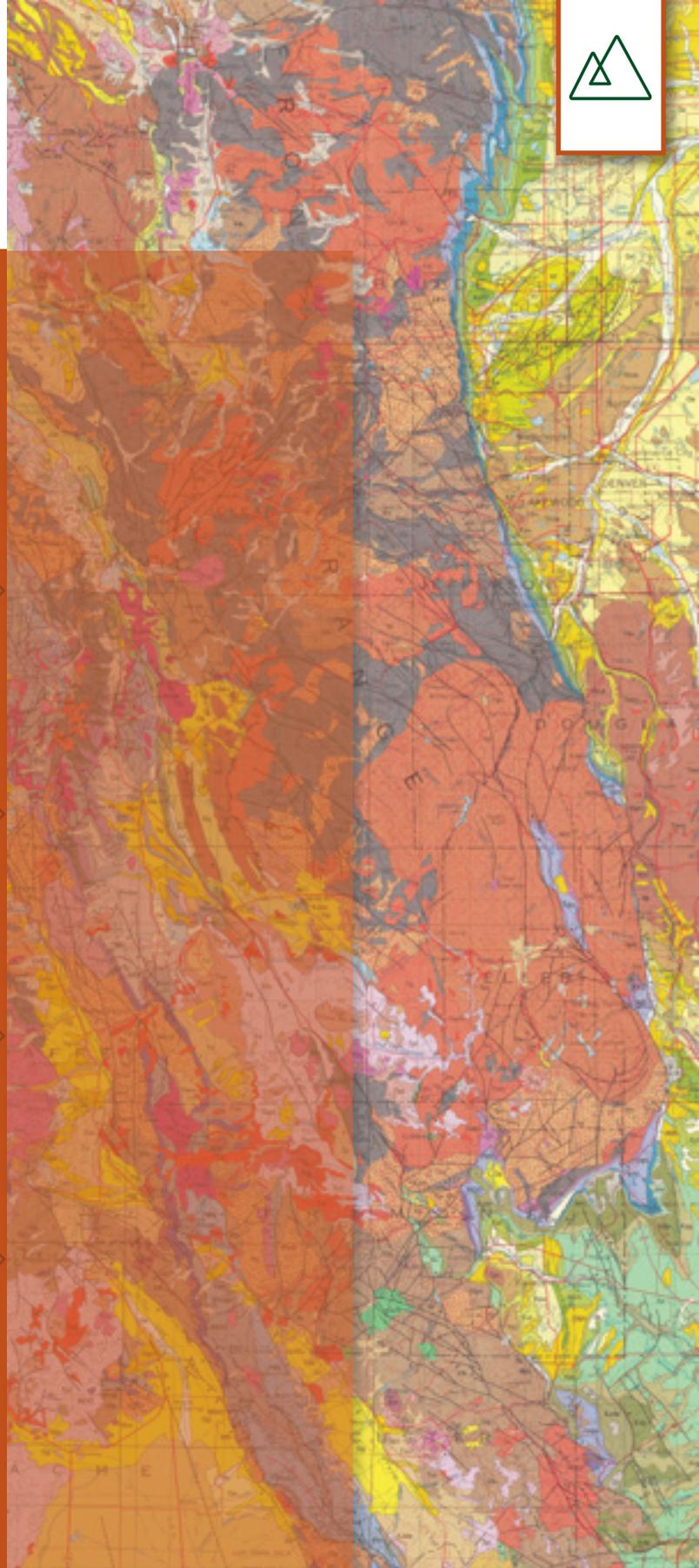




# GEOscape 2016

Department of Geosciences  
Alumni and Friends Annual  
Newsletter



**GEOSCIENCES**  
COLORADO STATE UNIVERSITY

## A Message from the Department Head



What a dynamic and exciting year for the department and College!

This included breaking ground on a new Warner College of Natural Resources Building, new full-ride four-year and Field Camp scholarships for our students, long-awaited classroom renovations, and an expansion faculty position in the department focusing on near-surface geosciences.

While noting these recently developed and, in some cases, historic initiatives and opportunities, I certainly also want to emphasize and recognize the continuing excellence of our faculty and staff in delivering an extremely high-quality geosciences education and providing deep and professional mentorship to our students. Just a sample of the department's far-flung and internationally recognized teaching, research, and broader impacts efforts can be briefly summarized here.

The Michael Smith Natural Resources Building will be a substantial (approximately 50,000 square feet) expansion of the College, to be constructed beginning in 2017 on the front (south side) of the present Natural Resources Building and will give natural resources and geosciences a new level of campus prominence.

A generous donation from Michael Smith (who is, among other things, the chairman and chief executive of Freeport LNG) finalized this historic project, which also received critical donations from alumnus Ed Warner and our longtime department and college friends, John and Dolores Goodier.

Michael's donation also created the Michael Smith Scholarships for Undergraduates program, a new suite of full four-year geology scholarships (including summer Field Camp) to in-state students, beginning in the fall of 2017.

We also initiated a campaign this year to establish a Field Camp Scholarship program that is still picking up steam. Many of our geology students face financial challenges with the nearly \$6,000 (in-state) cost of the five-week field course, typically taken during the summer after the junior or senior year, when student financial aid and other resources may be wearing thin. With early donations, we were able to award the first 12 of these scholarships this summer to highly deserving recipients and, working with our Geosciences Advisory Council members and college development, next seek to



Early conceptual drawing of the new Michael Smith Natural Resources Building

further grow these resources for future in-need and high-achieving Field Camp students.

A generous anonymous donor has provided matching funds for this effort, and a number of alumni and other supporters, recognizing the fundamental importance of maintaining a strong and affordable Field Camp experience within the Geology curriculum, have already helped out as well.

Kindly reference the development news at the end of this newsletter for more details about this and other initiatives. As always, I thank our many, many alumni and other friends for their substantial and longstanding support to the department in so many ways.

Late-breaking news this fall is that we have been granted the College resources to create a new faculty position in the department, representing the highest priority area identified in our recent

faculty deliberations.

The focus of the new position will be in near-surface geoscience spanning the "Critical Zone" extending from the top of vegetation to the bottom of the weathered layer. We anticipate having a new faculty colleague on board by fall of 2017 to further expand our geological, geophysical, hydrogeological, geochemical, and other broad activities in near-surface processes and resource issues, and to build new bridges to other departments and specializations in the College, across CSU, and beyond.

Again, it is a great honor to serve as the department head and to be able to introduce another exciting annual *GEOScape* newsletter. My sincere thanks, once more, for your interest in and engagement in geosciences.

**Rick Aster**

Head, Department of Geosciences



## A Message from the Dean



their fields and the world. It is truly a global department; with work from far northern latitudes, to South America, all the way to Antarctica and here at home in Colorado.

It's also clear from the energy and enthusiasm I see in the halls, that the department's faculty are equally as passionate about their research as they are for teaching and mentoring students. We're also very proud of the work the graduate students in the Department are producing, further extending the impacts of the Department around the globe.

I'll close by expressing my gratitude and thanks to all of the alumni and friends of Geosciences for everything you do to advance our programs and support our students. During my travels, I've had the pleasure of meeting many of you and heard about the phenomenal personal and professional accomplishments you've achieved since leaving Warner College. Moreover, I've seen firsthand your commitment to supporting your alma mater. We are extremely grateful and cannot understate the importance of your support.

Thanks for all that you do and for representing our programs so well,

John P. Hayes  
Dean, Warner College of Natural Resources

Friends of CSU Geosciences,

Welcome to another great issue of *GEOScape*! We're thrilled to report on the exciting progress the Department of Geosciences has made over the past year in their teaching, research, and outreach.

As Rick mentioned, it's been a very exciting year for the College. We are looking forward to construction of the Michael Smith Natural Resources Building addition, which we'll anticipate occupying in Fall 2018. The addition not only provides much-needed classroom and teaching lab space, but will elevate the College's profile in a significant manner on campus and beyond.

I am consistently impressed with some of the tremendous research being generated by geosciences. Our researchers and faculty in geosciences are having tremendous impact on



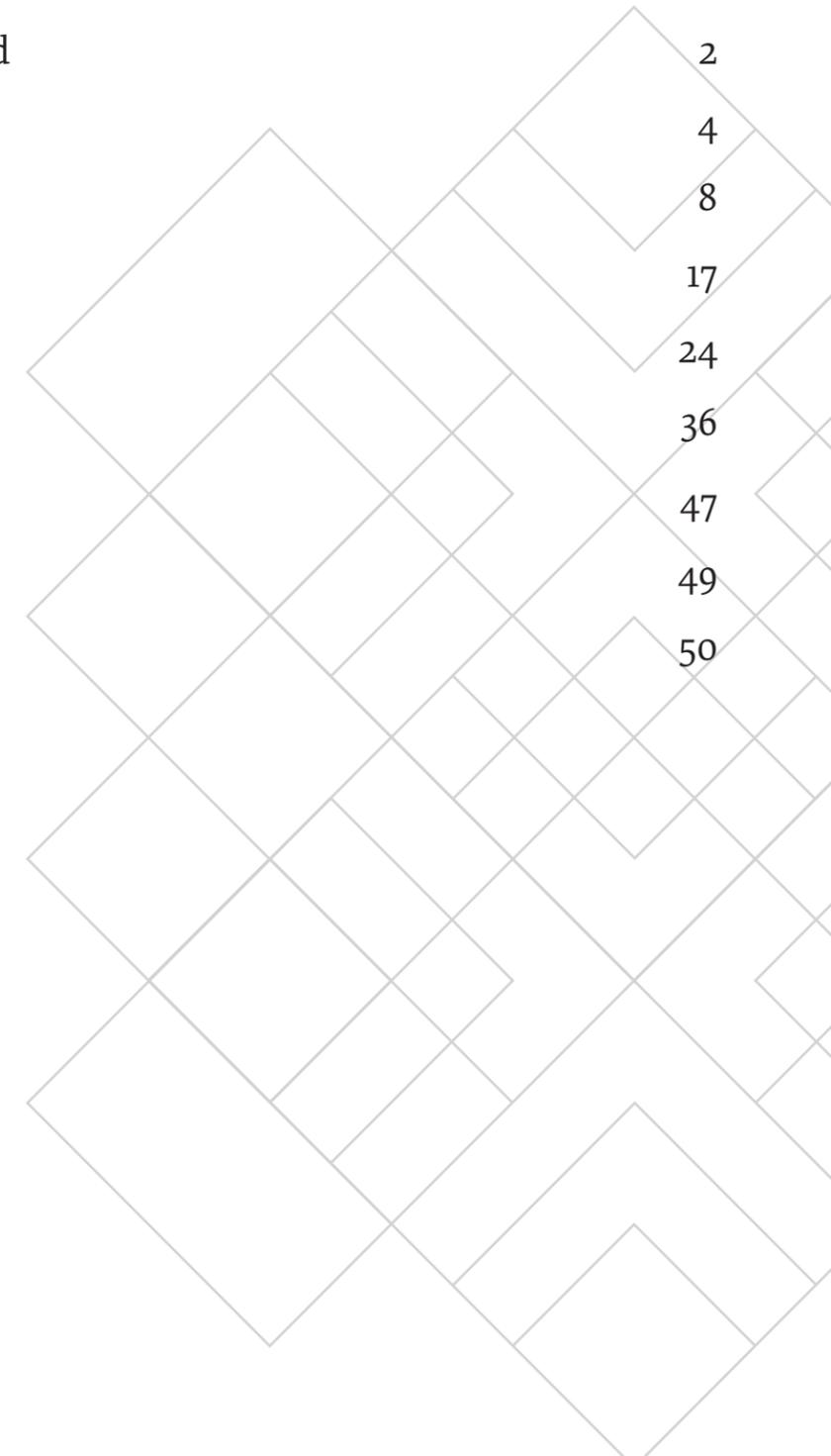
*Canyonlands National Park, Utah*



Rainbow Falls, Black River, Michigan (Photo: Jerry Magloughlin)

