

Geology and Geological Engineering

College of Earth Resource Sciences and Engineering



December, 2014 Volume XXV

Welcome from Berthoud Hall!

In an effort to update and beautify our conference room, a student photo contest was held. Above are the winners now proudly hanging in the room. Left to right: Andrew Graham - Eduardo Avaroa Andean Fauna National Reserve, Michael Bortnowski with two winners - Entrance of "The Narrows" Zion National Park, UT, and Delicate Arch Viewpoint Area - Arches National Park, UT, Connor Wallace - Molas Pass, San Juan Mountains, Colorado.



There is a lot going on in the Department, as you will read in the following pages, but I want to highlight some of the bigger things in the

following paragraphs. As always, one of the constant themes is "change," which seems to happen whether we want it or not! However, change also gives us a chance to evolve, advance, and evaluate what we do and how we do it. You will read about the efforts in our quest to better educate our students, better support our faculty, and better advance the reputation and quality of the department. In addition, we have decided to include a focus in this issue on our undergraduate curriculum, to give you a sense of how the pieces fit together and how geoscience education has evolved since your days wandering the halls of Berthoud.

My favorite story from 2014 was the graduate student recruiting experience at the annual GSA meeting in Vancouver last fall. I arrived at our table

a few minutes late, coming directly from another meeting, to find a line of interested students waiting to talk about Mines. I barely moved for the next four hours, as a steady stream of prospects asked about our faculty, research, classwork, and industry connections. A colleague at another university across the aisle later told me that he was walking the exhibit hall to find prospective students to talk with, but our booth was unusual because of the level of interest and large number of students. We clearly have a product that is in high demand!

Another great success from 2014 was our inaugural ConocoPhillips Department Research Fair in February. This event drew over 150 people, with 47 of our students presenting posters.



Judges came from industry, academia, and government agencies. Thanks to ConocoPhillips sponsorship, we had ample food, beverages, and substantial prizes for the students. Even better, 37 of

these students went on to present their work at the campus research fair two weeks later, with GE supplying 24% of their entrants. Congratulations to our grand prize winner, PhD candidate Jane Stammer (advisor David Pyles).

Our Geology Enhancement Committee, a group of dedicated and generous alumni, has been very active on our behalf this year. We placed before them the challenge of replacing our Scanning Electron Microscope, with a plan to develop a world-class Mineral Characterization Laboratory. Through the efforts of Drs. Thomas Monecke and Katharina Pfaff, we will leverage an opportunity to get both a field emission SEM and a new TIMA3 quantitative mineral analyzer (to replace our QEMSCAN). The fund-raising was stunningly successful and we expect to purchase these instruments within the next month.

Another wonderful source of funds this year is a new endowment from John and Carolyn Mann, with which we are initiating an undergraduate research program, purchasing equipment, supporting student field trips and professional society trips, creating a PhD "Mann Distinguished Fellows" fund, and offering competitive research grants for students.

We continue to be ranked as the 25th best earth science graduate program by US News and World Report. Even better, our quality is reflected by our graduates. We have over 180 graduate students, and 150 declared undergraduate majors. Once graduated, 90% of our BS graduates have jobs or graduate school lined up within a short period after graduation, and that number increases to 97% for our MS graduates and 100% for our PhD graduates. We expect the market for petroleum geologists to soften with the drop in oil and gas prices, but Mines is still one of their main recruiting sites.

The department is lucky to have a few great new additions. Cheryl Medford has stepped into Marilyn's role as administrative assistant, and her steady demeanor and versatile talents keep us running smoothly. Dr. Lesli Wood arrived in January 2015 as our new Robert J. Weimer Distinguished Chair in Sedimentary and Petroleum Geology. She brings an expertise in quantitative seismic geomorphology, submarine mass failures, and several aspects of petroleum geology. Dr. Alex Gysi joined us in the fall as a lithogeochemist, with skills in fluid-rock interaction, hydrothermal ore deposits, and chemical thermodynamics. We are excited and grateful for these new folks, and we love what they bring to the department. On the sad side, several folks have retired or left for other opportunities. Jerry Higgins has entered a transitional retirement in the summer, but will continue to teach for us for a few years. Assistant Professor Nigel Kelly has accepted a research position at CU-Boulder and Teaching Assistant Professor Elizabeth Holley has accepted a tenure track position in the Mining Engineering Department. Research Professor David Pyles has accepted a position with EOG Resources (so we are actively searching for a research professor to manage the Chevron Center of Research Excellence). Finally, the department is in the midst of a search for a new engineering geology faculty member who will also be part of the new Underground Construction and Tunneling program on campus.

On the topic of personnel, our faculty are truly exceptional – here are but a few examples of their roles and awards. Murray Hitzman was awarded the 2014 Daniel C. Jackling award from SME "For his outstanding achievements in mineral deposit research, his discovery of significant mineral deposits, his remarkable teaching and mentoring abilities and his leadership in professional societies related to mineral deposits." Donna Anderson was awarded an AAPG Distinguished Service Award. John B. Curtis received the 2014 Public Service Award of the American Association of Petroleum Geologists. Professor Emeritus Keith Turner was given the

2014 Schuster Medal by the Association of Environmental and Engineering Geologists and the Canadian Geotechnical Society. Kamini Singha's McBride honors class was profiled in the Denver Post on February 18.

As always, our alumni and industry partners are a huge part of our success. Your donations give us the resources to provide top-flight educational experiences for our students, with access to equipment and computing resources. These funds pay for field trips, attendance at professional meetings, scholarships and fellowships, research, field camp equipment, Van Tuyl and other special speakers, and much, much more. As I tell anyone who will listen: many geoscience departments are struggling simply to survive, but you have given us the ability to thrive. Thanks for your commitment and confidence in supporting what we are doing!

There is a strong sense that we are moving forward, in a positive direction, and this issue will tell you about many of the exciting developments underway. Please accept our best wishes to you and your families for a safe, healthy, and prosperous 2015. Please visit us, send an update on your life and career, or call to say hello.

Paul M. Santi
Department Head

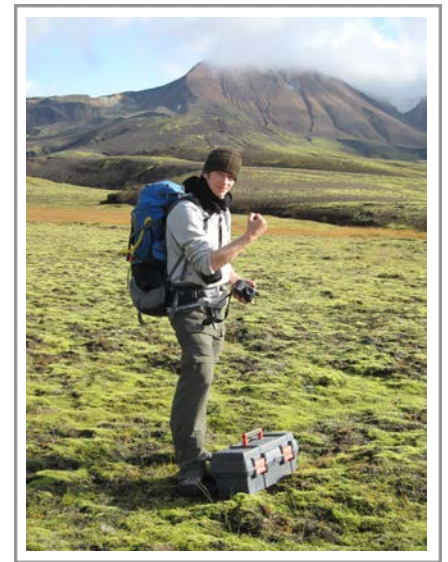
How did I become a Lithogeochemist?

Alexander Gysi

I am glad to have joined the department of Geology and Geological Engineering in August 2014! I specialize in the study of element mobilization during hydrothermal fluid-rock interaction in the crust. Give me a rock and a problem; I will try to solve it using numerical modeling, my new shiny experimental lab or fieldwork as natural laboratory. My research bridges the gap between metamorphic petrology, mineralogy and aqueous geochemistry. I am on a mission to build up my crustal fluid-rock reaction research group and want to give the students the opportunity to do cutting edge research and have lots of fun at the department. I also plan on organizing excursions in the near future, including the study of pegmatites and alteration in active/fossil geothermal systems.

I grew up in the Swiss Prealps at the heart of the fondue land. As a M.Sc. student, I went to ETH Zurich and discovered my passion for petrology/mineralogy and was also a hobby volcanologist, and I loved field excursions. For my Ph.D., I moved to Iceland where I got experience in aqueous geochemistry with an international project on CO₂ sequestration at the University of Iceland in collaboration with the geothermal industry. I developed my lab skills and also discovered my interest for thermodynamics and numerical modeling. Still, I had many outdoor moments and got to sample hot springs, carbonate springs, fumaroles and organize a field excursion to the Geysir area. Last but not least, I witnessed the Eyjafjallajökull volcano eruption live.

I then caught my next flight to Canada, where I worked as a Postdoctoral Fellow at McGill University. I discovered a new passion: hydrothermal-magmatic ore forming systems and rare earth elements (REE). I



Field sampling trip of carbonate springs surrounding the Torfajökull rhyolitic stratovolcano located in the South of Iceland.

realized, that besides my obsession for technology, our society might benefit from using REE for an environmentally sound use of energy. A stepping-stone was set and economic geology was added to my list. While I was on the verge of connecting the dots of my research path, I heard about a new position at Mines advertised as Assistant Professor in Litho geochemistry. So I flew down with my wife to Colorado and was immediately fascinated by all the outcrops surrounding Golden and the fantastic people at the department.

Thanks for your welcome!

Life is too Short to be Boring

Lesli Wood

I am a geologist, but anyone who knows me knows that I play music. My band The Spice Boys and I have played a lot of venues in and around Austin, Texas over the past 18 years, where I worked as a Senior Research Scientist at the University of Texas. In January, I started my new gig as the Robert Weimer Distinguished Professor of Sedimentology and Petroleum Geology. The move to Golden will be accompanied by the band's fourth appearance at the AAPG ACE meeting June 1. My band loves to play, what they call "the oily people", and I love to play music. It is something so different from doing geology, but not that different from lecturing geology. Just like music, geology can be boring or fascinating, it is how you present it to the audience that matters, and I enjoy that stage.

There is this Metallica song where Lars Ulrich says "What is it you think you're gonna find? Boredom sets into the boring mind." Although I am not a big Metallica fan, I like that quote. I have always felt that life was too short to be boring or bored. If I am boring myself, then I am sure that I am boring other people, so I try never to bore myself. One of the ways I do this is through music which you can find at <http://hazelberrymusic.com/>. I have two albums out of original songs. You can download them on iTunes or at CDBaby. I try to play with my band at least a half dozen to a dozen times a year. I need to learn the piano, but the guitar is easier to carry. Besides, my pig likes the guitar. Yes, we have a Pot Belly Pig named Bartley. He is the ultimate miner, able to dig up a stretch of ground in record time. It is amazing. Mostly placer mining, but I would not put it past him to

don a hard hat and grab a pick, or knowing Bartley, he will be blasting. Bartley makes the big move to Colorado at the end of March, along with my two Australian Heelers and something we affectionately call "The Chiweenie", Frankie. All the children, along with my patient spouse of 27 years, Sue, will haul into a rented van and drive 14 hours to Colorado so their mom/spouse can assume the job of a lifetime at one of the greatest schools in the world. They recognize it as an opportunity of a lifetime and I could not be more grateful for their support.

I was a junior in high school when I chose geology as a major in college at Arkansas Tech College in Russellville, Arkansas. I went to the University of Arkansas for my Masters degree (probably where I acquired my love for



Playing a great venue up in southern Connecticut.

Razorbacks), then on to Colorado State University in Fort Collins for my PhD where I had the good luck to be supervised by Frank Ethridge and Stan Schumm. I came to appreciate geomorphology and, when I joined Amoco in 1992, they were just at the initiation of a revolution in paleo-landscape imaging through development of coherency and spectral decomposition. I continue to this day to do research in seismic imaging of landscapes, quantitative seismic geomorphology, martian deltas, deep water landslides and sedimentation processes and fluvial/deltaic/shallow marine sands and reservoir systems. I have had the good luck to supervise over 45 graduates, do field work in Barbados, Trinidad, and all over the U.S. as well as work spectacular 3D seismic data in basins all over the world, from Indonesia to India to Morocco to New Zealand and the offshore U.S., as well as other margins. I travel, do geology, get engaged in all manner of racing because of my spouse, spend a lot of time now thinking about how to keep a Chiweenie from being someone's supper, and I like to keep a blog. It lets me express myself about things that few people care about, but at least I can get it out there. It is at <http://worldofroc.blogspot.com/> if you really want to know the smallest opinions in my head.

Lou Holtz, just the greatest Razorback coach of all time said, "If you're bored with life – you don't get up every morning with a burning desire to do things – you don't have enough goals." I have achieved one of my lifetime goals with my move to School of Mines, and I want to thank everyone who contributed to make that position possible. We might have to celebrate with a party. There will be music...and a pig.

It was 20 years ago today...



- | | | |
|------------------|-----------------------|------------------------|
| 1. Kendall Hovel | 6. Brett Byler | 11. Keith Woodburne |
| 2. Brad Woodard | 7. Harold Hutson | 12. Amy Johnson |
| 3. Jay Davenport | 8. Mike Berry | 13. Barry Gaston |
| 4. Pam Kimmel | 9. Michael Craig (CU) | 14. James Barron |
| 5. Kevin Creel | 10. Kerry Aggen | not shown: Moose Hofer |

Where are they now?

MUSEUM NEWS



Geology Museum Musings

Bruce Geller, Museum Director

My seventh year directing the Museum has seen a record number of guests and Gift Shop sales. Brianna Svoboda (GE '14 and current grad student), compiled our attendance data from 2014, showing over 37,900 guests (which is 64% over 2013). Guests came from every state, 45 foreign countries, and six continents. Over 79% of our guests were first-time visitors.

I'm proud to announce that as of this writing, we are ranked by Tripadvisor.com as the #2 tourist attraction in Golden, in terms of visitor satisfaction, out of 25 Golden attractions, and were again awarded their Certificate of Excellence. This year we also were awarded the Golden Living Landmarks Award. These resulted from the help

of our Advisory Council, Student Aides, staff, Friends of the CSM Geology Museum (FCSMGM), volunteers, and support from donors, specimen loaners, visitors, visiting researchers, CSM faculty, administrators, and students.

The Advisory Council has met monthly and steered the conservation of our six Hoffman mining murals, which have been rehung in their new location on the west wall of our main gallery (see photo on facing page), and they look magnificent. They were also professionally photographed and appraised. This project is nearly complete except for the installation of additional LED lighting fixtures.

Another fairly large project was expanding our Gift Shop. The Advisory Council along with Bryan Lees (GE '85, B.S.) and an anonymous donor supported our ten-page spread in the Mineralogical Record's "Mineral Collections in Colorado" supplement (available for purchase in our Gift Shop). At this point, nearly all of our upstairs displays are illuminated by LEDs and we hope to convert our entire basement to LEDs by this summer.

I held weekly meetings with our Collections Managers and volunteers. These folks ran our Book/Mineral Sales and have been busy keeping our Gift Shop well stocked. Our 2014 Gift Shop sales were up 80%, but our donations box contributions decreased 20%.

Our volunteer ranks have now risen to roughly 75. Our facebook fans are up 30% over last year. Ron Wolf (GE '69) has posted more sensational photos of our specimens on the web.

Our Student Aides have led a vast majority of our tours again, rented our teaching and fossil kits, helped with our Book/Mineral Sales, and rung up all of our Gift Shop sales. 47% of our Student Aides graduated in May (including five from GE). Last fall, we hired a record 16 Aides, but we will need some replacements in May when six are slated to graduate. Currently seven Aides are women – roughly twice the female demographic on campus!

Our Friends of the CSM Geology Museum (FCSMGM) now has over 164 paid memberships. Our President is Steve Sonnenberg (GE '81 Ph.D.). The Friends prepared and conducted our two wildly successful Book/Mineral sales in April and November. They also conducted field trips to Collector's Edge Minerals Inc.; Cherokee Ranch, CO; Petaca, NM, and the Gold Links Mine near Gunnison, CO and bestowed several fine specimens to our collections. As always, FCSMGM members receive 20% discounts in our Gift Shop. Application forms can be found at: http://issuu.com/csmgeologymuseum/docs/friends_app.

In September, we held an Ouray-Silverton Mineral Symposium in

Ouray, Colorado on 9/5-7. It featured an entire day of talks and a second day of guided field trips in the Ouray and Silverton areas. It was attended by 114 guests. Plans are underway for another gathering of smaller size to be held in Gunnison in July 2015. Anyone interested in planning future symposia is invited to contact me. Later that week, over 280 guests attended our Annual Open House, where they saw nine new exhibits and five upgraded exhibits. In 2014 we displayed our specimens at mineral shows in Tucson, Fort Collins, Colorado Springs, Denver, and Socorro.

Some of the donations to our Museum this year included specimens and/or books from Keith (GP '75) and Diane (GP '75) Brownlee, Maurice Chaffee (GE '59), Clare Dunning (GE '84, B.S.), Erik Hunter (ME '06), James A. Saunders (GE '86, Ph.D.), Kelsey Zabrusky (GE '09 B.S., M.S. '11); and significant funding from Jane and Marshall C. Crouch III (GE '67), William Gibbs, Jr. (GE '76), Mr. and Mrs. Robert E. Smith (GE '55), and Steve Sonnenberg (GE '81 Ph.D.). We gladly accept geological book, map, and specimen donations throughout the year.

As for upcoming events, we will hold another famous (infamous?) combined Book/Mineral Sale on 4/25+26/2015 from 9-4 P.M. in the Conference Room across the hall from our Museum entrance. Prices will drop frequently throughout

the event on most items. Our Annual Open House is scheduled for September 16, 2015 from 6 to 9 P.M.

In conclusion, please visit our Museum. Our address is 1310 Maple Street. We are open Monday – Saturday 9 A.M. to 4 P.M., Sundays 1 P.M. – 4 P.M., except for certain legal and school holidays. Admission to our Museum is free, but parking fees are required in our lots and on campus streets Mondays through Fridays before 5 P.M. Further information is available on our website (http://www.mines.edu/Geology_Museum), Facebook page (<http://www.facebook.com/pages/Colorado-School-of-Mines-Geology-Museum/168875179736>), or phone me at 303-273-3823.

Engineering Geology and Geotechnics

Paul Santi, Jerry Higgins, Wendy Zhou

It's an exciting time to be involved in engineering geology and geotechnics! Companies are hiring, offering a huge array of interesting projects and, like the rest of the Department, our program is bursting with students at the undergraduate and graduate levels, and our research programs continue to receive strong funding support from federal/state agencies and industry.

