

GEOLOGICAL SCIENCES
UNIVERSITY OF COLORADO BOULDER

Geology News

Drilling through Earth's
extreme climates
Inside on page 14

Editors

G. Lang Farmer
Dan W. Mitchell

2014 - 2015

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Letter from the Chair

Lang Farmer

Welcome to the 2014-2015 edition of the CU Geological Sciences Newsletter. It was another successful year all around, but with some particularly notable achievements by our faculty. The Mars Atmosphere and Volatile Evolution mission (MAVEN), with our own Professor Bruce Jakosky as Principal Investigator, entered Mars orbit on Sept. 21st, 2014, and has been transmitting back data on Mars' atmosphere ever since. Professor Eric Tilton was the co-recipient of the 2014 Creativity Prize from the Prince Sultan Bin Abdulaziz International Prize for Water. And Professor Alexis Templeton and her team obtained a prestigious NASA Astrobiology Institute award to investigate "Rock-Powered Life."

We successfully recruited four new faculty this past year, three of whom are associated either directly or indirectly with our "Geobiology" Initiative. Last Fall we welcomed organic geochemist Dr. Julio Sepulveda to our faculty ranks, in a position split with INSTAAR. This Spring, stable isotope geochemist Dr. Katie Snell arrived on the faculty and immediately began work on establishing a "clumped isotope" analytical facility to be housed in the Benson Earth Sciences Building. Finally, we landed geomicrobiologist Dr. Sebastian Kopf who will join us in a year or so, after first completing a postdoctoral appointment at Princeton University. Seb will represent the department's first effort to marry geological and health sciences and we are excited to see where this combination might lead. We will also welcome Dr. Kristy Tiampo to the department starting in the Fall. Kristy is an alumna of the department, having received her doctoral degree here in geophysics in 2000. She has since expanded her research portfolio in remote sensing techniques, including InSAR, as a professor at the University of Western Ontario and will join CU as a full professor in our department and as the director of the Earth Science and Observation Center at CIRES. In the upcoming year we will finish our hiring

initiative in Geobiology through a search for an "open rank" geobiologist, but you will have to wait until next year's newsletter to hear about the result of this faculty search.

With our geobiology initiative successfully in place, the department is now ready to embark on its next grand initiative in "geoenergy". The geoenergy initiative is multipronged and involves targeted faculty hires over the next five years or so in such areas as sedimentology/stratigraphy, geophysics, reservoir geology, rock mechanics and economic geology. The article on page 3 gives a detailed overview of what the initiative entails.

As far as undergraduates go, we maintained a level of about 250 majors, and graduated about fifty students in 2014-15. Our majors are still interested in both conventional and unconventional energy resources, as well as hard rock economic geology and environmental geosciences. Our students continue to deal well with our more flexible geology major although, if the truth be told, most of our students are following a course trajectory that most of you would recognize as a "traditional" geology program.

We also had about twelve M.Sc. and thirteen Ph.D. students complete their degrees this year. Theses this year included topics in petroleum geology, planetary geology, geomorphology, seismology, and paleoclimatology, and involved work conducted in such exotic locales as New Zealand, Greenland, Nepal, Chile, and eastern Colorado.

Alumni events again included an alumni get-together in the Houston area sponsored by Penny Patterson and organized this year by Penny and alum Benjamin Schupack. We are exceptionally grateful to both Penny and Ben for their efforts. In addition, Bruce and Marcy Benson sponsored a Denver area alumni reception this Spring at the Brown Palace Hotel, and the department is exceptionally grateful to the Bensons and to all who attended for making this event a success.

You may recall from last year's newsletter that the department launched its first international field course last year, with a "Global Seminar" on the Quaternary Geology and Volcanology of Southern Iceland. This was a joint course with the University of Iceland, and thanks in part to generous alumni donations, the Iceland students are coming to Colorado for the reciprocal course this July. We are well on our way to establishing a similar field course with the University of Wollongong in SE Australia for Summer 2016 and hope you might consider a donation to the "Braddock in the Field" Fund to help this cause. A donation to any of our other departmental funds would help support graduate student research and travel grants and undergraduate mentorships.

On another front, Professor Shemin Ge was elected as the new departmental Chair and begins her four-year term on July 1st, 2015. As a result, the quality of next year's Chair letter is expected to markedly improve.

We want to thank our Advisory Board members for donating their time and energy to the department.

GeoEnergy Initiative Department of Geological Sciences, University of Colorado Boulder

In 2015, Geological Sciences inaugurated a new research, teaching and hiring initiative in “GeoEnergy”. This initiative will marshal new and existing faculty and operational resources towards establishing CU-Boulder and the Department as a leader in innovative, interdisciplinary research in energy issues related to the solid Earth and its interactions with hydrosphere, biosphere and atmosphere. The central goal is to strengthen and coordinate departmental teaching and research activities in geoenery to support the highest-quality educational experience for a growing number of geological sciences students and enable visionary research across petroleum geology, geothermal energy, alternative energy resources, and economic geology.

The Geoenery Initiative will support this vision of excellence through the establishment of a 21st century energy center and its interaction with faculty across the Department.

The **Geoenery Center** will become the centerpiece of the Department’s activities in applied geosciences for the next several decades. The Center will leverage the successful twenty-five year history of excellence of the **Energy and Minerals Applied Research Center (EMARC)**, led by internationally-known and former AAPG President Paul Weimer. The Geoenery Center will play two vital roles.

- **Organizing Industry Programs:** For those faculty primarily working in energy-related research, including the Benson Chair in Petroleum Geosciences, currently held by Professor Weimer, and a new Geoenery Chair, the center will provide the mechanism for organizing industry consortia programs, a role served well by EMARC over the past 25 years.
- **Engaging Faculty:** The Geoenery Center will serve as the bridge required for joining the “pure” research taking place in the department with potential energy industry applications. It will engage faculty members who are interested in applying their specific research expertise to energy-related issues but have not previously been involved in the energy sector. Geological Sciences faculty expertise currently exists in many areas relevant to, but not yet explicitly directed towards, energy research including hydrogen generation, geothermochronology, and metal ore deposit formation.

“**Bridging**” activities conducted by the Center would include short course development, symposia, colloquia, and short-term visits by industry scientists. These activities will inform department faculty and graduate and undergraduate students on current research trends in the energy industries and will support the rich collaborations among Geological Sciences faculty and students to develop ideas for interdisciplinary, energy-related projects that explicitly take advantage of research expertise unique to the Department. The Center should be considered as the equivalent of a **business incubator** in which entrepreneurial business practices are used to develop innovative geoenery-related research activities.

The Department will leverage the focused activities in the Center through **strategic faculty hiring in “Geoenergy”** to strengthen and coordinate with departmental teaching and research activities. This cluster hire of four new positions through the College of Arts and Sciences will be departmental tenure-track faculty in the general fields of geophysics, rock physics, sedimentology/stratigraphy, economic geology, and hydrocarbon reservoir characterization.

Investment Opportunities

The Geoenery Initiative and related Center seeks an investment of \$13.5 million to create an endowment that will sustainably foster this entrepreneurial approach to geoenery research with the resources to allow faculty to operate effectively in this arena. Funding a core investment in three major areas will create the initial critical mass to establish a sustainable and robust initiative.

- **A “named” Chair in Geoenergy Science:** The Chair will be a tenure-track faculty member with considerable industry experience who has the vision and expertise to both run their own energy-related research programs, as well as spearhead efforts to engage the entire faculty in energy-related research and teaching activities. Adding a second “long term” position to the extant Benson Endowed Chair in Petroleum Geosciences will provide a robust, stable presence for the department in geoenery activities.
- **A “named” Visiting Chair in Geoenergy Science:** These “medium term”, rotating visiting Chairs will be targeted for individuals with successful careers in industry or government who can teach classes in their specialty and organize informational short courses, symposia, colloquia. Visiting chairs are critical for maintaining an entrepreneurial spirit in the department, by continually providing “in-depth” exposure to faculty and students of new issues and opportunities developing throughout the energy industry.
- **An “operating fund” for support of short courses, symposia, colloquia:** These short-term activities are required to provide faculty and students with up-to-date information on research needs of energy industry. This fund would be used to support two short courses per year, two to three innovation research grants per year, and colloquium speakers.

Complementing the central core of the Geoenery Initiative’s resources with support for professorships and students will provide the opportunity for CU-Boulder to attract and retain the next the generation of academic and student talent creating a fully-formed culture of excellence in this innovative and critical area.