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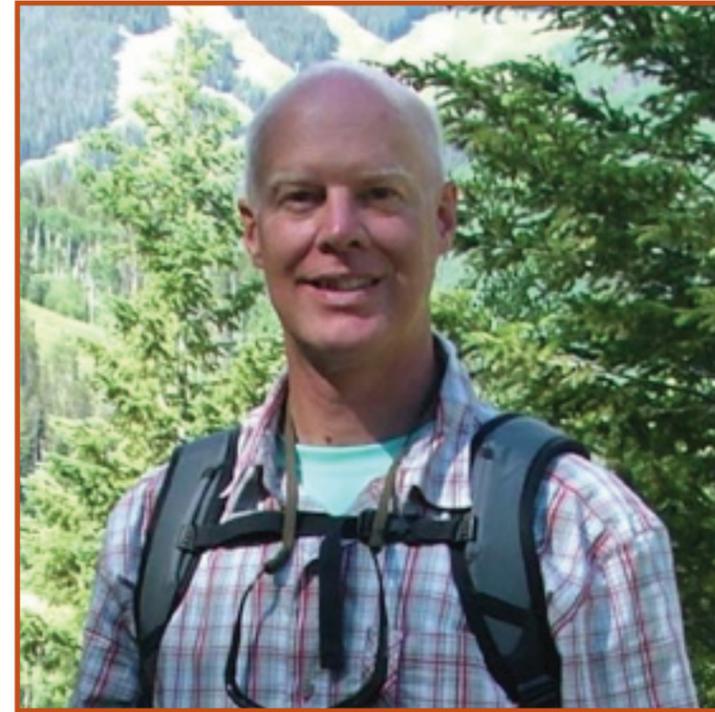
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*Black Canyon of the Gunnison National Park, Colo.*

## Alumni Thoughts



## Harold 'Hal' Pranger, M.S., Geology, 1988

*Hal Pranger currently is chief of the Geologic Features and Systems Branch of the National Park Service's Geologic Resources Division in Lakewood, Colo. GRD is part of the Washington office of the NPS, located in the Natural Resource Stewardship and Science Directorate.*

Hello, fine people of CSU geology! I have three short things to mention in this note: 1) how an average student in the CSU grad school was able to launch a dream career in the geosciences; 2) a summary of my undeservingly fantastic career; and 3) the tremendous recent developments in the CSU Department of Geosciences that are making it a national leader.

I was fortunate enough to get into CSU grad school in 1985 under Stan Schumm, who, as many of you know, was one of the most important scholars and practitioners of fluvial geomorphology in the 20th century. I was a good student at CSU, but certainly not of the caliber of some of my fellow students such as Dave Jorgensen Harbor, Dru Germanoski, and John Pitlick, who each are now successful professors (see <http://geology.wlu.edu/harbor/vita.htm>; [http://geography.colorado.edu/people/faculty\\_member/pitlick\\_john](http://geography.colorado.edu/people/faculty_member/pitlick_john)).

While these guys were studying active tectonics

in India, Fall River in Rocky Mountain National Park, and the like, Stan was kind enough to let me – Joe six pack – work on a NASA project studying strange channels on Mars. I was glad for this funded project, even though it provided, let's say, limited field opportunities. When Stan told me of my draft thesis, "you are a very poor writer," it struck me as harsh (although true), and those words have motivated me throughout my career to at least not be a totally lame writer. The lesson I learned is that you don't necessarily have to be an academic superstar to have a very rewarding career.

After grad school, job prospects were grim, and so I asked Stan if I could work at his consulting firm. I worked for two years as a geomorphologist, collecting field data, digitizing data, analyzing data, writing code, writing reports, and evaluating stream channels all over the country. Phenomenal experiences – thank you, Stan (and Chester Watson, and Mike Harvey.)



I was “let go” from Stan’s company due to financial strain, and became a hydrologist for the state of Wyoming, where I regulated a couple of dozen gigantic surface coal mines to ensure that the land was properly reclaimed. That job paid little, but carried with it a lot of power to literally shape the land. I left for six months to be a consulting hydrologist in Portland, Ore., which broadened my understanding of wet environment hydrology and restoration tremendously.

In between two stints (1991-2000 and 2006-2008) with the U.S. government as a hydrologist regulating the coal industry as I had done in Wyoming, I was incredibly fortunate to be hired as a geomorphologist with the National Park Service, where I visited more than 40 national park units, helping to run the disturbed lands restoration program, evaluating glacier changes, helping park managers with geologic hazards, and so on. For a geomorphologist, this was the absolute job of dreams. I actually was paid really well to kayak in Glacier Bay and helicopter into the Klondike to study glaciers and hazards. Unbelievable.

Since late 2008, I have been a supervisory geologist for NPS. I supervise program leads in our geologic resource inventory program (see article in this edition of *GEOScape*), coastal geology, geologic hazards, cave and karst, paleontology, education and outreach, and geologic heritage. Except for not getting in the field enough, I NOW think I have the best job in the world. I supervise a cadre of nine very energetic, creative, and passionate people committed to all things geologic in the 413 national parks, preserves, monuments, seashores, lakeshores, battlefields, etc. (<http://www.nature.nps.gov/geology/index.cfm>).

Our group created National Fossil Day (<http://www.nature.nps.gov/geology/nationalfossilday/index.cfm>). Our group responded to hurricanes Sandy, Matthew, and others, and are studying the impacts of sea level rise on coastal parks. Our group sup-

ported studies of a massive landslide and tsunami that occurred in Alaska a year ago (<https://vimeo.com/186109797>). We developed Junior Paleontologist and Cave Scientist programs (<https://www.nps.gov/subjects/fossils/junior-paleontologist.htm>; <https://www.nps.gov/subjects/caves/junior-cave-scientist-program.htm>). We’re working on the cutting edge of photogrammetry (<http://nature.nps.gov/geology/monitoring/photogrammetry/index.cfm>). We recently published a book on *America’s Geologic Heritage* (<http://www.nature.nps.gov/geology/geoheritage/>). The people in my branch are astounding.

Last spring I was invited to be part of the Geosciences Advisory Council, whose job it is to essentially think and advise about the future of the department. In addition to the large donations Michael Smith so generously provided for the new College building and for full undergraduate scholarships, with your help, the GAC has recently raised a great deal of money for associated priorities, such as Field Camp scholarships. There are plans now to hire a top-tier “critical zone” geoscientist. Exciting plans are becoming a reality!

I cannot fully express my excitement at the developments in the department. In addition to the new scholarships, the new building, and the new critical zone faculty position, the department already has exceptional leadership in areas that include geomorphology (Ellen Wohl) and petroleum geology (Lisa Stright). As a department alumnus and now GAC member, I’m proud to say, without overstating the case (and from seeing it firsthand), that CSU geosciences is becoming a world-class department that has even better days ahead.

You don’t have to be Michael Smith or Ed Warner to contribute to or participate to the department. I’m thrilled as a regular guy to be able to serve on the GAC and play a role in developing ideas and plans for the department. For alumni who have benefited from your CSU education, I encourage you to

donate, send personal success stories, or just spread the word about developments such as the Smith scholarships. For graduating or soon-to-be graduating students, I’d encourage you to consider broadening your experience and apply for a position with the NPS geoscientists-in-the-parks program (<http://www.nature.nps.gov/geology/gip/index.cfm>), which funds about 150 three- to 12-month internships in national parks on a variety of geologic resource issues. Participate as you see fit, but please participate.

Great things are happening at your alma mater!



Spring Creek Trail, Horsetooth Mountain Open Space, Fort Collins, Colo.

## Ernie Brown, B.S., Geology, 1978



*Ernie Brown in Fort Collins*

Having grown up in a small rural town nestled in the mountains of Colorado, selecting CSU as my college of choice was completely logical. Being the descendant of a gold miner from the Leadville mining district, deciding to get a geology degree was also a natural direction. However, life's path since graduating with that degree has been much less predictable.

Faced with a decision of taking a job in the oil and gas industry or further advancing my studies, the immediate financial benefit of working in the oil and gas industry was clear. My idea of mapping geological structures in remote and gorgeously scenic mountains was about to change. This was the first of many life lessons: recognizing that goals and ideals could change.

Most assignments during my early career were geographically close to home. There was plenty of drilling activity throughout Colorado, Utah, and Wyoming. Then the downturn of the mid-'80s arrived, and as rigs idled in parallel with the price

of oil, my family began a series of relocations: first to the deserts of West Texas, then to the humid congestion of Houston, and quickly overseas to the U.K. I was no longer in familiar territory or close to friends and family, but I learned another valuable lesson: Be a bit flexible in life. There can be fun and excitement ahead if you just allow yourself to get there.

Following a career path within the technical career structure of Schlumberger, I gained invaluable guidance from some great mentors, some of whom were true icons of the oil and gas industry. This led to life lesson #3: mentors are necessary, but they do not magically appear nor can they be assigned through job descriptions. It is wise to identify and gainfully seek out mentors early in your career, developing a relationship over time. Don't be afraid to ask questions, seek guidance, and follow the strong leadership of those who can be potential mentors. You will quickly identify those who are willing to help.

As the years progressed, came life lesson #4: reach out to mentor others and share your knowledge. Over time, experience was gained by being exposed to a variety of problems and technical challenges, and they were each solved through the application of unique solutions. Passing this knowledge and experience on to others and developing into a mentor was the next natural step. Ultimately, it has been extremely rewarding to see those who I have mentored rise to become successful and recognized individuals throughout industry.

