to freezing cold as the July monsoon rains moved through, while steep slopes tested nerves and ankles. Prospecting forays yielded many exciting discoveries, including tyrannosaur teeth, crocodile bones, and even tiny mammal molars, all from ancient pond and channel deposits.

The bulk of our work focused on one particular site, a horned dinosaur bonebed discovered in 2015 now thought to preserve the remains of several individuals of the rare and bizarre Kosmoceratops, their bones broken and scattered by ancient floods. The news of the discovery, (and looming controversy over the Monument's boundaries) attracted several film crews to the dig site during the expedition, including teams from France and Denver.

The course was transformative for students and instructors alike. Overcoming flash floods, long hikes, and grueling days, we excavated a major portion of the dinosaur bonebed, recovering portions of skull, limbs, and vertebrae, along with countless snails and bivalves; discovered and collected several new microvertebrate sites permitting detailed analyses of paleoclimate and ancient diets; and discovered significant new fossils sites for next season.

The expedition and course will continue next summer – the badlands await!



Student Rebecca Korn takes a break after capping a small horned dinosaur bone with a plaster bandage.



After a harrowing escape from the field area during a thunderstorm, the Week 2 crew poses for a quick, and very wet, photo. Left to right: Rebecca Korn, Patrick Gillette, Tut Tran, Jules Buchko, Joe Sertich, Natalie Toth (DMNS), Clinton Rothschild, Salvador Bastien (DMNS).

Field Camp 2021

Sven Egenhoff, John Singleton, Sean Gallen, and John Ridley

Field Camp in 2021 again presented some unusual challenges. Notably, Bill Sanford, who had taught a hydrogeology portion of the class for the past 16 years, “retired” from teaching Field Camp, and Sven Egenhoff and John Singleton added extra teaching to compensate.

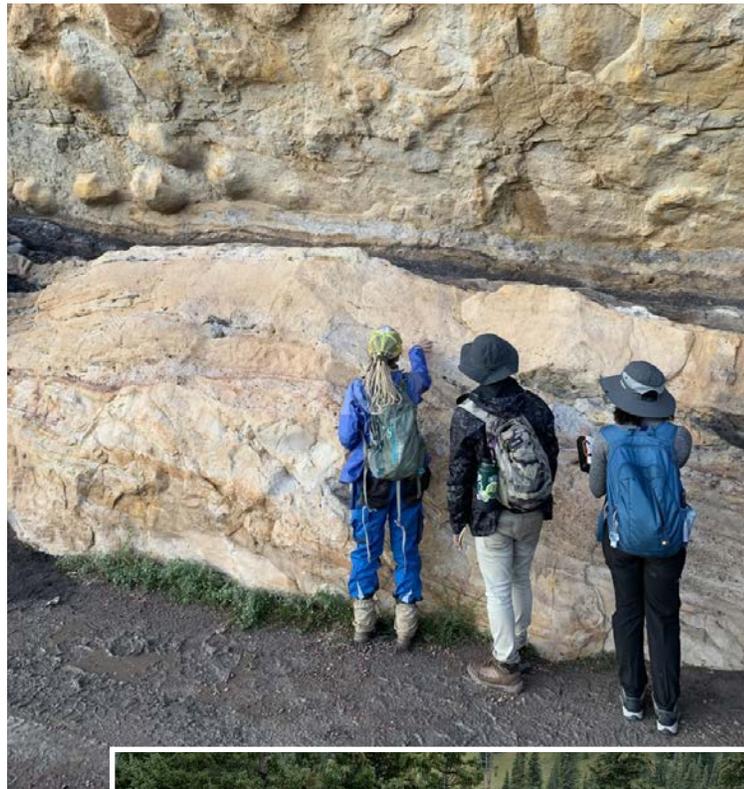
The location of Field Camp also changed somewhat relative to previous years: We exclusively taught in Colorado (and did not use sites in New Mexico for the first time in many years), but our locations were all known from previous years. Of course, the COVID-19 pandemic continued to be a factor in our planning, which resulted in moving our course from our usual end of May through early July timeframe to finish up just before the start of the fall semester.