- **Four endowed professorships in Geoenergy Science:** Endowing four professorships will provide critical resources for attracting and retaining the next generation of teaching and research talent. These professorships will be awarded to faculty who are hired for research and teaching excellence in their area of expertise who will collaborate with the Geoenery Center.
- **Graduate Student support:** We continue to make Geological Sciences graduate student a priority and we will continue to seek funds to support graduate students interested in geoenery research.

Continued on page 4...

GeoEnergy Initiative Continued...

Legacy investment - Setting the path for CU-Boulder's 21st century leadership in world-class geoenergy research and education

Investment in an endowment to support these core and complementary pieces of the Geoenergy Initiative will create a world-class, robust, long-lasting culture that will leverage CU-Boulder's recognized leadership as in Geosciences education and research. Endowment amounts are targeted to provide a competitive salary with peer institutions to attract and retain leading faculty and the best students. Nationally known leaders in the field will bring critical research awards and faculty relationships to benefit the reputation of the campus, the quality of teaching and research, and the entire state of Colorado.

Please contact Department Chair Shemin Ge directly (ges@colorado.edu) if you have questions regarding this ambitious initiative and how you can help make it a reality.

Notes from the Advisory Board

by Dean Miller

The Alumni Advisory Board had another successful year. The Board experienced some turnover in its membership. We said goodbye to Rich Goldfarb, Greg Davis, and Ted Ball, whose terms ended this Spring. However, we are fortunate to have Karen Kelly, Cheree' Stover, and Tyler Kane join the Board. While we certainly will miss the folks stepping down, it always is nice to have some new people with different perspectives added to the Board.

As Lang Farmer mentioned in his column, he is stepping down as Chair of the Department this Summer. He has done a remarkable job at the helm these past six years. During his tenure, the University of Colorado was recognized by U.S. News and World Report as number two in the world in geosciences, behind only Cal Tech. In addition, the Department kicked off its Geobiology and Geoenergy initiatives, which will greatly enhance the nature and scope of research and teaching in the Department. In addition, several new, top-notch faculty joined the Department. Professor Shemin Ge will be the new Department Chair as of July 1, 2015. We are very much looking forward to working with her.

As in past years, the Board met with undergraduate students in the Fall and graduate students in the Spring to discuss the state of the Department. The feedback we received was very positive. The students made a few suggestions for improvement, which we passed along to Lang. Following the Spring meeting, the graduate students put on a poster session describing their current research,

which clearly reflected the wide-ranging nature of the research students are conducting around the world.

During our Spring meeting, we had a conference call with President Bruce Benson to discuss fund-raising strategies for the Geoenergy initiative. It will take a significant effort, but we are hopeful that we can reinvigorate the Department's petroleum and economic geology programs through this initiative. If you would like to help out the Department, this would be a very worthy cause to support.

The Board held another career night for undergraduate and graduate students. This is one of the more rewarding aspects of serving on the Advisory Board. It is especially important to help students with networking strategies and job-hunting skills with the current downturn in both the petroleum and mining industries. We are confident that our insights, rather than the free pizza, were the big draw for this event. If you know of any internships or other opportunities for students, please let us know.

Last August, the Department once again held the annual Bill Bradley Field Trip for the six new graduate students that came into the Department, during which Department faculty and some Board members introduce incoming graduate students to the local geology. The trip includes an overnight stay at the Mountain Research Station near Ward on Saturday night, with a hike up Niwot Ridge on Sunday morning. This year, we will have twenty-six new graduate students coming into the Department, so it will be a much larger group this year.

Geological Sciences Advisory Board Members

Andres Aslan
Colorado Mesa University

Patricia Corbetta
BHP Billiton

Dawn S. Kaback
Geomatrix Consultants

Tyler Kane
USGS Boulder

Karen Kelley
USGS Denver

Houston Kempton
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ExxonMobil Exploration Company

Alan Seeling
Petroleum Geologist

Shannon Cheree' Stover
BP

Chandler Wilhelm
Shell Exploration and Production Co.

Joe Zamudio
ITT Visual Information Solutions

Faculty Activities

Becky Flowers

The CU TRaLL (Thermochronology Research and Instrumentation Lab) had a productive year, producing 100's of (U-Th)/He analyses for internal and external projects, and hosting a variety of visitors to our facility. Prof. Becky Flowers' research group is continuing work on projects in South Africa, New Zealand, Canada, the Rockies, and the Grand Canyon, as well as on samples from the Moon. Former PhD student Alexis Ault began a tenure-track faculty position at Utah State University, and published her final thesis paper on the relationships between kimberlite magmatism and cratonic burial/erosion histories in early 2015. PhD student Jacky Baughman completed her first field season in South Africa, and subsequently mentored a South African MSc student during her visit to CU. PhD student Jess Stanley was awarded a top student poster award at the 2014 International Conference on Thermochronology in Chamonix, France for her kimberlite thermochronology work across the southern African Plateau. PhD student Rachel Landman presented her conodont (U-Th)/He thermochronometer development studies at multiple conferences. MSc student Josh Johnson defended his thesis in spring 2015 on the interpretation of (U-Th)/He dates for high-damage zircon from the Colorado Front Range. RESESS intern Wes Weisberg worked on a He dating project in the



PhD student Jacky Baughman taking a break while hiking up Table Mountain outside Cape Town, South Africa. Jacky spent 3 weeks in Africa collecting thermochronology samples in May 2014

Wet Mountains with Dr. Jim Metcalf and Flowers in summer 2014. Several other CU undergraduates worked in the lab throughout the year. In fall 2014, Dr. Nigel Kelly joined the group to work on (U-Th)/He dating of lunar zircons as part of a newly funded collaborative NASA project with Prof. Steve Mojzsis. In early 2015, Flowers participated in a river trip down the Clarence River in New Zealand as part of a project with Prof. Greg Tucker and others to decipher the evolution of strike-slip faulting in the Marlborough Fault System. Flowers and Metcalf, along with several other collaborators, initiated the new EarthScope AGeS (Awards for Geochronology Research) program, aimed at enhancing interdisciplinary, innovative, and high-impact science by promoting training, education, and new interaction between graduate students, scientists, and geochronology labs at different institutions. A geochronology short course kicked off the program at the 2014 GSA meeting in Vancouver. The first proposal round saw 10 proposals funded out of the 47 submitted by graduate students.

Kevin Mahan

Kevin's group continues to work on tectonics and deformation processes and properties of deep continental crust, with ongoing projects in western Canada and the northern Rockies of Montana and Wyoming. Cailey Condit, a 4th year PhD student, continues her work on exhumation of now exposed deep crust in southwestern Montana. Her first paper is currently in review in GSA's journal *Lithosphere*. Phil Orlandini just completed his 2nd year in our PhD program and successfully passed his comprehensive exam in May. His research focuses on the origin and conditions of formation of a network of deep crustal pseudotachylyte ("fossil earthquakes") exposed in northern Saskatchewan, Canada. A new MSc student will be joining Mahan's group in Fall 2015. Craig Peterson will work with both Mahan and Vera Schulte-Pelkum (CIRES research associate) on a joint seismological and geological study of deep crustal seismic anisotropy. Finally, Mahan and Research associate Julien Allaz (electron microprobe lab manager) received an NSF grant in summer 2014 to purchase a new state-of-the-art electron microprobe that not only serves the needs for routine major/minor element work but also has advanced capabilities for high resolution trace element analysis. We are in final stages of making the purchase, planning the lab space renovation, and hope to have the new instrument installed and operational in Spring 2016.

Peter Molnar

In 2014, Peter Molnar had the privilege of spending several days in the Sierra Nevada del Cocuy in the Eastern Cordillera of Colombia with Camilo Montes and other Colombian geologist friends. Vegetation in this region is specially adapted to special conditions that include daytime temperatures exceeding 10°C nearly every day and often reaching 20 °C, but nighttime temperature dropping below freezing nearly every day. The summary is "summer every day, and winter every night." This vegetation, called *Páramo*, seems to have evolved only in the past 2.5 Ma, since ice ages began. Moreover, some of the high-altitude vegetation of the Eastern Cordillera came from North America, with oaks arriving only since 300 ka, and alder only since ~800 ka.

The standard interpretation is that the Eastern Cordillera rose only in the past 2-3 Ma, but this would be hard to accomplish at present tectonic rates. Peter is pursuing the idea that climate change enabled large furry mammals, some with big intestines, to cross from North to South America when ice ages occurred, beginning at ~2.5 Ma, and those horses, camelids (llamas), bears, dogs, big cats, mammoths, mastodons, and fellow mammals

brought seeds from North America in an invasion of North American plant species. (Some of his friends think he has lost it, but he is having fun learning new stuff.)