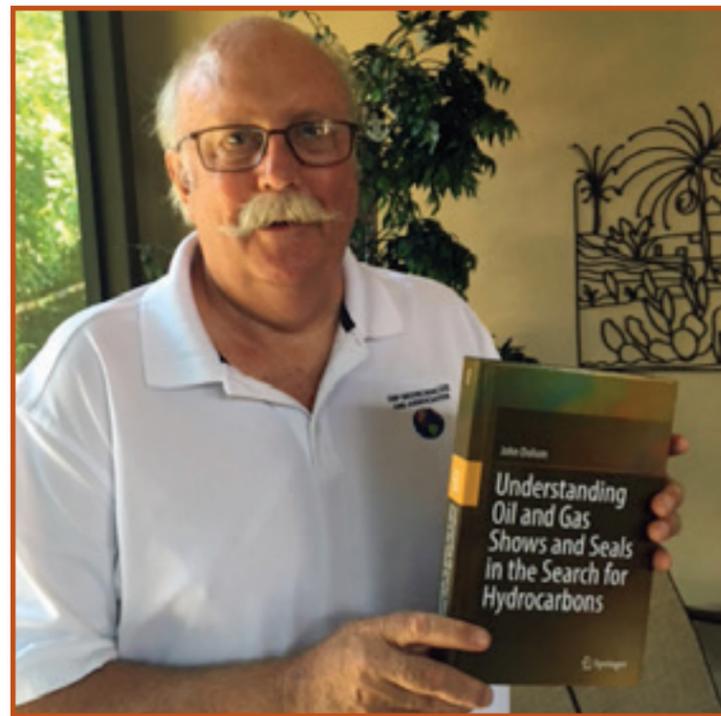
I have had the fortune of working for a single company for an entire career; a company that kept me employed through the ups and downs of numerous business cycles. Perhaps life lesson #5 is simply that life likes to throw curve balls. They can be hard to hit, and sometimes you simply miss. It takes a bit of luck, as well as hard work, a good attitude, and perseverance, to have a successful career.

If you happen to run into bad luck and get knocked down, don't be discouraged. Get back up and go forward again. Recognize that geoscientists work in a cyclical job environment, and the next upturn really isn't too far away. Keep focused on the rewards of the good times.

After nearly 40 years since embarking on a professional geoscience career, I see there are still opportunities to help the overall geoscience community. Help can come in the form of gifts or simply engagement. The gifts can be financial, but they can also use the currency of time. Staying connected by teaching a class at a local school, volunteering time with a professional society, and engaging with geosciences back at CSU, are all excellent ways to keep involved.

## John Dolson M.S., Earth Sciences, 1981

*John Dolson received his B.A. in natural science in 1971 from the Colorado College and M.S. in earth science from CSU in 1981. He taught junior high earth science for 5 years in Loveland, Colo. and was Colorado/SW Region first place and second place nationally for Environmental Conservation Teacher of the Year in 1978, before heading back to graduate school. He retired from BP-Amoco as a senior geological advisor in 2008 after 28 years in global and domestic oil and gas exploration. He lives in Coconut Grove, Fla., with his wife of 43 years (Debbie) and is director of DSP Geosciences and Associates and a senior advisor for Delonex Energy in London, UK. He has served as vice president of the American Association of Petroleum Geologists and ran for president of the organization in 2010. He holds two Distinguished Public Service awards for work with Dinosaur Ridge, the Denver Earth Science Project and the Whale Valley (Egypt) UNESCO World Heritage site.*



“The trouble with you, Dolson, is that you have found oil and gas but still believe all these maps you show us.” That admonishment came over cocktails from Amoco’s vice president of exploration a good six years after my graduation from CSU. I think I must have looked a bit shellshocked. “Of course I do,” I sheepishly stammered back. “You pay me to.” “But you’ll be a better explorer once you start thinking about other ways to draw them and just what might be wrong about them,” he replied as he headed back to the bar.

That conversation jarred me and brought back another conversation in 1980 with Professor Frank Ethridge at CSU. I had stumbled into Frank in April coming back in from my fieldwork on the Dakota Hogback north of Fort Collins. By now, I was finishing two years on my thesis and had been out re-examining and checking my measured sections with another CSU student. Frank glowered at me and let me have it. “You need to stop going back to the field. You are done! You keep trying to check everything and make sure it is 100 percent accurate. Geology isn’t like that! I have news for you, I have no money, no desk for you next fall, you need to finish. You are trying to make things perfect, and science isn’t like that. So start writing that thesis and graduate, Junior!” I started writing that afternoon and had the draft finished

by early May. I defended successfully in September.

This wouldn’t be the last time I had to be reminded about uncertainties in our field and a belief, often built into it by decades of teachers, that you must “get it right.” Get a 100 percent on the test. Memorize tons of stuff. Spit it back, get it right. We are preprogrammed that way from the time we are born to some point in the future when someone or an event wakes you up to an alternative reality.

In 1994, our family relocated to Cairo, Egypt, where I was the senior technical advisor for GUPCO, a joint-venture company formed between Egypt and Amoco. When I walked in a door, a sign above our work declared “The map is wrong, it is always wrong. The question is, ‘how wrong is it?’” GUPCO was one of those places where active drilling was always occurring, with 11 rigs and 400,000 BOPD production. Over the next five years, I watched 105 wells get drilled, some with my name stamped on them. I arrived at a time when exploration had finished 3 years of 32 consecutive dry holes, and the production teams were missing their targets by 40 percent. We were given six months to three years to turn it around or “turn out the lights and go home.” The heat was on.

The old plays were “played out” and we needed new data, new seismic, and new concepts to find more oil. More importantly, we had to break paradigms, to challenge conventional wisdom. The transition wasn’t easy. The entire company had to adopt new ways of doing things.

Workstations, 3-D seismic and peer reviews became part of the workplace. Every prospect needed at least two maps to show alternative trap styles and sizes. Resistance was strong at first, but when these steps started finding new oil and targets got met, the money for equipment, travel, and training started flowing from management. In 1997, we ended up with Amoco’s First Place Award for Excellence in Exploration, a terrific accomplishment by hundreds of staff members. What an awesome experience that was. As they said when we arrived, “You will have your best and worst days at GUPCO, and they may come on the same day!” Drilling wells is like that. You find out just how wrong you can be and, occasionally, you find how just how right you can be.

A lot of CSU grads won’t go into the oil business, but those who have know exactly what I am talking about. It is your ability to think out of the box and to recognize just how wrong you might be that will make you a good explorer and scientist. The same holds true in any field of science, but particularly geology.

That goading by Frank Ethridge back in 1980 has done me a lot of good over the years. He taught me the importance of “closure,” of being able to finish something full of uncertainty. A well recommendation is like that, just as is a thesis or senior project. The true excitement of science, contrary to what comes out in many classes, is that of entering the unknown. It isn’t what you know that is important, but “what you know that just ain’t so,” as the old expression goes. My greatest professors often peppered their lectures or stories with phrases like, “We used to think this, but now we see it this way,” “I was horribly wrong on that idea”; “What were we thinking back in the day”?

After defending my thesis, I took two months to do some minor revisions and map folding to get the copies to the department that would allow me to graduate. That eight-hour procrastination kept me from graduating until 1981, and closure was stimulated primarily by the \$1,500 owed me by Amoco for when I delivered the final product they had funded. I needed cash for Christmas, so I finished up!

A year later, I pulled out a 1976 vintage unfinished manuscript I’d started while a park ranger at Black Canyon of the Gunnison National Monument. I shipped it off to a publisher who picked it up and had it out by 1983 as *Black Canyon of the Gunnison: A Story in Stone*. As I told my wife, “that thesis wasn’t so hard, why not try a book”? Another lesson in closure.

The oil patch has taken my family around the world; 8½ years in Egypt, kids graduating at the Pyramids, 18 months in London, and four years in Moscow. The lessons learned at CSU and Amoco have served me well, and I now teach as an adjunct professor at the University of Miami. I get feedback that my course in petroleum geology is hard, a ton of work, but valuable. When I ask what is hard, I am told “you don’t give us easy answers-you make us think.”

As long as I hear that, I am happy and go to bed thinking that maybe I am finally giving something back.

This year, I published a book with Springer-Verlag: *Understanding Oil and Gas Shows and Seals in the Search for Hydrocarbons*. As it has a relatively narrow market, I don’t expect to make money on it. It is written with many personal examples of both successes and failures not only from me, but others. You don’t write something like this for money; you do it to give back, and I hope this book does just that.

I was fortunate from 1978-1981 to be at CSU in a department where virtually all the undergraduates and graduates knew one another. You knew all the professors and had a close relationship. Some of those professors had the gift of teaching you how to think, how to “get out of the box” and go beyond facts. Having to write, defend, and publish a thesis was a huge step in learning how to get to closure. You can’t be successful as a professional without these qualities and demonstrated abilities.

My advice to current students? Learn to be comfortable with uncertainty and to pride yourself on the ability to define, explain, and defend your ideas in light of that uncertainty. Most importantly, finish what you start. CSU taught me that, along with a lot of other people along the way. I am grateful to the gifted teachers and mentors in my life, my incredible wife and family, and those who have pushed me to stay a lifelong learner. They taught me two things: 1) it is OK to be wrong; 2) It is not OK not to try.



## Roger Steinger, Ph.D., Geology, 1986 Recipient of the 2016 Warner College of Natural Resources Alumni Award

Roger Steinger received the Warner College of Natural Resources Honor Alumnus award on Oct. 26, 2016, at the Lory Student Center on the CSU campus. Roger (profiled in the 2015 edition of *GEOScape*) is, among other things, the current chair of the Geosciences Advisory Council, serves on the Warner College Dean's Council, and is the industry sponsor of our Society of Economic Geologists student chapter. He and his wife, LuAnne, have endowed the Roger and LuAnne Steinger Fellowship, which was awarded this year to Ph.D. student Nikki Seymour, profiled later in this newsletter.



*Great Sand Dunes National Park, Colo.*

## Student Highlights



*Elisabeth on the links with the CSU golf team (photo by Abbie Parr)*

## Elisabeth Rau, Geology Undergraduate

When I was 12 years old, my family took an excursion to Hawaii Volcano National Park. I distinctly remember driving and the road abruptly ending as a result of a lava flow. The sight enamored me, and my head filled with questions of the process that made this once passable road impassable. From that moment on, I was captivated by the Earth processes occurring around me. When it was time to make a college decision, the curiosity of my 12-year-old self pushed me to attend a university where I could pursue my interest in geology.