Our planning turned out to be fortunate in that the course was successfully completed before the late summer U.S. COVID-19 resurgence. 2021 Field Camp began with a session in Cañon City focusing on the stratigraphy and sedimentology of the beautifully exposed Paleozoic to Mesozoic succession (taught by Sven). This part was followed up by a segment emphasizing the geomorphology of the area (taught by Sean).

The next week focused on the structure of Cañon City (taught by John Singleton). After all this activity in the Cañon City area, we moved to South Fork, Colorado, for a segment emphasizing economic geology and volcanism taught by John Ridley. Our last two weeks highlighted sedimentology, stratigraphy, and structural geology in the Molas Pass region of southwest Colorado near Silverton. Despite a second year of exceptional challenges, Field Camp was again an overall success, the students enjoyed it, the scenery was beautiful as always, and the geology in the Cañon City, South Fork, and Silverton regions was, of course, breathtaking.

This year marks a transition in that our lead Field Camp professor, Sven, will be departing CSU. Sven has been teaching and organizing Field Camp for the past six years with a steady hand, and his contributions will be greatly missed! John Ridley has stepped up to lead our 2022 Field Camp team.

With our sincere thanks to department friends and alums who continue to support this capstone course and professional preparation experience for our majors, we are now in the process of planning new elements to continue to offer exceptional Field Camp experiences for next year’s students.



Top: 2021 lead graduate teaching assistant Emily Perman (left) pointing out details within a Dakota Group outcrop near Cañon City, Colorado; note *Ankylosaurus* reverse-cast trackway above. Bottom: Field Camp students studying the coarse-grained Gilbert-type delta succession of the Hermosa Group, Pennsylvanian, near Silverton Colorado.



Field Camp group 2021: Before (above) and after (below)!

Department and College Scholarships and Awards

With sincere thanks to the generous donors who have made these scholarships and awards possible

Undergraduate Students

Ethan Andrews: College Council Outstanding Geosciences Student

Kaitlyn Berckmann: Geology Field Camp Scholarship

Ian Clary: Geology Field Camp Scholarship

William Fabrocini: D.R. and Virginia D. Pulliam Scholarship, Undergraduate Explorationist Scholarship

Benjamin Fowler: Michael Smith Scholars in Geosciences, Philip A. Connolly Memorial Scholarship, Steve and Gail Kloppel Scholarship in Geosciences

Kajsa Holland-Goon: David V. Harris Scholarship, Thomas C. Evans Scholarship

Nathan Hollars: Michael Smith Scholars in Geosciences

Jacob King: Geology Field Camp Scholarship, Geosciences Field Camp Scholarship

Levi Lintner: Geology Field Camp Scholarship

Samantha Malavarca: Charles E. Beverly Memorial Scholarship, Michael Smith Scholars in Geosciences, Myron Brown Ludlow Memorial Scholarship

Cielo Martos: Undergraduate Explorationist Scholarship

Cheryl Novakovich: Geology Field Camp Scholarship, Katharine E. Compton Field Experience Scholarship

Joshua Nugent: Geology Field Camp Scholarship

Meggie Olson: Honor Senior

Adam Parol: Chris Lidstone and Kate Laudon Scholarship in Geosciences, Michael Smith Scholars in Geosciences

Meaghan Pascual: Thomas A. and Anne L. Shepherd Diversity Scholarship

Briana Rodriguez Cruz: Michael Smith Scholars in Geosciences, Salonee Kharkar Memorial Scholarship

Aren Roybal: Geology Field Camp Scholarship

Andrew Ruatti: Chris Lidstone and Kate Laudon Scholarship in Geosciences, Ernest and Bernice Dice Scholarship

Dawn Russell: Michael Smith Scholars in Geosciences, John and Dolores Goodier Scholarship in CNR

Gaby Sanchez Ortiz: Michael Smith Scholars in Geosciences

Heather Scheetz: Treckles Scholarship in Geosciences

Julie Spawn: Chris Lidstone and Kate Laudon Scholarship in Geosciences, WCNR Student Success Scholarship