Among the three faculty members of engineering geology and geotechnics, Dr. Wendy Zhou

continued as a full-time faculty member. Dr. Paul Santi is department head and a faculty member at the same time. Dr. Jerry Higgins has stepped into transitional retirement status since the summer of 2014. On the plus side, a new faculty member in geological engineering with specialty in Underground Construction and Tunneling (UC&T) could join us as soon as fall 2015.

In addition to his administrative duties, Dr. Santi maintains his research program dealing with geologic hazards, predominantly debris flow analysis and mitigation. An ongoing project to minimize the social and economic impacts of post-wildfire debris flows is sponsored by the National Interagency Fire Center. The Central Federal Lands (FHWA) is

funding additions to a manual for geologic hazard characterization along transportation corridors (with Jerry Higgins). He also had a project funded by Mesa County Colorado to conduct stability analysis of the West Salt Creek landslide near the town of Collbran that killed three people last summer. Four of his students graduated last year: Chris Peterson (BGC Engineering, Edmonton), Joe Gartner (BGC Engineering, Golden), Dan Pratt (Sanborn, Head and Associates, Ohio), and Ian Donovan. Dr. Santi also serves as Vice-President/President-Elect for the Association of Environmental and Engineering Geologists, continuing a five-year commitment as an officer in the Association.

Dr. Jerry Higgins is in his 28th year teaching and conducting

Field camp students learn about debris-flow hazards and the flooding of a nearby house after the 2002 Missionary Ridge Fire near Durango.



research at CSM, with a current research group including graduate students Carlos Hernandez, Paige Cybulski, and Amanda Rock. Amanda finished her MS thesis work on evaluating rock scour in dam spillways and is now employed by Golder Associates. Carlos Hernandez and Paige Cybulski are working on slope stability studies supported by the Director of Geotechnical & Hydrological Engineering, Newmont Mining Corporation. Dr. Higgins is continuing work on the NCHRP study on rock fall barrier testing standards and asset management of barrier systems for transportation agencies in cooperation with Yeh and Associates.

Dr. Zhou has continued to conduct research on geohazard and environmental impact using GIS and remote sensing technology. Ph.D. student, Matt Minnick, continued working on a DOE project entitled “GIS- and Web-based Water Resource Geospatial Infrastructure for Oil Shale Development”. Matt is expected to defend his dissertation in December 2015. He has started his job at RESPEC Consulting & Services and is Director of the Hydrogeology Group recently. Ph.D. student Ben Lowry is working on high resolution displacement monitoring of landslides and earth dams by using ground based radar interferometry and ground based LiDAR. His research is part of the NSF funded SmartGeo program. He is also working as an intern at the CGG Geoscience Company. M.S. students include Ben Haugen (working on landslide monitoring by using terrestrial LiDAR scan funded by NSF SmartGeo Program), Stephen Semmens (working on Advancing Earth Dam and Levee Sustainability through Monitoring Science and Condition Assessment, funded by NSF PIRE Program), Josh Stewart (co-advisor Dr. Santi, working on developing remote sensing methods for bedrock mapping of the Colorado Front Range Mountains), Robert Duran (co-advisor Dr. Santi, working on mapping and analysis of the Rio Chama Rockslide, Archuleta County, Colorado and the Edgar Mine rock mass characterization for geothermal energy projects), and Alvaro Puente (working on coal mine induced subsidence by using InSAR techniques for Colorado Springs). Additionally, one M.S. student Celena Cui (co-advisor: Mengistu Geza) graduated in May 2014. She is now working for EcoCion Environmental Solutions in the Great Denver Area.

Dr. Zhou has advanced to a role as Associate Editor of Journal Applied Remote Sensing (JARS) since March 2014. She also serves on the GSA EEGD Division - Burwell Award Committee and the Technical Program Committee of the International Conference on Remote Sensing Technologies and Applications (ICRSTA 2015).

News from the Geodynamics and Ore Deposit Research Group

Alexander Gysi, Wendy Harrison, Murray Hitzman, Elizabeth Holley, Nigel Kelly, Yvette Kuiper, Thomas Monecke, Katharina Pfaff, Richard Wendlandt, Graham Closs, Steve Enders

This has been an eventful year with the arrival of a new faculty, promotions, acquiring of new state-of-the-art analytical and experimental equipment and addition of new courses to our curriculum. A new research center has also been launched! Read on further to get a glimpse of what is going on in the Geodynamics and Ore Deposit Research Group.

Outlook for our students

Despite the grim outlook in the mineral exploration and mining industry during 2014 most of our grad students were able to find positions during the year. The outlook for 2015 is tougher. If any grads of the program have jobs, summer jobs, or internships available for CSM students and recent graduates, please let us know!

Personnel Changes

The past year brought some changes to the make-up of the Geodynamics and Ore Deposit Research Group. Nigel Kelley left CSM and took up a new position at CU Boulder. Although this is very unfortunate for our group, we wish him all the best! Elizabeth Holley has transitioned from her previous position as teaching assistant professor in our department to a new position as assistant professor in the Department of Mining Engineering. In her new role, she will be able to focus more on research in ore deposit geology and its application in mining engineering. Having a larger group of excellent graduate students is certainly exciting.

New tenure track faculty in Lithogeochemistry



We welcome our new faculty Alexander Gysi who arrived in August 2014 and joined the ranks as a Lithogeochemist! His research is on the geochemistry of hydrothermal fluid-rock interaction applied to understanding the formation of ore deposits, the evolution of pegmatites and the stability of minerals and their chemical changes in the crust. In the past year, he has been building the framework for his crustal fluid-rock interaction group by acquiring new experimental lab equipment and preparing projects for his graduate students coming in Fall 2015. Our new faculty is also bringing additions to our course curriculum with a new graduate class entitled “Lithogeochemistry of Hydrothermal Ore Deposits” and a new undergraduate class entitled “Thermodynamics for Geoscientists”.



Promotion of Katharina Pfaff

Congratulations to Katharina, who was promoted to Research Assistant Professor in August 2014! Besides her responsibilities for the QEMSCAN Facility that includes day-to-day maintenance and operation of the instrument and advising of users of the Facility, Katharina Pfaff is also conducting research in igneous/metamorphic petrology and economic geology. In her new role, Katharina Pfaff is currently advising 5 graduate students (one of whom successfully defended his thesis in March 2015) and teaches the 500-level class “Reflected Light and Electron Microscopy”.

Brand new crustal fluid-rock interaction lab



The crustal fluid-rock interaction lab, overseen by Alexander Gysi, is now ready for experimental research. The lab permits calorimetric studies of minerals with the acquisition of brand new solution and differential scanning calorimeters. Experiments involve the synthesis and dissolution of minerals using a corrosion resistant high-pressure titanium reactor, which permits fluid-rock interaction experiments, sampling in situ of liquids and gases, and mixing of fluids. Research is currently on the way for graduate students to work on the thermodynamic properties of REE minerals, and the partitioning of REE between fluid-mineral and the stability of carbonate solid solutions.

New Center for Subsurface Earth Resources (CSER) launched!

Richard Wendlandt, Thomas Monecke and Wendy Harrison sat down many hours this year to discuss and organize a new research center involving the collaboration of academia, industry and the USGS to tackle problems related to the exploration and discovery of mineral resources. The new Center for Subsurface Earth Resources was officially accepted in Fall 2015 and next steps are being undertaken to find partner Universities and organize funding. The broad purpose and long-term vision of this research Center is directed toward research challenges in the development of 3D subsurface geologic models for mineral deposits.

Field trips, conferences and rock hammering

Murray Hitzman was once again on leave during the Spring semester. He spent the majority of January through May overseas working with students in southern Africa and teaching short courses. During the year he taught short courses on different types of ore deposits in Brazil, Democratic Republic of Congo, Namibia, Sweden, and Zambia and presented lectures at a number of venues including one for the OECD in Germany. Despite the downturn in the industry, Murray was able to sustain a large group of graduate students conducting field research around the world funded by exploration companies. During the fall semester, the Advanced Minerals Deposits class (GEOL 515) focused this year on iron formations – a new topic. As usual, several of the student research projects turned into posters presented in January 2015 at the Exploration RoundUp in Vancouver. At year's end, he was busy planning for the upcoming SEG Student Chapter field trip to Namibia for April-May, 2015.

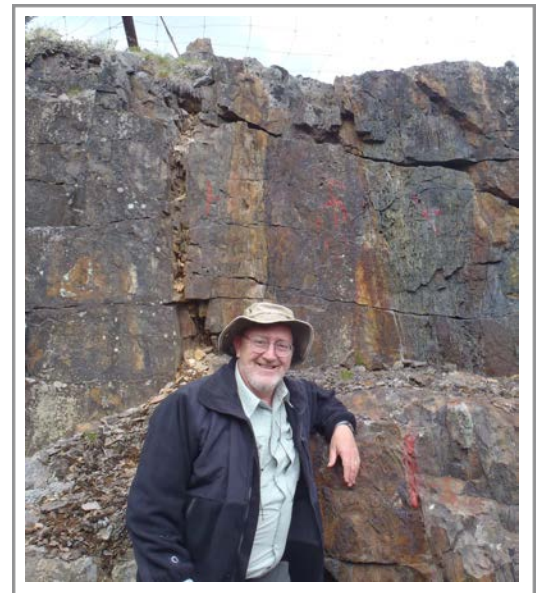
The Society of Economic Geologist's Keystone conference in September represented one of the major professional events for economic geologists this year. The conference brought together 620 scientists and professionals in addition to over 180 students. About 110 student members received travel support from the Society. A record-breaking 180 posters were presented at the conference. Once

again,
Thomas

Monecke was heavily involved in the conference planning and success of the student program. The three years of planning ahead of the conference and those thousands of emails certainly paid out!

As every year, Thomas Monecke also organized his Abitibi Geology and Exploration Field School

Abitibi Geology and Exploration Field School (GEOL 519) within the mill complex of the Canadian Malartic mine that exploits an Archean low-grade large-tonnage intrusion-centered gold deposit in northern Quebec.



Murray standing in front of steeply dipping, highly altered rocks at the Nautanen iron oxide-Cu-Au prospect of Boliden in June.



(GEOL513) that took 14 graduate students to the Archean Abitibi greenstone belt of northern Ontario and Quebec, one of the most prolific base metal and gold producing areas of the world. During the field trip, the group visited a number of world-class base and precious metal deposits. This included the world-famous Cobalt silver mining district in Ontario, the Hollinger-McIntyre and Dome orogenic gold deposits in Timmins, the giant Kidd Creek deposit, the Kirkland Lake camp, the volcanic-hosted massive sulfide deposits of the Noranda district, the gold-rich massive sulfides at LaRonde-Penna, and the Canadian Malartic gold deposit. The intense 14 day field school not only provided students with a unique opportunity to visit world-class deposits, but also provided them with an overview of Archean geology. During the field school, students gained experience in mineral prospect evaluation, structural geology, physical volcanology, deposit definition, alteration mapping, mining methods, and ore processing, and further developed skills including core logging, underground stope mapping, and open pit mapping.



As part of the course Hydrothermal Geochemistry (GEOL513), Thomas Monecke also took a group of graduate students to Steamboat Springs to learn how to analyze geothermal liquids in situ. During the field trip, students learn to appreciate complexity. Although all the pools in Steamboat Springs are nicely aligned along a single fault, the chemistry of every pool is different!

Professor Yvette Kuiper organized many field trips, looking at faults, folds and all other things that make a structural geologist enjoy life.

Hydrothermal Geochemistry class (GEOL 513) conducting sampling of geothermal liquids in Steamboat Springs, Colorado. This picture is at the end of the day before the group went to Strawberry Hot Springs to test what relaxing in alkaline waters feels like.



Yvette Kuiper and Wes Buchanan leading a 2014 New England Intercollegiate Geological Conference field trip in Eastern Massachusetts.



New economic geology and mineral characterization classes for our students

Reflected Light and Electron Microscopy

In this class, Katharina Pfaff teaches the basics of reflected light microscopy, electron microscopy, automated mineralogy, electron probe microanalysis and cathodoluminescence. Thomas Monecke and Heather Lowers (USGS) gave guest lectures and Alan Koenig (USGS) invited the class to tour the analytical facilities at the US Geological Survey here in Denver.

Lithogeochemistry of Hydrothermal Ore Deposits

In this class, Alexander Gysi gives an overview of hydrothermal-magmatic ore deposits and the formation of alteration zones including porphyry and epithermal systems, Greisen Sn deposits, rare minerals and pegmatites. The tools learned in classes include numerical modeling of fluid-rock reactions using GEM-Selektor, thermodynamic phase diagrams, field observations, mineral paragenesis, mineral/bulk rock chemistry and textural relationships in thin sections and hand samples. The class includes an excursion to the Henderson porphyry molybdenum deposit.

Thermodynamics for Geoscientists

We are bringing back our students to our department with this new class on the basic principles of thermodynamics applied to problems in geosciences. The students learn to evaluate the stability and chemical transformation of minerals and rocks, the evolution of vapors and liquids and their reaction paths when subjected to different P-T geological regimes.

Metallogeny of Modern and Ancient Submarine Arcs

Thomas Monecke developed a new course that focuses on submarine hydrothermal systems, which represent one of the oldest and most important ore-forming processes in the geologic record. The course examines the diversity of hydrothermal systems and the nature of fluid flow in submarine volcanic environments, with an emphasis on the formation of volcanic-hosted massive sulfide deposits. The geological characteristics of these base and precious metal deposits and the hydrothermal processes that produce these deposits are discussed with students. Special emphasis is placed on the interpretation of geological settings, controls on mineralization, ore mineralogy and geochemistry, hydrothermal alteration, and enrichment of precious metals. The class also derives strategies for exploration in ancient volcanic terrains.

In addition to new classes we continue to train students in new software and technology applications. During 2014 the SEG Student Chapter aided by Dr. Graham Closs helped organize a class on Leapfrog software, and a class on ioGAS software was taught in early 2015.

Friends of the Department

Contribution records span from July 1, 2013 to June 30 2014, the school fiscal year.

We gratefully acknowledge contributions and research funding received in the past year from our Friends and Supporters.

Contributions include funding, data, software, materials, and access to areas needed for classes and research. Our endowed funding continued to show positive earnings, and industry giving continued to be strong this past year.

Whether people designate their funds as discretionary or for specific purposes, the funds are used accordingly. Most of the activities highlighted in this *Newsletter* are funded with this money. It pays for field trips connected to classes including vehicle rentals, lodging, and airfare, field camp expenses, classroom materials, lab materials, lab and classroom equipment, software, computer purchases, fellowships, teaching assistants, and many other necessities. Many of our supporters enhanced their giving by using their companies' matching gift programs.

Five years ago, the Enhancement Committee embarked upon an ambitious goal to build a discretionary endowment fund to support the Department. A constant stream of funding would

allow us to invest in strategic-level enterprises that will raise the profile of the department and improve the educational experience of our students. This funding will also guarantee that our programs would not suffer if State/School funding levels drop. We want this endowment to grow, and we will be happy to share our vision with you if you would like to know more.

Abraxas
Anadarko Petroleum Corp.
Donna S Anderson
James U Ansley
Anschutz Corp.
Apache Corporation
Heather Ardeel
Scott M Ardeel
Brett Arpin
ATAC Resources Ltd.
Roger Banghard
Bartshe Exploration, Inc.
R Timothy Bartshe
Belcaro Park Home Owners
BHP Billiton Ltd.
Bill Barrett Co.
Black Hills Exploration & Prod.
Bonanza Creek Energy
BP Exploration
John Briedis
Keri Hunter Brill
Robert W Butler
Canadian Mining Industry
Center for Underground
Construction and Tunneling
Chevron
Classen & Co.
Stephen P Collings



SEG student chapter for a trip to Pikes Peak, on the path to study pegmatites.

ConocoPhillips
Matthew D Cornellison
James and Lois Daniels
Stan and Judy Dempsey
Kim de Rubertis
Devon Energy
Ginger S Dodson
Endeavour International Corp.
Enerplus
EOG Resources
Jane Estes-Jackson
ExxonMobil Corporation
Federal Highways Administration
Fidelity E&P
Weldon G Frost
Jeffrey E Fullmer
Global Geophysical
Goldcorp USA
Kimberly H Grimmer
Tim & Mary Haddon Family
Foundation
Halliburton
Helis Oil & Gas
Hendricks & Assoc.
Hess Corp.
Megan L Hesse
HRM Resources, LLC
Christopher Humphrey
John D Humphrey
Husky Energy
IHS

ION
John A Karachewski
Kodiak O&G
Mr. and Mrs. Ronald Krantz
Edward J Krish
Laramie Energy II, LLC
E Dean B Laudeman
Marathon Oil Company
Theodore R Maynard
Mesa County, Colorado
Mike Johnson & Associates
MJ Systems
Craig E Moore
Duane E Moredock
Mr. and Mrs. Matthew Morgan
Amy C Moss
Kevin L Mosser
National Interagency Fire Center
National Science Foundation
Newfield Exploration
Noble Energy
Oasis Petroleum
Occidental Oil and Gas
Osisko Mining Corporation
Thomas W Olsen
Dr. and Mrs. Arthur J Pansze
Suzanne S Paschke
Sandra L Perry
Timothy J Piwowar Jr.
Karen W Porter
Susan M Perrell
Platte River Assoc.
Plus Petrol
James Priestley
QEP
Mr. and Mrs. James E Riley
George T Ring
John W and Diane Robinson
Mr. and Mrs. Bradley Rock
Samson
Dr. and Mrs. Paul M Santi
Schlumberger
Dr. and Mrs. Myles W Scoggins
Mark E Shaffer
Shell Oil Company

SM Energy Company
Mr. and Mrs. Robert E Smith
Stephen A Sonnenberg
Statoil
Kimberly Stevens
Joan V Stratton
Jennifer A VanDinter
Mr. and Mrs. Roger N Wagerle
Ward
Weatherford
Michele L Wiechman
Robert J and Ruth Weimer
Gregory R Wessel
White Eagle Exploration
WPX
Whiting Petroleum Corp.
Mark R Williams
XTO Energy
J Stevens Zuker

Educational Outreach at Mines

Christian Shorey

Mines is a school known for its technological prowess, and our students are the best evidence of our excellence, but more and more potential students view our publicly available on-line offerings as principal evidence of our technological standing. Therefore, besides continuing to run our 101 course and planning a new Paleoclimate course for next Spring, Dr. Shorey has been busy making new content for the Colorado School of Mines iTunesU site.