Anne Sheehan and Gaspar Monsalve enjoying fresh fruit during a break from field work, Bolivar, Colombia

Anne Sheehan

Anne spent Fall 2014 on sabbatical at the Earthquake Research Institute, University of Tokyo, Japan. Sheehan worked with Prof. Kimi Mochizuki at ERI on a study of the Hikurangi subduction zone using ocean bottom seismometers, and started a new collaboration with Prof. Kenji Satake on tsunami studies using seafloor pressure gauge data. While in Japan Sheehan had a chance to get a closeup view of volcano geology by climbing Mount Fuji, participated in a field excursion along the coast near Sendai to observe damage and landform change from the Tohoku tsunami, and felt several small earthquakes in Tokyo and Sendai. Sheehan visited and gave lectures at the National Research Institute for Earth Science and Disaster Prevention and the Geological Survey of Japan, both in Tsukuba, gave a keynote talk at a slow slip workshop in Kyoto, and participated in the US Japan Panel on Earthquake Research meeting in Sendai.

Sheehan was back in Boulder in spring 2015. Sheehan's graduate students are involved with a variety of projects including Rio Grande Rift magnetotellurics (Danny Feucht), seismic tomography using ocean bottom seismic data (Dan Zietlow, Justin Ball), tectonic and induced earthquake studies in Colorado and New Mexico (Jenny Nakai received Seismological Society of America best student presentation award for this work in April 2015), seismological studies of the Bighorn Mountains region in Wyoming (Colin O'Rourke), and tomography, receiver function, and induced earthquake studies (Dr. William Yeck, graduated May 2015 and now at USGS). First-year graduate student Steven Plescia will join

Sheehan and Justin Ball on board the R/V Roger Revelle in June 2015 to retrieve seismometers from an ocean bottom seismic experiment offshore the North Island of New Zealand. New graduate student Jefferson Yarce teamed up with Justin Ball to compete in and win the Denver Geophysical Society Geophysics Challenge Bowl in February 2015 – winning them both a trip to the Society of Exploration Geophysicists International Meeting and Expo in New Orleans (Sheehan was pleased that they beat the Colorado School of Mines).

Joe Smyth

Joe taught a mineralogy field module in spring, 2015. Most of the course was a laboratory module dealing with mineralogy of the Earth's interior. They conducted high pressure synthesis experiments and examined the results of these experiments by electron microprobe, Raman spectroscopy, and X-ray single-crystal diffraction.

The class also went on a field trip to the White Cloud Pegmatite in the South Platte Valley in Jefferson County. They collected some rare earth minerals like gadolinite, thalenite, allanite, and bastnaesite.



Here are students posing for a photo at the mine: Beth Moger, Jack Castellano, Garrett Stoll, Danae Winkler, Lena Ray, and Cameron Pritekel

Chuck Stern

Chuck visited Chile in October and November to present papers at the 9th Jornadas de Arqueologia de la Patagonia in Coyhaique, Chile, and the 4th Southern Deserts Conference in Mendoza, Argentina. The first concerned the source of obsidian artifacts in the late Pleistocene Pilauco archaeological site in Osorno, Chile, one of the oldest human occupational sites in South America. The second concerned the impact of volcanic eruptions for the prehistoric people in the arid region of southern Patagonia. In between the two conference he visited the town of Chaiten, Chile, partially destroyed by the May 2008 eruption of the Chaiten volcano. Chuck's former student, Jorge Muñoz (Ph.D. 1984), then director of the Chilean Volcanic Observatory Network, recommended the evacuation of the town to then (and now) president Michelle Bachelet, and 5,000 people were evacuated the day before lahars swept through the town. Good work Jorge!

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Jorge Muñoz (glasses right in front of his laptop) discusses his recommendation to evacuate the resident of the town of Chiaten with Chilean President Michelle Bachelet



Chuck stand on the surface of the May 2008 lahar that destroyed the town of Chaiten in May 2008. The volcano, still smoking, is in the background

Alexis Templeton

Last year, the Templeton lab was busy with fieldwork in three major project locations, the Canadian High Arctic, at the northern tip of Ellesmere Island, in the desert of Oman, and at Crystal Geyser, Utah.

In June 2015, Prof. Alexis Templeton, graduate student Graham Lau, and collaborators at the Colorado School of Mines, spent two weeks at Borup Fiord Pass at 81oN to determine geochemical and biological controls on large scale sulfur deposits that form on the surface of unique sulfur ice deposits that issue from the toe of the glacier system. This field site is a priority analog site for testing mineralogical, geochemical and biological processes that may be



Graham Lau and Alexis Templeton sampling at Borup Fiord Pass

relevant to upcoming NASA missions to detect life within icy bodies in our solar system, such as Jupiter's moon Europa.

In January, Alexis Templeton then traveled with graduate students Hannah Miller and Katie Rempfert to the Ibra region of Oman to further develop investigations of modern water/rock interactions within peridotite aquifers. In particular, they focused on the geochemical and biological processes that give rise to the formation of hyperalkaline fluids rich in dissolved gases such as hydrogen and methane just beneath the surface of the desert. Both Hannah and Katie will conduct several seasons of fieldwork in Oman for their PhD research, examining novel life forms that can live under the extreme conditions found in serpentinizing systems, and unraveling the biogeochemical cycling of Fe, C, N and S. Alexis Templeton is also a member of the Steering Committee for an upcoming ICDP Oman Drilling Project that will drill several boreholes into the actively altering peridotites to create an observatory system that will support integrated hydrological, geochemical and biological research.



Alexis Templeton at Wadi Quafifah, a hyperalkaline (pH >11) seep located in the peridotite mountains of Oman

In October, Prof. Alexis Templeton led a multi-day fieldtrip for the undergraduate Environmental Field Geochemistry course (GEOL 4716/5716) to Rifle, CO and Crystal Geyser, Utah to expose students in active research in subsurface hydrogeochemical systems. Crystal Geyser is also an active research site for the Templeton lab, where Postdoc Julie Cosmidis and Research Associate Eric Ellison are engaged in examining the microbial communities hosted in a cold CO₂-geyser, and examining mechanisms of travertine formation. In February, Alexis Templeton also started a new collaboration with Prof. Roy Parker in the BioFrontiers institute at CU-Boulder, using Crystal Geyser as a field site for seeking primordial forms of RNA-based life.

GEOL 4716/5716 at Crystal Geyser, UT



New Faculty



Julio Sepúlveda

Julio Sepúlveda is an organic and isotope biogeochemist interested in climate change. His research group studies the interplay between microbial and biogeochemical processes, and climate in contemporary environments subject to increasing anthropogenic influences (e.g., continental margins, marine oxygen minimum zones), and paleo-ecosystems across some of the major biotic transitions in Earth history (e.g., glacial-interglacial transitions, greenhouse climates, mass extinction events). He approaches these systems with a focus on the structures, distributions, and stable isotopic composition of cell membrane lipids (biomarkers) that can be identified in water bodies, sediments, soils, and their fossilized remains preserved in the rock record.

Julio recently joined CU in August 2014 as an Assistant Professor in Geological Sciences and Fellow in the Institute of Arctic and Alpine Research (INSTAAR). He comes to CU after having worked as a postdoctoral associate and research scientist in the Geobiology and Astrobiology Group in the Department of Earth, Atmospheric and Planetary Sciences at MIT. Originally from Chile, Julio began his career as a marine biologist (B.Sc.) and chemical oceanographer (M.Sc.) at the University of Concepción, Chile, where the field of organic biogeochemistry fascinated him. After feeling the desire to explore the world and expand his expertise, he moved to Germany and obtained a Ph.D. in Marine Geosciences from the University of Bremen.

Julio will oversee the new Organic and Isotope Geochemistry Laboratory—expected to open its doors in Spring 2016—in collaboration with Sebastian Kopf, a new assistant professor in Geological Sciences starting in Fall 2016. The new state-of-the-art analytical facility will be housed in the Sustainability, Energy and Environment Complex (SEEC), and will be equipped with instrumentation for gas and liquid chromatography-mass spectrometry, in addition to gas chromatography-isotope ratio-mass spectrometry. The array of instruments will allow the chemical and isotopic characterization of a wide range of organic molecules in modern and ancient environments. The laboratory will serve as a new analytical platform for research fields such as geobiology, biogeochemistry, astrobiology, environmental microbiology, energy, and paleoceanography and paleoclimatology, among others. Julio is very excited to join such a thriving community of Earth scientists at CU, and he looks forward to initiating new collaborations around campus.

Katie Snell

Katie is a new Assistant Professor in Geological Sciences since January of this year. Prior to moving to Boulder, she spent the last 10 years in California as a postdoctoral scholar in the Division of Geological and Planetary Sciences at Caltech, and as a PhD student at UC Santa Cruz. Katie grew up in Minnesota, but she received her initial training in Geology here on the Front Range, at Colorado College. While California is nice, she's very excited to be back in a place with snow in the winter and Lyons Sandstone everywhere!

