GEOLOGICAL SCIENCES
UNIVERSITY OF COLORADO BOULDER

Geology News

2019 Bill Bradley New Graduate Student Field Trip
photo credit: Houston Kempton

Editors
Robert Anderson
Dan Mitchell

2019 - 2020

Letter from the Chair

Robert Anderson

I am sitting beneath an umbrella on our patio. I moved out here to change scenes a bit, and of course I did so right as it began to rain. Fitting. In my backyard I am safely distanced from all as we continue to face the ravages of the global COVID-19 pandemic. There is nothing about this last year, and my first as chair, that has been anything like normal. My task here is to outline what this year has meant to the department. There is a lot to report. And there is no way to anticipate what this next year will bring. No way.

Our faculty is about the same size now as it was last year. That reflects two retirements and two hires. Both Joe Smyth and Jaia Syvitski retired and are enjoying watching the events of the year from a distance. Our two new faculty members, Carolyn Crow and Brad Markle, are profiled on page 5 in this newsletter. We welcome them to the department!

Speaking of retirees, the department and our advisory board had embarked on the design of an event to honor all of our retired professors. This celebration was to occur in early April. Many members of the advisory board had stepped up to get organized, fund raise, and invite our past faculty members for a night of celebration. After hundreds of hours of preparation, sadly, we had to postpone the event. The decision was a hard one, but an appropriate one given the vulnerability of both present and past faculty to a pandemic in its early phases of its first crescendo. I want to thank the advisory board and the members of the advancement office who had supported this event. We'll make it happen somehow, but in the meanwhile I'd like to raise a glass to all of our past faculty on whose backs this department has been built.

Several faculty members successfully went through promotion steps this last year. Irina Overeem, Leilani Arthurs and Mike Willis all stepped through the pre-tenure review process. And Becky Flowers, Karen Chin and Brian Hynek all became full professors. We celebrate all of these accomplishments! Just as impressively, however, two instructors in the department, Jen Stempien and Lon Abbott, were recognized. Jen was reappointed and has been promoted to Senior Instructor. And Lon was anointed the honor of a Teaching Professor. There are presently only a few Teaching Professors on campus who hold this honor, an honor that recognizes both the high quality of his teaching, and his sustained contributions to the department's teaching cause.

Our staff went through several changes as well. Most importantly to the chair, our office Manager Ruth Mansbach decided to retire in April. She was absolutely crucial to my "on-boarding" as the new chair, and I could not have survived this year without her consistent support. We all wish her well. As I write in mid-July, we are in the final stages of the process of hiring Ruth's replacement, and in all of the months between April and now, Ruth has stayed on in a part-time role to keep the wheels from falling off. We also welcomed Maddy Atteberry as the new undergraduate program assistant. Maddy immediately stepped into this role, taking over not only the organization of transportation (did you know we run 267 field trips per year?), but teaming up with our undergraduate assistant Alexis to tackle the conversion of the office to digital by scanning filing cabinets worth of old paper files. Without the able assistance of Ruth, Maddy, Kara, Marilynn, Ingrid and Dan, this department would have been swallowed whole by the chaos of a very weird year.

This academic year 2019-2020 was dominated by the global pandemic wrought by COVID-19. In mid-March the campus became a ghost-town as we all were asked to begin teaching the remainder of the Spring semester remotely. We all learned Zoom. We "met" with our students virtually rather than face-to-face. We all, students and faculty alike, faced the challenges of drop-outs from meetings and classes as the internet became more than ever our intellectual highway. We twiddled with our virtual backgrounds, some choosing to have glaciers and mountains in the background, others Star Trek consoles. But we all made it through the semester. Grades were turned in. PhD and Masters students defended their research as zoom events. We even held a remote graduation. And it was these events that revealed a thin silver lining. While of course we would rather have held these celebrations in person, holding them remotely allowed attendance of researchers and family members from far-flung places. Families tuned in from South America and from both coasts of the US. Researchers attended defenses from Germany and Switzerland. Our virtual "tent" was truly full.

We have remained largely in remote mode over the summer. Research was re-started in a "Return to Research" that has seen now two phases. R2R, as it came to be called, started at 10-20% occupancy of the building, and has now expanded in Phase 2 to roughly 30-40%. But in reality it remains the case that any and all who do not require an instrument in a lab in the Benson Building are still asked to work from home. We have developed protocols to document who is in the building when, and in fact what rooms they are in over the course of their daily routine. That

is all about tracing. If we find that someone who has been in the building becomes ill, we will know with whom that person was been in contact over the last few days. And so far we have been safe.

What this will look like in the fall remains to be seen. The entire campus, as is the case across the nation, has been scrambling to put in place a plan for teaching in the fall semester. As I write, the plan is this. When students return in late August, we plan to teach our full curriculum with about half of the teaching being in-person. The other half will be remote, either through streaming of lectures (synchronous mode) or through viewing of lectures made available by the professor (asynchronous). Our experience in the Spring taught us that synchronous is far better – that face-to-face teaching either remote or in person is far superior as it allows interaction. For that teaching done in person, all rooms on campus have been evaluated for how many students can attend with proper social distancing. And it is small. Even our large rooms can hold less than 20 students. So we face teaching of any class larger than 15 or so in smaller groups, some attending in person one day while others see lectures remotely, and then flip-flopping for the next lecture. I'll not go into details about what labs will look like. And don't get me started about field classes. Just know we are doing our best to provide as close to our curriculum as we can… given the circumstances. That is the plan. The reality of the Fall will depend almost entirely on events out of our control. Much hinges on whether the arriving students are well upon arrival, on whether there is sufficient compliance with the need for masks, social distancing and hand washing, and on our ability to tamp down the flare-ups that will occur with testing, quarantining, and contact tracing. There is no doubt that the place will look different. For example, I expect a lot of open-air tents to allow students to hang out between classes, as libraries cannot accommodate even 30% of their normal load. And who knows, we may have to go back into fully remote mode if infection rates exceed a threshold.

The department has also been caught up in the deep sadness of ongoing racism in the nation. In efforts catalyzed by graduate student discussions in our department and across the campus, we have both acknowledged the lack of diversity in our students and our faculty, and have attempted to take concrete steps to make progress in both attracting a more diverse population and in supporting all who chose to come to CU. Among those steps is the expansion of our Diversity and Inclusivity committee to include a pair of graduate students. I also envision transformation of that committee from an ad hoc to a standing committee status in recognition that this is not a one-time issue, but an ongoing and important one. We have been entrained in an effort to bring diverse speakers to campus under the broader umbrella of geosciences at CU, sharing in the hosting of those seminars and visits with other departments and institutes. While we have begun to leverage partnerships with AGU and with CU to bring a more diverse class of graduate students to our department, we have a long way to go. Just as importantly, we must be sure to provide all existing students proper financial and social support. And we are seeking a variety of means of providing field equipment for fieldwork and fieldtrips alike for any who do not have such resources. While I am sad that it took the events of the summer to catalyze these actions at the department level and parallel actions at the campus level, I am confident that we will be better for this.

The bottom line is that this summer has been like no other. I am sure that is the case for everyone reading this newsletter. We need to seek all the little good things that have come or will come from facing these challenges. We need to celebrate all the little glints of selenite crystals from the broader dull gray outcrops of shale that we can see. The need for communication with other leaders on campus has catalyzed a new seminar series. The attendance at celebrations can be truly global in scale.

I do wish you all well as we enter an uncertain Fall. Know that the department is doing fine in the midst of all this. It has risen to the paired challenges of the pandemic and continued racism by the strength of its staff, its students, and its faculty.

Sincerely,
Bob Anderson

Contents

Greetings from the Alumni Advisory Board

Dean Miller

This has been an unusual year to say the least. I hope everyone reading this is safe and healthy.