Nicholas Widler: Michael Smith Scholars in Geosciences, Roy G. and Ruth K. Coffin Memorial Scholarship

Graduate Students

Randall Bonnell: NASA FINESST Fellowship

Nick Chohan: Colorado Groundwater Association 2021 Harlan Erker Memorial Scholarship, American Water Resources Association's Richard A. Herbert Memorial Scholarship, Robert L. Stollar Scholarship In Hydrogeology

Valerie Doebley: Colorado Groundwater Association 2021 Harlan Erker Memorial Scholarship, American Water Works Association 2021 Hazen and Sawyer Scholarship, Geological Society of America Graduate Student Research Grant, Hill Memorial Fellowship

Sarah Dunn: Warner Research Assistantship

Johanna Eidmann: Geological Society of America Graduate Research Grant

Demi Giro: Roger and LuAnne - Roger and LuAnne Steininger Fellowship

Sarah Hinshaw: Hill Memorial Fellowship, Schumm Graduate Scholarship, Warner College Student Success Scholarship

Cece Hurtado: Warner Research Assistantship

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John Kemper: Ware Geosciences Fellowship

Eyal Marder: Evelyn I. Clark Scholarship

Anna Marshall: Lary Kent Burns Memorial Scholarship

Mickey Means-Brous: Hill Memorial Fellowship

Department and College Scholarships and Awards

With sincere thanks to the generous donors who have made these scholarships and awards possible

Juni Park: Warner Research Assistantship, McCallum Mineralogy and Petrology Graduate Scholarship

Brianna Rick: The Sustainability Leadership Fellowship from the School of Global Environmental Sustainability CSU, the Students Advancing Permafrost Research Fellowship U.S. Permafrost Association

Patrick Ronnau: Warner Research Assistantship

Juli Scamardo: NSF Awards for Geochronology Student Research Award

Siânin Spaur: NSF Awards for Geochronology Student Research (AGeS) award

Christoph Jens Suhr: WCNR Student Success Scholarship

Kemi Taiwo: Wyoming Geological Association Gene George Scholarship, Society for Mining, Metallurgy and Exploration, SME – Colorado Section.

Christophe Wakamya: Colorado Groundwater Association Harlan Erker Memorial Scholarship, Colorado Scientific Society Memorial Funds Research Grant, McCallum Mineralogy and Petrology Graduate Scholarship

Celeste Wieting: Oscar and Isabel Anderson Graduate Fellowship

Lucas Zeller: GSA Graduate Student Research Grant, American Alpine Club Research Grant

Faculty and Staff

Rick Aster – American Geophysical Union Fellow

Sean Gallen – NSF-CAREER Award from the Division of Earth Sciences Tectonics program

Jeremy Caves Rugenstein – WCNR Outstanding Publication Award, Co-variation of silicate, carbonate, and sulfide weathering drives CO₂ release with *Erosion, Nature Geoscience*, 2021.

Sara Rathburn – 2020-2021 Fulbright-NSF Arctic Research Scholar to Iceland

Holly Stein – Wilhelm Bunsen Medal of the EGU (2020; Bunsen Lecture Delivered in 2021).

SPECIAL THANKS

Sincere thanks to our 2020 Geosciences Advisory Council: Roger Steininger (chair), Ed Warner, Harold Pranger, Matt Morgan, Bob Stoller, Scott Larson, Jon Robbins, Tara Tafi, Chris Lidstone, Steven Crews, and Landry Griffin.

We also thank our speakers in the Geosciences Seminar Series and student club events this year – we truly appreciate your inspirational mentoring of the next generation of CSU geoscientists. Speakers this year included: Zoltan Sylvester, Joe Sertich, Amy Glimer, Kerstin Braun, Patrick Ball, Boswell Wing, Howard Feldman, Charles Livingston, Katie Snell, Ryan Pollyea, Sarah Schanz, Sarah Evans, and Karl Mueller.