Katie's research combines sedimentology and field relations with low-temperature traditional and "clumped" stable isotope geochemistry to determine climatic and topographic changes in ancient terrestrial basins. These tools enable her to reconstruct past temperature and elevation, which are intrinsically linked boundary conditions that are fundamental for understanding climatic and tectonic changes. In addition to these topics, Katie also uses these tools to better understand formation and diagenesis of terrestrial carbonate rocks. With the Department's range of complementary expertise in tectonics, paleoclimate, and sedimentology, Katie is looking forward to broad collaborations with many of the faculty.

To continue this research at CU, Katie is building a new stable isotope facility in Benson Earth Sciences that will contain two magnetic sector isotope ratio mass spectrometers for high-precision dual inlet stable isotope analysis of multiply substituted ("clumped") isotopologues of CO₂, and for continuous flow stable isotope analysis of C,H,N,O and S isotopes from solids and gases by headspace sampling, on-line combustion, and high temperature conversion elemental analysis. This facility will nicely complement the new instrumentation being developed in the Organic Geochemistry facility in INSTAAR and will open up a wide array of research applications in Geological Sciences and broadly across the University. She hopes instrumentation will be installed during Spring semester 2016, so come by and check it out!



Faculty Awards



Bob Anderson (middle) with John Anderson (left) and Chancellor Phil DiStefano (right) at the Hazel Barnes Prize reception

Bob Anderson named 2014 Hazel Barnes Prize winner

Professor Robert S. Anderson was awarded the 2014 Hazel Barnes Prize, the most distinguished award a faculty member can receive from the University.

Since 1992, the Hazel Barnes Prize has been awarded each year to a CU-Boulder faculty member who best exemplifies the enriching interrelationship between teaching and research, and whose work has had a significant impact on students, faculty, colleagues and the University.

“Professor Anderson is an outstanding teacher and mentor,” said Chancellor Philip P. DiStefano. “His impact on students inspires their continued interest in science, and his classroom is intellectually stimulating and supportive. Through his research, his students also are on the leading edge of new knowledge in geomorphology.”

Edited from the University of Colorado Boulder website.

Shemin Ge selected as the 2016 Birdsall-Dreiss Distinguished Lecturer

Shemin Ge was selected as the 2016 Birdsall-Dreiss Distinguished Lecturer by the Geological Society of America (GSA) Hydrogeology Division. The selection is based on outstanding contributions to hydrogeology or a closely related field through original research and public communication, and the potential for continued contributions to the profession. She will start the lecture tour in January 2016 and end at the 2016 GSA meeting in Denver.

Anne Sheehan elected AGU fellow for 2014

In December 2014 Anne Sheehan was made a Fellow of the American Geophysical Union “for developing methods to image the Earth using seismometer arrays, to explain deformation processes of mountains, oceanic, and continental plates.” The AGU Fellow awards are given to individual AGU members who have made “exceptional scientific contributions and attained acknowledged eminence” in the fields of Earth and space sciences and are conferred on no more than 0.1 percent of AGU members in any given year.



New AGU Fellow Anne Sheehan being congratulated by AGU President Margaret Leinen at the Honors Ceremony at the AGU Annual Meeting in 2014

Eric Small is on CU-Boulder-led team that won the Prince Sultan Bin Abdulaziz International Prize for Water

A research team led by aerospace engineering Professor Kristine Larson was awarded the Creativity Prize, part of the Prince Sultan Bin Abdulaziz International Prize for Water, in Riyadh, Saudi Arabia, on Dec. 15, 2014.

The research team includes CU-Boulder’s **Eric Small**, as well as Valery Zavorotny of the National Oceanic and Atmospheric Administration and John Braun of the University Corporation for Atmospheric Research.

The award honors the team’s discovery that standard GPS instruments can be used to measure soil moisture, snow depth and vegetation water content. The technique is based on the discovery that “noise” observed with ordinary GPS instruments correlates with the water content of the reflecting surface in the vicinity of the receiving antenna. Edited from the University of Colorado Boulder website.



Department wishes Joanne Brunetti a happy retirement!

Joanne Brunetti



Current and former Geological Sciences staff members at Joanne's retirement reception.

Back row L-R: Lisa Massengill, Carrie Simon, Susan Pryor
Front row L-R: Beth Hanson, Barbara Easter, Kristine Johnson, Joanne Brunetti, Tiernen McConaughy, Marcia Kelly

It has been a great honor to work at the University of Colorado for the last 21 years, and to be a part of the Geology department family for 14 of them. Thank you for giving me a home here. I have cultivated great friendships and have wonderful memories that I will always cherish and take with me. So it is bittersweet and with a heavy heart that I say Goodbye to this chapter of my life. I am retiring and going to live out the rest of my days in the fun and sun of Miami FL. :)

- Joanne

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L-R: Joanne Brunetti, Kristine Johnson, Susan Pryor, Paul Boni and Carmen Juszczyk

Front Office News

by Carmen Juszczyk

Geological Sciences would not be the same without the key personnel in the staff office. **Joanne Brunetti**, who has served with dedication for 14 years, has retired. We will miss her and have a huge hole to fill when she leaves. Thank you, Joanne, for all that you've done to help us over the years.

Paul Boni has contributed 29 years to Geological Sciences. He currently serves as, among other things, our building proctor and manages our rock shop and x-ray diffraction lab. He also trains students in the use of the rock shop and diffraction lab. A key to our hands-on STEM-style learning opportunities, Paul provides those who are willing to get their hands dirty the real deal in preparing rocks for geologic studies.

Kristine Johnson was hired in November to serve as the new Undergraduate Program Assistant. She loves her job--specifically being able to help students and faculty and helping in all areas that she can around the office. She also enjoys spreading the word to prospective students about how wonderful the Geological Sciences program is at CU Boulder.

Carmen Juszczyk continues as the Office Manager and has discovered the wonderful community that is Geological Sciences. She loves to work with the faculty, staff and students as well as the many fiscal department folks on campus, vendors, recruiters, and various cross-functional teams. She has learned a lot this year, and is ready to take on the coming years, too.

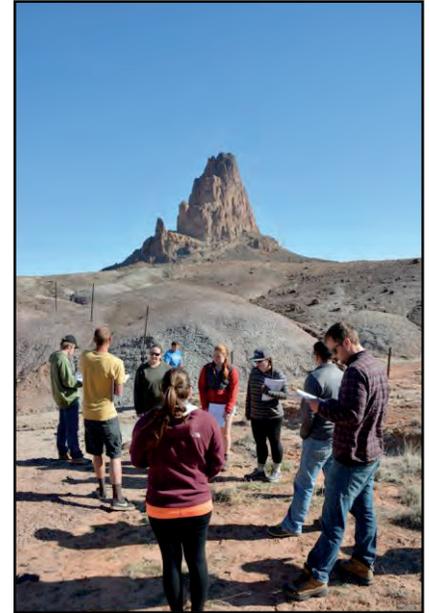
Susan Pryor is in her third year serving as our Graduate Program Assistant. She effectively manages the myriad of responsibilities for new students, continuing students, and their advisors. She also keeps the department on track with curriculum management and often provides assistance with day-to-day front office operations.



Field Trips



The 2014 Bill Bradley Field Trip for incoming graduate students



GEOL 4717 at Shiprock, NM



GEOL 4717 at Mexican Hat, San Juan, Utah

GEOL 4716 students in action learning how to do groundwater sampling and analysis of a uranium contaminated aquifer in Rifle, CO

GEOL 4717 at the Grand Canyon



Alumni Events



President Benson speaking at the alumni reception on April 23, 2015

On the evening of April 23rd, 2015, Bruce and Marcy Benson hosted a reception for Colorado area Geological Sciences alumni at the Brown Palace Hotel in downtown Denver. The elegant event was highlighted by an overview of the state of the University of Colorado given by President Benson (the current University President), and by a description of how alumni donations are helping current doctoral student Sarah Crump to complete her degree program. Department Chair Lang Farmer also took the opportunity to introduce attendees to the department's new "Geoenergy Initiative". We are indebted to the Bensons for their generous support of this event. All photos by **Patrick Campbell**, University of Colorado



President Benson speaking at the alumni reception on April 23, 2015



President Benson and John Harms at the alumni reception on April 23, 2015

Diane and Larry Barber, Karen and Kirk Nordstrom and Professor Alexis Templeton



GEOLOGY NEWS



L-R: John Roesink, Craig Canon, Steve Marks and Lang Farmer at the alumni reception on April 23, 2015



Bill and Mary Lou at the Brown Palace reception



Don Eicher at the alumni reception on April 23, 2015



Ted and Kari Scambos chatting with Emeritus Professor Hartmut Spetzler



The Houston area alumni event was sponsored by Penny Patterson and organized this year by Penny and alum Benjamin Schupack. We are exceptionally grateful to both Penny and Ben for their efforts.