All this content is publicly available and only requires the download of the free iTunes

software. In the iTunes program, go to the iTunes store, and then search “Colorado School of Mines” to find our offerings. We have several new home-based and guest lectures under “Campus Lectures”, including the lecture by Ron Blakey on the paleogeography and tectonics of Western North America, and a fascinating look into corporate social responsibility with Jessica Ralston and Murray Hitzman.

Under “Earth Explorations”, Dr. Shorey is adding content that complements our GEGN 101 Earth and Environmental Systems course. Highlights there are a series on using free software to construct basic climate models, an update on the recent flooding in Lyons, CO., and instructions for some of the 101 labs.

Possibly of greatest interest to our alumni is the new section titled “The Bob Weimer Geology Trail with Bob Weimer”. These programs have been made with both regular sound versions and closed captioned versions. Either way, you get the ever-dynamic and insightful Bob Weimer giving us invaluable insights into the geology and history on our venerable campus.

Dr. Shorey plans to continue contributing more public material to the iTunesU site, so if you’re interested in keeping up with Mines in the 21st century, pay the site a visit, and then come by occasionally to see what’s new.

The Undergraduate Curriculum

Freshman Year



The only geoscience course our undergraduates take their first year is Earth and Environmental Systems, GEGN101. This course presents the fundamental concepts concerning the nature, composition and evolution of the lithosphere, hydrosphere, atmosphere and biosphere of the earth integrating the basic sciences of chemistry physics, biology and mathematics. Students are exposed to field trips that enhance their classroom learning. They also learn that field trips are conducted regardless of the weather or how inappropriately the student(s) are dressed. The basic Freshman curriculum concentrates on building the foundations of physics, chemistry, and calculus preparing them for the advanced courses.

Sophomore Year

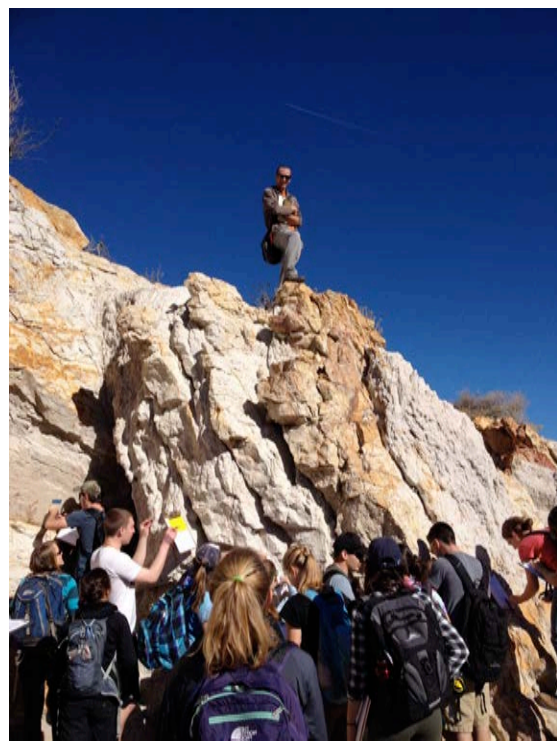


Students on the GEGN203 field trip check out the coke ovens in front of the Grand Hogback near Redstone, CO

Finally, the GE majors are able to take courses in their major. In the fall, they take a 5-hour block of three courses: Engineering Terrain Analysis (which includes many elements of Geomorphology), Geologic Principles and Processes (which covers scientific and historical principles in geology), and Advanced Geology Lab. These classes serve as a welcome to the Department and a deeper introduction to the many topics they will cover in detail over the next couple of years. This is their soft landing into GE. In the spring semester, reality sets in as the students take GEGN 206, Earth Materials.

By design, this course sets the high expectations we will have throughout their GE curriculum. The students also take their second EPICS (“Engineering Practices Introductory Course Sequence”) course in the spring. We offer a GE-specific version that concentrates on GIS skills and geology-related design projects.

Junior Year



All roads lead to summer field camp. Courses during the Junior year prepare students for the ultimate GE experience of six weeks in field camp. In the fall, they take Structural Geology, and either Petrography for Geological Engineers (Engineering Track students) or Mineralogy (Exploration Track students). They also begin their technical elective sequence, involving some combination of soil mechanics, rock mechanics, and other specific classes involving official “engineering design” hours to meet our engineering accreditation requirements. In the spring, they dive into geology with both feet. All students take Field Methods as a prelude to Field Camp, and they all take Stratigraphy and Geological Fluid Mechanics. Those in the engineering track add Site Investigation and those in the exploration track add Petrology. By May, they are armed and prepped for Field Camp, which starts two days after the end of finals and graduation for the Seniors.

GEGN317 students on the geology trail where the students use measurements on small scale faults to determine the relationship between fault orientation and paleostresses, as well as their relationship to the Golden fault. TA Ben Frieman supervises.

Senior Year

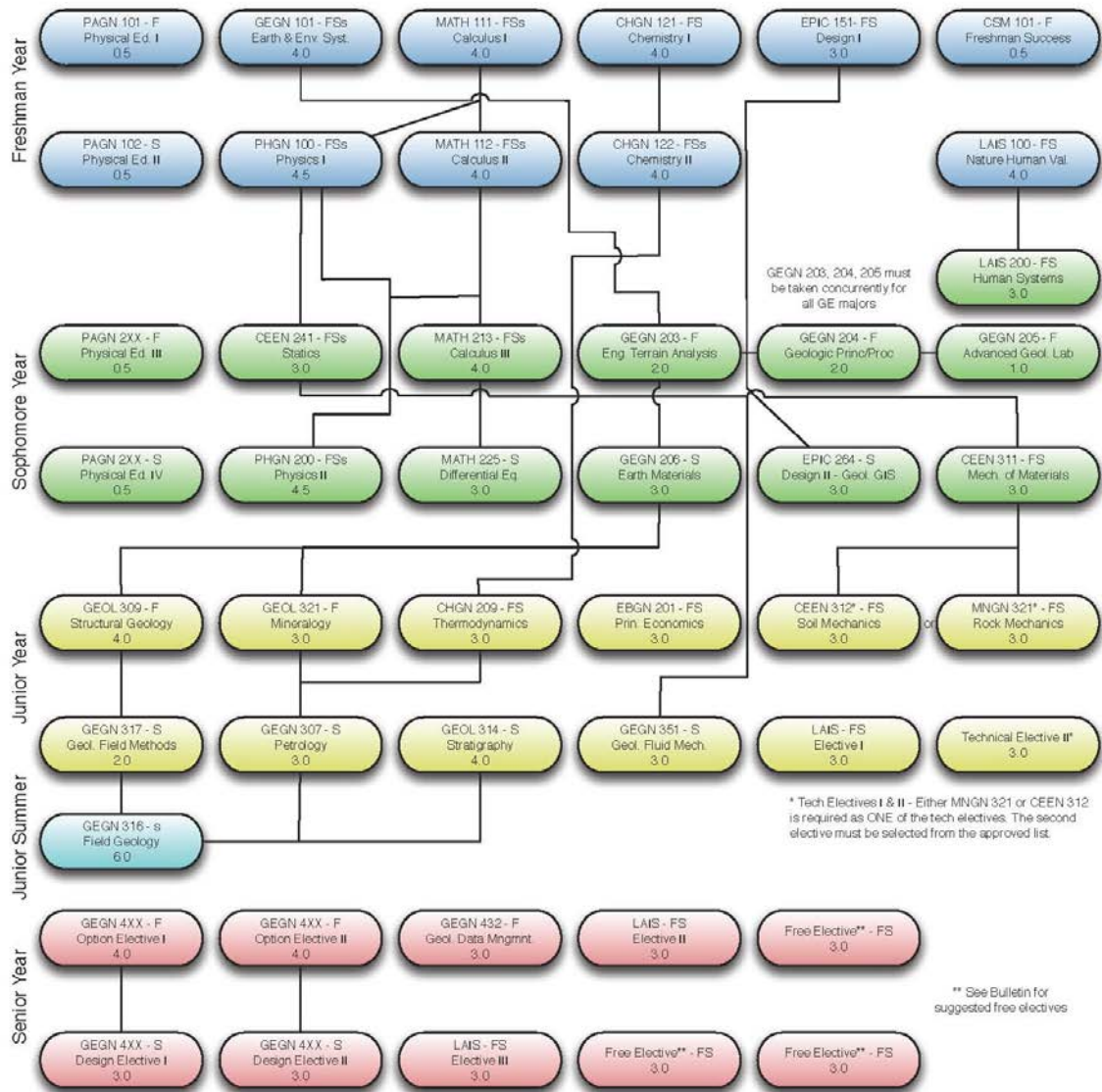
The Senior curriculum focuses on specialization, as design courses in the degree options have students solving real-world problems with the geological tools they have been developing. In the fall, they take two option electives from the list of mineral deposits, petroleum geology, ground-water engineering, and engineering geology and geotechnics. In the spring, they take two design electives from the same areas. All students also take Geological Data Management in the fall, learning statistical analysis and computer programming methods to apply in their design classes.

In the following pages, we outline the undergraduate curriculum and how the coursework builds skills and knowledge preparing them for the next advanced class.



EXPLORATION TRACK

Geological Engineering Flowchart - Exploration Track



Students must take TWO Option Electives and TWO corresponding Design Electives

Option Electives:
 GEGN 401 - Mineral Deposits
 GEGN 438 - Petroleum Geology
 GEGN 467 - Ground-water Engin.
 GEGN 468 - Engin. Geology

Design Electives:
 GEGN 403 - Mineral Expl. Design
 GEGN 439 - Petroleum Design
 GEGN 470 - Ground-water Design
 GEGN 469 - Engin. Geology Design

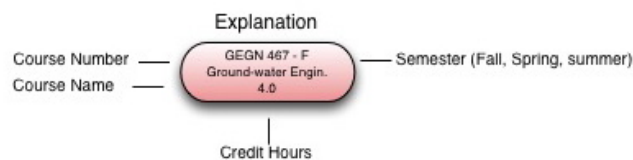
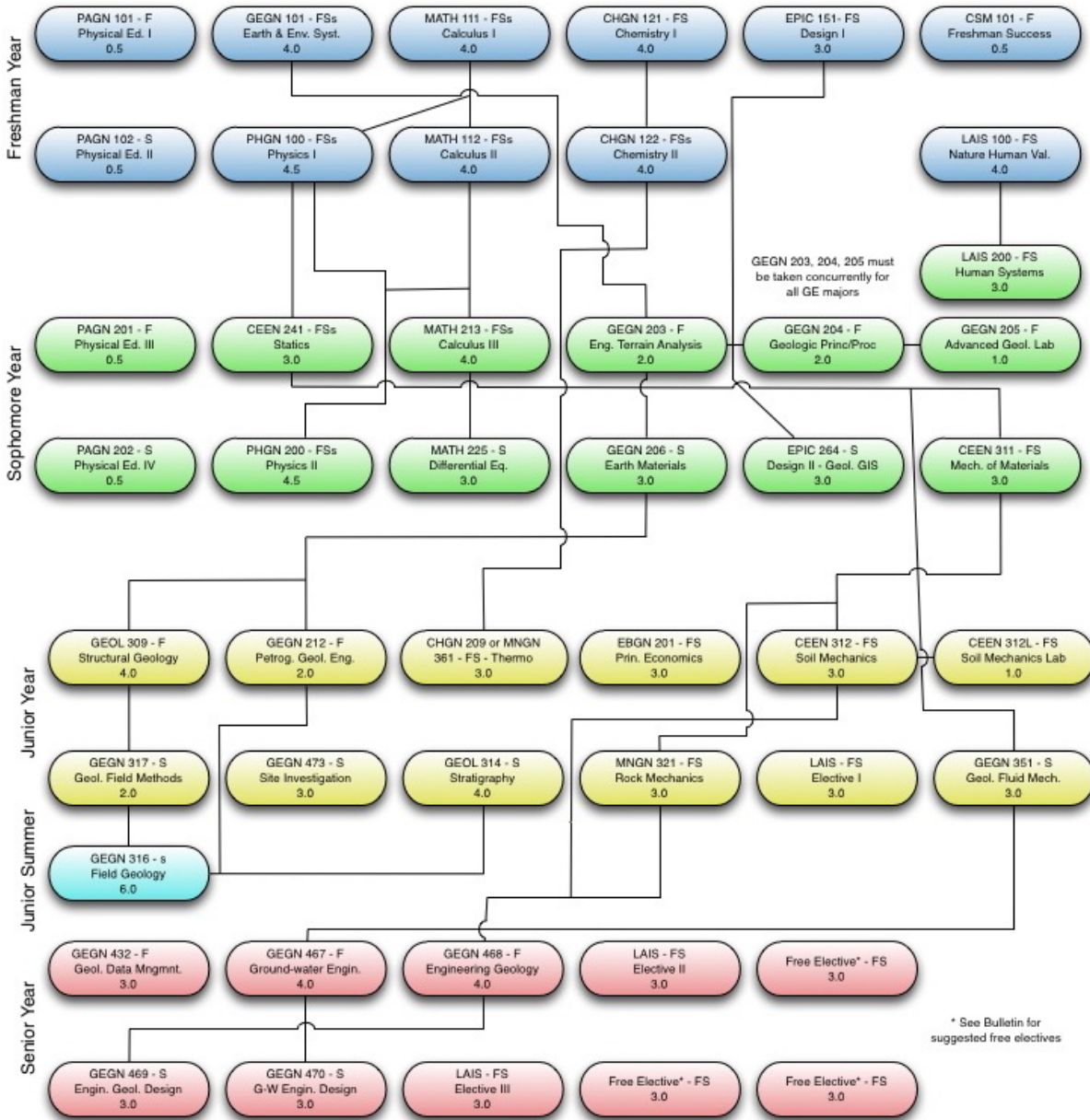
Explanation

Course Number — GEGN 314 - S
 Course Name — Stratigraphy
 Credit Hours — 4.0

Semester (Fall, Spring, summer)

ENGINEERING TRACK

Geological Engineering Flowchart - Engineering Track



GEGN 101 Earth and Environmental Systems

All our undergraduates begin the regular sequence with GEGN 101; Earth and Environmental Systems. These lectures begin with a basic physical geology course in half a semester, followed by hydrology (oceans, streams, groundwater, and cryosphere), meteorology, climatology, biology, ecology and cosmology. The physical geology based labs cover map reading and orienteering, rock and mineral ID, basic structure and field methods, and geology field trips on campus, to Red Rocks and Dinosaur Ridge, and up North Table Mountain, at the end of which the students must write a geologic history of the Golden Valley. In hydrology, the students work on groundwater resources and dynamics, streams and flooding, and a field lab to assess Clear Creek ecologically and chemically. The final labs involve computer modeling of radiative energy balance to assess an Earth-like planetary climate system, and a final project involving groups of students presenting on a pertinent topic they have been working on in a mini-thesis through the later half of the class. Two papers are assigned through the semester allowing us to influence writing skills.

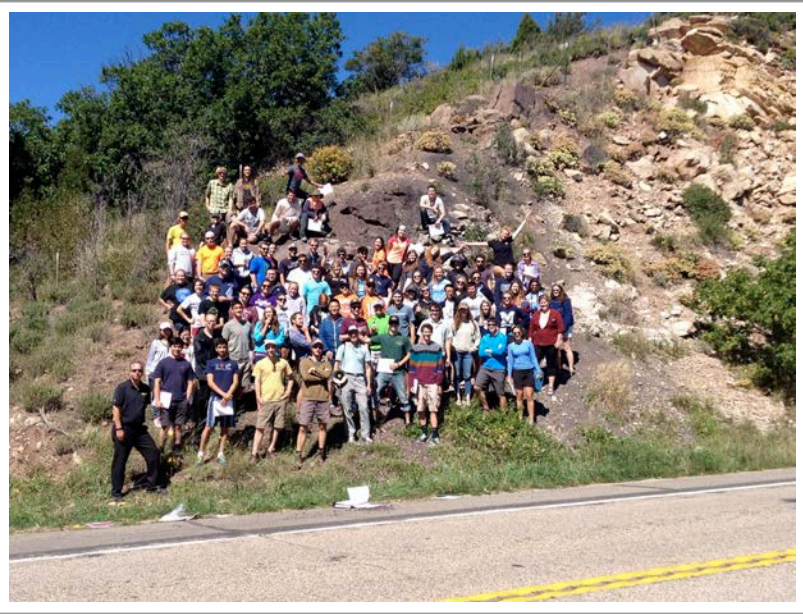


GEGN101 field trip to North Table Mountain

Being the informational foundation for all future study in our Department, Dr. Shorey is attempting to get a standard set of knowledge and practice in place, both directly in the classroom and in various forms of media which alumni and the general public can access as well. He has covered the totality of the 101 course content, plus some, in the Earth and Environmental Systems Podcast (a series of audio recordings providing an overview the basics of the Earth sciences). On New Year's Day of 2015, Dr. Shorey released the first episode of a new video series titled "Earth Explorations" and plans on releasing another episode every Friday. This video series will cover lab and field methods, and will serve as a reference and standard for our future classes. We hope to remove the need to reteach basics such as map reading or how to take a strike and dip, giving the students a stable resource to which they can refer, and opening more time in our advanced courses to introduce new ideas and concepts. Both audio and video resources mentioned here, along with many others, are available on the CSM iTunesU site, as well as other non-Apple based sites. If you need assistance accessing these materials, please feel free to contact Dr. Christian Shorey for help at: cshorey@mines.edu

GEGN 203 Engineering Terrain Analysis and GEGN 205 Advanced Physical Geology Lab

These courses build on the freshman GEGN 101 course by exploring fundamental geology concepts from a standpoint of landscape development, landforms, and surficial processes. Students spend ample time in the field, and in the lab they work nearly every week with geologic and topographic maps, air photos and electronic images, and solve applied problems using geologic information. Several years ago, many members of the



GEGN 203 students atop one of the world-class radial dikes in the Spanish Peaks area.

department faculty worked together to revise the content of the courses to ensure that they were effective prerequisites for our more advanced courses. One of the highlights of the class is a 3-day field trip to observe landforms in Colorado, supported in part by donations from our alumni and industry partners.