SHARE YOUR THOUGHTS WITH US IN OUR ALUMNI SURVEY

As a member of the worldwide CSU geosciences community, you are invited to share your interests with us in a brief (just three pages) online friends and alumni survey. Opportunities for engagement may include guest lectures; student field trips; supporting and advising our AAPG, SEG, or other student club activities; and becoming a mentor to enhance a student's preparation for a geosciences career. Kindly access the survey via the web page at warnercnr.colostate.edu/geosciences, go to the "Alumni" tab, and click Geosciences Friends and Alumni Survey.

Your Gift's Impact

Sarah Dunn

Ed Warner Graduate Research Fellowship

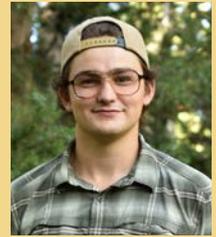
"The Ed Warner Graduate Research Fellowship has supported me in completing a substantial amount of field and lab work for my Master's research. In August 2021, I collected several sediment cores from high mountain reservoirs to examine the impacts of disturbances, including fire, on sediment dynamics in these watersheds. Funding from the fellowship allowed me to collaborate throughout the semester with researchers at CU Denver who are providing lab space and guidance in core analysis. I am deeply grateful for the support and generosity of donors."



Patrick Ronnau

Ed Warner Graduate Research Fellowship

"Receiving the Ed Warner Graduate Research Fellowship has impacted me significantly. In particular, the support eases the transition of moving to Fort Collins. This extra liquidity, in turn, allowed me to attend the Houston Geological Society recruiting event this year. Attending in person, I met with industry professionals and developed insights into what research is most relevant to the private sector. I am extremely grateful for being afforded this opportunity, and I look forward to what CSU has in store for me next."



Heather Scheetz

Scholarship in Geosciences

"Your generous scholarship donation has made it possible for me to finish my second degree. Receiving this scholarship provided the remaining money I needed to afford tuition for summer Field Camp. The struggles of COVID-19 and commuting to campus put a strain on my income. The field of hydrogeology is still very reliant on fieldwork, especially for my career in groundwater remediation. The skills I have acquired over the last academic year at CSU were further developed at Field Camp this summer, allowing me to be more competitive in the workforce. I want to thank you for giving me this opportunity to take the next step in achieving my dreams of becoming a hydrogeologist."



Cheryl Novakovich

Geology Field Camp Scholarship and Katharine E. Compton Field Experience Scholarship

"I would like to personally thank the donors for providing me this scholarship award. Your generosity will significantly impact my ability to finish my degree and realize my dreams. I believe Field Camp is a vital component of my degree. I look forward to using everything I've learned, testing my skills, and acquiring new ones during this hands-on experience. There are some aspects of geology that need to be explored in the field that cannot be obtained in a classroom. I think Field Camp will be an invaluable experience that will ultimately set me apart in the future. Thank you, again, for your generosity and commitment to the Field Camp program."



Aren Roybal

Geology Field Camp Scholarship

"Words cannot describe how grateful I am to you for your generosity. Without you and your gift, I fear that many students would not reach their full potential and achieve their dreams. I cannot thank you enough for providing me and others with the chance to achieve the impossible. I am one of the many other voices that cannot say 'thank you' enough for your generosity. Your generosity will help me finish this part of my life and give me the tools necessary to start working in the field. With these tools and skills I learned in school, I hope to be able to provide some solutions to our increasing environmental problems. Your gift has given me the ability to finish this adventure and to start another. Once again, thank you so much for this opportunity to achieve my dreams."



Joshua Nugent

Geology Field Camp Scholarship

"It's no secret that students of all backgrounds are struggling under the debt of higher education. This generous gift helps me to continue my educational journey. I don't have to go into detail, and I know many students share the same financial struggles as I, but it feels nice to have a little help. When I start working, I want to donate a portion of my earnings to a cause such as this. I have had my fair share of roadblocks and hard times, and I'm sure there are other students as well. Scholarships and grants, at minimum, help to alleviate stress and worry about where the money will come from. That is absolutely huge for anyone trying to better their life."