The Alumni Advisory Board held its semi-annual meeting in October, which was Bob Anderson's first meeting with the Board as Department Chair. Much of the meeting was devoted to planning the emeritus professor event that was scheduled for last April. But, as Bob Anderson discusses in his column, we had to cancel the event because of the COVID-19 pandemic. Our planning subcommittee members held dozens of meetings and dedicated significant time to planning the event for which we all are very grateful. We hope to reschedule it or come up with a creative alternative once the pandemic ends. We also met with undergraduate students at the October meeting, who generally reported that they are having a very positive experience in the Department. The undergraduates are reaping the benefits of the recent changes to undergraduate advising in the Department, which has alleviated their concerns about matching their career path with the appropriate classes.

We held our virtual Spring meeting in April, during which we primarily focused on the Department's plans to deal with the impact of the COVID-19 pandemic on students, faculty, and the broader geoscience community. Zoom technology has allowed us to have additional conversations with Bob Anderson about the Department's reopening plans. As the annual Bill Bradley field trip for new graduate students will not take place this year because of the pandemic, we are planning a Zoom call with the Advisory Board and as many of the 21 new graduate students as can join us shortly after classes begin next month. We think it is important to impress upon them that they are joining a unique and very collegial community that makes up the Department, especially during these unprecedented times.

The Department is doing remarkably well despite the current circumstances. We are fortunate to have Bob Anderson at the helm, who took the reins of the Department just a few months before the pandemic threw everything into turmoil. There is a lot of work being done on many levels to figure out how to resume classes in the Fall and keep everyone safe. Fortunately, the dedication of the Department faculty and staff, as well as modern technology, will allow the Department to continue to provide world-class teaching and research regardless of how things progress for the rest of the year.

Hopefully, the pandemic will be a distant memory by this time next year. In the meantime, take care and stay safe.

Advisory board L-R: Connor Newman, Patricia Corbetta, Houston Kempton, Lisa Campbell, Dean Miller, Dawn Kaback, Harold Miller, Penny Patterson, Eric Anderson, Shannon O'Dunn, Shannon Stover, and Department Chair Bob Anderson.

Geological Sciences Advisory Board Members

Eric Anderson
USGS

Lisa Campbell
Anschutz Exploration Company

Patricia Corbetta
BHP Billiton

Tim Farnham
Shell

Dawn S. Kaback
Wood PLC

Houston Kempton
Environmental Consultant

Dean Miller - Chair
Davis Graham & Stubbs, LLP

Harold Miller
Subsurface Consultants & Associates, LLC

Connor Newman
USGS

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Penny Patterson
ExxonMobil Exploration Company

John Roesink
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Sean Sundermann
Brierley Associates

Charlie Wilson
Thornburg Investment Management

Joe Zamudio
Exelis Visual Information Solutions

New Faculty

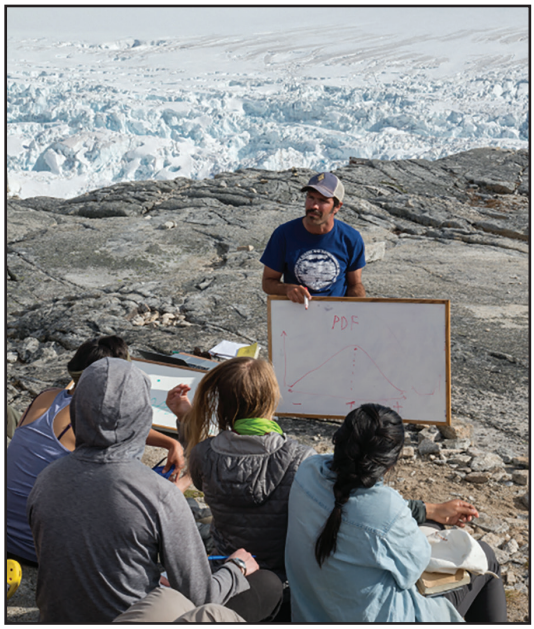
Bradley Markle

Brad's research interests are in paleoclimate and climate dynamics, particularly in the high latitudes. He employs geochemical proxy records, especially those from ice cores, along with models that vary in complexity, to understand the evolution of the Earth's climate and the mechanisms by which it works. He is particularly interested in the interactions between different components of the climate that include the atmosphere, oceans, land, and cryosphere.

Originally from the Northwest, he studied geology and physics at Pomona College. He went to New Zealand on a Fulbright Fellowship and obtained a Masters Degree from Victoria University in Wellington. In his PhD at the University of Washington, he studied Antarctican ice core records from which Antarctic paleoclimate dynamics can be assessed. He has done postdoctoral research at the University of Washington, the University of California Santa Barbara, and Caltech.

Brad is also an Associate Director of the Juneau Icefield Research Program (JIRP), and is a member of its Academic Council and Faculty. JIRP is an interdisciplinary summer school focusing on polar science, primarily for undergraduate students. JIRP is an immersive experience and provides training in expeditionary research, glacier travel, field techniques, and fundamental science.

Brad begins this Fall at CU, taking up his assistant professor position doing research through INSTAAR and teaching through the Geological Sciences. We welcome him and relish the opportunity to interact on both teaching and research efforts.



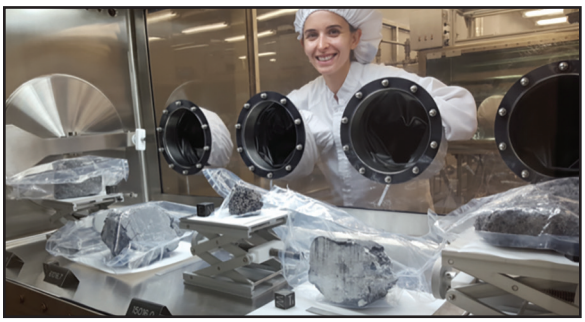
Carolyn Crow

Carolyn grew up in the granite state of New Hampshire. She was inspired by the dark night skies to study something related to space. She studied Astronomy at the University of Maryland - graduating with a BS in 2008. While working on an undergraduate research project focused on exoplanets, her research mentor handed her a meteorite … and she was sold. She decided to switch gears and went to UCLA, where she obtained both her Masters and PhD in Geochemistry. Her thesis work aimed to deconvolve the impact and magmatic histories of the moon as recorded in lunar zircons.

During her postdoc at Lawrence Livermore National Laboratory, she expanded her work in cosmochemistry to include Ar-Ar geochronology and other noble gas analyses. She also worked on a large DOE nuclear forensics project investigating the signatures of underground nuclear explosions.

At CU Boulder she will to continue her research in both cosmochemistry and nuclear forensics. She hopes to build a one-of-a-kind noble gas laboratory that will both push the state of the art in geochronology and be ideally suited for analyzing materials from sample return missions.

Carolyn is also a founding team member of the Ad Astra Academy (http://www.adastra.world/), a program that aims to inspire under-resourced students through science exploration and discovery.



When Rocks become Art

Karl Mueller

As the world turned upside down this year, our students, faculty and staff were forced to self-isolate, teach and learn remotely while struggling with an uncertain future. But silver linings sometimes appear in unexpected places. The discovery of new interests, kickstarting of old and new hobbies and a greater appreciation of things in life often taken for granted made living in a pandemic more bearable. While learning and discovery will always be a fundamental reward of being an Earth Scientist, so too is capturing and sharing the wonders of this planet. For me, that process includes photographing natural landscapes, the geologic record they contain and sharing those images with students in my courses, the general public and other photographers. This gives me the opportunity to learn more about the geologic history of the landscapes I've photographed in order to better explain their meaning to other photographers. It has also taught me to look at landscapes very differently and requires observational skills that lie outside a typical skillset for Geology fieldwork. I previously used a camera purely as a functional tool to illustrate geologic structures, often shooting a panorama without much regard to anything else besides basic composition. I began to move beyond this approach during a recent trip to Death Valley with a professional photographer. We hiked to a scenic part of the Park late in the day and he told me to take an image. I shot a typical panorama of outcrops of inclined, multicolored Pliocene strata. The Pro looked at the image and said, well, that's boring, what are you trying to convey with the shot? I dutifully answered with some banal comments about how the strata recorded a key aspect of the Park's geologic history. He then asked me to sit down and look at the same landscape for five minutes and find something more interesting, a scene that yielded a

An abstract, focused-stacked shot of eolian sandstone called The Wave in northwest Arizona. Stained by fluids migrating through a Laramide monocline, this otherworldly location was first published as an iconic cover shot for the AAPG Bulletin decades ago. Now accessible only by a special permit, the nearby town of Kanab is host to a daily lottery where hundreds hope and pray for one of the few slots that open on any particular day. I saw dozens of images of this location, but nothing really prepared me for what it looked like in person. Even after 40 years as a geologist, my first thought was "How can this be real?".