Growing up, I not only had an affinity for geology, but I also found my passion for the game of golf. When I was being recruited to play at the Division I level, I knew that I wanted to go to a school where I would be able to follow these two passions of mine while challenging myself academically in the

classroom. Colorado State University, a NCAA Division I school with an Honors Program and geology program, was the place for me.

As my time at CSU is coming to a close with my graduation in May 2017, I have been reflecting on my multifaceted involvements at this University. My experiences as an Honors student, as a student-athlete, and in the Department of Geosciences have each taught me something that will prepare me for life after graduation and my goal of a career in the petroleum industry.

Being a student in the Honors Program has given me the opportunity to challenge my view of the world through participation in smaller, discussion-based classes on topics distant from those found in the geology curriculum. My horizons

were broadened through lessons such as the importance and perceptions of everyday body movements and the benefits of studying history through the analysis of the life of Abraham Lincoln and the American Civil War. The unique topics and class opportunities provided by the Honors Program diversified my educational background.

While the Honors Program taught me the importance of expanding my intellectual reach, golf taught me important life lessons. From early-morning workouts, late practices, and competing on the collegiate level, an emphasis was placed on the importance of hard work and dedication. Through golf, I have grown in my decision-making abilities and learned to accept the consequences of my choices. I learned the importance of having a tenacious mindset and pushing through adversity. Ultimately, I grew in my understanding of the importance of teamwork and that each member must focus on their individual roles in order for a team to be successful.

As an undergraduate geology student, I am fortunate and grateful to be doing research and my Honors thesis with Dr. Lisa Stright conducting forward modeling of deep-water slope deposits in Chile. In this, I have been introduced to industry software such as RokDoc and Petrel and learned how to create geological models. Dr. Stright's infectious enthusiasm for her work only makes me more motivated and excited to be involved in this research.

Thinking back to my 12-year-old self, I not only can answer that little girl's questions about the lava flow across the road, but I can also answer questions about many other geologic processes. My supportive professors in geosciences fed my curiosity and guided me to ask important questions that will be my responsibility as a future geologist to answer. I found confidence in my geological abilities when concepts my professors taught us in class came to life at Field Camp this past summer. Having the opportunity to apply and observe geological

concepts at real field sites gave me the motivation and determination to continue down the geology path, and I am excited to next continue my geosciences education in a graduate program.

Being an Honors student, a student-athlete, and a geology major at CSU, has influenced who I am today and who I will be in the future. I not only learned didactic geological concepts through lectures and research, but I also had experiences that challenged me and helped me grow as a person. Having the opportunity to be involved in such unique aspects of the University shaped me into a well-rounded individual ready to take on the world after graduation. While the path to achieving my ultimate career goals in the petroleum industry will expectedly be grueling, I am excited to face the journey, because my time and experiences at CSU have, no doubt, prepared me.



## Nikki Seymour, Ph.D. Graduate Student

After completing a masters' degree at the University of Texas at Austin, I was admitted to CSU as the recipient of an Edward Warner Research Assistantship in the fall of 2015 to work with then-newly hired structural geologist, Professor John Singleton. My dissertation will focus on the rheological behavior and tectono-magmatic relationship of the Atacama Fault System, a 1,000-km structure in the Atacama Desert of northern Chile.

Although the system is one of the most important Andean Mesozoic structures and is two-thirds the length of the San Andreas fault, many first-order questions regarding the exact timing and magnitude of slip still have not been definitively answered.

In our first Chilean field season last January, we scouted locations along a central segment of the Atacama Fault System from Copiapó north to Taltal, looking for exposures that would provide us

the most information about the history and rheology of the fault system as a whole. We collected samples and analyzed zircon and apatite mineral separates to understand the timing of brittle and ductile deformation along the fault system.

We also used the newly developed garnet U-Pb chronometer to directly date iron oxide copper-gold-related skarn formation associated with the fault system. This winter, we will build upon our reconnaissance work and map three key areas to understand the along-strike variation in brittle vs. ductile behavior of the fault and how the location of the fault relates to the position of the Mesozoic volcanic arc. Based on our preliminary fieldwork, we are optimistic that this mapping project will also provide the first robust constraints on total displacement across the fault system.

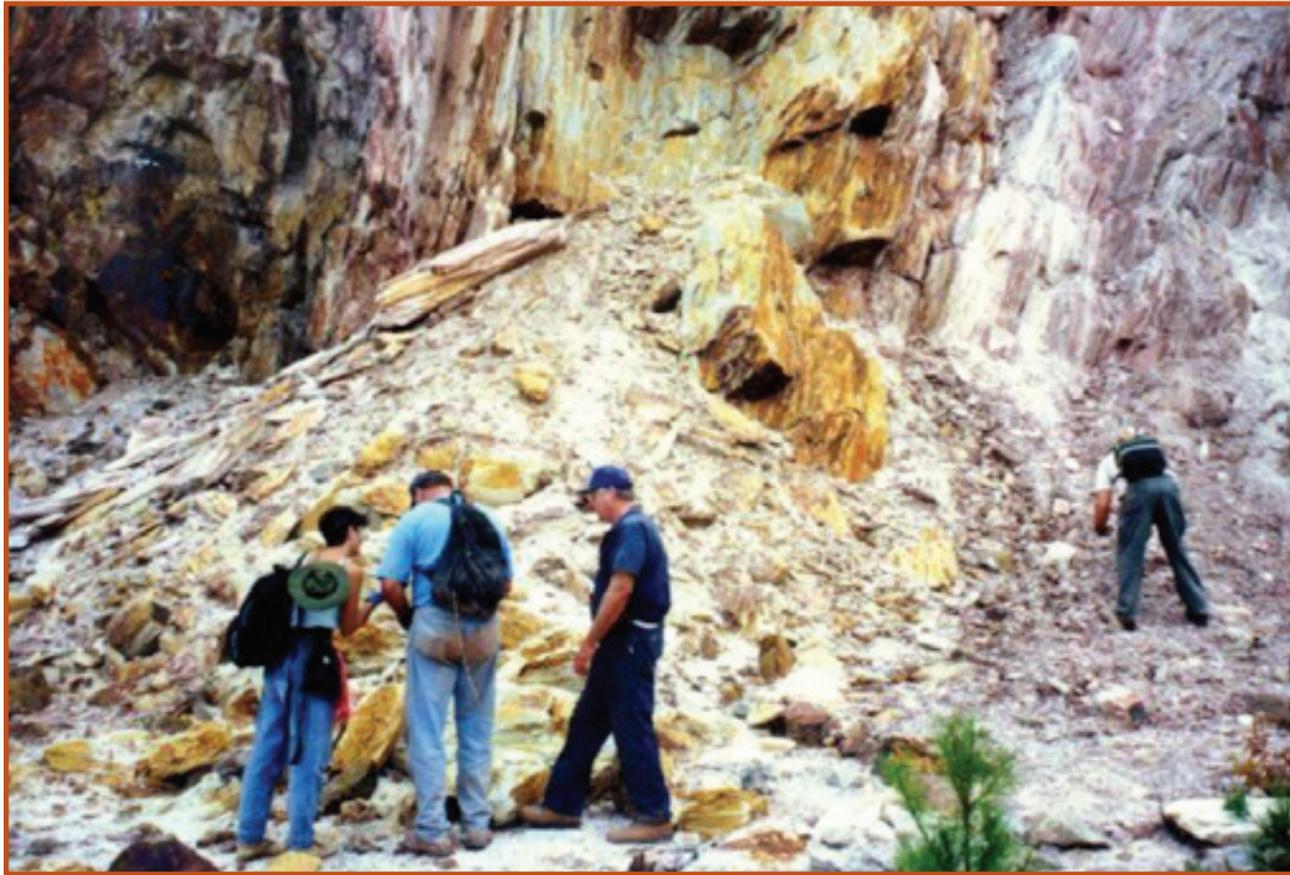
The Warner RA also provided me with the opportunity to work on additional projects in west-central Arizona with Singleton. Through detailed studies of fault kinematics, we have documented recent dextral strike-slip faults throughout the lower Colorado River Extensional Corridor. These faults are along strike with the northeastern margin of the Eastern California Shear Zone, and likely represent the diffuse influence of the North American-Pacific plate boundary as far east as Phoenix. I have also conducted Ti-in-quartz analyses on mylonites from several classic metamorphic core complexes to constrain temperatures of deformation.

These analyses support our interpretation of two distinct phases of mid-crustal extension in the region. Finally, I have also been involved with graduate student Evan Strickland's exciting new discovery of the Orocopia Schist in the Plomosa Mountains, a distinct unit that was subducted beneath North America during the Laramide Orogeny. Strickland's mapping and identification of key lithologies in conjunction with our detrital zircon work has identified the furthest-inboard occurrence of this schist, which has important implications for extent of Laramide flat-slab subduction and Cenozoic exhumation.

These next few years promise to be exciting, and I could not be more grateful for the incredible springboard that the Warner RA and Department of Geosciences has provided me during my first year as a Ph.D. student. ¡Salud!



*Nikki Seymour exploring a dextral fault in the White Tank Mountains of Arizona.*



2016 Geosciences Club rockhounding trip to a Lyons area pegmatite locale (photo by Garrett Brown)

## Geosciences Club Update

This year, the department expanded the activities of several student-led clubs to enhance student career development, build community, and encourage exploration of geosciences topics. The Geosciences Club serves as the umbrella organization for student club activities, which now include student chapters of the American Association of Petroleum Geologists and Society of Economic Geologists. We sincerely thank our student leaders and advisers for making this such a great year for advancing club activities.

Geosciences Club (president: Andy Auer, faculty Adviser: Sven Egenhoff) is a student organization that seeks to bring together students across geo-

sciences. The club provides activities and talks that cover a broad range of topics and expose students to mentors, career paths, and new opportunities. The club hosts biweekly meetings, often featuring guest speakers who are professionals with lifelong careers in varied geoscience specialties. Most recently, the club hosted talks by Chris Lidstone (M.S., 1981) and Larry Cope (M.S., 1989), as well as a number of graduate students to speak on their current research projects. The club works to foster community among undergraduate and graduate students within the department and also sponsors rockhounding trips, and museum and mineral show visits, and spearheads department involvement

in CSU community service events, such as Cans Around the Oval and CSUnity.

American Association of Petroleum Geologists Student Chapter (president: Adam Nielson, faculty adviser: Sven Egenhoff), re-activated in Spring 2016, provides additional avenues for geosciences students to develop and grow their awareness and involvement within energy and related disciplines. The club hosts industry speakers and is planning 2016-17 field trips and activity proposals to AAPG. Future plans include participating with faculty member Lisa Stright in the Imperial Barrel Award, a well-respected international competition for graduate students to test their knowledge, skills, and team collaboration skills using real industry data sets. The club is also pursuing opportunities for field trips to field locations, including drilling rigs, production facilities and possibly a refinery, to gain a better perspective on what this industry does and what it takes to provide energy to consumers. We'd very much welcome suggestions and opportunities from our alumni and industry friends to grow the club further.