Chandler and Laura Wilhelm (L) and Michael and Nawatha Hayes (R) at the Houston area alumni event.

On The Cover: Drilling through Earth's extreme climates By Julio Sepúlveda

In 2014-2015, two independent teams of national and international researchers drilled expanded sedimentary sequences recording two of the most extreme climatic events of the Mesozoic Era leading to biological turnovers and extinction. These events are known as the Oceanic Anoxic Event 2 (OAE-2) across the Cenomanian-Turonian Boundary (~94 million years ago), and the Cretaceous-Paleogene mass extinction event (K/Pg, ~66 million years ago). Notably, these two drilling programs will attempt to reconstruct the interplay between extreme climate change and biological responses at unprecedented temporal resolution (centennial-millennial scale). Julio Sepúlveda—a PI in these two multidisciplinary teams—will lead high-resolution, organic-isotopic analyses of fossilized molecules (lipid biomarkers), and supervise the work of CU students Garret Boudinot (graduate) and Michael Gross (undergraduate). The work at CU will allow assessing the role of marine planktonic communities lacking hard skeletons in sustaining primary productivity, at times when calcifying organisms were severely affected by extinction due to ocean acidification and deoxygenation.

National Science Foundation Earth-Life Transitions (ELT) Project: Perturbation of the Marine Food Web and Extinction During the OAE-2 Event

This project seeks to refine our understanding of the climatic and oceanographic changes that accompanied the onset of OAE-2, a major earth-life transition due to massive volcanic eruptions, the vast release of greenhouse gases, ocean deoxygenation and acidification, and global warming. This collaborative study includes researchers from Northwestern (CU alumnus Prof. Brad Sageman), UMass-Amherst (CU alumnus Prof. Mark Leckie), Penn State (Profs. Tim Bralower, Mike Arthur, Lee Kump and Matt Fantle) and MIT (Prof. Mick Follows). In July 2014, Profs. Sageman, Leckie and Bralower, and graduate students Matt Jones, Rosie Oakes, Amanda Parker and Scott Karduck successfully drilled and sampled outcrop sections of the OAE-2 interval on the



Sampling of El Kef cores
(credit: A. Gerdes)



Drilling core with fossil, Utah
(credit: B. Sageman)

Cover picture: Scientific Drilling in the Grand Staircase-Escalante National Monument, Utah
Credit: Scott Karduck (PSU)



Drilling in El Kef, Tunisia (credit: H. Negra)

Grand Staircase-Escalante National Monument (Big Water Section) in Utah. This work was made possible by logistical support and permits from the National Park Service and the Bureau of Land Management. In June 2015, the ELT team met at Northwestern University for the sampling of cores for subsequent geochemical and fossil analyses. The results from this project will present a unique opportunity to unravel the impact of rapid environmental perturbations on marine food webs across OAE-2.

El Kef Coring Program

Logo by J. Whiteside



This international program is designed to explore the mass extinction at the Cretaceous-Paleogene Boundary in the classic, GSSP section of El Kef in northwestern Tunisia. The overarching goal of the program is to better understand the killing mechanisms and the response of different planktonic organisms (calcareous and non-calcareous) to environmental perturbations across the K/Pg. This collaborative study includes researchers from Penn State (Prof. Tim Bralower), Tunis, Tunisia (Prof. Hedi Negra, Ms. Marwa Baroumi), Bremen, Germany (Dr. Ursula Röhl, Dr. Thomas Westerhold, Prof. Simone Kasemann), Zaragoza, Spain (Prof. Laia Alegret), Yale (Prof. Pincelli Hull, Dr. Michael Henehan), Utrecht, The Nederland (Prof. Appy Sluijs, Dr. Johann Velekoop), and Southampton (Dr. Jessica Whiteside). In January 2014 and March 2015, Prof. Negra and Ms. Baroumi successfully drilled several holes in the El Kef section. In November 2014, the first sampling party of the El Kef Coring Team took place in the International Core Repository at the University of Bremen, Germany. A second sampling party will follow during the second half of 2015.

For more information please contact:
Julio Sepúlveda (jsepulveda@colorado.edu), or visit:
<http://instaar.colorado.edu/people/julio-sepulveda/>
<http://www.ktboundary.org>

2014 Graduate Student Award Winners.....

Evan Anderson

Thanks to the W. O. Thompson Research Award I received from the Geological Sciences department, I was able to perform a key research component for one of my dissertation chapters. I had been running decay experiments on modern insects, and wanted to be able to see the effects of this decay on the individual histological components of the bugs at a microscopic level under the SEM. However, to render the insects stable under the electron beam I had to first embed them, a time-consuming and delicate procedure. With my research award, I was able to buy the embedding supplies I needed and practice and perform this new skill. With the funds I was able to also visit the SEM lab at the Discovery Learning Center and analyze and image the insects. I am happy to report that the embedding procedure worked quite well and I was able to gain new and surprising insights into the state of decay of my buried insects. While at the macroscopic scale degradation was often obvious, at a microscopic scale fine details, including preserved muscle tissue, could usually still be preserved. These analyses would not have been possible without the aid I received from Geological Sciences Department.

Cailey Condit

I was lucky enough to have been awarded the Spetzler research award last year. My proposed research focused on obtaining zircon U-Pb geochronology from several leucogranite bodies from the N. Madison Range in Southwest Montana in hopes of constraining the timing of partial melting of the deep crust within the region. In July of 2014 I took three leucogranite candidates to the University of Kansas and collected U-Pb and trace element data from zircon within these rocks on the laser ablation inductively coupled mass spectrometer (LA-ICP-MS) laboratory. By using this specialized instrument I was able constrain the timing of crystallization. The results of this study have yielded a GSA talk in Fall 2014 titled "Zircon textures and U-Pb evidence for syn-orogenic crustal melting in the Paleoproterozoic Big Sky orogen, SW Montana". I am currently continuing this research by collecting additional U-Pb geochronology and trace element geochemistry on monazite and rutile to gain a more complete picture of the timing of crystallization of these granitoid bodies. This work will become a chapter of my dissertation, and I hope to publish this study in the future.



View of Gallatin Peak in the N. Madison Range, Montana, with leucogranite sampled for geochronology in the foreground. Photo credit: Cailey Condit

**Your donations
make these awards possible!**

Sarah Evans

My 2014 Department of Geological Sciences, Shell Research Award was instrumental in conducting research on the effects of climatic change on groundwater resources in mountainous, headwater watersheds such as the Niwot Ridge Watershed in Colorado. It is critical to understand the effect of surface temperature variations on hydrologic properties of soils and shallow depth rock formations and on groundwater flow in these watersheds, as headwater watersheds have a direct impact on the water resources of downstream regions. With the Shell Research Award I conducted three-dimensional, hydrogeologic modeling and examined the influence of temperature on soil hydrologic properties. Modeling was used to characterize groundwater flow and evaluate groundwater and surface water interactions. Preliminary findings suggest that groundwater contributes significantly to streams in the form of baseflow and with increased warming there may be increased groundwater discharge to streams, whereas with cooling there may be decreased groundwater discharge to streams. These results have implications for ecosystem health and water resource availability in downstream regions.



Hulugou headwater watershed, northern Qinghai-Tibet Plateau, China. Photo credit: Sihai Liang

Danny Feucht

I have used the W.O. Thompson Research Award to collect magnetotelluric data across the state of Colorado. Magnetotellurics, a passive-source geophysical technique, involves measuring naturally occurring variations in the Earth's electric and magnetic fields and can provide an image of the electrical conductivity structure of the crust and mantle. Electrical conductivity varies with temperature, rock type, and water content; hence the distribution of conductive and resistive bodies in the subsurface can be used to answer questions about the tectonic history and current physical properties of the lithosphere beneath our feet. The award allowed us to collect data in both the South Park Basin and the Great Plains of eastern Colorado. Data from these new stations will be combined with existing magnetotelluric data to produce a conductivity cross section of almost the entire state of Colorado, which will provide insight into Colorado's tectonic past and perhaps help answer the question of what supports the high topography of the plains and the Rocky Mountains.