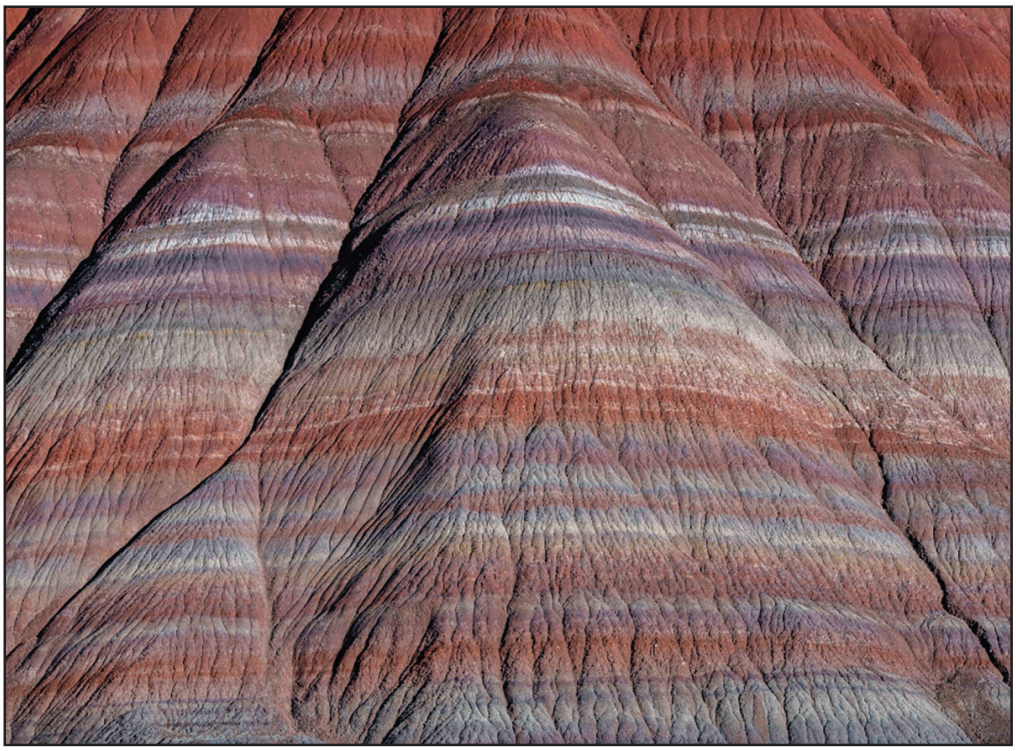
Perfect columns of basalt from a rock quarry in Iceland. Notice the way the shadows and width of each column face change across the image – simply related to the direction the surfaces face on a cloudy day. Wider to narrower, lighter to darker and vice versa. Iceland is filled with endless opportunity for photography, from crystalline blue icebergs calved off icecaps and washed onto black sand beaches in freezing cold surf, to cliffs of perfectly columnar basalt, to iridescent mud in hot springs, to polychrome rhyolite in calderas. The geology is even more amazing, where some of the fastest isostatic rebound on Earth occurs due to anthropogenic melting of icecaps that is interspersed with endless tracts of hydrothermal volcanic flows, arrays of active normal faults and springs.

Polygonal contraction features in Navajo sandstone and one very tough pine tree exposed in the magical White Pocket, a photographer and geologist's paradise in Arizona that records the most photogenic liquefaction features I've ever seen. Much like mud cracks in a dried creek bed, these features form "cracks in cracks" where giant soccer ball-shaped fracture networks form barrier networks, isolating pockets within which, younger, smaller fractures are subsequently formed. Created late in the liquefaction process as fluidized sand dewaters and contracts, the dilatant cracks are contained in strata where original cross bedding is completely obliterated during the earthquake induced slumping of the ancient sand dune.

more intriguing story. After narrowing my view, I came up with much tighter compositions of the same strata with a more deliberate interplay of color, texture and light. He looked at the new images, tweaked the field of view ever so slightly and asked me to look at the difference. I was blown away by how much better his compositions looked than mine, with just the tiniest difference in perspective and framing. Modern cameras, software, online tutorials and field workshops offer technology and techniques that make creating great images a lot easier, but simply looking at a landscape and understanding light remains the challenge of a lifetime. Another recent trip with two other pro photographers really made this apparent. We were high up in the Cirque of the Towers in the Wind River Mountains of Wyoming waiting for sunrise. At one point one of the pro's excitedly yelled out "Look at that light!". I looked around, bewildered, until I glimpsed the slightest tinge of pink alpenglow on one of the huge granite towers forming the rim of the cirque. After processing the shot later on the trip, I realized why he became so excited; modern cameras pick up fleeting instances of light that most people would never notice, even standing there in person. On yet another trip to a magical part of Arizona where outcrops of astounding Navajo sandstone record liquefaction and slumping of sand dunes in past earthquakes, another pro taught me about how a viewer's pathway works in an image. The idea is to create a composition where the viewers eye is purposely drawn to a certain aspect of a scene, which is then followed in a defined sequence through subtler points of interest. Purposely creating a visual pathway whose goal is to lead a viewer through some amazing set of relationships is similar in many ways to scaffolding a lecture in geology or research in active learning using retinal tracking. The ultimate goal is to take both student and viewer on a pedagogic or artistic journey, where new wonders unfold at every corner and an appreciation is gained for the interconnectedness of the natural wonders of our planet. The images contained in this article are from some recent trips to the American Southwest, Iceland and the Himalayas. A big thanks is due to the pro photographers, geology students and guides that enabled me to become a better photographer and gain access to some of the more remarkable parts of this wonderful orb we inhabit.

The “small” satellite peaks of Kangtega and Thamserku in the Khumbu region of the Nepalese Himalaya. Taken from the overlook at Namche Bazaar on the trek into Everest Base Camp, these 21,000 ft monsters are dwarfed by the south face of Lhotse lurking in the distance. Sunset here is magic as clouds float up the valley, with sunlit, snow fluted faces appearing and disappearing every minute. Rocks here are comprised of the Greater Himalaya Series, a gigantic fold nappe of high-grade metamorphic rocks and igneous intrusions advected upward from underneath Tibet. Nowhere else on Earth does crustal channel flow occur at this scale. A thick section of completely inverted and telescoped middle crust is shown in this image.

One of my favorite rocks in Death Valley, a basalt boulder etched and fluted by blowing sand for thousands of years. This image is nearly indistinguishable from rocks photographed by NASA’s rovers on Mars. Ventifacts like these are common in hyper arid deserts. The angular shape begins as a huge rounded boulder deposited on an alluvial fan that then breaks apart into smaller fragments due to thermal stresses caused by daily temperature changes.



Outcrops of the Chinle Formation in the Paria region of Utah. Formed as paleosols in fluvial overbank deposits, these exquisitely colored slopes glow at sunset. Textured by rills formed in steep hillslopes, these outcrops are easily accessible and are some of the most beautiful strata in existence. Changes in ground water in the floodplain give rise to the multicolored spectrum where grey is wet and red is dry.