GEGN 204 Geologic Principles and Processes

GEGN 204 is part of the “Sophomore Fall” sequence of courses that also includes GEGN 203 (Engineering Terrain Analysis) and GEGN 205 (Advanced Physical Geology Laboratory). Following on the heels of the introductory GEGN 101 (Earth and Environmental Systems), Principles and

Processes introduces students to more advanced concepts of physical geology and also provides an overview of Earth history, with particular focus on North America and Colorado. Fundamental concepts in crustal development, stratigraphy, basin analysis, geochronology, and evolution and the fossil record all are integrated into a “historical geology” perspective. This course thus provides foundational material as our students move on to more advanced geoscience classes.

GEOL206 Earth Materials

GEGN 206 is part of the “Sophomore Spring” sequence of courses that follow GEGN 101 (Earth and Environmental Systems, GEGN 203 (Engineering Terrain Analysis), GEGN 204 (Geologic Principles and Processes), and GEGN 205 (Advanced Physical Geology Laboratory). GEGN 206, Introduction to Earth Materials, emphasizes the structure, composition, formation, and behavior of silicate and non-silicate minerals. This forms the foundation for understanding minerals in advanced geoscience classes. The labs emphasize the recognition, description, and engineering evaluation of minerals and introduce students to optical mineralogy.

GEGN212 - Petrography for Geological Engineers

Students in GEGN212 use knowledge gained in Earth Materials (GEGN206) to identify minerals in metamorphic and igneous rocks and interpret rock formation environments from rock composition. The students learn about the processes that create rocks of different chemical composition and how those processes relate to tectonic environments. Students also begin to evaluate how different rock types translate to different engineering behaviors. This concept is enforced with a mapping exercise of a high wall failure at the Cripple Creek Victor Gold Mine. Because the students in GEGN212 are interested in hydrology and geological engineering, the course also covers chemical behavior of rocks in surface environments. Students learn about weathering processes and apply concepts from their soil mechanics class to soil descriptions in a field setting and get a background in clay mineralogy and weathering needed for Engineering Geology and Geotechnics (GEGN468).

Design EPICS II 264

Geology GIS (Geographic Information System) builds on the design process introduced in Design EPICS I, which focuses on open-ended problem solving in which students integrate teamwork and communication with the use of computer software as tools to solve engineering problems. Computer applications emphasize information acquisition and processing based on knowing what new information is necessary to solve a problem and where to find the information efficiently. There are typically eight to ten geological team projects in the course, based on the needs of multiple project clients. Course deliverables include project reports, PowerPoint presentations, and maps with associated data sets.

GEOL 321 Mineralogy and Mineral Characterization

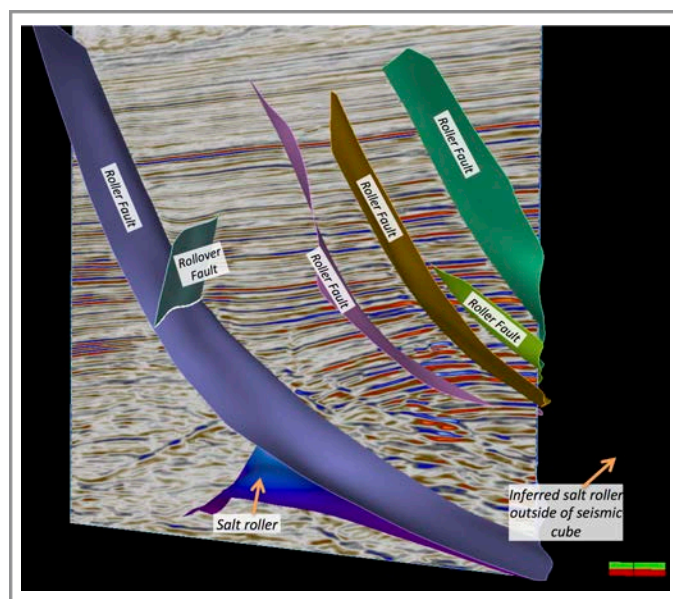
which is offered during fall semester of the junior year, builds systematically on the sophomore GEGN 206 Earth Materials course by developing an advanced understanding of concepts and analytical techniques routinely used for mineral identification. Labs emphasize developing a proficiency in the use of optical microscopy as applied to mineral characterization; however, students are also exposed to X-ray diffraction methods and utilize the scanning electron microscope to determine the mineralogy and mineral paragenesis of rock samples. Lectures transition from discussion of principles governing these various analysis techniques to controls on mineral composition and stability under variable external conditions, pressure, and temperature. In this manner, the course content transitions into Petrology GEGN 307.

GEGN307 Petrology

Taken during the junior year spring semester, petrology emphasizes the petrographic characterization and petrogenesis of igneous and metamorphic rocks. Lab exercises utilize previously learned optical microscopy skills and focus on suites of samples from classic locations, including the Tuolumne intrusive series, San Juan volcanic field, Duluth gabbro, and several metamorphic terrains in Scotland. Petrology emphasizes the petrographic characterization and petrogenesis of igneous and metamorphic rocks. The skills and learning obtained in these two courses prepare students for the summer field geology course and senior option electives.

GEOL 309 Structural Geology and Tectonics

Taught in the Fall semester of the junior year, this course builds on the sophomore sequence by introducing fundamental concepts in structural geology and tectonics. Students are also introduced to the methodologies of geological mapping and undertake two separate field mapping projects along the Front Range. To integrate modern technology and 3D visualization into the course, students learn the fundamentals of seismic reflection technology and undertake a sub-surface seismic interpretation project using 3D seismic data. This course puts the foundations in structural geology/tectonics and field mapping in place for subsequent courses in the junior year, specifically field methods and field camp.



From the GEOL309 final project: a seismic interpretation exercise where the students map faults and horizons on a Gulf of Mexico 3D seismic dataset.

GEOL 314 Stratigraphy

Stratigraphy has the following goals: students will be able to (1) synthesize sedimentologic and stratigraphic data to address specific geological problems, (2) critically evaluate existing sedimentologic and stratigraphic interpretations, and (3) interpret sedimentologic and stratigraphic data by testing multiple hypothesis. GEOL 314 builds directly on GEOL 203, 204 and 205, as it includes a more advanced and in depth analyses of sedimentary processes, tectonic and climatic boundary conditions, paleo-terrains, and the resulting sedimentary record. GEOL 314 also benefits from GEGN 351 (Geological Fluid Mechanics), as understanding the basics of fluid mechanics is a key for analyses of sedimentary processes. In addition to the theoretical knowledge and the ability to synthesize sedimentologic and stratigraphic data, the focus is on applications to a range of geological problems, including provenance, palaeoclimate and tectonic analyses, stratigraphic correlations and predictions,



TA Ben Frieman pointing at some of the tilted strata in the mapping area at Ralston Buttes.

and not least the petroleum, mining and engineering industry applications. The labs are designed to reinforce practical skills to prepare the students for GEGN 317 Field Methods and the Field Camp.

GEGN 317 Field Methods

Beginning Spring 2015, Dr. Shorey took over our Field Methods course. This course continues as a bridge for Seniors to reach the skills needed for Field Camp. We cover the equipment used, safety in the field, basic field techniques, and a strong focus on organization and strategy when approaching the reconnaissance, note taking, field mapping, and map making aspects of field geology. The course is different from previous courses in being more focused on letting students struggle and learn through mistakes, rather than on giving students information and asking them to repeat it back. A series of field trips through the semester allows students to learn from previous mistakes and build a more independent confidence to field work. Being that Dr. Shorey also teaches our 101 course and the first week of Field Camp, he is uniquely situated to teach Field Methods with an understanding of student's base knowledge, and what will be needed in this course to help students succeed in Field Camp.

GEGN 316 Field Geology

GEGN 316 is taken after the junior year, and consists of six consecutive weeks of applied, field-oriented exercises. Each week is conducted in a different field locality in Utah and Colorado. Students are together for the first five weeks, and then split into specialized groups for the sixth week, depending on their interests (engineering geology, underground mapping, and petroleum stratigraphy). Weekly exercises include structural and stratigraphic mapping, engineering geology of Quaternary deposits, igneous and metamorphic mapping, volcanic stratigraphy, and mineral assessment mapping. Preparation for field geology includes all the GE

classes through the junior year, including a field methods class (GEGN 317) taken the semester immediately before field session. Students see field camp as an incomparably intense experience that is their true passage to becoming professional geoscientists/engineers. It sets the stage for their option and design courses taken during their senior year.

GEGN 40I Introduction to Mineral Deposits

This design course utilizes all the skills students have learned up to their senior year (geomorphology, mineralogy/petrology, structural geology, stratigraphy, rock mechanics, geochemistry, geophysics) to examine the genesis of metallic (and some non-metallic) mineral deposits. The course provides an introduction to the science (and art) of economic geology to understand what economic geologists (exploration and mining geologists) do and how they work with mining engineers, metallurgists, and environmental scientists. The course examines basic mineral deposit types through lectures, readings, and laboratory examination of samples. A number of practical exploration problems are presented that utilize maps and sections for students to develop their skills at locating mineral resources. Up to ten written assignments on topics including worldwide utilization of mineral resources, social license in the minerals industry, and ethics give breadth and ensure

students are able to write short and intelligible reports. A semester-long project involves each student choosing a local (Front Range) minerals company, tracking their share price, interviewing a company representative (generally CEO or chief geologist) to learn how geology is used in their company, and then orally reporting to the class on their findings (in 5 minutes or less).



Above: Ambyr Douglass and Jacob Smith consider where to “drill” their next hole using straws to find the buried ore deposit in the cake. This early lab exercise gets students to think about how to spatially plan a drilling campaign.



Above: The cake with marked drill holes from the 6 exploration teams.

Right: Dr. Hitzman getting ready to reveal the truth by cutting the cake. The team’s interpretations of the cake’s geology (geological sections through the cake and drill hole location) are on the chalkboard.



GEOC 408 Oceanography

Besides a vacation trip here or there to enjoy the beach, students in Colorado don't get much exposure to the oceans, which occupy approximately 70% of the Earth's surface. Oceanography is an elective course, open to any Mines student who has completed the freshman core. It provides a broad-brush approach to understanding the oceans and, as such, covers geological, chemical, physical, and biological oceanography. More focused topics also include modern methods of oceanographic research, descriptive and synoptic physical oceanography, mineral resources of the marine environment, El Niño-Southern Oscillation, and paleoceanography.

GEGN 432 Geological Data Management

builds on all the mathematical and geological courses taken by the students up to their senior year. It teaches techniques for managing and analyzing geological data, including statistical analysis procedures and computer programming. Topics addressed include elementary probability, populations and distributions, estimation, hypothesis testing, linear regression, and an overview of univariate and multivariate statistical methods. Students are provided with practical experience using principles of software programming and statistical analysis for geological applications via supplied software and data sets from geological case histories.

GEGN 438 Petroleum Geology

is organized around the concept of a petroleum system, which is comprised of multiple elements and processes: source, reservoir, trap, seal, generation–migration–accumulation–preservation of hydrocarbons. We focus on an integration of geological, geophysical, geochemical and petroleum engineering concepts. The course emphasizes applied laboratory projects in each of these areas. Students function in lab as members of a 3-person industry team, composed of geology, geophysics and petroleum engineering students. Knowledge of earlier courses, particularly stratigraphy and sedimentology, structural geology, petrophysics and mapping skills are necessary to successfully complete the course. GEGN 439, Multi-Disciplinary Petroleum Design, follows with application of the concepts studied in this course to projects with extensive, real-world datasets.

GEGN 439 Multi-Disciplinary Petroleum Design

This senior design class integrates fundamentals and design concepts in geological, geophysical, and petroleum engineering. Students work in integrated teams from each of the disciplines. Open-ended design problems are assigned including the development of a prospect in an exploration play and a detailed engineering study. Students are provided a 3D seismic data set and subsurface well information to analyze. Students also need to identify potential risks of the field development and address current, hot topics in the industry including health, safety, security, environment and social responsibility (HSSE-SR), life-cycle management, and sustainability. This course gives students practice with a real life, hands-on work example.

GEOL 444 Invertebrate Paleontology

Fossils are the basis for establishing global correlation among Phanerozoic sedimentary rocks, and thus are critical to the reconstruction of the past 550 million years of Earth history. GEOL 444 is an elective senior-level course that aims to complement and round out the geological background of our students. All students will have had a stratigraphy class prior to enrolling, allowing for the course to build upon concepts in biostratigraphy. While the lectures focus on such topics as taphonomy, systematics, evolution, and mass extinctions, much of the course is spent studying and describing the major marine invertebrate phyla and their geologic history and evolution. Toward the end of the course, attention is paid to ichnology, vertebrate evolution, and paleobotany.

GEGN 466/467 (Groundwater Engineering)

builds on Geological Fluid Mechanics, and takes the principles of Bernoulli and the Navier-Stokes equations and applies them at the field scale to porous media and fractured rock. Students explore how water moves in the subsurface, as well as the transport of contaminants, leaning on analysis of differential equations. GEGN 466 is the graduate portion of the class that doesn't have a lab; 467 is mostly undergraduates that has a lab. Students use this class to prepare for groundwater design, GEGN 470, where they model pumping tests, design a plume characterization program, and design water balance landfill covers--all from principles learned in 467.

GEGN 468 Engineering Geology and Geotechnics

This course requires students to apply their knowledge and skills in geology, engineering mechanics, and earth mechanics to solve civil, mining and environmental engineering problems. The emphasis is on recognition of potential engineering problems in various geologic environments, techniques to characterize the geologic materials and processes, state-of-practice analysis techniques, and mitigation actions appropriate for the problem. Field trips to observe geological constraints on construction and the performance of various forms of mitigation are included. Several lab projects are assigned that require the students to practice the concepts presented in the lecture.

GEGN 469 Engineering Geology Design

consists entirely of design projects that provide students experience in applying the principles and technical skills presented in GEGN 468. Typically there are three to four projects that collectively require field data collection (engineering geologic mapping and/or measurements), analysis of boring logs or trench maps, computer modeling, and design of mitigation actions. All projects result in technical reports/presentations.

GEGN 470 Ground-Water Engineering Design

The GEGN 470 class builds upon coursework in Fluid Mechanics and Groundwater Engineering, and uses computer-based simulation of groundwater and surface water flow, along with contaminant transport in both media. The class currently is based on the completion of several real-world projects, including 1) design and calibration of a numerical model that simulates non-ideal pumping test data collected near Clear Creek, 2) Design of a multi-site investigation campaign and creation of a calibrated model of the South Lake Tahoe MTBE Contamination, 3) Analysis of a potential blowout of the Leadville Tunnel, drainage of the mine works, and downstream contamination of the Arkansas River including Monte Carlo uncertainty assessment, and 4) Design of a evapotranspiration/storage landfill cover.

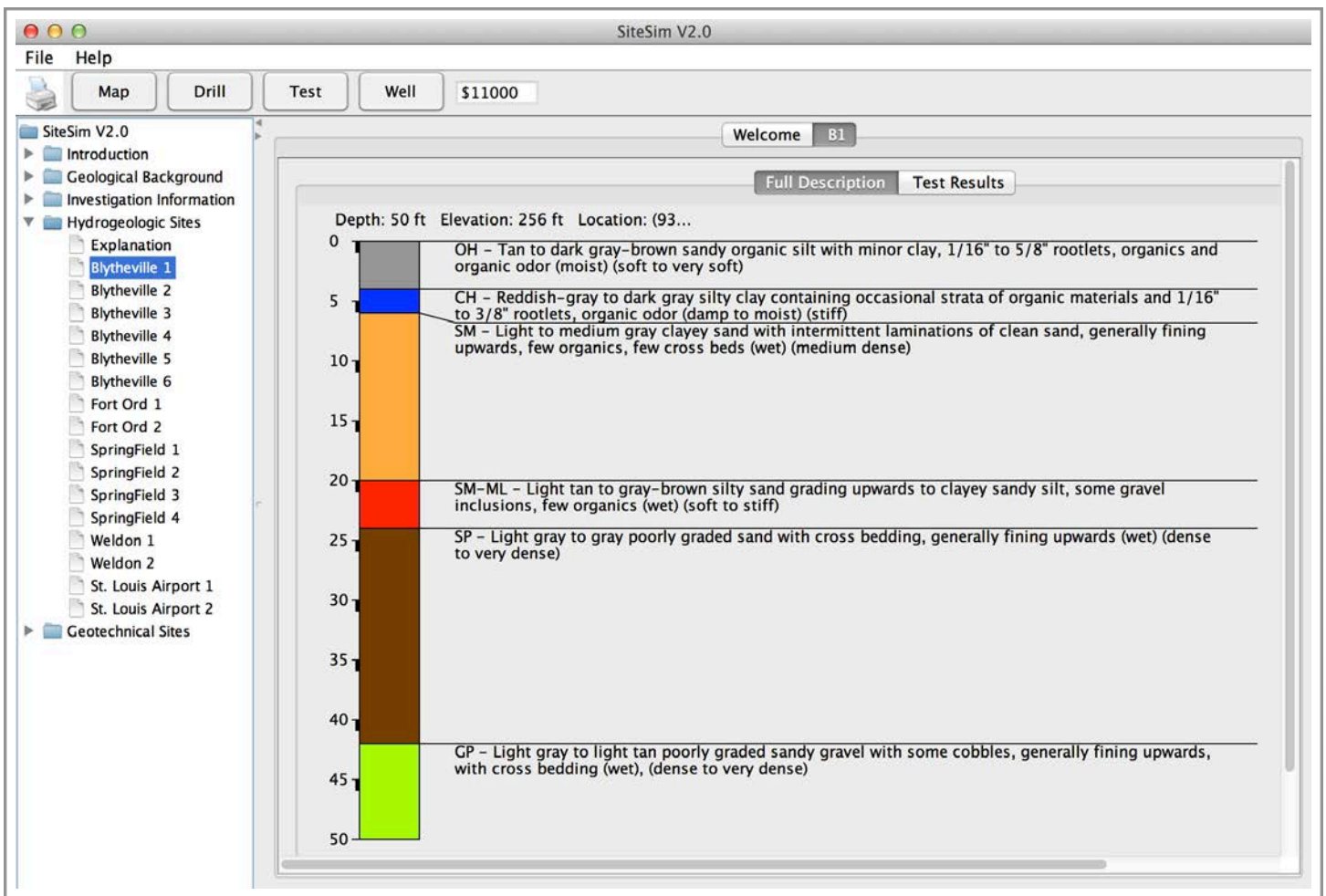


Field camp students week 4 in field area near Sagauche, CO.