Melissa Foster

I am calculating basin-averaged denudation rates from fluvial sands deposited during the 2013 Boulder, Colorado flood to answer these questions; I am using ^{10}Be to calculate these erosion rates. Because basin-wide erosion rates were calculated at ~20 sites prior to the 2013 flood (Detheir et al., 2014), I will also have the opportunity to test a critical assumption underlying the method. Cosmogenic radionuclides are assumed to represent an average of various erosive events over thousands of years; therefore, basin-wide erosion rates calculated with CRNs should not be altered by a moderate, discrete event (Brown et al., 1995). At this time, all samples have been measured and submitted. Results were recently received from the accelerator mass spectrometry lab. Full analysis of the data is not yet complete. However, preliminary results indicate that: [1] small basins with landsliding or debris flows demonstrate notable differences in pre- and post-flood basin-wide denudation rates; [2] larger streams show small or negligible fluctuations in basin-wide erosion rates; and [3] small basins that did not experience landsliding still show fluctuations in basin-wide denudation rates, demonstrating that these systems may display more natural variability in the cosmogenic radionuclide concentrations associated with sediment in transport.

Joshua Johnson

We acquired 121 zircon (U-Th)/He (ZHe) dates from 29 samples from an ~50 km east-west transect across the Colorado Front Range that span the full range of alpha dosages (radiation damage) encompassed by previous diffusion experiments. Date-eU patterns within our ZHe dataset are broadly consistent with the expected influence of radiation damage, showing positive and then negative correlations. ZHe dates from the range core in Rocky Mountain N.P. record cooling to near-surface temperatures during the Laramide Orogeny (65-45 Ma). Closer to the range front, there is a sharp transition to Oligo-Miocene ZHe dates despite the presence of Laramide apatite He (AHe) dates in the immediate vicinity. Titanite He (THe) dates from the area record cooling through ~200 °C in the Neoproterozoic, precluding reheating above that temperature in the last 600 myr. High-damage zircons (>1018 $\text{\AA}/\text{g}$) from Big Thompson Canyon have ~20 Ma ZHe dates that are “inverted” with respect to 65-45 Ma AFT and AHe dates from the same area. This inversion implies that these zircons are sensitive to temperatures of <70 °C, significantly lower than their nominal closure temperature of ~180 °C. The utility of applying ZHe in this manner is demonstrated by the detection of a previously unrecognized reheating event on the order of ~50 °C in the Oligo-Miocene, implied by the ~20 Ma ZHe dates. Our preferred hypotheses for this event invoke either the movement of hydrothermal fluids along fault networks or the the reburial of the range front under ~1 km of sediment derived from erosion of the high topography of the range core followed by the subsequent unroofing in the early Miocene.

Omero Felipe Orlandini

The 2014 Shell Research Grant awarded to me through the CU Department of Geological Sciences has been invaluable in allowing me to pursue my research into the high temperature mineralogy of the Cora Lake pseudotachylyte (veins of coseismic frictional melt, also known as “fossil earthquakes”) network. This grant has been used to gain access to CU’s electron microprobe facility and collect key textural and chemical data within these fossil earthquakes, as their opaque nature prevents the use of traditional transmitted light microscopy. This data has allowed us to document and characterize multiple episodes of garnet growth

within the frictional melts, strongly supporting the hypothesis that these seismic events either began or propagated to significantly below the traditional seismogenic zone in the earth’s crust. This hypothesis, if correct, could have major implications to the fields of fault mechanics and paleoseismicity.

A zeolite from an Oregon coast basalt. The pen tip in this photo is 0.5 mm across
Photo credit: Omero Felipe Orlandini



Simon Pendleton

During the summer of 2014 a team of researchers and I spent the month of August collecting bedrock samples from the margins of retreating ice caps on southern Baffin Island. The cold-based ice on Baffin Island preserves the landscape beneath and the record of ice activity over long time periods. Utilizing cosmogenic radionuclides from these preserved landscapes, we can reconstruct past histories of ice extent and surface erosion rates. Back at the University of Colorado Boulder Cosmogenic Isotope Lab, funding from the Geology Department allowed us to process pilot rock samples and produce our first results. These initial samples suggest varied and complex exposure-burial histories for the Cumberland Peninsula region. Some samples indicate that fjord incision began ~1.5 Ma, which has implications for how the horizontal and vertical dimensions of the Laurentide Ice Sheet has evolved throughout the Quaternary. Additional sampling will further improve the the spatial and temporal resolution of the reconstructed histories and provide important insight into the cryosphere-climate-landscape dynamic in the region.

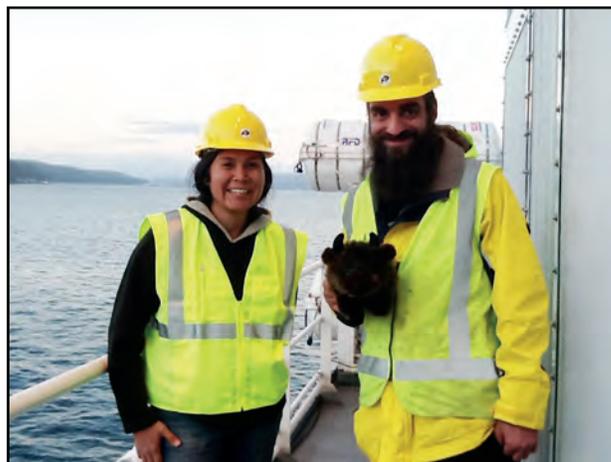
Photo provided by Simon Pendleton



Student Activities...



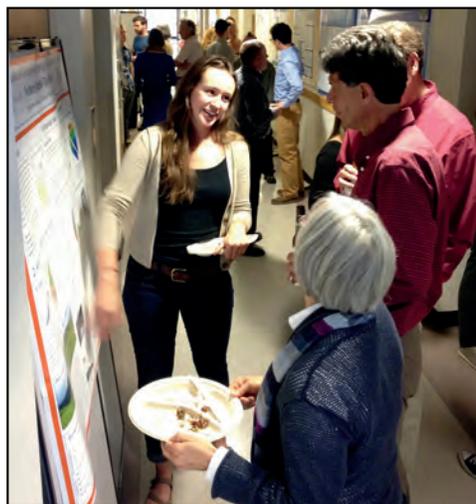
Eric Alterman, Jamie Hansen, and Dan Zietlow setting up ground-penetrating radar experiment near Boulder Creek for GEOL 4130 Principles of Geophysics



Graduate students Jenny Nakai and Justin Ball departing Wellington, New Zealand, on the R/V Tangaroa at the start of an ocean bottom seismometer experiment



Spring 2015 graduate student graduation



Sarah Evans talks to Advisory board members during the 2015 graduate student poster session



Denver Geophysical Society Geophysics Challenge Bowl, February 2015. CU Geophysics graduate students Jefferson Yarce and Justin Ball (on right) were the top team in the challenge bowl. They won a trip to the SEG International Expo in New Orleans. CU Geophysics alumni Tom de la Torre and Scott Cook, both with Tricon Geophysics, Inc., in Denver, on left



Fall 2014 graduation

2014-2015 Undergraduate Mentoring Program

by Kristine Johnson

The Undergraduate Mentorship Program is a crucial stepping-stone for many who want to go to graduate school or pursue a research career in geology. This past year, several undergraduates paired up with either graduate students or faculty on research projects.

Craig Peterson mentored with Professor **David Budd**. Together, they processed and analyzed 3-D cubes of SEM images that were collected to characterize nano-scale pore systems in the Niobrara Formation of the Denver-Julesburg Basin in Colorado. They segmented organic matter and pores in 3-D data cubes using the software Avizo Fire. From the cubes, they obtained information on size, shape, orientation, connectivity and pore network parameters. They also created visualizations of the samples' pore systems. Furthermore, their research is being funded by the oil and gas industry and is contributing to the larger research question of "How do pores connect so we can better understand how to most efficiently extract hydrocarbons?"

The mentoring experience led Craig to both a paid research position in the department and acceptance to the Geology Graduate Program at CU. According to Craig, "This experience has been extremely beneficial for getting into graduate school. Having undergraduate research experience is invaluable for applying to graduate school. It sets you apart." Professor David Budd agreed and said, "The types of things I work on with mentorship students parallels what I do with graduate students. The key with the Mentoring Program is it gives the undergraduates an opportunity to do science at a higher level--exploring a question, dealing with dead-ends, having to draw conclusions and having to present something. It also allows for the mentor to write a more honest and thorough letter of recommendation on work habits, synthesizing data and contributing to a team."

Sara Constantine worked in both the Geology Cosmogenic Isotope Lab and the Amino Acid Geochronology Lab at IN-STAAAR. The work done in the Cosmo laboratory was to analyze the amount of ^{10}Be in glacial moraine samples as a means of exposure dating. The geochronology lab served as a place to analyze lake sediments for the biologic silica content. Together with Professor **Giff Miller** and graduate student **Sarah Crump**, her goal is to reconstruct glacial and climate history on Baffin Island in the

Canadian Arctic. Sara said, "It was good to see how a graduate student works. It gave me more insight into post grad work when I pursue graduate work in Geophysics or Geotechnical Engineering."