The images in this article were all created by Karl Mueller. Fine art prints of these and any of his other images of geology and landscapes are available by contacting him by email at Karl.Mueller@Colorado.edu

Research Associate News

Lisa Mayhew, a Research Associate in the Department of Geological Sciences, was recently selected as a Principal Investigator for her proposal to be a participating scientist on the Mars 2020 Mission. The mission, which will launch between July 20-August 11, 2020, will deliver the Perseverance Rover to Jezero Crater, home to an ancient river delta, on the surface of Mars. Perseverance's main goals will be to seek signs of life while characterizing the geology of the Martian surface and collecting samples that will be cached on Mars. These samples will lie in wait until a future sample return mission collects and returns them to Earth for detailed characterization in analytical laboratories.

As a Returned Sample Scientist, Lisa, in collaboration with other selected RSSs and the broader science team, will participate in choosing which samples will be taken and cached for future return to Earth. As a geochemist with expertise in collecting and interpreting spectral data of water altered rocks and minerals, Lisa hopes to inform the selection of samples that have experienced water/rock interaction on Mars. These rocks hold high potential for having acted as habitats or energy sources for putative microbial life on Mars. As such they may retain signatures of past Martian life. Perseverance's payload includes three instruments that will collect elemental, mineralogic, and organic spectral data to shed light on the geochemistry of the Martian rocks. Several instruments will collect high resolution images for geologic and textural context at a variety of scales. This data will be collected and interpreted and used to inform the sample collection process for each of the 43 samples that may possibly be collected by the rover. In preparation for landing, which will occur on February 18, 2021, Lisa is currently co-leading a strategic process group that is exploring the questions and hypotheses specific to the rim of the crater that can be addressed using the rover instrument payload and/or by sample return.

TRaIL Moves Forward James Metcalf

The past year has been productive for the CU TRaIL (Thermochronology Research and Instrumentation Lab). Perhaps most exciting is that in 2019 Professor Becky Flowers (lab director) and Dr. Jim Metcalf (lab manager) were awarded an ~$500k grant from NSF's Instrumentation and Facilities Program to acquire and commission an excimer laser to develop in situ laser ablation (U-Th)/He dating, element mapping, and U-Pb geochronology capabilities. This machine will interface with the TRaIL's existing ICP-MS and with a new custom He analysis machine that Dr. Metcalf will build in the coming year. To accommodate the new equipment, the CU TRaIL will be undergoing renovations, with plans to move the new equipment into Benson this fall.

The Flowers' research group has continued a variety of research that includes both technique development and application studies. PhD Student Colin Sturrock submitted a paper documenting the long time-scale history of burial and erosion across the Canadian Shield. MS student Katherine Robinson successfully defended her thesis in May of 2019 and published her research on rutile (U-Th)/He thermochronology. The lab welcomed several new members: PhD student Barra Peak, a CU Chancellor's Fellow working on an NSF project focused on the timing and causes of the Great Unconformity; MS student Morgan Baker who is working on garnet (U-Th)/He chronology; and postdoc Peter Martin, who recently completed his PhD at Caltech and is working on an NSF project aimed at understanding the influence of arc-continent exhumation on long-term climate. Spencer Zeigler, a CU graduate who worked as a research assistant developing X-ray measurement techniques to better characterize apatite grain dimensions earned a "Best Student Presentation" at the 2019 GSA meeting in Phoenix for her work. Zeigler also was awarded a prestigious NSF graduate student fellowship and will be joining the Flowers group as a PhD student this fall. Flowers continues to lead the AGeS Program, a research grant and education program in its 5th year that awards graduate students up to $10k to visit labs and obtain geochronology data. Metcalf continued his work on the exhumation of the Ruby Mountains – East Humboldt Range Metamorphic Core complex, and had two undergraduate students, Carlton Mueller and Nicole Gonzalez, complete honors theses on these rocks. Dr. Lon Abbott expanded his research aimed at constraining the patterns, timing, and rates of exhumation in Colorado, engaging a large number of undergraduates in the TRaIL that lead to 4 undergraduate honors theses in the last year. Undergraduate Lane Daigle also worked in the TRaIL with postdoc Ben Johnson on a project in the Pilbara craton of Australia and successfully defended his honors thesis in spring 2020.

Dr. Becky Flowers doing field work in Canada! photo credit: Barra Peak

In the Field

The last in-person meeting of GEOL/GEOG 4241(Geomorphology) for the Spring 2020 semester, doing a field exercise on landslides. photo credit: Suzanne Anderson.

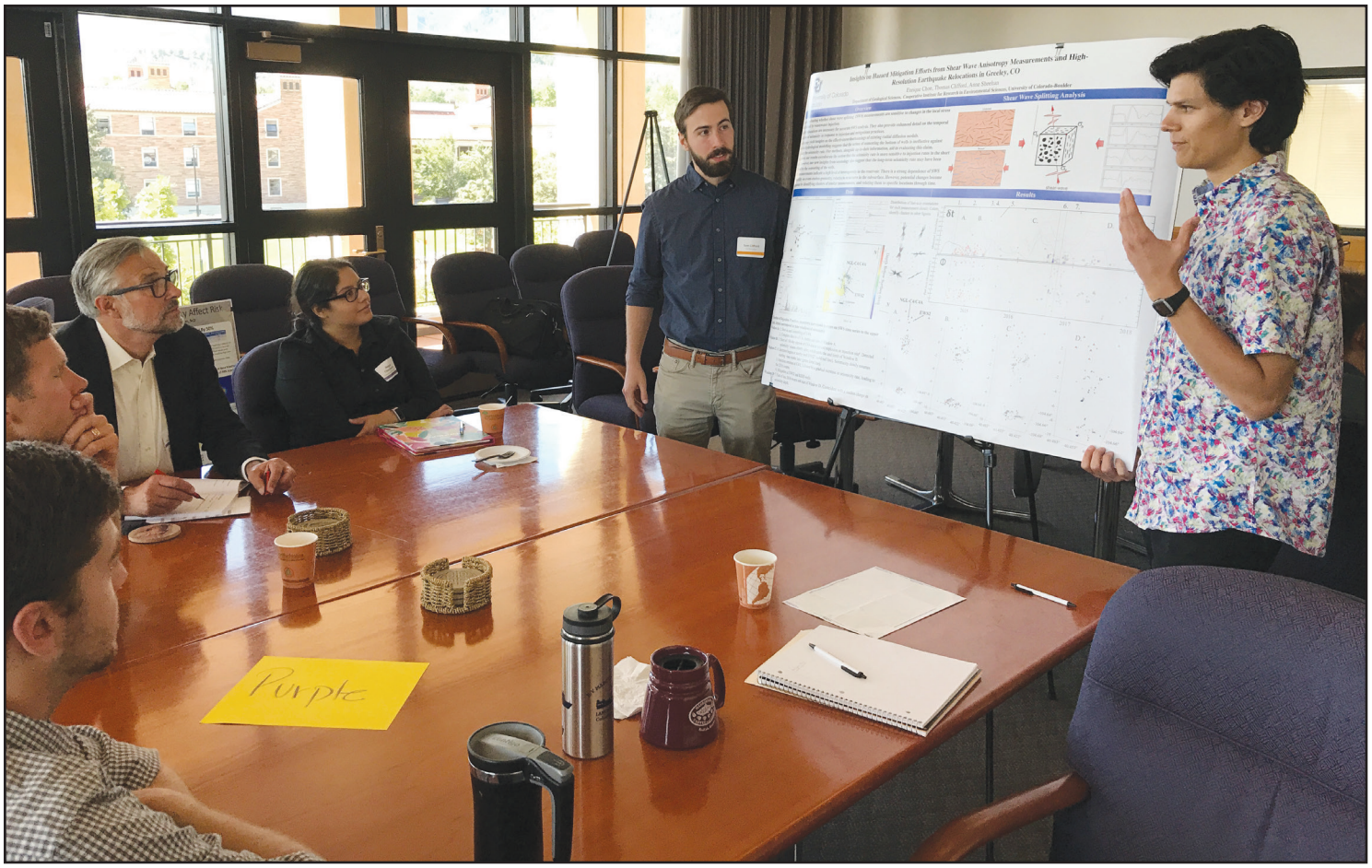
Researchers repairing bear-damaged seismometer at Naknek Lake, Alaska, May 2019. L to R: Mel Zhang (CU GEOL), Pnina Miller (New Mexico Tech), Anne Sheehan (CU GEOL and CIRES).