GEGN 473 Geological Engineering Site Investigation

is designed to prepare engineering geology and hydrogeology students for the workplace. The course relies on applying knowledge of landforms, stratigraphy, structures, and petrology to typical techniques used to acquire information for investigations for water supply, contaminant, foundation, geologic hazards, and construction projects. Students log soil and rock borings, trenches, outcrops, and they design investigations for various types of projects. The labs culminate with three weeks using a software package, the Geotechnical and Hydrogeologic Site Investigation Simulator (GHYSIS), to run simulated investigations under the constraints of time, money, and limited data.

Geotechnical and Hydrogeologic Site Investigation program developed with NSF funding and used for GEGN 473 Site Investigation.



STRATIGRAPHY FIELD TRIP



The stratigraphy class gathers around on Torrey Beach as Piret discusses parts of the Torrey Sandstone. It was such a pleasure walking barefoot all day in the sun!

Deepwater Environments on an Active Margin

Nicole Allen

Piret Plink-Bjorklund's stratigraphy class had the opportunity to spend October 17-20th, 2014 near San Diego exploring different deepwater environments on the active margin. The trip focused on identifying the diverse nature of turbidity flows, hybrid flows, debris flows and slumps across various positions along the shelf-margin profile. Another objective of the field trip was to gain experience in drawing representative measured sections, including notes on composition, textures, sedimentary structures, bed thickness and boundaries, and depositional geometries. We learned that determining where you are in the submarine system is often an iterative process. The first day, we got a gorgeous overview of the city from the Cabrillo National Monument and spent the later part of the day looking at a Cretaceous forearc basin by learning about the Point Loma and Cabrillo Formations; we hypothesized these were deposited in outerdistal mid-outerfan or at slope base and inner or inter channels settings, respectively. In summarizing what we had learned that day, Piret posed questions on the beach and we concluded by playing double-dutch with long kelp strands. An awesome classroom!

On the second day, we traversed Torrey Pines State Reserve to Black's Beach to Scripps Institute of Oceanography in order to learn about an Eocene forearc basin. During our day-long beach transect we crossed over the Delmar, Torrey Sandstone and Ardath Shale Scripps Formations. These interpreted shallow marine environments were the shallowest environments we saw along the trip (except the San Onofre breccia) and contained the most terrigenous input. Surprisingly, we learned that channels do not always contain sand, but rather can contain much finer-grained material.



Day one after discussions and measuring sections.

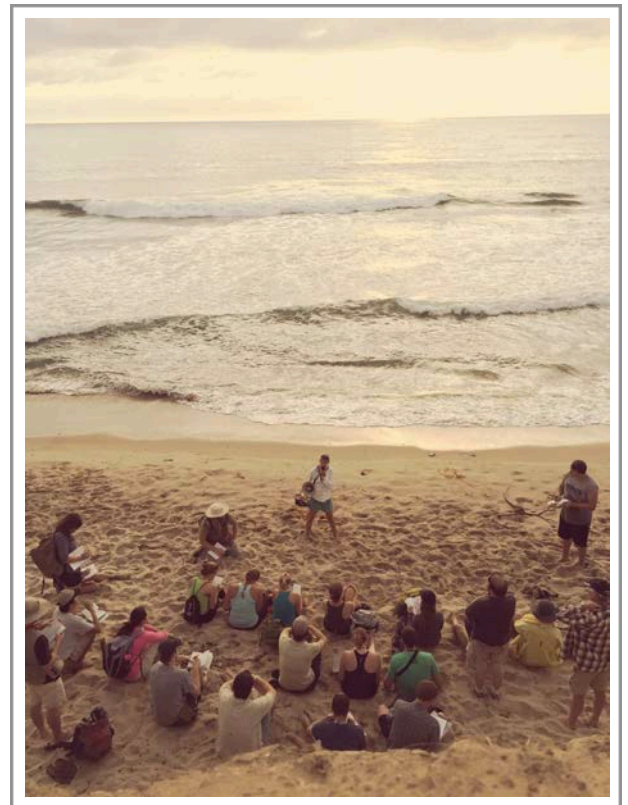
Swimming and body surfing became an active part of our lunch break; being able to study geology barefoot was an awesome perk too.

Day three was spent gaining an appreciation for a Miocene transtensional basin, a Pliocene transpression and continued Eocene forearc basin architecture. The Capistrano Formation outcrop, an hour north of La Jolla, was interpreted to be a lower slope-migrating channel environment. During this stop, one girl sneakily slipped pebbles into another student's backpack so naturally it

was hilarious when he eventually realized his bag was fifteen unwanted pounds heavier than normal. Our next stop after ice cream was the San Onofre breccia, which has spectacularly large clasts and was hypothesized to be from a subaerial alluvial fan. Our last formation stop that day was at dusk so it was hard to distinguish defining characteristics of the Pliocene San Diego Formation. That evening we proceeded to have the best fish tacos I've ever had! I think many of us were sad we did not find this cheap, local restaurant sooner.

On our final day, we explored a Cretaceous forearc basin by doing a representative measured section of the Point Loma Formation where it was agreed to be from an inner fan environment. Over thirty seals helped participate in this study with us. This part of the Point Loma Formation contained all the previously discussed turbidity current, hybrid flow, debris flows and slump deposits, making it a good final stop to wrap up the thought-provoking trip. Given that Golden, Colorado does not have any deep marine outcrops nearby, having the chance to study these systems with both a sedimentary stratigrapher and a tectonics geologist was a unique, fun opportunity. Personally, I love geology field trips because they enable the program to bond in a different way to other departments. I hope many of the CSM geology students will be lifelong friends as we continue along our geology career.

To conclude the first day, Piret lead a sunset discussion on the Cretaceous forearc basin.



FACULTY NEWS



‘Geological Field Research’ Taught by Yvette Kuiper

Dr. Kuiper taught this course for the second time in May 2014. The course is part of her NSF CAREER



grant. The course was taught in beautiful springtime eastern Massachusetts, where the rocks are deliciously deformed

and metamorphosed under the forces of the Appalachian orogeny. Two Colorado School of Mines, two Colorado College and three Boston College students took the course. The course focuses on geological field work through inquiry-based research and hypothesis-testing. It is geared towards students who will be conducting thesis research involving a significant structural mapping component. In the first week, students wrote a brief research proposal including hypotheses, tests and a work plan for the next two weeks. We studied appropriate literature and took an introductory field

trip to the field area. The second week focused on field work. In the third week, students prepared a geological map and appropriate cross sections, and a report presenting rock descriptions, structural analysis, a geological history, and interpretation of results in the context of the hypotheses posed in the proposal. The course forms a unique opportunity for the students to learn how to design and conduct a field research project, and present the results in an organized manner. They also have an opportunity to interact with and learn from students from other schools, who have different backgrounds and different learning and thinking styles (e.g. Liberal Arts). Skills acquired during the course are beneficial in their future careers, whether that is in academia or in industry. Yvette taught a modified version of the course in Fall 2013 in Colorado, which will become part of the standard curriculum in the future.

Photos on page 30: Students from Colorado School of Mines, Colorado College and Boston College examining rocks in the woods of eastern Massachusetts, as part of the Geological Field Research course.

Donna Anderson

received an AAPG Distinguished Service Award in 2014.

Jerry Boak

was one of 40 invited participants at a Ditchley Foundation conference (held outside Oxford, UK) entitled “The Shale Energy Revolution and Geopolitics.”

John B. Curtis

received the 2014 Public Service Award of the American Association of Petroleum Geologists on April 6, 2014. Curtis was honored for his extensive work in educating government officials and the public on matters involving the energy industry.

John Curtis moderated a panel discussion of “Energy from the Earth - Expanding Natural Gas Production: Opportunities and Constraints”. The panel was held

June 26, 2014 in the Longworth House Office Bldg., Washington DC. Attendees included the target audience of Congressional staffers and Congressional Research Service members and other professionals (including our own Maeve Boland!). The briefing was one of a series sponsored by AAAS, AAPG, AGU, AGI, AASG, GSA, NSF, SSSA and the USGS.

Murray Hitzman

was part of a Blue Ribbon Panel for an Organisation of Economic Co-Operation and Development (OECD) workshop: Prospects and Challenges of Deep-Sea Mining to 2030, held in Kiel, Germany, and



sponsored by the US State Dept. and OECD.

Murray Hitzman was awarded the coveted 2014 Daniel C. Jackling Award. Established in 1953 and funded by AIME, this award honors significant contributions to technical progress in mining, geology, and geophysics. The award was presented at the SME Annual Conference and Exhibit February 18, 2015, in Denver, Colorado. Murray’s citation will read, “For his outstanding achievements in mineral deposit research, his discovery of significant mineral deposits, his remarkable teaching and mentoring abilities and his leadership in professional societies related to mineral deposits.”

He continues his research into the geology and genesis of metallic ore deposits, particularly the

sedimentary rock-hosted Cu-Co and now Ni deposits of the Central African Copperbelt as well as iron oxide-copper-gold deposits. He also continues work on public policy issues related to natural resources development.

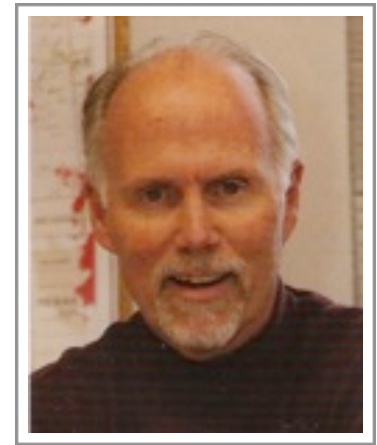
Piret Plink-Bjorklund

is the Convener for Siliciclastics Theme for AAPG/SEPM Annual Convention June 2015. She gave six invited presentations at universities and national and international conferences. She was recognized for the top-rated luncheon presentation of 2014 for RMAG for her talk “Fluvial megafans in the Uinta Basin, a consequence of extremely bad early Eocene weather?”.



Kamini Singha

has been elected to the Board of Directors of the Consortium of Universities for the Advancement of Hydrologic Science (CUAHSI).



Steve was honored with the CSM Foundation Outstanding Philanthropic Partner Award 2014. He was elected President of the “Friends of the CSM Geology Museum” for 2015. His book with co-author Richard Seeley “Elements of Petroleum Geology” was published in 2015.

Reed Maxwell

has been awarded the prestigious Belle van Zuylen Chair at Utrecht University for summer 2015. Normally awarded for distinguished authors and playwrights, this is the first one awarded in Hydrology. Reed and family will be in the Netherlands from May through July. This is a great accomplishment for him, and it really raises the profile of the department.

His research focuses on unconventional petroleum systems (from the micro-pore to outcrop scales). He runs three research consortia along with John Humphrey: Bakken, Niobrara, and Vaca Muerta. Each of these projects is multi-faceted (geology, geophysics, engineering) and industry supported. Monies from industry are used for tuition, fees, and stipends for students and laboratory analyses as needed.

Stephen Sonnenberg

and Craig Kaiser (MS GE '12) were awarded The Rocky Mountain Association of Geologists best paper award for 2014, for their paper “The Graneros-Greenhorn Petroleum System: Greater Wattenberg Area, Denver Basin, Colorado”.

Keith Turner

received two “rather nice awards this year” (his words):

- He was awarded The Schuster Gold Medal for North American geohazards research at the AEG Annual Meeting in September.

- He received The Burwell Award (jointly with Bob Schuster) at the GSA Annual Meeting in Vancouver in October. The Burwell was for the TRB Rockfall book that they co-edited for TRB.

John Humphrey continues to work closely with Steve Sonnenberg as co-PI on thriving industry-supported consortia. He and his students are working on various aspects of the Bakken, Niobrara, and Vaca Muerta petroleum systems. Ongoing work also includes the Eagle Ford Shale and future plans are to become involved with tight rocks of the Permian Basin. The stable isotope lab continues to support efforts in hydrogeology, mineral deposits, and petroleum geology.

John received the 2014 Alumni Teaching Award.

Morocco Field Trip

John Humphrey

Ten students and three faculty (Humphrey, Sarg, Emme) set out from Colorado on the 24th of May 2014, for a CSM AAPG Student Chapter field course on Jurassic carbonates and rift tectonics of the Central High Atlas Mountains of Morocco. Throughout the trip, spectacular geology was combined with stops of cultural interest, including visits to the imperial cities of Rabat, Fes, Meknes, and Marrakech.

The Central High Atlas exposes a stratigraphic basin fill succession. From the end of the Triassic through the Jurassic, the region was a rift basin that developed as part of the opening of the Atlantic Ocean. Early through

Middle Jurassic marine carbonates filled the rift. After a period of quiescence and burial, the rift basin experienced inversion, as northwest Africa collided with the Iberian Peninsula at the beginning of the Alpine orogeny. This basin inversion fully exposed the carbonate succession in the High Atlas. Fabulous exposures of carbonate environments include tidal flats, open shelf, reefs, shoals, platform margins, slopes, and basinal deposits. The field trip participants wish to acknowledge the generous support by the trip's sponsors: Anadarko, BP, Chevron, Rocky Mountain Petroleum Technology Transfer Council, and Whiting Petroleum.



Group photo in Meknes at the stables of 17th century King Ismail, who had 12,000 horses and 50 wives.

RESEARCH



Structural Geology and Tectonics Forum

Yvette Kuiper

The Third Biennial Structural Geology and Tectonics Forum was held at the Colorado School of Mines, June 16-18, 2014, under the lovely sunny skies of a surprisingly green Golden, Colorado. Four field trips and nine short courses/workshops were held in the two days before and after the Forum. Some 110 geoscientists attended the meeting and/or field trips and short courses. The National Science Foundation provided support for the Forum, resulting in zero registration fees, and support towards travel and accommodation for numerous attendees, especially graduate students and participants from four-year colleges. In addition, the GSA Structural Geology and Tectonics Division made a generous donation, and other forms of support came from the Colorado School of Mines Department of Geology and Geological Engineering and the Colorado College Department of Geology.

Eric Erslev explaining the geology of Eldorado Canyon on a field trip of the Structural Geology and Tectonics Forum.

The Forum provided an excellent environment for discussion of a wide variety of research and educational topics. The Forum itself was held as six one-session-at-a-time oral and poster sessions, giving plenty of time for discussion. Posters were up for the entire Forum. An hour of discussion time was included each day to discuss the future of the Forum, our newly approved bylaws, and general topics of interest to the Structural Geology and Tectonics community. Field trips took participants to various places in Colorado, including the Garden of the Gods, the Homestake Shear Zone, Big Thompson Canyon and Eldorado Canyon. Short courses included topics such as teaching using various strain analysis programs, Google Earth, Visible Geology, GPS data, and linear algebra, as well as microstructures, Ar/Ar illite geochronology and LiDAR. One evening during the Forum was dedicated to graduate student networking and advising and on another evening, participants had the opportunity to visit the Colorado School of Mines Geology Museum. Participants mostly stayed and dined at the University residences, close to downtown Golden providing additional opportunity for discussion over a meal, during a stroll along Clear Creek or over a beer at one of our local breweries.

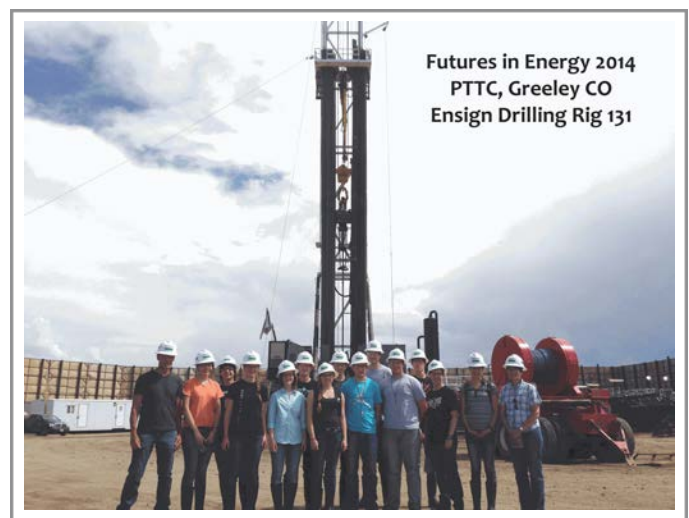
Abstracts, field trip and short course materials and other useful materials are available at: http://serc.carleton.edu/NAGTWorkshops/structure/2014_Forum_index.html (and links).

News from Rocky Mountain PTTC (Petroleum Technology Transfer Council)

Mary Carr

On Sept. 30, the Petroleum Technology Transfer Council and the National Energy Technology Laboratory contractually parted ways. This milestone represents the end of a 20-year relationship with the Department of Energy.

However, PTTC will continue to bring high-quality, low-cost workshops and symposia to your local area. We are exploring new funding resources and one of them is through Sponsorships. To learn more about becoming a sustaining sponsor of PTTC, please go to our website at www.pttc.org/sponsor.



The Rocky Mountain Region of PTTC has experienced another successful year of support by the Oil and Gas community. We held 21 workshops and field trips over 34 contact days with 700 attendees. We continue to work cooperatively with local societies: Montana Geological Society, Rocky Mountain Association of Geologists and the Rocky Mountain Section of AAPG. We held classes to help professionals brush up on their skills on the computer as well as improve interpretation skills.

Once again I had the opportunity to spend a week with a terrific group of high school students from across Colorado. These high achievers are interested in being the next generation of engineers and geologists. This year, with Andy Leonard as instructor, we trained 13 high school students in Golden, Colorado. Field trips were the highlight of the program (see photo) especially the tour of the Ensign Energy Services natural gas-powered drilling rig inside the Greeley city limits. The program is free to the students thanks to the continued support of the following companies that provided \$12,750: QEP, Nico Resources, RMS-AAPG Foundation, White Eagle

Exploration, Ensign Energy Services Inc., North Ranch Resources, LLC, Rocky Mtn. Association of Geologists Foundation, US Bank and SM Energy. For several years, the Rocky Mountain PTTC has enjoyed the unwavering support of sponsors involved with the Futures in Energy program.