The Department of Geosciences

Faculty

Rick Aster, Professor and
Department Head

Sean Bryan, Senior Instructor

Sven Egenhoff, Professor

Jeremy Caves Rugenstein,
Assistant Professor

Sean Gallen, Assistant Professor

Judy Hannah, Professor

Dennis Harry, Professor

Jerry Magloughlin, Associate
Professor

Dan McGrath, Assistant Professor

Sara Rathburn, Professor

John Ridley, Associate Professor

Mike Ronayne, Associate Professor

Bill Sanford, Associate Professor

Derek Schutt, Associate Professor

John Singleton, Associate
Professor

Lisa Stright, Associate Professor

Sally Sutton, Associate Professor

Ellen Wohl, Professor

Lee MacDonald, Professor
Emeritus, Ecosystem Science
and Sustainability, Colorado State
University, Joint Professor with
Geosciences

Holly Stein, Director, AIRIE
Program, Senior Research Scientist,
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Patti Uman, Administrative
Assistant III & Graduate
Coordinator

Kailarae Lilly, Administrative
Assistant II



Front Range foothill fall aspens and young lodgepole pines within the 2012 High Park Fire burn near West Pine Mountain. Photo by Rick Aster.

Thank You to Our Department of Geosciences Affiliates

We sincerely thank our Department of Geosciences affiliates for their many contributions to teaching, research, and engagement in 2021.

Kerstin Braun, Assistant Research Scientist, Institute of Human Origins, Arizona State University

Joel Cubley, Instructor and Geological Technology Program Coordinator, Yukon College, Canada

Kenneth Dueker, Associate Professor, University of Wyoming-Laramie

Neil Fishman, Senior Geologic Adviser, Hess Corporation, Houston

Jonathan Friedman, Hydrologist, U.S. Geological Survey, Fort Collins Science Center

Vineet Goswami, Physical Research Laboratory, Ahmedabad, India

Ethan Greene, Director, Colorado Avalanche Information Center

James Hagadorn, Denver Museum of Nature and Science

Øyvind Hammer, Associate Professor, Natural History Museum, University of Oslo, Norway

Dario Harazim, Technical Geologist, ETC Seal and Trap Team, Chevron Energy Technology Company

Eric Harmsen, Professor, University of Puerto Rico, Department of Agricultural Engineering

Ed Harvey, Supervisory Hydrologist and Chief of the U.S National Park Service Water Resources Division (retired)

Christopher Hiemstra, Research Physical Scientist, U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory

Kenneth S. Hughes, Department of Geology, University of Puerto Rico

Antun Husinec, Associate Professor, Department of Geology, St. Lawrence University, Canton, New York

Chris Lidstone, Geologist, Lidstone and Associates

John Lisle, USGS, St. Petersburg Coastal and Marine Science Center

Hans Peter Marshall, Associate Professor, Boise State University, Director of CryoGARS

Scott McCoy, Assistant Professor, Department of Geological Sciences and Engineering, University of Nevada, Reno

Samuel Mukasa, Senior Executive – Global Initiatives, Office of the Provost, University of Minnesota

Snorre Olaussen, Professor of Arctic Petroleum Geology, University Centre in Svalbard, Norway

Frank J. Pazzaglia, Professor, Department of Earth and Environmental Sciences, Lehigh University

Robert Porritt, Geophysicist, University of Texas, Institute for Geophysics

Sandra Ryan-Burkett, Research Station Research Geomorphologist, USFS Rocky Mountain,

Kaleb Scarberry, Montana Bureau of Mines and Geology

Daniel Scott, Postdoc, University of Washington

Michael Scott, Adjunct Faculty, Watershed Sciences Department, Utah State, University, Logan, Utah

Joe Sertich, Curator of Dinosaurs, Department of Earth Sciences, Denver Museum of Nature and Science

Graham Sexstone, USGS Denver

Roger Steininger, CSU Geosciences Advisory Council

Robert Stollar, Regenesis Management Group; CSU Geosciences Advisory Council

Ghana Tripathy, AIRIE Group

David Wald, USGS

Edward Warner, Geologist and Philanthropist; CSU Geosciences Advisory Council

Thad Wasklewicz, Geomorphologist, Principle in Charge of Western U.S. Geohazards and Geomorphology – Stantec

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Your gifts and support provide critical resources to our students and geology programs and elevate the department's teaching, research, and outreach.

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