Ruth Mansbach Retires

After serving four years as the Geological Sciences Department Office Manager and Assistant to the Chair (for Shemin Ge and Bob Anderson), Ruth Mansbach officially retired on April 30, 2020. Leaving during a pandemic was not in Ruth's original plan and working remotely during her last months at CU was disappointing to not be able to say goodbye in person. The pandemic brought an unexpected opportunity for Ruth to continue working and helping the GEOL department part time, since the hiring of her replacement was delayed. She is looking forward to visiting family across the country, in between hiking in beautiful Colorado, with her husband Richard. She says that she is open to life's next adventure and new chapter. She indicates that she will miss everyone in GEOL and it has been rewarding to see the advances made as a department over the past four years. She is especially grateful to the accomplished department staff.

Ruth Mansbach and husband Richard enjoying a little rest and recreation as Ruth embraces retirement... and Richard...

Graduate students Tom Clifford and Enrique Chon present their research at Colorado Collaboratory for Induced Seismicity advisory board meeting held in the Benson Earth Sciences Building on August 26, 2019. Attendees included representatives from industry, government labs, law firms, policy centers, FEMA, and local and state agencies. Photo credit: Anne Sheehan



2019-2020 Undergraduate Mentoring Projects

Porsche Adams-Wootton worked on “Timing of ductile shear zone formation in an exhumed orogenic crustal cross-section in the Northern Madison Range, southwest Montana, USA” with Dr. Kevin Mahan.

Emma Devin’s project was “Lithospheric Mantle Earthquakes in Southwestern Wyoming” with Dr. Anne Sheehan.

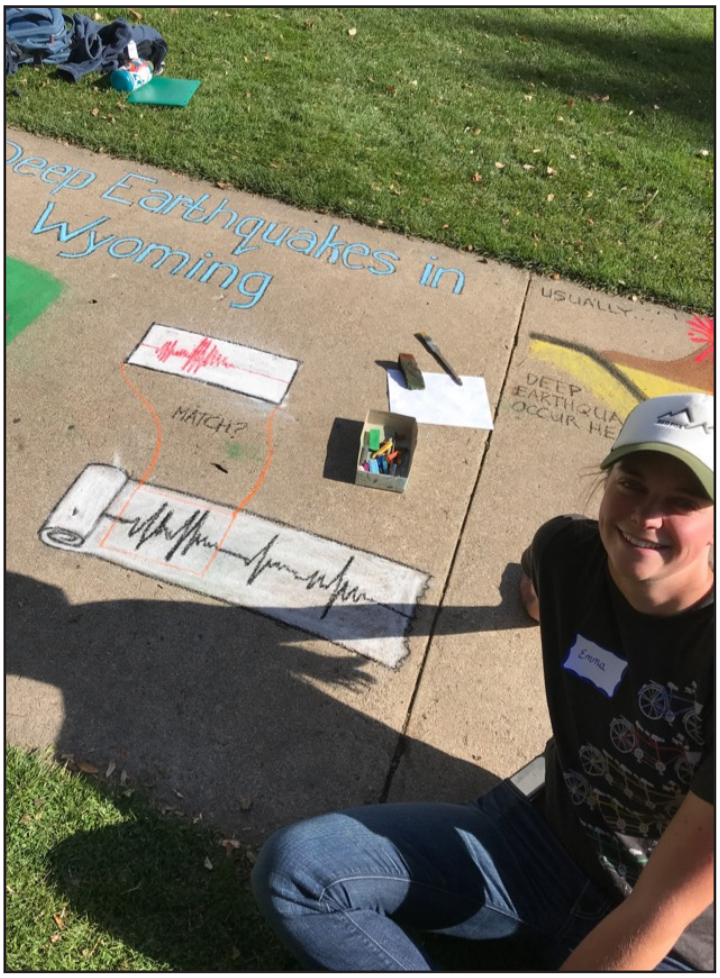
Emma’s work focused on a study of deep lithospheric earthquakes using template matching methods. Earthquakes in the continental mantle are unusual and have implications for our understanding of the rheology of the lithosphere. Two deep earthquakes occurred in SW Wyoming in 2013, and another one in 2010. Emma used these events as ‘templates’ to search for other similar earthquakes in the continuous ground motion data of the Pinedale seismic array in Wyoming.

Brooke Holman worked on “How warm was the Arctic during the Late Cretaceous?” with Dr. Julio Sepulveda.

Shelby Dianne Litton became familiar with the usage of the Electron Microprobe and helped with the analysis of data during her undergraduate thesis research titled “A Petrologic Study of the Huerfano Butte Lamprophyre”. Using optical petrology and EMP geochemical data the formation history of Huerfano Butte’s Lamprophyre was discover. Shelby worked with Dr. Aaron Bell.

Madeline Schwartz worked on “GIS mapping of active faults and fissures in Iceland using Arctic DEM data” with Dr. Karl Mueller.

Stephen Sheehan worked on “Active fault scaling and extensional folding in Iceland” with Dr. Karl Mueller.



Emma Devin from the Fall 2019 UROP Sidewalk Symposium held on Oct 16, 2019.

Outstanding Undergraduate Student Awards

Porsche Adams
Sean Clarke
Emma Devin
Shaoting (Cici) Feng
Keely Lawrence
Josie Marquez
Estevan Munguia
Mitchell Ramba
Maddie Schwarz
Cynthia Tong
Daisy White

Graduate Student Awards & Fellowships

Ciara Asimoto
Anne Fetrow
Jon Raberg
Mike Zawaski

Graduate Student First-authored Publications

Havranek, R.E., Snell, K.E., Davidheiser-Kroll, B., Bowen, G.J. and Vaughn, B., 2020. The Soil Water Isotope Storage System (SWISS): An integrated soil water vapor sampling and multiport storage system for stable isotope geochemistry. Rapid Communications in Mass Spectrometry, 34(12), p.e8783.

Hughes, A. G. and Jones, T. R. and Vinther, B. M. and Gkinis, V. and Stevens, C. M. and Morris, V. and Vaughn, B. H. and Holme, C. and Markle, B. R. and White, J. W. C.}, High-frequency climate variability in the Holocene from a coastal-dome ice core in east-central Greenland, Climate of the Past, 16, 2020, 4, 1369--1386, https://cp.copernicus.org/articles/16/1369/2020/, 10.5194/cp-16-1369-2020.

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Attention Alumni

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

Name _____ Date _____

Address _____

Degree(s) (years and institutions) _____

Current Position/Employer _____

News About Yourself/Family/Friends _____

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

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

Graduate Student Research, Outreach, and Recognitions

Mike Zawaski was awarded a $2000 grant to assist with his expenses to travel to Greenland for summer fieldwork. The field season was a success. Several news outlets have reported about the high temperatures leading to melting of the ice sheet in Greenland. This warm air also helped reduce the snowpack that has for decades, covered the outcrop that Mike was investigating. He spent days digging out the outcrop, but claims it is much easier to dig and swing a pickax through snow, ice, and unconsolidated sediments that is "warm" versus below freezing, like it was in 2018.

Without the financial support from Dr. Steve Mojzsis' grant, this trip was only possible because colleagues from MIT working on paleomagnetism offered to let Mike come on their helicopter ride if he was able to pay his way to Greenland's capital, Nuuk. It also helped that Mike was the most rescue and medically trained person. So he was also partially brought along as someone who could deal if a severe accident occurred. Because he was coming along, mostly at their expense, Mike was essentially on his own -during the day- for two weeks of fieldwork.