COSTAR

Jeremy Boak

The Center for Oil Shale Technology and Research (COSTAR) is nearing the end of its third two-year phase, with Total the remaining participant supporting the research program. The COSTAR team is working to complete an integrated geologic framework for the Green River Formation in the Piceance Basin and coordinate efforts with the Uinta Basin Consortium. Teng-Fei Wu is preparing his Doctoral Thesis proposal to study the mineralogy and inorganic geochemistry of the Green River Formation in the Colorado reference sections, and possibly in Utah.

Rick Sarg and Jeremy Boak are preparing chapter submissions on geochemistry to a book on source rocks of the Rocky Mountains, edited by Michael Dolan for the Rocky Mountain Association of Geologists, and summarizing the stratigraphic and mineralogical interpretations to a volume on the Green River Formation edited by Michael Smith and Alan Carroll.

34th Oil Shale Symposium

Jeremy Boak

The 34th Oil Shale Symposium held at the Green Center at the Colorado School of Mines from October 13-15 highlighted significant progress in research and development of oil shale resources in the U. S. and around the world. Approximately 200 delegates from 13 countries and 18 states in the U.S. attended the two and one-half days of sessions on science, engineering, environmental, socioeconomic and policy issues relating to potential production of oil from oil shale. The program also included a tour of the Colorado Fuel Cell Center's Geothermic Fuel Cell test facility at the Colorado School of Mines.

On the opening day of the Symposium, representatives of AMSO, Red Leaf Resources, Enefit American Oil and Viru Keemia Grupp of Estonia presented status reports on their projects. Jeremy Boak, Co-Chair of the Symposium, gave a talk on the global status of oil shale development. World production has increased to 35,000 BOPD, although further increases may be tempered over the next two to three years by the decline in oil price.

The technical sessions included presentations from international oil companies like ExxonMobil, Shell, and Total, from companies and universities in Estonia, China,

Jordan, Israel, Canada, Australia, and Morocco, from U. S. universities and independent oil shale companies, and from the U. S. and Utah geological surveys. Total is partnered with two smaller American companies to test both surface retorting and in situ methods for production in the U.S. One of these, Red Leaf Resources presented nine papers on various aspects of their upcoming sub-commercial test. Enefit, the Estonian national energy company, presented papers on efforts in Estonia, Jordan, and the U.S. Jason Hanson of the Center of the American West in Boulder chaired a panel discussion on public perceptions of the oil shale industry. The U.S. Geological Survey presented results of analysis of mineral occurrences in the Green River Formation, based on qualitative X-Ray Diffraction data.

The Oil Shale Symposium is the premier international conference on the development of oil shale, which could potentially add another three trillion barrels of oil to global resources. For more information, see past Symposium Proceedings at: http://www.costar-mines.org/oil_shale_symposia.html and the 34th Oil Shale Symposium program (with hyperlinked abstracts) at: <http://mines.conference-services.net/programme.asp?conferenceID=4255&language=en-uk>

STUDENT NEWS



SEG Student Chapter members ready to go underground at the Revenue Mine in Ouray, Colorado. From left to right: Michael Berger, Shawn Lopez, Ambyr Douglass (SEG Secretary), Ryan Mulhall, Steffan Ball, Halley Keevil (SEG President), Brandon Meehl, Michael Hurth, Patrick Quigley, and Greg Hufford (SEG Vice President).

Society of Economic Geologists

Halley Keevil, President

The Fall 2014 semester started off with a bang for the SEG Student Chapter at the Colorado School of Mines, with the term commencing just weeks before the SEG conference in Keystone, Colorado. As such, many talented and well-respected professionals were able to come in and speak for the SEG Student Chapter while they were visiting Colorado. Keith Laskowski, Principal Mining Specialist at the International Finance Corporation, spoke to us about the financial side of the international mining and minerals industry. Dr. Jeffrey Hedenquist, world-renowned economic geologist and specialist on epithermal deposits, gave a talk on geochemical and ore deposit models. Dr. Dave Leach, expert on sediment-hosted base metal deposits and evaporites, also gave a fascinating talk to the SEG Student Chapter during the fall semester, and Dr. Jim Franklin of Franklin Geosciences spoke about the mineral potential of Ontario's far north. These are just a few examples of great speakers we hosted at CSM fall semester. We also hosted informal "Rock Talks", in which graduate students present their rocks, discuss their research, and receive feedback from fellow students. Many

more talks were scheduled for this spring, including the 2015 award-winning Thayer Lindsley lecturer Dr. Karen Kelly on April 8th.

In addition to bringing in these remarkable speakers, students were provided with networking opportunities with professionals and academics alike. During the Keystone conference, executives and geologists from First Quantum Minerals Ltd. generously agreed to meet with geology students at CSM to provide advice and answer our questions about the current mining industry. The close relationship the SEG Student Chapter maintains with the DREGS (Denver Region Exploration Geologists' Society) group allows us to network with many local professionals on a regular basis. Our department hosts a DREGS speaker on the first Monday of every month, and the SEG Student Chapter provides assistance with set-up at these meetings. DREGS often brings speakers in early just to meet with students. For example, Dr. Tommy Thompson from the University of Nevada, Reno, met with students prior to his DREGS presentation on Carlin gold deposits in November. He brought many interesting rock samples and gave us career advice, showing a presentation he had created solely for students.



Shawn Lopez, MSc student, showing off his high grade ore sample at the Revenue Mine.

Helen Gibson from Intrepid Geophysics conducted a two-day short course in September on how to operate the 3D Geomodeller software, which many students will use in their research and future careers. Additionally, Dr.

Michael Berger, MSc student, with bags of high-grade ore at the Revenue Mine.

Richard Goldfarb came to CSM in October to give a one-day short course on orogenic gold deposits to students and local professionals, and Britt Bluemel from REFLEX ioGAS taught a short course on how to use the ioGAS geochemical software.



A field trip to St. Peter's Dome in El Paso County, Colorado, was also conducted in October. St. Peter's Dome is a classic example of an alkaline, REE/HFSE-enriched granite considered to be a late-stage sodic series pluton within the larger "A-type" Pikes Peak Granite. This area has been poorly studied and despite its economic potential for rare earth element mineralization, the most recent academic work on the area was a 1962 PhD thesis! Phil Persson, SEG Field Trip Coordinator and MSc student studying such rare element mineralization, kindly led the field trip and explained the unusual and interesting rocks to fellow students and faculty.

During the spring of 2015, the SEG Student Chapter will concentrate on planning a 10 day trip to northern Namibia to view and understand the geology and mining activity of this part of the country. The trip will be led by Dr. Murray Hitzman and Dr. Roy Miller of the Geological Survey of Namibia, and

it is sure to be the experience of a lifetime! We are also planning a long weekend trip to Missouri in order to visit the world-class Viburnum Trend Zn-Pb deposits that the area is known for. Phil Persson has led two local SEG field trips this spring so far: one to Golden Gate Canyon State Park for uranium-bearing minerals, and one to North Table Mountain for zeolite crystals. For those of you who would like to participate in local field trips, keep your eyes peeled for e-mails regarding trips to the Jamestown rare mineral occurrences and the Stateline kimberlite district. Local mine trips are also being planned, and our first underground mine trip of the year was held at the Revenue Mine in Ouray, Colorado, in February. The SEG speakers for the spring semester are scheduled for Wednesdays at 12:00pm in BE 108, and we hope you can all make it to these talks!

The SEG Student Chapter would like to thank Dr. Murray Hitzman, Dr. Thomas Monecke, and Dr. Elizabeth Holley for their help and support with the activities of the SEG Student Chapter. We would not have made it very far without the assistance of Debbie Cockburn and Cheryl Medford, who are always there for the SEG Student Chapter and ensure everything runs smoothly in the Department. Lastly, we would like to thank the personnel at the SEG headquarters and the academics and industry professionals who have kindly donated their time and expertise for the sake of the students in the Department of Geology and Geological Engineering at the Colorado School of Mines. We are looking forward to a great year in 2015, and encourage anyone to join the SEG Student Chapter if you haven't already!

To contact the SEG Student chapter, e-mail Halley Keevil at hkeevil@mymail.mines.edu or Greg Hufford at ghufford@mymail.mines.edu.

http://www.segweb.org/SEG/Students/Student_Chapters/SEG/_Students/Student_Chapters.aspx

America Association of Petroleum Geologists

Steve Brennan, President

The 2014-2015 officers of the AAPG Student Chapter had the benefit of following the many successes of previous years. However, it was our objective to evade complacency and strive to further advance the mission of the AAPG on the Mines campus. We adopted a motto of "Raising the Bar" of our own expectations. This year's chapter hosted a record 27 Lunch & Learns (1 per week fall/spring), 7 social and outreach events, 5 domestic field trips, 1 international field trip (Belize), 6 technical workshops, and 4 community service events. Our student chapter is considered a Tier 3 campus based organization, and we are certainly one of the most active groups at Mines.

We had three core goals for the school year. First, we worked to involve more undergraduate students in the student chapter by better accommodating their class schedules with our events. Historically, the Mines AAPG has been predominantly composed of graduate students. The undergraduate students have much to offer, and we hoped to better involve them this year. Second, we aimed to offer more programming across disciplines on campus, both technical and non-technical. Examples of this included: our fall semester social with the Society of Economic Geologists and our spring outreach event hosted jointly with SPE, AADE, ARMA, and the Jefferson County Energy Action Project (Switch documentary screening and panel discussion). Third and perhaps most important, we aimed to enhance our role as a campus and community based organization. This was accomplished by holding two service events in the Golden/Denver metro area. In the fall, 21 students

participated in a Habitat for Humanity “group work day”, and in the spring over 30 students volunteered to work Golden’s Ullr Grass music festival.



AAPG students joined for a group work day with Habitat for Humanity north of Denver (October 17, 2014). Projects included: landscaping, exterior painting, installing drywall, and roofing.

Our student chapter was fortunate to hold six field trips throughout the school year with the generous support of industry and AAPG Foundation donations. Dr. Donna Anderson (CSM and EOG Resources) led 22 students to Pueblo, CO on a rare warm day in November to evaluate Cretaceous mudrocks in outcrop. The excellent exposures and abundant fossils make this a classic area for defining biostratigraphy and physical stratigraphy of rocks deposited during the Cenomanian through Campanian stages. Spring field trips included: the National Ice Core Lab (Lakewood, CO), the

exquisite outcrops of carbonate and deepwater siliciclastics of the Guadalupe Mountains with Dr. Rick Sarg (West Texas and Southeast New Mexico), a transect of Mesozoic paleogeography in collaboration with CoRE (Utah and Colorado), an investigation of the enigmatic Monterey petroleum system with Dr. Larry Meckel (Santa Barbara, CA), and a visit to the mixed carbonate and siliciclastic environments of Belize led by Dr. André Droxler from Rice University.

The Mines AAPG Student Chapter has over 90 registered members. We expect the downturn in the oil and gas industry may impact fund raising in the 2015- 2016 school year, however, we’re confident that next year’s officers will



AAPG students gathered in front of El Capitan peak in the Guadalupe Mountains of West Texas and Southeast New Mexico (March 7-11, 2015). Dr. Rick Sarg led them through world renowned outcrops of seismic scale examples of sequence stratigraphic packages.

be adaptable and find ways to mitigate such challenges. We're thankful for the continued support of the AAPG Foundation towards student chapters across the globe. The AAPG ACE annual convention will be hosted in Denver this summer. Our student chapter will be a major contributor to the event. If alumni are interested in attending future events or would like to give a presentation to the student chapter, please don't hesitate to contact any of the current/future officers through the chapter email (csmaapg@gmail.com).

2014-2015 Officers: Steve Brennan (President), Spencer Rolfs (Vice President), Katie Logan (Treasurer), Rana ElGhonimy (Secretary), and Dr. Steve Sonnenberg (Faculty Advisor)

Student News

Travis Brown (Hydrology) received first place as part of the winning team in the 2014 Geothermal Case Study Challenge, sponsored by the Energy Department's Office of Energy Efficiency and Renewable Energy. They published their case studies on OpenEi.org, a Wiki for energy information (advised by Dave Benson).

Robert Duran's poster on "Application of Discontinuity Multivariate Clustering Analysis in Support of Rock Mass Characterization for a Small Scale Hydrothermal Fluid Flow Study at the Edgar Mine in Idaho Springs, Colorado" won the Geology and Geological Engineering Award Colorado at the School of Mines Graduate Student Government hosted Conference on Earth and Energy Research in the Green Center, an event that showcases graduate student research (advised by Wendy Zhou).



Congratulations to our 2014 CSM IBA Team!! The CSM team of: Stephen Brennan, Jennifer Brush, Joshua Day, Rana ElGhonimy, and Spencer Rolfs, placed Third in the National AAPG IBA competition held April 5 in Houston, TX. They competed against regional winners from the Eastern, Gulf Coast, Mid-Continent, Pacific and Southwest sections, along with teams representing Africa, Asia/Pacific, Canada, Europe, Latin American and the Middle East.

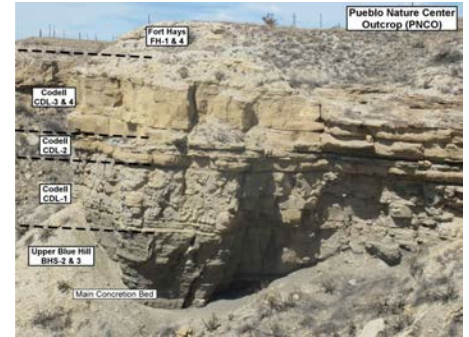
Elena Finley won the Runge Award (Best Student presentation) RMS AAPG 2014!

Mohammed Al-Duhailan won 2nd best student paper award at the AAPG ACE 2014. Mohammed also won the AAPG Energy Mineral Division's President's Certificate for Excellence in Presentation (Paper) for his paper titled, "The Curious Case of Hydrocarbon-Expulsion Fractures: Genesis and Impact on the Bakken Shales" (advised by Steve Sonnenberg).

Kevin McCoy received a Best Student Presentation award from the Geology and Society Division of GSA (advised by Paul Santi).

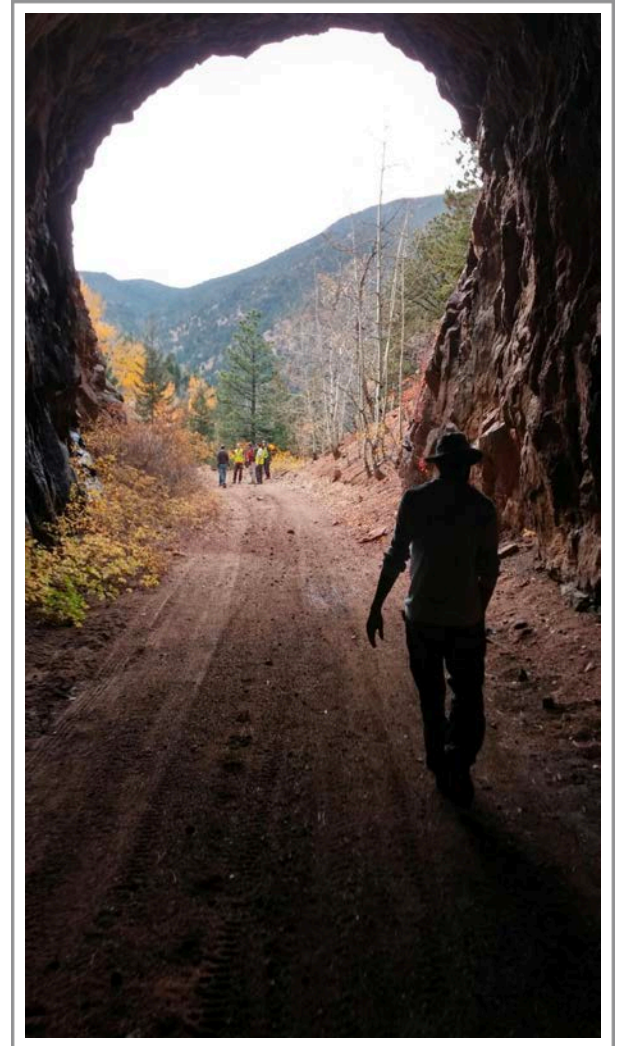
Student Support

Nicole Allen	First Quantum Minerals Ltd.
Ashley Anderson	James L. and Arlene H. Payne Fellowship
Matthew Andresen	Chevron Center of Research Excellence
Stephen Ball	ENRC
Matt Belobraydic	ADMC Consortium/Green River Consortium, Schlumberger
Michael Berger	U.S. Bureau of Indian Affairs
Kyra Blaco	Niobrara Consortium
Emma Bradford	Department Teaching Assistant Funds
Steve Brennan	Bakken Consortium
Peter Brice	Endeavour
David Broughton	Ivanplats
Hayden Brown	Department Teaching Assistant Funds, National Interagency Fire Center
Nathan Brown	Bakken Consortium
Wesley Buchanan	NSF Career Grant, Department Teaching Assistant Funds
Wes Bucker	Department Teaching Assistant Funds
Grainne Byrne	ENRC
Franki Carver	Marathon, Hemmesch Fellowship



Robert Charnock	NSF Career Grant, GSA Grant, Department Teaching Assistant Funds
Alyssa Charsky	Chevron Center of Research Excellence
Douglas (Ty) Conner	Nova Copper
Brandon Conway	Robert Allardyce Scholarship, Greater Denver Area Gem & Mineral Council Scholarship, GE Faculty Scholarship, Rex Monahan Scholarship, Questar Scholarship, Department Teaching Assistant Funds, Devon Energy Scholarship
Lauren Cross	Fred F. Meissner Scholarship, Apache Field Camp Scholarship
Paige Coufal	Florida Department of Health
Celena Cui	Newmont Mining
Paige Cybulski	Department Teaching Assistant Funds, Niobrara Consortium, Harry Kent Scholarship
Ben Dellenbach	Vaca Muerta Consortium
Andrew Dietrich	National Interagency Fire Center, Harold Hickey Fellowship
Ian Donovan	Department Teaching Assistant Funds
Casey Dowling	NREL, Colorado Geological Survey
Robert Duran	Niobrara Consortium
Hannah Durkee	Department Teaching Assistant Funds, NSF Graduate Research Fellowship
Rania Eldam	Undergraduate Research Fellowship
Abdulah Eljalafi	Department Teaching Assistant Funds, GSA Roy J. Shlemon Scholarship
Ethan Faber	Bakken Consortium
Ellen Fehrs	Goldcorp, Inc.
Matt Fithian	Stewart Wallace Graduate Scholarship, Barrick Gold Scholarship
Lauren Foiles	Bakken Consortium
Alyssa Franklin	Vaca Muerta Consortium
Jessica Franklin	Bakken Consortium
James Frederick	Bakken Consortium