The Society of Economic Geologists Student Chapter (president: Rocky Barker, faculty adviser: John Ridley, industry advisor: Roger Steininger), is a newly established department club aimed at students with interests in ore deposit and broader economic geology. The student chapter offers additional opportunities to meet like-minded professional geoscientists and gain experience and knowledge through field trips and guest lectures from industry and academic experts. The chapter is currently in the planning stages for a field trip to Utah, California, and Nevada with the purpose of visiting Zion National Park, Death Valley, and several large copper and gold deposits during 2017 spring break. The chapter welcomes lectures from invited guest speakers and plans regular meetings to discuss research plans and academic papers, and to organize events. SEG students note that they are very grateful for faculty member John Ridley and

Roger Steininger's sponsorship, making the chapter a reality.

We very much welcome alumni and other friends to address and inspire our clubs through mentoring/career talks, to mentor students individually, or otherwise become involved in club and chapter activities. Please contact the department office to connect (rick.aster@colostate.edu or jill.putman@colostate.edu). To further strengthen and support the speaker and mentorship activities of our clubs, please consider a donation to our Speakers and Visitors fund.





GEOL 150 field trip gauging the mighty Cache la Poudre River, Fall 2016

## Departmental Highlights

## Thinking About Landscapes Through Time Andy Darling, Research Scientist



*Andy Darling admiring the geomorphology on the Green River in Desolation Canyon, Utah. Darling arrived at CSU in 2016 as a postdoctoral researcher and instructor and is currently a research scientist in the department. He is a Colorado native and graduate of Colorado Mesa University (B.S.) before attending the University of New Mexico (M.S.) and Arizona State University (Ph.D.).*

I am a geomorphologist studying how rivers help form their surrounding landscapes over geological time. On the Colorado Plateau, many rivers drain the Rocky Mountains and flow through rugged canyon country. This landscape is the framework of most of my current research as well as vacation adventures. The combination of passions for studying landscapes and undertaking expeditions has led me to spend nearly a year camped along rivers on rafting trips thinking about how the canyons they have carved develop over long periods of time, as well as countless road trips and backpacking excursions.

John Wesley Powell, one of the first European-descended explorers of the canyons on the Colorado Plateau, said, "You cannot see the Grand Canyon

in one view, as if it were a changeless spectacle from which a curtain might be lifted, but to see it, you have to toil from month to month through its labyrinths."

For both scientists and explorers (are they really different?), the mystery of the Grand Canyon and the Colorado Plateau requires thorough exploration and inquisitiveness to decipher. Geologists have studied the Grand Canyon and its river for more than a century to unravel its story. We know a lot about the Colorado River system over the past 5 million to 6 million years as it evolved via tributaries integrating across former divides, tectonic activity altering the landscape, and an ever-changing climate that has oscillated discharge, vegetation, and

sediment. Many questions remain unanswered, of course, so the future is bright for new projects to explore this landscape and many other less-studied regions!

I hike mountains and canyons or raft rivers to look for patterns in how the erosion of a landscape is reflecting the history and driving landscape change. Erosion can be seen as the competing effects between drivers of landscape change such as tectonism and climate, and resisting factors such as rock strength. This work requires an appreciation of faults, folds, and epeirogeny as they relate to geophysical drivers and surface kinematics.

Dynamic rivers have a tendency to erase, as well as preserve, surface features that relate to tectonic and climatic changes, and so fluvial processes must be incorporated. Variable rock strength affects many aspects of erosion and has been a significant part of several projects. In general, I compare patterns in topography and erosion rates measured from (mostly) cosmogenic isotopes to numerical simulations of river and hillslope erosion to improve our understanding of landscape evolution.

For several years, I have also been interested in education research. I find that the ways of thinking and learning I use for studying landscape change in broad spatial and temporal scales are themselves interesting topics for research.

How do people learn to grasp complex series of events spanning millions of years? What evidence and research methods show progression of people's thinking from novice to expert in complex arrays of ideas? As a geomorphologist, I help develop what society learns about past events and their timing; as an education researcher, I am interested in exploring how people learn to assimilate those new ideas and incorporate them into their prior experiences and thinking. I find this duality of thinking about science and thinking about learning to

be mutually beneficial, because novel research is learning, and those of us who work at universities teach and learn on a regular basis.

Future projects include a new application of geochronology of volcanic ejecta found in small quantities in fluvial terrace deposits. The plan is to focus on Desolation Canyon of the Green River to collect material to try to date those deposits with a combination of new and previously used dating methods with several collaborators, mostly in New Mexico. Further, developing collaboration with colleagues at the University of Northern Colorado and the CSU mathematics department hopes to begin projects to research thinking and learning about mathematics in geoscience contexts.



*Horseshoe Bend Canyon, Ariz.*

# Classroom and Introductory Geology Improvements Around the Department

## Sean Bryan

Interest and enrollments in our Introductory Geology courses for non-majors continue to be very strong. This fall semester, 592 students took GEOL 120, the Introductory Geology lecture course, and 440 students took the GEOL 121 labs!

Over the past several years, it had become increasingly clear that the physical conditions of NR 336, the classroom used for the GEOL 121 labs, and NR 338, the next-door study room, had deteriorated to the point where they did not provide an optimal learning environment. (These rooms hadn't received serious attention since the 1980s). Those of you who took a class or served as a TA in NR 336 over the past couple decades might, for example, remember the notoriously low stools and benches, a loud ventilation system, and large lab tables that formed a barrier between the instructor and the students. The growing popularity of our introductory geology labs has also meant that these rooms are now in almost continuous use (hosting 25 lab sections for the nearly 450 students enrolled this fall semester).

During the 2015-16 academic year, the faculty and academic success coordinator, Jill Putnam, submitted a proposal to the University Facility Fee Advisory Board to renovate NR 336 and 338. We were excited to hear this spring that the proposal was fully fund-

ed, and the two rooms were thoroughly renovated over the summer with a new layout featuring new furniture, flooring, soundproofing, lighting, A/V equipment, and white boards. The aesthetic and functional improvements to the classrooms are dramatic. (See the before and after pictures!). The new movable tables have already proved to be very useful in reconfiguring the classroom for different lab setups, and the rooms are much quieter and provide a hugely improved learning environment.

We also made progress this year addressing the challenge of escalating introductory geology textbook costs while maintaining high-quality instruction. In GEOL 120 we adopted a free open textbook that is downloadable in multiple formats (<https://opentextbc.ca/geology/>), supplemented with an increasing number of available high-quality online geology resources, such as YouTube videos, online simulations, and popular science articles. In GEOL 121, we now use an in-house lab book, originally pioneered by Sara Rathburn. This also reduces costs to students, allows us to customize lab exercises, and takes advantage of our spectacular local geology. By printing on campus, we reduced the cost of the lab book to about \$15 and further increased our flexibility to update and adapt our lab activities.

In another big department classroom development, we redesigned and renovated our NR 320 teaching and seminar classroom. The new room has a much more functional and adaptable layout (with movable furniture and extensive white boards) that is already benefiting teaching, club events, and seminars.

## Before



## After



## Advances in Petroleum Geology

### Lisa Stright



*Lisa Stright teaching in the new NR 321 Visualization Laboratory.*

Petroleum geoscience is a longstanding strength of the department, and I'm happy to be reporting that, with my faculty colleagues, we have made some exciting strides in broadening and enhancing our research capabilities and teaching in this area.

Our focus in this area has recently been expanded with the 2015 creation of my faculty position specializing in petroleum geoscience, and the creation of a new in-department visualization and teaching laboratory in NR 321 for course, workshop, and research efforts in topics that include petroleum system characterization and modeling, geological and seismic stratigraphy, petrophysics, well logging, and high-resolution (structure from motion) visualization and analysis of outcrop data.

The Petroleum Geoscience Visualization and Modeling computer laboratory was completed in

January 2016. Prior to this, the room functioned as an aqueous chemistry laboratory, so extensive remodeling in late 2015 was undertaken to convert the room into a clean new classroom space incorporating 13 high-end computers (12 students and one instructor).

Each computer is loaded with Schlumberger software (a \$135 million-valued donation of Petrel, PetroMod, Eclipse, and Intersect software), Ikon Geoscience's RokDoc (a \$4 million-valued donation of RokDoc and Chronoseis), HIS (Kingdom Suite and Roxar), ArcGIS, Matlab, and Agisoft Photoscan, as well as useful open-source software packages.

The visualization laboratory desks are convertible, allowing the space to be interchangeably used for both paper- and computer-based exercises. The classroom also includes three large dry-erase

boards, a high-resolution projector, indirect and dimmable LED-lighting, and a LAN-wired network box that allows for multiple students to project their computer screens to the front board for sharing and comparing results.

This new teaching space will be integral to the delivery of several key senior to graduate-level petroleum-related courses, including Reservoir Characterization and Modeling, Petrophysics and Well Log Interpretation, and Petroleum Geology. These courses augment current strong department offerings in Shale, Sandstone, and Carbonate Sedimentology, Basin Analysis, Applied Geophysics, and Reflection Seismology and Sandstone Petrology. These petroleum-related courses will further advance the preparation of our graduates to be competitive for impactful research and careers. This spring, the teaching space will be used for the first time by a team of graduate students to propose drilling prospects as part of the AAPG Imperial Barrel Award competition (also mentioned in this newsletter in department club highlights).

The Visualization Laboratory is still in its early phase of realization. If you would like to further advance the department's educational and research activities in petroleum geology, please consider contributing to our Petroleum Geology Visualization Laboratory fund.

*Sally Sutton teaching in the recently renovated NR 320 teaching and seminar room.*



# CSU NPS Geologic Resources Inventory Staff Celebrate National Park Service's 100th Birthday

**Katie KellerLynn,  
Stephanie O'Meara,  
Trista Thornberry-Ehrlich,  
and Judy Hannah**

The National Park Service turned 100 on Aug. 25, 2016, and has been celebrating all year long! Research associates and interns, many of whom are department alumni (e.g., Jim Chappell, John Graham, Stephanie O'Meara, Trista Thornberry-Ehrlich, and James Winter), joined the festivities by completing geologic reports and digital geologic maps for the NPS Geologic Resources Inventory.

The GRI, administered by the NPS Geologic Resources Division with funding from the NPS Inventory and Monitoring Program, hosted within the geosciences department, is a cooperative program between the NPS and CSU. Since its inception in 1999, the program has employed several research associates, as well as funded 24 undergraduate and graduate GRI student interns to provide geologic information to support resource management and science-based decision making throughout the National Park System.