With warmer weather, Mike accomplished everything on his to-do list. In addition to field checking their geologic map for its accuracy, he was able to investigate similar geologic structures, km-scale folds, to look for similar outcrop patterns as he was seeing within his fold. With less snow, Mike identified clearly tectonic structures within the mapping area that had been covered the year before. In 2018, because he had excavated the outcrop from 2 m of snow and ice, and minimal melting occurred around the outcrop during our field season, Mike made a justifiable assumption that the outcrop extended into the mountain. It was only on the last day when he saw Steve banging on some rock with his hammer behind the outcrop that he realized the outcrop may not be attached. In 2019, Zawaski's critical observation was that he dug behind the outcrop through about a meter of unconsolidated blocks and soil to find that the structures on the front of the outcrop penetrated through the outcrop.

These last 2 observations provided the essential observations to help conclude that these 3.7 billion-year-old structures failed the classification criteria for ancient life, stromatolites, but instead were tectonic structures, boudins, caused by deformation after deposition of the original sediments. A paper was subitted to Earth and Planetary Science Letters (EPSL) on 1 April 2020. Mike hope's to have his second paper about the origin of these rocks through trace element analysis plus silicon and oxygen isotopes completed by the end of the summer.

Thank you again for the support! Without it, their paper would have lacked significant details and others may still have remained skeptical about the origin of the structures.

With the assistance of the Spetzler Award, **Sarah Baumann** was able to provide compensation for participants and hire an undergraduate assistant, making significant progress in her master's research. In spring 2019, Sarah conducted a classroom intervention to investigate the relative benefits of different topographic map-reading instructional methods, including instruction with an augmented reality sandbox (ARS). Sarah's main goals for summer 2019 were to analyze results from this study and gain additional insight on these instructional interventions through participant interviews.

In summer 2019, CU undergraduate Chelsie Kowalski joined the Geocognition Research for Advancing Science Communication and Education (GRASCE) Lab to assist with Sarah's research. She assisted with participant interviews, data analysis, and coding participant responses. Chelsie reflected that the skills she developed through her summer research go beyond what she learned in the classroom:

During the time Chelsie assisted Sarah, she learned several valuable skills that she will take with her into the workforce. Chelsie learned about the importance of responsible conduct of research and ways to ensure this, working with human participants. She also learned some basics of statistics, which she greatly appreciated since she had never been exposed to it as a Geology major. Chelsie is passionate about a well-rounded science education, so being able to help with an important study, while also learning new skills was much more than a summer job to her.

The grant also allowed for participant compensation in a further study of the classroom interactions which occur as a result of the ARS. Participants completed think-aloud interviews while conducting activities on the ARS and 2-D paper maps. These interviews provided insight on the processes students use while working on topographic map-reading activities and the interactions between instructors and students.

Overall, the results of classroom intervention and video study showed students working with the ARS did not improve their topographic map-reading skills significantly over students in more traditional instructional methods. Nevertheless, the ARS provided other instructional benefits including collaboration between students, greater visibility to the instructor of student, difficulties and challenges,

and improved the ability for the instructor to provide real-time feedback and guidance.

Garrett Boudinot received the Marks Award. The Cretaceous Oceanic Anoxic Event 2 (OAE2, ~94Ma), is characterized by both global-scale ocean anoxia and carbon cycle perturbations, making it an ideal case study to help understand how global change affects ocean ecology. Stable isotopes and lipid biomarkers have been used to identify important feedbacks under climate change, including impacts of greenhouse gas inputs and sea level rise on marine ecology, from a rock core from the Western Interior Seaway. Results suggest that altered nutrient cycling contributed to ecosystem variability, but the specifics of those nutrient cycle dynamics have remained unclear.

With help from the Marks Award, researchers are identifying the ways in which nitrogen cycling was sensitive to sea level rise, ocean deoxygenation, and marine ecology in the Western Interior Seaway during OAE2. They analyzed nitrogen preserved in bulk organic matter and within specific chlorophyll-derived compounds to elucidate changes in nitrogen inputs and utilization, correlating nitrogen cycling with marine anoxia and carbon cycle perturbations. The Marks Award also allowed Garrett and his group to analyze samples from a deeper-water section from the Western Interior Seaway, providing a more comprehensive, basin-scale understanding of nutrient cycle changes through OAE2. This study helps to constrain how future oceanic nutrient cycling may change in response to rising sea level and greenhouse gas inputs.

Sarah Leventhal, with funds from the Department of Geology Research Award, was able to travel to the Smithsonian Institute in Washington, D.C. to digitize several hundred specimens of Stylopoma, a genus of bryozoan that are the subject of the first chapter of her dissertation. Stylopoma are encrusting bryozoans that grow on the undersides of Scleractinian corals and can be found in the waters around Panama. These specimens have been housed at the Smithsonian for over twenty years. Additionally, she used the award money to purchase the software and equipment necessary for digitization, namely, a Stackshot rail for taking precise, measured stacks of images, and a software program that allows her to stitch together composite images.

Bryozoans are modular animals, meaning they form colonies that are comprised of exclusively clonal members. Sarah's research concerns the evolutionary mechanisms of these animals – typically, animals are understood to experience evolution either at the species level or the individual level. Underlying the idea of evolution is heritability. Evolution can only occur when traits are heritable. Bryozoans have no individual heritability – this has been demonstrated in several studies over the past couple of years. Sarah's geology award funding allowed her to test the idea that some bryozoans have an intermediate form of heritability – one that lies hierarchically between the individual and species levels: group heritability.

Rachel Havranek received a Curtis Research award in 2019. This award has helped her purchase supplies to build a Soil Water Isotope Storage System (SWISS). This is a novel system that she developed and tested that can automatically sample and store soil water vapor for stable isotope analysis. This system is useful because it allows researchers to create high temporal resolution soil water isotope datasets from potentially remote field sites. Rachel will be using the SWISS that she built to create a serial soil water isotope dataset from a field site near Briggsdale, Colorado. This dataset will help her to better understand the timing and drivers of calcium carbonate nodule formation in soils, which is the topic of the second chapter of her dissertation.

Jackson Bell used his Departmental Research Award funds to travel to the San Luis Valley in order to install and maintain a network of three seismometers to complement the permanent seismometer in the region. These seismometers were installed after an increase in seismicity was observed by the USGS in the Sangre de Cristo mountains. As there was only one seismometer in the region, the seismic activity could not be accurately located. The research award funds allowed Jackson and team to install three additional seismometers with a geometry suited to more accurately detect and locate earthquakes in the region, leading to the detection of over 650 previously undetected earthquakes over a three month period. The seismometers also allowed them to collect an additional six months of seismic data which has yet to be analyzed, but will likely lead to thousands of additional earthquakes being detected and located, giving a more complete picture of the seismicity in the Sangre de Cristo mountain region.

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

Degrees Awarded (Fall 2019- Spring 2020)

BA Geology Majors

Dane Abernathy
Porsche Adams
Reem Al-Rowaished
Yousef Yaqoub Alshaheen
Sierra Baker
Todd Bol
Lacee Broeder
Racheal Renee Burger
Hector Camm - cum laude
Rocky Peter Casino
Ulrik William Cappelen
Ronnie Clark
John R. Cole
Lane W. Daigle - cum laude
Ian P Devlyn
Rachel Donati
Katelyn Eaman
Shaoting Feng
Colleen Feuerborn
Marc Anthony Fernandez
Kelsie Gering
Russell D. Glickman
Nicole Gonzalez magna cum laude
Jacob Hirsh
Brooke Holman
Sarah K Jamison-Todd
Israel Jaramillo
Robert Vincent Kelleher - magna cum laude
Gregory Kennedy
Chelsie Maryanna Kowalski
Seth Bolton Kurtz
Maike Li
Tyler Lincoln - magna cum laude
Shelby Dianne Litton - cum laude
Andres Lopez-Alba
Jonah Richard Madrid-Andrews
Mohd Fitri Mazeli
Hunter Merlo
Isaac Caslow Meyer
Mohamad Fiqry Bin Mohd Latif
Jessica Nation
Mitchell W. Ramba - summa cum laude
Joel Malcolm Rice
Devon Robb
Eric Lee Ruggles
Baylee Sergent - cum laude
Sheena Leigh Skinner
David Kyle Spivey
Cynthia Tong
Benjamin Wagner
Janice Wallenburg
Quanzheng Wang
Seung Yeon
Cyrus S. Young

Fall 2019 graduates on a sunny December day.