Ben Frieman	SEG Grant, GSA Grant, Department Teaching Assistant Funds, Kuiper start-up funding
Caleb Garbus	Undergraduate Research Fellowship, Kuiper start-up funding
Joseph Gartner	U. S. Geological Survey
Isabel Gary	Niobrara Consortium
Karena Gill	C. Richard Wagner Scholarship
Tsolmon Gonchig	Oyu Tolgoi LLC
Andrew Graham	Bakken Consortium
Wesley Hall	Cupric Canyon Capital, Discovery Metals
Charlie Harman	Whiting Oil & Gas
John Harper	Niobrara Consortium, Devon Energy Scholarship
Ben Haugen	National Science Foundation
Amelia Hayes	Department Teaching Assistant Funds
Mehmet Hazar	Turkish Petroleum Corporation
Lindsay Hefton	Niobrara Consortium
Dina Hegazy	Vaca Muerta Consortium
Andrew Heger	Niobrara Consortium
Carlos Hernandez	Newmont Mining
Eider Hernandez-Bilbao	Vaca Muerta Consortium
Matt Herzog	Vaca Muerta Consortium
Marcus Hinricher	Niobrara Consortium
Anna Hissem	Department Teaching Assistant Funds
Marta Hodan	ADMC Consortium/Green River Consortium, Anadarko Petroleum Fellowship, Orlo Childs Fellowship, Nikki Hemmesch Fellowship, Marathon Oil Fellowship, John S. Phillips Fellowship, Paul S. Pustmueller Fellowship, Devon Energy Scholarship
Zachary Hollon	Robert and Ruth Weimer Fellowship
Elizabeth Horn	ConocoPhillips Fellowship
Pengfei Hou	Chevron Center of Research Excellence
Danielle Hunt	Robert Hutchinson Fellowship
Michael Hurth	First Quantum Minerals Ltd., Fogarty Fellowship
Evan Jones	ADMC Consortium/Green River Consortium, GSA research grant, BP Fellowship
Heewon Jung	CSM First Year PhD Fellowship
Katy Kaproth-Gerecht	NSF Fellowship
Amy Kenwell	Department of Energy
Niko Kernan	Niobrara Consortium
Mason Kreidler	Center for Underground Construction and Tunneling
Fabien Laugier	RioMAR Consortium, BP Fellowship
Katie Lehman	RPSEA
Gary Listiono	Bakken Consortium
Thomas Lockwood	Bakken Consortium
Ben Lowry	CGG Geoscience Company
Madison Lytle	John S Phillips Memorial Scholarship, Geochemistry Fellowship, GE Education Fund
Claire Maddox	Greater Denver Area Gem & Mineral Council Scholarship, Stewart Wallace Scholarship, William Y Klett, Jr. Scholarship
Ryan Marsters	Colorado Geological Survey
McKenzie Mason	Frank and Peter Andrews Scholarship
Kevin McCoy	National Interagency Fire Center, Department Teaching Assistant Funds, Mesa County, AEG Stout Scholarship
Bryan McDowell	REPSEA, DOE, BP Fellowship
Mack McLain	AEG Tilford Scholarship, Harold Hickey Fellowship, Weldon Frost Fellowship



Kaleb McMaster	NSF Career Grant, Undergraduate Research Fellowship
Corey Meighan	USGS, First Quantum Minerals Ltd., Fogarty Fellowship
Matt Minnick	RESPEC Consulting & Services
William Minor	AEG Foundation Beardsley-Kuper Scholarship
Nathan Mollica	Fred Meisner Memorial Scholarship
Ryan Mulhall	John Steven Cone Memorial Fellowship, Stewart Wallace Graduate Scholarship, Geochemistry Fellowship, Harold Bloom Fellowship
Devin Murray	Niobrara Consortium
Kazumi Nakamura	Niobrara Consortium, Whiting Oil & Gas
Dipanwita Nandy	Bakken Consortium
Miguel Nassif	Capes Foundation (Brazilian Federal Fellowship)
Mohammad Naqi	Kuwait University
Jackie Negri	Federal Highways Administration, U.S. Geological Survey
Zach Newnam	Chevron Fellowship, Daniels Graduate Fellowship, John and Lois Haun Fellowship, Nikki Hemmesch Fellowship, Marathon Oil Fellowship
Bradley Nuse	Chevron Center of Research Excellence
Kimber O'Brien	BP Fellowship, Chevron Center of Research Excellence
Denton O'Neal	Niobrara Consortium
Kenya Ono	RioMAR Consortium, INPEX
Justin Palmer	ITAC Resources, Ltd., SEG Grant
Chris Pederson	John & Carolyn Mann Fellowship
Jesse Pisel	Chevron Center of Research Excellence
Claire Pless	Department Teaching Assistant Funds, Chevron Fellowship
Alvaro Puente	Department Teaching Assistant Funds
Patrick Quigley	James L. and Arlene H. Payne Fellowship
Mandi Reinshagen	Rare Element Resources
Jennie Rietman	Niobrara Consortium
Tony Rios	Bakken Consortium
Amanda Rock	Harold Hickey Fellowship, Weldon Frost Fellowship
Spencer Rolfs	Bakken Consortium
Cole Rosenbaum	David Bolin Scholarship, Greater Denver Area Gem & Mineral Council Scholarship
Allison Schaiberger	UNGI Eagle Ford Consortium, ConocoPhillips Fellowship
Stephen Schwarz	Chevron Center of Research Excellence
Stephen Semmens	Jack R and Mary D Weber Fellowship, National Science Foundation
Colgan Smith	John Poate Ph.D. Fellowship
John Stammer	Niobrara Consortium
Josh Stewart	John and Carolyn Mann Graduate Fellowship
Ryan Swanson	NSF Fellowship
Michael Sweetenham	Center for Underground Construction and Tunneling
Carter Timbel	Chevron Fellowship, BP Fellowship, Devon Energy Scholarship
Bulut Tortopoglu	Turkish Petroleum Corporation
Andrew Van Deusen	Stewart Wallace Scholarship
Emily Voytek	Poate Fellowship, GSA research grant
Jianqiao Wang	ADMC Consortium/Green River Consortium, REPSEA, DOE, Department Teaching Assistant Funds
Robert Weber	RPSEA
Mitchell Weller	BP Fellowship, Daniels Graduate Fellowship, Nikki Hemmesch Fellowship, Marathon Oil Fellowship



Amanda Wescott
Travis Wokasch
Long Wu
Jinqi Xu
Kristi Zellmann

Bakken Consortium
Department Teaching Assistant Funds
GSA Research Grant, GSA Structural Geology and Tectonics travel award, China Scholarship Council
Bakken Consortium
ADMC Consortium/Green River Consortium, Anadarko Petroleum Fellowship, USGS

Murray Hitzman, left, David Broughton, right

Alumni News

David Broughton, (PhD GE '14) was awarded the prestigious Thayer Lindsley Award from the Prospectors and Developers Association of Canada (PDAC) for the discovery of the Kamao copper deposit in the Democratic Republic of Congo. The award, presented annually by the PDAC, is its highest award for mineral exploration and recognizes an individual or team of explorationists credited with a recent highly significant mineral discovery anywhere in the world. The Kamao deposit formed part of Dr. Broughton's PhD dissertation under advisor Dr. Murray Hitzman. Dr. Hitzman and CSM were cited during Broughton's acceptance speech in Toronto on March 3, 2015.



FIELD CAMP

Cole Rosenbaum

Field Camp at Mines is a time-honored tradition and a sort of rite of passage as a geologist (and required for graduation). Those who have completed Field Camp often describe it as 'the best experience they never want to relive'. Field Camp teaches one more about geology and ones' classmates than one may have thought possible (or desired).

At Mines we have the privilege to not only spend six weeks in some of the most beautiful locations in the world with a vast variety of exciting geology, but also to be led by professors with a gift for developing our field geology skills. We would not have found success throughout Field Camp without the gentle and sometimes stern guidance of our professors and teaching assistants (TAs).

The six-week Field Camp program at Mines involves geologic field mapping and interpretation of a wide variety of geology, from surficial mapping of glacial deposits in Durango, Colorado to mapping the variable volcanic deposits near Saguache, Colorado to mapping salt-related relay ramps and cross-bedded sedimentary units near Moab, Utah. Armed with rock hammers, scribes, acid, all the necessary and unnecessary mapping, hiking, and camping equipment, and our initial geologic mapping experience, we endeavored on six of the most challenging and rewarding weeks of our lives.

Week 1 – Moab, UT

When asked, most the members of the class of 2015 describe Moab as one of their favorite, but chaotic weeks. We battled the winter wrath of Mother Nature on the way to Moab, pressing through blizzard conditions just to make it to Moab. With



The road to our mapping area near Delicate Arch was flooded and covered in sediment from the same storm we battled on the drive to Moab which provided us with awesome ripples and liquefaction to study and a little extra hiking (photo credit: Connor Wallace).



Taking a quick break from mapping to take in the beautiful view of Delicate Arch (photo credit: Rachael Hallnan).

everyone safely in Moab and checked into the Lazy Lizard Hostel, we started our first Sunday evening briefing and began preparing for the week to come.

We were led first week by Dr. Bruce Trudgill, Dr. Christian Shorey, and Dr. Mary Carr and TAs Carter Timbel and Katie Lehman during our three days mapping sedimentary units and salt-related tectonic features near Delicate Arch in Arches National Park and two days in Mill Canyon north of Moab. With great outcrop exposure around Moab, faults could be mapped in detail and sedimentary structures could be observed and studied. The first week of Field Camp was an intense introduction of the work to come, but offered rewarding views and beautiful geology and our first opportunity to begin really getting to know each other.

In addition to strengthening some hard skills relating to geology, we also learned a few soft skills:

- What some consider a large jump can actually mean a cliff if you value your knees
- Formation names can be easily remembered when varied slightly to be a tad more entertaining
- It is difficult to distinguish between a very talented person's screech and a real life pterodactyl
- Karin is your friend and helps you locate the trail

Week 2 – Durango, CO

After taking a much-needed break the weekend after Moab by visiting Mesa Verde National Park and traveling through the beautiful San Juan Mountains, we reunited in Durango, Colorado to begin mapping deposits as different as the setting. Dr. Paul Santi and Dr. Wendy Zhou



Beautiful cross-bedding in front of the ever-so-helpful AhHa Butte in Arches National Park.

and TAs Kevin McCoy and John Kranz were excited to greet us in Southwestern Colorado. Mapping glacial deposits and completing an aggregate resource evaluation in Durango took roadside mapping to a new level.



Austin Wilkes expressed his excitement for glacial and alluvial deposits while taking in the beautiful view in Durango, Colorado (photo credit: Rachel Hallnan).

While living in the luxury of the Fort Lewis College dormitories and having shuttle service to and from field sites, we learned how to identify glacial moraines and outwash and distinguish them from human re-grading. Our navigation skills transitioned to finding sidewalks and public land where we could get the best views of the glacial deposits within the city limits of Durango. Despite the cushy accommodations and city amenities, we quickly learned discerning a moraine from an outwash is quite challenging; however, with practice and some help from the professors and TAs we were able to estimate aggregate resources for the City of Durango.



Mapping with stereopair in style and the comforts of Fort Lewis College (photo credit: Rachel Hallnan).

Additionally, we took a field trip on Wednesday to explore some of the local engineering geology. John Ey, Reservoir Superintendent for Lemon Reservoir, gave us a site tour of the Lemon Reservoir and Dam and discussed his innovative and resourceful methods for mitigating post-wildfire debris flows that threatened the reservoir. We then visited some recently active landslides and discussed different mitigation methods and how effective or not so effective they were. We concluded the field trip by examining debris flow deposits and rockfall hazards.

Similar to week one, we also learned a variety of soft skills:

- Nothing concludes a day of mapping better than delicious BBQ and an intense intra-department soccer game
- Plan your mapping to make happy hour at Sonic
- Cookies are also deposited in moraines, outwashes, and terraces

Week 3 – Salida, CO

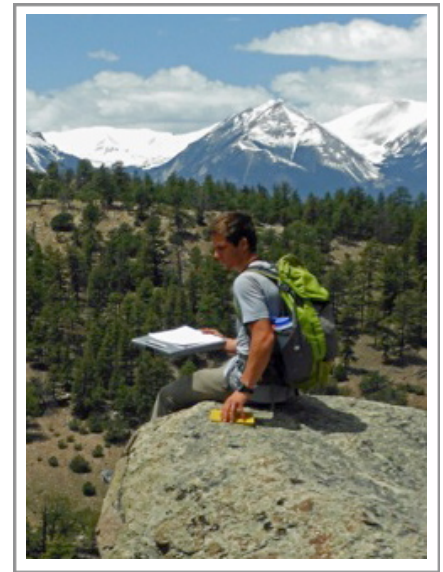
Once we wrapped up our maps in the luxury of Durango, it was time to travel to Salida and emphasize the camp part of Field Camp. After heavy rains rendered the access road to the campsite in Salida, Colorado nearly impassible, the skies finally cleared and we were able to meet Dr. Alexis Sitchler, Dr. Rick Wendlandt, and Dr. Nigel Kelly and our TAs Chris Enright and Nate Mollica. We provided quite the entertainment for the

professors and TAs as we struggled to assemble the large group work tents. Once our gear was all in place, we had our weekly briefing about the week to come, and the cooking of diverse and amusing camp dinners began.

We began the week with Dr. Wendlandt driving the herd of students through the stratigraphy of the site at a brisk pace. With knowledge of the stratigraphy, we dispersed and began our mapping. This was the first week we were mapping metamorphic, igneous, and sedimentary rocks all at once. With less outcrop exposure than Moab, we learned to use marker beds and float to map the geologic units. The week was also unique in that we were able to collect excellent mineral specimens including garnet and epidote. The mid-week BBQ was a hit as usual, providing that extra motivation to finish the week strong and with a stomach full of delicious fajitas. The week concluded with the typical frantic coloring of maps, writing of reports and a feeling of accomplishment.

The soft skills learned in Salida include:

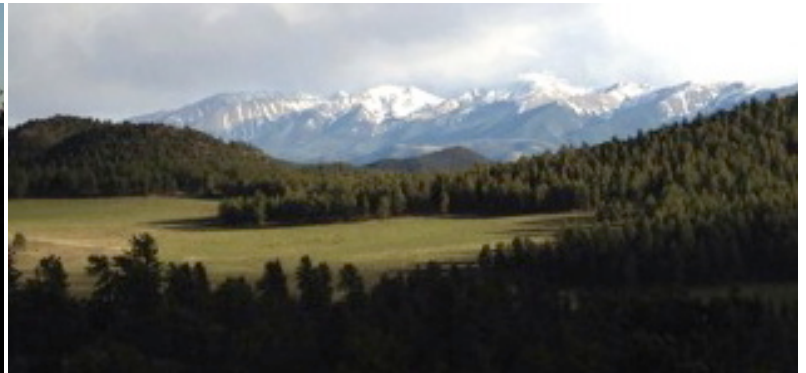
- Wet wipe showers and generous deodorant application keeps the relationship with your mapping partner positive
- You cannot get orientation measurements from magnetite using a compass
- It takes a lot of rock and dirt engineers to set up work tents
- Sunsets and sunrises in the Rockies are breathtaking
- Campfires are a welcoming place to socialize and make s'mores
- Stopping for a moment and taking in your surroundings cures even the worst mapping frustrations



Best mapping view in the whole area. Who said you cannot map on your butt?



A view that makes waking up before dawn worthwhile!



Every way we looked the views never ceased to amaze...I knew there was a reason I picked this major (photo credit: Rachel Hallnan).

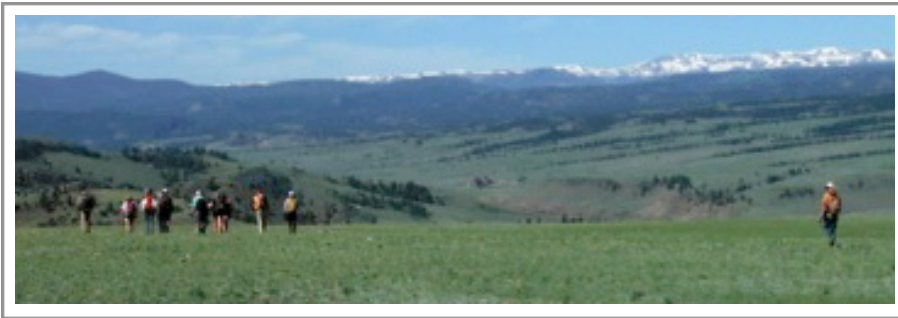
Week 4 – Saguache, CO

Week three got us into the camping mode and we were excited to take on what was rumored to be one of the toughest weeks of Field Camp: Saguache, Colorado. Our professors for the week: Dr. Rick Wendlandt and Dr. Nigel Kelly and TAs: Chris Enright and Lyndsey Fisher did not receive the same level of entertainment as did

the professors and TAs from week three while we set up the work tents as we had developed a much more efficient system. Once the camping equipment was assembled, we met as usual for the weekly briefing. We learned we would be mapping an assortment of volcanic deposits in a field area of 12 square miles. The professors split the mapping area into a northern and southern section, and we were assigned one section and a mapping companion that would complete the opposite section.