Jamie Glass works on research with Researcher and Senior Instructor **Lon Abbott**, and Lab Manager **Jim Metcalf**. Together they are attempting to constrain the time of unroofing of a large igneous batholith in northeastern Australia by using the apatite U/Th-He method of thermochronology. Jamie said, "This experience has allowed me to get first-hand experience with the process of research and the nitty-gritty of publishing papers. The program opens up opportunities for letting people see your work ethic, which can lead to other opportunities as well." Lon and Jim both agree that the program is crucial for everybody involved, not just the undergraduate students. It is also very important for the department to fund these types of projects as a way to keep CU competitive.

Naomi Ochwat works on the Front Range Ground Water Project with graduate student **Steven Henning**. They are looking at how much of the flood water in Boulder made it into the subsurface and how it has contributed to groundwater. Naomi is collecting and analyzing a data set on a computer. Naomi's project can stand alone by itself, but it also contributes to Steven's project, "Dynamic Response of Watershed Subsurface System to Extreme Rainfall". Naomi said, "When I go to graduate school, I will already know what it is like because of this program. It is nice to know what is expected of you before you get there. It's a good program and if anything, it should be bigger to be able to involve more students." Mentor Steven Henning agreed and said, "There is a large difference between school on the undergraduate and graduate levels. I know I didn't really understand the concept. It's always helpful to know who you're getting advice about graduate school from. Plus, being able to communicate my thinking to another person is an important part of the process in my research."

This program would not be possible without the help of alumni. We greatly appreciate everyone's generosity. To make a donation or for any information about the Undergraduate Mentoring Program, please contact the Geology Main Office: 303-492-8141.

Bob Anderson on Niwot Ridge with incoming graduate students, August 2014



The Department of Geological Sciences undergraduate mentor program is funded solely from gifts like yours!

News and Awards

Undergraduate Awards for Spring 2015

AWARD	RECIPIENTS
Bruce Curtis Scholarship, Outstanding Junior	Ryan Stoner Cole Pazar
Johnston Memorial Scholarship	David Liefert
Kolber Award	Evan Lloyd Clea Bertholet
RMAG Outstanding Senior Award	Mike Guido
T. Keith Marks Scholarship	Stephanie Junior Anna Klein

Shell Exploration & Production Graduate Research Awards



Shell provided funding that is helping graduate students complete research projects for their degrees.

Kolber Award	Sarah Black William Armstrong Rachel Glade
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Graduate Awards for Spring 2015

AWARD	RECIPIENTS
Department Research Award	Derek Weller
Spetzler Award for Research	Sarah Crump Jennika Greer Charlie Shobe Harrison Gray



2015 undergraduate award recipients

Other Awards

Jenny Nakai

Seismological Society of America best student presentation award, 2015
Association of Women Geoscientists Outstanding Student Award, 2015

Dan Zietlow

CIRES Graduate Fellowship Award, 2014

Danny Feucht

Geological Society of America Graduate Student Research Grant
Society of Exploration Geophysicists (SEG)/Henry Bates Peacock Scholarship
Rocky Mountain Association of Geologists Bolyard Scholarship

Sarah Evans

Herbert Scholarship by the American Water Resources Association. The awards are on the basis of strong academic performance, research relevance to water resources, and leadership in extracurricular activities.

Spring 2015 graduation



Degrees Awarded (Fall 2014 - Spring 2015)

B.A. Geology Majors

Eric Alterman	Tyler William Grosek	Mark Gregory Leonard	Lena Elizabeth Ray
Christopher Beliveau	Michael Andrew Guido (summa cum laude)	Jeremy Taylor Liby	Stewart Ray (magna cum laude)
Alec James Berarducci	Jamie M. Hansen	David T. Liefert (magna cum laude)	Matt Reed
Christopher James Blade	Tate Hardesty	Evan Lloyd	Jeremy Taylor Ross (magna cum laude)
Lilianna Regina Broussalian	Blaine Hudson	Zach Mahaffey	Samuel Rumel
Thomas Bunn	Muhammad Ismail	Ned Andrew McElfresh	Line Camilla Schug
Wesley Cordes Christensen	Corey B. Jarrett	John McIntyre	Connor L. Simmons
Alexander Michael Connelly	Genevieve Lana Keller-Milliken	Neal McMorrow	Emily Skau
Sara M. Constantine	Sarah Kirk	Pablo Maldonado Moreno	Ariana Jene Solis
Maureen Ann Dady	Eric Scott Klammer	Austin David Morgan	Zachary Stults
Jacquelyn Daves	Kevin B. Knopp	Mackenzie K. Mullins	Bryan Troast
Kara Epple	Robert Kowalsky	Brandon Oliff	Jason William Van Fosson
Bryan Takeshi Florence	Rachel Christine Krueger (cum laude)	Myranda Emily Prentiss	Marshall Van Swaay
		Cameron Davis Pritekel (cum laude)	Jacob Whritenour

Undergraduates graduating with honors

	Advisor	Thesis Title
Stewart Ray magna cum laude	Charles Stern	Genetic relations of West Spanish Peak stock with surrounding radial dikes containing cognate xenoliths and miarolitic cavities in South-Central Colorado
Jeremy Ross magna cum laude	Charles Stern	Petrochemical differentiation of the Silver Plume-type, Long's Peak-St. Vrain granite and pegmatites, and aplites associated with REE-rich pods and veins near Jamestown, Colorado
Michael Guido summa cum laude	Charles Stern	Continental and island rhyolites: An effort to further understand the genesis of Icelandic rhyolites
Cameron Pritekel cum laude	Joseph Smyth	The crystal structure of meteoric schreibersite: Refinement of their absolute structure
David Liefert magna cum laude	Rebecca Flowers	Constraints on the timing of exhumation in the Colorado Front Range using apatite and zircon (U-Th)/He thermochronometry
Rachael Krueger cum laude	David Budd	Lateral variations in facies and facies associations of the Codell sandstone, Wattenberg field and northeastern Colorado

M.S. Candidates Graduating with Degrees

	Advisor	Thesis Title
Mohammed Al-Qattan	David Budd	Microfacies, Diagenesis, Stable Isotope Geochemistry, and Reservoir Characterization of the Late Permian Khuff-C Reservoir, Southern Ghawar Field, Saudi Arabia
Tristan Betzner	Karen Chin	Trace Elemental Distributions within Organophosphatic Brachiopod Shells: Implications for Growth and Paleoenvironment
Connor Burt	David Budd	Pore Systems of the Tow Creek Bench of the Niobrara Member of the Mancos Shale Group, Piceance Basin, Colorado
Nora Catolico	Shemin Ge	Numerical Modeling of a Shallow Borehole Thermal Energy Storage System
Chelsea Fenn	Matthew Pranter	Outcrop to Subsurface Reservoir Characterization of the Lower Mesaverde Group, Red Wash Field, Uinta Basin and Douglas Creek Arch, Utah and Colorado

Hannah Grist	Thomas Marchitto	Solar and Orbital Forcing of the El Nino-Southern Oscillation System During the Holocene
Joshua E. Johnson	Rebecca Flowers	“Inverted” Zircon and Apatite (U-Th)/He Dates and Interpretation of High-Damage Zircon from the Southern Rocky Mountains, Front Range, Colorado
John McFadden	Matthew Pranter	Depositional Environment and Reservoir Heterogeneity of the Upper Mesaverde Group, Upper Philadelphia Creek, Douglas Creek Arch, Colorado
Julian Michaels	David Budd	Pore Systems of the B Chalk and Lower A Marl Zones of the Niobrara Formation, Denver-Julesburg Basin, Colorado
Jeremy Ring	Matthew Pranter	Petrophysical Evaluation of Lithology and Mineral Distribution with an Emphasis on Feldspars and Clays, Middle and Upper Williams Fork Formations, Piceance Basin, Colorado
Derek Weller	Charles Stern	A Large Late-Glacial Eruption of the Hudson Volcano, Southern Chile
Ellen Wilcox	David Budd	Detailed Core Facies Analysis and Well-Log Response in the Mesaverde Group, Eastern Greater Natural Buttes Field, Uinta Basin, Utah