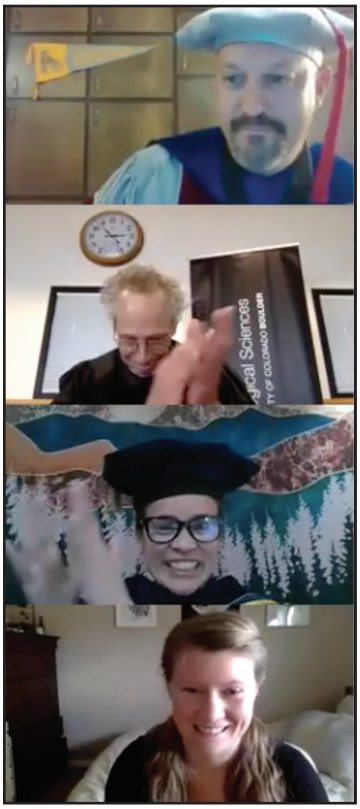
MS Candidates Graduating with Degrees

	Advisor(s)	Thesis
Sarah Baumann	Dr. Leilani Arthurs	Map-Reading Skill Development: Historical Perspectives & Instructional Implications.
Jackson Bell	Dr. Anne Sheehan	Seismic Activity in the Northern Sangre de Cristo Fault Zone.
Mike Lotto	Dr. Brian Hynek	Characterizing Martian Hydrothermal Analogs at Þeistareykir and Námafjall, Iceland using a UAV-Mounted Hyperspectral Imager.
William Bradley Skorski	Dr. James White	Exploring the Viability of Using Unmanned Aerial Vehicles for Atmospheric Sampling of Water Vapor in the High Latitude Arcticö.

PhD Candidates Graduating with Degrees

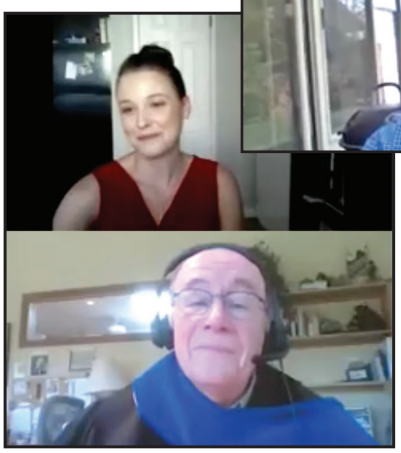
Anna Bergstrom	Dr. Michael Gooseff and Dr. Shemin Ge	Thesis: The effect of sediment on hydrological and biogeochemical connectivity of glaciers within the McMurdo Dry Valley ecosystem, Antarctica.
Garrett Boudinot	Dr. Julio Sepúlveda	Black dirt live again: Black shale organic and stable isotope geochemistry reveals ecosystem responses to global environmental change.
Thomas Li-shan Enzminger	Dr. Eric Small	Estimating changes in western U.S. terrestrial water storage using GPS vertical displacements
Kelly Kochanski	Dr. Robert Anderson and Dr. Greg Tucker	The Growth of Snow Bedforms.
Brigitta Rongstad	Dr. Thomas Marchitto	Investigating Past El Niño Southern Oscillation Using Mg/Ca in Individual Planktic Foraminifera.
Neesha Regmi Schnepf	Dr. Anne Sheehan	Earth's oceanic electromagnetic signals and their applications in geomagnetic sounding, monitoring circulation, and hazard warning systems
Rebekah Simon	Dr. David Budd	Integrating the Effects of Diagenesis and Catagenesis on Pore Network Evolution in an Unconventional Chalk Reservoir: Cretaceous Niobrara Formation, Colorado, USA.
Jefferson Yarce	Dr. Anne Sheehan	Microearthquake detection and seismic imaging using ocean bottom seismometers in the Hikurangi Margin, New Zealand.

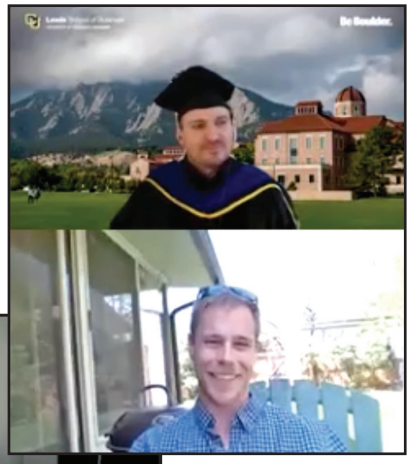
2020 Spring Graduation via Zoom...



Left: Tom Marchitto, Bob Anderson, Lelani Arthurs congratulate Sarah Baumann.

Below: David Budd congratulates Becky Simon.





Above; Julio Sepulveda congratulates Frank Boudinot.

Right: Anne Sheehan and Bob Anderson congratulate Jefferson Yarce.

In Memoriam

Robert Dow Francis Cody, age 84, of Ames, passed away on Wednesday, June 12, 2019 at Green Hills Health Care Center in Ames.

Robert was born February 23, 1935 in Oklahoma City to Joseph Francis and Frances (Tucker) Cody. He graduated from John Carroll Elementary School in May 1949 and in 1953 from Bishop McGuiness High School where he won the Scholastic Art Award and a scholarship to study at the Layton School of Art in Milwaukee, Wisconsin while taking academic classes at Marquette University. In 1955, he set sail on the Queen Mary from New York to Paris, France where he studied at the Academy de La Grande Chaumiere under the direction of the world-renowned French sculptor, Osip Zadkine.

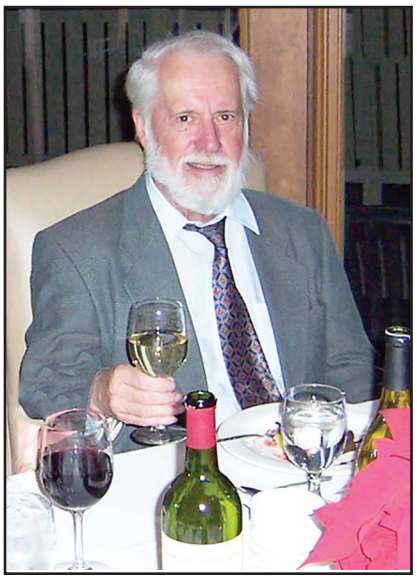
He returned to the states and completed an undergraduate degree in geology from St. Louis University in 1060, a M.A. degree in geology from the University of Wyoming in 1962 and a Ph.D. degree in Geology from the University of Colorado in 1968.

On July 16, 1967, Robert married fellow geologist, Anita Meleshka (U. COLO. GEOL MS 70') in East Meadow, New York. Their marriage was blessed with two children: Elizabeth in 1970 and Nicholas Robert in 1973. In September 1967, Robert began teaching geology at Iowa State University where he taught classes in chemical sedimentation, clay minerology, invertebrate paleontology, mineralogy, earth materials, aqueous geochemistry and contaminant hydrogeology. He taught at an NSF Summer Field Institute for Earth Science Teachers at Philmont Scout Ranch in New Mexico (1970) and at the ISU Karl Vondra Field Camp in Shell, Wyoming. He served as the thesis director to 26 ISU graduate students and obtained grants to support his research and their work. Grants from the Academy of Applied Sciences (1982-2000) supported the summer work of Ames High students growing crystals and working in his laboratory.

Among the many scientific papers that he published, he and Anita co-authored 18 publications and many lectures at scientific meetings. After the International Geologic Congress in Beijing, China, they traveled to Tibet, Nepal and Thailand. They also traveled to Russia, the Republic of Georgia, Cyprus, Egypt, Israel, Morocco, Mexico, most European and South American countries, New Zealand, Australia, Canada, Hawaii and throughout the United States.