During the 100th-year celebration, Graham, Thornberry-Ehrlich, and Katie KellerLynn completed five detailed geologic reports in cooperation with the NPS Geologic Resources Division, detailing prominent geologic features and processes and how these relate to each park's purpose. Addressed this year were Aztec Ruins National Monument (N.M.), Colonial National Historical Park (Va.), Glen Canyon National Recreation Area (Utah), Ozark National Scenic Riverways (Mo.), and Santa Monica Mountains National Recreation Area (Calif.).

Past and present research associates and interns—O'Meara, Chappell, Ron Karpilo, Heather Stanton, Winter, and Derek Witt (now a graduate student working with Derek Schutt and Rick Aster), as well as NPS colleague Andrea Croskrey—compiled GIS data used in these centennial year reports.

The California Geological Survey, Canyonlands National History Association, New Mexico Bureau of Mines and Mineral Resources, a University of Colorado dissertation, U.S. Geological Survey, Utah Geological Survey, and Virginia Division of Geology and Mineral Resources provided source maps for the GRI. Associated GIS efforts focused on: Big South Fork National River and Recreation Area (Tenn., Ky.); Fire Island National Seashore (N.Y.); Fort Frederica National Monument (Ga.); Fort Point National Historic Site (Calif.); Gateway National Recreation Area (N.Y., N.J.); Gauley River National Recreation Area (W. Va.); Golden Gate National Recreation Area (Calif.); Governors National Monument (N.Y.); Great Smoky Mountains National Park (N.C., Tenn.); Hovenweep National Monument (Utah, Colo.); Muir Woods National Monument (Calif.); National Park of American Samoa; New River Gorge National River (W. Va.); Point Reyes National Seashore (Calif.); Rosie the Riveter WWII Home Front National Historical Park (Calif.); San

Francisco Maritime National Historical Park (Calif.); Santa Monica Mountains National Recreation Area (Calif.); Sitka National Historical Park (Alaska); Statue of Liberty National Monument, (N.Y., N.J.); and Vicksburg National Military Park (Miss.).

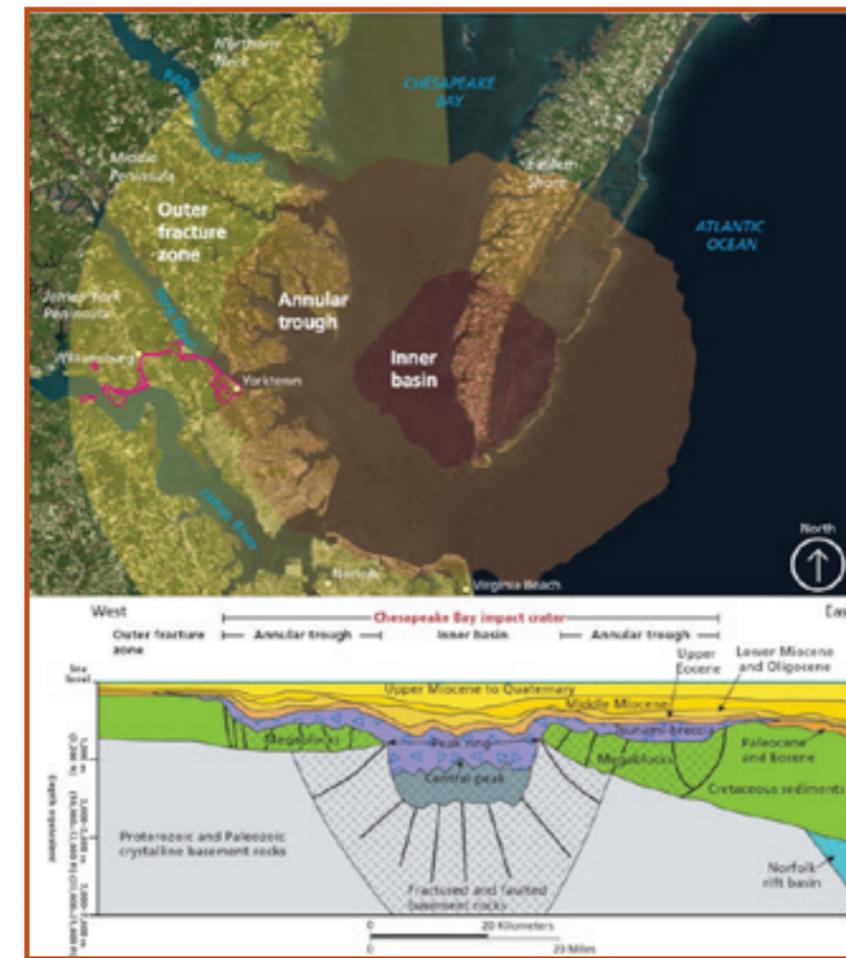
CSU research associates also worked with the American Geosciences Institute to develop a graphic for this year's annual Geologic Map Day poster. The graphic displays GRI digital geologic-GIS data combined with elevation data and imagery in Google Earth. Graphic text was derived from the GRI report for Mesa Verde National Park (John Graham, 2006, CSU research associate).

Lastly, to commemorate the NPS centennial, CSU research associates O'Meara, Karpilo, Chappell, Winter, and Georgia Hybels produced a poster, "Celebrate the National Park Service Centennial with 10 Fun Geology Facts." The poster was presented at several conferences, including this year's Geological Society of America annual meeting.

Additional information on GRI is available at <http://warnercnr.colostate.edu/geo-research/departamental-research/geologic-resources-inventory>, or at the NPS GRI webpage, <http://www.nature.nps.gov/geology/inventory/>.

All GRI reports and GRI GIS data are publicly available on the GRI publications website at <http://go.nps.gov/gripubs>.

Map and cross section of the Eocene (35.5±0.3 Ma) Chesapeake Bay impact structure (from GRI Colonial National Historical Park report; graphic by Trista Thornberry-Ehrlich).



# AIRIE Program Update

## Holly Stein

The AIRIE Program continues to be based entirely on soft money, all salaries and operation of the Re-Os laboratory. The petroleum industry purchased a second mass spectrometer for the program's CHRONOS project. In the last year, AIRIE funding has sponsored the research of two top-notch, award-winning, graduate students, Marisa Connors and Jenna Di Marzio, assuring that they present their results at international meetings. The first study to show that a single oil can be dated directly was published this year, spearheaded by research associate Svet Georgiev.

Research associates Gang Yang and Aaron Zimmerman continue to hammer away to make our analytical capabilities the best in the world, each sporting a technical publication of their own in the last year.

Research associate Rich Markey has a journal publication, deriving Re-Os isochron ages across a faulted section of organic-rich Upper Jurassic shale from a new Arctic petroleum discovery. Postdoc Nicole Hurtig has figured out why the Re-Os clock works in petroleum systems by doing experimental work, partly in the chemistry department. Her paper will be benchmark, as the "how and why" of the Re-Os chronometer in petroleum systems has been an intractable problem.

Vineet Goswami finished a paper on dating coals, and is working on Cretaceous cherts and chinks in eastern Denmark inclusive of the K-T boundary (bolide impact, demise of dinosaurs). Cretaceous chinks are a major reservoir rock for North Sea oil, and we have mapped the pre-impact and post-impact recovery of bryozoan reefs using Os (osmium)

isotopes. The AIRIE Program published 13 journal papers (seven in ore geology, not discussed here); an invited encyclopedia article with Springer (awarded best reference book in 2016 for geosciences); two papers are in press; and three papers in journal review. In 2015-2016, AIRIE personnel authored 27 abstracts, presenting at major conferences on four continents ([www.airieprogram.org](http://www.airieprogram.org)).

The hallmark of the AIRIE Program is its ability to work across broad disciplines in Earth science, chemistry, and biology. One of our papers is now being referenced in the biological/medical literature! AIRIE's work interfaces with biological and chemical processes that drive dynamic interactions within and between the atmosphere-hydrosphere-lithosphere. Interfaces between spheres are critical boundaries of transfer and disequilibrium. Professors Holly Stein and Judith Hannah continue to hold half-time appointments at CEED-University of Oslo, where there is an exciting environment for scientific exchange.





*GEOL 150 field trip to Lory State Park*

## Faculty Brief Notes

### John Ridley

The task that I found most inspiring this last year was putting together a talk with a geochemical focus (and with nothing on appropriation of guilt) on the Animas River (Gold King) spill of last year, based on my geological and ore deposit knowledge of the area and students' work there. What will happen in the future beyond our own lifespans? I have given this talk twice, to the New Mexico Geological Society and at a fall mining conference in Montana. Recent purchase of a TerraSpec Halo portable infrared spectrometer for use in the department and in field research and on field trips will, in particular, enhance research on the distribution and conditions of hydrothermal fluid flow in and around ores. No more guessing of clays and fine-grained white minerals in the field!

### Derek Schutt

The last year was both intellectually fun and full of adventure. Our NSF-funded work with Anthony Lowry of Utah State University has led to an interesting discovery on the relationship between U.S. plate strength and the water content of the lithosphere. We have presented the work at several meetings to some significant interest, and are currently writing up the first of several papers on the topic. Graduate student Ana Corbelan collaborated with CSU statistics Professor Jay Breidt to work on a new method of analyzing split shear waves, which tells about the flow in the mantle. Corbelan successfully defended her M.S. last spring (and we still miss her) but are excited that she has gone on to pursue her Ph.D. on marine geophysics at Dalhousie University. Graduate student Derek Witt has had a particularly busy year. While being a teaching assistant for two classes, he has also tackled the challenges of fieldwork in the remote Mackenzie Mountains of Canada in the NSF EarthScope Project that I am carrying out with Rick Aster, Joel Cubley (Yukon College), and Jeff Freymueller (University of Alaska). Thanks much to his hard work, and that of graduate students, undergraduate interns, and postdocs from CSU and elsewhere, the seismograph and GPS deployment went very smoothly (even in rainy conditions). At the same time, Witt is also following up on Corbelan's work and will present these results at the American Geophysical Union Meeting in December, 2016.



*Derek Witt installs a seismograph in the Mackenzie Mountains, Northwest Territories, Canada, Summer 2016.*

## Sven Egenhoff

My research group got even more international this year as I welcomed Aleksandra Novak, originally from Russia, as a new Ph.D. student. She will work on a project funded by Hess Corp. on carbonates in the Williston basin, North Dakota, and the location of hydrocarbon reservoirs within these Ordovician units. Nevertheless, the continued low oil prices kept my graduate student numbers down, and I am currently left with only four, one of whom has just defended his M.S. thesis. Oguzhan Kendigelen is working on the sedimentology of the Permian Lyons Formation. He will return to Turkey after this semester to start a job with the Turkish Petroleum Corporation, which sponsored his graduate work.