The stratigraphy was shown to us Monday morning, and we were released to begin mapping that afternoon. We quickly learned that one of the tuffs we were mapping made a distinct “clunk” noise when hit with the rock

hammer. We also learned that volcanic deposits really have no regard to lateral continuance and have a mind of their own. The Wednesday BBQ was highly anticipated as the tuff turned out to be quite tough to map. Steak and fish were a sure remedy for lost motivation and provided the push to get back out and map. Despite the challenges of the week (such as running from rattlesnakes), we learned



Expansive mapping area near Saguache, Colorado.

to focus on the details and mineralogy of the outcrops to distinguish units and how to increase our efficiency to cover a larger field area.

While covering a large field area, we learned a few lessons:

- You cannot cut steak with a camping spork
- Rattlesnakes are best left to themselves
- The wind in southern Colorado will make you feel as if you are in a hurricane

Week 5 – Molas Pass, CO

With two weeks of camping under our belts we were excited to make our last week mapping together an experience to remember. Dr. Donna Anderson, Dr. John Humphrey, and Dr. Steve Sonnenberg were aided by TAs Eider Hernandez-Bilbao and Nate Mollica week five at the Molas Lake Campground, Colorado. Although we were professional tent pitchers by this point, strong winds, snow, and ice tested our abilities as we set up the tent in a small snowstorm. Once the tents were up, we quickly turned on the propane heaters and huddled in the work tents for our last weekly briefing together. Dr. Humphrey taught us the motto for the week: “This is how we do it fifth week,” and provided a refresher on karst geology and information about the field area.



Frantically assembling the work tents at Molas Lake Campground as a snowstorm begins.

Monday morning we emerged from our snow covered tents to begin mapping the metamorphic and sedimentary units that surrounded our camping area. The mapping area looked to be out of a calendar it was so beautiful. The crisp morning air got us moving quickly as we prepared for the day. While the professors were providing us



Above and right: Fifth week included some of the most beautiful lunch spots (photo credit: Connor Wallace).

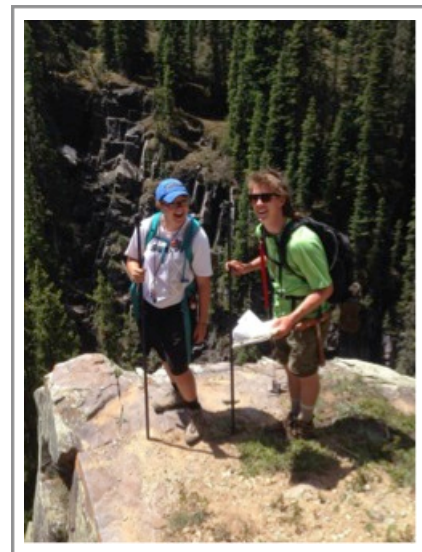
an overview of the stratigraphy, Dr. Humphrey demonstrated the fossil dance which we were to perform when we found a fossil, which happened frequently. The week involved mapping metamorphic and sedimentary units that featured modern and ancient karst features such as sinkhole ponds, pinnacles and disappearing streams.

Living up to the ‘this is how we do it fifth week’ slogan, one of the students found a very complete crinoid fossil that instigated celebratory fossil dances from many. The slogan lived on at the

Wednesday BBQ as we enjoyed delicious steak, fish, beverages, and an epic wiffle ball game between the exploration geologists



and geotechnical engineers. I won't say the outcome of the game, but Umpire Humphrey (Humpire) should check his message machine because he was missing calls left and right. After the fun wiffle ball game, the festivities ensued around the campfire as stories were told. The next day we traveled to a section of the mapping area known as The Swamp. As Dr. Humphrey led us through The Swamp, we felt as if we were going to find Yoda on the



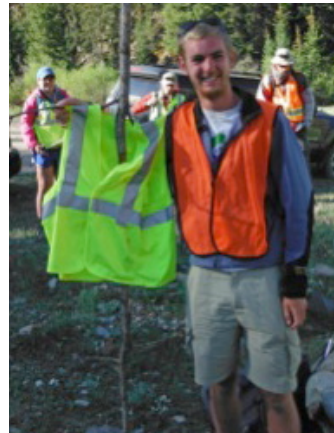
Having fun in the sun while measuring section with Jacob's Staff (photo credit: Kelsey Lewis).

Degobah Planet. As usual, maps and reports were frantically completed in the last hours before they were due Friday morning. Week five taught us not only important mapping skills, but also how to have a lot of fun while mapping.

Fifth week did not fail to provide ample learning opportunities beyond those related to geology:



- Pink flags make much better markers than green flags in the forest
- Umpire Humphrey should stick to his day job due to some questionable game calls
- No matter how small the stream crossing, you can still fall
- Secure all items in your backpack before tossing it across the stream or something will end up floating down the stream, and it will inevitably be your field map
- There are numerous beautiful lunch spots in the mapping area
- Warm sleeping bags are a hot commodity when camping at an elevation of 10,500 feet



Left: Silverton crew at an outlook on Red Mountain Pass on the Million Dollar Highway. The Pass has many examples of exciting engineering geology in a stunning setting. Middle: Our trusty mapping partner in Silverton helped us map surficial deposits...safety first! Right: Silverton crew atop the Morrow Point Dam on the Gunnison River. The tour inside and outside the dam was a sure highlight for everyone that attended.

Week 6 – Variety

The conclusion of week five was bittersweet: it meant we only had one more week until our completion of Field Camp, but it was also the last time we would all be together. Week six students could choose between underground mine mapping at the Edgar Mine, the CSM Experimental Mine in Idaho Springs, Colorado, studying sedimentary and petroleum geology in Wyoming, and surficial mapping in Silverton, Colorado.

I cannot speak for the other locations, but those in Silverton had a great time mapping surficial deposits as a part of a feasibility study for a new resort. We spent our days mapping in a beautiful glacial valley and evenings working in the local library with a librarian that brought us fresh cookies. We made sure to continue the fun and dancing from fifth week and made the last week really count.



Week six group at Dinosaur National Monument overlook of the Weeber Sandstone.

Conclusion

Field Camp proved to be an amazing experience, immersing us in the process of geologic mapping surrounded by experienced and helpful leaders and our classmates who came to be some of our best friends. Although the geology we studied was ever metamorphosing from week to week, our companions were not; the support and teamwork amongst classmates built relationships that will surely not weather.

Theses Completed May 2014

AL IBRAHIM, MUSTAFA ALI H – M.SC. – GEOLOGY

Sequence Stratigraphy, Cyclostratigraphy, and Depositional Environment of Carbonate Mudrocks: The Case of the Tuwaiq Mountain and Hanifa Formations, Saudi Arabia (Adv. Dr. Sarg)

BAZZELL, AARON C. – M.SC. – GEOLOGY

Origin of Brecciated Intervals and Petrophysical Analyses; The Three Forks Formation, Williston Basin, North Dakota, U.S.A. (Adv. Dr. Sonnenberg)

BEISMAN, JAMES J. – M.SC. – HYDROLOGY

High-Resolution Reactive Transport: A Parallel Hydrogeochemical Model (Adv. Dr. Maxwell)

BENNETT, MITCHELL – M.SC. – GEOLOGY

Cathodoluminescence and Fluid Inclusion Characteristics of Hydrothermal Quartz from Porphyry Deposits (Adv. Dr. Monecke)

BETHUNE, JAMES – M.SC. – HYDROLOGY

Non-Invasive Flow Path Characterization in a Mining-impacted Wetland (Adv. Dr. Singha)

BIRCHER, MATTHEW J. – M.SC. – GEOLOGY

Depositional Environment and Reservoir Characterization of The Paleocene Fort Union Formation, Washakie Basin, Southwest Wyoming (Adv. Dr. Curtis)

CARVER, FRANKI JILL – M.SC. – GEOLOGY

Diagenesis and Dolomitization of the Devonian/Mississippian Ouray Fm., San Juan Mountains, Southwestern Colorado (Adv. Dr. Humphrey)

CUI, CELENA – M.SC. – HYDROLOGY

GIS-Based Nitrogen Removal Model for Assessing Florida's Surficial Aquifer Vulnerability from Onsite Wastewater Treatment Systems (Adv. Dr. Zhou/Co-Adv. Dr. Geza)

CYBULSKI, PAIGE G. – M.SC. – GEOLOGICAL ENGINEERING

Rock Fall Mitigation for An Open Pit Mine Experiencing Substantial Rock Fall from Overblasting (Adv. Dr. Higgins)

DOE, MICHAEL – PH.D. – GEOLOGY

Reassessment of Paleo- And Mesoproterozoic Basin Sediments of Arizona: Implications for Tectonic Growth of Southern Laurentia and Global Tectonic Configurations (Adv. Dr. Trudgill)

DONOVAN, IAN – M.SC. - GEOLOGICAL ENGINEERING

A Probabilistic Approach to Post-Wildfire Debris-Flow Volume Modeling (Adv. Dr. Santi)

FINLEY, ELENA C. – M.SC. – GEOLOGY

A 3-D Characterization of the Niobrara Formation, Silo Field, Laramie County, Wyoming (Adv. Dr. Sonnenberg)

GARTNER, JOSEPH E. – PH.D. – GEOLOGICAL ENGINEERING

Empirical Models for Post-Fire Hazard Assessments: Analysis of Terrain, Burn Severity, Rainfall, and Soil Influences on Post-Fire Erosion (Adv. Dr. Santi)



GIBSON, ALEX – M.SC. – GEOLOGY
Paleoenvironmental Analysis and Reservoir Characterization of
The Late Cretaceous Eagle Ford Formation in Frio County,
Texas, USA (Adv. Dr. Sonnenberg)

GROSS, TIMOTHY – M.SC. – GEOLOGY AND GEOLOGICAL
ENGINEERING
Controls and Distribution of Au-Cu Mineralization at the Island
Mountain Deposit, Whistler Project, Alaska (Adv. Dr. Kelly)

HANNEMAN, HARRY C. – M.SC. – GEOLOGY
Mineralogy and Geochemistry of Shale as a Vector to Ore: A
Case Study at the Lagunas Norte High-Sulfidation Au Deposit,
Peru (Adv. Dr. Monecke)

JASPER, CAMERON A. – M.SC. – HYDROLOGY
New Geophysical Methods for Mapping Infiltration Pathways at The Aurora Water Aquifer Recharge and
Recovery Test Bed (Adv. Dr. Revil)

KERNAN, HENRY E. – M.SC. – GEOLOGY
Relationship Of Electrofacies, Mineralogy, And Elemental Composition Characteristics Along Seismic Reflectors
Of The Vaca Muerta Formation In The Loma La Lata Area, Nuequen Basin, Argentina (Adv. Dr. Sonnenberg)

KOCMAN, KATIE BETH – M.SC. – GEOLOGY
Interpreting Depositional and Diagenetic Trends in The Bakken Formation Based On Handheld X-Ray
Fluorescence Analysis, Mclean, Dunn and Mountrail Counties, North Dakota (Adv. Dr. Sonnenberg)

KREIDLER, MASON – M.SC. – GEOLOGICAL ENGINEERING
Response to Changes In Humidity of Shales in Tunnels (Adv. Dr. Santi)

LONG, JENA MARIE – M.SC. – GEOLOGY
Structurally Influenced Roll-Front Mineralization At The Buss Pit Deposit, Gas Hills District, Wyoming (Adv. Dr.
Monecke)

MATTHIES, NICHOLAS – M.SC. – GEOLOGY
Understanding and Mapping Variability of The Niobrara Formation Across Wattenberg Field, Denver Basin (Adv.
Dr. Sonnenberg)

MOODY, JEREMIAH D. – PH.D. – GEOLOGY
Variations In The Architecture Of Fluvial Stratigraphy Within A Marginal Marine Setting, Eocene Sobrarbe And
Escanilla Formations, Spain (Adv. Dr. Pyles)

OSEGUERA, OLIVIA M. – M.SC. – GEOLOGY
The Significance of Magma Mingling and Mixing During the Formation of the Host-Rock Successions of
Archean Massive Sulfide Deposits in the Noranda Camp, Abitibi Subprovince, Quebec (Adv. Dr. Monecke)

PALMER, JUSTIN C. – M.SC. – GEOLOGY
Structural Geology and Geochronology of Carlin-Type Gold Deposits in the Nadaleen Trend, Rackla Gold Belt,
Yukon Territory, Canada (Adv. Dr. Kuiper)

PEDERSON, CHRISTOPHER A. – M.SC. – GEOLOGICAL ENGINEERING
Compensational Behavior of Three Debris Flow Fans in Southern Colorado (Adv. Dr. Santi/Co-Adv. Dr. Pyles)





PLESS, CLAIRE R. – M.SC. – GEOLOGY
Implications of Scaling Relationships for Relay Ramps:
Arches and Canyonlands National Parks, SE Utah (Adv.
Dr. Trudgill)

POOLE, SHEVEN – M.SC. – GEOLOGY
Quantitative Mineralogy and Mineral Distribution in the
Green River Formation, Piceance Creek Basin, Western
Colorado (Adv. Dr. Boak)

PRATT, DANIEL R. – M.SC. – GEOLOGY
A Landslide Hazard Rating System for Colorado
Highways (Adv. Dr. Santi)

PRUGUE, RODRIGO – M.SC. – HYDROLOGY
Identification of Reducing Conditions and Correlated Hydrological and Biogeochemical Properties in a
Heterogenous Floodplain Aquifer (Adv. Dr. Navarre-Sitchler)

PRYHODA, MOIRA – M.SC. – GEOCHEMISTRY
Chemical Characterization and Water Quality Implications of Pine Needle Leachates from a Mountain Pine Beetle
Infested Watershed (Adv. Dr. Sitchler)

SANDERS, MICHAEL – M.SC. – HYDROLOGY
Development and Evaluation of a Stream Temperature Component in The PRMS Watershed Modeling Program
(Adv. Dr. Benson)

SMITH, COLGAN B. – M.SC. – GEOLOGY
Determining the Source of Variable Water Chemistry in Perennial Tributaries: Influences from Water-Rock
Interaction and Marine Evaporite Dissolution (Adv. Dr. Navarre-Sitchler)

STAMMER, JANE – PH.D. – GEOLOGY
Hydrodynamic Fractionation of Minerals and Textures in Submarine Fans: Quantitative Analysis from Outcrop,
Experimental, and Subsurface Studies (Adv. Dr. Pyles)

SWANSON, RYAN DAVID – PH.D. – HYDROLOGY
Geophysical Monitoring of Solute Transport in Dual-Domain Environments Through Laboratory Experiments,
Field-Scale Solute Tracer Tests, and Numerical Simulation (Adv. Dr. Singha)

SWIERENGA, MICHAEL – M.SC. – GEOLOGY
Depositional History and Lateral Variability of Microbial Carbonates, Three Mile Canyon and Evacuation Creek,
Eastern Uinta Basin, Utah (Adv. Dr. Sarg)

WEBBER, ROBERT B. – M.SC. – GEOLOGY
Structural and Stratigraphic Controls on Fracture Distribution within Sand Bodies of the Upper Iles and Lower
Williams Fork Formations, Mann Creek and Divide Creek Fields, Piceance Basin, Colorado (Adv. Dr. Trudgill)

WEIGEL, JACOB – M.SC. – GEOLOGY
Evaluation of Folding and Thrusting of The Deadman Creek Thrust Fault, Sangre De Cristo Range, Saguache
County, Colorado (Adv. Dr. Boak)

WOKASCH, TRAVIS – M.SC. – GEOLOGY
Elemental Chemostratigraphy and Depositional Environment Interpretation of The Eagle Ford Shale, South Texas
(Adv. Dr. Humphrey)

Theses Completed December 2014

AL DUHALIAN, MOHAMMED – PH.D. – GEOLOGY

Petroleum-Expulsion Fracturing In Organic-Rich Shales: Genesis And Impact On Unconventional Pervasive Petroleum Systems (Adv. Dr. Sonnenberg)

ALSUWAIDI, MOHAMMAD – PH.D. – GEOLOGY

Lower Bab Member (A0): A Study of Sequence Stratigraphy, Porosity Characterization and Tight Reservoir Development, Abu Dhabi, UAE (Adv. Dr. Sarg)

BUCHAN-TURNER, OLIVIA CLAIRE – PH.D. - GEOLOGY

Depositional Framework of Coeval Slope Channel and Slope Fan Systems in The Eocene Juncal Formation, Southern California (Adv. Dr. Dykstra/Co-Adv. Dr. Warne)

FRANKLIN, ALYSSA – PH.D. – GEOLOGY

Deposition, Provenance, Isotopic Analyses, Stratigraphy, And Reservoir Characterization Of Carbonate Mudstones: The Three Forks Formation, Williston Basin (Adv. Dr. Sarg/Co-Adv. Dr. Sonnenberg)

HOLLON, ZACHARY GRANT – M.SC. – GEOLOGY

Elemental Chemostratigraphy and Reservoir Properties of the Mowry Shale in the Big Horn and Powder River Basins, Wyoming, USA (Adv. Dr. Sonnenberg)

LAUGIER, FABIEN – PH.D. – GEOLOGY

Three-Dimensional Facies and Process Regime Variability in Shelf-Edge Deltas: Implications for Shelf Margin Progradation and Deepwater Sediment Delivery (Adv. Dr. Plink-Bjorklund)

ROCK, AMANDA J. – M.SC. – GEOLOGICAL ENGINEERING

A Semi-Empirical Assessment of Plunge Pool Scour: Two-Dimension Application of Annandale's Erodibility Index Method on Four Dams in British Columbia, Canada (Adv. Dr. Higgins)

Stratigraphy Field Trip



Grey zip-offs were definitely in style fifth week (photo credit: Laura Hughes)

GEGN101 class field trip



Department of Geology and Geological Engineering
Colorado School of Mines
1516 Illinois Street
Golden, CO 80401-1887

Nonprofit Organization
U.S. Postage Paid
Golden, Colorado
Permit No. 7

CUTTING EDGE RESEARCH

Our faculty, staff and students work in a number of areas important to earth, environment and engineering, ranging from minerals and energy exploration, to ice sheet dynamics, to natural hazards, and water quantity and quality.



OUTSTANDING EDUCATION



We take education seriously, and have excellent teaching facilities, world class laboratory facilities, and access to some of the best field sites in the world.

Serving Society

Geology is important to many areas important to humanity, from hazards to water resources to changing climate. We are training outstanding students to be stewards of our earth's natural resources.