Ph.D. Candidates Graduating with Degrees

	Advisor	Thesis Title
Leif Anderson	Robert Anderson	Glacier Response to Climate Change: Modeling the Effects of Weather, Debris-cover, and Flexure
Katy Barnhart	Robert Anderson	Erosion of Icy Coastlines in the Face of Changing Sea Ice
Clara Christabel Chew	Eric Small	Soil Moisture Remote Sensing Using Global Positioning System-Interferometric Reflectometry
Whitney Doss	Thomas Marchitto	New Insights into Ice Age and Post-industrial Marine Carbonate System Dynamics Inferred from the Geochemistry of Benthic Foraminifera and a Scleractinian Coral
Elizabeth Frank	Stephen Mojzsis	Temporal Limits on the Habitability of Rocky Worlds
Michelle Hopkins	Stephen Mojzsis	Geochemical Signatures in Zircons as Probes of the Impact History of the Inner Solar System
Ulyana Nadia Horodyskyj	Roger Bilham	Contributing Factors to Ice Mass Loss on Himalayan Debris-Covered Glaciers
Benjamin Hudson	James Syvitski	Meltwater and Sediment Dynamics of the Greenland Ice Sheet
Abigail Langston	Gregory Tucker	The Torrential and the Mundane: Climate Controls on Hillslope Weathering, Channel Bed Material, and Landscape Evolution of the Colorado Front Range
Mariela Perignon	Gregory Tucker	A Rolling Stone Gathers No Moss: Modeling the Geomorphic Impacts of Floods on the Southern Rocky Mountain Region, USA
Francis Rengers	Gregory Tucker	The Influence of Transient Perturbations on Landscape Evolution: Exploring Gully Erosion and Post-wildfire Erosion
Fei Xing	James Syvitski	Deltas' Responses to Fluvial and Marine Forces
William Luther Yeck	Anne Sheehan	Investigation into the Deformation of the Lithosphere Past and Present through Passive Seismic Methods: Case Studies of the Wyoming Craton and South Island of New Zealand

Alexis Templeton leads new NASA Astrobiology Institute at CU



NASA recently chose a team of researchers led by CU-Boulder Associate Professor of Geological Sciences Alexis Templeton to be one of seven new NASA Astrobiology Institutes. NASA Astrobiology Institutes conduct collaborative, interdisciplinary research on the origins, evolution, distribution and future of life in the universe. The CU-led team will use the ~\$7 million award to study 'Rock-powered Life' over the next 5 years. Rocky planets store enormous amounts of chemical energy that can power living systems when this energy is released through the interaction of rocks with water. Yet there is little known about how, when, and where geological systems power biological processes, particularly within the vast but under-defined realm of environmental conditions where rocks and water react at low temperatures. The Colorado Rock-Powered Life NAI team was created to investigate how the mechanisms of low temperature water-rock reactions control the distribution, activity, and biochemistry of microbial life in rock-hosted systems. This challenging astrobiological question has implications for considering the biological potential in the shallow crust of Earth, Mars, and icy satellites such as Europa and Enceladus.

The University of Colorado has a rich history as a NASA Astrobiology Institute. Professor Bruce Jakosky in Geological Sciences and the Laboratory for Space Physics led an interdisciplinary NAI team at CU for 10 years with Professor Steve Mojzsis (GEOL) and 10 other faculty distributed across campus, leading to the establishment of the CU Center for Astrobiology. The new Colorado NAI team led by Alexis Templeton includes co-investigators Lisa May-

hew, a research associate in the Department of Geological Sciences, and Tom McCollom a research associate in the Laboratory for Atmospheric and Space Sciences (LASP). Core collaborators include Department of Geological Sciences and LASP Professor Brian Hynek, who also is the current director of the CU Center for Astrobiology, and Professor Carol Cleland of CU-Boulder's philosophy department. Other co-investigators on the CU-Boulder-led proposal include scientists from the Colorado School of Mines, Montana State University, Arizona State University, NASA Ames Research Center in Moffett Field, Calif., Michigan State University, the University of Rhode Island, the University of Utah, and the Massachusetts Institute of Technology.

Oman ophiolite photo by Hannah Miller



Alumni News

Diane Fritz has returned to the Geological Sciences department as a lecturer after graduating in 2002 and spending time in England. Her inspiration to pursue a PhD related to isotope geochemistry and hydrology came from a Grand Canyon river run she did in the



Diane Fritz says....
"skiing on Memorial Day is the most fun..."

90s. This trip made her want to do research on water issues in the arid Southwest, so England wasn't the best place to be.

After being away from Boulder and the mountains, she returned and discovered the wonderful world of GIS while volunteering at The Nature Conservancy (TNC). She applied this new skill to water issues in the Colorado River Basin, as well as to other projects, after being hired on at TNC.

The past two years Diane has put her knowledge of GIS to use in the department of Geological Sciences teaching the GEOL 3050 GIS class, which she loves doing.

Also this past year, Diane tapped into another passion of hers (skiing) and obtained her Ski Patrol Cross. She enjoys helping people get off the slopes safely at Eldora Mountain Resort.



CU Geophysics alum **Prof. Gaspar Monsalve** (National University of Colombia, Medellin) in the field near Monteria, Colombia

Obituaries

Raymond M. Batson (Geol'62)

Robert W. Blaha (Geol'50)

William A. Chren III (Geol ex'11)

Frank G. Cooley (Geol'47, Law'51)

Clare Gregg (Geol'51)

Laurence R. Kittleman Jr. (MGeol'56)

Gary P. Kugel (Geol'58)

Frederick N. Murray (MGeol'62, PhD'66)

Samuel J. Pollock (Geol'57)

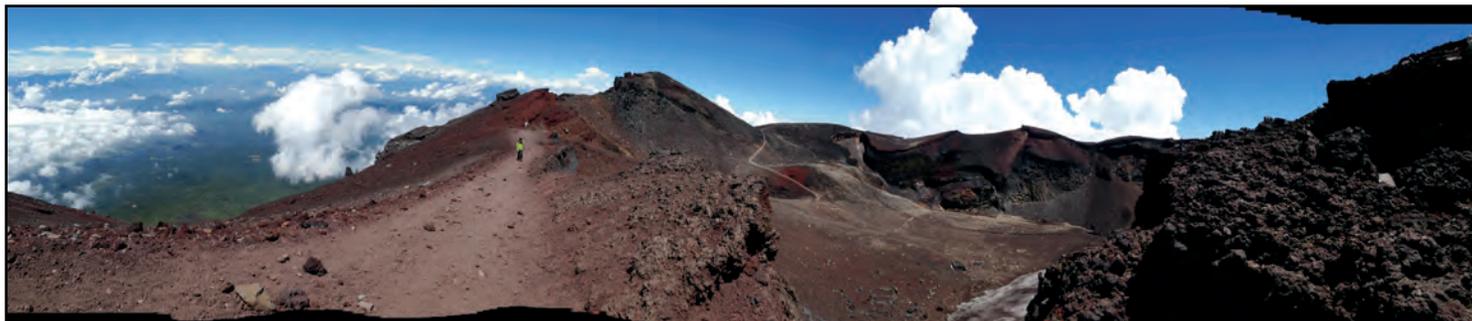
Henry E. Repp Jr. (Geol'50)

Robert B. Rhodes Jr. (Geol'51)

Gordon A. Swann (Geol'58, PhD'62)

Thomas L. Thompson, of Boulder, passed away on January 22, 2015. Thomas was born to Warren and Jane Thompson on December 25, 1927, in Boulder. Nancy A. Nelson and Thomas (Tommy) were married on July 3, 1956, in Princeton, Illinois. They raised seven children together. Tommy thrived outdoors, particularly in the mountains and on the ski slopes. After earning his B.S. degree at the University of Colorado and a PhD at Stanford University, Tommy started his lifelong career in geology. He worked for Amoco, taught at the University of Oklahoma, and established an independent consulting firm, Thompson Geo-Discovery, Inc. He was a member of AAPG, AIPG, SIPES, Geolly Boys, GSA and many other professional organizations. Tommy was a good man; he loved life and lived it fully. Thomas is survived by his wife, Nancy N. Thompson; children, Warren (Griff) Thompson, Dorothy Thompson, Jennie Thompson, Nancy (Suzy) Christensen, Julie Stratmeyer, Amy Shrum and Heidi Casey; grandchildren, Brit-tany Thompson, Victoria Thompson, James Thompson, Jonathon Thompson, Nathan Christensen, Luke Christensen, Emma Christensen, Wyatt Stratmeyer, Cooper Stratmeyer, Reece Stratmeyer, Olivia Shrum, Oscar Shrum, Cash Casey and Stone Casey; brothers, Robert W. Thompson and Peter M. Thompson. A celebration of life was held on Saturday, January 31, at 2:00 at the University of Colorado Benson Earth Science Building. The interment will be later in the year at The Swoose. Contributions in lieu of flowers may be made to the charity of one's choice.

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View at summit of Mt. Fuji, Japan

Photo submitted by Anne Sheehan

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