Robert retired from ISU as an Emeritus Professor of Geological and Atmospheric Sciences in 2001.

Robert was preceded in death by his parents and his older brother, Joseph (Fr. Aelred Cody O.S.B.) He is survived by his wife, Anita; daughter, Elizabeth Cody and her husband, Brian Hayes D.V.M. (ISU) of rural Kalona and their children, Lily and Robbie Hayes; and son, Nicholas Robert Cody of Chicago. He is also survived by his good friend, Fred DeLuca, of Ames. Ames Tribune, Jun 19, 2019.



George Armbrust, a 1968 Ph.D. Geological Sciences graduate of C.U. Boulder, passed away in Lakewood, Colorado on September 11, 2019.

George was born in Welland, Ontario on 13 November 1940, and grew up there. He obtained his B.S. degree in Geology at the University of Ottawa in 1963 and his PhD in Geology at the University of Colorado in Boulder in 1968. His dissertation on the Tribag Mine north of Sault Ste. Marie, Ontario was supervised by Professor Russel Honea. In 1969, he married Cecilia Travis in Denver.

After graduate school, George taught Geology at the University of Northern Iowa, the University of Chile in Santiago, and, from 1972 to 1982, was Associate Professor of Geology at the University of Ottawa in Canada, specializing in geology of mineral deposits.

George and family moved back to Colorado in 1982. He worked in the International section of Anaconda Minerals Company until 1986, then joined the mining consulting firm of Pincock, Allen and Holt. In 2002 he co-founded the consulting group Chlumsky, Armbrust and Meyer, which undertook independent diligence on mining projects world-wide. George retired in 2008, having practiced his profession in numerous mining districts on six continents, with enthusiasm and a recognized high level of competence.

After retirement George greatly enjoyed life as a gourmet chef and raconteur, and a world-class birder;

his birding expeditions took him to many additional corners of the planet.

George is survived by a brother in Ontario; a sister in Manitoba; daughter Louisa in Brooklyn, NY; daughter Elizabeth (Beth) and granddaughter in Seattle, Washington; his ex-wife Cecilia in Colorado; and many friends around the world. At his request, there was no funeral service, and he was cremated.
by Fred Barnard, Nov 2019

Marshall Keene Corbett died of natural causes Jan. 4 in Kalispell, MT, three days shy of his 90th birthday. He was a vigorous man for most of his life, with an irrepressible sense of humor and a penchant for storytelling.

Marshall was born Jan. 7, l 930, in Colebrook, NH, to Gerald Albert and Doris (Keene) Corbett. His New England heritage, which traced back to the mid-1600s, was evident throughout his life in every word he spoke.

Marshall grew up in Colebrook on the family farm about 10 miles south of the Canadian border. Country life in the far north was tough: he had to walk uphill both ways to school every day, pulling himself along by the foliage along the icy road - or so he often liked to say.

He and his two brothers, Albert and Roy, took advantage of the freedom that farm life afforded and found creative ways to make mischief, like using cookie sheets to sled off the high barn roof. A sister, Gerri, was born when he was in his teens.

Marshall graduated from Colebrook Academy and attended the University of New Hampshire in Durham, earning a bachelor's degree in forestry. While there, he met Jean Anne Parmenter at a fraternity party. They married in 1950 but divorced 50 years later, after raising two daughters, Gayle and Lauren.

Marshall served in the Air Force during the Korean War. He left service as a first lieutenant specializing in aerial-photo interpretation. Then he continued his education at Cornell University in Ithaca, NY, earning a master's degree in geology. Soon, the family rnoved to Melbourne, Australia, for a year-long opportunity to work in the oil industry. They returned to the U.S. to live in Denver. This marked the beginning of Marshalls transformation into a die-hard Westerner (and Broncos fan). He earned a PhD in geology at the University of Colorado-Boulder.

Marshall was proud of the 17 years he spent as a professor of geology at Idaho State University in Pocatello. His favorite part of the job was taking graduate students on field trips to the Jackson Hole area. He always made a point of proving that he could beat his students to the top of any hill.

When he tired of watching his students get jobs after graduation that paid much better than his, he left teaching and returned to the oil industry. When he was laid off in his 50s during an oil bust, he retrained as a hydrogeologist and took a job with the Montana Department of Natural Resources and Conservation in Helena, where daughter Gayle and her family lived.

Although Marshall's career was spent in the pursuit of science, he had a creative side. He designed and at least partially built three family homes: in Pocatello ID, Kalispell MT, and above the Missouri River between Helena and Great Falls MT. He often enhanced birthday and other holiday cards with playful poems he wrote for the occasion.

In 2002, Marshall married Margie Puckett. They lived briefly in Libby, MT, before building a home together on 10 acres in Kalispell. Marshall was never more content than when sitting on a John Deere tractor, mowing hay or plowing snow. He also was an avid, lifelong hunter, with mounts of deer, elk, pronghorns, and a black bear hanging in his home to prove it.

Marshall was preceded in death by his parents and two brothers. Survivors include his wife Margie, Kalispell, MT; daughter Gayle Shirley and her husband Steve, Helena MT; daughter Lauren (now Corbett Sionainn) and wife Arlene Wheeler, Jeffersonville, VT; grandsons Colin and Jesse Shirley and Jesse's wife Emily, Helena; and sister Gerri Kruger and her husband Dave, Sun City Center, FL.

Other survivors include stepchildren Michael Puckett (Tina), Sandpoint ID; Brenda Herbst, Kalispell MT; Karee Sweedman (Frank), Libby MT; Becky Cassel (Keith), Kalispell; and 15 step-grandchildren. Finally, he is survived by his cat, Saco, last in a long line of beloved felines.

Marshall chose to be cremated and have half his remains buried in Montana and half in Colebrook, NH. Johnson-Gloschat Funeral Home in Kalispell is in charge of arrangements. The farnily will hold private services.

The family would like to thank staff of Kalispell Regional Medical Center for their compassionate care and the West Valley Volunteer Fire Department in Kalispell for their frequent, kind, and respectful emergency responses.

In Memoriam ...continued

Timothy J. Beesley (MGeol'67)
John R. Coash (MGeol'49)
Robert D. Cody (PhDGeol'68)
Marshall K. Corbett (PhDGeol'64)
Kenneth F. Cummings (Geol'53)
Marco J. De Marco (Geol'60)
Jack D. Garber (Geol'51)
Willard J. Guy Jr. (Geol'55)
Vernon I. Hill Jr. (Geol'54)
Henry E. Holt (PhDGeol'62)
Ralph L. Langenheim (MGeol'47)
John C. Leifer (MGeol'85)
Robert G. Luedke (Geol'50; MS'53)
Shannon M. Maher (MGeol'83)
Thomas R. Marshall Jr. (Geol'50)
Henry W. Ranspot (Geol'54; MS'58)
Omer B. Raup (PhDGeol'62)
James W. Richards (Geol'55)
John E. Ringle (Geol'55)
Larry H. Rose (Geol'83; MEcon'84)
Seymour L. Sharps (MGeol'56; PhD'62)
Karl R. Soppeland (Bus'71; Geol'79; MGeog'83)
Joan B. Stough (Bio'54; MGeol'57)
Charles D. Wasson (Geol'60)
George E. Welder (MGeol'54)

Alumni and Emeritus

Emeritus professor Harmut Spetzler near and at the top of Old Fall River Road in Rocky Mountain National Park, June 1st, 2019.

Your generous support helps to fund many of our graduate and undergraduate field trips.
Thank you!

Due to the COVID 19 pandemic, we had to postpone the spring marquee event honoring our retired professors. While the future of this event is still pending based on the ongoing global health challenges, we wish to take a moment and thank the dedicated group of alumni advisory board members who volunteered over 100 hours of service to the planning and preparation for this event. On behalf of the Department of Geological Sciences, the Office of Advancement, and all our faculty, staff, students, and alumni, we thank you for your dedication, commitment, and service.

Jazmin Brooks - Director of Development
College of Arts & Sciences

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