Although my students and I partly focus on the geology in the vicinity of Fort Collins, the Williston basin, and especially the Bakken Formation, continues to be at the center of my research activities: With one of my former M.S. students, Damien Borcovsky, we submitted a manuscript on the sequence stratigraphy of the upper Bakken Shale to *AAPG Bulletin* earlier this year and are waiting for its final acceptance. I also summarized the sequence stratigraphy of the middle Bakken member in a manuscript that is currently in review in *Marine and Petroleum Geology*. The new research on the Ordovician succession in the subsurface of North Dakota provides a great opportunity to broaden my horizon, learn about carbonate deposition in the early stages of intracratonic basin development, and enjoy another one of many, many stays in the now newly renovated core facility in Grand Forks.

My focus on research into shale depositional systems resulted in presentation at three international conferences this year, AAPG and GSA, and an SEPM research meeting in Santa Fe, N.M., on mudstone diagenesis. I will also present some new thoughts on mudstone deposition in an invited talk in Kansas next week and teach a workshop on mudstone petrology for the AAPG student chapter in Salt Lake City, Utah, in November.



*Sven Egenhoff examines samples in his core and sedimentology lab.*

## Jerry Magloughlin

My 2016 geo-adventuring started in the Midwest in early January. You may recall that the Mississippi River was flooding in Missouri/Illinois/Arkansas, so I took a general geo-photography/videography/drone-ography trip. The flooding was amazing, though a lot of the river was still confined between the master levees. I ended up getting a lot of good video and photos for my courses, including of some sand blows (acres in size) still visible(!) from the 1811-1812 New Madrid earthquakes. I flew our plucky departmental drone out over the floodwaters for some ultrahigh-definition video.

At the end of May, I again took our large Field Camp group, with three TAs for the first time ever, to New Mexico for the first 10 days of the course, before handing off to Bill Sanford. It was terrific to have, for the first time, department Field Camp scholarships to help students defray the cost of the course. In June, I started both GEOL 120 (at CSU) and the first offering of GEEOL 110, Introductory Physical Geology, online! Plans are to teach GEOL 110 several times a year. The course emphasizes the geology of U.S. parks and monuments.

In July, Linda and I went to Newfoundland to look at geology, whales, and coast. Although difficult to do in Newfoundland, I managed to get sunburned when the temps got into the 80s. In August, Mineralogy and Mineral Optics started, with a slightly smaller enrollment than the past several years. John Singleton and I organized and led the student GEOL 401 fall field trip, this time to the Black Hills (excellent weather), and (with Derek Schutt) I am conducting a fall seminar on ultramafic rocks. In September, it was fun to meet up and tour around with Ed Warner during our annual GEOL 232 visit to the massive Denver Gem & Mineral show, where I purchased many new specimens for our growing departmental collection.

I am continuing my research on fault rocks and probable high-pressure ultramafic rocks (with new graduate student Christine Almer) from the Washington Cascades, including fieldwork in October. I discovered a massive, recent debris flow (still “fluffy”) that led to new exposures of fault rocks. M.S. student Adrian Kahn is nearing completion of his thesis on fault zones in a small pluton, and Russell Thomas is making good progress on his thesis on a peculiar amphibolite from the Cascades. We’re getting clues that Russell’s rocks could be the hottest in the Pacific Northwest, while at the same time, my ultramafic rock research continues to turn up clues about previously unknown high-pressure metamorphism. Adrian and Russell both presented posters at GSA, where I had a nice time catching up with former M.S. students Doug Raszewski and Alan Koenig. I participated in a workshop at GSA on a fairly new technique that combines laser-assisted bulk chemical analysis with geochronology—a powerful new approach to micro-petrology that I intend to utilize soon.

I am looking forward to a short sabbatical in Spring 2017, including research trips planned to Chile (first time—Atacama Desert) and New Zealand (South Island). I should have available a new drone (love that technology), designed to follow me around for aerial moviemaking and photography applicable to both teaching and research.

*Jerry Magloughlin explores Ape Cave lava tube on the flanks of Mount St. Helens.*



## Sara Rathburn

A highlight of this year is the fascinating and diverse locations where I get to pursue research interests in drainage basin response to natural and anthropogenic disturbances with my graduate students. Maisie Richards evaluated river response to confinement and gravel extraction in Denali National Park and Preserve; Derek Schook used riparian vegetation to reconstruct flow history and climate change in the Yellowstone basin; Annette Patton established a chronology of mass movements in Rocky Mountain National Park; and Matt Sparacino monitored hydrologic changes resulting from a channel realignment on the Upper Colorado River, Rocky Mountain National Park. New student Johanna Eidmann is tracking ongoing sediment transport along North St. Vrain Creek following 2013 flooding. I also collaborated with visiting Italian Ph.D. student Francesco Mitidieri and postdoctoral fellow Georgina Bennett (co-host U.S. Forest Service) on several projects.

I continue to teach or co-teach Physical Geology for Scientists and Engineers, Historical Geology, and various graduate seminars. New this fall is a graduate course in Field Geomorphology that will become a regular course I teach. Additionally, I advised one undergraduate geology student in independent research, an Honors student in Historical Geology, and numerous geology undergraduates as field assistants or volunteers, providing them extra opportunities to glimpse geology outside of the classroom.

Finally, I was awarded the Gladys W. Cole Memorial Research Award at the 2016 Annual GSA Meeting in Denver to support my research on post-flood sediment, wood, and carbon flux into a Front Range water supply reservoir.



*Geology undergraduates helping with a constant injection salt tracer test on the Upper Colorado River, Rocky Mountain National Park, Colo., Fall 2016.*

## Sally Sutton

I continue to work on both mudrocks and sandstones, including a new effort focused on identifying targets for aquifer storage and recovery. With my graduate students and colleague Tom Sale in civil and environmental engineering we have begun looking at the potential of ASR in local sedimentary strata. My students, Daniel Collazo and Adam Adam, are integrating well data with geologic information and permeability information to identify possible storage targets. New student Amanda Doherty plans to do geochemical modeling of rock-water interaction that might occur with injection of fresh water for storage. Ahmad Issa is exploring diagenesis of the Ingleside, a study that could contribute background information to our understanding of permeability in that unit.

Currently, I am working on putting together a new course in sandstone petrology, while continuing to teach Sedimentary Petrology, Sedimentary Geochemistry, and Modern Gas and Oil, a course taking a broad approach to understanding technical, social, and political aspects of oil and gas development.

## Mike Ronayne

A major activity for my research group this year has been our continued study of the hydrogeology and groundwater resources in the Denver Basin. In September, Cat Cannan defended her thesis on the influence of subsurface heterogeneity during aquifer storage and recovery in the Denver Basin. Cat is now employed as a hydrogeologist with Lidstone and Associates and has been working on several projects throughout Wyoming. Garrett Brown (B.S., hydrogeology student) is assisting with piezometer installations and stream bed measurements that will be used to quantify preferential recharge from alluvial channels south of Denver. Daniel Shugert (natural resource management major) is mapping depth to water and spatially distributed pumping rates as part of a new project to investigate the energy cost of groundwater production in major sandstone aquifers of the Denver Basin.

Gavin Rach (M.S., geosciences) recently joined my group to work on the hydrologic impacts of open-pit aggregate mining along the Colorado Front Range. On the teaching front, I am offering a new graduate-level geostatistics course this semester. The course covers spatial data analysis, spatial estimation, stochastic simulation, and uncertainty analysis, and is keeping me very busy as a first-time offering!

## Bill Sanford

I am continuing my research on the flow and transport of nanoparticles through porous media. This includes a new initiative working with Cornell University and a Norwegian research group on designing an extensive field test program using multiple tracers in fractured rock. The proposed research site is on CSU's Foothills Campus. In addition, I received funding from the U.S. Forest Service to quantify baseflow to streams in various geologic settings in the Medicine Bow-Routt National Forest.



*Bill Sanford with CSU design and merchandising department nanoparticle collaborator, Yan (Vivian) Li.*

## Dennis Harry

Major accomplishments during the past year include overseeing the graduation of M.S. students Chris Wenman (working on a stratigraphic model of subsidence in the West Antarctic Rift System) and Brad Sparks (co-advised with Ellen Wohl, working on a near-surface geophysical study of Sand Creek in southeastern Colorado). I have also been occupied with revisions of my classes in Subsurface Mapping and Applied Geophysics, with the focus being on better integration with other new classes into our growing petroleum geosciences curriculum.

Research accomplishments include completion of a plate reconstruction of the Gulf of Mexico (collaborating with M.S. student Phil Eskamani and Ph.D. student Sumant Jha), completion of a new software tool for analysis of isostasy in flexural basins (the work of Jha), and initiation of a new research focus on feedbacks between magmatism and continental rifting.

## Ellen Wohl

My highlights for the past year include continued work on large wood dynamics and organic carbon storage along river corridors in the Western U.S.

Ph.D. student DeAnna Laurel finished her fieldwork, which involves characterizing changes in soil carbon storage, surface spatial heterogeneity, and stream flow attenuation with time after beaver meadows are abandoned by the beaver. Ph.D. student Katherine Lininger, who has been doing her dissertation work on floodplain carbon storage along the central Yukon River in Alaska, received supplemental funding from the National Science Foundation and CUAHSI to examine floodplain carbon storage along managed rivers in northern Sweden.

M.S. student Andrew Pfeiffer measured wood and organic matter storage throughout the North St. Vrain Creek watershed in Rocky Mountain National Park. Ph.D. student Dan Scott quantified longitudinal distribution of large wood and floodplain soil carbon from the headwaters to the base of the mountains in watersheds of Washington's Olympic Peninsula and Wyoming's Wind River Range. All of these students presented their preliminary results at the annual GSA meeting in Denver, where Lininger's work was featured on the website of *Nature*. Sara Rathburn and I hosted the 47th annual Binghamton Symposium in Geomorphology at CSU, which this year focused on connectivity. We're still resting and recuperating from that.

These photos illustrate a different form of connectivity than we usually think about. This is from a time-lapse camera that Scott has set up to monitor logjams in Rocky Mountain National Park. The camera recorded numerous animals crossing North St. Vrain Creek, day and night, using the logjam as a bridge.



## John Singleton

2016 has been a fun year for geologic research. In January, I started a new project on the Atacama fault with Ph.D. student Nikki Seymour. We are investigating the slip history and rheological evolution of this fault zone, which extends for about 1,000 km across the early Cretaceous magmatic arc in the Coastal Cordillera. We had a great reconnaissance field season that has laid the groundwork for a long-term research project and collaboration with Chilean geologists.

This January, we are returning to the Atacama Desert with new M.S. student Rachel Ruthven and Jerry Magloughlin for some detailed field mapping. I have also been re-energized with research in western Arizona through M.S. student Evan Strickland's work. Strickland has been mapping the northeastern-most exposure of the Orocopia Schist, which was subducted beneath the North American Plate during the Laramide Orogeny. The presence of this unit within previously thickened crust more than 500 km from the plate boundary has important implications for the geometry of the Farallon slab and synconvergent exhumation during the Laramide Orogeny. This September, Magloughlin and I led the GEOL 401 field trip to the Black Hills and Badlands, S.D. Everyone had great time, and I am hoping to start a new research project in the Black Hills next year.



Grad students Rocky Barker, Evan Strickland, Alexandra Racosky, Rachel Ruthven, Nikki Seymour, and Marissa Fichera in the Black Hills during this year's fall department field trip, led by John Singleton and Jerry Magloughlin.



November 2016 field trip to the newly discovered Orocopia Schist unit in the Plomosa Mountains. The field trip was led by CSU M.S. student Evan Strickland (front center), CSU Assistant Professor John Singleton (back center), CSU Ph.D. student Nikki Seymour (purple shirt, on left), and CSU alumnus Andrew Griffin (class of 2016, blue shirt on right). Field trip participants included geologists from the USGS, Arizona Geological Survey, Arizona State University, University of Nevada Las Vegas, and University of Arizona. The group is centered around a 2 m-long block of metasomatized peridotite encased within quartzofeldspathic schist that was subducted during the Laramide Orogeny.

## Rick Aster

Ph.D. student Nicole McMahon, working with colleagues at the USGS National Earthquake Information Center, made exciting strides this year in the detection and processing of swarm and aftershock seismicity, including a high-resolution relocation of the aftershock seismicity from the remarkable Prague, Okla. (M 5.7), earthquake of 2011. She is also applying her new seismic methodologies to studying sub-icecap swarm seismicity in the volcanic Executive Committee range of west Antarctica as part of the ongoing POLNET project. Ph.D. student Michael Baker (doing fieldwork in Antarctica as I write this) and postdoc Julien Chaput are looking at a totally new type of seismic data – two years of recording by a 34-station state-of-the-art seismic network spanning of the (Texas-sized) Ross Ice Shelf. The RIS network of floating seismographs (the ice shelf and underlying Ross Sea water column are each hundreds of meters thick) has produced nearly two years of outstanding and unique data (replete with never-before-seen types of seismic signals) that will newly inform us on both the ocean/glaciological excitation and stability of the shelf and, especially during times of the year when the sea ice muffles signals from the ocean, the deep structure of the Antarctic continent (applying earthquake tomography methods). Student Rob Anthony expects to complete his Ph.D. thesis in Antarctic seismology and fluvial seismology this fall, and is looking forward to beginning a prestigious USGS Mendenhall Postdoc at Albuquerque Seismological Laboratory in early 2017.

This July, we also had a successful (although rather wet and sometimes buggy) deployment of seismographs along the remote Canol Road in the Yukon for the Mackenzie Mountains EarthScope project. Chaput, Baker, Anthony, and Derek Witt, as well as our Canadian and Alaskan colleagues, all played key roles.

I've recently begun work with my co-authors (Brian Borchers from NM Tech and Cliff Thurber from the University of Wisconsin) on a third edition of my *Parameter Estimation and Inverse Problems* textbook, and will be testing new material in the department as I teach GEOL 579 (Solid Earth Inverse Methods and Practices) in the spring semester.

Other projects this year included working closely with the Incorporated Research Institutions for Seismology on a community facilities proposal that, if funded, will underpin seismological research for the next 10 years in the U.S. Looking forward to next year, I will be leading a one-week international Glacial Seismology School to be hosted here at CSU this coming June with around 30 students and 10 international colleagues.



Rob Anthony and Rick Aster in Antarctica near McMurdo Station and Mount Erebus volcano.



Michael Baker installs a Yukon broadband seismograph, July 2016.

## Dan McGrath

I've had an exciting year developing collaborations and starting new projects! I once again enjoyed teaching Geology of the Environment last year and worked to increase the experiential-learning component of this large introductory course. In addition, this fall I'm teaching a new seminar in the Honors Program, focused on climate change.

On the research front, I completed exciting fieldwork examining the geomorphic impacts of glacial lake outburst floods in Patagonia, Chile, with colleagues from the University of Nevada. I also started a new National Park Service-funded project measuring the mass balance of perennial snowfields and glaciers in Rocky Mountain National Park with a number of collaborators in Warner College. This spring, I'll be participating in two field campaigns, first as part of NASA's SnowEx seasonal snow experiment in Grand Mesa, Colo. and later, monitoring glacier mass balance in Alaska with USGS colleagues. I was very pleased to have my 2015 *Journal of Geophysical Research* paper, "End-of-winter snow depth variability on glaciers in Alaska" honored this May with the Warner College Outstanding Publication Award!



*Dan McGrath (Left) and Dominik Schneider, of the University of Colorado (Right), conducting an ice-penetrating radar survey of Andrews Glacier, Rocky Mountain National Park, in Spring 2016.*

# Department Honors

## 2016 Faculty and Staff Honors

**Jerry Magloughlin:** The Warner College of Natural Resources Outstanding Service Award

**Dan McGrath:** Warner College of Natural Resources Outstanding Publication Award

## 2016 Student Honors Undergraduate Students

**Jay Merrill:** The Philip A. Connolly Memorial Scholarship

**Amanda Eddleman:** The Clinton H. Wasser Scholarship and The Salonee Kharkar Memorial Scholarship

**Brian Longstreth:** The Charles E. Beverly Memorial Scholarship and the D.R. and Virginia Pulliam Scholarship

**Rachel Toler:** The Charles E. Beverly Memorial Scholarship and the D.R. and Virginia Pulliam Scholarship

**Kevin Ramm:** The Roy G. and Ruth K. Coffin Memorial Scholarship

Geology Field Camp Scholarships:

**Joey Linder**

**Maddi Egger**

**Jay Merrill**

**Rylan Rudebusch**

**Miranda "Andy" Auer**

**Lonnie Justin Hufford**

**Dalton Meyer**

**Rachel Toler**

**Garrett Brown**

**Audra Lorton**

**Kyle Mori**

**Breanna Van**

**Breanna Van:** The John and Dolores Goodier Scholarship

**Michael Wyatt:** The David V. Harris Memorial Geology Scholarship

**Dalton Meyer:** The Chris Lidstone and Kate Laudon Scholarship, and the Philip A. Connolly Memorial Scholarship

**David Herman:** The Undergraduate Explorationist Scholarship and the Leon H. and Katherine Rust Hurd Scholarship

**Trevor Miller:** The Undergraduate Explorationist Scholarship

**Jeremy "Til" Tullis:** The Ernest and Bernice Dice Scholarship



# Department Honors

**Josephina Blue:** The Thomas A. and Anne L. Shepard Diversity Scholarship

## Graduate Students

**Dan Scott:** Warner College of Natural Resources Outstanding Master's Thesis Award

**Derek Schook:** The Oscar and Isabel Anderson Graduate Fellowship

**Matthew Sparacino:** The Hill Memorial Fellowship and the Evelyn I. Clark Graduate Scholarship

**Daniel Collazo:** The Thomas A. and Anne L. Shepherd Diversity Scholarship and the Joby Adams Geosciences Graduate Scholarship

**John Hammond:** The Lary Kent Burns Memorial Scholarship

**Anna Pfohl:** Joby Adams Geosciences Graduate Scholarship and the WCNR Graduate Fellowship

**Phil Dalhof:** The McCallum Mineralogy and Petrology Graduate Scholarship

**Andrew Pfeiffer:** The Marie Morisawa Graduate Fellowship, and the Hill Memorial Fellowship

**Katherine Lininger:** The Schumm Graduate Scholarship

**Nikki Seymour:** The Roger and Luanne Steininger Fellowship

**Garrett Brown:** The Robert L. Stollar Scholarship in Hydrogeology

**Annette Patton:** The Ware Geosciences Fellowship and The Edward M. Warner Graduate Research Assistant fund

**Andrew McCarthy:** The Edward M. Warner Graduate Research Assistant fund

# Department History

We continue to update the department history, building on the document initiated by David Harris, Jack Campbell, Bob Johnson, Frank Ethridge, and Don Doehring. Please check out the latest edition by clicking the link on our department homepage (<http://warnercnr.colostate.edu/geosciences-home>) or at <http://warnercnr.colostate.edu/docs/geo/GEO%20HISTORY-CSU-UPDATE-5-24-2016.pdf>. We certainly welcome additions or corrections!

# 2016-17 Development Priorities



*2016 Field Camp students enjoying northern New Mexico somewhere near Taos.*

## Field Camp Scholarship Fund

This fund is being developed exclusively to provide undergraduate scholarships to geology majors to reduce tuition in our intensive five-week Field Camp course. A generous donor has recently provided 1:1 matching funds for 2016-17 donations. Please consider contributing to this fund this year (and have your contributions doubled!).

## Geosciences General Fund

Broadly supports department activities and improvements.

## Geosciences Experiential Learning and Field Studies Fund

Specifically supports field trip and other field education efforts across the department.

## Speakers and Visitors Fund

An important element of an internationally engaged department is the ability to host visitors of all varieties to enhance our mentoring, educational, and research activities. We are building a fund to support career and mentoring speakers at our Geoscience Club events, to give department seminars, and to visit the department for longer (e.g., multiday through sabbatical year) periods. Visitors to our department are critically important to enrich both our teaching and research activities and to more generally spread the word outside of CSU about exciting developments within the department.

## Petroleum Geology Visualization Laboratory Fund

To further build our activities in petroleum geology, including continued development of the Visualization Laboratory (please note Lisa Stright's highlight in this newsletter), we seek individual or corporate donations to continue to upgrade our petroleum geology computer, software, and other facilities and activities. If you would like to contribute firsthand to strengthening these programs, kindly consider a donation in this area this year.



# Special Thanks to our Supporters

A very special thank-you to donors who have invested in the department's success in 2016.

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

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**We sincerely thank the many, many CSU Geosciences community friends that contributed financially, in student mentoring, in volunteer activities, and other critical contributions to the department this year.**

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Harold Pranger  
Jon Robbins  
Roger Steininger  
Bob Stollar  
Tara Tafi  
Tommy Thompson  
Ed Warner  
Cindy Williams

Thanks to the Geosciences Advisory Council for their continued guidance, support, and leadership in making the department an international leader in geosciences research and training geosciences professionals.

A special thank-you to Ed Warner and Jackie Erickson for broad and continued support to the geosciences department and the Warner College.

**GEOscape - 2016**

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